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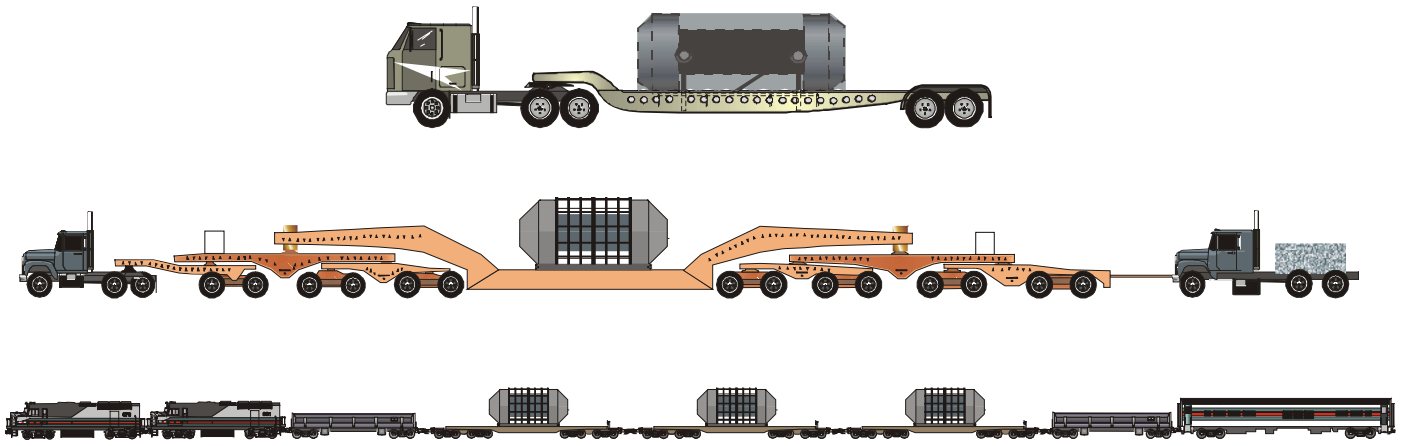
Nevada Transportation Options Study



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CHANGE HISTORY

Revision Number	Interim Change No.	Effective Date	Description of Change
0	0		Initial issue

EXECUTIVE SUMMARY

This study performs a cost and schedule analysis of three Nevada Transportation options that support waste receipt at the repository. Based on the U.S. Department of Energy preference for rail transportation in Nevada (given in the Final Environmental Impact Statement), it has been assumed that a branch rail line would be constructed to support waste receipt at the repository. However, due to potential funding constraints, it is uncertain when rail will be available. The three Nevada Transportation options have been developed to meet a varying degree of requirements for transportation and to provide cost variations used in meeting the funding constraints given in the Technical Direction Letter guidelines for this study. The options include combinations of legal-weight truck, heavy-haul truck, and rail.

Option 1 uses a branch rail line that would support initial waste receipt at the repository in 2010. Rail transportation would be the primary mode, supplemented by legal weight trucks. This option provides the highest level of confidence in cost and schedule, lowest public visibility, greatest public acceptability, lowest public dose, and is the recommended option for support of waste receipt. The completion of rail by 2010 will require spending approximately $800 million prior to 2010.

Option 2 uses a phased rail approach to address a constrained funding scenario. To meet funding constraints, Option 2 uses a phased approach to delay high cost activities (final design and construction) until after initial waste receipt in 2010. By doing this, approximately 95 percent of the cost associated with completion of a branch rail line is deferred until after 2010.

To support waste receipt until a branch rail line is constructed in Nevada, additional legal-weight truck shipments and heavy-haul truck shipments (on a limited basis for naval spent nuclear fuel) would be used to meet the same initial waste receipt rates as in Option 1.

Use of heavy-haul shipments in the absence of rail is restricted to approximately twelve, without upgrading public highways. There is high uncertainty as to what road upgrades and security/escorts the Nevada Department of Transportation would require to obtain an overweight/overdimensional permit. In addition, the Naval Nuclear Propulsion Program has indicated that a larger cask weight than that analyzed in the Final Environmental Impact Statement may be required for naval shipments, resulting in additional costs for heavy-haul transport. These uncertainties result in a high cost and schedule risk.

Option 3 assumes that the start of rail construction will be delayed until after construction authorization is received from the Nuclear Regulatory Commission. Similar to Option 2, Option 3 uses legal-weight truck shipments and limited heavy haul truck shipments to meet the same initial waste receipt rates as Option 1, until rail becomes available. By using heavy-haul truck for two years, Option 3 contains the same uncertainties and resultant high cost and schedule risk as Option 2.

The cost and schedule of legal-weight truck transport are not included in this report as that will be evaluated in the report on national transportation.

In addition to the Nevada Transportation options that support waste receipt at the repository, this study also performs a cost and schedule analysis of three alternative site access roads from U.S. 95 to Yucca Mountain. The site access road would support repository construction, operations, and waste receipt.

Alternative 1 assumes construction of a new site access road with an interchange at U.S. 95 west of Fortymile Wash. Alternative 1 is the most expensive alternative but provides the greatest level of traffic safety, and the lowest level of cost and schedule risk of the three alternatives evaluated. It also provides the most flexibility to accommodate higher traffic rates and vehicle mix, and, as such, is the preferred alternative of the Bechtel SAIC Company, Limited Liability Corporation, design and operations departments.

Alternative 2 assumes construction of a new site access road west of Fortymile Wash, without an interchange. Alternative 2 is less expensive than Alternative 1, but requires vehicles to cross traffic on U.S. 95.

Alternative 3 assumes use of the existing Lathrop Wells Road from Gate 510 and the existing H-Road to Yucca Mountain. While Alternative 3 is the lowest cost initially, the confidence in performance is low, and it presents a higher risk in cost and schedule due to uncertainty in performance. As such, it is the Bechtel SAIC Company, Limited Liability Corporation, design and operations departments' non-preferred alternative.

Based on the results of this study, Bechtel SAIC Company, Limited Liability Corporation, recommends that the activities in FY 2002 and FY 2003 be performed on schedule. It is crucial that rail corridor land acquisition be completed on schedule even if construction of the branch rail line is delayed. This will minimize the possibility of delays during final design and construction of the branch rail line. It is also recommended that funding be provided for construction of the rail system to support initial waste receipt at 2010, consistent with Option 1.

Bechtel SAIC Company, Limited Liability Corporation, also recommends site access road Alternative 1, because it provides the greatest level of traffic safety and the lowest cost and schedule risk.

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
BSC	Bechtel SAIC Company, LLC
CRWMS	Civilian Radioactive Waste Management System
DOE	U.S. Department of Energy
E&S	Engineering and Survey
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
HLW	High-Level Radioactive Waste
LWT	Legal-Weight Truck
MK	Morrison Knudsen Corporation
MTHM	Metric Tons Heavy Metal
NAC	Nevada Administrative Code
NDOT	Nevada Department of Transportation
NEPA	National Environmental Policy Act
NHP	Nevada Highway Patrol
NRC	U.S. Nuclear Regulatory Commission
O&M	Operations and Maintenance
RCP	Reinforced Concrete Pipe
SNF	Spent Nuclear Fuel
TDL	Technical Direction Letter
TSLCC	Total System Life Cycle Cost

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1. INTRODUCTION

1.1 PURPOSE

The purpose of this study is to present cost and schedule parameters for viable Nevada Transportation options. These options will be combined with repository design alternatives, which accommodate different transportation solutions depending on available funding. In addition, this study presents alternative solutions to repository site access road requirements.

1.2 BACKGROUND

Technical Direction Letter 02-003 (TDL) (DIRS 157462) directed Bechtel SAIC Company, LLC (BSC), to complete a System Design Alternatives Study. The Design Alternatives Study will recommend repository design solutions, under constrained funding, to support the receipt and emplacement, as soon as practicable, but beginning no later than 2010, of any or all of the following:

- Commercial spent nuclear fuel (SNF)
- High-level radioactive waste (HLW)
- U.S. Department of Energy (DOE)-managed SNF, including naval SNF
- Immobilized plutonium (if available).

Recommended repository design solutions will integrate Nevada Transportation options and waste receipt rates supported by those options. From the possible design solutions, a recommended approach will be determined to support a management decision on the preliminary design for License Application.

1.3 QUALITY ASSURANCE

An activity evaluation was performed in accordance with AP-2.21Q, *Quality Determinations and Planning for Scientific, Engineering, and Regulatory Compliance Activities*, and is attached to the *Technical Work Plan for: Nevada Transportation Options for the Preliminary Design Alternatives Study for License Application* (DIRS 157713).

The report has been determined not to be quality affecting in accordance with the activity evaluation report. Therefore, this report is not subject to the requirements of the *Quality Assurance Requirements and Description* document (DIRS 149540). This technical product was prepared with AP-3.11Q, *Technical Reports*, as guidance.

The control of electronic information is in accordance with the Technical Work Plan for this task (DIRS 157713).

1.4 SUMMARY OF ANALYSIS

This study evaluates a number of scenarios for transporting SNF and HLW, within Nevada, to the repository at Yucca Mountain. These scenarios include use of legal-weight truck (LWT), rail, and limited heavy-haul truck. The study also addresses infrastructure upgrades.

One of the scenarios (Option 1) discusses providing rail access to the repository site by 2010, when the surface facilities are ready to receive the waste. Option 1 also includes transporting the waste in LWTs starting in 2010. The initiation of rail construction for Option 1 would be required by early FY 2007 or about one year prior to repository construction authorization.

The second scenario (Option 2) considers a phased approach to having rail access to the repository by 2015, with limited heavy-haul transport of naval rail casks during the initial five years. This approach addresses constrained funding during repository construction where approximately 95 percent of the cost to design and construct the railroad is deferred until after 2010. The use of limited heavy-haul truck requires an intermodal transfer of the shipping cask from a railcar to a heavy-haul truck at the mainline railroad (a road from the transfer location to an existing highway), and upgrading of the highway between the transfer location and the repository site. This mode of transport also requires a Nevada Department of Transportation (NDOT)-issued heavy-haul permit for each movement of a heavy-haul truck on the highway.

The third scenario (Option 3) discusses having rail access to the repository by 2012. This option requires limited heavy-haul transport of naval rail casks during the initial two years. This approach addresses the impact of not starting the branch rail line construction until DOE receives repository construction authorization in 2008. This use of limited heavy-haul has the same requirements as identified in Option 2.

Also discussed in this study are three alternatives for a site access road from U.S. 95 to the repository site. The function of the site access road is to support repository construction, operations, and waste receipt. Alternatives 1 and 2 identify a new road approximately 20-miles long that starts from U.S. 95, about one mile west of the Gate 510 entrance road, and proceeds to the repository site along the west side of Fortymile Wash. The difference between the two alternatives is that Alternative 1 includes an NDOT scope to design and construct an interchange at U.S. 95, whereas Alternative 2 requires that vehicles cross the highway. Alternative 3 discusses using the existing Gate 510 entrance and upgrading the existing site roads to accommodate heavy-haul as well as the other site traffic.

2. ASSUMPTIONS

This section lists the Office of Civilian Radioactive Waste Management (from here on "Program")-level assumptions that relate to this study, along with other assumptions specific to Nevada Transportation. Assumptions specific to Nevada Transportation were derived from the guidelines set in the TDL (DIRS 157462) and from existing Nevada Transportation documents.

This study is based on the following assumptions:

Waste Receipt Assumptions

1. Nevada Transportation options shall support waste receipt as soon as practicable, but no later than 2010.

   Rationale: The programmatic planning approach is to begin receiving waste in 2010 and is consistent with the guidance given in the TDL (DIRS 157462).

2. Nevada Transportation options will have the flexibility to support the target receipt schedule for commercial SNF given in Table 1 of the *Civilian Radioactive Waste Management System Requirements Document* [CRWMS Requirements Document] (DIRS 154147)–400 MTHM beginning in 2010, which will continue rising annually to 600, 1,200, and 2,000 MTHM, before leveling out at 3,000. Corresponding naval SNF receipt rates in the first five years are 3, 3, 6, 6, and 12 casks.

   Rationale: Receipt rates of each waste type will be determined by the capabilities of the repository design and transportation system that can be developed under the funding constraints. However, receipt of commercial SNF will have priority, due to contractual obligations with utilities and the need to receive waste for initial thermal testing. In addition, receipt of naval SNF is a priority due to the agreement between the DOE and the State of Idaho (DIRS 151577).

Nevada Rail Transportation Assumptions

1. Transportation nationally and in Nevada will be consistent with a mostly rail scenario, defined in the repository *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (FEIS) (DIRS 155970).

   Rationale: In the repository FEIS, the DOE has stated a preference for rail transport both nationally and in the State of Nevada for shipment of SNF and HLW.

2. There will be no requirement for availability of rail transportation within Nevada prior to start of repository operations.

   Rationale: Given the constrained funding assumptions for the Program in the TDL (DIRS 157462), it may not be possible to begin rail transportation of waste to the repository during the initial operations phase. Consequently,

Nevada Transportation design solutions support initial waste receipt without rail access to the repository. However, start of rail transportation as early in repository operation as possible is highly desirable.

3. Nevada Transportation options will be integrated with the national transportation system.

   Rationale: An integrated approach to the system design must be taken to ensure Nevada Transportation design options can support waste receipt rates of the national transportation system.

4. Nevada Transportation options will be bounded by the impacts presented in the FEIS.

   Rationale: Consistent with the guidelines given in the TDL (DIRS 157462), impacts must be bound by those presented in the repository FEIS (DIRS 155970) so that design options will not be predicated upon additional repository National Environmental Policy Act (NEPA) work.

Site Access Road Assumptions

A new site access road will be completed to support the start of repository construction.

Rationale: Based on information received from the BSC design and operations departments, a site access road capable of supporting transport of heavy equipment required for repository construction activities is needed at the time of repository construction start.

Limited Work Authorization, Regulatory Changes, and Program Redirection Assumptions

Nevada Transportation options will not be predicated on the receipt of a Limited Work Authorization, regulatory changes, or legislative redirection of the Program. However, the design must be flexible enough to accommodate early construction of non-nuclear portions of the facility outside of the Geologic Repository Operations Area, assuming adequate funding and authorization.

Rationale: Uncertainty exists in obtaining a Limited Work Authorization from the Nuclear Regulatory Commission (NRC) or DOE Program direction changes. However, implementation alternatives will be evaluated in which construction of non-nuclear portions of the facility outside of the Geologic Repository Operations Area are permitted prior to construction authorization.

3. NEVADA TRANSPORTATION SCENARIOS

This section describes the Nevada Transportation options developed to support receipt of waste at the repository. Options were developed within Nevada using a combination of rail and LWT transport, with two options using a limited heavy-haul transport scenario to support waste receipt while rail transport is not available.

In addition, this section describes site access road alternatives, which were developed to support repository construction and operations, as well as transport of SNF and HLW by LWT or a limited use of heavy-haul truck.

All Nevada Transportation options and site access road alternatives interface with surface design at a point shown in Appendix D. Construction of roads and any rail switchyard to accommodate support of waste receipt on-site is incorporated in surface design costs.

3.1 DESCRIPTION OF NEVADA TRANSPORTATION SUPPORT OF WASTE RECEIPT OPTIONS

Based on the DOE's preference for rail transportation in Nevada, it has been assumed that a branch rail line would be constructed to support waste receipt at the repository; however, due to potential funding constraints, it is uncertain when rail will be available. The Nevada Transportation options have been developed to meet a varying degree of requirements for transportation and to provide cost variations used in meeting the funding constraints given in the TDL (DIRS 157462) providing direction for this study.

Each of the Nevada Transportation options would use LWT shipments to some extent, because some utility sites are not capable of loading rail casks. LWT shipments provide flexibility for delivering SNF to the repository, whether for early receipt (prior to 2010) or to increase the delivery rate until a branch rail line to the repository is constructed. However, LWT casks transport a limited amount of SNF per shipment (four assemblies vs. 24 or more in a rail cask). LWT shipments have a greater dose to the public, a slightly greater number of estimated traffic-related fatalities, and a higher public visibility than shipments made by rail, the preferred method (DIRS 155970, Chapter 6).

Even after construction of a branch rail line in Nevada, shipments would continue to be made by LWT. There are some utilities in the U.S. that, for various reasons, are unable to ship by rail. These utilities would ship SNF by LWT to the repository. Shipping LWT casks by rail is being considered, but is beyond the scope of this analysis.

With the initial use of LWTs, in the absence of rail, there is a need to transport naval SNF (rail casks) by heavy-haul truck. Previous heavy-haul truck analyses evaluated five heavy-haul truck routes, but these analyses focused on long-term heavy-haul operations in the absence of rail. Nevada Transportation design options, using delayed rail construction, would transport naval SNF on a limited heavy-haul basis. Previous heavy-haul truck analysis information was used in part to analyze the limited heavy-haul truck shipment of naval SNF.

3.1.1 Description of Option 1

Option 1 most closely represents the base case scenario for Nevada Transportation in the 2000 TSLCC (DIRS 153255) and provides for rail transportation to a repository in 2010. Option 1 includes construction of a branch rail line within Nevada and use of LWT for shipments coming from utility sites that cannot support rail shipments. Because a branch rail line would be available to support waste receipt at the repository, no heavy-haul truck shipments are required in this scenario.

Option 1 differs from the base case Nevada Transportation scenario in the 2000 TSLCC by using the Caliente rail route described in the FEIS (DIRS 155970, Chapter 6). The 2000 TSLCC for cost estimating was non-route specific, it used an average cost of the five routes analyzed in the repository FEIS; however, the 2000 TSLCC used the schedule for the Caliente rail route. This study used the Caliente route so that a bounding cost and schedule could be developed, consistent with the guidance given in the TDL for this activity. A map of the Caliente rail route can be found in Figure 1.

An analysis of Option 1 costs and schedule can be found in Section 4.1.

3.1.2 Description of Option 2

Option 2 uses a phased rail approach to address the constrained funding described in Section 1.2. Option 2 allows maximum funding for repository construction and defers the majority of rail design and construction funding (about 95 percent) until after 2010. Two phases of Nevada rail development were used to defer high cost activities (final design and construction of the branch rail line) until after initial repository construction. High cost activities in Phase 2 of rail development would be delayed until after initial waste receipt at the repository in 2010. In this scenario, repository operations could begin by relying principally on LWTs and limited heavy-haul transportation, with rail construction being completed in 2015.

A phased approach was used to satisfy Program funding constraints for two reasons: provide flexibility to satisfy possible Program funding constraints and rail corridor preservation.

Flexibility

A phased rail approach was used to provide flexibility in satisfying the Program funding constraints given in the TDL (DIRS 157462) guiding this study. By performing rail activities in a two phased approach, DOE has the ability to conduct required Phase 1 activities (preliminary design, NEPA activities, and rail corridor land acquisition) and delay Phase 2 activity costs (rail final design and construction) until after repository construction costs peak. Use of the phased approach, rather than a delay of all rail activities, also provides flexibility to make rail available earlier than 2015, should funding become available.

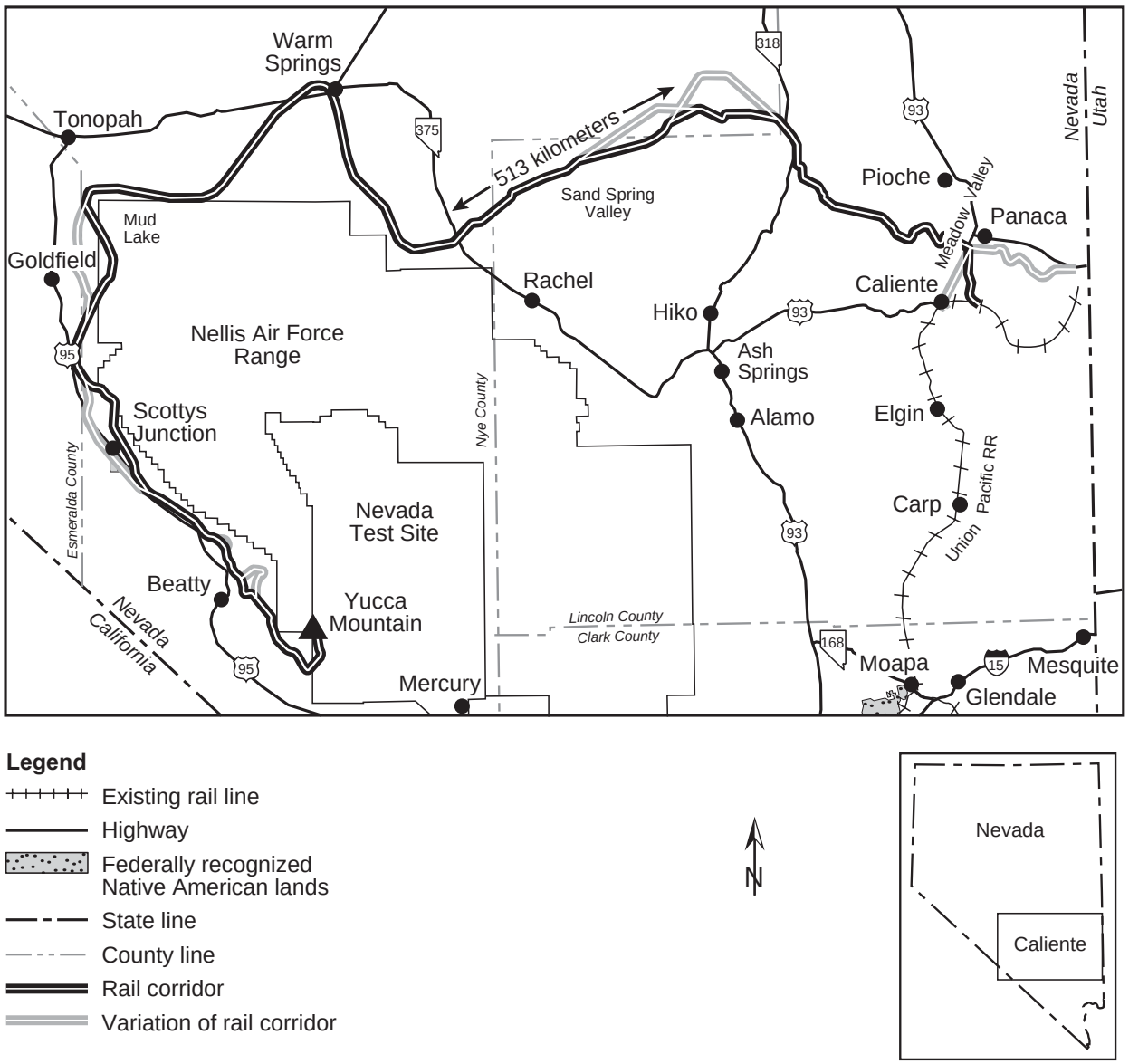

Figure 1. Caliente Rail Route

Rail Corridor Preservation

A phased rail approach was designed to preserve the rail corridor land. In recent years, rail corridors analyzed in the repository FEIS (DIRS 155970) have already seen an increase in land use conflicts due to new federal land transactions. The phased rail approach provides for acquisition of land during Phase 1 so that the rail corridor can be preserved during the delay of rail construction. This corridor preservation philosophy is similar to the land acquisition philosophy used in developing the Clark County Beltway in Nevada (see the *Northern & Western Las Vegas Beltway Clark County, Nevada, Tier 1 Final Environmental Impact Statement and Corridor Location Study* [DIRS 101826]).

Recent federal land transactions have created additional land use conflicts within rail corridors (e.g., Ivanpah Valley Airport allotment near Jean, Timbisha Shoshone land allotment near Scotty's Junction, Apex Industrial Park allotment near Las Vegas). In addition, mining claims may be filed within proposed rail corridors (similar to claim made at Yucca Mountain). By establishing and preserving a corridor well in advance of any development of the area, the environmental, economic, and social impacts associated with a branch rail line would not increase. In addition, if corridor preservation does not take place, advantage of early route designation would likely be lost (see also *Report of the AASHTO Task Force on Corridor Preservation* [DIRS 157695]).

Limited Heavy-Haul Transport

Use of a phased rail approach requires waste to be shipped in Nevada by means other than rail until rail construction is complete. This would be accomplished primarily by use of LWTs. However, to meet the waste receipt schedule given in the CRWMS Requirements Document (DIRS 154147), limited heavy-haul of naval SNF would also be required (naval SNF cannot be shipped by LWT). This is a scenario similar to the LWT scenario described in the repository FEIS (DIRS 155970, Section 6.3.1). Use of a full scale heavy-haul truck scenario, as described in the repository FEIS (Section 6.3.3), was not considered for an intermediate solution because the impacts associated with full scale heavy-haul transport, combined with construction of a branch rail line, would not be bounded by the impacts analyzed in the repository FEIS.

As part of a limited heavy-haul scenario, lacking any specific input from NDOT, minimum highway upgrades were considered. This approach has a high risk as NDOT may require potentially expensive highway upgrades to satisfy the requirements to obtain an overweight/overdimensional permit under NAC 484.542. In addition, the Naval Nuclear Propulsion Program indicates that the naval shipping casks with impact limiters and skid could weigh as much as 200 tons. This means that a larger heavy-haul truck, having more axles, would be required to meet the Nevada maximum axle load limits. A heavy-haul truck capable of transporting a 200-ton load (the potential maximum load of the naval cask and skid) would require special fabrication. No known trucks capable of transporting multiple 200-ton loads have been fabricated for commercial use. Additional costs for fabrication of trucks would be above those estimated in this study.

The following assumptions were used for the limited heavy-haul transport analysis.

1. Limited heavy-haul shipments would use the Caliente route described in the repository FEIS (DIRS 155970, Section 6.3.3). See Figure 2 for a map of the Caliente heavy-haul route described in the repository FEIS.

   Rationale: The Caliente heavy-haul route was used because shipments through the Las Vegas Valley would require funding for accelerating construction to completion of the Las Vegas Beltway, a high cost activity (eliminated consideration of the Apex/Dry Lake route, the Sloan/Jean route, and the Caliente/Las Vegas route). In addition, the Caliente/Chalk Mountain route was not used because it was considered a non-preferred alternative in the repository FEIS.

2. Limited heavy-haul would use a truck configuration described in the repository FEIS (DIRS 155970).

   Rationale: An analysis of the heavy-haul truck configuration is contained in the *Supplemental Transportation Analysis* (DIRS 154824). The configuration is shown in Figure 2-29 of the repository FEIS. However, the Naval Nuclear Propulsion Program identified that the naval cask and its attachments may weigh up to 200 tons. This could require a larger heavy-haul truck than what was analyzed in the repository FEIS.

3. Road upgrades would only be conducted in areas where the heavy-haul truck configuration could not negotiate existing roads.

   Rationale: In keeping with a minimum requirements, only the road upgrades necessary to maneuver existing roads were analyzed. These existing state and federal highways have been used for commercial overweight/ overdimensional shipments. The *Supplemental Transportation Analysis* report (DIRS 154824) identified that only the intersection at Warm Springs, Nevada, would require an upgrade for the truck configuration being considered to maneuver the intersection. However, to obtain an overweight/overdimensional permit from NDOT, substantially more upgrades may be required at significantly higher cost. In addition, if the larger heavy-haul truck is necessary to transport the naval fuel, there may be other turns or intersections that the heavy-haul truck is unable to maneuver.

4. An overnight stop area would be constructed near Tonopah.

   This facility would include a turnaround area, a space for parking the truck, temporary lighting for security purposes, and the ability to transport personnel to Tonopah for overnight accommodations. Additional overnight security personnel would be used during overnight parking of loaded casks.

   Rationale: A previous analysis*, Road Upgrades for Heavy Haul Truck Routes* (DIRS 154448), contains the operations plan for the Caliente route. The two-day trip requires approximately 15.6 hours driving time. Per NAC 484.562, overweight/overdimensional loads are restricted from transport at night, on weekends, and holidays. Due to the travel time, an overnight stop would be required. No overnight stop area exists so some construction would be required to accommodate the heavy-haul truck configuration.

5. Intermodal transfer that would occur at a rail siding requiring, at most, minimal construction to facilitate the transfer.

   It is considered that a location near Caliente would be used for the transfer of the spent fuel rail cask from the rail car to the heavy-haul truck. The location selected would require access to the railcar and a sufficiently hard surface to accommodate the lift. In

addition, the location would have to have relatively convenient access to an existing highway. If the site does not have a sufficiently hard surface, a substantial concrete pad would have to be constructed (the construction of which is not included in the cost). A heavy-duty portable crane (having sufficient capacity) would be positioned between the railcar and the heavy-haul truck. The crane would pick up the shipping cask and skid and transfer the cask and skid to the heavy-haul truck. The skid would then be tied down to the truck for transport. The lift would be limited to 9 meters and the impact limiters would not be removed during the transfer.

Rationale: In keeping with a minimum requirements, an analysis of a number of suitable intermodal transfer locations for limited heavy-haul trucks is beyond the scope of this study. This evaluation assumes no improvements (e.g., concrete pad, buildings, security fence) to the selected siding would be performed, although some or all of these features may be required if identified during more detailed analysis.

6. Only one cask per shipment of naval SNF would be received at a time.

   Rationale: The Union Pacific Railroad would be the rail carrier on the siding used for intermodal transfer near Caliente. U.S. Department of Transportation regulation 49 CFR 174.16, *Removal and disposition of hazardous materials at destination,* states, "A carrier shall require the consignee of each shipment of hazardous materials to remove the shipment from carrier's property within 48 hours (exclusive of Saturdays, Sundays, and holidays) after notice of arrival has been sent or given." The Naval Nuclear Propulsion Program has stated a desire to transport multiple casks in a rail shipment. A consignment of multiple casks would require use of multiple heavy-haul trucks, because turnaround times with a single vehicle would not meet the requirements of 49 CFR 174.16. Information received from heavy-haul shipping companies indicates that they do not have multiple heavy-haul trucks with the capacity to transport rail casks and attachments weighing up to 150 tons, for a limited heavy-haul shipping campaign. If consignments of multiple casks are necessary for transportation logistics, multiple heavy-haul transport contracts would be necessary, or land would need to be acquired for an intermodal transfer location and a new rail siding would have to be constructed with additional costs beyond those analyzed in this study.

7. Shipments of naval SNF would only be received at the siding from April through December.

   Rationale: NDOT restricts transportation of overweight loads on sections of the Caliente route during January, February, and March. These restrictions were established by the District Engineer because of spring freeze-and-thaw conditions.

An analysis of Option 2 costs and schedule can be found in Section 4.1.

A more detailed evaluation of the above assumptions will be conducted in the options study scheduled in FY 2003 (see schedules in Section 4.1).

3.1.3 Description of Option 3

Option 3 is similar to Option 2 in that it also uses a phased rail approach; however, the Option 3 assumption is that rail construction would not begin until after repository construction authorization has been received from the NRC. Option 3 uses a phased rail approach with initial receipt of waste being supported by use of LWT and limited heavy-haul shipments until branch rail line construction is completed in 2012. Option 3 uses the same assumptions for limited heavy-haul and rail as Option 2, with the exception of the timing of rail construction.

An analysis of Option 3 costs and schedule can be found in Section 4.1.

3.2 DESCRIPTION OF SITE ACCESS ROAD OPTIONS

The site access road will support repository construction and operations, as well as serving as a road for transport of both LWTs and limited heavy-haul trucks. There are three alternatives for a site access road for transport from U.S. 95 to Yucca Mountain.

3.2.1 Description of Alternative 1

Alternative 1 provides a new 20-mile site access road from U.S. 95 to the site, west of Fortymile Wash. In addition to the construction of a site access road, Alternative 1 includes an interchange at U.S. 95, similar to the interchange at Mercury. Figure 3 is a map of Alternative 1.

An analysis of Alternative 1 is provided in Section 4.2.

3.2.2 Description of Alternative 2

Alternative 2 provides a new site access road similar to Alternative 1, without an interchange at U.S. 95. Figure 3 is a map of Alternative 2.

An analysis of Alternative 2 is provided in Section 4.2.

3.2.3 Description of Alternative 3

Alternative 3 uses existing roads, a bare minimum approach. Alternative 3 uses Lathrop Wells Road and H-Road in their current condition, except for widening intersections at three locations and reworking the grade through Fortymile Wash. Figure 3 is a map of Alternative 3.

An analysis of Alternative 3 is provided in Section 4.2.

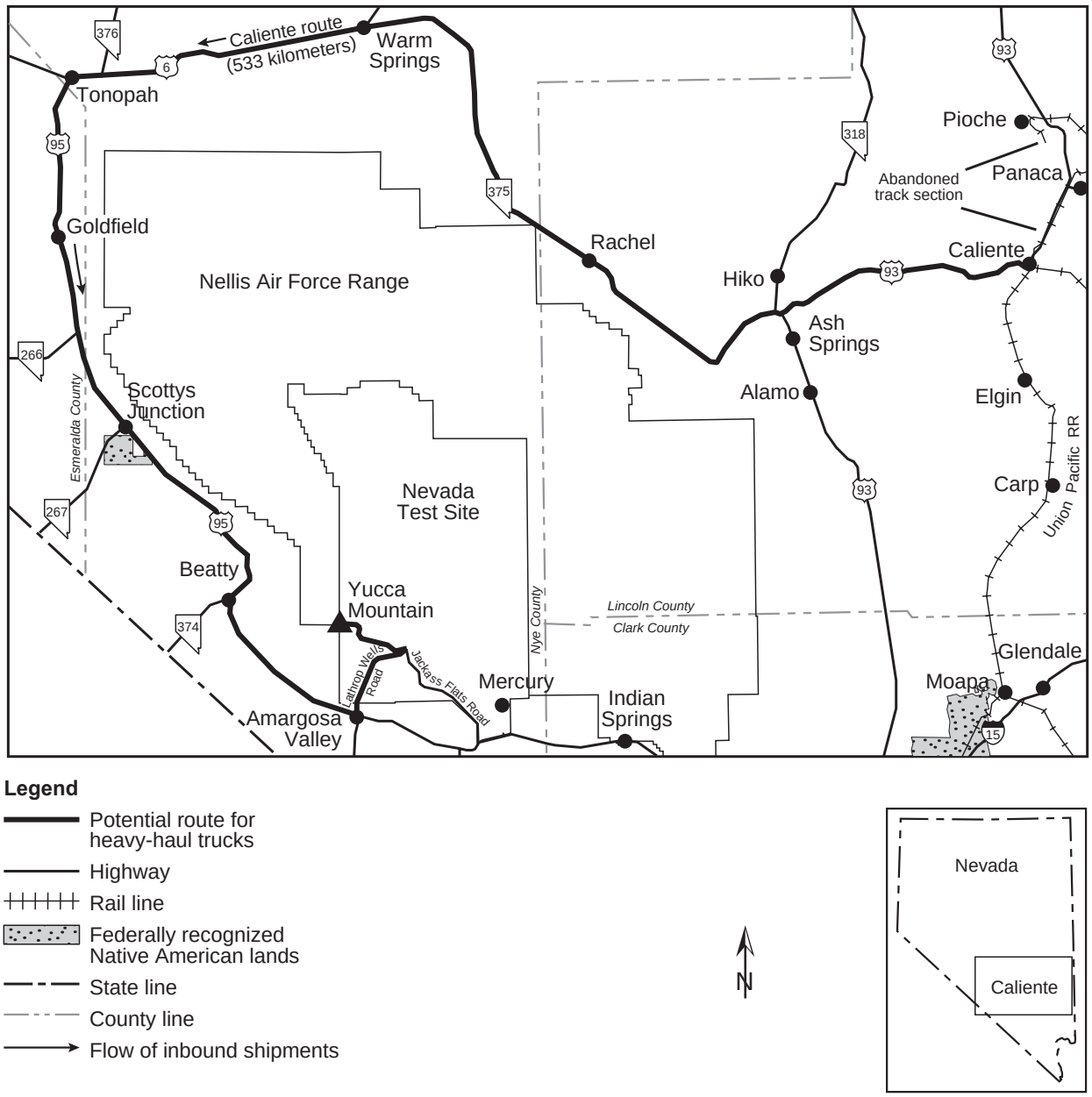

Figure 2. Caliente Heavy-Haul Route

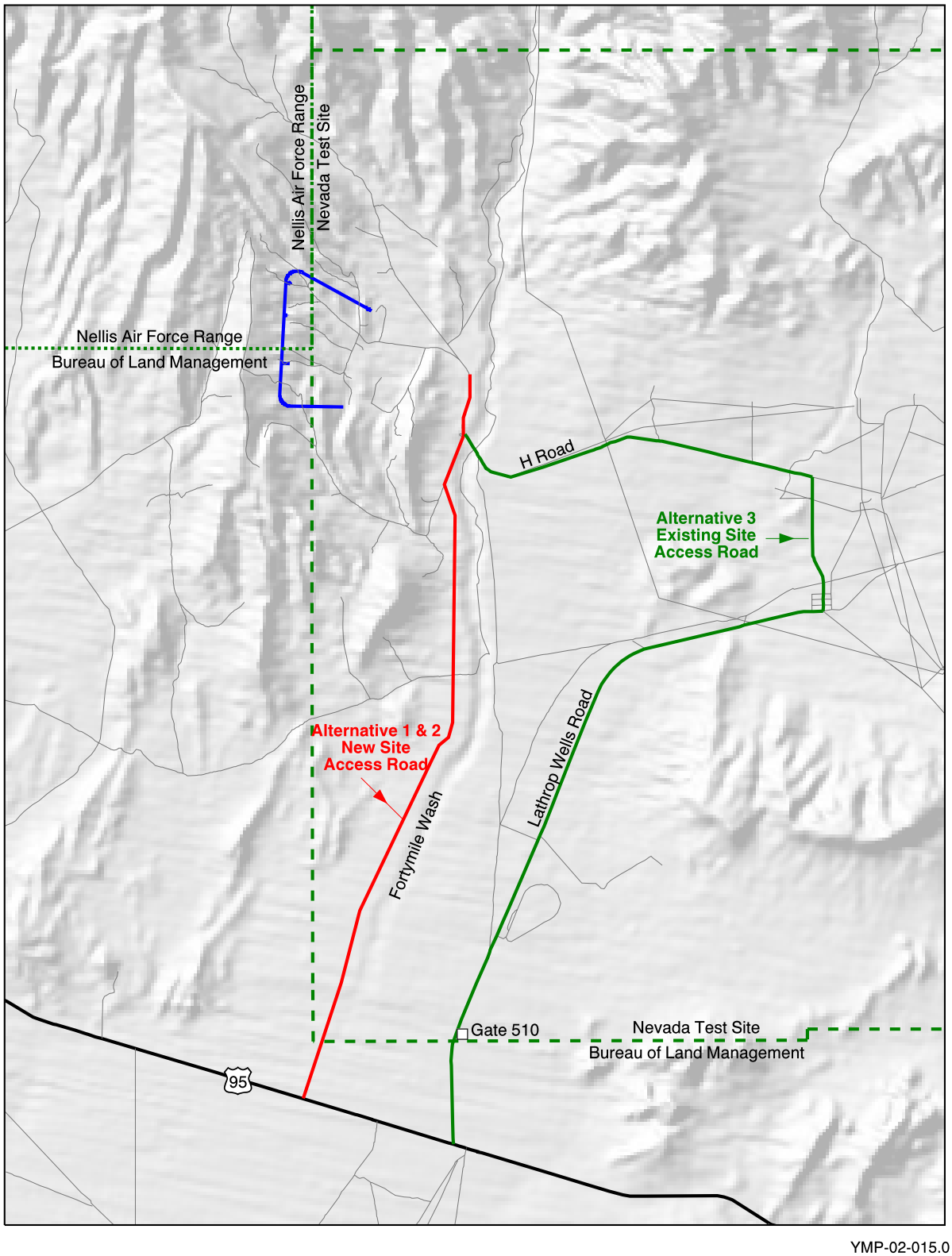

Figure 3. Site Access Road Alternatives

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4. DETAILED ANALYSIS OF OPTIONS AND ALTERNATIVES

This section provides an analysis of the Nevada Transportation options developed to support receipt of waste at the repository. In addition, this section provides an analysis of site access road alternatives. A cost and schedule analysis was performed for Nevada Transportation options and site access road alternatives. All costs and implementing schedules are preliminary in nature. More detailed analysis is required should any of the options or alternatives be used in the future.

4.1 ANALYSIS OF NEVADA TRANSPORTATION SUPPORT OF WASTE RECEIPT OPTIONS

As described in Section 3.1, each of the options would use a combination of rail, LWT, and/or limited heavy-haul shipments to support waste receipt at the repository. This section provides an analysis of the implementing schedule and costs for each of the options. This study is being integrated with a national transportation study being prepared in response to the TDL (DIRS 157462). Costs for LWT shipments in Nevada are not included here, but are in the national transportation study. Costs developed for rail activities used in each of the options do not change from option to option; rather the time frame for Phase 2 activities (see Figures 4, 5, and 6) changes based upon the bounding assumption used for each option.

4.1.1 Analysis of Option 1

Option 1, as described in Section 3.1.1, uses the assumption that rail transportation within Nevada is available to support the first waste receipt at the repository in 2010.

Option 1 Schedule

The implementing schedule developed for Option 1 is based primarily on the schedule developed by Civilian Radioactive Waste Management System Management and Operating Contractor (DIRS 155356) which was based on the *Nevada Transportation Study Construction Cost Estimate* (DIRS 118012). This schedule was modified after review by Bechtel Infrastructure Corporation in June 2001. Modifications included up-front planning activities and use of a design/build procurement strategy. To bound the duration of schedule activities, the schedule assumes use of the Caliente route as described in the repository FEIS (DIRS 155970, Section 6.3.2). This same route was used as a schedule basis for the 2000 TSLCC (DIRS 153255). The implementing schedule for Option 1 was developed using the bounding condition that a branch rail line would be available to support transport of the first waste shipment in 2010.

See Figure 4 for the Option 1 schedule.

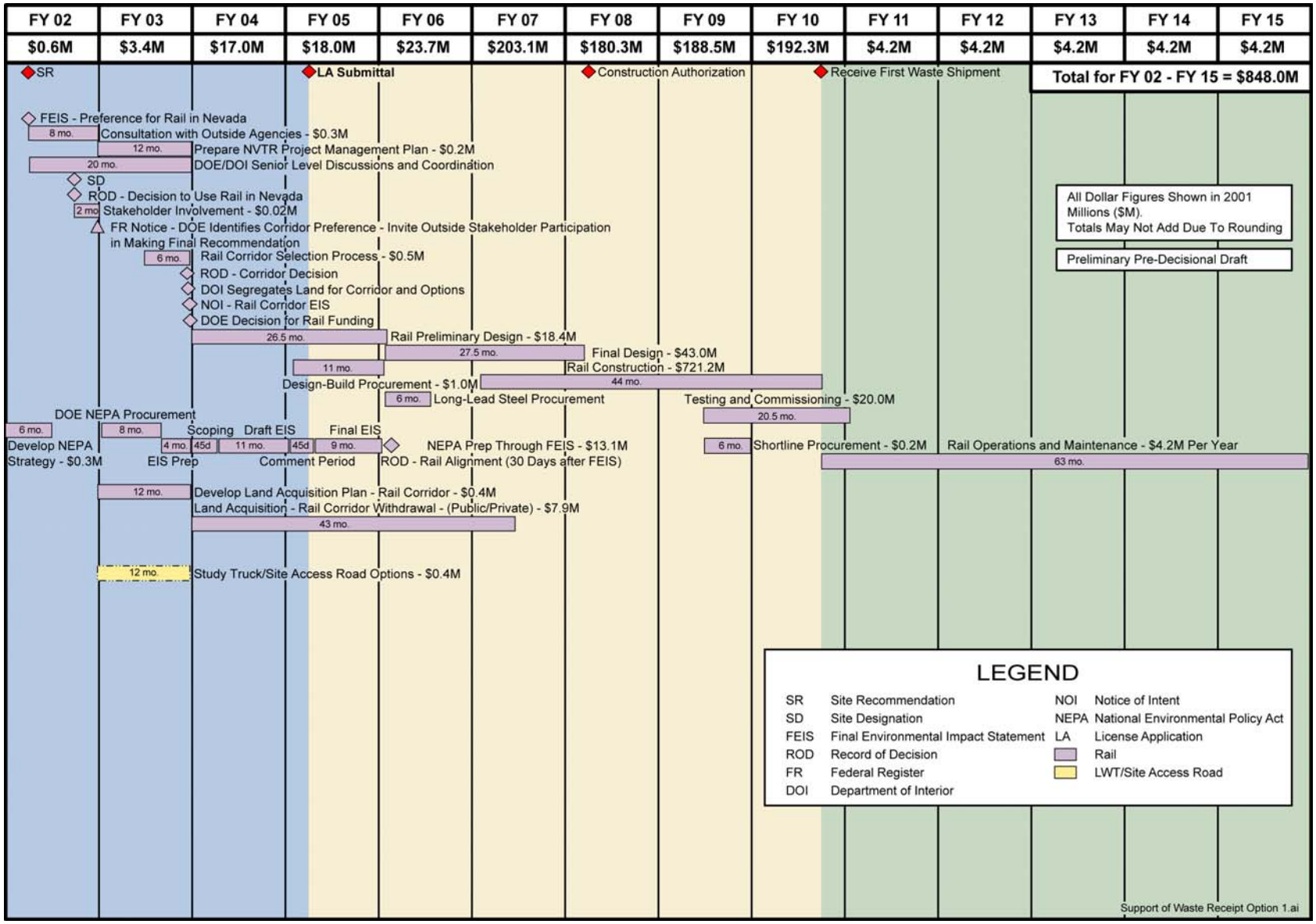

Figure 4. Nevada Transportation Support of Waste Receipt Option 1

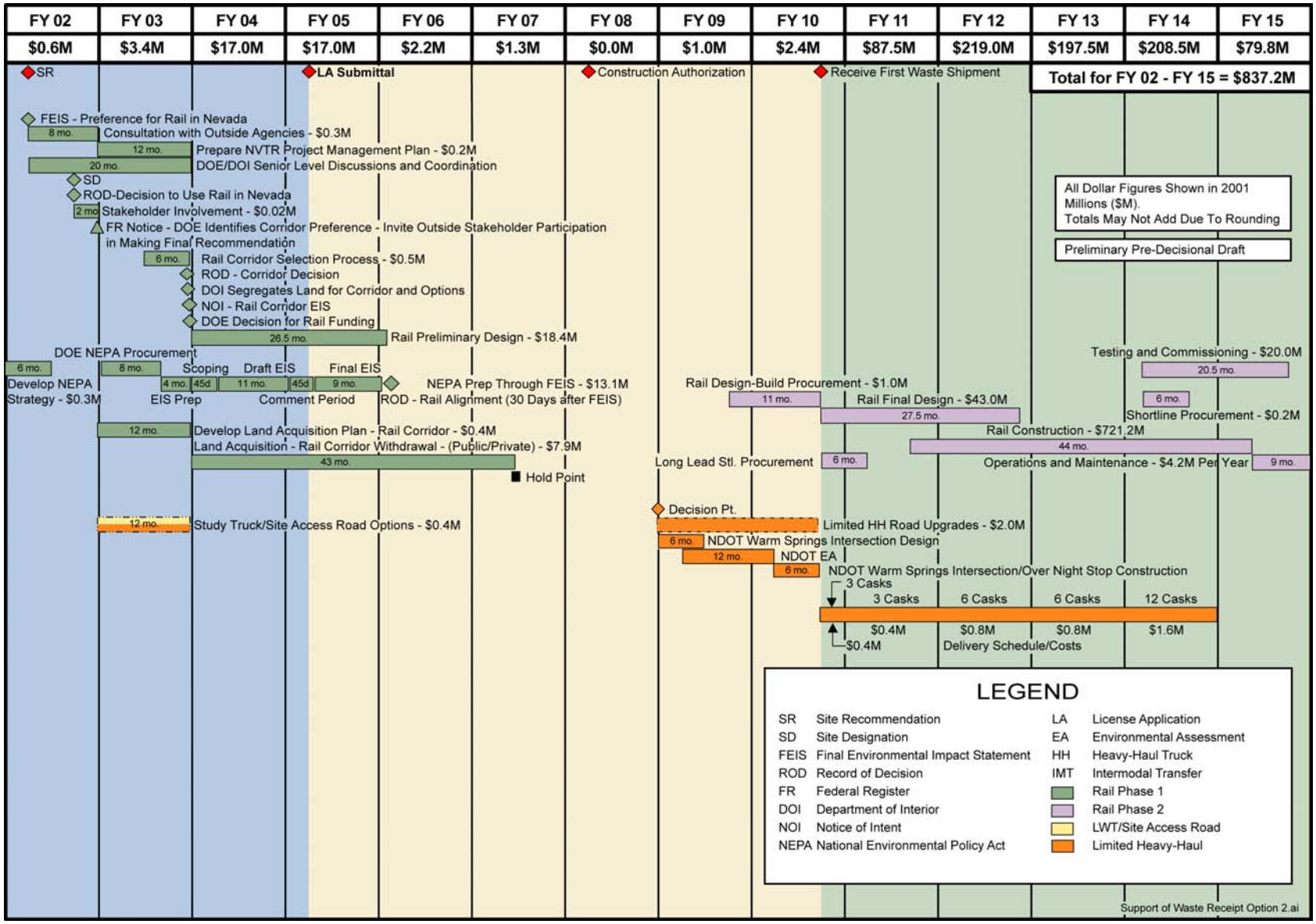

Figure 5. Nevada Transportation Support of Waste Receipt Option 2

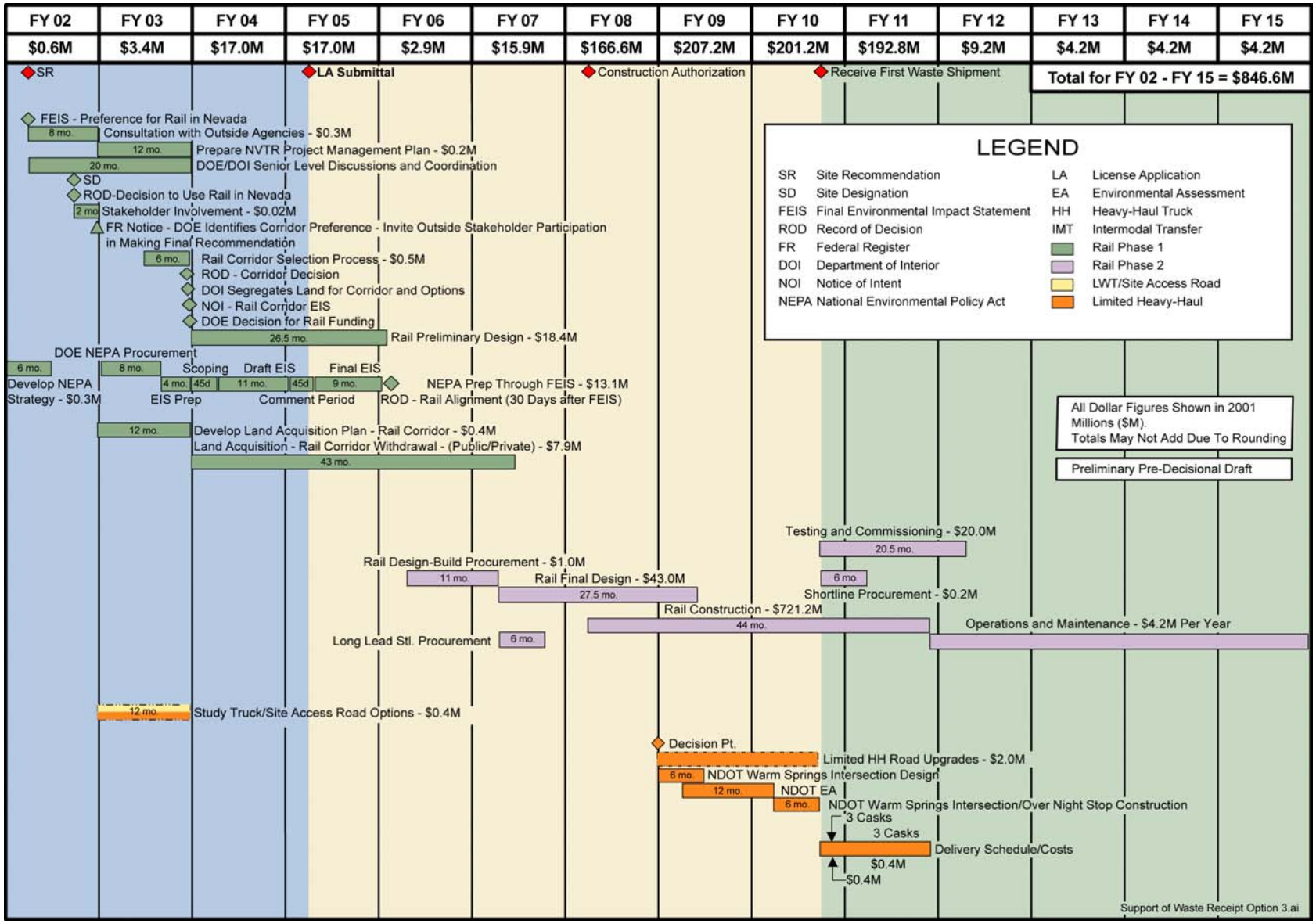

Figure 6. Nevada Transportation Support of Waste Receipt Option 3

The schedule assumes that a design/build contract will be used. The schedule shows the start of rail construction about a year before completion of the final rail design. The activities being performed in the first year include:

- Mobilization
- Drilling and operation of water wells
- Development of construction camps
- Relocation of utilities
- Topsoil stripping
- Rough grading.

These activities also apply to Options 2 and 3.

Option 1 Cost

A cost estimate for Option 1 was based primarily on the *Nevada Transportation Study Construction Cost Estimate* (DIRS 118012), using the Caliente rail route with the Eccles option. This rail route was used to bound the costs for branch rail line design, construction, operations, and maintenance. Use of the Caliente route differs from the assumption used in the 2000 TSLCC (DIRS 153255), which used an average cost of the five rail routes evaluated in the repository FEIS (DIRS 155970).

Estimated costs for Option 1 activities are contained in Table 1. A basis for Option 1 costs for select activities is contained in Appendix B; the remaining estimated costs have been developed during Nevada Transportation multi-year planning. In addition, Option 1 costs have been estimated in Appendix A (Table A-1) for each fiscal year from FY 2002 through FY 2015, the point at which fiscal year costs (operation and maintenance costs) for Options 1, 2, and 3 remain the same.

Table 1. Option 1 Activity Costs

	Costs in 2001 $ (Millions)
Consultation with Outside Agencies[1]	0.3
Prepare Nevada Transportation Project Management Plan[1]	0.2
Stakeholder Involvement[1]	0.02
Rail Corridor Selection Process[1]	0.5
Rail Preliminary Design[2]	18.4
Rail Final Design[2]	43.0
Design/Build Procurement[3]	1.0
Rail Construction[2]	721.2
Testing and Commissioning[3]	20.0
Shortline Procurement[3]	0.2
Develop NEPA Strategy[1]	0.3
NEPA Preparation through FEIS[2]	13.1

Table 1. Option 1 Activity Costs (Continued)

	Costs in 2001 $ (Millions)
Land Acquisition - Develop Rail Corridor Plan[1]	0.4
Land Acquisition - Rail Corridor Withdrawal[2]	7.9
Study Truck Options[1]	0.4
Annual Rail Line Operations and Maintenance[2]	4.2

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Costs for activities taken from the Multi-Year Planning System. Costs do not contain contingency or management add-ons.

[2]Cost basis contained in Appendix B.

[3]Costs based on input from subject matter experts. Allowances are assumed to contain a contingency.

4.1.2 Analysis of Option 2

Option 2, as described in Section 3.1, uses the assumption that high cost branch rail line activities (final design and construction) would not begin until after receipt of the first waste shipment at the repository. Like Option 1, Option 2 uses the Caliente route described in the repository FEIS (DIRS 155970, Section 6.3.2); however, because rail transportation would not be available to support initial waste receipt at the repository, limited heavy-haul trucks would be used to meet the receipt requirements given in the CRWMS Requirements Document (DIRS 154147) for naval SNF.

The route analyzed for limited heavy-haul shipments is similar to the Caliente route as described in the repository FEIS (DIRS 155970, Section 6.3.3). The Caliente route was used for analysis because of the level of detailed analysis available in previous studies, it avoids the Las Vegas Valley, and it bounds the operational costs of transport. As part of a limited heavy-haul scenario, the minimum highway construction needed to satisfy the requirements to obtain an overweight/overdimensional permit from NDOT under NAC 484.542, is used. The analysis uses an intermodal transfer location on a Union Pacific siding outside of downtown Caliente. Based on information received from Jake's Crane, Rigging & Transport, International (DIRS 157718), it was assumed that the siding would provide a suitable area (100-foot by 300-foot minimum) and level topography adjacent to the rail siding for intermodal transfer. It was assumed that this location would provide a suitable access road (gravel or paved) from the intermodal pad to the public highway. The *Supplemental Transportation Analysis* (DIRS 154824) identified the intersection at State Route 375 and U.S. Route 6, near Warm Springs, as the only intersection that the analyzed heavy-haul truck configuration could not maneuver. Hence, an intersection upgrade (addition of one 1,000-foot lane) was assumed for cost estimating purposes. In addition, due to the length of the Caliente route, an overnight stop would be required for transporting both loaded and empty casks (NAC 484.562 restricts overweight/overdimensional loads from transport at night). The analysis identified an area for an overnight stop on the Tonopah Test Range access road off U.S. Route 6 near Tonopah. This location was used because of its close proximity to lodging and the Nellis Air Force Range. For cost estimating purposes, it was assumed that a one-mile turnaround lane would be constructed to accommodate the overnight stop.

Option 2 Schedule

Like Option 1, the implementing schedule developed for Option 2 is based primarily on the schedule developed by the Civilian Radioactive Waste Management System Management and Operating Contractor (DIRS 155356), which was based on the *Nevada Transportation Study Construction Cost Estimate* (DIRS 118012). This schedule was modified after review by Bechtel Infrastructure Corporation in June 2001. Modifications included up-front planning activities and use of a design/build procurement strategy. To bound the duration of schedule activities, the schedule assumes use of the Caliente route as described in the repository FEIS (DIRS 155970, Section 6.3.2). This same route was used as a schedule basis for the 2000 TSLCC (DIRS 153255). The implementing schedule for Option 2 was developed using the assumption that high cost branch rail line activities (final design and construction) would not begin until after receipt of the first waste shipment in 2010. See Option 1 Schedule for a list of those activities that will start before final design is complete. See Figure 5 for the Option 2 schedule.

Option 2 Cost

Similar to Option 1, Option 2 uses a cost estimate for the Caliente route with the Eccles option given in the *Nevada Transportation Cost Estimate* (DIRS 118012). This rail route was used to bound the costs for branch rail line design, construction, operations, and maintenance. Use of the Caliente route differs from the assumption used in the 2000 TSLCC (DIRS 153255), which used an average cost of the five rail routes evaluated in the repository FEIS.

By using a phased rail approach, Option 2 defers the major cost activity (rail construction) until after 2010. Interim transportation of naval SNF through the limited use of heavy-haul trucks within Nevada would be required until construction of the branch rail line is complete. The estimated cost per heavy-haul shipment is $134 thousand (see Appendix B, Table B-3). For cost estimating purposes, it was assumed that the minimum waste receipt rates for naval shipments found in the CRWMS Requirements Document (DIRS 154147) would be conducted through use of limited heavy-haul. The delivery schedule used for cost estimating can be found in Figure 5. It should be noted that cost estimates for limited heavy-haul contain a high degree of uncertainty because of a limited dialogue with NDOT on the road upgrades necessary to obtain an overweight/overdimensional permit required for transport. In addition, cost estimates do not contain costs from impacts from naval fuel shipments should they exceed 150 tons.

Estimated costs for Option 2 activities are contained in Table 2. A basis for Option 2 costs for select activities is contained in Appendix B; the remaining estimated costs have been developed during Nevada Transportation multi-year planning. In addition, Option 2 costs have been estimated in Appendix A (Table A-2) for each fiscal year from FY 2002 through FY 2015, the point at which fiscal year costs (operation and maintenance costs) for Options 1, 2, and 3 are the same.

Table 2. Option 2 Activity Costs

	Costs in 2001 $ (Millions)
RAIL/LEGAL-WEIGHT TRUCK	
Consultation with Outside Agencies[1]	0.3
Prepare Nevada Transportation Project Management Plan[1]	0.2
Stakeholder Involvement[1]	0.02
Rail Corridor Selection Process[1]	0.5
Rail Preliminary Design[2]	18.4
Rail Final Design[2]	43.0
Design/Build Procurement[3]	1.0
Rail Construction[2]	721.2
Testing and Commissioning[3]	20.0
Shortline Procurement[3]	0.2
Develop NEPA Strategy[1]	0.3
NEPA Preparation through FEIS[2]	13.1
Land Acquisition - Develop Rail Corridor Plan[1]	0.4
Land Acquisition - Rail Corridor Withdrawal[2]	7.9
Study Truck Options[1]	0.4
Annual Rail Line Operations and Maintenance	4.2
LIMITED HEAVY-HAUL	
Limited Heavy-Haul Truck Construction[2]	2.0
Limited Heavy-Haul Truck Operations (per Cask)[2]	0.1

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Costs for activities taken from the Multi-Year Planning System. Costs do not contain contingency or management add-ons.

[2]Cost basis contained in Appendix B.

[3]Costs based on input from subject matter experts. Allowances are assumed to contain a contingency.

4.1.3 Analysis of Option 3

Option 3 Schedule

Like Options 1 and 2, the implementing schedule developed for Option 3 is based primarily on the schedule developed by the Civilian Radioactive Waste Management System Management and Operating Contractor (DIRS 155356), which was based on the *Nevada Transportation Study Construction Cost Estimate* (DIRS 118012). This schedule was modified after review by Bechtel Infrastructure Corporation in June 2001. Modifications included up-front planning activities and use of a design/build procurement strategy. To bound the duration of schedule activities, the schedule assumes use of the Caliente route as described in the repository FEIS (DIRS 155970, Section 6.3.2). This same route was used as a schedule basis for the 2000 TSLCC (DIRS 153255). The implementing schedule for Option 3 was developed using the assumption that branch rail line construction would not begin until after receipt of repository construction authorization from the NRC.

The schedule assumes that a design/build contract will be used. The schedule shows the start of rail construction about a year before completion of the final rail design. See Option 1 Schedule for a list of those activities that will start before final design is complete.

Option 3 Cost

Similar to Options 1 and 2, Option 3 uses a cost estimate for the Caliente route with the Eccles option given in the *Nevada Transportation Cost Estimate* (DIRS 118012). This rail route was used to bound the costs for branch rail line design, construction, operations, and maintenance. Use of the Caliente route differs from the assumption used in the 2000 TSLCC (DIRS 153255), which used an average cost of the five rail routes evaluated in the repository FEIS.

By using a phased rail approach, Option 3 defers the start of rail construction until after repository construction authorization is received from the NRC. Interim transportation of naval SNF through the limited use of heavy-haul trucks within Nevada would be required until construction of the branch rail line is complete. The estimated cost per heavy-haul shipment is $134 thousand (see Appendix B, Table B-3). For cost estimating purposes, it was assumed that the minimum waste receipt rates for naval shipments found in the CRWMS Requirements Document (DIRS 154147) would be conducted through use of limited heavy-haul. The delivery schedule used for cost estimating can be found in Figure 6. It should be noted that cost estimates for limited heavy-haul trucks contain a high degree of uncertainty because of a limited dialogue with NDOT on the road upgrades necessary to obtain an overweight/overdimensional permit required for transport. In addition, cost estimates do not contain costs from impacts from naval fuel shipments should they exceed 150 tons.

Estimated costs for Option 3 activities are contained in Table 3. A basis for Option 3 costs for select activities is contained in Appendix B; the remaining estimated costs have been developed during Nevada Transportation multi-year planning. In addition, Option 3 costs have been estimated in Appendix A (Table A-3) for each fiscal year from FY 2002 through FY 2015, the point at which fiscal year costs (operation and maintenance costs) for Options 1, 2, and 3 are the same.

4.1.4 Comparison of Options

All three options require common tasks during the NEPA preliminary design and land acquisition timeframe. For example, if Option 2 is chosen as the planning basis through FY 2004, a decision could be made anytime before the end of FY 2004 to revert to Option 1 and complete a branch rail line by 2010, assuming funding is available. Regardless of the choice made among Options 1, 2, and 3, the required activities through FY 2004 would be the same.

Option 1–Rail Available at 2010

- Requires approximately $200 million each year for four years (FY 2007 - FY 2010) while repository construction is underway.

- Not dependent on a non-rail option (limited heavy-haul truck) that poses high uncertainty on public highway upgrades; security/escorts; and community, county, and state resistance.

Table 3. Option 3 Activity Costs

	Costs in 2001 $ (Millions)
RAIL/LEGAL-WEIGHT TRUCK	
Consultation with Outside Agencies[1]	0.3
Prepare Nevada Transportation Project Management Plan[1]	0.2
Stakeholder Involvement[1]	0.02
Rail Corridor Selection Process[1]	0.5
Rail Preliminary Design[2]	18.4
Rail Final Design[2]	43.0
Design/Build Procurement[3]	1.0
Rail Construction[2]	721.2
Testing and Commissioning[3]	20.0
Shortline Procurement[3]	0.2
Develop NEPA Strategy[1]	0.3
NEPA Prep through FEIS[2]	13.1
Land Acquisition - Develop Rail Corridor Plan[1]	0.4
Land Acquisition - Rail Corridor Withdrawal[2]	7.9
Study Truck Options[1]	0.4
Annual Rail Line Operations and Maintenance[2]	4.2
LIMITED HEAVY-HAUL	
Limited Heavy-Haul Truck Construction[2]	2.0
Limited Heavy-Haul Truck Operations (per Cask)[2]	0.1

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Costs for activities taken from the Multi-Year Planning System. Costs do not contain contingency or management add-ons.

[2]Cost basis contained in Appendix B.

[3]Costs based on input from subject matter experts. Allowances are assumed to contain a contingency.

- Preferred by communities, counties, and state.
- Compatible with DOE preference in the repository FEIS (DIRS 155970).
- Flexible with early receipt through use of LWT shipments.
- Eliminates spending approximately $6 million for minor road upgrades, crane, transporter, escort, security costs, and other uncertainties associated with limited heavy-haul transport in Options 2 and 3.
- Requires funding for rail construction–approximately 18 months prior to construction authorization.
- The cost of Option 1, through 2015, is approximately $12 million more than Option 2 and $3 million more than Option 3, due to additional years of rail operations and maintenance. However, overall Program costs for transportation using Options 2 and 3 would increase due to the use of additional LWT shipments in conjunction with limited

heavy-haul shipments, to meet the same initial waste receipt rates as in Option 1. These additional costs would be reflected in national transportation costs.

- The schedule and estimated cost for Option 1 contains the lowest degree of cost and schedule risk of all the options (see Table 4).

- Rail transportation results in the least incident-free impacts to the environment as described in the repository FEIS (DIRS 155970, Section 6.2.3).

- Results in less cask handling steps, thereby decreasing the probability of drops.

Option 2–Start of Rail Construction after 2010

- Less than 10 percent of Option 2 funding required to complete Phase 1 through land acquisition prior to 2010.

- Because rail would not be available until 2015, limited heavy-haul transport is needed for five years of operations. Limited heavy-haul requires low capital cost, approximately $2 million before 2010, and $4 million in operating costs. There is high uncertainty as to what NDOT would require for road upgrades, permitting, and security/escorts (increase in cost and schedule risk).

- Could provide additional time for land acquisition (a high schedule risk activity) without overall schedule impacts.

- Contains the lowest cost, through 2015, of the three options due to the reduced number of years of rail operations and maintenance. However, overall Program costs for transportation would be the greatest for Option 2 because LWT shipments would be used in conjunction with limited heavy-haul shipments, to meet the same initial waste receipts as Option 1. These additional costs would be reflected in national transportation costs.

- Flexible with early receipt through use of LWT shipments.

- The schedule and estimated cost for Option 2 contains the highest degree of cost and schedule risk of all the options (see Table 4).

Option 3–Start of Rail Construction after Repository Construction Authorization

- Delays approximately $200 million of rail construction cost after 2010.

- Like Option 2, rail access would not be available until after 2010, and a limited use heavy-haul truck is required.

- Flexible with early receipt through use of LWT shipments.

- Option 3 contains a lower cost, through 2015, than Option 1 due to the reduced number of years of rail operations and maintenance. However, overall Program costs for

transportation would be greater in Option 3 because more LWT shipments would be used in conjunction with limited heavy-haul shipments, to meet the same initial waste receipts as Option 1. These additional costs would be reflected in national transportation costs.

- The schedule and estimated cost for Option 3 contains a higher degree of cost and schedule risk than Option 1 (see Table 4), but a lower degree than Option 2.

4.2 ANALYSIS OF SITE ACCESS ROAD ALTERNATIVES

This section provides an analysis of site access road alternatives developed to support repository construction, operations, and waste receipt. A description of each of the alternatives is provided in Section 3.2. Section 4.2 provides an analysis of the implementing schedule and costs for each of the alternatives. The driving schedule assumption for each of the alternatives is to support the start of repository construction activities. Cost and schedule information analyzed for the alternatives has been based on a rough order of magnitude estimate and contains a high degree of uncertainty. A more detailed analysis would be required if one of the alternatives is considered for future planning. A highway safety assessment is required before any recommendation is made.

It should be noted that the performance of the existing and proposed facilities differ greatly. In particular, in comparing Alternatives 1 and 2 to Alternative 3, the performance of the existing road has the following negative characteristics:

- Lathrop Wells Road and H-Road were not designed to handle heavy loads and high volumes of tractor-trailer trucks along with passenger car traffic.

- Numerous bottlenecks exist at three intersections, and at the Nevada Research and Development Area and Fortymile Wash crossing.

- Width of lanes, shoulders, grade, curvature, and sight distance are expected to have a significant impact on vehicle speed.

- Existing road was not designed to accommodate large volumes of truck traffic, including trucks that require large turning radii at intersections.

- Two-lane road with no provisions for passing a stalled vehicle.

- Fortymile Wash does not have a bridge that can accommodate traffic during flood conditions.

Table 4. Cost and Schedule Risk

Activity	Schedule Risk			Cost Risk		
	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3
RAIL/LEGAL-WEIGHT TRUCK						
Consultation with Outside Agencies	Medium	Medium	Medium	Low	Low	Low
Prepare Nevada Transportation Project Management Plan	Medium	Medium	Medium	Low	Low	Low
Stakeholder Involvement	Medium	Medium	Medium	Medium	Medium	Medium
Rail Corridor Selection Process	High	High	High	Medium	Medium	Medium
Rail Preliminary Design	Medium	Medium	Medium	Low	Low	Low
Rail Final Design[1]	Low	Medium	Low	Low	Medium	Low
Design/Build Procurement	Low	Low	Low	Low	Low	Low
Rail Construction	Medium	Medium	Medium	Medium	Medium	Medium
Testing and Commissioning	Low	Low	Low	Low	Low	Low
Shortline Procurement	Low	Low	Low	Low	Low	Low
Rail Line Operations and Maintenance	N/A	N/A	N/A	Medium	Medium	Medium
Develop NEPA Strategy	Low	Low	Low	Low	Low	Low
NEPA Preparation through FEIS	High	High	High	High	High	High
Land Acquisition - Develop Rail Corridor Plan	Low	Low	Low	Low	Low	Low
Land Acquisition - Rail Corridor Withdrawal	High	High	High	High	High	High
Study Truck Options	Low	Low	Low	Low	Low	Low
LIMITED HEAVY-HAUL						
Limited Heavy-Haul Truck Construction	N/A	High	High	N/A	High	High
Limited Heavy-Haul Truck Operations	N/A	High	High	N/A	High	High

[1]Additional risks due to possible environmental changes occurring during the delay from the FEIS.

Site Access Road Alternative Schedules

The implementing schedule developed for Alternative 1 contains two construction activities that would be conducted by two different organizations. Interchange design and construction (see Section 3.2.1) would be conducted under the jurisdiction of NDOT. A schedule estimate was developed from a telephone conversation with Washington Group International (and documented in an e-mail [DIRS 157723]). Road construction would be conducted under the jurisdiction of DOE. The design and construction schedule developed for the construction of the new site access road was based primarily (with a contingency added for construction) on an estimate provided by Morrison Knudsen Corporation (and documented in an e-mail [DIRS 157727]). The schedule for Alternative 1 can be found in Figure 7.

The implementing schedule developed for Alternative 2 is based on the same information as Alternative 1, with the exception that an interchange was not included as part of Alternative 2. The schedule for Alternative 2 can be found in Figure 7.

The implementing schedule for Alternative 3 was developed assuming that the upgrades to existing roads would not require an environmental assessment, upgrades would be conducted by the repository management and operations contractor, and external procurement would not be required. The schedule for Alternative 3 can be found in Figure 7.

Site Access Road Alternative Costs

The cost estimate for Site Access Road Alternative 1 has been based primarily on an order of magnitude estimate for construction obtained from MK Centennial, Inc. (DIRS 157722). The estimate was based on a 20-mile site access road from U.S. 95 to the site, west of Fortymile Wash. A cost estimate for the design, procurement, and environmental work was completed by Morrison Knudsen Corporation (and documented in an e-mail [DIRS 157727]). In addition to the construction of a site access road, Alternative 1 includes an interchange at U.S. 95. The cost information for this interchange was obtained by phone call from Washington Group International (and documented in an e-mail [DIRS 157723]), and was based on an interchange on I-80 near Fernley, Nevada (east of Reno), currently being worked on by the Washington Group International. Road maintenance and overlay costs for Alternative 1 have been based on estimated per-mile road maintenance costs from the *Cost Estimate for the Heavy Haul Truck Transport Design* (DIRS 153442). For cost estimating purposes, the assumption was made that road overlays would be conducted every eight years, the same assumption as that used in the *Cost Estimate for the Heavy Haul Truck Transporter Design*. Estimated costs for Site Access Road Alternative 1 are included in Table 5, and fiscal year costs are included in Appendix A (Table A-4). A basis for these costs is included in Appendix C.

Site Access Road Alternative 2 uses the same basis for its cost estimate as Alternative 1, except that Alternative 2 does not include an interchange at U.S. 95. Estimated costs for Site Access Road Alternative 2 are included in Table 5, and fiscal year costs are included in Appendix A (Table A-5). A basis for these costs is included in Appendix C.

Site Access Road Alternative 3 looks at a bare minimum approach. Alternative 3 uses existing site roads, only upgrades intersections, and re-grades the existing road at Fortymile Wash. A

rough cost estimate was made for Alternative 3, and the basis of the estimate can be found in Appendix C. Alternative 3 uses the same basis for road maintenance and overlays as Alternatives 1 and 2. For purposes of road maintenance and overlays cost estimating, Alternative 3 was assumed to be 22 miles long. Estimated costs for Alternative 3 are included in Table 5, and fiscal year costs are included in Appendix A (Table A-6).

Table 5. Site Access Road Costs

	Costs (2001 $ Millions)
Site Access Road Alternative 1 Costs	
Site Access Road Construction	36.3
U.S. 95 Interchange Construction	13.8
Annual Maintenance	0.08
Overlay (Every 8 Years)	1.9
Site Access Road Alternative 2 Costs	
Site Access Road Construction	36.3
Annual Maintenance	0.08
Overlay (Every 8 Years)	1.9
Site Access Road Alternative 3 Costs	
Site Access Road Construction	2.7
Annual Maintenance	0.09
Overlay (Every 8 Years)	2.1

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

4.2.1 Comparison of Site Access Road Alternatives

Alternative 1–New Site Access Road and Interchange

Alternative 1, consisting of a new site access road, with an interchange similar to the Mercury interchange, has a decision point at the beginning of FY 2004 (see Figure 7). This alternative consists of the following characteristics:

- Most expensive of three alternatives.
- Overall schedule is the same for Alternatives 1 and 2.
- Assumes NDOT completes the design and construction of the interchange on U.S. 95.
- Can best accommodate higher traffic rates and vehicle mix.
- Most likely favored by the state and county because of safety considerations.
- Alternative 1 is the preferred alternative of the BSC design and operations departments because it would support repository construction and operation with the greatest degree of traffic safety.

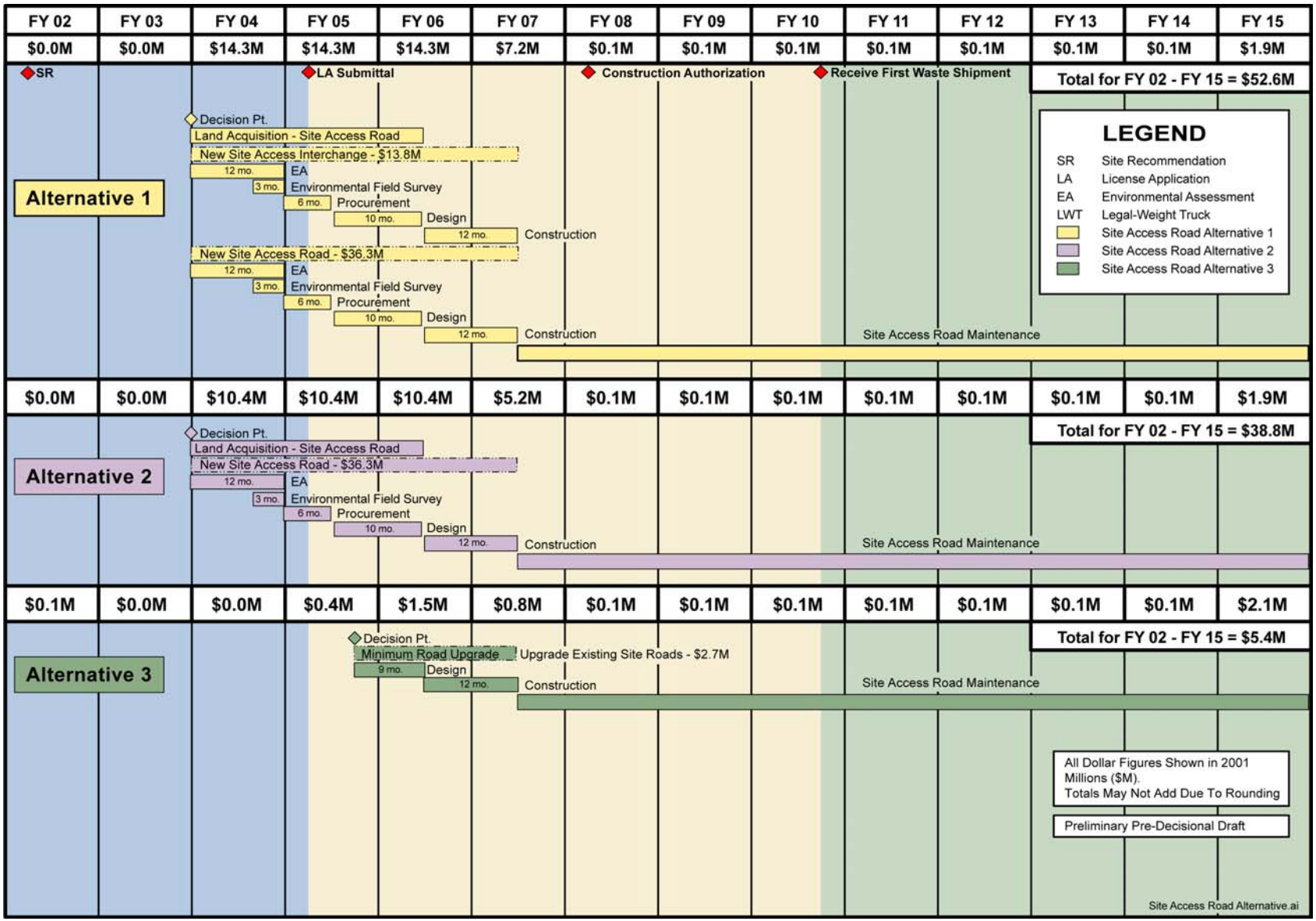

Figure 7. Site Access Road Alternative Schedules

- Environmental assessment required.
- Less likely than Alternative 3 to have conflicts with Nye County land development and road right-of-way.
- Highest confidence that road will meet the transportation needs over the life of the repository.
- The safest of the three options–does not require crossing traffic on U.S. 95.

Alternative 2–New Site Access Road

Alternative 2 consists of building a new site access road without an interchange and has a decision point at the beginning of FY 2004 (see Figure 7). This alternative consists of the following characteristics:

- Less flexible than Alternative 1, to accommodate changes in traffic volume and traffic mix
- Less likely than Alternative 3 to have conflicts with Nye County land development and road right-of-way
- Environmental assessment required
- Cost is $13 million less than Alternative 1
- Is designed with greater safety features than Alternative 3, but requires trucks to cross traffic on U.S. 95.

Alternative 3–Minor Upgrades to Existing Site Roads

Alternative 3 has the shortest construction time and is unlikely to require an environmental assessment. Alternative 3 has a decision point in late FY 2005 (see Figure 7). This alternative consists of the following characteristics:

- Has the highest traffic safety risk of the three alternatives.
- Alternative 3 is the BSC design and operations departments' non-preferred alternative because a proper analysis has not been conducted to show that the existing site roads would be capable of supporting repository construction and operations.
- Roadway is a non-engineered oil-and-chip surface, over 40 years old.
- Roadway through Fortymile Wash has an approximate 7 percent grade, which will need to be modified.
- Limited to road width and route.

- Longest distance of the three alternatives.
- Lowest initial cost and the least time to construct of all three alternatives.
- Three intersections must be modified.
- Likely to not require an environmental assessment.
- Potential land use conflicts outside the Nevada Test Site.
- Contains the greatest cost and schedule risk (see Table 6).

Alternatives 1 and 2 require an environmental assessment. Alternative 1 is also the safest and most efficient and functional of the three alternatives.

Table 6. Site Access Road Cost and Schedule Risk

	Schedule Risk	Cost Risk
Alternative 1		
Construction	Medium	Medium
Interchange	Medium	Medium
Annual Maintenance	N/A	Low
Overlay (Every 8 Years)	Low	Low
Alternative 2		
Construction	Medium	Medium
Annual Maintenance	N/A	Low
Overlay (Every 8 Years)	Low	Low
Alternative 3		
Construction	Medium	Medium
Annual Maintenance	N/A	Low
Overlay (Every 8 Years)	Medium	High

5. RESULTS AND CONCLUSIONS

The Nevada Transportation options developed for this study provide flexibility in dealing with changes to funding levels and waste receipt schedules. Flexibility was achieved through use of a combination of rail, LWT, and heavy-haul trucks. Varying degrees of cost and schedule risk are associated with the use of each of the mode combinations analyzed in the options. Options that rely on use of heavy-haul transport in Nevada contain the greatest cost and schedule risk. Options that use heavy-haul transport (Options 2 and 3) trade cost and schedule risk for flexibility in annual funding. An analysis of limited heavy-haul transport, which could reduce uncertainty in cost and schedule estimates, is planned for FY 2003.

Option 1, which provides rail transport for the first waste shipment in 2010, is the recommended option for support of waste receipt. This option provides the highest level of safety, the greatest flexibility in waste receipt rates after 2010, the highest level of confidence in cost and schedule estimates, lowest public visibility, the greatest public acceptability, and the lowest overall transportation costs (when national transportation costs are also considered) of all the options analyzed.

Should funding constraints limit transportation activities in the future, Option 2, a phased rail approach, could be used to provide the necessary flexibility, provided Phase 1 activities (preliminary design, NEPA activities, and land acquisition) are completed up-front.

All site access road alternatives that were analyzed would support repository construction, operations, and waste receipt. The least expensive alternative (Alternative 3) uses the existing site roads, with minor upgrades, and is the BSC design and operations departments' non-preferred alternative. An engineering analysis for the site access road is scheduled for FY 2003. As such, preliminary cost and schedule information has been used for this study.

Site Access Road Alternative 1, which provides a new site access road with an interchange at U.S. 95, is the recommended alternative. Alternative 1 provides the greatest level of safety, a low level of cost and schedule risk, and is likely to be preferred by NDOT. In comparison to the new branch rail line, the site access road is not a major cost driver.

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APPENDIX A

OPTIONS AND ALTERNATIVES COSTS ROUNDED INTO FISCAL YEARS

Table A-1. Option 1 Costs Rounded into Fiscal Year Totals

Costs In 2001 $ Millions	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**Total Cost per Activity Through 2015**
Support of Waste Receipt Option 1 Costs Rounded into Fiscal Year Totals	*0.6*	*3.4*	*17.0*	*18.0*	*23.7*	*203.1*	*180.3*	*188.5*	*192.3*	*4.2*	*4.2*	*4.2*	*4.2*	*4.2*	*848.0*
RAIL/LEGAL-WEIGHT TRUCK															
Consultation with Outside Agencies	0.3														0.3
Prepare Nevada Transportation Project Management Plan		0.2													0.2
Stakeholder Involvement	0.02														0.02
Rail Corridor Selection Process		0.5													0.5
Rail Preliminary Design			9.2	9.2											18.4
Rail Final Design					21.5	21.5									43.0
Design/Build Procurement				1.0											1.0
Rail Construction						180.3	180.3	180.3	180.3						721.2
Testing and Commissioning								8.0	12.0						20.0
Shortline Procurement								0.2							0.2
Rail Line Operations and Maintenance										4.2	4.2	4.2	4.2	4.2	21.1
Develop NEPA Strategy	0.3														0.3
NEPA Preparation through FEIS		1.9	5.6	5.6											13.1
Land Acquisition - Develop Rail Corridor Plan		0.4													0.4
Land Acquisition - Rail Corridor Withdrawal			2.2	2.2	2.2	1.3									7.9
Study Truck Options		0.4													0.4

Table A-1. Option 1 Costs Rounded into Fiscal Year Totals (Continued)

Costs In 2001 $ Millions	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	Total Cost per Activity Through 2015
SITE ACCESS ROAD															
Alternative 1			14.3	14.3	14.3	7.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.9	52.6
Alternative 2			10.4	10.4	10.4	5.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.9	38.8
Alternative 3				0.4	1.5	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2.1	5.4
Option 1 with Site Access Road Alternative 1 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*31.4*	*32.4*	*38.0*	*210.2*	*180.4*	*188.5*	*192.4*	*4.3*	*4.3*	*4.3*	*4.3*	*6.1*	*900.6*
Option 1 with Site Access Road Alternative 2 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*27.4*	*28.4*	*34.1*	*208.3*	*180.4*	*188.5*	*192.4*	*4.3*	*4.3*	*4.3*	*4.3*	*6.1*	*886.8*
Option 1 with Site Access Road Alternative 3 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*17.0*	*18.4*	*25.2*	*203.9*	*180.4*	*188.5*	*192.4*	*4.3*	*4.3*	*4.3*	*4.3*	*6.3*	*853.4*

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. Costs may not add due to rounding.

Table A-2. Option 2 Costs Rounded into Fiscal Year Totals

Costs in 2001 $ Millions	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**Total Cost per Activity Through 2015**
Support of Waste Option 2 Receipt Costs Rounded into Fiscal Year Totals	*0.6*	*3.4*	*17.0*	*17.0*	*2.2*	*1.3*	*0.0*	*1.0*	*2.4*	*87.5*	*219.0*	*197.5*	*208.5*	*79.8*	*837.2*
RAIL/LEGAL-WEIGHT TRUCK															
Consultation with Outside Agencies	0.3														0.3
Prepare Nevada Transportation Project Management Plan		0.2													0.2
Stakeholder Involvement	0.02														0.02
Rail Corridor Selection Process		0.5													0.5
Rail Preliminary Design			9.2	9.2											18.4
Rail Final Design										21.5	21.5				43.0
Design/Build Procurement									1.0						1.0
Rail Construction										65.6	196.7	196.7	196.7	65.6	721.2
Testing and Commissioning													10.0	10.0	20.0
Shortline Procurement													0.2		0.2
Rail Line Operations and Maintenance														4.2	4.2
Develop NEPA Strategy	0.3														0.3
NEPA Preparation through FEIS		1.9	5.6	5.6											13.1
Land Acquisition - Develop Rail Corridor Plan		0.4													0.4
Land Acquisition - Rail Corridor Withdrawal			2.2	2.2	2.2	1.3									7.9
Study Truck Options		0.4													0.4
LIMITED HEAVY-HAUL															
Limited Heavy-Haul Truck Construction								1.0	1.0						2.0
Limited Heavy-Haul Truck Operations									0.4	0.4	0.8	0.8	1.6		4.0

Table A-2. Option 2 Costs Rounded into Fiscal Year Totals (Continued)

Costs in 2001 $ Millions	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**Total Cost per Activity Through 2015**
SITE ACCESS ROAD															
Alternative 1			14.3	14.3	14.3	7.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.9	52.6
Alternative 2			10.4	10.4	10.4	5.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.9	38.8
Alternative 3				0.4	1.5	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2.1	5.4
Option 2 with Site Access Road Alternative 1 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*31.4*	*31.4*	*16.5*	*8.4*	*0.1*	*1.1*	*2.5*	*87.6*	*219.1*	*197.6*	*208.5*	*81.7*	*889.7*
Option 2 with Site Access Road Alternative 2 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*27.4*	*27.4*	*12.6*	*6.5*	*0.1*	*1.1*	*2.5*	*87.6*	*219.1*	*197.6*	*208.5*	*81.7*	*876.0*
Option 2 with Site Access Road Alternative 3 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*17.0*	*17.4*	*3.7*	*2.0*	*0.1*	*1.1*	*2.5*	*87.6*	*219.1*	*197.6*	*208.5*	*81.9*	*842.5*

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. Costs may not add due to rounding.

Table A-3. Option 3 Costs Rounded into Fiscal Year Totals

Costs in 2001 $ Millions	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	Total Cost per Activity Through 2015
Support of Waste Option 3 Receipt Costs Rounded into Fiscal Year Totals	0.6	3.4	17.0	17.0	2.9	15.9	166.6	207.2	201.2	192.8	9.2	4.2	4.2	4.2	846.6
RAIL/LEGAL-WEIGHT TRUCK															
Consultation with Outside Agencies	0.3														0.3
Prepare Nevada Transportation Project Management Plan		0.2													0.2
Stakeholder Involvement	0.02														0.02
Rail Corridor Selection Process		0.5													0.5
Rail Preliminary Design			9.2	9.2											18.4
Rail Final Design						14.3	19.1	9.6							43.0
Design/Build Procurement					0.7	0.3									1.0
Rail Construction							147.5	196.7	196.7	180.3					721.2
Testing and Commissioning									3.0	12.0	5.0				20.0
Shortline Procurement									0.1	0.1					0.2
Rail Line Operations and Maintenance											4.2	4.2	4.2	4.2	16.9
Develop NEPA Strategy	0.3														0.3
NEPA Preparation through FEIS		1.9	5.6	5.6											13.1
Land Acquisition - Develop Rail Corridor Plan		0.4													0.4
Land Acquisition - Rail Corridor Withdrawal			2.2	2.2	2.2	1.3									7.9
Study Truck Options		0.4													0.4
LIMITED HEAVY-HAUL															
Limited Heavy-Haul Truck Construction								1.0	1.0						2.0
Limited Heavy-Haul Truck Operations									0.4	0.4					0.8

Table A-3. Option 3 Costs Rounded into Fiscal Year Totals (Continued)

Costs in 2001 $ Millions	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	Total Cost per Activity Through 2015
SITE ACCESS ROAD															
Site Access Road Alternative 1			14.3	14.3	14.3	7.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.9	52.6
Site Access Road Alternative 2			10.4	10.4	10.4	5.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.9	38.8
Site Access Road Alternative 3				0.4	1.5	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2.1	5.4
Option 3 with Site Access Road Alternative 1 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*31.4*	*31.4*	*17.2*	*23.0*	*166.7*	*207.3*	*201.3*	*192.9*	*9.3*	*4.3*	*4.3*	*6.1*	*899.2*
Option 3 with Site Access Road Alternative 2 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*27.4*	*27.4*	*13.3*	*21.1*	*166.7*	*207.3*	*201.3*	*192.9*	*9.3*	*4.3*	*4.3*	*6.1*	*885.4*
Option 3 with Site Access Road Alternative 3 Rounded into Fiscal Year Totals	*0.6*	*3.4*	*17.0*	*17.4*	*4.4*	*16.7*	*166.7*	*207.3*	*201.3*	*192.9*	*9.3*	*4.3*	*4.3*	*6.3*	*852.0*

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. Costs may not add due to rounding.

Table A-4. Site Access Road Alternative 1 Costs Rounded into Fiscal Year Totals

Costs in 2001 $ Millions	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**Total Cost per Activity Through 2015**
Site Access Road Alternative 1 Costs Rounded into Fiscal Year Totals	*0.0*	*0.0*	*14.3*	*14.3*	*14.3*	*7.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*1.9*	*52.6*
Road Construction			10.4	10.4	10.4	5.2									36.3
Road Interchange			3.9	3.9	3.9	2.0									13.8
Annual Maintenance							0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.6
Overlay (Every 8 Years)														1.9	1.9

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. Costs may not add due to rounding.

Table A-5. Site Access Road Alternative 2 Costs Rounded into Fiscal Year Totals

Costs in 2001 $ Millions	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**Total Cost per Activity Through 2015**
Site Access Road Alternative 2 Costs Rounded into Fiscal Year Totals	*0.0*	*0.0*	*10.4*	*10.4*	*10.4*	*5.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*1.9*	*38.8*
Construction			10.4	10.4	10.4	5.2									36.3
Annual Maintenance							0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.6
Overlay (Every 8 Years)														1.9	1.9

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. Costs may not add due to rounding.

Table A-6. Site Access Road Alternative 3 Costs Rounded into Fiscal Year Totals

Costs in 2001 $ Millions	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**	**Total Cost per Activity Through 2015**
Site Access Road Alternative 3 Costs Rounded into Fiscal Year Totals	*0.0*	*0.0*	*0.0*	*0.4*	*1.5*	*0.8*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*2.1*	*5.4*
Construction				0.4	1.5	0.8									2.7
Annual Maintenance							0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.6
Overlay (Every 8 Years)														2.1	2.1

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. Costs may not add due to rounding.

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APPENDIX B

OPTION 1, 2, AND 3 COST BASIS

APPENDIX B

Table B-1. Rail Construction Costs

Rail Construction Costs[1]	Cost
Total Direct Construction Costs (1997 $)	466,413,000
Prime Contractor Overhead and Fee [12.5% Directs] (1997 $)	58,301,625
Contingency for Directs and Overhead/Fee [25%] (1997 $)	131,178,656
Construction Management [6% of Directs + 25% Contingency] (1997 $)	6,996,195
Total Construction Costs (1997 $)	*662,889,476*
Construction Cost of Caliente Route w/Escalation [1.088] (2001 $)	**$721,223,750**
Rail Final Design Costs[1]	
Engineering and Surveying (1997 $)	45,179,000
Engineering and Surveying Contingency [25%] (1997 $)	11,294,750
Engineering and Surveying Costs of Caliente Route w/Escalation [1.088] (2001 $)	61,443,440
Preliminary Design Cost [30% E&S]	**18,433,032**
Final Design Cost [70% E&S]	**$43,010,408**
Rail Land Acquisition Costs[1]	
Direct Land Acquisition Costs (1997 $)[1]	4,202,000
Prime Contractor Overhead & Fee [12.5% Directs] (1997 $)[1]	525,250
Contingency for Directs and Overhead/Fee [25%] (1997 $)	1,181,813
Administrative Management [6% of Directs + 25% Contingency] (1997 $)[1]	315,150
Subtotal Land Acquisition Costs (1997 $)	*6,224,213*
Subtotal Land Acquisition Costs w/Escalation [1.088] (2001 $)	*6,771,943*
Land Withdrawal Application (1999 $)[3]	750,000
Negotiate Options on Private Lands (1999 $)[3]	100,000
Subtotal Land Withdrawal/Options (1999 $)	*850,000*
Contingency for Land Withdrawal/Options [25%] (1999 $)	212,500
Subtotal Land Withdrawal/Options w/Escalation [1.050] (2001 $)	*1,115,625*
Total Land Acquisition Costs (2001 $)	**$7,887,568**
Annual Rail O&M Costs[2]	
Annual O&M Cost for Caliente Route (1995 $)	2,980,000
Contingency [25%] (1995 $)	745,000
Annual O&M Cost of Caliente Route w/Escalation [1.133] (2001 $)	**$4,220,425**
NEPA Analysis Costs through FEIS[3]	
Conduct EIS Scoping Meetings/Agency Consultation (1999 $)	500,000
Conduct Environmental Field Surveys (1999 $)	5,500,000
Prepare Draft NEPA Document (1999 $)	2,500,000
Conduct Public Comment Period (1999 $)	300,000
Prepare Final NEPA Document (1999 $)	1,200,000
Contingency [25%] (1999 $)	2,500,000
NEPA Analysis Cost (1999 $)	12,500,000
NEPA Analysis Cost with Escalation [1.050] (2001 $)	**$13,125,000**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Costs based on *Nevada Transportation Study Construction Cost Estimate* (DIRS 118012).

[2]Costs based on *Nevada Potential Repository Preliminary Transportation Strategy, Study 2,* Volume I (DIRS 101214).

[3]Costs based on an Ed McCann e-mail (DIRS 157728).

Table B-2. Round Trip Limited Heavy-Haul Transport and Transfer Costs Breakdown

Round Trip Limited Heavy-Haul Transport and Transfer Costs Breakdown[1]		
Activity	**Cost Breakdown**	**Costs (2001 $)**
Mobilization and Demobilization		30,400
Transport	License, Insurance, Certifications, Inspections	18,500
	Crew Cost per Week	16,900
	Equipment Cost per Trip	2,620
	Escorts[2]	3,354
Total Transport Costs		*41,374*
Total Round Trip Transport and Transfer Costs		**$71,774**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.
[1]Costs based on estimate from Jake's Crane, Rigging & Transport, International (DIRS 157718).
[2]Escorts required by Nevada Administrative Code 484.545.

Table B-3. Total Limited Heavy-Haul Round Trip Cost per Cask

Total Limited Heavy-Haul Round Trip Cost per Cask					
	Cost Breakdown	**Man-hour Basis**	**Total Man-hours/Cost Units**	**Labor Rate or Unit Rate ($)**	**Cost (2001 $)**
Round Trip Limited Heavy-Haul Transport and Transfer Costs[1]					71,774
Nevada Highway Patrol (NHP) Escort Service[2]	NHP Labor	$100/hour, 1½ (Overtime Rate), 22 Hours per One-way Trip (4 Escorts)	88	100	8,800
	Return Trip to Caliente				8,800
	Per Diem	Two Day Trip with Two Nights Lodging $100/Day/Person x 4 People x 2 Days	8	100	800
	Car Allowance	600 Miles One Way x 4 Vehicles	2,400	0.35	840
	Return Trip Car Allowance				840
	Total Round Trip NHP Escort Expenses				*20,080*
Armed Security Guards at Stops[3]	Intermodal from Rail to Truck	Three Shifts/6 people per shift $75/hour x 8 hours	144	75	10,800
	Overnight Stop	Two Shifts/4 people per shift $75/hour x 8 hours	64	75	4,800
			Contingency for Limited Heavy-Haul Round Trip Cost per Cask [25%]		26,864
			Total Limited Heavy-Haul Round Trip Cost per Cask		**$134,318**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.
[1]Costs based on estimate from Jake's Crane, Rigging & Transport, International (DIRS 157718).
[2]Cost based on *Supplemental Transportation Analysis* (DIRS 154824).
[3]Armed escorts are required for stops, per 10 CFR 73.37, for loaded casks only (not for return trip).

Table B-4. Limited Heavy-Haul Road Upgrade Construction Cost

	Unit	Quantity	Unit Cost ($2001)	Cost Totals ($2001)
Warm Springs Intersection Upgrade[1]	Foot	1,000	$172.03	172,034
Overnight Stop Turnaround Road Construction[2]	Mile	1	$1,816,675	1,816,675
Limited Heavy-Haul Road Upgrade Construction Total Cost				**$1,988,709**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%. A 25% contingency is included in costs.

[1]Based on 1/2 of the per foot cost of the Site Access Road construction in Alternative 2 (Intersection would only be widened by adding one additional 20' lane).

[2]Based on per mile cost of the Site Access Road construction in Alternative 2.

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APPENDIX C

SITE ACCESS ROAD COST ESTIMATE BASIS

Table C-1. Alternative 1 Site Access Road Construction Cost

	Cost Break Down	Cost (2001 $)	Cost Totals (2001 $)
U.S. 95 Interchange Construction Cost[1]			11,000,000
U.S. 95 Interchange Construction Contingency [25%]			2,750,000
Site Access Road Design and Procurement Cost[2]			2,000,000
Site Access Road Design and Procurement Contingency [25%]			500,000
Site Access Road Construction[3]			
	Roadway Excavation	$2,815,800	
	12' Aggregate Base	$5,631,000	
	6" A.C. Pavement	$7,762,500	
	3/4" Open Grade	$830,000	
	Concrete (Box Culverts)[4]	$1,520,000	
	Reinforcing Steel	$696,800	
	24" RCP Culvert Pipe[5]	$480,000	
Subtotal Initial Construction Costs			*19,736,100*
	25% Appurtenances[6]	$4,934,025	
Subtotal Initial Costs + Appurtenances			*24,670,125*
	25% Construction Contingency	$6,167,531.25	
Subtotal Initial Costs + Appurtenances + Contingency			*30,837,656*
	Mobilization	$2,995,850	
Total Site Access Road Construction Cost			*33,833,506*
Alternative 1 Total Cost			**$50,083,506**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Source: Washington Group (DIRS 157723).

[2]Source: MK estimate (DIRS 157727).

[3]Source: MK Centennial (DIRS 157722).

[4]Assume double 10' x 4' box culvert every 2 miles.

[5]Assume 24" RCP culvert approximately every 1,000 feet.

[6]Appurtenances would include stripping, signing, guide posts, fencing, guardrail, prime coat, tack coat, headwalls/end sections for culverts, granular backfill for culverts.

Table C-2. Alternative 2 Site Access Road Construction Cost

	Cost Break Down	Cost (2001 $)	Cost Totals (2001 $)
Site Access Road Design and Procurement Costs[1]			2,000,000
Site Access Road Design and Procurement Contingency [25%]			500,000
Construction[2]			
	Roadway Excavation	$2,815,800	
	12' Aggregate Base	$5,631,000	
	6" A.C. Pavement	$7,762,500	
	3/4" Open Grade	$830,000	
	Concrete (Box Culverts)[3]	$1,520,000	
	Reinforcing Steel	$696,800	
	24" RCP Culvert Pipe[4]	$480,000	
Subtotal Initial Construction Costs			*19,736,100*
	25% Appurtenances[5]	$4,934,025	
Subtotal Initial Costs + Appurtenances			*24,670,125*
	25% Construction Contingencies	$6,167,531	
Subtotal Initial Costs + Appurtenances + Contingencies			*30,837,656*
	Mobilization	$2,995,850	
Total Road Construction Cost			*33,833,506*
Alternative 2 Total Construction Cost			**$36,333,506**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Source: MK estimate (DIRS 157727).

[2]Source: MK Centennial (DIRS 157722).

[3]Assume double 10' x 4' box culvert every 2 miles.

[4]Assume 24" RCP culvert approximately every 1,000 feet.

[5]Appurtenances would include stripping, signing, guide posts, fencing, guardrail, prime coat, tack coat, headwalls/end sections for culverts, granular backfill for culverts.

Table C-3. Alternative 3 Site Access Road Construction Cost

	Cost Break Down	Cost (2001 $)	Cost Totals (2001 $)
Design, Procurement, and Environmental Work			200,000
Design, Procurement, and Environmental Work Contingency [25%]			50,000
Construction			
	Fortymile Wash Regrading	$1,000,000	
	Existing Road Intersection Upgrades	$200,000	
Subtotal Initial Construction Costs			*1,200,000*
	100% Construction Contingencies[1]	$1,200,000	
Total Road Construction Cost			*2,400,000*
Alternative 3 Total Construction Cost			**$2,650,000**

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]High contingency percentage due to minimal design.

Table C-4. Site Access Road Maintenance Costs

Site Access Road Annual Maintenance				
(Cost Includes Contingency)	**Annual Cost per Mile[1, 2] (1998 $)**	**Site Access Road Miles**	**Annual Maintenance (1997 $)**	**Annual Maintenance with Escalation [1.066] (2001 $)**
Alternative 1	$3,798	20	$75,960	$80,973
Alternative 2	$3,798	20	$75,960	$80,973
Alternative 3	$3,798	22	$83,556	$89,071

Site Access Road Overlay Costs						
(Assumed Every 8 Years)	**Overlay Cost per Mile[1] (1998 $)**	**Site Access Road Miles**	**Overlay Cost (1998 $)**	**Construction Management Costs [6%][1] (1998 $)**	**Contingency Cost [25%][1] (1998 $)**	**Overlay Cost with Escalation [1.066]**
Alternative 1	$67,376	20	$1,347,520	$80,851	$357,093	$1,903,305
Alternative 2	$67,376	20	$1,347,520	$80,851	$357,093	$1,903,305
Alternative 3	$67,376	22	$1,482,272	$88,936	$392,802	$2,093,635

NOTE: Costs are based on an order of magnitude estimate and are assumed to have an accuracy of +/- 40%.

[1]Source: *Cost Estimate for the Heavy Haul Truck Transport Design* (DIRS 153442).

[2]Includes built in contingency.

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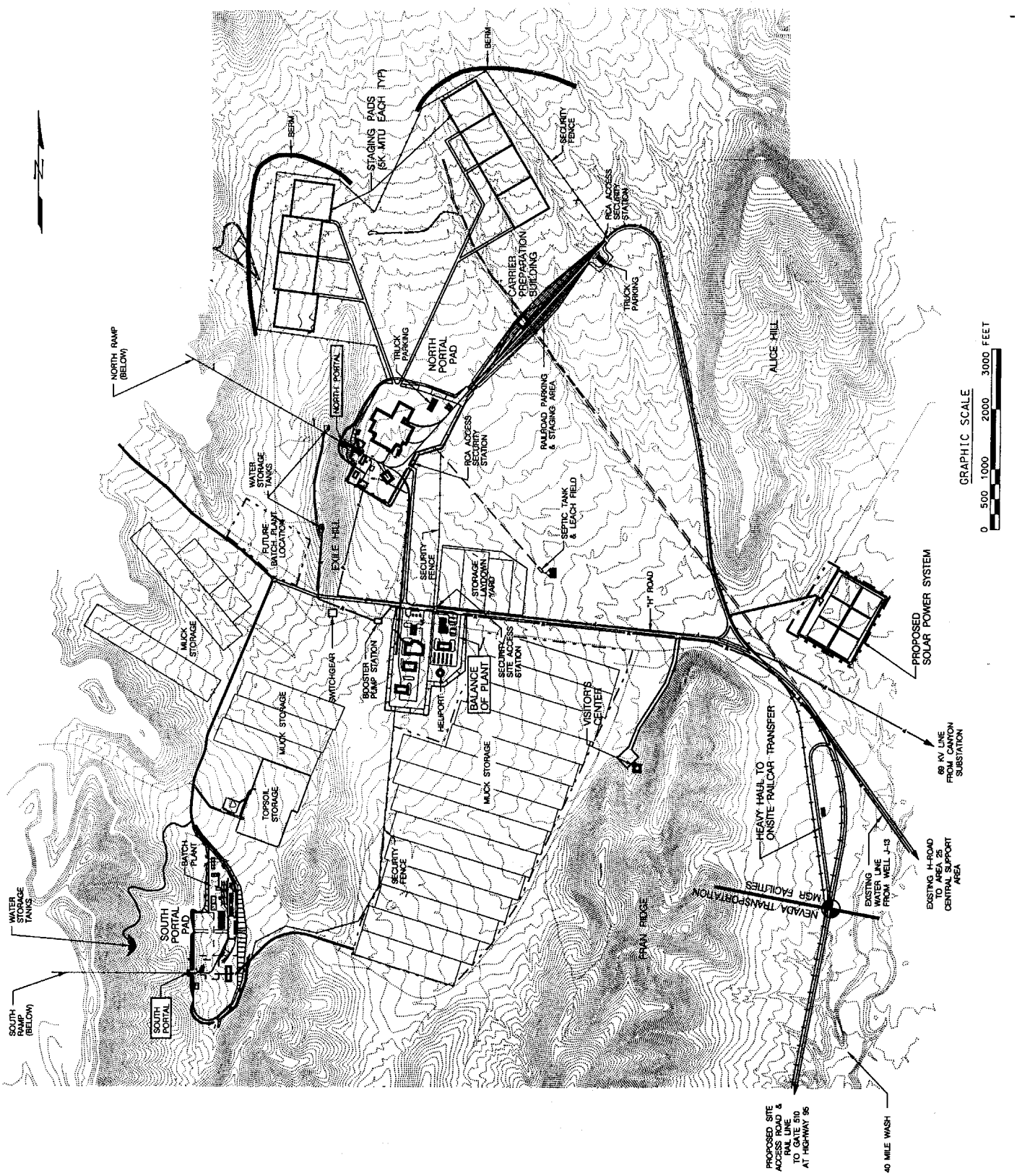
APPENDIX D

INTERFACE BETWEEN NEVADA TRANSPORTATION AND SITE FACILITIES


N
GRAPHIC SCALE
0 500 1000 2000 3000 FEET
NORTH RAMP (BELOW)
NORTH PORTAL
NORTH PORTAL PAD
TRUCK PARKING
STAGING PADS (5K MTU EACH TYP)
BERM
SECURITY FENCE
RCA ACCESS SECURITY STATION
CARRIER PREPARATION BUILDING
RAILROAD PARKING & STAGING AREA
ALICE HILL
WATER STORAGE TANKS
FUTURE BATCH PLANT LOCATION
EXILE HILL
SEPTIC TANK & LEACH FIELD
STORAGE LAYDOWN YARD
"H" ROAD
PROPOSED SOLAR POWER SYSTEM
MUCK STORAGE
SWITCHGEAR
BOOSTER PUMP STATION
HELIPORT
BALANCE OF PLANT
SECURITY SITE ACCESS STATION
VISITOR'S CENTER
TOPSOIL STORAGE
BATCH PLANT
SOUTH PORTAL PAD
SOUTH PORTAL
SOUTH RAMP (BELOW)
WATER STORAGE TANKS
HEAVY HAUL TO ONSITE RAILCAR TRANSFER
NEVADA TRANSPORTATION MGR FACILITIES
EXISTING WATER LINE FROM WELL J-13
EXISTING H-ROAD TO AREA 25 CENTRAL SUPPORT AREA
69 KV LINE FROM CANYON SUBSTATION
PROPOSED SITE ACCESS ROAD & RAIL LINE TO GATE 510 AT HIGHWAY 95
40 MILE WASH
FRAN RIDGE

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