MEASURES TO IMPROVE THE SAFETY OF TRANSPORTING SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE BY TRUCK ON ALTERNATIVE ROUTES THROUGH CHURCHILL, ESMERALDA, LANDER AND MINERAL COUNTIES, NEVADA TO THE PROPOSED YUCCA MOUNTAIN GEOLOGIC REPOSITORY

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1. INTRODUCTION

The Department of Energy proposes to transport approximately 2,700 truck transportation casks of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) on highways through Nevada to the proposed Geologic Repository at Yucca Mountain.

According to the Supplemental Environmental Impact Statement (SEIS), "Trucks that carried transportation casks probably would be overweight rather than legal weight"[1]. Trucks with gross vehicle weights less than 36,000 kilograms (80,000 pounds) are defined as being of legal weight on the nation's highways and were initially evaluated in the FEIS as a potential transportation mode for SNF and HLW. However, "DOE has since determined that trucks carrying truck casks would be more likely to have gross vehicle weights in the range of 36,000 kilograms to 52,000 kilograms (115,000 pounds)."[2] As proposed and evaluated in the SEIS, the truck shipments of SNF and HLW would be transported to the Repository using overweight trucks on Nevada highways as part of the DOE's Proposed Action.

The SEIS identified and analyzed representative national truck routes from SNF and HLW origination sites throughout the United States to the Repository. In the State of Nevada, the only truck routes identified and analyzed in the SEIS were highway routes passing through the Las Vegas metropolitan area. The SEIS goes on to state, however, that that "At this time, before receipt of a construction authorization for the Repository and years before a possible first shipment, DOE has not identified the actual routes it would use to ship spent nuclear fuel and high-level radioactive waste to Yucca Mountain. However, the highway and rail routes that DOE used for analysis in this Repository SEIS are representative of routes that it could use. The highway routes conform to U.S. Department of Transportation regulations (49 CFR 397.101). These regulations, which the Department of Transportation developed for Highway Route-Controlled Quantities of Radioactive Materials, require such shipments to use preferred routes that would reduce the time in transit. A preferred route is an Interstate System highway, bypass, beltway, or an alternative route designated by a state routing agency. Alternative routes can be designated by states and tribes under U.S. Department of Transportation regulations (49 CFR 397.103) that require consideration of the overall risk to the public and prior consultation with local jurisdictions and other States."[3]

[1] SEIS, page 2-45
[2] SEIS, page 2-45
[3] SEIS, page 6-4

This statement makes it clear that under U.S. Department of Transportation regulations, a state routing agency, presumably the Nevada Department of Transportation[4] (NDOT), could designate routes to the Repository through the State of Nevada which are different than the representative routes analyzed in the SEIS. Such alternative routes, which certainly exist, have not been identified or analyzed in the SEIS and include routes through Churchill, Esmeralda, Lander and Mineral Counties (the Four Counties.)

This report identifies alternative truck routes through the Four Counties which are highly likely to be selected by NDOT as alternative routes for the shipment of SNF and HLW to the Repository and identifies and evaluates measures which are recommended to improve the safety of these routes under the Proposed Action.

2. LIKELY ALTERNATIVE TRUCK SHIPMENT ROUTES THROUGH THE FOUR COUNTIES

Two interstate highways cross the State of Nevada. I-80 crosses the northern part of the State from east to west from Utah to Northern California. I-15 crosses the southern part of the State from northeast to southwest from Arizona (and Utah) to Southern California. Any SNF and HLW waste shipped to the Repository by truck would enter Nevada on I-80 or I-15 since the preferred route in neighboring states is likely to be an Interstate System highway. I-15 is located in Clark County and passes through Las Vegas, the largest and most populous City in the State of Nevada. I-80 extends through Churchill County and Lander County as well as six other Northern Nevada counties.

The proposed Yucca Mountain Repository is only accessible from US-95, a national highway which extends north-south through Nevada from Oregon to Southern California and connects to both I-80 and I-15. While the portion of US-95 from Las Vegas northward to the Repository has been identified and analyzed in the SEIS as a representative truck route, there are several other routes within the State of Nevada which lead from I-80 and/or I-15 to the Repository and which the NDOT would have the authority to designate as alternative routes for the transportation of SNF and HLW.

Without limiting the number of alternative routes that could be considered, two alternative routes which would be highly likely candidates are:

(a) I-80 westbound from Utah to US-95 and then US-95 southbound to the Repository. (This route passes through Lander, Churchill, Mineral and Esmeralda Counties); and,

[4] FEIS, Appendix J, page J-30

(b) I-80 eastbound from California to Fernley, Nevada, Alt. US-50 eastbound to US-50, US-50 eastbound to Fallon, Nevada, and then US-95 southbound to the Repository. (This route passes through Churchill, Mineral and Esmeralda Counties.)

These alternative routes, utilizing existing highways in the Four Counties (see Figure 1), are the most likely routes that would be used to reduce the time in transit for overweight truck shipments entering the State on I-80 from northern U.S. origins, and would be expected to accommodate a portion of the projected 2,700 truck shipments. Furthermore, these routes would be the most likely alternative routes used to avoid the shipment of SNF and HLW by overweight truck through Las Vegas.

The SEIS does not assess impacts associated with either of these routes which are highly likely to be designated as alternative routes by the State of Nevada.

I-80 is a four-lane Interstate highway, designed, constructed and maintained to Interstate standards. Alt. US-50 and US-50 are rural highways between Fernley and Fallon which have been recently widened to four lanes by the NDOT. US-95 within Churchill, Mineral and Esmeralda Counties is a two-lane rural highway. The FEIS and SEIS do not consider the sufficiency or reliability of US-95, US-50 or Alt. US-50, as rural highways, to accommodate overweight trucks carrying SNF and HLW.

As shown in Table 1, at least 299 miles of highway in the Four Counties are highly likely to be designated as Alternative Routes for the shipment of SNF and HLW, including 248 miles of two lane rural highway (US-95).

TABLE 1

Length of Truck Routes in the Four Counties which are Highly Likely to be Designated as Alternative Routes for the Shipment of SNF and HLW (miles)

	I-80	US-95	US-50	Alt. US-50	TOTAL
Churchill County	5.6	58.9	9.1	9.3	82.9
Esmeralda County		96.8			96.8
Lander County	27.0				27.0
Mineral County		92.4			92.4
Total	32.6	248.1	9.1	9.3	299.1

Rural highways, especially low volume rural highways, such as US-95, are upgraded and maintained less frequently than interstate highways. Based on our review of available documentation, the initial condition of the roadway and the reliability of maintenance is insufficient for the safe transportation of SNF and HLW using overweight trucks.

Overweight trucks shipping SNF and HLW will travel at a slower rate of speed than automobile traffic, especially on long ascending grades. This is generally not a problem on four-lane interstate highways where an additional lane is available for passing. However, on two-lane highways such as US-95, faster traffic tends to queue up behind slower moving vehicles. Normal operating procedure is for faster traffic to pass slower moving vehicles by temporarily occupying the on-coming traffic lane in locations where there is adequate sight distance and a gap in on-coming traffic. Roadway safety depends upon the skill and judgment of individual motorists as well as the frequency of passing opportunities. As traffic volumes continue to increase in the future, passing opportunities will become less available.

Specific impacts which can be anticipated include the following:

(a) Traffic safety will decline as traffic backs up behind overweight trucks on two lane highways;

(b) Traffic safety is also compromised if substandard highway design features are not upgraded to current standards; and,

(c) Overweight trucks accelerate the deterioration of pavement, shortening pavement life.

Failure to address these impacts with appropriate mitigation would lead to increased accident rates, increased radiological affects, increased air pollution and increased costs to state and local jurisdictions.

3. MEASURES TO IMPROVE THE SAFETY OF TRANSPORTING SNF AND HLW ON RURAL HIGHWAY ROUTES THROUGH THE FOUR COUNTIES

To evaluate the characteristics of US-95 as well as US-50, Alt. US-50 and I-80 in the Four Counties, the Nevada Department of Transportation record documents in Table 2 were reviewed.

The following measures to improve the safety and reliability of rural highways in the Four Counties were evaluated:

(a) Construction of passing lanes at intervals of 5 to 10 miles, in accordance with the guidelines of the American Associate of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highways and Streets, to allow faster traffic to pass;

(b) Increase shoulder width to a minimum of 8 ft. in accordance with AASHTO guidelines;

(c) Construct truck climbing lanes on long upgrades;

(d) Upgrade roadside design features through the use of guardrail, flattened slopes and improved drainage;

TABLE 2

Nevada Department of Transportation Construction Drawings Reviewed to Determine the Existing Characteristics of I-80, US-95, US-50 and Alt. US-50 in the Four Counties

CONTRACT NO.	ROUTE	COUNTY	BEGIN MILEPOST	END MILEPOST	PROJECT TYPE
1089	I 80	CH	12.84	27.69	ORIGINAL CONSTRUCTION
3130	US 50	CH	11.27	16.07	WIDEN
619	US 50A	CH	2.11	9.02	ORIGINAL CONSTRUCTION
3130	US 50A	CH	8.53	9.29	WIDEN
1169	US 95	CH	0.00	3.11	ORIGINAL CONSTRUCTION
1159	US 95	CH	3.11	15.90	ORIGINAL CONSTRUCTION
735	US 95	CH	25.05	26.09	ORIGINAL CONSTRUCTION
1012	US 95	CH	26.20	27.91	ORIGINAL CONSTRUCTION
985	US 95	CH	27.91	43.42	ORIGINAL CONSTRUCTION
1010	US 95	CH	43.42	58.60	ORIGINAL CONSTRUCTION
1089	US 95	CH	58.60	58.91	ORIGINAL CONSTRUCTION
2282	US 6/95	ES	0.00	18.73	OVERLAY
1095	US 6/95	ES	0.00	0.12	ORIGINAL CONSTRUCTION
344	US 6/95	ES	0.12	19.01	ORIGINAL CONSTRUCTION
614	US 6/95	ES	40.99	51.23	ORIGINAL CONSTRUCTION
731	US 6/95	ES	51.23	57.74	ORIGINAL CONSTRUCTION
1370	US 95	ES	0.00	5.76	ORIGINAL CONSTRUCTION
1319	US 95	ES	5.76	19.28	ORIGINAL CONSTRUCTION
764	US 95	ES	19.28	19.96	ORIGINAL CONSTRUCTION
1528	US 95	ES	32.88	44.95	ORIGINAL CONSTRUCTION
390	US 95	ES	85.24	86.43	ORIGINAL CONSTRUCTION
1454	US 95	ES	85.78	99.07	ORIGINAL CONSTRUCTION
410	US 95	ES	86.43	94.17	ORIGINAL CONSTRUCTION
1516	I 80	LA	3.21	9.05	GRADE & DRAIN
1163	I 80	LA	9.05	15.90	ORIGINAL CONSTRUCTION
1137	I 80	LA	15.90	26.97	ORIGINAL CONSTRUCTION
1454	US 95	MI	0.00	5.87	ORIGINAL CONSTRUCTION
364	US 95	MI	11.47	27.98	ORIGINAL CONSTRUCTION
1922	US 95	MI	11.86	15.87	OVERLAY
3340	US 95	MI	27.70	40.03	WIDEN
386	US 95	MI	27.98	36.43	ORIGINAL CONSTRUCTION
	US 95	MI	39.68	52.86	ORIGINAL CONSTRUCTION
2675	US 95	MI	44.09	44.09	SAFETY
1074	US 95	MI	62.34	70.58	ORIGINAL CONSTRUCTION
1508	US 95	MI	63.21	63.61	SAFETY
980	US 95	MI	70.58	84.86	ORIGINAL CONSTRUCTION
1295	US 95	MI	82.77	82.94	ORIGINAL CONSTRUCTION
1169	US 95	MI	84.86	92.56	ORIGINAL CONSTRUCTION
1295	US 95A	MI	0.00	10.38	ORIGINAL CONSTRUCTION

(e) Provide realignment of the highway in locations with substandard geometrics, in accordance with AASHTO guidelines;

(f) Improve signage to alert drivers to the locations of climbing and passing lanes as safe passing zones;

(g) Upgrade signage to better designate no-passing zones;

(h) Upgrade intersection controls and sight visibility zones as warranted; and,

(i) In accordance with the State of Nevada Highway Preservation Report,

- Provide corrective maintenance on sections of pavement which have been overlayed within the previous 12 years but show signs of physical deterioration;
- Re-construct pavement which has not been overlayed within 12 years; and,
- Provide a pavement maintenance overlay at a minimum of twelve year intervals.

The following sections discuss recommended improvements based on the review of the documents in Table 2. The estimated costs for these improvements are presented in Section 6.

3.1 Passing Lanes

Two-hundred and forty-eight miles of US-95, a two-lane rural highway, are likely to be used to transport SNF and HLW through the Four Counties. With the introduction of slower moving overweight vehicles traveling to and from the Repository, and with the volume of traffic continuing to increase, passing opportunities are reduced due to the increased likelihood of traffic being in the oncoming opposing lanes. This makes the construction of passing lanes at regular intervals highly desirable. Passing lanes "are particularly advantageous in rolling terrain, especially where alignment is winding or the profile includes critical lengths of grade."[5] This type of terrain exists along much of US-95 in the Four Counties.

Construction of passing lanes improves traffic operations by providing additional opportunities to pass slower moving overweight vehicles hauling SNF and HLW to the Repository and empty transport casks on return trips. The addition of passing lanes, to augment existing passing zones, and with advance signing, would provide motorists added safety and assurance that passing opportunities are forthcoming. This knowledge would dissuade motorists from engaging in risky passing maneuvers. Providing additional passing opportunities would not only increase safety but also reduce motorist delay.

[5] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, page 251

Based on AASHTO recommended guidelines for frequency and length, a review of the grades and alignment of US-95 and the typical performance of trucks carrying 115,000 pounds loaded and 95,000 pounds empty, a total of 65 locations for passing lanes are recommended along US-95 in Churchill, Esmeralda and Mineral Counties. This would provide for one passing lane every 7.6 miles on average. Each passing lane would be approximately one mile in length, providing sufficient distance for trucks to pull over to allow faster moving vehicles to pass and then to move back into the travel lane without losing speed. The estimated cost to construct these passing lanes is presented in Section 6. The estimated cost includes provision for appropriate signing.

3.2 Widened Shoulders

For rural arterials with similar characteristics to US-95, US-50, and US-50A in the Four Counties, AASHTO recommends shoulder widths of 8 feet[6].

The use of shoulders provides many operational and safety benefits. Among those cited by AASHTO[7] are:

- Space is provided away from the traveled way for vehicles to stop because of mechanical difficulties, flat tires, or other emergencies.
- Space is provided for motorists to stop occasionally to consult road maps or for other reasons.
- Space is provided for evasive maneuvers to avoid potential crashes or reduce their severity.
- The sense of openness created by shoulders of adequate width contributes to driving ease and reduced stress.
- Sight distance is improved in cut sections, thereby potentially increasing safety.
- Some types of shoulders improve highway aesthetics.
- Highway capacity is improved because uniform speed is encouraged.
- Space is provided for maintenance operations such as snow removal and storage.
- Lateral clearance is provided for signs and guardrails.
- Storm water can be discharged farther away from the traveled way, and seepage adjacent to the travel way can be minimized. This may directly reduce pavement breakup.
- Structural support is given to the pavement.

[6] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, Exhibit 7-3

[7] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, page 314.

- Space is provided for pedestrian and bicycle use, for bus stops, for occasional encroachment of vehicles, for mail delivery vehicles, and for the detouring of traffic during construction.

"Regardless of width, a shoulder should be continuous. The full benefits of a shoulder are not realized unless it provides a driver with refuge at any point along the traveled way."[8]

Existing shoulder widths for US-95, US-50 and Alt. US-50 were obtained from the records of the Nevada Department of Transportation. According to the NDOT records, these highways do not have the recommended shoulder width of 8 ft. for 220 of the 299 miles through the Four Counties. Therefore, 220 miles of shoulder widening is recommended. The estimated cost of constructing the recommend shoulders is presented in Section 6.

3.3 Truck Climbing Lanes

Trucks, especially overweight trucks, are affected by grades much more than passenger cars. The effect of grades on trucks causes operational and safety issues. Passenger cars can queue up behind trucks on ascending grades which cause time delays to motorists. This queuing can also cause motorists to become impatient and may lead them to attempt unsafe passing maneuvers.

"Studies show that, regardless of the average speed on the highway, the more a vehicle deviates from the average speed, the greater its chances of becoming involved in a crash."[9] The study cited shows that the crash involvement rate for trucks in which their running speeds are reduced by 10 miles per hour below the average running speed of all traffic is increased approximately three-fold.[10]

Where safety is a concern, AASHTO[11] criteria define locations recommended for the construction of truck climbing lanes as up-grades where truck flow exceeds 20 vehicles per hour and 10 mph or greater speed reduction is expected for heavy trucks.

Existing grades on US-95 were analyzed to determine where truck climbing lanes would be warranted. Accordingly, 27 miles of truck climbing lanes are recommended for construction

[8] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, page 315.
[9] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, page 239.
[10] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, Exhibit 3-58.
[11] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Street, 2004 edition, pages 244-245.

on US-95 in Churchill, Esmeralda and Mineral Counties. The estimated cost to construct these climbing lanes is presented in Section 6.

3.4 Roadside Design Features

"On Nevada's roadways, there were 605 fatal run-off-the-road crashes between 1998 and 2002, resulting in a total of 675 traffic fatalities, which is an average of 135 fatalities per year. This accounts for approximately 39% of all traffic fatalities during the five-year period."[12] Of the 675 fatalities, 63% occurred on rural roadways and 20% of that total occurred on arterials[13] similar to the types that are the subject of this study.

In 2006, the Nevada Department of Transportation and the Nevada Department of Public Safety published the Nevada Strategic Highway Safety Plan. As part of the plan, twenty critical strategies were identified to help reduce the number of severe and fatal crashes occurring in the state. ***Flatten side slopes and remove roadside objects*** was identified as critical strategy number 11. This strategy is meant to "reduce the consequences of leaving the road by designing safer slopes and ditches to prevent rollovers and provide adequate clear zones by removing/relocating objects (i.e., trees, utility poles, light pole, and etc.) in hazardous locations."[14]

NDOT has recognized that it is highly desirable to keep vehicles in their travel lanes and has placed rumble strips along most of their rural arterial highways in an effort to keep motorists on the roadway. However, there will always be vehicles that run off the road and "a clear unobstructed roadside is highly desirable."[15]

Slope flattening (or installation of guardrail) to provide a traversable and unobstructed roadside are recommended for 44 miles along US-95 in Churchill, Esmeralda and Mineral Counties based upon review of the construction drawings for the highways. The estimated cost to improve the safety of roadside features is presented in Section 6.

3.5 Highway Realignment and Intersection Upgrades

Most of US-95 is posted for a 70 mph speed. In rural locations with substandard geometrics, especially on curves where the safe speed is lower than 70 mph, re-alignment

[12] Nevada Department of Transportation and Nevada Department of Public Safety, Nevada Strategic Highway Safety Plan, 2006, page 20
[13] Nevada Department of Transportation and Nevada Department of Public Safety, Nevada Strategic Highway Safety Plan, 2006, page 20
[14] Nevada Department of Transportation and Nevada Department of Public Safety, Nevada Strategic Highway Safety Plan, 2006, page 72
[15] American Association of State Highway and Transportation Officials A policy on Geometric Design of Highways and Streets, 2004 edition, page 448

would allow vehicles to travel at higher speeds and avoid delays. However, passing lanes and climbing lanes in areas near substandard geometric features would allow slower moving trucks to move aside, reducing delays to faster moving vehicles and increasing safety for all. Appropriately placed passing and climbing lanes should, therefore, minimize the need for realignment in the Four Counties.

In urban areas, sharp turns are accompanied by caution signing or traffic signals to provide for the safe movement of trucks at slower speeds. Therefore, no specific up-grades of the highways in urban areas have been identified. However, measures to improve roadside visibility should be considered during design and construction.

4. SECURE PARKING/REST AREAS

The AASHTO Strategic Highway Safety Plan[16] identified drowsy or distracted drivers as an emphasis area and keeping drivers alert as a strategic highway safety plan goal. In Nevada, of the seven accident categories with the highest numbers of fatal crashes, inattentive and asleep/fatigued drivers were cited in 18% of crashes.[17]

An overweight, over-dimensional truck traveling on the National highway system requires permits from each state through which it travels. The permit may place restrictions on vehicle operations to protect public safety. In Nevada, for example, an overweight truck permit may restrict shipments to daylight hours. The distance traveled by trucks in Nevada may range up to 675 miles following I-80 and US-95 from the Utah border to the Repository. Assuming that the overweight truck permit restricts travel to daylight hours, night-time layover locations will be needed in Nevada. The night-time layover locations may include amenities for the drivers, a refueling station, inspection area and site security features

Besides a convenient place for drivers of SNF and HLW transport vehicles to rest, these secure parking areas could also be used as an opportune location to tow the transport vehicles to when mechanical breakdowns occur. The transport vehicles could be towed and secured until such a time that the vehicle is either repaired or the cask is loaded onto another vehicle.

A total of five secure parking/rest areas specifically for SNF and HLW transport vehicles are recommended in the Four Counties, with placement at about 70 mile intervals. The estimated cost of constructing these rest areas is presented in Section 6.

[16] American Association of State Highway and Transportation Officials Strategic Highway Safety Plan, 2005 edition.
[17] Nevada Department of Transportation and Nevada Department of Public Safety, Nevada Strategic Highway Safety Plan, 2006, page 6.

5. PAVEMENT MAINTENANCE

Overweight trucks hauling SNF and HLW will accelerate the wear and tear on rural highways, increasing pavement maintenance requirements.

Based on the classification of US-95, US-50 and Alt. US-50, the State of Nevada Highway Preservation Report recommends a pavement maintenance overlay at a minimum of 12 year intervals. The maintenance overlay commonly consists of milling 2-inches of pavement and overlying the highway with up to 4 inches of new asphalt. Based on pavement age and condition, a normal maintenance schedule would resurface approximately 25 miles, or one-twelfth of the 299 miles of US-95, US-50 and Alt. US-50 in the Four Counties, annually.

Clearly, use of the highways in the Four Counties by overweight trucks shipping SNF and HLW to the Repository would only be a contributory factor in the need to periodically rehabilitate highway pavement. However, highway maintenance is expensive and rural highways such as US-95 serving relatively low traffic volumes are a lower priority for the State of Nevada. Accordingly, maintaining a good riding surface to provide a safe, reliable route for the transport of SNF and HLW may require a substantial contribution by the user. The estimated cost of recommend pavement maintenance for US-95, US-50 and Alt. US-50 is presented in Section 6.

6. ESTIMATED COST OF MEASURES TO IMPROVE THE SAFETY OF HIGHWAYS IN THE FOUR COUNTIES

Table 3 provides an estimate of the cost to improve the safety of the highways in the Four Counties to transport SNF and HLW by trucks in accordance with the recommendations in this report. Table 4 provides an estimate of the annual cost to maintain the highways in the Four Counties. Cost estimates are in 2009 dollars and should be escalated to the actual year of construction. Costs are based on preliminary quantity estimates and unit rates bid by contractors for similar work in Nevada.

TABLE 3

Estimated Cost to Improve the Safety of Highways in Churchill, Esmeralda, Lander and Mineral Counties in Nevada as Alternative Routes to Transport Spent Nuclear Fuel and High-Level Radioactive Waste by Truck

	CHURCHILL COUNTY		ESMERALDA COUNTY		LANDER COUNTY		MINERAL COUNTY		TOTAL
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	
PASSING LANES	10 ea	$7,540,000	23 ea.	$17,342,000		-	32 ea.	$24,128,000	$49,010,000
SHOULDER WIDENING	39.0 miles	$15,709,000	95.5 miles	$30,310,000		-	85.6 miles	$34,325,000	$80,344,000
CLIMBING LANES	3.4 miles	$3,684,000	18.6 miles	$18,629,000		-	4.6 miles	$4,513,000	$26,826,000
SLOPE FLATTENING	21.6 miles	$10,148,000	11.8 miles	$4,630,000		-	10.9 miles	$12,645,000	$27,423,000
SECURE PARKING AREAS	1 ea	$432,000	2 ea.	$864,000	1 ea.	$432,000	1 ea	$432,000	$2,160,000
SUBTOTAL CONSTRUCTION		$37,513,000		$71,775,000		$432,000		$76,043,000	$185,763,000

Note:

1. All costs shown in 2009 dollars.

TABLE 4

Estimated Annual Cost to Maintain the Rural Non-Interstate Highways in Churchill, Esmeralda, and Mineral Counties in Nevada as Alternative Routes to Transport Spent Nuclear Fuel and High-Level Radioactive Waste by Truck

	CHURCHILL COUNTY	ESMERALDA COUNTY	MINERAL COUNTY	TOTAL
ANNUAL MAINTENANCE	$5,768,000	$6,318,000	$6,031,000	$18,117,000

Note:

1. All cost shown in 2009 dollars

7. CONCLUSIONS

A review of the characteristics of I-80, US-95, US-50 and Alt. US-50 as highly likely alternative routes for the transportation of SNF and HLW through Churchill, Esmeralda, Lander and Mineral Counties, Nevada, identified numerous deficiencies in these highways to safely and reliably accommodate overweight trucks. Based on an assessment of the construction drawings for these highways, and federal and state criteria and guidelines for roadway safety, this report recommends the following safety enhancements:

- Passing lanes at 65 locations along US-95;
- Shoulder widening along 220 miles of US-95, US-50 and Alt. US-50;
- Climbing lanes for 27 miles along US-95;
- Flattening of slopes along 44 miles of US-95; and,
- Five secure parking/rest areas.

The estimated cost of these recommended improvements is $185,763,000 in 2009 dollars.

The 267 miles of US-95, US-50 and Alt. US-50 in Churchill, Esmeralda and Mineral County require annual maintenance which is estimated to cost $18,117,000 per year. Contribution towards this annual maintenance cost would be recommended to ensure the reliability of these rural highways.

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