Inyo County Transportation Risk Assessment Project

Identification of Mitigation Strategies & Measures Designed to Maximize Public Safety on Inyo County Roads Associated With Potential Shipments of Spent Nuclear Fuel and High Level Radioactive Waste *(Task 5)*

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The Inyo County Transportation Risk Assessment Project is a joint effort of Radioactive Waste Management Associates (lead), E. J. Bentz & Associates, Inc., Black Mountain Research (Fred Dilger), James David Ballard, and Richard C. Moore, P.E. in behalf of Inyo County, California

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and the *National Park Service, US Department of the Interior.*

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EXECUTIVE SUMMARY

The purpose of this report is to identify mitigation strategies and measures that may be undertaken to maximize safety on Inyo County roads associated with the potential shipments of Spent Nuclear Fuel (SNF) and High Level Waste (HLW) by legal weight trucks through the county en route to a proposed Yucca Mountain Nuclear Waste Repository. This current analysis represents **Task 5** of a larger effort that includes other Tasks and reports that will be referenced herein.

The topical focus of this analysis is the identification of preventative measures and strategies that might maximize safety by minimizing truck vehicular accidents, and all vehicle delay times.

The geographical focus of this analysis is SR 127 in Inyo County. Currently, the choice of final routes to be taken by the potential SNF / HLW shipments will depend on the State of California. Under current law, (*Docket HM-164, 49CFR397, Subpart D, overall, and 49CFR397.101-103 for HRCQ (highway route controlled quantities as defined in 49 CFR 173.403)*), the State of California may designate an alternate preferred route (to an interstate) in accordance with the above US Department of Transportation "Guidelines." In the absence of an alternative designation, the interstates are the preferred routes. Currently, the State of California has not designated an alternative to interstate I-15 into Nevada. Due to the existing and projected traffic volumes on I-15 (and associated projected service levels), the State of California may decide in the future to follow the precedent established by DOE for its internally regulated (self-regulated) shipments of Low Level Waste (LLW) and Transuranic Waste (TRU), and utilize SR 127 through Inyo County for shipments to Yucca Mountain during the inclement winter months to avoid the dense I-15 Las Vegas Corridor.

> **Neither route, although currently safe, is desirable, and each would require transportation improvements to maximize safety in the future to meet the potential significant and long-term Yucca Mountain truck shipments. This report identifies mitigation strategies and measures designed to maximize safety on Inyo SR 127 associated with the potential shipments of SNF and HLW.**

SR 127 is an undivided two-lane conventional highway running from Baker, California (in San Bernardino County) northward through Inyo County to the Nevada State line. The route length in Inyo County is 49.4 miles. The route is functionally classified and designed to meet the operational design specifications of a Rural Minor Arterial roadway. The anticipated shipments of SNF / HLW represents a significant departure from existing and historical movements on SR 127. The **Task 2**, November 2005 report " *Transportation Scenario Estimation*" provides shipment estimates. The anticipated shipment campaign will be far larger than any single previous US shipping campaign of any goods. The shipping campaign will also be far longer (24 - 38 years) than any previous shipping campaigns of any goods. Although Inyo County SR 127 has experienced limited shipments of radioactive waste in the recent past (approximately 1/10 of the anticipated number of SNF / HLW shipments per day), these radioactive materials have been low level activity radioactive wastes, not the high level activity wastes of the anticipated long term shipping campaign. Similarly, much of the existing emergency response infrastructure has

not been developed to meet emerging needs. The current infrastructure meets current, very limited needs.

The earlier, April 2006 **Task 4** report *"Risk Estimates for Inyo County"* has identified the potential radiological and non-radiological consequences of vehicle accidents on Inyo County roads. The primary focus of the analysis in this current report is the identification of mitigation measures and strategies to prevent the occurrence of tractor trailer truck accidents associated with the potential shipments of SNF and HLW. Toward that goal, a detailed accident analysis was conducted for all vehicle accidents on Inyo SR 127. This analysis included an initial comparison of accident rate histories - by road segment, to provide clues for roadway "hotspots." This was followed by a more detailed analysis of the entire vehicle accident database for Inyo SR 127. This more detailed analysis focused on the accident frequency and severity (fatalities; injuries) - by location - as well as accident characteristics (e.g. primary cause of collision; type of collision; move preceding collision; vehicles involved in collision) for every accident involving a tractor trailer truck at every location identified. This analysis was necessary to determine mitigation safety measure that might reduce the occurrence of future accidents associated with potential SNF/HLW materials.

The results of the analysis were very revealing:

- For several of the ***"hotspot"*** locations on Inyo SR 127, both the total vehicle accident rate, and the total vehicle fatality & injury accident rate, were significantly higher than the respective California State averages.

- Two adjoining ***"hotspot"*** segments constitute 62% of all tractor trailer truck accidents. Over half of all vehicle accidents involve tractor trailer trucks at mile post (MP) 17.0-17.99, and 80% of all vehicle accidents involve tractor trailer trucks at MP 16.0-16.99.

- For the two above-cited ***"hotspot"*** segments," speeding and improper turning comprised 75% of the primary causes of collisions involving tractor trailer trucks. Overturning comprised 75% of all the tractor trailer truck accidents, and running off the road dominated 88% as the event preceding the overturning.

- Of all the tractor trailer truck accidents on Inyo SR127 over the last five years (2000-2005), 12 out of 13, or 92 percent, did not involve any other vehicle. The single multi-vehicle accident involved a sideswipe, with speeding the event preceding the sideswipe.

The dominant tractor trailer truck accident profile on Inyo SR 127 is going off the road after speeding or making an improper turn, resulting in overturning of the truck off the road.

The results of the accident analysis were then compared with the operational road conditions and physical limitations for all of the accident locations. The results were equally revealing:

- ALL of the tractor trailer truck accidents occurred at locations having less than desired curve radii, or minimal paved shoulders.

- 80% of tractor trailer truck accidents having injuries occurred at locations having BOTH less than desired curve radii, AND minimal paved shoulders.

- The remaining 20% of tractor trailer truck accidents occurred at locations having 0 width paved shoulders.

In sum, the operational limitations (e.g. minimal paved shoulders, very limited curve radii) are very "unforgiving" of any driving behavior that exceeds the posted speed limits.

The typical tractor trailer truck accident profile is approaching a sharp curve at high speeds, or having limited sight lines due to a sharp curve, being unable to correct in time, having limited paved shoulder to mitigate any off road deviation due to curve sharpness, and running off the road and overturning.

Improvement of the physical road conditions, at these ***"hotspot"*** locations, could significantly enhance both operational flow and operational safety, and minimize accident occurrence. Based on the analysis, following is an identification of selected mitigation strategy measures that might be instituted to maximize safety on Inyo SR 127 in the event a decision is made to make Yucca Mountain shipments on SR 127. These include **preventative** measures, mainly **transportation infrastructure improvements**, and **transportation traffic management initiatives.** These measures, though designed to reduce accident occurrence, could also afford operational benefits by reducing delay times, and consequent potential incident-free exposure times.

Suggested Transportation Infrastructure Improvement Mitigation Measures are:

- *Increase Paved Shoulder Widths on Inyo SR 127* ***at identified "hotspot locations." Preferably, increase paved shoulder width to a minimum of 1.2 meters along the entire route length of SR 127.***

- *Realign Curves on Inyo SR 127* ***at identified "hotspot" locations. Preferably, realign all curves to a minimum specification of 1970 feet to meet an observed increase in average vehicular speed.***

- *Improve Drainage Conditions on Inyo SR 127* ***at the identified locations (see text).***

- *Create Passing Lanes on Inyo SR 127.* ***As a minimum, there should be passing lanes constructed every 10 mile segment along the route. Preferably, although expensive, make Inyo SR 127 into a four-lane roadway. Passing lanes (or a new roadway) would significantly increase the roadway effective capacity, minimize traffic buildups (and road rage) behind slow moving traffic, and facilitate emergency response access and recovery.***

- *Create Truck Turn-Outs on Inyo SR 127.* ***Construct simple turn-outs for trucks (and passenger vehicles) to change direction. These may be coupled with roadway rest stops.***

Suggested Traffic Management Mitigation Measures are:

- *Negotiate Continuation of Selected Black-Out Periods.* ***Continue and extend the current existing SR 127 "preferred routing program" agreement with DOE, Nevada to the DOE Yucca Mountain Program (see text).***

- *Installation of Optical Speed Bumps at Selected Locations.* ***Install optical speed bumps at identified*** "hotspot" ***locations to promote driver awareness of speed limitations at these physically restricted roadway locations.***

- *Increase Utilization of Highway Visual Aids and Signage* ***at the identified*** "hotspot" ***locations.***

Funding*: **The utilization of traffic management mitigation measures will help to improve safety, but their value will be severely limited in usefulness for Inyo SR 127, unless accompanied by highway infrastructure improvements such as passing lanes and turn-outs***. Many of the transportation improvement mitigation measures were identified by CALTRANS almost a decade ago. More recently, the 2002 DOE FEIS Comment Response Document addressed these same concerns and potential impacts of Yucca Mountain shipments. In the 2002 DOE FEIS, DOE recognized the need to potentially fund roadway improvements to facilitate shipments and to mitigate local adverse impacts. The Nuclear Waste Policy Act, as amended, explicitly provides a mechanism for DOE, in Section 116(c), to provide for impact assistance for designated affected units of local government. Inyo County has been designated as such. DOE has historically funded roadway improvements for radioactive waste shipments. The Santa Fe, New Mexico Bypass – Route 599 - was funded to support WIPP shipments and to minimize adverse impacts on the city of Santa Fe.

Time to implement the above identified transportation mitigation measures would be a significant factor. Many of the infrastructure improvements would require significant lead times due to right of way acquisition and necessary environmental, cultural, and community reviews and consultations with affected parties. These lead times might be significantly shortened by segmenting and prioritizing the selected measures, and staging their implementation accordingly.

Data and findings in this report, and the other associated Task reports, could support the development of an impact assistance request for funding the above safety improvements under Section 116(c).

Emergency Response Preparedness Considerations: DOE historically has recognized the limited nature of emergency response capability along SR 127. A specific reason given by DOE for current route diversification for LLW shipments on SR 127 is *"to limit the number of shipments that travel on SR 127 due to extremely limited and remote emergency response capabilities."* In addition, even with the relatively low number of total LLW shipments, DOE has created a fund (paid by DOE users of the NTS LLW disposal facility) to enhance emergency response capabilities along the LLW routes. This funding has been used to support emergency response personnel and equipment. The overall program has been well received. It serves as a model for future efforts in enhancing emergency response at the local level - especially in rural areas which depend on volunteer support. This program was designed for six Nevada Counties. Although Inyo is not a Nevada County (it shares reciprocal mutual aid agreements with Nevada

Counties), it has received over $200,000 in funds since the program's inception through several annual grants.

Actions to improve emergency response preparedness include:

- **Improve the route:** The single best action to improve emergency response capability on Inyo SR 127 would be to improve the route, as identified above. This would reduce the probability of an accident (with potential release), and it would also enable first responders to respond more effectively.

- **Conduct Demonstration / Pilot Project To Support Development of Section 180(c) Initiatives**: The second best action would be to develop, with DOE's support, a demonstration pilot emergency response project to support the development of DOE's forthcoming Section 180(c) program initiatives.

There is currently no Section 180(c) assistance available. DOE plans that *"Section 180(c) assistance would be made available approximately 4 years prior to shipment through a jurisdiction."* There is, however, a current need to develop the content and approach for an effective Section 180(c) assistance program. This demonstration pilot project would propose to support that development. The design of the project would address many of the issues and capabilities identified in the recent **Task 5** emergency response field survey report, and in the 2002 FEIS Comment Response Document. The results of this pilot demonstration project could be applied to other rural communities on campaign routes across the nation which depend heavily on volunteer and part time staff to provide emergency response.

Elements for consideration in the proposed demonstration pilot project to support the development of a Section 180(c) assistance program might include:

- **Utilization of non-traditional training techniques** "to reach" the volunteer constituency that staffs most rural emergency response capability.

- **Assessment, Testing, & Evaluation of Emergency Response Equipment** to support proposed emergency response actions regarding potential Yucca Mountain shipments.

- **Assessment of the Utilization & Adaptation of other on-going emergency response–related pilot programs** for use and application in the Section 180(c) program.

In summary, significant efforts and resources will have to be directed to accommodate the potential HLW movements. These resources include emergency response equipment, personnel, training, and exercises (at the operational level, as well as the supporting level). The development of an emergency response demonstration pilot project may facilitate the safe, timely, and cost effective development (and eventual deployment) of local emergency response assets to meet these potential needs.

Chapter 1. INTRODUCTION

1.1 Purpose

The purpose of this report is to identify mitigation strategies and measures that may be undertaken to maximize safety on Inyo County roads associated with the potential shipments of Spent Nuclear Fuel (SNF) and High Level Waste (HLW) by legal weight trucks through the County en route to a proposed Yucca Mountain Nuclear Waste Repository.

This report supports **Task 5**: "*Public Safety, Regulatory Review, and Strategy Development*" of the *Inyo County Transportation Risk Assessment Project* effort. It also provides information and support-in part- to meet the goals adopted by the Inyo County Board of Supervisors on April 27, 2004 regarding the "*Inyo County Yucca Mountain Nuclear Waste Repository Assessment Office (Proposed Nuclear Waste Program Goals" 2 ,3, 4, and 5*)."

1.2 Focus

1.2.1 Topical Focus of Analysis: The topical focus of this analysis is the identification of **preventative measures and strategies** designed to maximize safety by minimizing potential truck vehicular accidents, and all vehicular delay times. The previously delivered **Task 4** Report, *"Risk Estimates for Inyo County," March 2006," by Radioactive Waste Management Associates, Chapter 4* described the adverse consequences of potential accidents involving release (and non-release) of radioactive materials. The earlier, **Task 2** Report, *"Transportation Scenario Estimation," November 2005, Fred Dilger, Black Mountain Research* provided the forecast estimated for potential spent fuel and HLW shipments used in this analysis. In addition, this current report analysis is supplemented by a separate report entitled *"Public Safety Assessment, April 2006" prepared by Richard C. Moore, and James David Ballard.* This separate public safety assessment report describes the findings of an Emergency Response Preparedness, and Needs Questionnaire conducted in-field by Moore and Ballard as part of the overall Team effort.

1.2.2 Geographical Focus of Analysis: The geographical focus of this analysis to develop strategies to maximize safety is **SR 127 in Inyo County, California**. This is the 49.4 mile segment that runs from the San Bernardino - Inyo County line northward through Inyo County to the Nevada State line. This segment has been chosen for the development of safety strategies for the following reasons: It is within Inyo County's jurisdiction; it has been identified in a previous risk analysis (**Task 4** report) as the route with the least risk of all those considered in Inyo County; it has been identified in the **Task 2** transportation scenario report and in the 2002 DOE FEIS Comment Response Document as the route anticipated for potential HLW shipments that might travel through Inyo County; and by precedent, it is one of the routes (only route through Inyo County) that has been selected and used since 2000 by DOE in its shipments of LLW to the NTS to bypass the high density Las Vegas Corridor.

Chapter 2. SR 127

2.1 SR 127 Road Characteristics & Operational Limitations

SR 127 is an undivided two lane conventional highway running from Baker, California (in San Bernardino County) northward through Inyo County to the Nevada State line. The entire route begins at the interchange with I-15 in Baker, and terminates 90.9 miles north at the Nevada State line. The County line between San Bernardino and Inyo Counties is 41.5 miles north of the I- 15 interchange. The route length in Inyo County is 49.4 miles. Much of the land bordering SR 127 in Inyo County is publicly owned. CALTRANS (fee simple owner of the road) owns a right of way varying from 30 meters to 122 meters over the entire route.

SR 127 is **functionally classified** by the State of California as a Rural Minor Arterial. The terrain is mostly flat desert and rolling terrain. Ninety-eight percent of the route enjoys a grade profile of less than three percent. The route passes through the communities of Baker, Shoshone, and Death Valley Junction. There is no designated rest stop facilities along the entire route. Shoshone, and Death Valley Junction are the only existing roadside locations offering limited traveler facilities.

The existing road structure of SR 127 is 12-foot-wide paved road, with paved shoulders varying between 0 and 2 feet (**Table 1** below).

Table 1. Paved Shoulder Widths (SR 127, Inyo County)

Mile Post Segment Within Inyo County	Paved Shoulder Width (Meters)
Inyo 0.0-6.2	0
Inyo 6.2-14.79	0.3
Inyo 14.79-16.43	0.6
Inyo 16.43-37.3	0.6
Inyo 37.3-42.15	0.3
Inyo 42.15-49.42	0
Source: *Route 127 Route Concept Report*, CALTRANS District 9, November 1997	

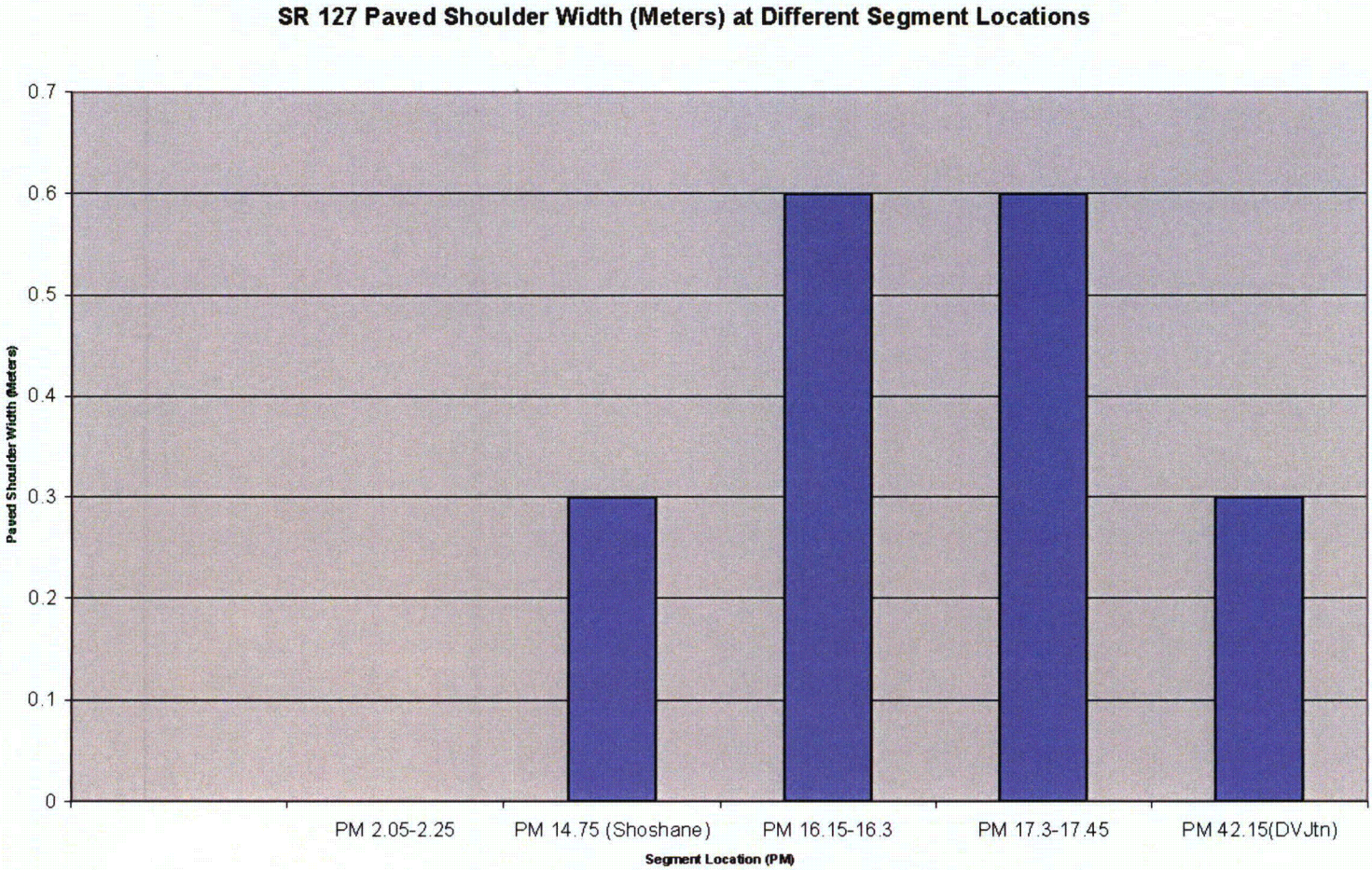


Figure 1.
Source: EJB&A derived from communications with Caltrans, 2005 and Caltrans data, 1997 and 2002

Along the entire route from Baker to the Nevada State line (90.9 miles) there are no turnouts or passing lanes.

Highway segments are subject to temporary closure due to flash floods with water depths exceeding 2 feet. These include locations where the road crosses the dry river bed of the Amargosa River (at locations MP 21.8-23.4; and MP 29.2-31.6), as well as road areas with poor drainage (at locations MP 11.0; and MP 48.0) (Source: "*Attachment G: Preliminary Drainage Recommendations, May 3, 2002, Feasibility Analysis Report SR 127 Improvements, October 2002", CALTRANS).*

Average speeds have varied by road segment on SR 127: from an average of 62-65 mph along most of the route to an average speed of 34 mph at Shoshone (**Table 2** below).

Table 2. Average Speed By Road Segment (SR 127, Inyo County)

Mile Post Segment in Inyo County	Average Speed (mph)
Inyo 0.0-14.79	62
Inyo 14.79-16.43	34
Inyo 16.43- 42.15	65
Inyo 42.15-49.42	63
Source: 1996 highway inventory data,CALTRANS, as reported	

Curve & Horizontal Alignment Road Limitations: CALTRANS has identified curve and horizontal alignment road limitations throughout the route at the following locations (the desired minimum curve radius to allow 65 mph vehicular speeds is 600 meters (1970 feet):

Table 3. Curve Radii for SR 127, Inyo Ciounty

Inyo Mile Post	Existing Curve Radius (feet)	Minimum Curve Radius (feet) for 65 mph
2.1	853	1970
2.4	853	1970
3.9	853	1970
6.0	853	1970
14.2	853	1970
15.7	696	1970
15.9	696	1970
16.8	558	1970
17.4	558	1970
18.3	696	1970
20.2	971	1970
34.5	853	1970
36.8	853	1970
39.0	853	1970
Source: *Feasibility Analysis Report: SR 127 Improvements*, October 2002, CALTRANS		

Numerous horizontal curves have posted advisory speeds that range between 25-50 mph. In addition, needed road horizontal re-alignments in the Death Valley Junction area have been identified at locations MP 41.6, and 41.9 where the existing curve radii are 427' and 230' respectively to improve vehicular operations and improve safety.

2.2 Traffic Characteristics

2.2.1 Highway Traffic Volume & Capacity: Total traffic volume has been historically low on SR 127. It is expected to remain "flat" over the forecasted future. The volume to capacity ratios (measure of congestion) are also low indicating significant capacity. This is unlike the forecasted capacity concerns raised on the I-15 corridor from California into Las Vegas, Nevada. **Figure 2** depicts the forecasted Annual Weighted Average Daily Traffic (AADT) on all 6 segments of SR 127 (2 in San Bernardino County, and 4 in Inyo County).

Figure 3 depicts the forecasted highway volume to capacity ratios (V/C) for the 6 segments.

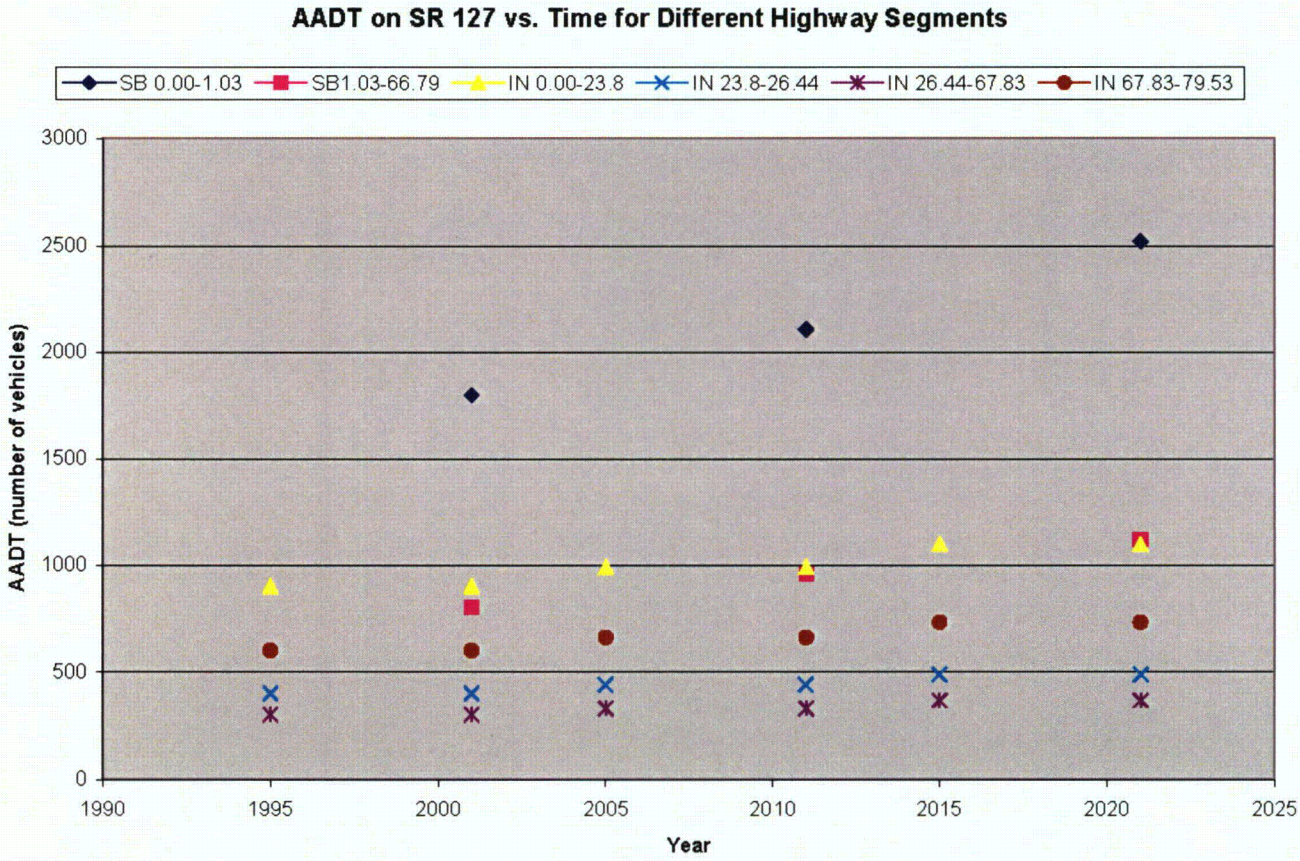


Figure 2.
Source: EJB&A derived from data in Caltrans, *Feasibility Analysis Report*, October 2002

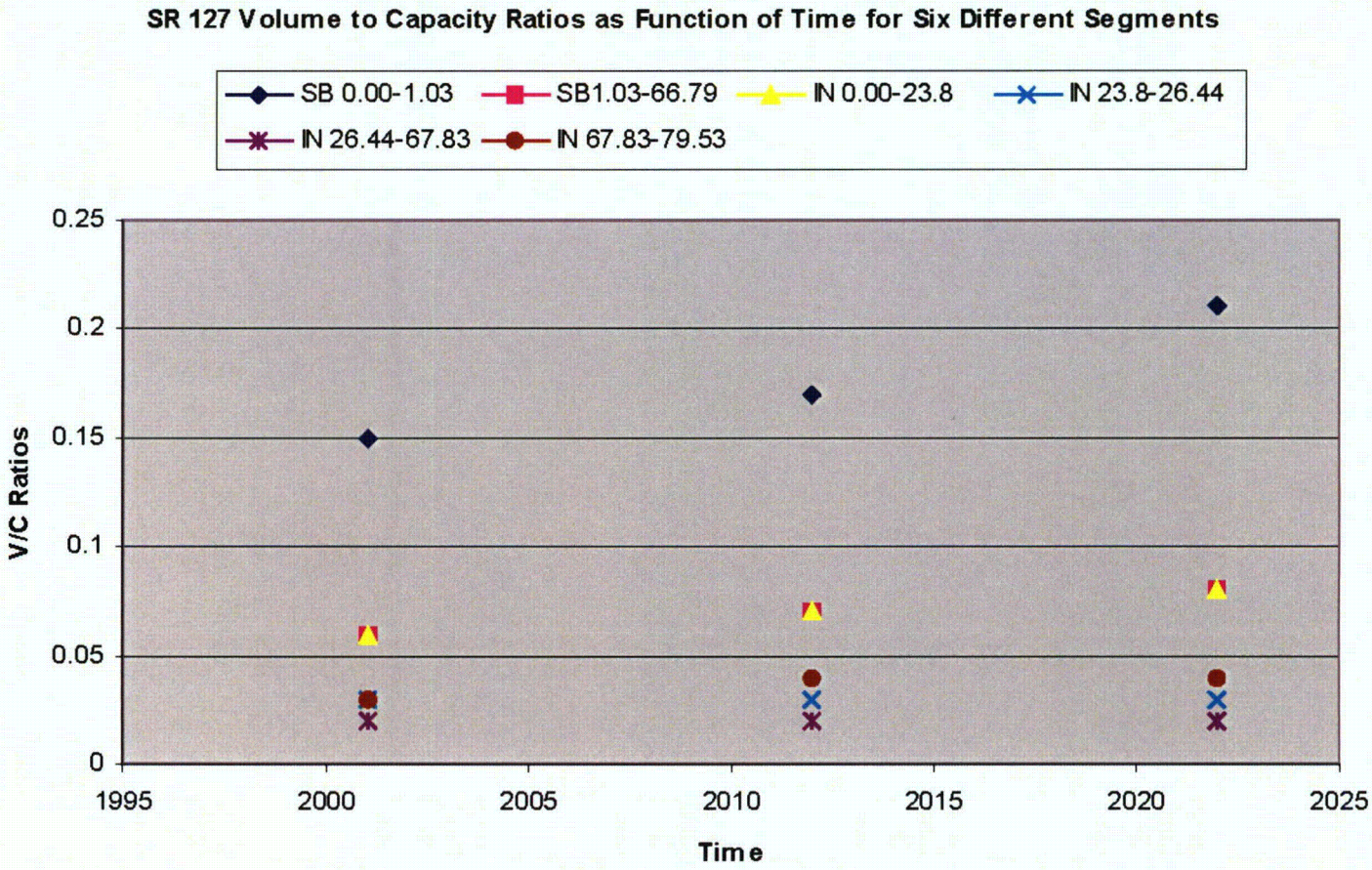


Figure 3.
Source: EJB&A derived from data in Caltrans, *Feasibility Analysis Report*, October 2002

Although the average traffic density is light compared to the available highway capacity, it is not uniform, and creates localized congested "spots" due to seasonal traffic surges. This is further compounded by lack of turning locations or passing lanes throughout the roadway, and the vehicular composition consisting of slower moving vehicles (e.g. trucks, RVs, buses).

Figure 4 depicts the seasonal surges of tourist traffic in 2004 visiting Death Valley Park (SR 127 is a major gateway highway to the Park). **Figure 5** shows the trend from 2000-2004, demonstrating that this is a yearly occurrence, even in times of diminished tourist traffic (after 9/11).

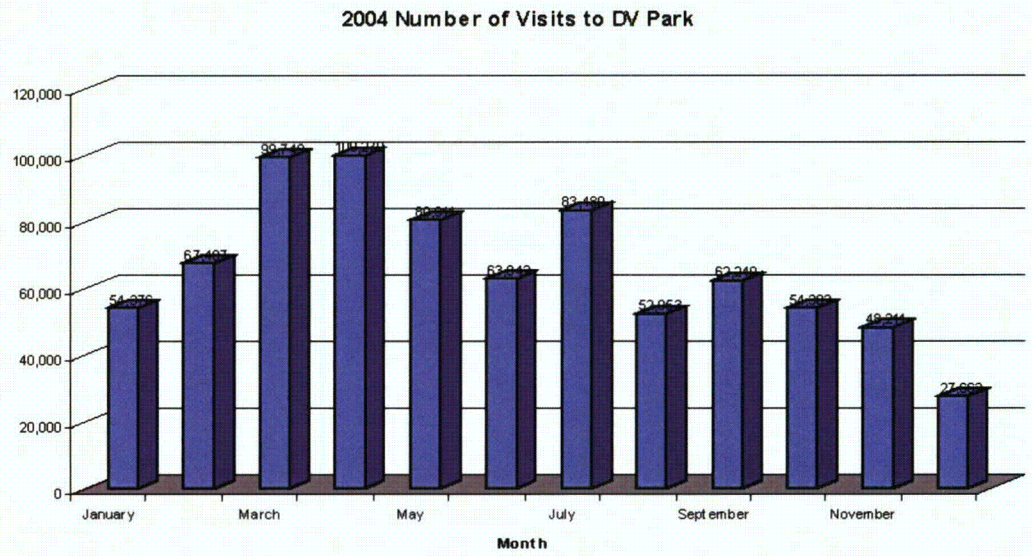


Figure 4.
Source: EJB&A derived from data provided in November 2005 by the National Park Service, U.S. DOI

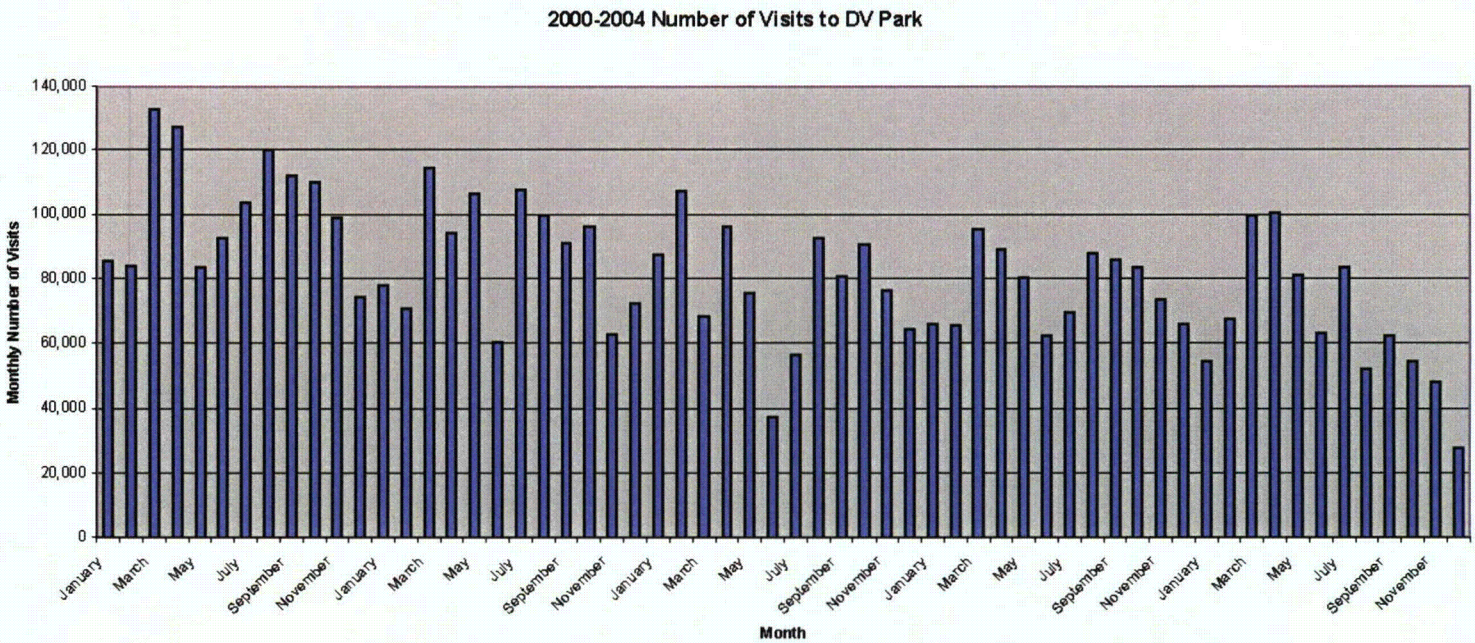


Figure 5.
Source: EJB&A derived from data provided in November 2005 by the National Park Service, U.S. DOI

2.2.2 Vehicle Composition: Light duty passenger vehicles dominate the historical traffic. Legal Size and Weight Tractor Trailer Trucks (*our focus of interest*) are second, historically averaging from eight – 15 percent of total traffic. Recreational RVs and buses follow, reflecting the large seasonal tourist and recreational traffic.

Figure 6 depicts the historical vehicle composition on SR 127 in 1995. Note the seasonality in total traffic (discussed above), reflecting recreational traffic surges in the Spring, and late Fall.

For comparison purposes, Scenario 3 and 4 (**Task 2** Report, HLW truck estimates) are provided.

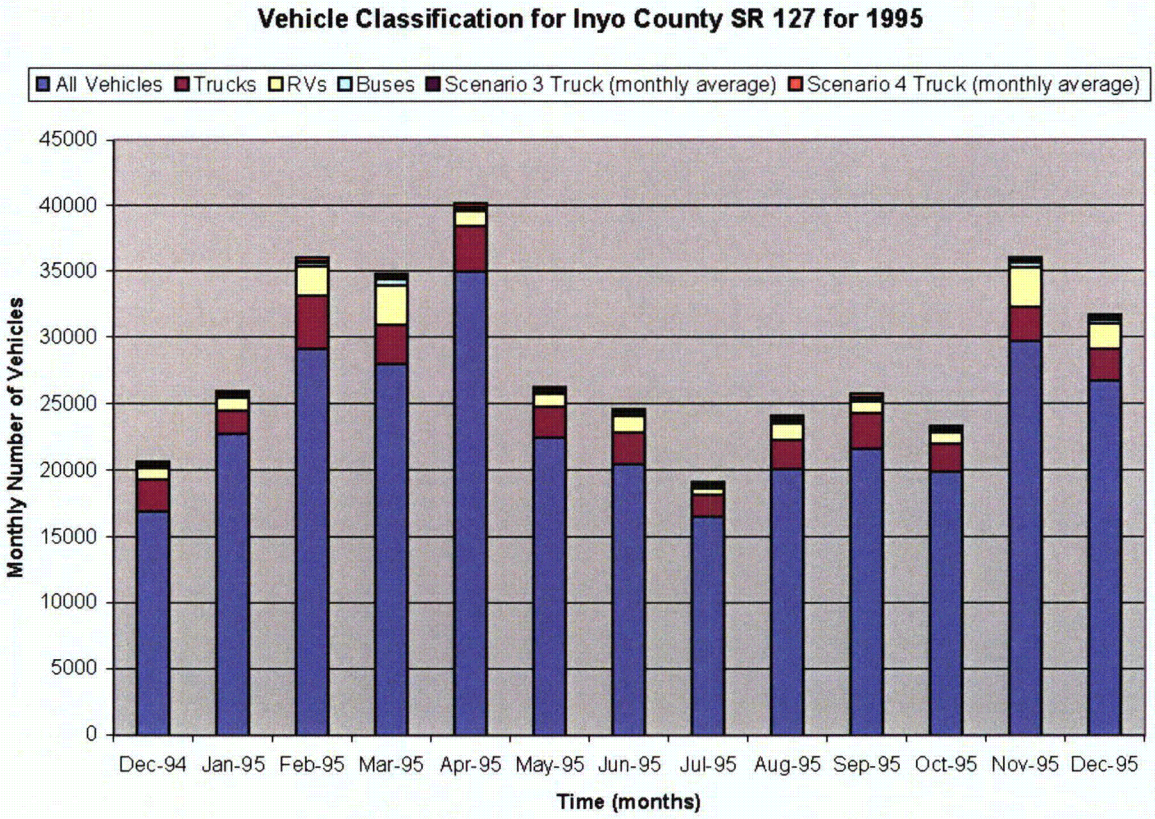


Figure 6.
Source: EJB&A from Caltrans data and from *Transportation Scenario Estimation*, Fred Dilger, Black Mountain Research (**Task 2**)

Scenario 3 SNF/HLW truck traffic would represent five – 11 percent of 1995 total truck traffic; Scenario 4 SNF/HLW truck traffic would represent seven – 14 percent of 1995 total truck traffic, depending on the season. This is depicted in **Figure 7** below. Although this number appears small, it would represent the single largest and longest (24 (Scenario 3) - 38 (Scenario 4) years) shipment campaign in Inyo County SR 127's history by a single shipper.

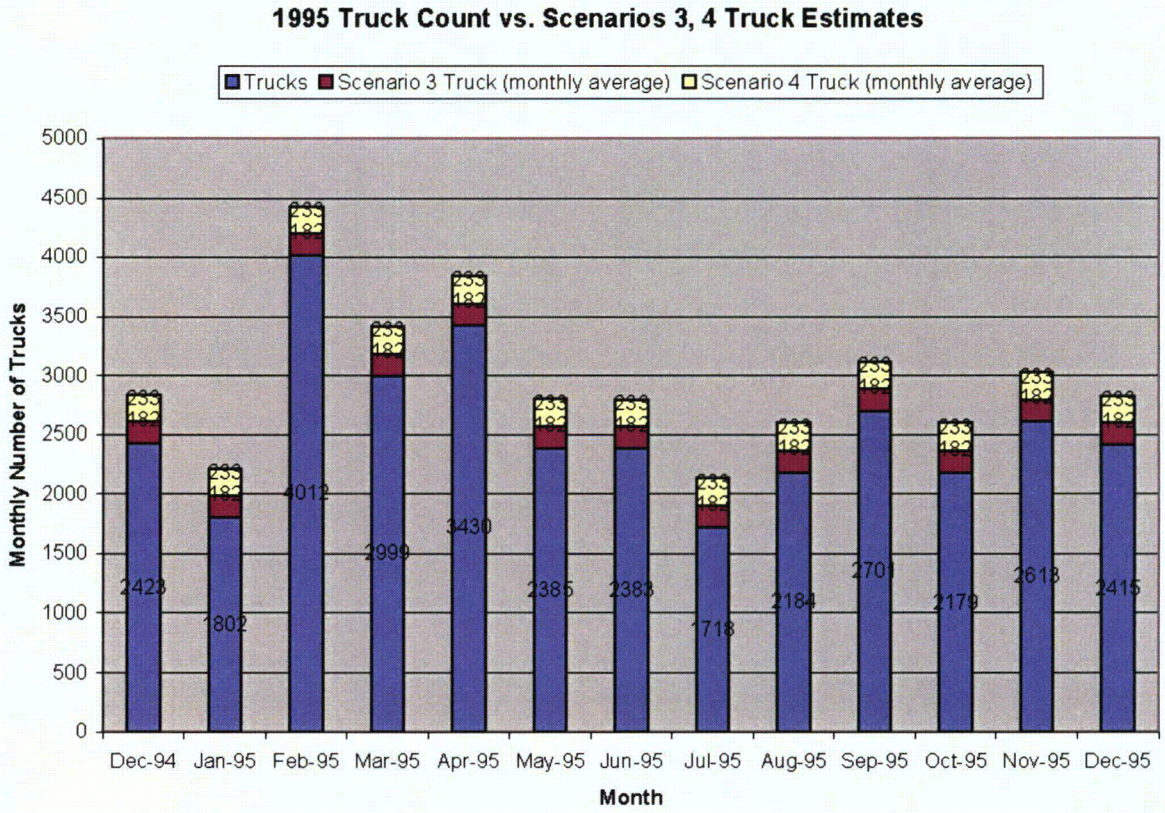


Figure 7.
Source: EJB&A from Caltrans data and from *Transportation Scenario Estimation*, Fred Dilger, Black Mountain Research (**Task 2**)

In addition, **truck traffic distribution is not uniform** along the segments of SR 127 in Inyo County. Although total truck traffic has historically constituted eight – 15 percent of total traffic over the entire length of SR 127 in Inyo County, several highway segments have experienced a significantly higher percentage of truck traffic. This leads to degradation of speed as slower trucks (and seasonal RVs) share the same highway with passenger vehicles. With no opportunity for "turn-arounds" (there are none), no special passing lanes (there are none), and operational highway limitations discussed earlier (lack of paved or minimal shoulders; horizontal curve alignments constraints), conditions are not optimal for efficient highway flow or accident prevention. **Figure 8** depicts truck volume as percentage of total traffic by segment for Inyo SR 127.

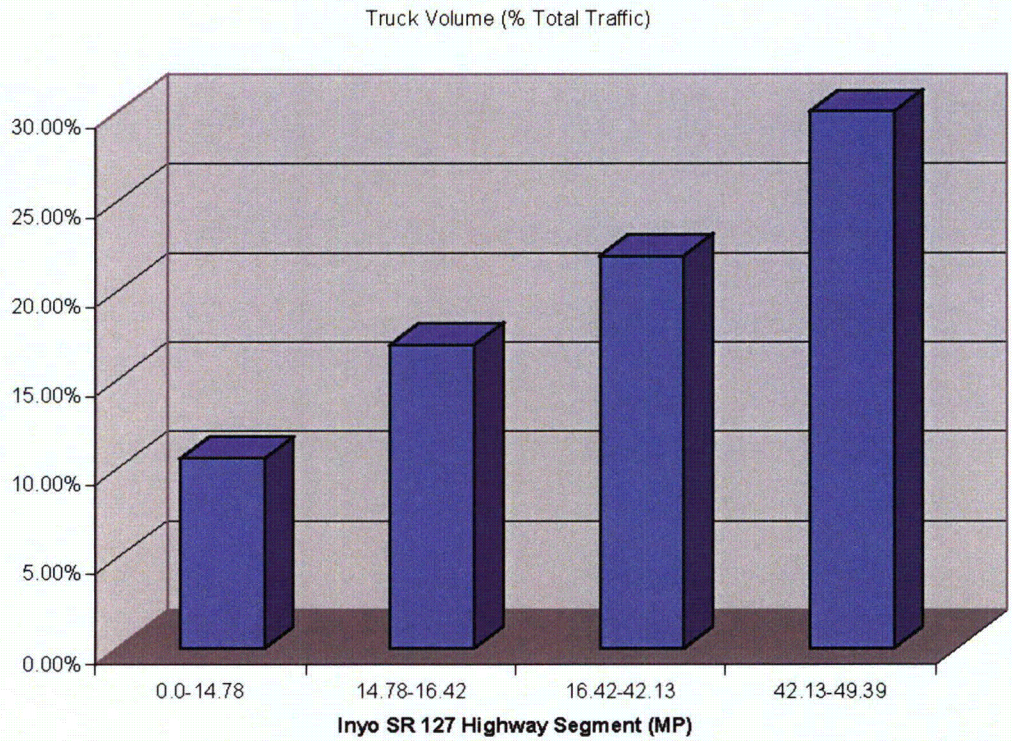


Figure 8.
(Source: CALTRANS, *Route 127 Route Concept Report, Appendix, Inyo County SR 127 Operating Conditions*, November 1997"

2.3 Recent Radiological Waste Shipments on SR 127

DOE has already established a precedent (and policy) for shipment of low level (LLW) and TRU radioactive wastes on SR 127 to/from the Nevada Test Site (NTS) to avoid the dense Las Vegas corridor, and to accommodate the winter conditions for most east-west travel across the U.S. (*There is limited highway circulation to reach the NTS from originations east and west*). This policy has been established by discussion between DOE Generator Defense Weapons Complex Sites, the NTS, and highway carriers. This policy calls for "Preferred Low-Level Waste Transportation Routes to the Nevada Test Site." The "preferred" routing calls for highway carriers to use the I-80 route for summer shipments, and to divide shipments between California SR 127 and NV 160 during winter months to avoid downtown Las Vegas. In addition, "black out" dates have been established for SR 127. A specific reason that has been given by DOE for adopting this route diversification over SR 127 is *" to limit the number of shipments that travel along SR 127 due to extremely limited and remote emergency response capabilities."* This policy has been used since 2000. Over the last five consecutive years (2000-2004), the number of legal weight truck LLW shipments (there are no overweight or oversize truck shipments) on SR 127 has ranged from 150 to 485 shipments representing from 7-14 DOE generators. This is out of annual LLW totals of 520 to 2,405 shipments. This represents from 12 percent to 32 percent of total LLW shipments over each of the five years, or a five-year average of 21 percent of total shipments. During this time, there has not been a single vehicular incident/accident on either SR

127 or any California roads with respect to these 7,914 shipments over a five-year period. (*There has been one vehicular incident (side-swipe) on U.S. 95 in Beatty, Nevada on October '03, and one accident on I-10 in Arkansas in January '04).* In contrast to the proposed HLW/Spent Fuel shipments (Scenarios 3 and 4) these historical low level waste DOE shipments have been very limited in number, and carry much lower activity radioactive contents). *See Figures following.*

Figure 9 depicts the recent annual shipments of LLW to the NTS.

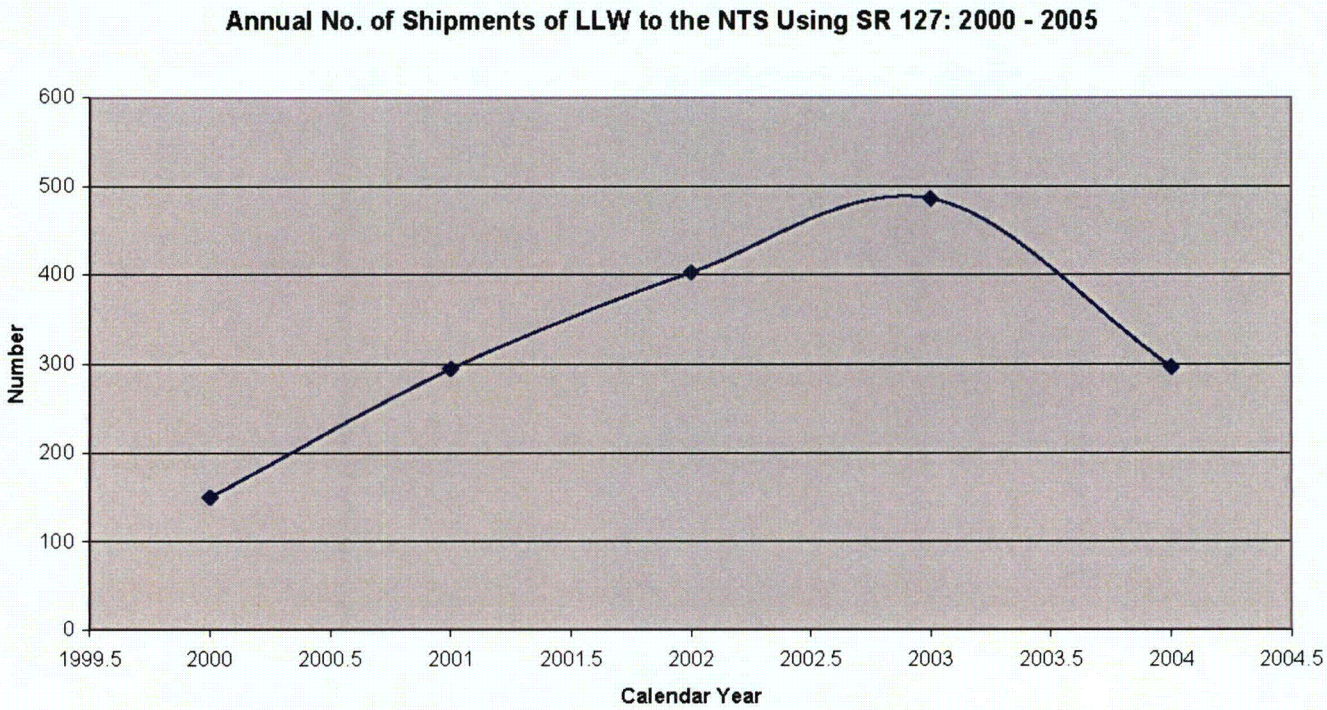


Figure 9.
(**Source:** EJB&A derived from DOE data)

Figure 10 depicts a comparison of the five-year annual average of these recent historical shipments (last five years) of LLW, with the forecasted (**Task 2**) average shipments of the potential Yucca Mountain. Campaigns. For the 2 scenarios using SR127, the number of potential Spent Fuel/HLW shipments is approximately 10 times the average annual recent historical LLW shipments. In addition, the Spent Fuel/HLW shipment campaigns are anticipated to take between 24 and 38 years to complete. In contrast, the LLW shipments are already tailing off, as DOE Defense Sites complete their remediation/cleanup missions, and as alternative waste disposal areas are opened.

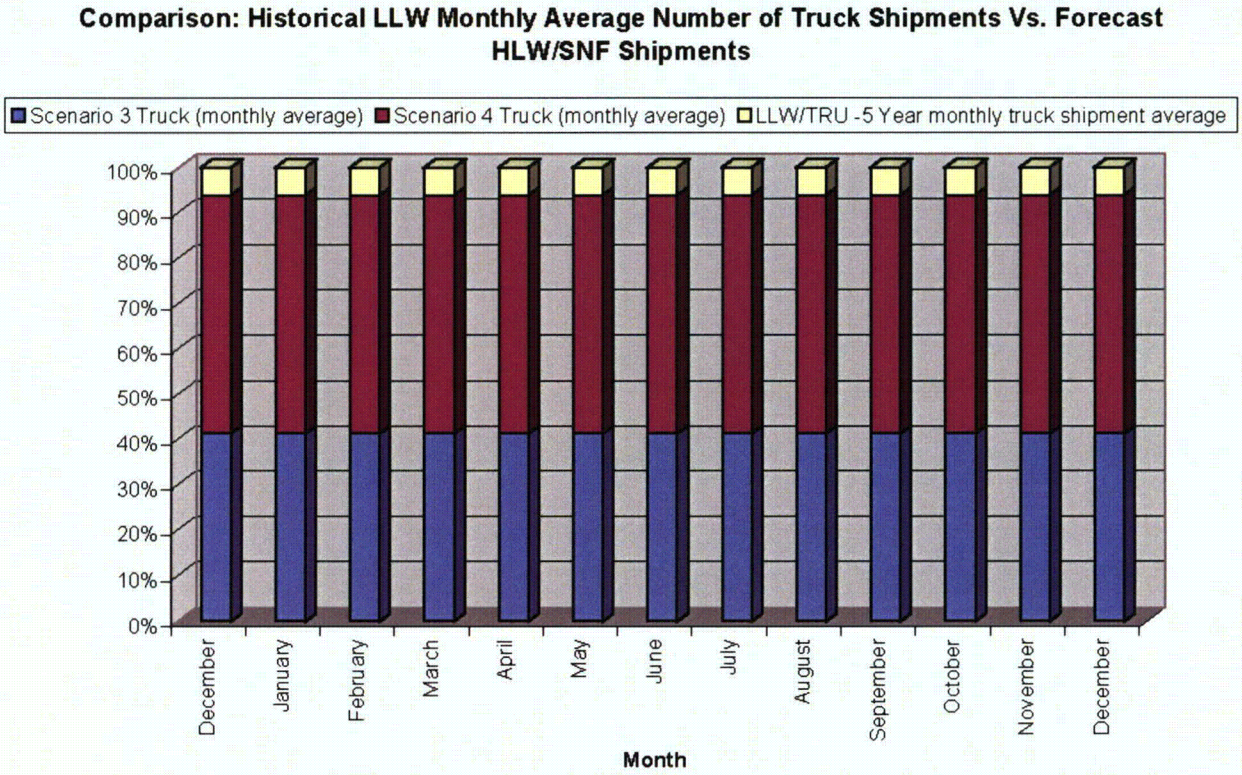


Figure 10.
Source: EJB&A derived from DOE data and from *Transportation Scenario Estimation*, Fred Dilger, Black Mountain Research (**Task 2**)

Chapter 3. SR 127 ACCIDENT LOCATIONS & CHARACTERISTICS

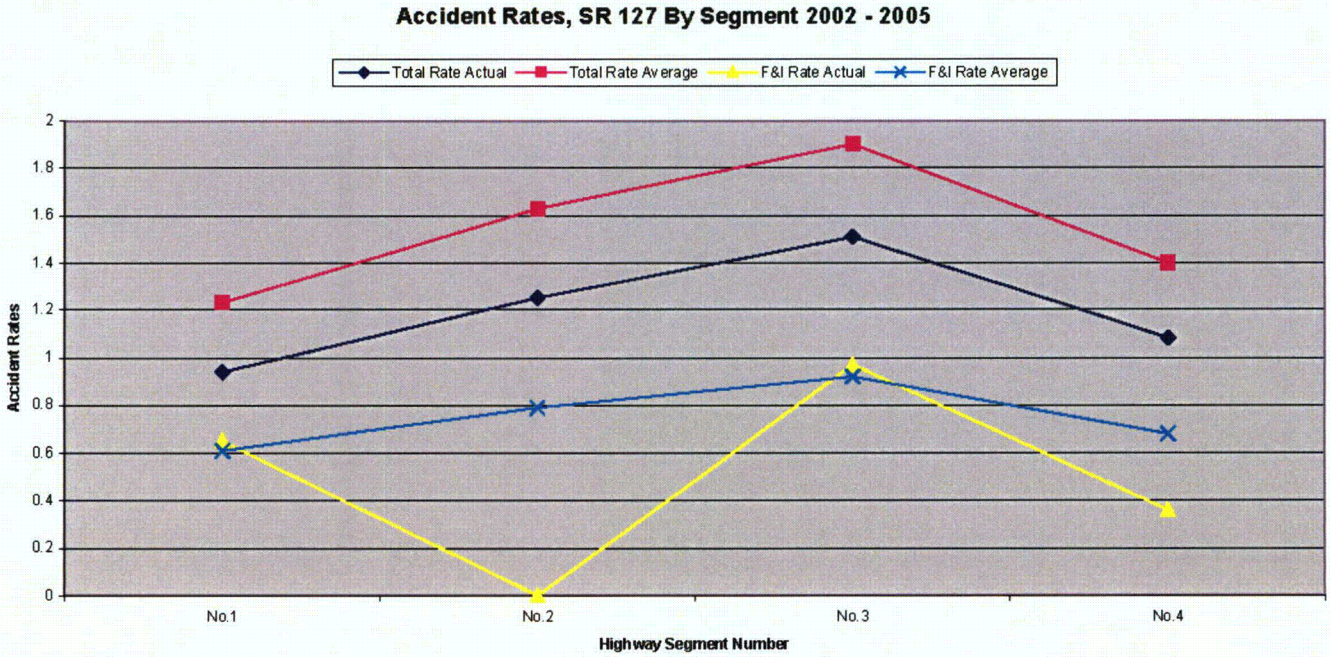
3.1 Comparison of SR 127 Accident Rates

Table 4 compares the accident rates for five highway segments for the recent time period 4/1/00 - 3/31/05.

Table 4. Comparison of Accident Rates - All Vehicles - for 5 Highways 4/1/00-3/31/05

Highway & Segment	Fatalities Rates			F&I Rates			Total Rates			ADT
(mile post)	Actual	Average		Actual	Average		Actual	Average		(number of vehicles)
Inyo 127	0.02	0.061		0.65	0.79		1.28	1.61		500
0.0-49.42										
Inyo 178	0	0.44		0.28	0.59		0.66	1.19		900
42.93-62.186										
Inyo 190	0.01	0.044		0.31	0.83		0.7	1.74		800
9.85-140.69										
SBD 127	0.092	0.043		0.66	0.57		1.11	1.15		1000
0.0-41.473										
SBD 15										
68.770-186.238	0.023	0.014		0.25	0.22		0.55	0.51		36,100
Notes:										
Table B Selective										
Accident Rate Calc										
Caltrans										
Period 4/1/00-3/31/05										
Rates=# Accidents/ MVM										

(**Source:** EJB&A derived from Caltrans 12/05 data)



SR 127 Segment No.1 = MP 0.0-14.75; Segment No.2 = MP 14.75-16.43; Segment No.3 = MP 16.43-42.15; Segment No.4 = MP 42.15-49.42

Figure 11.

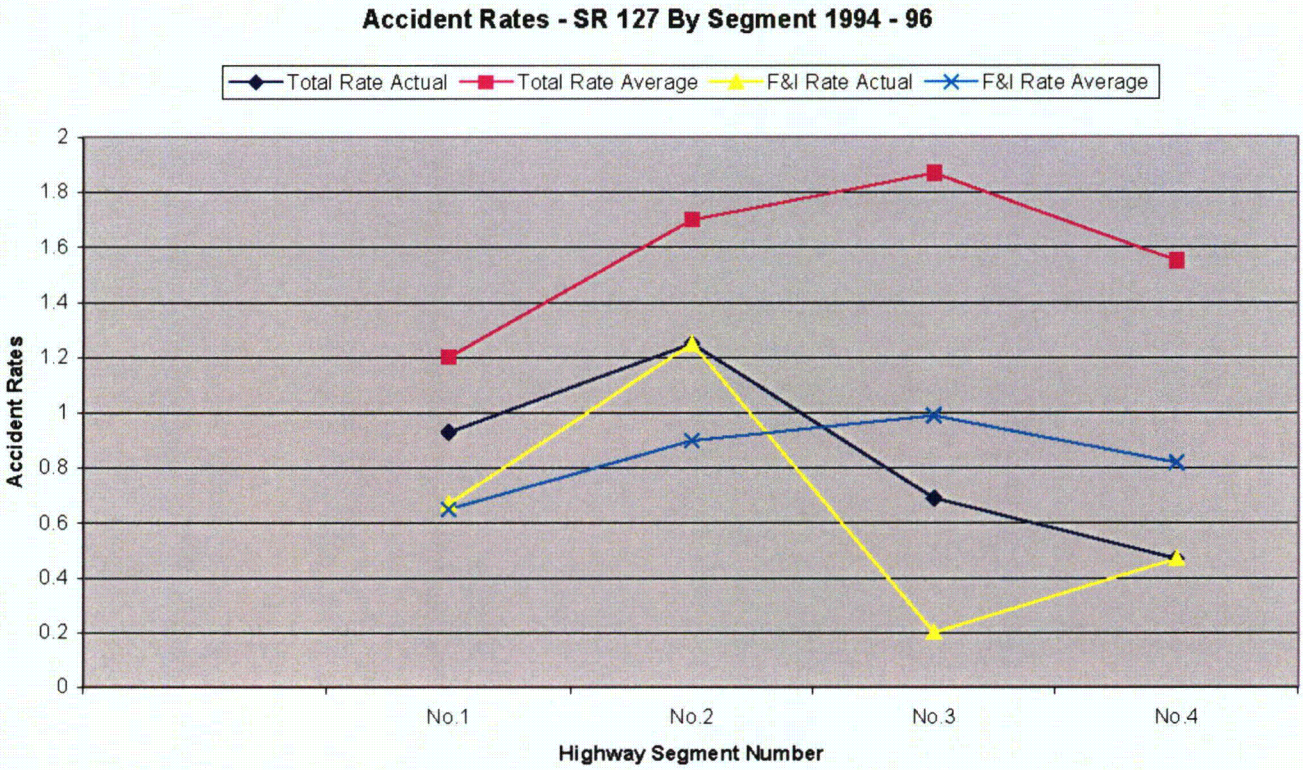
Source: 2005 Correspondence, EJB&A-Caltrans.

Note that all Inyo County SR 127 historical accident rates (Fatalities; Fatalities and Injuries (F&I); and Total) are lower than the respective California State average for comparable highway segments. In contrast, all of the historical accident rate indicators for I-15 are higher than their respective State averages. A comparison of the average daily traffic (ADT) over this time period also demonstrates the significant traffic load that I-15 carries. As mentioned previously, this load is expected to grow significantly for I-15.

However, the numerical accident rates depend, in part, on segment length being considered, and on the chosen segment location. As such, they can disguise or "average" over localized highway "hotspots" by averaging over longer highway segments that have fewer accidents. **Figure 11** above depicts the accident rates (Actual vs. State average) for Inyo SR 127 for the 2002-2005 time period, broken down into 4 highway segments (vs. much longer segments depicted on the previous table). Note the large fluctuations by segment for the F&I accident rate. Segment 3's (MP 16.43-42.15) F&I accident rate is actually higher than the State average rate vs. the longer segment's lower than average rate in the above table.

In addition, statistically, since there is much less traffic on SR 127 - and consequently less total accidents (than on I-15), any single year may distort the accident rate picture. **Figure 12** below depicts the historic accident rate for the same four Inyo SR 127 segments for an earlier time period (1994-1996). As can be seen, even though the general trend is the same (State average rates are higher than actual rates), actual rates may be higher in very specific "hotspot"

locations. For example, Segment 3 this period has much lower actual rates than the State average, in contrast to the above Figure, for the time period 2002-2005.



Inyo 127 Segment No.1 = MP 0.0-14.75; Segment No.2 = MP 14.75-16.43; Segment No.3 = MP 16.43-42.15; Segment No.4 = MP 42.15-49.42

Figure 12.

(Source: 2005 Correspondence, EJB&A – Caltrans.

Figures 13 and 14 below show a comparison of accident rates at a still "finer level" of detail. **Figure 13** depicts actual vs. average accident rates at selected accident locations for the time period 1997-2001. For all of the three locations (including one on SR 127 in San Bernardino County), the actual total rates are significantly higher than the State average total rate. For the 2 locations in Inyo County, both the *actual total* and the *F&I actual total* rates are significantly higher than the State average rates respectively. Note also that these two locations have minimal paved shoulders (0.3 meters), which represents an infrastructure operational restriction.

Figure 14 below depicts *actual* vs. *State average* rates for three very limited length segments on Inyo SR 127 for the more recent time period 2002- 2005. For two of these segments (MP 2.05-2.24 and 17.3-17.45), the *actual total rate* is significantly higher than the *State average rate*. For the third segment (MP 16.15-16.3), both the actual total rate and the actual F&I

rates are lower. For the last segment (MP 17.3-17.45), both the *actual total* and the *actual F&I* rates are significantly higher than their respective average State rates.

Accident rates are a useful relative tool in identifying clues in determining accident locations. However, they are limited in their value. Additional, more detailed information is needed on the distribution and frequency of accidents - by location - for each of the respective highway segments. In order to develop strategies to limit, or mitigate, accident occurrence, it is necessary to develop this information. This includes the frequency and severity of accidents, by location — AND the characteristics (e.g. primary collision factor; event preceding accident; ...) of each individual accident (at each individual location). Further, because Inyo SR 127 has an overall relatively low number of accidents (vs. I-15 as seen later), standard statistical averaging methods cannot be used to achieve confidence. Instead, the **entire accident data base** must be examined for all of the recent accidents, including the individual accident report records. This includes a separate examination of all legal weight tractor trailer truck accidents, as this is the focus for the development of preventative safety strategies associated with potential HLW/SNF truck shipments. This follows in the next sections.

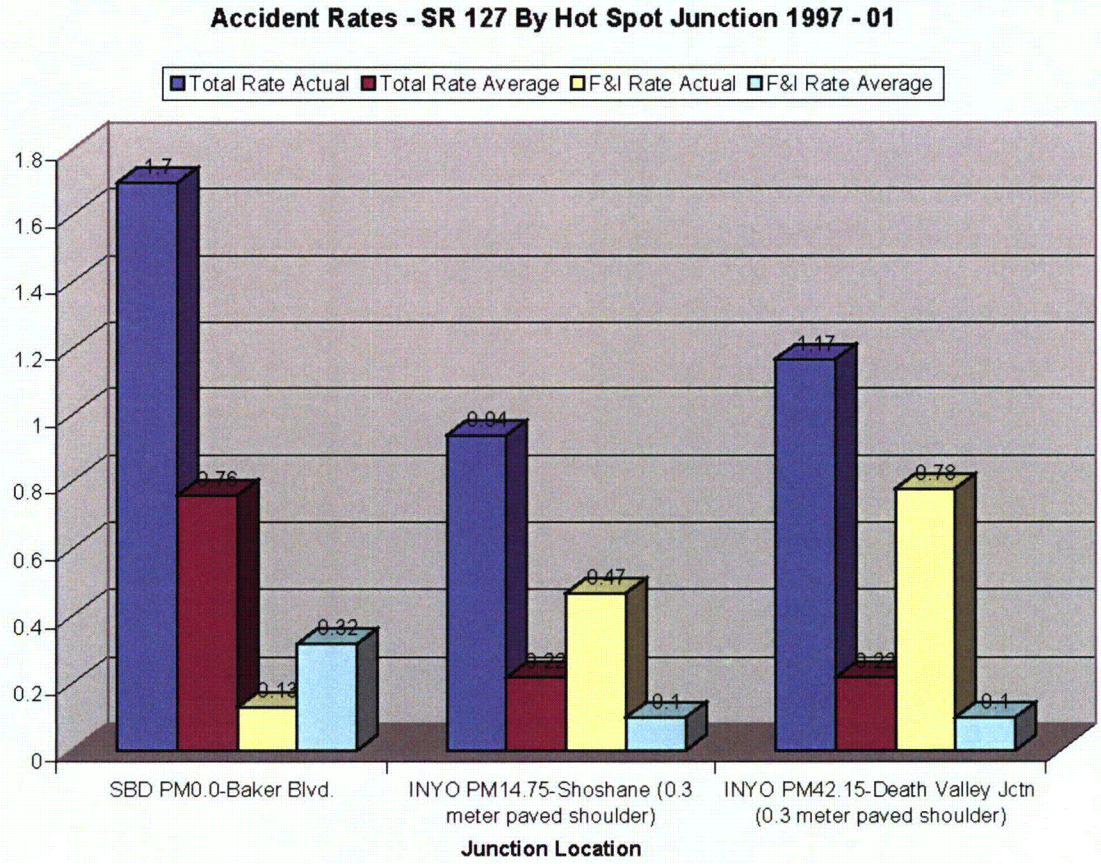


Figure 13.
(Source: 2005 Correspondence, EJB&A - Caltrans)

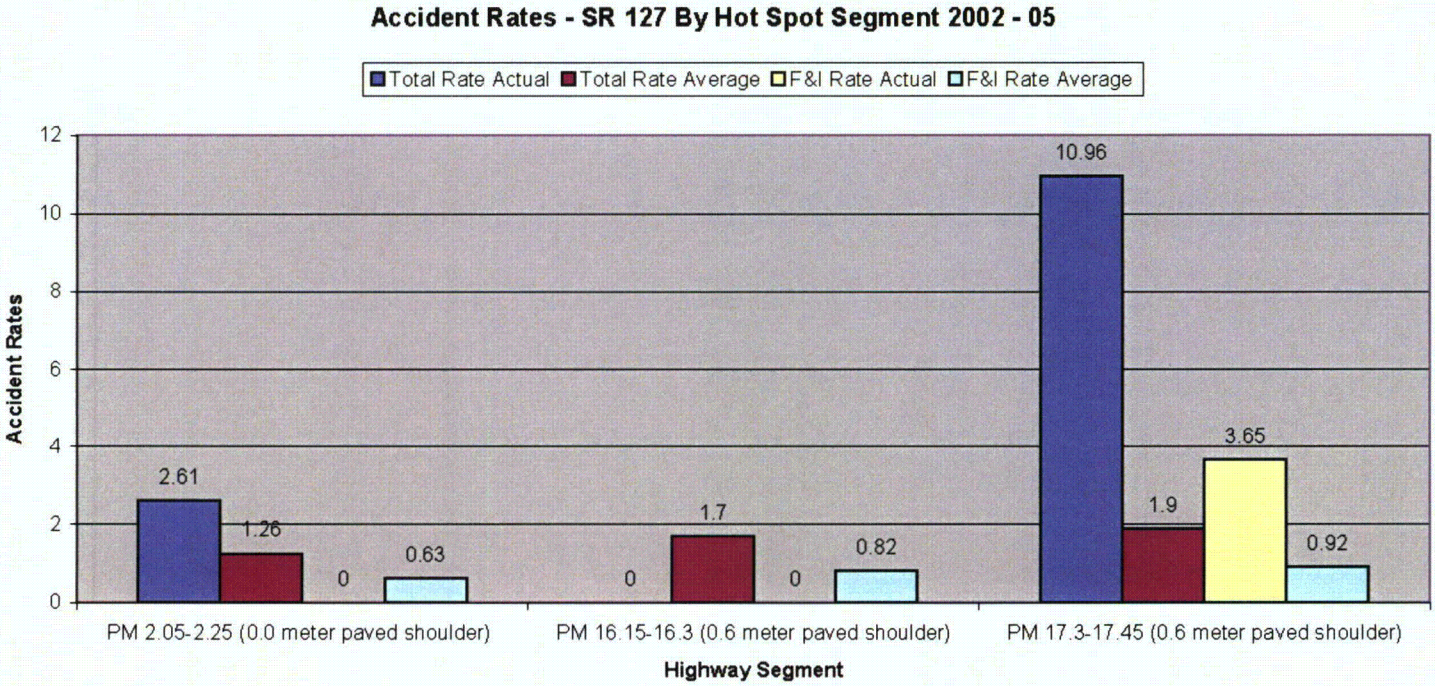


Figure 14.
(Source: 2005 Correspondence, EJB&A - Caltrans)

3.2 Comparison of SR 127 Overall Accident Characteristics and Other Highways

Table 5 provides a comparison of accident characteristics for all vehicular traffic on each of five highways for the time period 4/1/2000-3/31/2005.

Table 5. Comparison of Accident Characteristics for Five Highways 4/1/2000 – 3/31/2005

Accident Characteristic	I-15 (MP 68.77-186.23)	Inyo 178 (MP 42.93-62.18)	Inyo 190 (MP 9.85-140.69)	Inyo 127 (MP 0.0-49.42)	SBD 127 (MP 0.0-41.47)
ADT	36100	900	800	500	1000
Total No. of All Accidents	4454	21	134	63	84
Total No. of Truck Accidents	867	0	8	13	13
Total No. Killed-All Accidents	245	0	2	1	7
Total No. Killed-Truck Accidents	24	0	0	1	0
Total No. Injuries-All Accidents	4070	21	105	38	78
Total No. Injuries-Truck Accidents	475	0	2	5	2
No. of All Accidents Involving Fatalities	185	0	2	1	7
No. of Truck Accidents Involving Fatalities	17	0	0	1	0
No. of All Accidents Involving Injuries	1834	9	57	31	50
No. of Truck Accidents Involving Injuries	257	0	2	5	2

Source: EJB&A derived from Caltrans 12/05 data

Over this time period:

I-15 (MP 68.777-186.238) had a significantly greater number of accidents (4,454) than did Inyo SR 127 (MP 0.0-49.42) (63).

Similarly, for the same segments as above, I-15 had significantly greater numbers of truck accidents (867) than Inyo SR 127 (13). This in part reflects the greater volume of traffic experienced on I-15 (ADT of 36,100 vs. 500), and the differences in million vehicle miles (MVM) traveled on the respective highway segments. In this recent historical time period, MVM for Inyo SR 127 was 49.25 vs. 8,062.17 for I-15.

However, the percentage of accidents involving trucks is similar for both I-15 and Inyo SR 127 (19 percent and 21 percent respectively).

Regarding all vehicular accidents, Inyo SR 127 has a higher percentage of accidents involving non-fatal injuries than does I-15 (49 percent vs. 41 percent), but I-15 has a higher percentage of accidents having fatalities (4 percent vs. 2 percent). Overall, I-15 has experienced 245 fatalities and 4,070 injuries vs. one fatality and 38 injuries on Inyo SR 127.

Whereas almost one-half of all accidents on I-15 were those involving multiple vehicles; only 8 percent involved multiple vehicles on Inyo SR 127.

3.3 SR 127 Accident Locations & Accident Frequency

Over the last five years (4/1/2000-3/31/2005), Inyo SR 127 has experienced 63 accidents. Of these 63 accidents, 13 were accidents involving tractor trailer legal weight trucks.

The locations of these accidents are highly "peaked."

Figure 15 below depicts the location segments for all 63 accidents.

High frequency location segments, in descending order, are presented in **Table 6**.

Table 6. High Frequency Accident Location Segments for Inyo County SR 127

Mile Post	No. of All Accidents	No of Truck Accidents
17.0-17.99	8	4
42.0-42.99	6	0
16.0-16.99	5	4
2.0-2.99	5	0
43.0-43.99	4	1
6.0-6.99	4	0
3.0-3.99	4	0

Source: EJB&A derived from Caltrans 12/05 data

The above seven mile-segments constitute 57 percent of the total accidents, although they are only seven out of a total of 48 mile-segments.

Similarly, truck accidents are also highly peaked in location. Two adjoining mile segments, MP 16.0-16.99 and MP 17.0-17.99, constitute 62 percent of all truck accidents. In addition, half of total accidents at segment MP 17.0-17.99 and 80 percent of total accidents at segment MP 16.0-16.99 are truck accidents. This is depicted in **Figure 16** below.

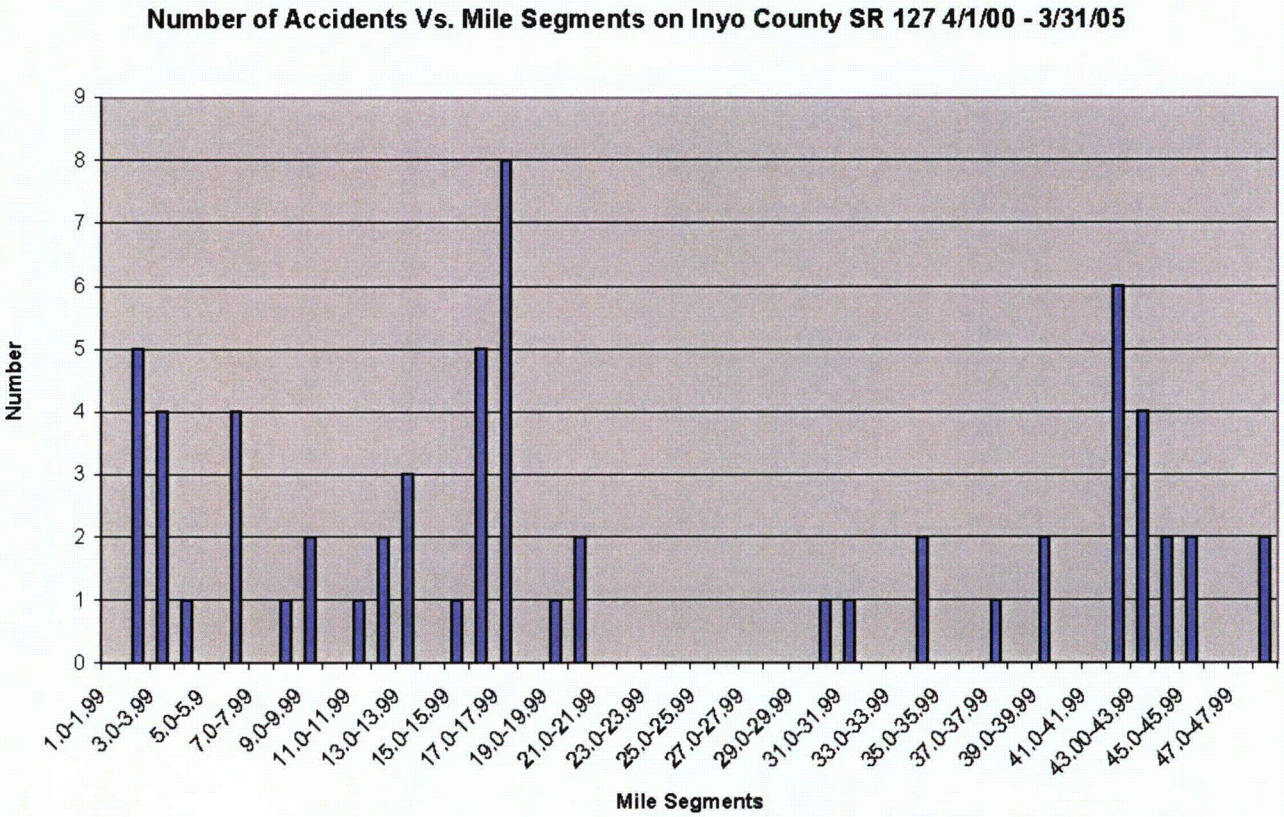


Figure 15.
Source: EJB&A derived from Caltrans 12/05 data

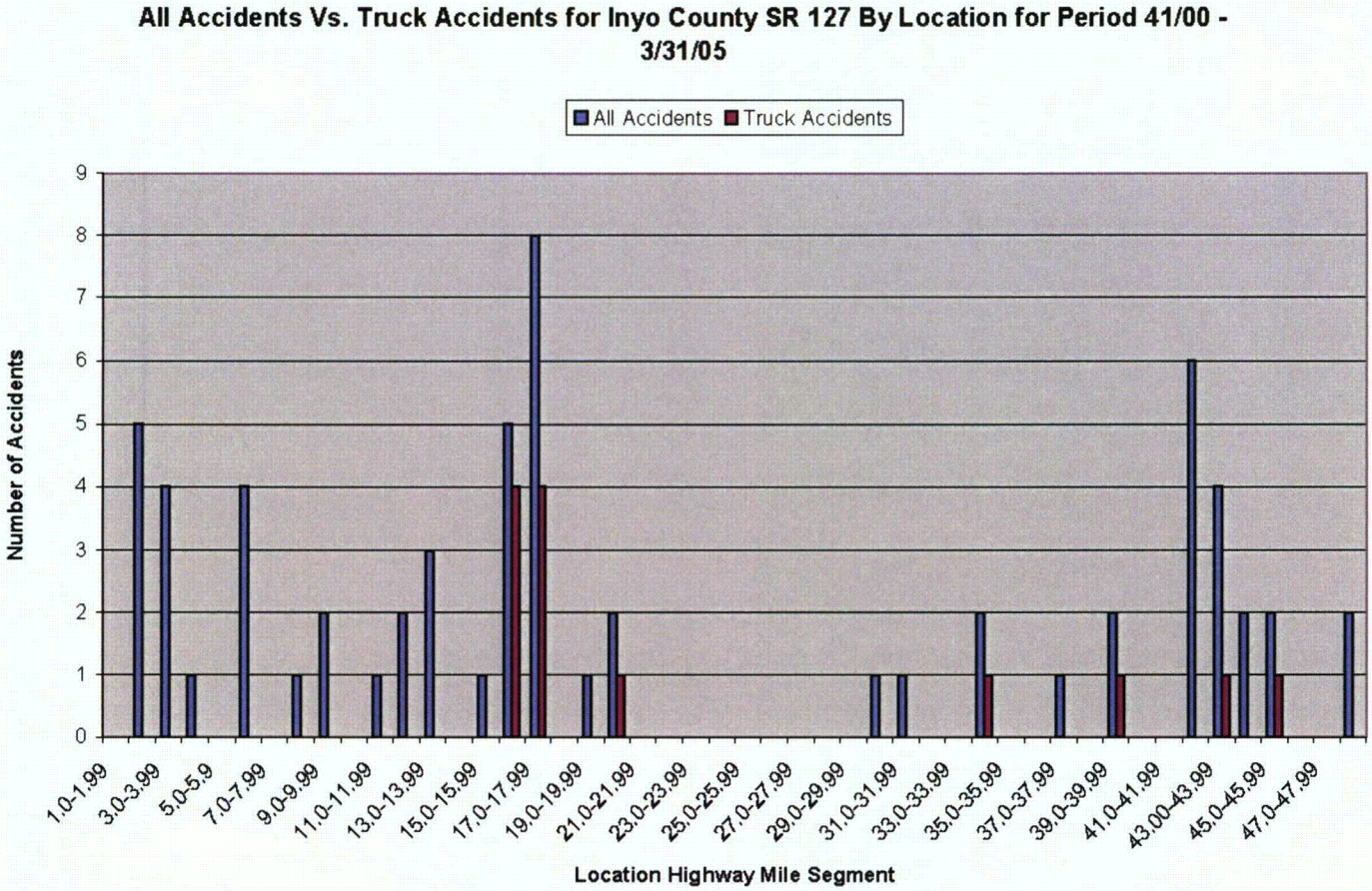


Figure 16.
Source: EJB&A derived from Caltrans 12/05 data

3.4 SR 127 Accident Severity by Location

On Inyo SR 127 there were 63 total accidents (all vehicles) in the last five years (4/1/2000-3/31/2005). These accidents involved 37 non-fatal injuries and one fatality.

Of this total, 13 accidents were truck accidents, which accounted for five non-fatal injuries and the one fatality. The fatality occurred at location MP 16.16.

Figure 17 depicts the number of injuries from all accidents for each accident location on Inyo SR 127. Many accidents did not have an injury. Twenty-eight accident locations had non-fatal injuries. Of these, four locations (MP 2.2; 6.2; 17.39; 17.40) had two accidents involving five non-fatal injuries. One location (MP 43.70) had three accidents involving no injuries, and one location (MP 42.149) had five accidents involving three non-fatal injuries. This is depicted in the following **Table 7**.

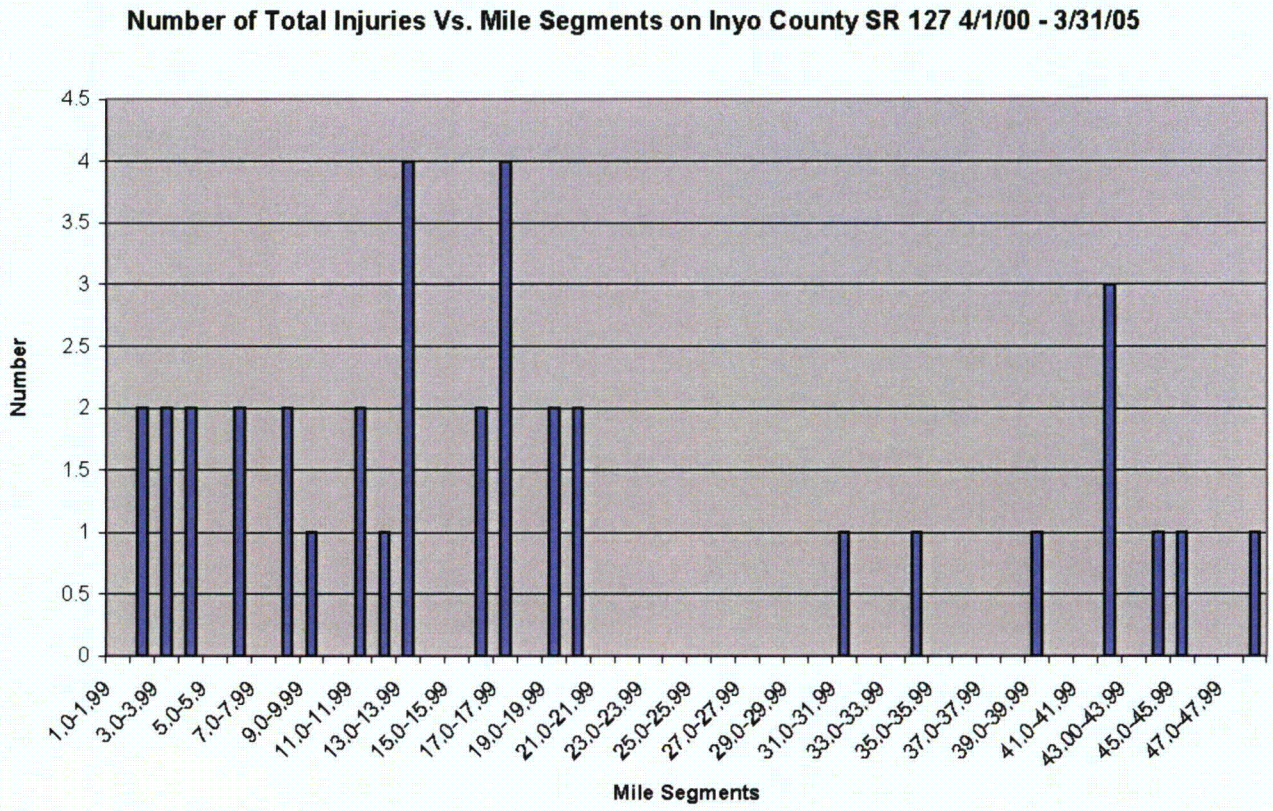


Figure 17.
(**Source:** EJB&A derived from Caltrans December 2005 data)

Table 7. Injuries Vs. Accidents by Accident Location

Location on SR 127 (MP)	Total Number of Non-Fatal Injuries at Location	Total Number of Accidents at Location
2.20	1	2
3.940	1	1
3.990	1	1
4.03	2	1
6.150	1	1
6.20	1	2
8.10	2	1
9.80	1	1
11.70	2	1
12.85	1	1
13.0	1	1
13.57	1	1

13.78	2	1
16.24	1	1
16.91	1	1
17.37	1	1
17.39	1	2
17.4	2	2
19.36	2	1
20.21	1	1
20.30	1	1
31.70	1	1
34.60	1	1
39.22	1	1
42.149	3	5
44.10	1	1
45.96	1	1
48.25	1	1

Source: EJB&A derived from Caltrans 12/05 data

Figure 18 depicts the number of injuries for truck accidents for Inyo SR 127 for the time period. Truck accidents accounted for 13 of the total accidents, five of the non-fatal injuries, and the one fatality during this recent five-year period. Truck accidents involving non-fatal injuries occurred at five locations, each accident having one non-fatal injury (**Table 8** below).

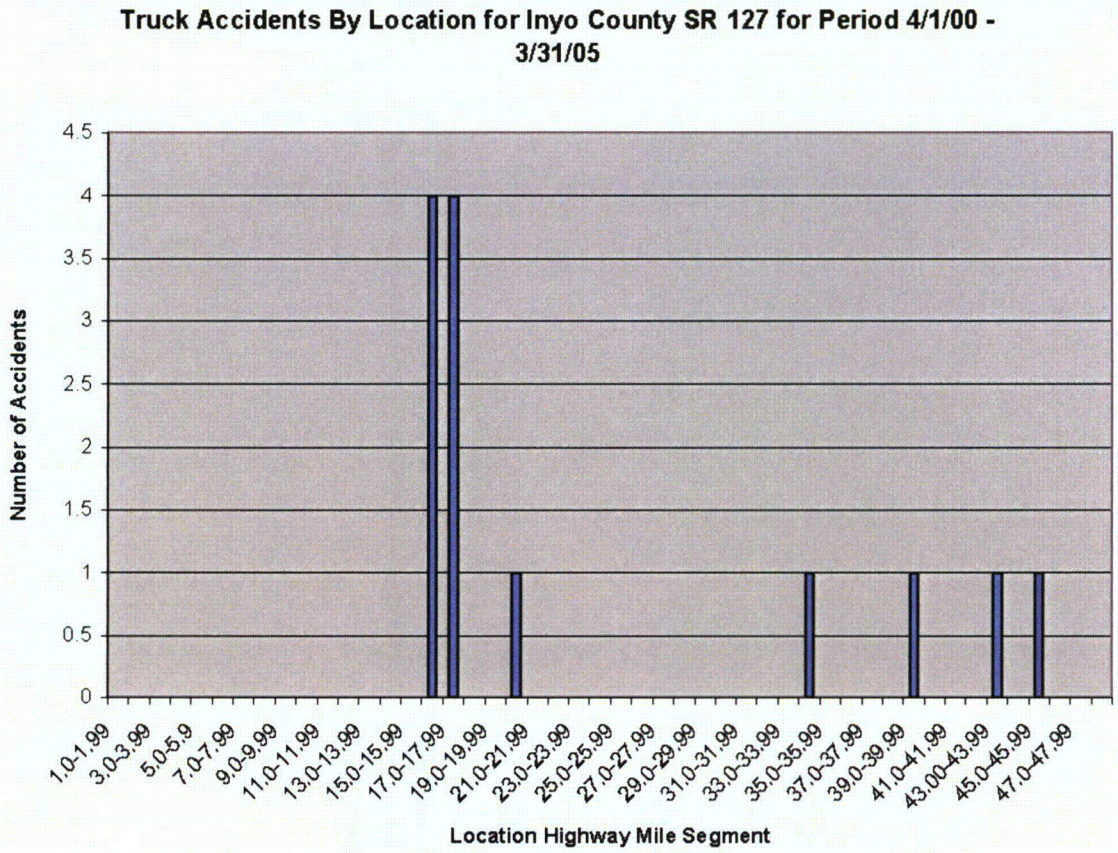


Figure 18.
(**Source:** EJB&A derived from Caltrans 12/05 data)

Table 8. Truck Accident Location Involving Non-Fatal Injuries

Inyo SR 127 Location (MP)	Number of Accidents	Number of Non-Fatal Injuries
16.24	1	1
16.91	1	1
17.37	1	1
20.3	1	1
39.22	1	1

(**Source:** EJB&A derived from Caltrans 12/05 data)

ALL of the truck accidents occurred at locations having less than desired curve radii or minimal paved shoulders (**Chapter 2** above). Eighty percent of truck accidents having injuries occurred at locations having BOTH less than desired curve radii AND minimal paved shoulders. The remaining 20 percent of truck accidents occurred at locations having 0-width paved shoulders.

Many of the truck accidents occurred at locations coincident with passenger vehicle accidents. **Figure 19** below depicts the overlay of truck accident locations on all vehicle accident locations for the same five-year time period.

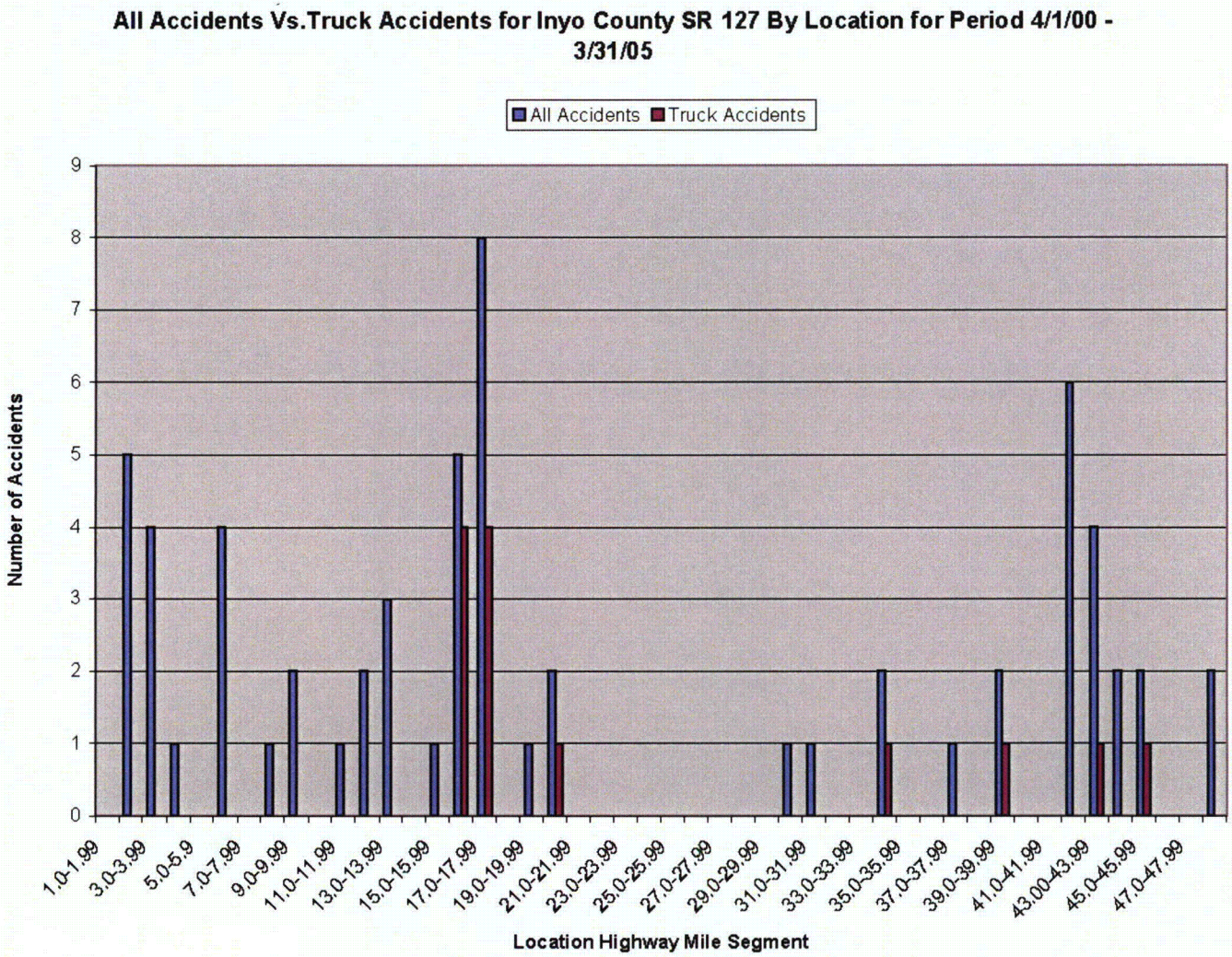


Figure 19.
(**Source:** EJB&A derived form Caltrans 12/05 data)

3.5 SR 127 Accident Records

3.5.1: Primary Collision Factors: The primary recorded collision factors for truck accidents on Inyo SR 127 are ***Speeding*** (38.5 percent); ***Improper Turning*** (46.2 percent); **and Falling Asleep at the Wheel** (15.3 percent).

The primary recorded collision factors for all vehicles on Inyo SR 127 is similar: ***Speeding*** (29 percent); ***Improper Turning*** (56 percent); and ***Falling Asleep at the Wheel*** (three percent).

Figure 20 depicts the Primary Collision Factors for Trucks vs. All Vehicles on Inyo SR 127 for the recent five-year period.

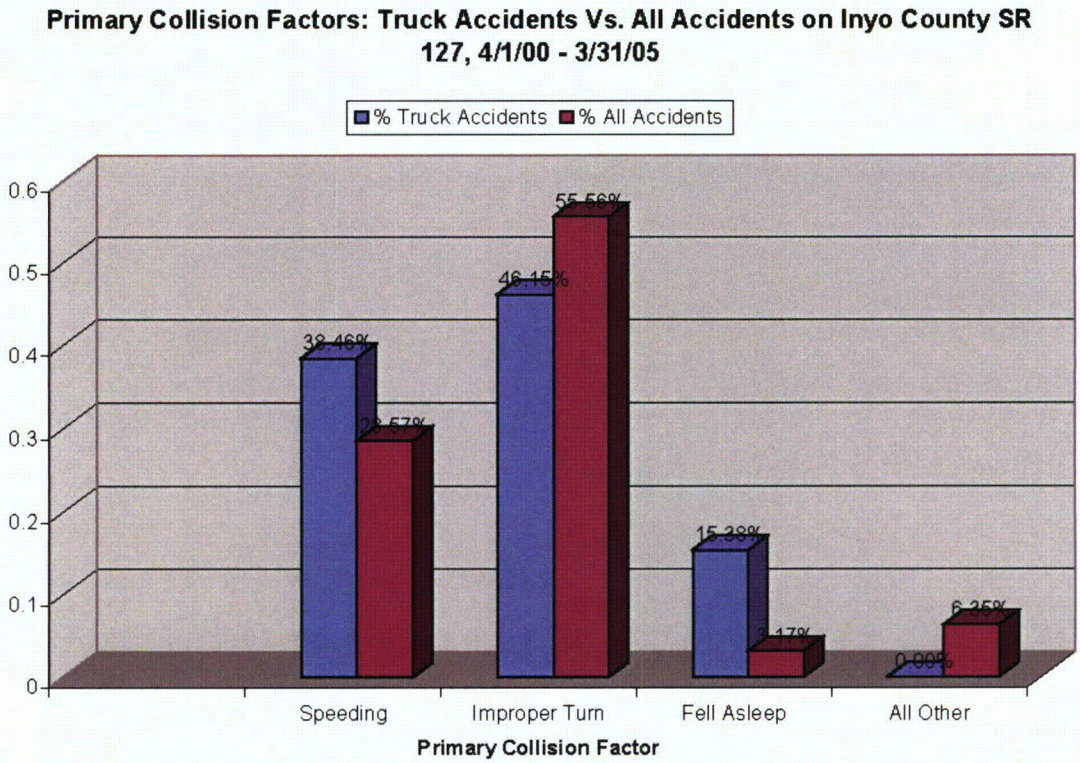


Figure 20.
(**Source:** EJB&A derived from Caltrans 12/05 data)

Inyo SR 127 vs. I-15: ***Speeding*** and ***Improper Turning*** are the leading recorded primary collision factors for truck accidents on both I-15 and Inyo SR 127. Both factors are significantly higher for Inyo SR 127 than for I-15. ***Speeding*** and ***Improper Turning*** account for 84.7 percent of all primary collision factors for Inyo SR 127 vs. 47.2 percent for I-15. ***Falling Asleep at the Wheel*** was the third most important factor for Inyo SR 127, accounting for 15.3 percent of truck accidents. In contrast, ***Falling Asleep at the Wheel*** only accounted for 2.2 percent of truck accident primary collision factors.

3.5.2 Types of Collisions: The dominant type of collision for truck accidents on Inyo SR 127 was ***Overturning*** (69.2 percent) and ***Hitting an Object*** (23.10 percent).

In contrast, for all vehicle accidents on Inyo SR 127, the dominant type of collision was ***Hitting an Object*** (56 percent). ***Overturning*** was 29 percent.

Figure 21 depicts the type of collision for trucks vs. all vehicles on Inyo SR 127 for the recent five-year period.

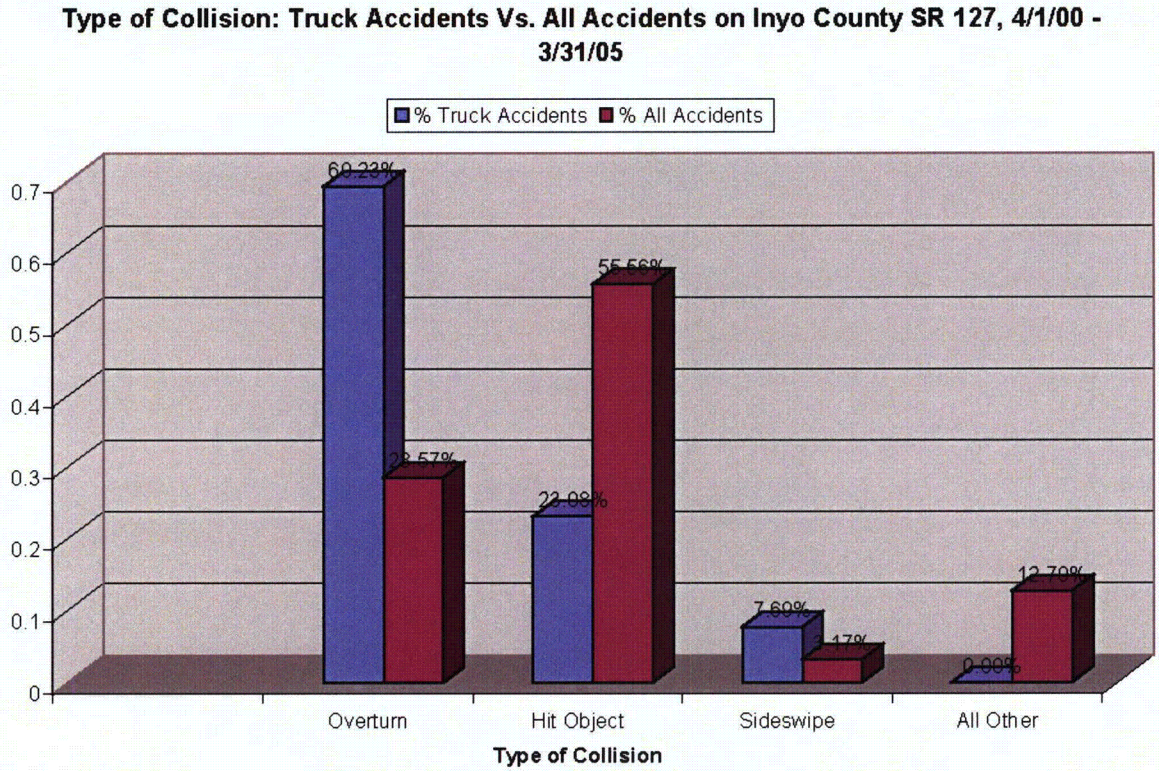


Figure 21.
(**Source:** EJB&A derived form Caltrans 12/05 data)

Inyo SR 127 vs. I-15: The types of collisions for truck accidents are significantly different for Inyo SR 127 and I-15. On I-15, the dominant types of collision were ***Sideswipe*** and ***Rear End Collision***, accounting for 36.4 percent and 32.5 percent, respectively, of all truck accidents. In contrast, for Inyo SR 127, the dominant type of collision was ***Overturning***, accounting for 69.2 percent of all truck accidents. ***Hitting An Object*** was second, at 23.1 percent of all truck accidents.

3.5.3 Move Preceding the Incident: The dominant **Move Preceding the Incident** for truck accidents on Inyo SR 127 was ***Run off the Road*** (76.92 percent); with ***Proceeding on Straight*** (23.8 percent) as second.

The same pattern was observed for all vehicle accidents on Inyo SR 127: ***Run off the Road*** (76.19 percent); and ***Proceeding on Straight*** (23.81 percent).

Figure 22 depicts the **Move Preceding the Incident** for Truck Accidents Vs. All Accidents on Inyo SR 127 for the recent five-year period.

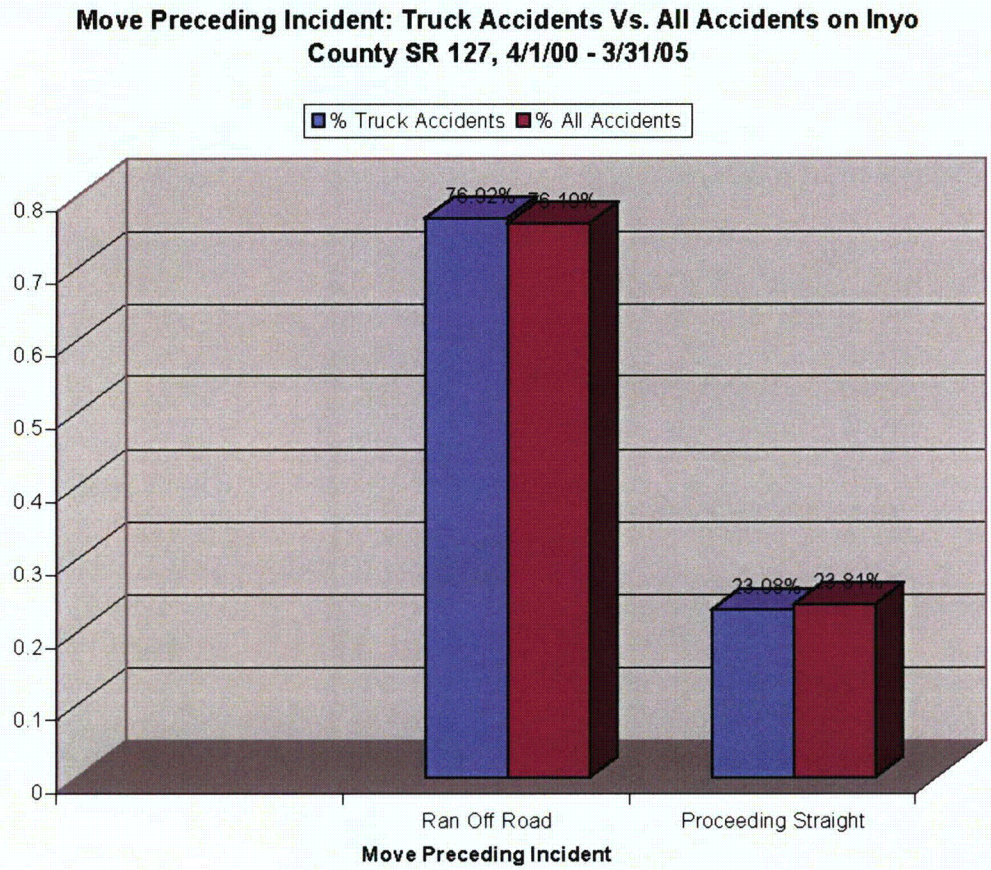


Figure 22.
(**Source:** EJB&A derived from Caltrans 12/05 data)

The dominant truck accident profile on Inyo SR 127 was going off the road after speeding or making an improper turn, resulting in overturning of the truck off the road.

Next we will match the specific collision characteristics above with the actual accident locations.

3.6 SR 127 Truck Accident Collision Factors & Characteristics By Accident Location

Figures 23, 24, and 25 below depict *Primary Collision Factors*, *Type of Collision*, and *Move Preceding Accident* for all truck accidents - by location – on Inyo SR 127 for the recent five-year period.

For the two highway segments (MP 16.0-16.99 and 17.0-17.99) having the highest frequency of truck accidents:

Speeding and Improper Turning dominate, comprising 75 percent of all truck accidents, with *Falling Asleep* comprising the remaining 25 percent.

Overturning dominates as the type of collision, comprising 75 percent of all truck accidents, and *Hitting an Object* the remaining 25 percent.

Running off the Road dominates at 88 percent of truck accidents, with *Proceeding Straight* tailing at just 12 percent of all truck accidents at these locations.

For all the remaining truck accident locations depicted:

Speeding and Improper Turning are the sole collision factors.

Overturning represents 50 percent of all types of collision.

Running off the Road dominates at 88 percent of all truck accidents.

These factors and results are consistent with the physical operational limitations and restrictions of the road at these locations (identified in **Chapter 2**).

In brief, the operational limitations (e.g. minimal paved shoulders, very limited curve radii) are very "unforgiving" of any driving behavior that exceeds the posted speed limits. The typical truck accident profile is approaching a sharp curve at high speeds, or having limited sight lines due to the sharp curve; being unable to correct in time; having limited paved shoulder to mitigate any off-road deviation due to curve sharpness; and consequently running off the road and overturning.

Improvements of the physical road conditions at these locations could significantly enhance both operational flow and operational safety, and minimize accidents.

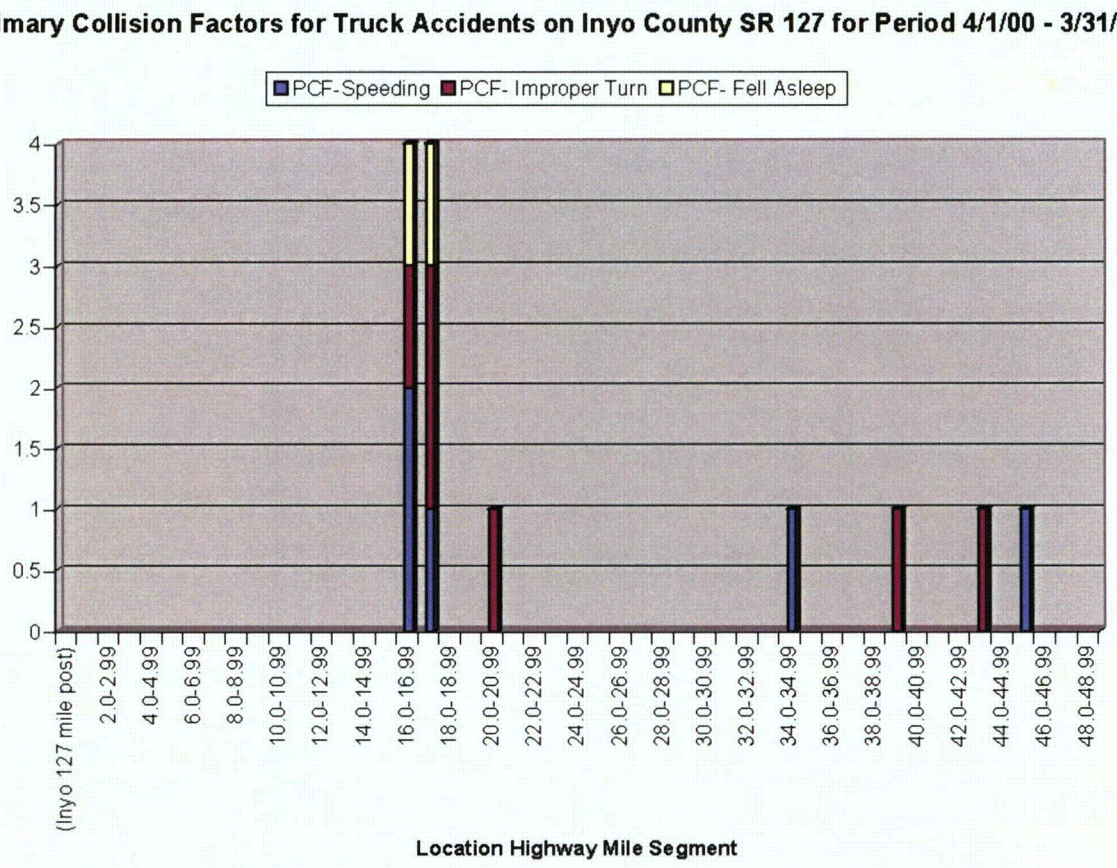


Figure 23.
(**Source:** EJB&A derived from Caltrans 12/05 data)

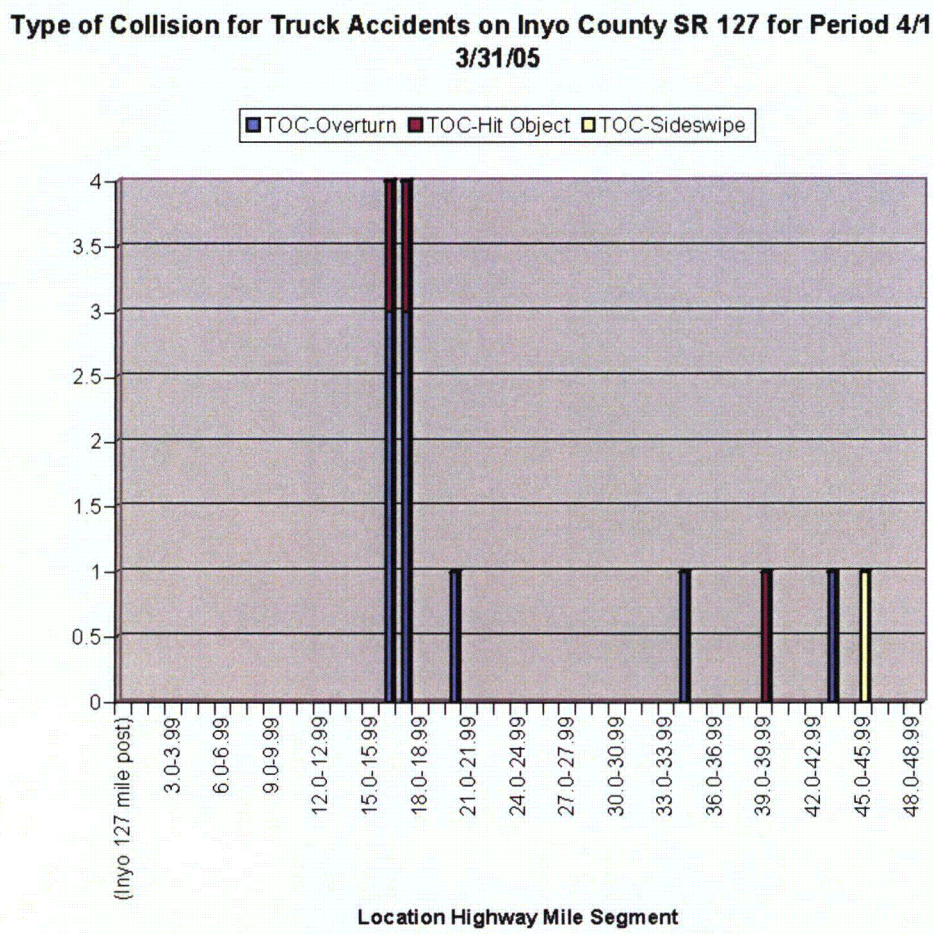


Figure 24.
(**Source:** EJB&A derived from Caltrans 12/05 data)

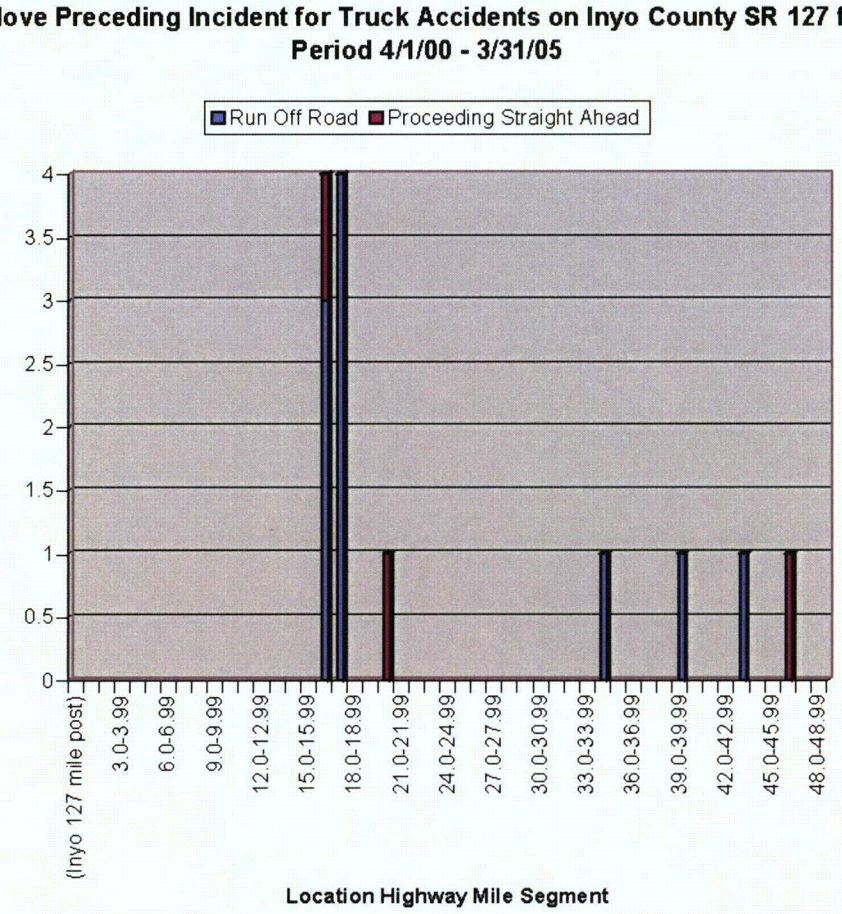


Figure 25.
(**Source:** EJB&A derived from Caltrans 12/05 data)

3.7 SR 127 Truck Accident Occurrences: Seasonality; Day of Week; Time of Day

Just as truck accidents are not uniformly distributed over Inyo SR 127, truck accident occurrences do not occur uniformly in time. These occurrences have been quite peaked in season, day of week, and time of day, reflecting non uniform traffic characteristics.

Seasonality: During the recent five-year time period, truck accidents have been highly seasonal. **Figure 26** depicts the number of truck accidents, by month, for the last five years. From the figure, it can be seen that the months of July and September alone account for 54 percent of the total number of accidents.

Day of Week: Similarly, truck accidents are "peaked" by day of week. The end of the work week - Thursday through Saturday - has accounted for 695 of all truck accidents. This is depicted in **Figure 27**.

Time of Day: Truck accident occurrences s have also been highly "peaked" in time of day. The morning "rush hour" (4am-8am) has accounted for 54 percent of all truck accident times of day as depicted in **Figure 28**.

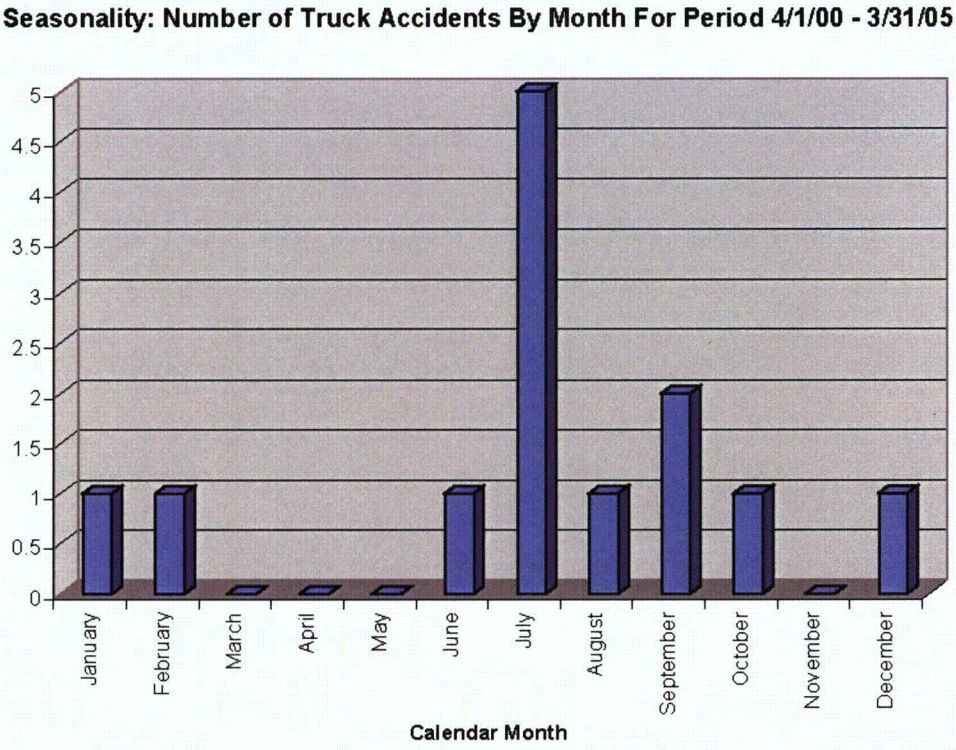


Figure 26.
(**Source:** EJB&A derived from Caltrans 12/05 data)

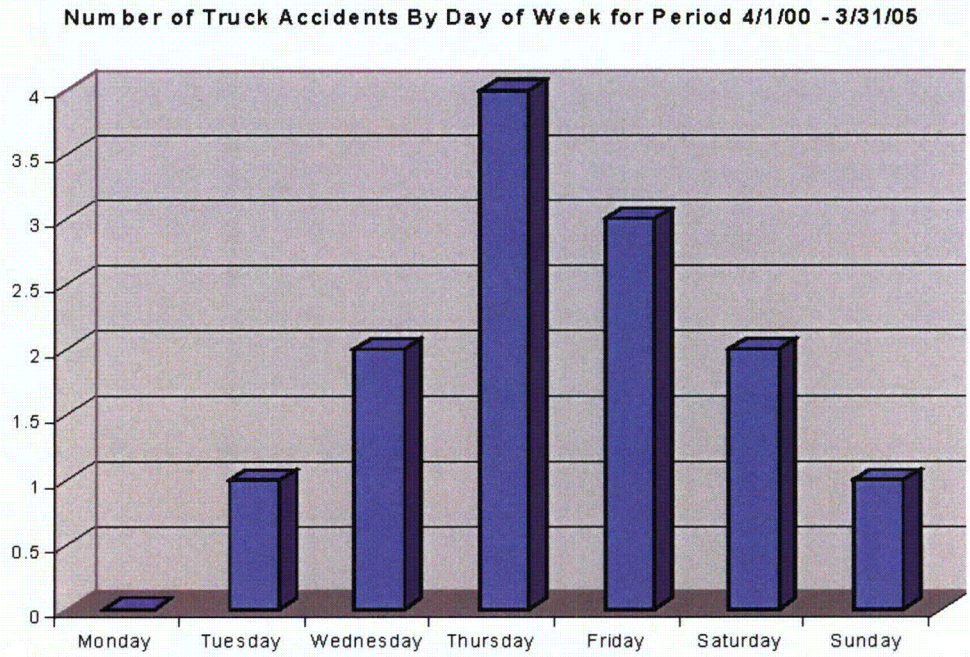


Figure 27.
(**Source:** EJB&A derived from Caltrans 12/05 data)

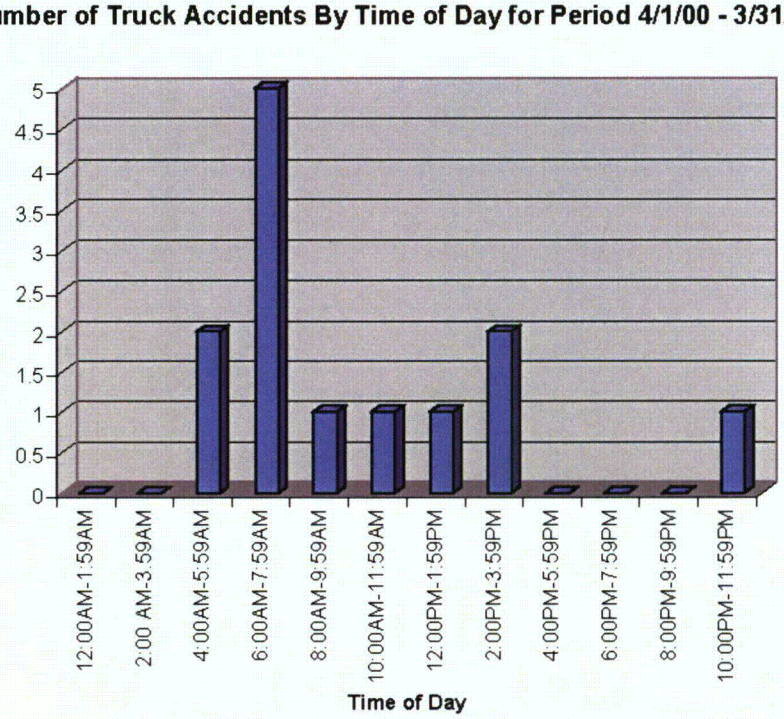


Figure 28.
(**Source:** EJB&A derived from Caltrans 12/05 data)

Traffic Management Strategies have been developed and utilized to "skirt" these higher traffic times on SR 127. Since 2000, DOE, Nevada has instituted, through its negotiations with DOE Generators and its truck carriers, preferred times for shipment of Low Level Waste on SR 127 in California. These strategies have included SR 127 "Black Out Dates" during high volume tourist times (e.g. July 1–6) and during periods of flash flood risk from the Amargosa River (June–September). These strategies were developed in recognition of the seasonal nature of the traffic on SR 127, as well as the " extremely limited and remote emergency response capabilities" (*Documented on the Nevada Test Site Web page at http://www.nv.doe/emprograms/environment/wastemanagement*).

These traffic management strategies could offer continuing relief for prospective shipments. However, these strategies may be significantly compromised in their future effectiveness unless highway improvements such as passing lanes and truck turnouts are instituted. As discussed in **Section 2.2** above, anticipated shipments of HLW/Spent Fuel are expected to be as much as ten times the average number of historical LLW shipments on SR 127, and to continue for a much longer period of time, i.e., 24-38 years. Compressing the prospective shipment schedule into 200 days a year (avoiding black-out days and weekends) leads to 11-14 shipments each day on SR 127. Further compressing the travel schedule to a 14-hour day (to maximize the higher speeds that daylight affords) leads to – on average - one shipment every one to one-and-one-half hours. Most historical shipments have observed speed limits of 50 mph or

less. At posted truck speeds of 50 mph, this translates into at least two shipment truck vehicles on SR 127's 90.9-mile length at any one time (49.4 miles in Inyo County + 41.5 miles in San Bernardino County). With no designated rest stops, passing lanes, or turnouts along the entire route (**Section 2.1** above), and with average all vehicle speeds nearing 60 mph, this leads to moving bottlenecks. This operational situation is further compromised by the earlier described curve limitations, paved shoulder width limitations, and limited sight lines in many locations. In effect, the ample capacity identified in **Section 2.1** is compromised, and the real capacity would be significantly lowered. Passenger vehicle drivers will be increasingly "platooned" behind a constant flow of slower moving trucks. This will occur "every day" (200 days a year) for the next 24-38 years. Incidents of road rage will most probably increase, and tourist traffic will probably not be inclined to travel this route.

Hence, traffic management strategies can help, but will be severely limited in usefulness for SR 127 unless accompanied by highway infrastructure improvements such as passing lanes and turn-outs.

Chapter 4. STRATEGY MEASURES TO MAXIMIZE SAFETY AND MITIGATE RISKS ON SR 127 THROUGH INYO COUNTY

Currently, the choice of final routes to be taken through California by the potential Spent Fuel/HLW shipments will depend on the State of California. Under current law *(Docket HM-164 - 49CFR 397, Subpart D, overall, and 49CFR 397.101-103 for HRCQ (highway route controlled quantities as defined in 49 CFR 173.403))*, the State of California may designate an alternate preferred route (to an interstate) in accordance with the above U.S. Department of Transportation "Guidelines." In the absence of an alternative designation, the interstates are the preferred routes. Currently, the State of California has not designated an alternative to the interstates for I-15 into Nevada. Due to the existing and projected traffic volumes on I-15 (and associated projected service levels), the State of California may decide in the future to follow the precedent established by DOE (in negotiation with its carriers) for its internally regulated (self-regulated) shipments of Low Level Waste (LLW) and Transuranic Waste (TRU), and to utilize Inyo SR 127 for shipments to Yucca Mountain during the inclement winter months to avoid the dense I-15 Las Vegas Corridor.

As discussed in the previous technical chapters, neither route, although currently safe, is desirable, and both would require transportation improvements to maximize safety to meet potential significant and long-term Yucca Mountain truck shipments.

Based on the previous technical discussions, following is an identification of selected strategy measures that may be instituted to maximize safety and to mitigate risks on Inyo SR 127 in the event a decision is made to make Yucca Mountain shipments on that route. These measures have been identified in respective previous technical sections, and are summarized here. These include preventative measures, mainly **transportation infrastructure improvements** and **transportation traffic management initiatives**.

Post incident emergency response preparedness considerations are briefly outlined in the following **Chapter 5**.

4.1 Transportation Infrastructure Improvement Measures for Inyo SR 127

4.1.1 Increase Paved Shoulder Widths on Inyo SR 127: As a ***minimum***, increase paved shoulder widths at the hotspots identified in **Sections 2.1, 3.4, and 3.6**. ***Preferably,*** increase the paved shoulder width to a minimum of 1.2 meters along the entire length of Inyo SR 127. Previous field assessments, conducted and reported by Caltrans almost a decade ago and cited previously in the text (**Section 2.1**), concluded the need to increase paved shoulder width along Inyo SR 127. These assessments did not have the benefit of more recent confirming accident statistics or of significant projected SNF/HLW truck volumes and the anticipated long campaign duration.

Caltrans did, however, identify this need associated with potential Yucca Mountain shipments: *" Given the conditions on SR 127 where many of the existing paved shoulders are narrower than the stated minimum width, and the projected increased truck traffic, Caltrans metric design guidelines require 1.2 m paved shoulders on the right side of vehicle lanes as part of roadway Resurfacing, Restoration, and Rehabilitation projects. This being the case, the recommended minimum shoulder width would double from 0.6 to 1.2 m"* (***Route 127 Route Concept Report,*** *Caltrans District 9, November 1997*).

Additional stakeholder perception of this need is found in the more recent ***2002 DOE FEIS Comment Response Document, Part 4***, Chapters 8 through 13. Examples of these comments include: *"our confidence in truck transportation for dangerous materials on remote, narrow, two-lane roads is not high"* (Section 8.3.1, Comment # EIS 000261/0003); and *"does not include turnouts or wide shoulders and is subject to periodic flash flooding"* (Section 8.3.1, Comment # EIS 001622/0012).

4.1.2 Realign Curves on Inyo SR 127: As a ***minimum***, realign curves at the hotspot locations identified in **Section 3.6**. Preferably, realign all the curves indicated in **Table 3** to the minimum specification of 1970 feet radius to meet observed increases in average vehicular speed. In addition, realign the road through the community of Death Valley Junction. This roadway improvement measure has been identified by Caltrans in previous assessments. Additional stakeholder perception of this need is found in the more recent ***2002 DOE FEIS Comment Response Document, Part 4,*** Chapters 8 through 13. Examples of these comments include: *" it's got flat-graded curves, and it's only a two-lane roadway"* (Section 8.3.1; Comment # EIS 000382/0001); and *"Inyo County's recent survey of the route...* ***revealed many unbanked, unsigned, high-speed turns, numerous blind rises where visibility is limited****... the route passes through four towns, two of which include* ***sharp 90 degree turns in the middle of town****... a hazardous waste* ***truck failed to negotiate a turn near a rest stop, rolled over and crushed a picnic facility"*** (Section 8.3.1, Comment # EIS 000261/0003).

4.1.3 Improve Drainage Conditions on Inyo SR 127: Improve the drainage conditions on SR 127 by a combination of improved culverts at some locations and re-alignment at other locations as identified in **Section 2.1**, where current conditions have led to road closures. This measure has also been identified in the **Task 4** report and by Caltrans in their previous field assessments (*2003 Feasibility Analysis Report (SR 127), Appendix G: Preliminary Drainage Recommendations, May 2002*). In addition, stakeholder perception of need has been documented in the ***2002 DOE FEIS Comment Response Document, Part 4***. Examples from the FEIS

include: *"Inyo County's recent survey of the route... dozens of washes crossing both over and under the pavement"* (Section 8.3.1, Comment # EIS 000261/0003); and *"has tight horizontal and vertical curves... and dozens of washes crossing both under and over the pavement"* (Section 8.3.1, Comment # EIS 001622/0012).

4.1.4 Create Passing Lanes on Inyo SR 127: As discussed above in **Section 3.7**, there is a significant need for passing lanes for operational purposes, for safety purposes, and for emergency response purposes. As a ***minimum***, there should be passing lanes constructed every ten-mile segment along SR 127. **A preferable, though expensive alternative, would be to make Inyo SR 127 a four-lane roadway**. Stakeholder perception of this need has been voiced in the recent ***2002 DOE FEIS Comment Response Document, Part 4***. Examples include: *"certain times of the year, this route is the primary access road for thousands of tourists to the Death Valley National Park"* (Section 8.3.1, Comment # EIS 001622/0012); *"Considerable recreational travel occurs on this road due to its providing primary access to Death Valley National Park from the south. Slow moving recreational vehicles are well-known locally as a traffic hazard on this route"* (Section 8.3.1, Comment # EIS001865/0014); and *"in the event of an incident, there are few alternate routes useful to diverting commercial and passenger traffic around accident or cleanup sites. For long sections of 127, there is no alternate route whatsoever"* (Section 8.3.1, Comment # EIS 000261/0003).

The need for passing lanes associated with the Yucca Mountain truck shipments was also recognized by Caltrans almost a decade ago: *"... Truck volumes could also possibly warrant installation of passing lanes in some locations" (**Route 127 Route Concept Report**, Caltrans District 9, November 1997).*

4.1.5 Create Truck Turn-Outs on Inyo SR 127: Locations are needed for trucks (and passenger vehicles) to turn to change direction. These can be simple physical turn-outs, or be coupled with rest stops. As **Section 3.5.1** indicated, falling asleep at the wheel is one of the three main primary collision factors. These turn-outs along the route could also be used to facilitate vehicle break-down recovery, emergency response operations, and even serve as evacuation staging areas. Relevant comments from the recent ***2002 DOE FEIS Comment Response Document, Part 4*** include: *"in the event of an incident, there are few alternate routes useful to diverting commercial and passenger traffic around accident or cleanup sites. For long sections of 127, there is no alternate route whatsoever"* (Section 8.3.1, Comment # EIS 000382/0001).

Caltrans confirms the above need for truck turn-out areas. In their ***2003 Feasibility Analysis Report: SR 127 Improvements***, one of their specific recommendations (page 9) was constructing turnout areas to allow large trucks to make U-turns *"at approximately 16 kilometers (10 miles) spacing throughout ... ."*

4.2 Transportation Traffic Management Strategies:

Section 3 above indicated the need for, historical use of, and limitations of traffic management strategies to maximize safety and to mitigate risks, and to improve operational traffic flow. Following are selected traffic management strategies.

4.2.1 Negotiate Continuation of Selected Black-Out Periods: Continue and extend existing SR 127 "preferred routing program" agreement with DOE, Nevada to the DOE Yucca Mountain Program. This includes "black-out dates" for holidays and other significant time periods. As discussed in **Section 3.8** above, the benefits of this strategy will be "capped" unless complementary transportation infrastructure improvements are made.

4.2.2 Installation of Optical Speed Bumps at Selected Locations: Conduct feasibility demonstration, and potential installation of optical speed bumps at selected hotspot locations. Optical speed bumps are a low cost, minimum lead time device to make drivers more aware of their vehicle speeds. Their use on sharp curves and limited sight line locations might improve the recognition of the need for speed reduction.

4.2.3 Increase Utilization of Highway Visual Aids and Signage: The need for and benefits of increased signage and other visual aids describing SR 127 route operational limitations (e.g. speed limits, tight curves, pavement narrows, ...) has been documented in the ***2002 DOE FEIS Comment Response Document, Part 4***. Examples include: *"Inyo County's recent survey of the route ... revealed many unbanked, unsigned high-speed turns ..."* (Section 8.3.1, Comment # EIS 000261/0003).

4.3 Funding the Implementation of the Transportation Mitigation Measures

4.3.1 Authority: The NWPAA provides authority for financial assistance to affected units of local government.

Section 116 (c), as amended, provides:

"(B) The Secretary shall make grants to the State of Nevada and any affected unit of local government for purposes of enabling such Sate or affected unit of local government

(i) to review activities taken under this subtitle with respect to the Yucca Mountain Site for purposes of determining any potential economic, social, public health and safety, and environmental impacts of a repository on such State, or affected unit of local government and its residents;

(ii) to develop a request for impact assistance under paragraph (2)."

Paragraph (2):

"(2)(A)(i): The Secretary shall provide financial and technical assistance to the State of Nevada, and any affected unit of local government requesting such assistance.
(ii) Such assistance shall be designed to mitigate the impact on such State or affected unit of local government of the development of such repository and the characterization of such site."

In addition, DOE has indicated in the ***2002 FEIS Comment Response Document*** the consideration of transportation infrastructure improvements on SR 127.

DOE Responses To Comments Concerning SR 127:

8.3.1 (1155):

"California State Route 127 is currently not a preferred route so DOE has not determined how these risks would be mitigated. As mentioned above, DOE would not designate preferred highway routes based on the information in the EIS alone. Additional environmental and engineering studies would be conducted before such a decision was made. DOE anticipates that potential mitigation measures, which might include infrastructure upgrades, would be considered as a part of these additional studies."

And

8.3.1 (5194):
"...Where upgrading would be required for safe transport or maintenance would be required to keep roads and railroads safe, the necessary funding would be made available to responsible jurisdictions."

Almost a decade ago, Caltrans explicitly recognized the need for external DOE funding to meet the impacts generated by potential Yucca Mountain truck shipments:

*" In the event that SR 127 is selected as a haul route, considerable capital improvements would be necessary to safely accommodate shipments of high-level radioactive waste, regardless of the transport scenario implemented. Caltrans District 9 would request DOE to fund the necessary facility improvements as mitigation of impacts to the transportation system" (**Route 127 Route Concept Report**, Caltrans District 9, November 1997, page 14).*

4.3.2 Funding Precedence: DOE has funded transportation road improvements for radioactive waste shipments to mitigate local impacts. The Santa Fe, New Mexico Bypass Road, also known as the "Santa Fe Relief Route" (and recently renamed the Veterans Memorial Highway, Route 599) was built 1988-2000 and is currently operational to bypass the City of Santa Fe for TRU shipments from Los Alamos to the WIPP Repository in Carlsbad, New Mexico. This separated grade highway avoided any congestion for travel through the City of Santa Fe. It also coincidentally enabled a significant increase in economic values for real estate in the route vicinity by "unlocking" previously relatively inaccessible real property locations. A DOE study, providing the first documented review of property values in the Santa Fe City/County area since the initial land condemnation proceedings in 1988, concluded that the Bypass has had a significant positive economic impact on real property values by unlocking the area for development *("Santa Fe Bypass Route Property Values Study," May 2001, E. J. Bentz & Associates; updated June 2002).*

4.3.3 Cost & Timing Considerations: Cost for implementing the transportation mitigation measures identified above will depend on a variety of factors including: right-of-way acquisition costs; construction costs (e.g. earthwork, structural); drainage costs (e.g. culverts); and necessary environmental, cultural, and community review costs. Firm cost estimates will be based on final engineering designs for the selected improvements. Historically (1997), Caltrans has developed estimates for improving SR 127. Estimates were developed for improving the entire length of SR 127 (90.89 miles: 41.47 miles in San Bernardino County, and 49.42 miles in

Inyo County). These estimates have varied from $500,000 for all right-of-way costs to $10 million for drainage improvements. A total estimate of $285 million was developed to implement comprehensive improvements including expanded paved shoulders; curve corrections; realignments; placing a new road surface chip seal; building the Baker Bypass; and traffic improvements (*previously cited* ***"Route 127 Route Concept Report, November 1997; Attachment C: Draft Cost Estimates"***).

Time to implement the selected transportation mitigation measures is a significant factor. Many of the infrastructure improvements will require significant lead times due to right-of-way acquisition and necessary environmental, cultural, and community reviews and consultations with affected parties (e.g. National Park Service). Documentation would include Environmental Impact Reports and/or Environmental Impact Statements, depending on the transportation improvement mitigation measures selected. For the total comprehensive SR 127 program that Caltrans identified in 1997 (for both San Bernardino and Inyo Counties), their estimate was 109 months to complete all environmental reviews, reports, and to obtain a final environmental determination (*previously cited* ***"Route 127 Route Concept Report, November 1997; Attachment D: Preliminary Environmental Analysis Report"***).

These lead times may be significantly shortened by segmenting and prioritizing the selected improvement mitigation measures, and staging their implementation accordingly.

Chapter 5. EMERGENCY RESPONSE PREPAREDNESS CONSIDERATIONS

As discussed earlier, the anticipated shipments of Spent Fuel/HLW represent a significant departure from existing and historical movements on SR 127. The anticipated Yucca Mountain shipping campaign will be far larger than any previous single U.S. shipping campaign of any goods. The campaign will also be far longer (24-38 years) than any previous shipping campaign of any goods. Although Inyo County SR 127 has experienced limited shipments of radioactive waste in the recent past (approximately 1/10 of the anticipated number of SNF/HLW shipments per day), these radioactive materials have been low-level activity radioactive wastes, not the high-level activity wastes of the anticipated long-term shipping campaign.

Accordingly, the existing emergency response infrastructure has not been developed to meet these potential needs. The current infrastructure meets current, very limited needs.

5.1 Current Emergency Response Infrastructure Vs. Anticipated Needs

The 2002 DOE FEIS documents comments regarding current emergency response capabilities vs. anticipated needs for the potential SNF/HLW shipments. **Table 9** below presents some of these comments.

Table 9. ***Selected FEIS Comments on Emergency Response***
(Yucca Mountain FEIS, Volume 3, Comment Response Document, Part 4, Chapters 8 through 13, February 2002)

Comment Number	Comment
8.3.1/EIS 000262/0002	"The virtual absence of emergency response capability on Route 127"
8.3.1/EIS000261/0003	"the time delay in getting toxic waste expertise into the region was the reason for the severity of the incident"
8.3.1/EIS000382/0001	"there's not even the manpower to close the highway. We can't even put one person at each end of the truck spill to close the thing down" "there's no trained manpower" "in that part of the County there is no fire department" "Shoshone only has one resident police officer. The next one would be Death Valley, and you are talking about 45 minutes away." "Pahrump has volunteered to come over on occasion. They have more than they can handle on State Route 160"
8.3.1/EIS001443/0018	"most of the route lies one to three hours from any public assistance" "assistance with road incidents must come from Inyo County Sheriff Unit at Shoshone, Park Service Rangers dispatched out of Cow Creek near Furnace Creek, or California Highway Patrol also coming out of Death Valley or out of Pahrump, Nevada" "to deal with major road incidents, County Sheriff Units are sent from Lone Pine, which is 3 hours away from the closest segment of SR 127" "currently, the State Route 127 towns of Tecopa, Shoshone, and Death Valley Junction are served by a single Volunteer Fire Protection District that is without adequate funding" "in case of a serious toxic or radiological release in Inyo County, specialist response teams must be brought in from either San Bernardino or Bakersfield, a process which takes a minimum of three to four hours, assuming that the response team is not occupied elsewhere" "the closest medical facility of any note is in Pahrump, which is a minimum of thirty minutes from the closest segments of the road and several hours away from the furthest. The closest fully

	equipped hospital is in Las Vegas, which is at least two hours away from the closest sections of SR 127"
8.3.1/EIS001273/0001	"haz-mat teams are 85 & 100 miles distant" "the Calif. Highway Patrol would have to close down # 127 at both ends in case of a spill"
8.3.1/EIS001865/0014	"is remote and emergency response units are limited in number and sufficiently distant from some road portions adding to the complexity of spill containment and cleanup should an accident occur"
8.3.1/EIS002299/0005	"scarcity and long response time for emergency response to a shipment accident"

More recently, the field survey conducted by Ballard and Moore for **Task 3** *(and reported in the report entitled "**Public Safety Assessment**," April 2006)* confirms the earlier FEIS observations.

To quote that *April 2006 Survey Report* (page 15):

"6.0 CONCLUSIONS AND RECOMMENDATIONS

Emergency response agencies in southern Inyo County are hard pressed to provide the minimal level of basic services. The combination of very large geographic area and minimal resources (personnel and equipment) makes it difficult for fire, law enforcement and emergency medical service agencies to meet current demands. These agencies cannot, and should not be expected to respond to additional demands created by shipment of spent nuclear fuel and high level radioactive waste through the County to Yucca Mountain."

5.2 Historical DOE Financial Support for SR 127 (to Meet Current Emergency Response Needs)

DOE historically has recognized the fragile and very limited nature of emergency response capability along SR 127.

As noted in **Section 2.4**, a specific reason given by DOE for route diversification for low level radioactive waste shipments on SR 127 *is "to limit the number of shipments that travel on SR 127 due to extremely limited and remote emergency response capabilities."*

In addition, even with the relatively low number of low level waste shipments, DOE has created a fund (paid by users of the NTS disposal site) to enhance emergency response capabilities. This fund is administered by the Nevada Department of Emergency Management. Over $7 million has been disbursed in grants since fund creation in 2000. Most of the funds have been disbursed to six Nevada counties for emergency response purposes. Although Inyo County is not a Nevada County (it shares reciprocal mutual aid agreements with Nevada Counties), it has received over $200,000 in funds since program inception through several annual grants. This

funding has been used to support emergency response personnel and equipment purposes. The overall program has been well received. It serves as a model for future efforts in enhancing emergency response at the local level - especially in rural areas depending on volunteer support.

5.3 Potential Financial Support Opportunities for SR 127 (to Meet Potential Future Emergency Response Needs)

5.3.1 Improve the route: The single best action to improve emergency response capability on Inyo SR 127 would be to improve the route, as identified previously in **Chapter 4**. This would reduce the probability of an accident (with potential release), and it would also enable first responders to respond more effectively.

5.3.2 Conduct Demonstration Pilot Project To Support Development of Section 180 (c) Initiatives: The second best action(s) would be to develop, with DOE's support, a demonstration pilot emergency response project to support the development of DOE's forthcoming Section 180 (c) program initiatives.

There is currently no Section 180 (c) assistance available. DOE plans that *"Section 180 (c) assistance would be made available approximately 4 years prior to shipment through a jurisdiction"* (2002 DOE FEIS, *"DOE Responses to Comments Concerning Emergency Response on SR 127"*). There is, however, a current need to develop the content and approach for an effective Section 180 (c) assistance program. This demonstration pilot program would propose to support that development.

5.3.2.1 Background: DOE has authorities and responsibilities for provision of emergency response to support its anticipated shipments. This includes DOE Transportation Orders, as well as NRC physical security requirements (10 CFR 73.37) as a NWPA NRC licensee.

DOE has historically developed a robust technical response capability to an incident involving a radioactive release. Like all emergency response programs, there is also a need for local government to provide assistance for the incident (e.g. first responders; perimeter control; emergency medical team …). In general, organization of response will follow the Incident Command System (ICS) of the National Response Plan but the form, nature, and degree of local assistance will depend, in part, on the specific emergency response program developed and administered by DOE to support its potential shipments.

The need for local emergency response assistance to support the potential DOE shipments has been anticipated in provisions of the Nuclear Waste Policy Act, as Amended (NWPAA).

To cite DOE (2002 DOE FEIS Comment Response Document, *"DOE's Response to Comments Concerning Emergency Response on SR 127"*):

"Section 180 (c) requires DOE to provide technical assistance and funds to states for training of public safety officials of appropriate units of local government and

Native American tribes through whose jurisdiction it would transport spent nuclear fuel and high level radioactive waste. The training would cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations. DOE would provide the assistance based on the training needs of the states and tribes, as they are determined using an up-front planning grant and based on availability of funds in annual Program budgets specified by Congress."

5.3.2.2 Demonstration Pilot Project Elements: The proposed demonstration pilot project would be used to support the development of the DOE Section 180 (c) program initiatives by being a test bed for the development of technical content and alternative approaches to provide the 180 (c) assistance for affected rural communities along the routes. The design of the proposed demonstration pilot project would address many of the issues and capabilities identified in the recent emergency response field survey, and the above-cited FEIS comments that are common to numerous rural communities. The results of this demonstration pilot project could be applied to all of the rural communities on potential campaign routes across the nation which depend heavily on volunteer part-time staff to provide emergency response. This program would build on the findings of the existing DOE-funded and NDEP-administered emergency response preparedness grant program. It would be tailored to meet the specific needs and characteristics of the potential Yucca Mountain shipments. Since the Section 180 (c) funding assistance is not anticipated to be made available until approximately four years prior to shipments through a jurisdiction (63 FR 23753, April 30, 1998), the demonstration pilot project would have sufficient time to develop and test alternatives for use in the Section 180 (c) assistance program.

Elements for consideration in the proposed demonstration pilot project to support the development of a Section 180 (c) assistance program might include:

(a) Utilization of non-traditional training techniques "to reach" the volunteer constituency that staffs most rural emergency response capability. The use of stand-alone and interactive "games" has proved to be an effective and efficient way to develop awareness training and selected operation-level training in very short times, with high retention. The techniques developed have been used "to bridge the knowledge technology gap" for volunteers. A 2002 Report by the Federation of American Scientists, entitled "*Training Technology Against Terror: Using Advanced Technology To Prepare America's Emergency Medical Personnel and First Responders for a Weapon of Mass Destruction Attack*" ***"found that books, workplace training sessions, off-site seminars and other traditional methods aren't up to the task."*** Recent experiences in military training and law enforcement confirm the effective use of these non-traditional techniques as part of an overall training program. DHS, Office of Domestic Preparedness estimates that there are over 100 game programs that have already been developed for different aspects of emergency response training.

(b) Assessment, Testing, & Evaluation of Emergency Response Equipment to support proposed emergency response actions regarding potential Yucca Mountain shipments. Different equipment has been recently developed to support emergency

response programs nationwide. This includes in-field radiation detection equipment; personal protective gear, and interoperable communication systems. Most of the equipment has been designed for specialized purposes, and requires varying degrees of specialized expertise to operate. This assessment and evaluation would be designed to test the applicability and value of selected candidate equipment to meet the in-field conditions and operator expertise that will be common for potential Yucca Mountain shipments. Equipment selection will include the SEL (Standardized Equipment List) developed by the IAB (Interagency Board); The AEL (Authorized Equipment List) developed by the Office of Domestic Preparedness, DHS; the radiation technologies funded by the new DHS Office of Nuclear Detection; and the DOE.

(c) Assessment of the Utilization & Adaptation of Other On-Going Emergency Response–Related Pilot Programs for use and application in the Section 180 (c) program. Many agencies are currently conducting pilot emergency response demonstration projects. These include DOD, DHS, and HHS. One example in HHS is the HHS-funded *Pilot Program for Radiological Monitoring in Hospital Emergency Departments*. On a local level, another program is the on-going DOE-funded emergency response program for Nevada (cited earlier) to support the low-level waste shipments. Many of the findings of these efforts - such as the modification and use of "all-hazard" training developed in the DOE-funded LLW program – may be of immediate value and use to the Section 180 (c) program.

5.3.2.3 Summary: Significant efforts and resources will have to be directed to accommodate the potential HLW movements. These resources include emergency response equipment, personnel, training, and exercises (at the operational level as well as the supporting level). The development of an emergency response demonstration pilot project may facilitate the safe, timely, and cost effective development (and eventual deployment) of local emergency response assets to meet these needs.