Effects of NMOCD Proposed Rule 53
Reserve Pits Removal

Prepared for Industry Committee Joint Defense Technical Team

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Effects of NMOCD Proposed Rule 50
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Executive Summary

The New Mexico Oil Conservation Division (NMOCD) has proposed significant changes to Rule 50, which regulates oil and gas pits (e.g., drilling, reserve, operation), essentially requiring all pit materials to be transported and disposed of in NMOCD-permitted landfills. Implementation of proposed Rule 50 would have significant negative future impacts on the New Mexico environment, roads, public safety, and oil and gas industry business decisions.

Industry Assumptions

The New Mexico oil and gas industry has been drilling approximately 1400 wells per year over the last few years. This drilling and the associated oil and gas production volumes are not expected to decrease under the current oil and gas prices and current Rule 50. The proposed Rule 50 to eliminate drilling pits would cost the industry more than $50,000,000 per year.

Environment, Public Safety, and Road Impacts

To determine potential environmental and public impacts associated with the implementation of the proposed Rule 50, the oil and gas industry considered the additional activities associated with eliminating drilling/completion pits. In general, these impacts are related to the fact that only four currently approved OCD landfills are located in New Mexico, all in the southeast quadrant of the state. Accordingly, the impacts evaluated included regulated air pollutant emissions, dirt/paved road damage, and heavy truck accidents associated with the transport of drilling materials from the northeast, northwest, and southwest quadrants of New Mexico to one of the approved landfills in the southeast quadrant.

Identified impacts of the proposed changes to the pit rule include:

- A significant increase in regulated air pollutant emissions, including nitrogen oxides, particulate matter (dust), and greenhouse gas emissions, putting at risk emissions reduction goals in the northwest quadrant of the state

- Increase in surface owner complaints due to more traffic-induced road dust

- Accelerated deterioration of New Mexico roads, costing New Mexico taxpayers for increased road repairs

- A potential rise in injury accidents for New Mexico citizens as a result of the significant increase in heavy truck traffic

- Cumulative impacts of increased air pollutant emissions and truck traffic over the next 1 to 15 years

Table ES-1 lists both low and high estimates of the impacts related to implementation of the proposed Rule 50. The analysis included availability of landfill space relative to estimated annual volumes of drilling materials, expected heavy truck miles traveled, potential release of air pollutants from haul road and truck exhaust emissions (road dust, other pollutants, and greenhouse gas emissions), projected road damage, and anticipated heavy truck accidents.

Table ES-1. Summary of Estimated Annual Impacts

Area of Concern	Annual Impact		Comments	Source
	Low	High		
Annual business impact to comply with proposed Rule 50 (estimated costs per year)	\$50M	>\$100M	These expenditures and costs are activities in addition to current drilling activity levels and current landfill disposal costs.	Industry Committee poll
Volumes of drilling materials hauled per year (yd^3)	1,500,000	2, 700,000	Assuming 1,400 wells per year.	Industry Committee poll
Heavy truck miles traveled per year	27,000,000	81,000,000	Significant increase on rural roads, especially near permitted landfills, and more than 50% increase in local well drilling traffic.	Average distance from northwest, northeast, and southeast quadrants to NMOCD permitted landfills
Dust emissions (tons per year)	13,000	41,000	Detrimental to NMED FCAQTF and BLM air quality reduction goals.	Calculated using U.S. EPA MOBILE6.2 model
Greenhouse gas emissions (GHGs) (tons CO_2 per year)	50,000	149,000	Detrimental to the goals of Governor's initiative to reduce GHGs.	Calculated using U.S. EPA MOBILE6.2 model
Pavement damage (equivalent single axle loads) (annual road consumption)	60%	106%	Assuming 25% of the additional traffic is imposed in the vicinity of the four NMOCD landfills, the road design will be exceeded and the useful life of the roads will be less than 2 years.	NMDOT
Heavy truck accidents (adjusted rate based on 100,000,000 miles)	14	41	Goal is zero.	Estimated by J.W. Hall, P.E. (2006)
Heavy truck fatalities (adjusted rate based on 100,000,000 miles)	0.85	2.53	Goal is zero.	Estimated by J.W. Hall, P.E. (2006)
New landfill disposal capacity	Unknown	Unknown	NMOCD should complete this analysis. It is unknown how the new Rule 50 permitting process will affect increase in landfill capacity.	NMOCD permitted landfills

NMOCD = New Mexico Oil Conservation Division
NMED = New Mexico Environment Department
FCAQTF = Four Corners Air Quality Task Force
BLM = Bureau of Land Management
CO_2 = Carbon dioxide
NMDOT = New Mexico Department of Transportation

Effects of NMOCD Proposed Rule 50
Removal of Reserve Pits

1. Introduction

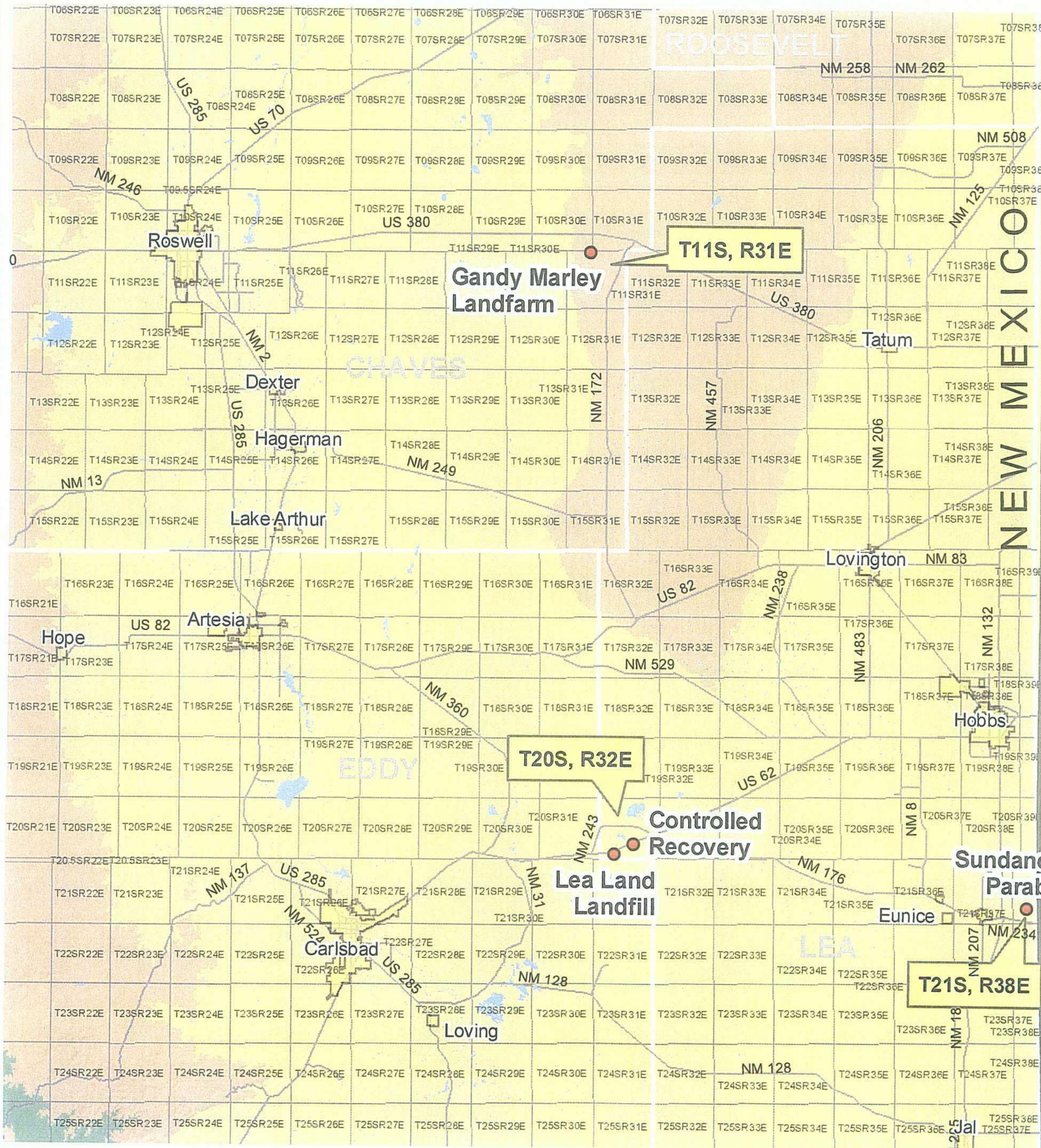
As requested by the Industry Committee, Daniel B. Stephens & Associates, Inc. (DBS&A), with assistance from subcontractors McKeen Consulting Engineers LLC and Serafina Technical Consulting LLC, has evaluated the effects of New Mexico Oil Conservation Division (NMOCD) proposed Rule 50 regulates oil and gas pits (e.g., drilling, reserve, operation) and essentially requires all oil and gas well drilling/pit materials in the state of New Mexico to be hauled and transported to a NMOCD permitted landfill. The Industry Committee provided DBS&A with estimated transport volumes of material and projected travel distances to landfills.

There are currently four NMOCD-permitted landfills in the state:

- Gandy Marley
- Controlled Recovery, Inc.
- Lea Land, Inc.
- Sundance Parabo

Figure 1 illustrates the locations of these landfills, all of which are within the southwest quadrant of the state.

Implementation of proposed Rule 50 would have significant negative impacts on the New Mexico environment, roads, public safety, and oil and gas industry business decisions over 15 or more years. Based on an Industry Committee poll, the New Mexico oil and gas industry has been drilling approximately 1400 wells per year over the last few years. This drilling and the associated oil and gas production volumes are not expected to decrease under the current oil and gas prices and current Rule 50. However, the proposed Rule 50 to eliminate drilling pits impacts the industry at greater than $50M per year.



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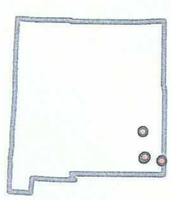

Explanation

Waste facility location

NMOCC HEARING

Waste Facility Locations with Township and Range

Daniel B. Stephens & Associates, Inc.

07-26-06

JN LT05.0257

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2. Landfill Capacity and Drilling/Reserve Pit Material Volumes

Estimated capacities have been evaluated according to the owners/operators of the landfills. Proposed Rule 50 (50D-E. (3) pg 12) requires that no surface waste management facility exceed 500 acres, which translates to an approximately 8,067,000-cubic yard [yd^3] capacity for a 10-foot-deep landfill and an approximately 40,330,000-yd^3 capacity for a 50-foot depth. All of the owners claim to have enough current capacity or the ability to expand the landfills faster than the rate at which material can be transported in.

Based on an Industry Committee poll, Table 1 lists the estimated volume of material hauled and the estimated number of trips to transport oil and gas well pit materials to the permitted landfill. As shown in Table 1, estimated hauled material from reserve pits ranges from 1.5 million yd^3 to 2.7 million yd^3 (Table 1).

Table 1. Estimated Transport Volumes

Region in State [a]	Well Depth (feet)	Volumes Disposed (yd^3)	
		Lowest Number of Trips	Highest Number of Trips
Northwest	0-4000	185,307	370,614
	4000-8000	203,144	406,288
	8000+	56,484	84,726
Subtotal		*444,935*	*861,628*
Southeast	0-4000	74,544	149,088
	4000-8000	299,692	599,384
	8000+	698,440	1,047,659
Subtotal		*1,072,676*	*1,796,132*
Northeast	0-4000	6,000	12,000
	4000-8000	0	0
	8000+	0	0
Subtotal		*6,000*	*12,000*
Total Volumes Hauled		1,523,611	2,669,760

[a] No oil well reserve pits are located in the southwestern part of New Mexico.

3. Air Pollutants Resulting from Increased Truck Traffic

The proposed pit closure requirement [19.15.2.50F.(3) NMAC] to transfer all contents from pits to NMOCD-permitted landfills would create additional truck traffic on New Mexico roads, resulting in release of air pollutants from haul road emissions and truck exhaust emissions. Truck traffic will occur on paved and dirt roads, with the percentage of dirt roads to be traveled varying geographically from 5 percent in northwestern New Mexico to 15 percent in southeastern New Mexico. To determine the amount of additional traffic, the Industry Committee poll results were used to calculate the minimum and maximum distances to be traveled annually in specific geographic regions in New Mexico to dispose of oil pit material at appropriate landfills. This analysis indicated that the proposed Rule 50 would result in additional truck traffic of 27 to 81 million miles annually (Table 2).

Table 2. Projected Travel Distance to Landfills

Region in State [a]	Depth of Well (feet)	Lowest Annual Miles Traveled/Shortest Distance		Highest Annual Miles Traveled /Longest Distance	
		All Roads	Dirt Road	All Roads	Dirt Road
Northwest	0-4000	4,632,675	231,634	11,912,593	595,630
	4000-8000	5,078,601	253,930	13,059,259	652,963
	8000+	1,412,099	70,605	2,723,333	136,167
Southeast	0-4000	174,380	26,157	1,046,278	156,942
	4000-8000	701,066	105,160	4,206,394	630,959
	8000+	1,633,850	245,077	7,352,323	1,102,848
Northeast	0-4000	64,286	6,429	282,857	28,286
	4000-8000	0	0	0	0
	8000+	0	0	0	0
Total one-way miles		13,696,955	938,992	40,583,038	3,303,794
Total annual miles		27,393,910	1,877,983	81,166,076	6,607,589

[a] No oil well reserve pits are located in the southwestern part of New Mexico.

Truck traffic tailpipe and tire-wear emissions were calculated for heavy trucks using EPA's MOBILE6.2 model (U.S. EPA, 2007a). The EPA vehicle fleet composition was used for various year models up to 2002. The air pollutant release rates resulting from this additional traffic were calculated using U.S. Environmental Protection Agency (EPA) approved air pollutant emission calculations from AP-42 (U.S. EPA, 2007b). These calculations were performed for empty and loaded truck traffic on roads outside the pit area and do not include pollutants released during pit closure. The air pollutants released from haul road traffic are total suspended particulates (TSP), particulate matter at and below 10 micrometers in aerodynamic diameter (PM_{10}), and particulate matter at and below 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$). For particulate emissions calculations, EPA's default emission rates and the New Mexico Environment Department (NMED) Air Quality Bureau's approved factors were incorporated into the model for dust and paved road emissions. Complete calculations are provided in Appendix A, and the results are summarized in Table 3.

Table 3. Summary of Projected Truck Traffic Air Pollutant Emissions

	Maximum Emissions (tons per year)			Minimum Emissions (tons per year)		
Pollutant	Dirt Road	Paved Road	Total	Dirt Road	Paved Road	Total
Project road dust emissions						
TSP	19,526	13,457	32,983	5,550	4,605	10,155
PM_{10}	4,976	1,957	6,934	1,414	894	2,308
$PM_{2.5}$	763	640	1,403	217	219	436
Total dust emissions			41,320			12,899
Projected tailpipe and tire-wear emissions						
CO	---	---	1,134	---	---	383
NO_x	---	---	1,965	---	---	663
VOC	---	---	74,592	---	---	25,175
PM_{10}	---	---	101	---	---	34
$PM_{2.5}$	---	---	21	---	---	7
Total non-GHG emissions			77,813			26,262
CO_2	---	---	149,386	---	---	50,418

--- = Not applicable GHG = Greenhouse gas

The pits in the northwest region of New Mexico are located in the San Juan Basin within the Four Corners Region, making the haul distances to the permitted landfills in the southeast region of the state quite long. The projected increase in pollutant emissions will be a detriment to the goals of the NMED's Four Corners Air Quality Task Force (FCAQTF) (NMED, 2006). The Oil and Gas Work Group for the FCAQTF has proposed mitigation options to reduce emissions from this industry sector. One of these proposed mitigation options is to reduce truck traffic (FCAQTF, 2006a, 2006b), and by instead increasing truck traffic, the NMOCD's proposed Rule 50 would jeopardize the proposed emission controls in the Four Corners region. According to Mark Jones, NMED coordinator for the FCAQTF, the Cumulative Impacts Work Group will review the mitigation options proposed by various work groups and will recommend quantitative mitigation options for air pollutants in 2007 (Mark Jones, telephone communication with Brinda Ramanathan, August 19, 2006).

Another major reduction being proposed in New Mexico is Governor Richardson's initiative to reduce greenhouse gas emissions (Executive Order 05-033, June 5, 2005), establishing the New Mexico Climate Change Action Council and the New Mexico Climate Change Advisory Group (CCAG). The Governor has charged the CCAG with presenting a report to the Climate Change Action Council by December 1, 2006 that will include proposals to reduce New Mexico's total greenhouse gas emissions to 2000 levels by the year 2012, 10 percent below 2000 levels by 2020, and 75 percent below 2000 levels by 2050 (New Mexico CCAG, 2006c).

The maximum and minimum quantities of air pollutant emissions that will be released annually as a result of pit closure rule changes, as summarized in Table 3, are contrary to the emissions reduction proposed for the Four Corners area and the New Mexico Governor's mandate to reduce greenhouse gas emissions. These emissions will occur annually and continue to do so every year as long as pits have to be excavated and material transferred to external landfills.

As shown in Table 4, the maximum TSP emissions that will be created from truck traffic as a result of the change in pit closure rules can very well exceed the NMED Air Quality Bureau-permitted TSP and VOC emissions. TSP emissions are visible and therefore elicit the most complaints from the public.

Table 4. Comparison of New Mexico Air Quality Bureau Permitted Emissions to Maximum Projected Truck Traffic Emissions

Pollutant	Permitted Emissions[a] (tons per year)	Maximum Projected Emissions (tons per year)
CO	92,825	1,134
NO_X	252,669	1,965
PM_{10}	22,249	7,035
$PM_{2.5}$	ND	1,424
TSP	26,052	32,983
VOC	36,988	74,592

[a] Based on 2006 MergeMaster data provided by NMED Air Quality Bureau (AQB) modeling section. The AQB has not determined the allowable PM2.5 emissions for all permits.
ND = Not determined

4. Effects on New Mexico Highway Pavements

To determine the effect of the increased truck hauling on the state's road surfaces, the quantity of drilling residue that would have to be removed from drilling sites and transported to an NMOCD-approved landfill was estimated on a per well basis for three different depths of drilling that bracket current practice on an annual basis (Table 5a). Both the dry and bulked or wet volumes were estimated, with the bulked volume based on the maximum water content allowed by regulation (40 percent). The actual material transported may be lower in water content, but it will not be higher; therefore, the actual situation may be worse (more trips may be required) than the estimates of pavement impact provided, but certainly not better.

Table 5a. Volume of Material to be Transported per Well

	Solids Volume (yd^3)		Transportation Volume [a] (yd^3)		Weight [b] (tons)	
Depth (feet)	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
0-4000	300	700	500	1,000	752	1,503
4000-8000	600	1,400	1,000	2,000	1,503	3,007
8000+	1,200	2,100	2,000	3,000	3,007	4,510

[a] Wet volume based on 40 percent water content
[b] Based on the estimated unit weight of 111.4 pounds per cubic foot

A truck hauling capacity of 14 cubic yards was assumed for transportation to a landfill site. Based on this hauling capacity, the minimum and maximum numbers of truck trips were calculated per well for the three depth ranges considered. Each of these trips is a round trip, one way loaded and one way unloaded. Table 5b shows the estimated total volume that would be transported over 1-, 10-, and 20-year periods.

Table 5b. Total Projected Volume of Material to be Transported

	Number of Truck Trips for Estimated Volume					
	1 year		10 years		20 years	
Depth (feet)	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
0-4,000	36	71	357	714	714	1,429
4,000-8,000	71	143	714	1,429	1,429	2,857
8,000+	143	214	1,429	2,143	2,857	0

To determine the impact of these increased loads on pavements, 18-kip equivalent single axle loads (ESALs), an expression of traffic loading used in structural design of pavements, were calculated (complete calculations are provided in Appendix B). The concept is that one ESAL represents the damage or consumption of pavement life associated with one 18,000-pound, or 18-kip (a kip is 1,000 pounds), single axle load. New Mexico limits gross vehicle weight to 86.4 kips, single axles to 21.6 kips, and tandem axles to 34.32 kips. In traffic analysis, all axle loads are converted to 18-kip ESALs.

Using the assumed truck capacity of 14 cubic yards, the unloaded axle loads were assumed to be 8 kips (front axle), 6 kips (middle dual tandem), and 6 kips (rear dual tandem). When loaded, the truck capacity of 14 cubic yards will translate to 42,094 pounds (42.1 kips with 21.05 kips added to each dual tandem). Thus, the axle loads on a loaded truck are 8 kips (front axle), 27 kips (middle dual tandem), and 27 kips (rear dual tandem). These axle loads do not exceed allowable loads.

Based on equivalent load factors published by the American Association of Highway and Transportation Officials (AASHTO), these loadings were converted to ESALs. The empty truck exerts 0.15 18-kip ESAL each time it passes over a point on the pavement. The loaded truck exerts 1.15 ESALs each time it passes over a point on the pavement (Table 6a). The total number of ESALs exerted across the road system as a result of the estimated total volume that must be hauled was calculated to be 387 ESALs per day minimum and 679 ESALs per day maximum (Table 6b). Table 6b also provides cumulative ESALs over 1-, 10-, and 20-year periods.

Table 6a. Calculated Round Trip 18-kip Equivalent Single Axle Loads

Axle	Empty		Loaded		Round Trip ESALs [a]
	kips	ESALs [a]	kips	ESALs [a]	
Front	8	0.05	8	0.05	0.10
Middle dual tandem	6	0.05	27	0.55	0.60
Rear dual tandem	6	0.05	27	0.55	0.60
Total	20	0.15	62	1.15	1.30

kips = 1,000 pounds ESALs = Equivalent single-axle loads
[a] Based on 14-yd^3-capacity truck

Table 6b. Calculated Total 18-kip Equivalent Single Axle Loads

Estimate	Total Haul Volume [a] (yd^3)	Total Number of Truck Round Trips	Total ESALs			
			Per Day	Per Year	10-Year Period	20-Year Period
Minimum	1,523,611	108,829.30	387	141,478	1,414,781	2,829,563
Maximum	2,669,760	190,697.10	679	247,906	2,479,063	4,958,125

[a] From Table 1

Table 7 is a compilation of data obtained from the New Mexico Department of Transportation (NMDOT) regarding the design of various classes of highways in New Mexico: Interstate Highways, U.S. Highways, and New Mexico State Highways. Average daily loads (ADLs), the number of daily 18-kip ESALs used for structural design of the pavement, were obtained from existing road designs. The pavement design on each road is uniquely developed for the specific traffic loading, environmental conditions, and soil support values. Because the volume and weight of vehicles on every road is uniquely determined by the local area, the maximum and minimum traffic values used in design vary widely among the highway classes (Table 7).

Table 7. Traffic Loading on New Mexico Roads

Estimate	Traffic Loading (ESALS per day)		
	Interstate Highways [a]	U.S. Highways [b]	New Mexico State Highways [c]
Average	4,264.5	409.7	159.8
Maximum	11,050.5	1,432.5	510
Minimum	388.5	19.5	12
Standard deviation	3,468.8	437.1	205.2

[a] I-10, I-25, I-40
[b] U.S. Highways 60, 180, 70, 380, 54, 285, 62, 64
[c] New Mexico Highways 26, 28, 52, 181, 47, 14, 518, 4, 53, 44

Using the minimum and maximum ESALs, the percentage of the ADL used for road designs was calculated (Appendix B). In the vicinity of the four known OCD-approved landfills, the traffic generated by Rule 50 will be concentrated on specific routes leading to those facilities, all of which are New Mexico State Highways. If it is assumed that 25 or 50 percent of the trucks will be on specific routes near the landfills, an estimate of the design life consumed may be obtained. On these New Mexico Highways, if 25 percent of the traffic is imposed, the minimum ESALs will consume 60.6 percent of design loading, and the maximum ESALs will consume 106.2 percent of the design loading. On this basis, the useful life of the road will be entirely consumed solely by these trucks, with no other traffic on the road. The conclusion is that the typical New Mexico state highways leading to the landfills will be overloaded, resulting in a substantial deterioration of the existing road network and pavement.

When pavement conditions reach an unacceptable level, rehabilitation of these pavements will be necessary. When that occurs will depend on the condition at the time the traffic is imposed and the period of time over which it occurs. The planning of pavement rehabilitation is a multi-year process. Dramatic increases in traffic loading over short time intervals will disrupt the normal condition evaluation and planning for these roads.

Experience shows that pavements deteriorate at an accelerating rate. That is, pavements in good condition will not be as severely impacted by increased traffic as pavements in poorer condition. Specific information on the original design traffic levels and present condition are necessary to develop more detailed estimates of rehabilitation costs. Nevertheless, on the basis of the incremental traffic loading, the pavements near the landfills will be dramatically affected.

5. Potential Increase in Traffic Accidents

The number of accidents likely to occur as a result of the increased truck traffic was estimated based on a database obtained from the National Center for Statistics and Analysis (NCSA), an arm of the National Highway Traffic Safety Administration (NHTSA, 2006). Data covered the period 1994 through 2004. The fatal accident incidence rate per 100 million vehicle miles traveled by trucks ranged from 2.73 in 1994 to 2.19 in 2004. The injury accident rate was in the range of 56 in 1994 to 41 in 2004. Experience has shown that as time passes the number of vehicle miles traveled increases while the accident rate decreases.

In units of 100 million miles, the additional hauling distance as a result of Rule 50 implementation ranges from a minimum of 0.27 to a maximum of 0.81. Using the 2004 rates, the estimated accidents per year and for intervals of 10 and 20 years were estimated for fatal accidents and injury accidents (Table 8).

Table 8. Number of Additional Accidents Anticipated as a Result of Increased Truck Traffic

Time Period	Accident Rate per 100 Million Miles in 2004[a]	Number of Additional Accidents	
		Minimum	Maximum
Number of truck miles	*100,000,000*	*27,400,000*	*81,200,000*
Fatal Accidents			
1 Year	2.16	0.001	0.013
10 Years	---	0.008	0.134
20 Year	---	0.015	0.268
Injury Accidents			
1 Year	41	0.015	0.254
10 Years	---	0.145	2.541
20 Year	---	0.290	5.082

[a] Accident rates based on National Center for Statistics and Analysis 2004 data for New Mexico (NHTSA, 2006)
--- = Not estimated

Additional analysis by Hall (2006), based on Federal Motor Carrier Safety Administration statistics (FMCSA, 2006) and using the same minimum and maximum levels of travel, resulted in predicted accident rates that surpass those shown in Table 8:

- 0.85 to 2.53 fatalities per year
- 13.9 to 41.1 injuries per year
- 35.1 to 103.9 property damage only (PDO) accidents

These calculations are provided in Appendix C.

6. Conclusions

If the proposed Rule 50 is implemented, the resulting transporting and disposal of oil and gas well drilling materials would have negative impacts on the environment, public safety and road conditions in New Mexico:

- Emission of air pollutants would increase, conflicting with the proposed emission controls in the Four Corners region put forth by the NMED FCAQTF.

- Traffic loading on New Mexico state highways would also increase significantly and could exceed the maximum design loading of these roads, requiring expensive upgrades to support the increased loads.

- Based on statistics from the Federal Motor Carrier Safety Administration, an additional 0.85 to 2.53 fatalities, 14 to 41 injuries, and 71 to 142 PDO crashes can be expected on an annual basis.

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Appendix A

Air Emissions Calculations

ANNUAL - PITS CUMMULATIVE IMPACTS BASELINE ASSUMPTIONS (e.g., 2007)
DIG/HAUL TO LANDFILL (USE bulked transport volume, CY)

CHANGE ONLY COLORED CELLS:

WELLS (estimated volumes / tons / truck trips):									
Depths (FT)		Solids Volume (CY)		Transport Volume (CY)		Transport Weight (TONS)		Number of Truck Trips by volume	
0-4000		300	700	500	1000	752	1503	36	71
4000-8000		600	1400	1000	2000	1503	3007	71	143
8000+		1200	2100	2000	3000	3007	4510	143	214

density (40% h2o): 111 lbs/cf
h2o = 62.4 truck volume: 14 cy
soil = 144

# WELLS (% by depth / area)			SE:					NW:					NE:
Depths (FT) (avg 2004/2005)			Chevron	Oxy	Yates	OCD db	% of total	Devon	Williams	BR	OCD db	% of total	Oxy
0-4000			2	12	0	295	19%	57	24	104	748	62%	12
4000-8000			17	15	21	593	38%	14	14	72	410	34%	0
8000+			7	30	70	691	44%	50	4	15	57	5%	0
		Totals:	26	57	91	1579		121	42	191	1215		12
Assume % wells (o,g,i,d) by area based on:				**1400**	yr		798					602	

VOLUMES DISPOSED:		Lowest number trips (cys):			Highest number trips (cys):		
NW	0-4000		185307			370614	
	4000-8000		203144			406288	
	8000+		56484			84726	
		subtotal:		444935			861628
SE	0-4000		74544			149088	
	4000-8000		299692			599384	
	8000+		698440			1047659	
				1072676			1796132
NE	0-4000		6000			12000	
	4000-8000		0			0	
	8000+		0			0	
TOTAL VOLUMES HAULED:			1,523,611			2,669,760	

Transport Distance (MILES one-way):	shortest	longest	% dirt
NW	350	450	5
SE	33	98	15
NE	150	330	10

Company - Haul	Oxy	Williams	Chevron	Yates	Hicks - NW	Hicks - SE
Shortest (miles)	30	35	8	60	NA	33
Longest (miles)	50	93	60	135	NA	148

ANNUAL MILES:		Lowest number trips/shortest distance:	Highest number trips/longest distance:
NW	0-4000	4632675	11912593
	4000-8000	5078601	13059259
	8000+	1412099	2723333
SE	0-4000	174380	1046278
	4000-8000	701066	4206394
	8000+	1633850	7352323
NE	0-4000	64286	282857
	4000-8000	0	0
	8000+	0	0
Total One-Way Miles:		13696955	40583038
TOTAL ANNUAL MILES:		27,393,910	81,166,076

CLOSED LOOP SYSTEM (USE solids transport volume, CY)

WELLS (estimated volumes / tons / truck trips):									
Depths (FT)		Solids Volume (CY)		Transport Volume (CY)		Transport Weight (TONS)		Number of Truck Trips by volume	
0-4000		300	700	500	1000	451	1052	21	50
4000-8000		600	1400	1000	2000	902	2105	43	100
8000+		1200	2100	2000	3000	1804	3157	86	150

density (40% h2o): 111 lbs/cf

h2o = 62.4 truck volume: 14 cy

soil = 144

# WELLS (% by depth / area)			SE:					NW:					NE:
Depths (FT) (avg 2004/2005)			Chevron	Oxy	Yates	OCD db	% of total	Devon	Williams	BR	OCD db	% of total	Oxy
0-4000			2	12	0	295	19%	57	24	104	748	62%	12
4000-8000			17	15	21	593	38%	14	14	72	410	34%	0
8000+			7	30	70	691	44%	50	4	15	57	5%	0
		Totals:	26	57	91	1579		121	42	191	1215		12
Assume % wells (o,g,i,d) by area based on:				**1400**	yr		798					602	

VOLUMES DISPOSED:		Lowest number trips (cys):			Highest number trips (cys):		
NW	0-4000		111184			259430	
	4000-8000		121886			284402	
	8000+		33890			59308	
		subtotal:		266961			603140
SE	0-4000		44726			104362	
	4000-8000		179815			419569	
	8000+		419064			733361	
				643605			1257292
NE	0-4000		6000			12000	
	4000-8000		0			0	
	8000+		0			0	
TOTAL VOLUMES HAULED:			916566			1872432	

Transport Distance (MILES one-way):				shortest	longest	% dirt
NW				350	450	5
SE				33	98	15
NE				150	330	10

Company - Haul	Oxy	Williams	Chevron	Yates	Hicks - NW	Hicks - SE
Shortest (miles)	30	35	8	60	NA	33
Longest (miles)	50	93	60	135	NA	148

ANNUAL MILES:		Lowest number trips/shortest distance:			Highest number trips/longest distance:		
NW	0-4000			2779605			8338815
	4000-8000			3047160			9141481
	8000+			847259			1906333
SE	0-4000			104628			732395
	4000-8000			420639			2944476
	8000+			980310			5146626
NE	0-4000			38571			198000
	4000-8000			0			0
	8000+			0			0
Total One-Way Miles:				8218173			28408127
TOTAL ANNUAL MILES:				16436346			56816253

Predicted distances to travel from pits to landfill

Area	Depth of well	Lowest number trips/shortest distance to landfill: All Roads	Lowest number trips/shortest distance to landfill: Dirt Road	Highest number trips/longest distance to landfill: All Roads	Highest number trips/longest distance to landfill: Dirt Road
NW	0-4000	4,632,675	231,634	11,912,593	595,630
	4000-8000	5,078,601	253,930	13,059,259	652,963
	8000+	1,412,099	70,605	2,723,333	136,167
SE	0-4000	174,380	26,157	1,046,278	156,942
	4000-8000	701,066	105,160	4,206,394	630,959
	8000+	1,633,850	245,077	7,352,323	1,102,848
NE	0-4000	64,286	6,429	282,857	28,286
	4000-8000	0	0	0	0
	8000+	0	0	0	0
Total One-Way Miles:		13,696,955	938,992	40,583,038	3,303,794
TOTAL ANNUAL MILES:		27,393,910	1,877,983	81,166,076	6,607,589

Unpaved Haul Road Traffic Emissions (AP42 13.2.2 - 2003)

$$E\left(\frac{lb}{vmt}\right) = k\left(\frac{s}{12}\right)^a\left(\frac{W}{3}\right)^b$$

Equation 1a

$$tons = E\left(\frac{lb}{VMT}\right) * \frac{ton}{2000\ lbs}.$$

Equation 1b

E = emission factor in lb/vmt

k = particle size multiplier (kTSP=4.9, kPM10=1.5, kPM2.5=0.23)
a = empirical constant (aTSP=0.7, aPM10=0.9, aPM2.5=0.9)
b = empirical constant (bTSP=bPM10=0.45, bPM2.5=0.45)
s = surface silt content (%) (NMED default value = 4.8%)

Capacity of trucks	14	cubic yard
Density	111	lb/cubic foot
Total weight of products	21	tons
W = Empty vehicle weight (tons)	10	tons
W = loaded vehicle weight (tons)	31	tons

variable change only colored cells

Predicted distances to travel from pits to landfill

Dust Emissions Release from Maximum Distance Traveled

Road Segment (truck type)	Truck Weight (W)	E TSP	E PM10	E PM2.5	Maximum one way trip
ID	tons	lb/VMT	lb/VMT	lb/VMT	miles
NW (empty)	10	4.44	1.13	0.17	1,384,759
NW (loaded)	31	7.38	1.88	0.29	1,384,759
SE (empty)	10	4.44	1.13	0.17	1,890,749
SE (loaded)	31	7.38	1.88	0.29	1,890,749
NE (empty)	10	4.44	1.13	0.17	28,286
NE (loaded)	31	7.38	1.88	0.29	28,286

Road Segment (truck type)	Uncontrolled TSP		Uncontrolled PM_{10}		Uncontrolled $PM_{2.5}$	
	lb	tons	lb	tons	lb	tons
NW (empty)	6,141,971	3,071	1,565,363	783	240,022	120
NW (loaded)	10,226,261	5,113	2,606,298	1,303	399,632	200
SE (empty)	8,386,244	4,193	2,137,345	1,069	327,726	164
SE (loaded)	13,962,930	6,981	3,558,637	1,779	545,658	273
NE (empty)	125,459	63	31,975	16	4,903	2
NE (loaded)	208,886	104	53,237	27	8,163	4
Total	**39,051,751**	**19,526**	**9,952,855**	**4,976**	**1,526,104**	**763**

Dust Emissions Release from Shortest Distance Traveled to Landfill

Road Segment (truck type)	Truck Weight (W)	E TSP	E PM10	E PM2.5	Maximum one way trip
ID	tons	lb/VMT	lb/VMT	lb/VMT	miles
NW (empty)	10	4.44	1.13	0.17	556,169
NW (loaded)	31	7.38	1.88	0.29	556,169
SE (empty)	10	4.44	1.13	0.17	376,394
SE (loaded)	31	7.38	1.88	0.29	376,394
NE (empty)	10	4.44	1.13	0.17	6,429
NE (loaded)	31	7.38	1.88	0.29	6,429

Road Segment truck type)	Uncontrolled TSP		Uncontrolled PM_{10}		Uncontrolled $PM_{2.5}$	
	lb	tons	lb	tons	lb	tons
NW (empty)	2,466,835	1,233	628,705	314	96,402	48
NW (loaded)	4,107,231	2,054	1,046,782	523	160,507	80
SE (empty)	1,669,462	835	425,484	213	65,241	33
SE (loaded)	2,779,621	1,390	708,423	354	108,625	54
NE (empty)	28,513	14	7,267	4	1,114	1
NE (loaded)	47,474	24	12,099	6	1,855	1
Total	**11,099,136**	**5,550**	**2,828,762**	**1,414**	**433,743**	**217**

Predicted distances to travel from pits to landfill

Area	Depth of well	Lowest number trips/shortest distance to landfill: All Roads	Lowest number trips/shortest distance to landfill: Paved Road	Highest number trips/longest distance to landfill: All Roads	Highest number trips/longest distance to landfill: Paved Road
NW	0-4000	4,632,675	4,401,041	11,912,593	11,316,963
	4000-8000	5,078,601	4,824,671	13,059,259	12,406,296
	8000+	1,412,099	1,341,494	2,723,333	2,587,167
SE	0-4000	174,380	148,223	1,046,278	889,337
	4000-8000	701,066	595,906	4,206,394	3,575,435
	8000+	1,633,850	1,388,772	7,352,323	6,249,475
NE	0-4000	64,286	57,857	282,857	254,571
	4000-8000	0	0	0	0
	8000+	0	0	0	0
Total One-Way Miles:		13,696,955	12,757,964	40,583,038	37,279,244
TOTAL ROUND TRIP MILES:		27,393,910	25,515,927	81,166,076	74,558,488

Calculation of Truck Emissions: Basis: AP42 Section 13.2.1 Paved Roads, Revision 12/2003

Emission in pounds/Vehicle Miles Traveled E (lb/VMT) = $[k(sL/2)^{0.65}(W/3)^{1.5} - C]$

Item Description	Value	Units	Basis
k particle size multiplier for TSP	0.082	dimensionless	AP42, Table 13.2-1.1
k particle size multiplier for PM_{10}	0.016	dimensionless	AP42, Table 13.2-1.1
k particle size multiplier for $PM_{2.5}$	0.004	dimensionless	AP42, Table 13.2-1.1
sL road surface silt loading	0.2	g/m^2	AP-42 Table 13.2.1-3, 500-5,000 ADT)
C Emission Factor for exhaust, brake and tire wear	0.00047	lb/VMT	AP42, Table 13.2-1.2
W Empty mean vehicle weight (tons)	10	tons	Projected
W loaded mean vehicle weight (tons)	31	tons	Projected

Note: C is included in mobile source exhaust emissions

Vehicle Type	Emission Factor (lb/VMT)		
Truck	TSP	PM_{10}	$PM_{2.5}$
Empty	**0.111**	**0.021**	**0.005**
Loaded	**0.611**	**0.119**	**0.029**

Paved Road Emissions for Maximum Distance Traveled

Road Segment (truck type)	Uncontrolled TSP lb	Uncontrolled TSP tons	Uncontrolled PM_{10} lb	Uncontrolled PM_{10} tons	Uncontrolled $PM_{2.5}$ lb	Uncontrolled $PM_{2.5}$ tons
NW (empty)	2,927,042	1,464	561,177	281	131,020	66
NW (loaded)	16,067,786	8,034	3,125,225	1,563	772,032	386
SE (empty)	1,191,963	596	228,525	114	53,354	27
SE (loaded)	6,543,194	3,272	1,272,668	1,957	314,390	157
NE (empty)	28,321	14	5,430	3	1,268	1
NE (loaded)	155,467	78	30,239	15	7,470	4
Total	**26,913,773**	**13,457**	**5,223,263**	**1,957**	**1,279,534**	**640**

Paved Road Emissions for Shortest Distance Traveled

Road Segment (truck type)	Uncontrolled TSP lb	Uncontrolled TSP ton	Uncontrolled PM_{10} lb	Uncontrolled PM_{10} ton	Uncontrolled $PM_{2.5}$ lb	Uncontrolled $PM_{2.5}$ tons
NW (empty)	1,175,604	588	225,389	113	52,622	26
NW (loaded)	6,453,396	3,227	1,255,202	628	310,075	155
SE (empty)	237,286	119	45,493	23	10,621	5
SE (loaded)	1,302,563	651	253,352	127	62,586	31
NE (empty)	6,437	3	1,234	1	288	0
NE (loaded)	35,333	18	6,872	3	1,698	1
Total	**9,210,620**	**4,605**	**1,787,542**	**894**	**437,891**	**219**

Area	Depth of well	Lowest number trips/shortest distance to landfill:	Highest number trips/longest distance to landfill:
		All Roads	All Roads
NW	0-4000	4,632,675	11,912,593
	4000-8000	5,078,601	13,059,259
	8000+	1,412,099	2,723,333
SE	0-4000	174,380	1,046,278
	4000-8000	701,066	4,206,394
	8000+	1,633,850	7,352,323
NE	0-4000	64,286	282,857
	4000-8000	0	0
	8000+	0	0
Total One-Way Miles:		13,696,955	40,583,038
TOTAL ANNUAL MILES:		27,393,910	81,166,076

Emission Rates Basis: Mobile Model Version 6.2 from www.epa.gov/oms/mobile.htm

Pollutant	**Mobile Model Emission Factor for 2002 [a] (lb/mile)**
CO	0.0279
NOx	0.0484
VOC	1.8380
PM_{10}	0.0025
$PM_{2.5}$	0.0005
CO2	3.6810

Note: [a] *Only heavy trucks classified as HDDV8B were modeled.*
Reference: User's Guide to Mobile 6.1 and Mobile6.2, August 2003, EPA420-R-03-10, page 244, Table 3

Projected Mobile Source Emissions for Lowest Distance Traveled

Area	**Depth of well**	**Projected Minimum Emissions (tons)**					
		CO	NOx	VOC	PM_{10}	$PM_{2.5}$	CO_2
NW	0-4000	64.72	112.13	4,257.43	5.78	1.23	8,526.43
	4000-8000	70.95	122.92	4,667.23	6.34	1.34	9,347.16
	8000+	19.73	34.18	1,297.72	1.76	0.37	2,598.97
SE	0-4000	2.44	4.22	160.25	0.22	0.05	320.95
	4000-8000	9.79	16.97	644.28	0.88	0.19	1,290.31
	8000+	22.83	39.55	1,501.51	2.04	0.43	3,007.10
NE	0-4000	0.90	1.56	59.08	0.08	0.02	118.32
	4000-8000	0.00	0.00	0.00	0.00	0.00	0.00
	8000+	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions One Way		191.35	331.52	12,587.50	17.10	3.62	25,209.22
Total Predicted Annual Emissions		382.71	663.05	25,175.00	34.21	7.25	50,418.44

Projected Mobile Source Emissions for Maximum Distance Traveled

Area	**Depth of well**	**Projected Maximum Emissions (tons)**					
		CO	NOx	VOC	PM_{10}	$PM_{2.5}$	CO_2
NW	0-4000	166.42	288.33	10,947.67	14.87	3.15	21,925.11
	4000-8000	182.44	316.09	12,001.46	16.31	3.46	24,035.54
	8000+	38.05	65.92	2,502.74	3.40	0.72	5,012.29
SE	0-4000	14.62	25.32	961.53	1.31	0.28	1,925.67
	4000-8000	58.77	101.81	3,865.68	5.25	1.11	7,741.86
	8000+	102.72	177.96	6,756.78	9.18	1.95	13,531.94
NE	0-4000	3.95	6.85	259.95	0.35	0.07	520.60
	4000-8000	0.00	0.00	0.00	0.00	0.00	0.00
	8000+	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions One Way		566.96	982.28	37,295.81	50.68	10.74	74,693.01
Total Predicted Annual Emissions		1,133.93	1,964.56	74,591.62	101.35	21.48	149,386.02

Appendix B

Road Impact Calculations

Table 1

Volume of Material to be transported PER WELL

(estimated volumes & truck trips/per well):							Year 1	Year 1	10 years	10 years	20 years	20 years
							No. Truck Trips for		**No. Truck Trips for**		**No. Truck Trips for**	
Depth (ft)	Solids Volume (CY)		Transp.Volume (CY)		Weight (TONS)		**estimated volume**		**10 years**	**10 years**	**20 years**	**20 years**
	(min)	(max)	(min)	(max)	(min)	(max)	**(min)**	**(max)**	**(min)**	**(max)**	**(min)**	**(max)**
0-4000	300	700	500	1000	752	1503	**36**	**71**	**357**	**714**	**714**	**1429**
4000-8000	600	1400	1000	2000	1503	3007	**71**	**143**	**714**	**1429**	**1429**	**2857**
8000+	1200	2100	2000	3000	3007	4510	**143**	**214**	**1429**	**2143**	**2857**	**0**

DENSITY (40% H2O) =	111.4 lbs./cu.ft.	Truck	
percent water =	40%		
Unti weight H2O =	62.4 lbs./cu.ft.	Volume	14 CY
Unit weight SOIL =	144.0 lbs./cu.ft.		

Table 2

18-kip Equivalent Singe Axle Loads (ESALs)

	Axle Loads (Unloaded, kiips)*			**Axle Loads (Loaded, kips)***			
	front (S)	mid (DT)	rear (DT)	front (S)	mid (DT)	rear (DT)	
	8	6	6	8	27	27	
	8	6	6	8	27	27	
	8	6	6	8	27	27	
	Total Wt. =	20000 lbs.		Total Wt.=	62094 lbs.		
				Pay Load=	42094 lbs.		

Axle	**Empty** (kips)	ESALs	**Loaded** (kips)	ESALs	Rd Trip ESALs	
front	8	0.05	8	0.05	0.10	
mid DT	6	0.05	27	0.55	0.60	
rear DT	6	0.05	27	0.55	0.60	
Total	20.0	0.15	62.1	1.15	**1.30**	**ESALs per truck pass**

*assuimes 14 cubic yard capacity truck, 1 kip = 1000 pounds

	(min)		(max)		ESAL/yr (min)	ESAL/10 (min)	ESAL/20 (min)	ESAL/yr (max)	ESAL/10 (max)	ESAL/20 (max)
Total Haul	1523611	cubic yards	2669760	cubic yds						
Total Truck Trips	108829.3	truck trips	190697.1	truck trips						
	141478	ESALs/year	247906	ESALs/yr						
Total ESALs	**387**	ESALs/day	**679**	ESALs/day	141478	1414781	2829563	247906.3	2479063	4958125

Table 3A

Traffic Loading on NM Roads

Roads	**Interstate**	**US Roads**	**NM Roads**
Classes	10, 25, 40	60, 180, 70, 380 54, 285, 62, 64	26, 28, 52, 181, 47, 14, 518, 4, 53, 44

Traffic Data on Typical NM Roads

	Interstate	*US Roads*	*NM Roads*
Average	**4265**	**410**	**160**
Max	11051	1433	510
Min	389	20	12
Stdev	3468.8	437.1	205.2
Count	12	19	8

ADL or ESALs/day

% on Roac	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	
25%	2.3%	4.0%	23.6%	41.4%	**60.6%**	**106.2%**	percent of average road life consumed
50%	4.5%	8.0%	47.3%	82.8%	**121.2%**	**212.4%**	percent of average road life consumed

Design Traffic Loading NM Roads

	ESAL/yr	ESAL/10	ESAL/20
Average	58349	583487	1166974
Max	186278	1862775	3725550

Table 4

Accidents: Fatality and Injury Accidents

	Minimum Truck Miles	Maximum Trucj Miles
Fatalitites**	27.4 million mi.	81.2 million mi.
per 100 M miles	Fatal Accidents	Fatal Accidents
2.16	0.001 per year	0.013 per year
	0.008 10 years	0.134 10 years
	0.015 20 years	0.268 20 years
Injuries**		
per 100 M miles	Injury Accidents	Injury Accidents
41	0.015 per year	0.254 per year
	0.145 10 years	2.541 10 years
	0.290 20 years	5.082 20 years

**Accident rates based on NM data 2004, National Center for Statistics and Analysis
Rates are reported as fatalities and injuries per 100 million vehicle miles traveled (VMT)
Over time the miles travled increases and the rate of accidents per 100 million VMT decreases

Appendix C

Accident Rate Calculations

J.W. Hall P.E.

August 30, 2006

Gordon McKeen
McKeenengineers.com

Re: Truck Accident Rates

At your request, I have conducted an analysis of tractor-semitrailer fatality, injury, and property damage only (PDO) rates. My primary source of data was the 2004 combination truck crash statistics from Tables 13, 15, and 16 in the following report prepared by the Federal Motor Carrier Safety Administration. I used the PowerPoint presentation by Aiken to get a general sense of the relative accident rates on urban and rural highways. The truck profile from the Bureau of Transportation Statistics provides information on the rural and urban vehicle miles of travel for large trucks.

References

Large Truck Crash Facts 2004, Federal Motor Carrier Safety Administration, USDOT, FMCSA-RI-06-040, http://ai.volpe.dot.gov/CarrierResearchResults/PDFs/LargeTruckCrashFacts2004.pdf

Aiken, C., *Fatality Rate Improvements and the Lives they Save*, Traffic Records Forum, July 2004, http://www.atsip.org/oldsite/forum2004/Sessions/Monday_1_12/S04/s4_aiken_Nashville.ppt

Truck Profile, Bureau of Transportation Statistics, USDOT, http://www.bts.gov/publications/national_transportation_statistics/html/table_truck_profile.html

Analysis

The FMCSA report contains data on large truck crashes, where a large truck is classified as weighing in excess of 10,000 pounds. In 2004, these vehicles were involved in 4,862 fatal accidents, 60,734 injury accidents, and 73,678 PDO accidents. Tractor/semitrailers were involved in 63% of the fatal crashes, 46% of the injury crashes, and 48% of the property damage only crashes. These vehicles account for approximately 64% of all the travel by large trucks.

Your case assumes that the annual travel will be between 27.4 and 81.2 million vehicle miles (mvm), with 80% of the travel on rural highways and 20% on urban highways.

Table 13 from the FMCSA shows that there were 3,924 fatalities (in 3,310 fatal crashes) involving tractor/semitrailers in 2004. Their total travel was 1,453.98 100mvm (100 million vehicle miles is the common denominator used to express fatality, injury, and crash rates), yielding a fatality rate of 2.70 fatalities per 100mvm. The data presented by Aiken in slide 14 indicates that fatality rates for all vehicles on rural highways are about twice as high as those on urban facilities. Data in the Performance section of the BTS truck profile for 2004 indicate that 56% of large truck vehicle miles of travel occur in rural areas while 44% occur in rural areas. Using these numbers, it is possible to calculate the tractor/semitrailer fatality rates in urban (u) and rural (r) areas.

$1453.98\,(0.56 \times 2 \times u + 0.44 \times u) = 1453.98 \times 2.70$ fatalities per 100mvm [1]
$u_f = 1.73$ fatalities per 100mvm
$r_f = 2 \times u = 3.46$ fatalities per 100mvm

The number of fatalities can be estimated for the minimum and maximum levels of travel.

Minimum fatalities = 0.274 100mvm $(0.8 \times 3.46 + 0.2 \times 1.73) = 0.85$ fatalities per year [2]
Maximum fatalities = 0.812 100mvm $(0.8 \times 3.46 + 0.2 \times 1.73) = 2.53$ fatalities per year [3]

Table 15 of the FMCSA's report indicates that the injury accident rate for tractors/semitrailers in 2004 was 43.9 injuries per 100mvm. Replacing the fatality rate in [1] with this injury rate, the expected urban and rural injury rates are:

$u_i = 28.1$ injuries per 100mvm
$r_i = 56.3$ injuries per 100mvm

Replacing the fatality rates in [2] and [3] with these injury rates, the minimum and maximum estimated injuries are 13.9 and 41.1 injuries per year, respectively.

Because of different thresholds among the states for reporting PDO crashes, the number of these crashes involving tractors/semitrailers is, at best, approximate. Table 16 of the FMCSA's report for 2004 indicates that these vehicles have a PDO rate of 110.9 crashes per 100mvm. Replacing the fatality rate in [1] with this crash rate, and assuming that the PDO rates are twice has high on rural highways, the approximate urban and rural PDO rates are:

$u_{PDO} = 71.1$ crashes per 100 mvm
$r_{PDO} = 142.2$ crashes per 100 mvm

Replacing the fatality rates in [2] and [3] with these crash rates, the minimum and maximum expected crashes are 35.1 and 103.9 crashes per year, respectively.

Limitations

The data from Aiken show that the fatality rates were twice has high on rural highways as on urban highways. This analysis assumed that this same ratio applied to injury and PDO crashes. This assumption is probably valid for injury accidents, but may overstate the situation for PDO crashes, which tend to occur at lower speeds on urban facilities. The analysis also assumed that the travel data split between rural and urban highways for all large trucks (>10,000 pounds) was the same as for tractor/semitrailers. In actuality, the percentage of tractor/semitrailer travel occurring in rural areas is probably higher than the assumed 56%. If the proper split was 70% rural and 30% urban, for example, the actual number of annual fatalities, injuries, and PDO crashes would be 92% of the values calculated above.

Please don't hesitate to contact me if you have any questions.

Sincerely,

Jerome W. Hall, PhD, PE