

EVALUATION OF THE IMPACTS OF REDUCING TRUCK SPEEDS ON INTERSTATE HIGHWAYS IN IDAHO – PHASE III

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EXECUTIVE SUMMARY

The 1998 Idaho Legislature passed legislation that lowered the speed limit for a certain class of trucks operating on interstate highways. The speed limit change results in a differential of ten miles per hour between passenger cars and trucks with five or more axles weighing more than 26,000 pounds. Since uniformity in traffic speeds is an important factor in highway safety, speed differentials may reduce the safety of the highway.

This study examines speed measurements taken at seventeen locations on interstate highways in Idaho, as well as crash statistics along these same highways, taken both before and after the change in truck speed limits. These measurements provide the information needed to make an assessment regarding the effect of the speed limit change.

Following is a summary of the key findings of this study:

- Passenger car speeds increased: mean speeds increased by 0.85 mph and 85th percentile speeds increased by 0.8 mph. Though this change is statistically significant, one cannot come to a definite conclusion regarding this, as the difference between the speeds is less than 1 mph.
- Truck speeds declined slightly: mean speeds dropped by 1.0 mph, while 85th percentile speeds declined by 2.5 mph. While these changes are small, they are statistically significant and indicate that the travel speed of the faster trucks has decreased.
- Speed differentials between trucks and passenger cars increased from 5.5 mph to 7.4 mph. Again, while this change is small, it is statistically significant.
- The proportion of trucks violating the speed limit increased significantly from about 10 to 20 percent before the speed limit change to between 60 and 75 percent after the change.
- The standard deviation of vehicle speeds including all vehicles did not increase, indicating that the overall uniformity in vehicle speeds remained unchanged.
- Crash data did not increase as a result of the speed limit change.

While the potential for a decrease in safety exists because of the speed limit differential, data collected show that a significant change in the safety level has not occurred. The passenger

car-truck speed differential increased slightly. But the standard deviation in vehicle speeds has not increased. And, while the crash data is limited, there is no evidence of an increase in crashes involving trucks.

The Idaho Transportation Department should continue to monitor the effects of the speed limit change, using both speed measurements and crash data.

BACKGROUND

House Bill 623, passed by the 1998 Idaho Legislature, made several significant changes in the law governing the operation of trucks on Idaho highways. The legislation contained, among other things, amendments to Idaho Code 49-654 to allow the Idaho Transportation Board to set a maximum speed limit of 65 miles per hour for trucks with five or more axles weighing more than 26,000 pounds for travel on interstate highways. The revised speed limit means that these trucks are restricted to speeds of ten miles per hour less than those of passenger cars.

It is generally believed that uniform vehicle speeds result in safer highways, while a higher deviation in vehicle speeds, particularly between different vehicle types, lowers the relative safety of the highway. If the change in the law increases the dispersion of vehicle speeds, especially increasing the differential between passenger cars and trucks, the relative safety of Idaho's interstate system may decrease.

The purpose of this report is to provide information to the following questions relative to the safety of interstate highways in Idaho:

- What are the speed characteristics of passenger cars and trucks on Idaho's interstate highways before and after July 1, 1998?
- Has there been a change in traffic safety on Idaho's interstate highways as a result of the change in the truck speed limit?

METHODOLOGY

The Idaho Transportation Department (ITD) regularly collects vehicle speed and crash data. ITD's Planning Division has a number of permanent traffic count stations located throughout the state at which speed, vehicle classification, and volume data are gathered continuously. ITD's Office of Traffic Safety records crash statistics and compile them periodically to assess the relative safety of different segments of the state's transportation system.

Speed data were assembled at 17 permanent count stations on Idaho's four interstate highways. These sites are listed in Table 1. Monthly mean speed, 85th percentile speed, and pace data were gathered for the following time periods:

- August 1997
- November 1997
- February 1998
- May 1998
- August 1998
- November 1998
- February 1999
- May 1999
- August 1999
- November 1999
- February 2000
- May 2000
- August 2000

A time series analysis of the changes in passenger car and truck speed was conducted to provide the basis for assessing any speed changes resulting from the change in the law. The data were also grouped into before and after categories to enable a study of the effect of the speed limit changes.

Table 1. Permanent count stations

Site			Data Collection Period	
Interstate	Milepost	ATR	Date	End Date
I-15	1.965	22	5/1/1998	8/1/2000
I-15	61.870	4	5/1/1998	8/1/2000
I-15	96.060	64	11/1/1998	8/1/2000
I-15	132.780	61	5/1/1998	8/1/2000
I-15	176.000	73	5/1/1998	8/1/2000
I-15	27.700	79	8/1/1999	8/1/2000
I-84	14.900	123	8/1/1997	8/1/2000
I-84	15.100	128	8/1/1999	8/1/2000
I-84	19.100	25	5/1/1998	8/1/2000
I-84	58.357	2	5/1/1998	8/1/2000
I-84	62.068	87	5/1/1998	8/1/2000
I-84	114.500	71	5/1/1998	8/1/2000
I-84	159.230	7	5/1/1998	8/1/2000
I-84	227.580	89	8/1/1997	8/1/2000
I-84	231.000	30	8/1/1997	8/1/2000
I-84	257.300	101	2/1/1999	8/1/2000
I-86	14.410	18	5/1/1998	8/1/2000
I-86	25.050	93	8/1/1999	8/1/2000
I-86	56.400	67	8/1/1998	8/1/2000
I-90	35.590	8	5/1/1998	8/1/2000

Figure 1 shows an example of the time plot of the passenger car and truck data measured between August 1997 and August 2000 for ATR site 30, on interstate 84 at milepost 231.0. Four measurements are shown before the speed limit change, and nine measurements after the speed limit change. The plot shows that passenger car speeds increased from 75 mph to 77 mph, while the truck speed remained the same.

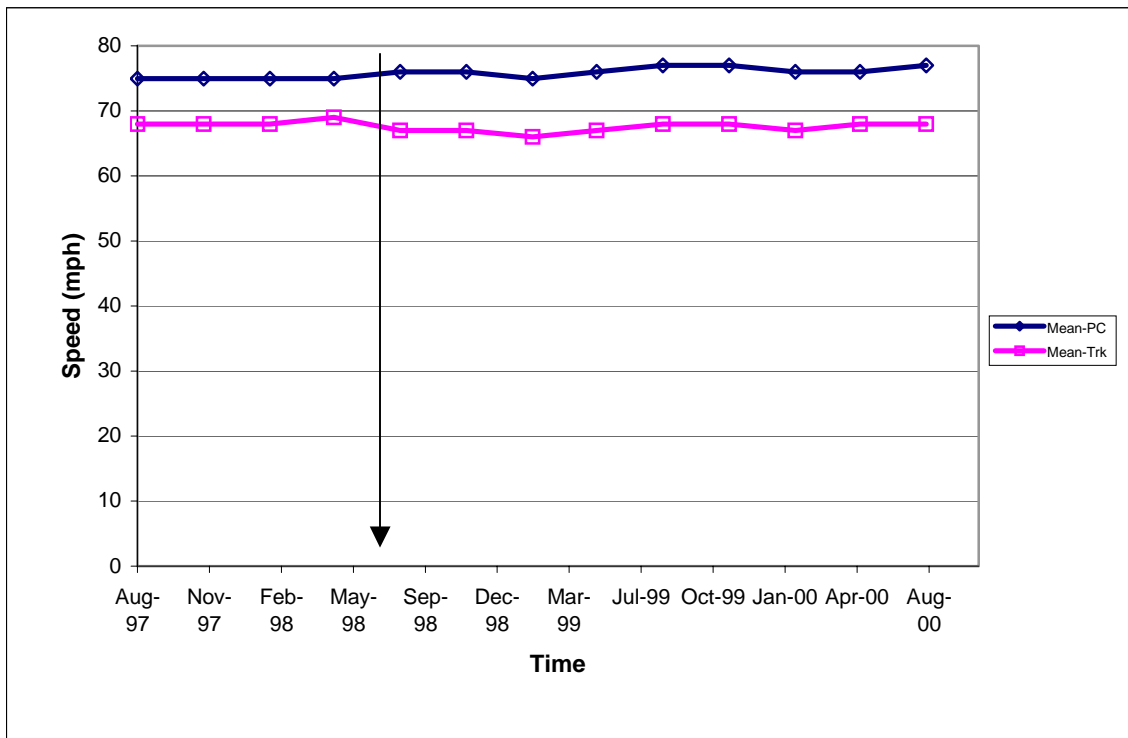


Figure 1. Mean speeds from August 1997 to August 2000, ATR 30

Figure 2 shows the time plot of the passenger car and truck data measured between May 1998 and August 2000 for ATR site 22, on interstate 15 at milepost 1.965. Only one measurement is shown before the speed limit change, and nine measurements after the speed limit change. The plot shows that passenger car speeds increased from 77 mph to 78 mph, while the truck speed declined from 72mph to 71 mph.

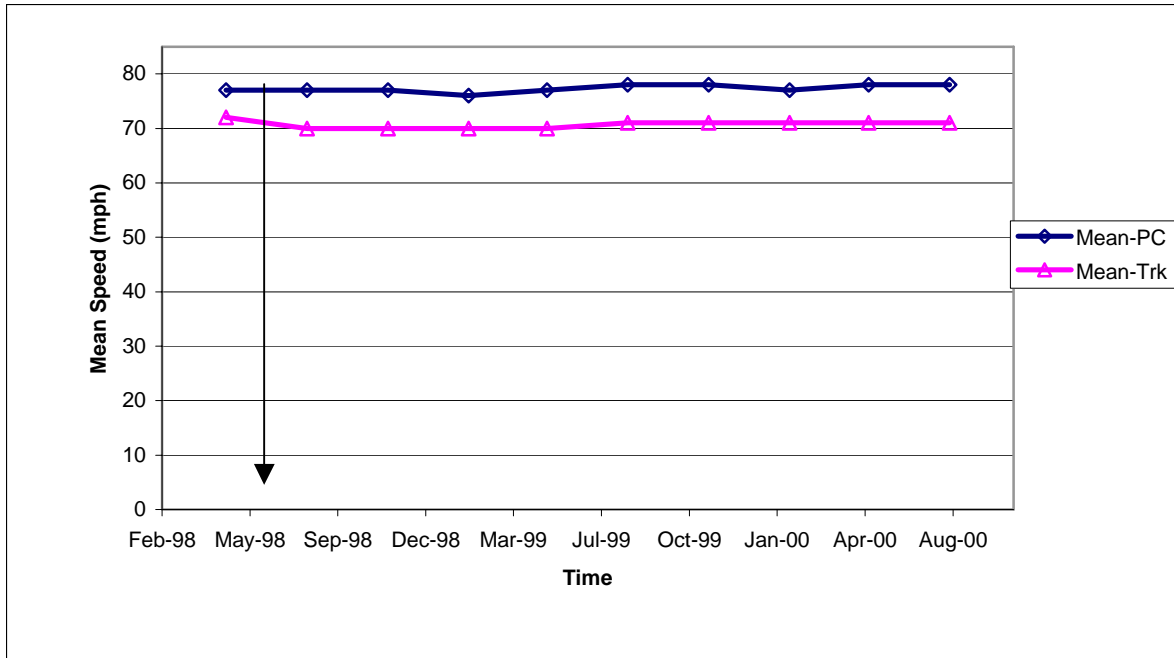


Figure 2. Mean speeds from May 1998 to August 2000, ATR 22

The above two plots (Figure 1 and Figure 2) show that the variation of truck speed varies from site to site. Overall, the variation of the truck speed is less at all the sites. To know about the consequences of these changes statistical analysis has to be done.

Crash data were assembled for each of Idaho’s four interstate highways. The data were gathered for four years, two years before the speed limit change and two years after the speed limit change. A comparison in the number of crashes was made for these two periods. Conclusions are only preliminary because of the limited amount of data.

Table 2 lists the locations for which the crash data were collected.

Table 2. Crash data locations

Interstate Highway	Site designation	Milepost range
I-15	I-15a	0 - 66.78
	I-15b	73.1 - 196.0
I-84	I-84a	0 - 25.5
	I-84b	25.501 - 48.660
	I-84c	55.0 - 275.65
I-86	I-86	0 - 61.268
I-90	I-90	33.38 - 59.0

RESEARCH QUESTIONS AND FINDINGS

The two basic questions that must be answered here are:

- What are the speed characteristics of passenger cars and trucks on Idaho’s interstate highways before and after July 1, 1998?
- Has there been a change in traffic safety on Idaho’s interstate highways as a result of the change in the truck speed limit?

This section of the report provides answers to each question supported by seven findings.

What are the speed characteristics of passenger cars and trucks on Idaho’s interstate highways before and after July 1, 1998?

Finding # 1: The speed of passenger cars on Idaho’s interstate highways increased slightly since the speed limit was reduced on July 1, 1998.

Table 3 lists the mean speed, the 85th percentile speed, and lower bound of the pace for all sites, and for each interstate separately, for measurements taken both before and after July 1, 1998.

Table 3. Passenger car mean speeds, before and after speed limit change (mph)

Summary	All		I-15		I-84		I-86		I-90	
	Before	After	Before	After	Before	After	Before	After	Before	After
Mean Speed	73.5	74.3	73.0	74.8	73.7	74.4	73.5	74.5	71.0	70.7
85th percentile Speed	79.6	80.3	79.5	80.9	79.8	80.4	79.0	80.2	78.0	77.3
Pace Lower Bound	70.5	71.5	68.8	71.7	71.1	71.8	71.0	71.7	67.0	67.6

Notes:

- *Before* data include all speed measurements taken before July 1998.
- *After* data include all speed measurements taken after July 1998.

After the speed limit change, the mean speed changes ranged from a 1.8 mph increase to 0.3 mph decrease. The mean passenger car speed averaged over all the sites changed from 73.5 mph before the speed limit change to 74.3 mph after speed limit change, essentially no overall change.

Similar changes were found for the 85th percentile speed and pace for passenger cars, where there was a small overall increase.

Finding #2: The speed of trucks on Idaho’s interstate highways decreased slightly since the speed limit was reduced on July 1, 1998.

Table 4 lists the mean speed, the 85th percentile speed, and lower bound of the pace for all sites, and for each interstate separately, for measurement taken both before and after July 1, 1998.

Before July 1998, the mean speed of trucks ranged from 67 mph to 70.5 mph on the interstate highways. After July, the speed decreased an average from 1 mph, with a decrease ranging from 0.5 mph on I-15 to 2.3 mph on I-86.

The 85th percentile truck speed decreased an average of 2.3mph, while the lower bound of the pace decreased 0.2 mph, suggesting that the decreased truck speed limit has resulted in a tighter distribution of truck speeds.

Table 4. Truck mean speed before and after speed limit change (mph)

	All		I-15		I-84		I-86		I-90	
Summary	Before	After	Before	After	Before	After	Before	After	Before	After
Mean Speed	67.9	66.9	68.5	68.0	67.5	66.1	70.5	68.2	67.0	65.7
85th percentile Speed	74.6	72.1	74.8	73.0	74.5	71.5	76.0	72.6	74.0	71.8
Pace Lower Bound	63.7	63.5	63.3	64.0	63.6	63.2	66.5	64.0	62.0	61.7

Notes:

- *Before* data include all speed measurements taken before July 1998.
- *After* data include all speed measurements taken after July 1998.

Table 5. Average speed changes in mph before and after speed limit change

Speed Differential	All Sites	I-15	I-84	I-86	I-90
Average of Mean-PC	0.8	1.8	0.7	1.0	-0.3
Average of Mean-Truck	-1.0	-0.5	-1.4	-2.3	-1.3
Average of 85th-PC	0.7	1.4	0.6	1.2	-0.7
Average of 85th-Trk	-2.5	-1.7	-3.0	-3.4	-2.2
Average of Minimum Pace-PC	1.0	3.0	0.7	0.7	0.6
Average of Minimum Pace-Truck	-0.3	0.7	-0.4	-2.5	-0.3

Finding #3: The decline in truck speeds was statistically significant.

Table 5 shows the before and after speed changes for both passenger cars and trucks for each interstate. Mean speed, 85th percentile speed, and the lower bound of the pace are shown in the table. While the truck speed changes appear to be greater than the passenger car changes, statistical tests are required to confirm this observation.

Figure 3 shows a plot of the before and after measurements including all sites for the mean speeds, 85th percentile speed data, and lower bound of pace for passenger cars and trucks. Figure 3 supports the notion that, although there were changes in the speed these changes are quite small relative to the overall magnitude of the speeds.

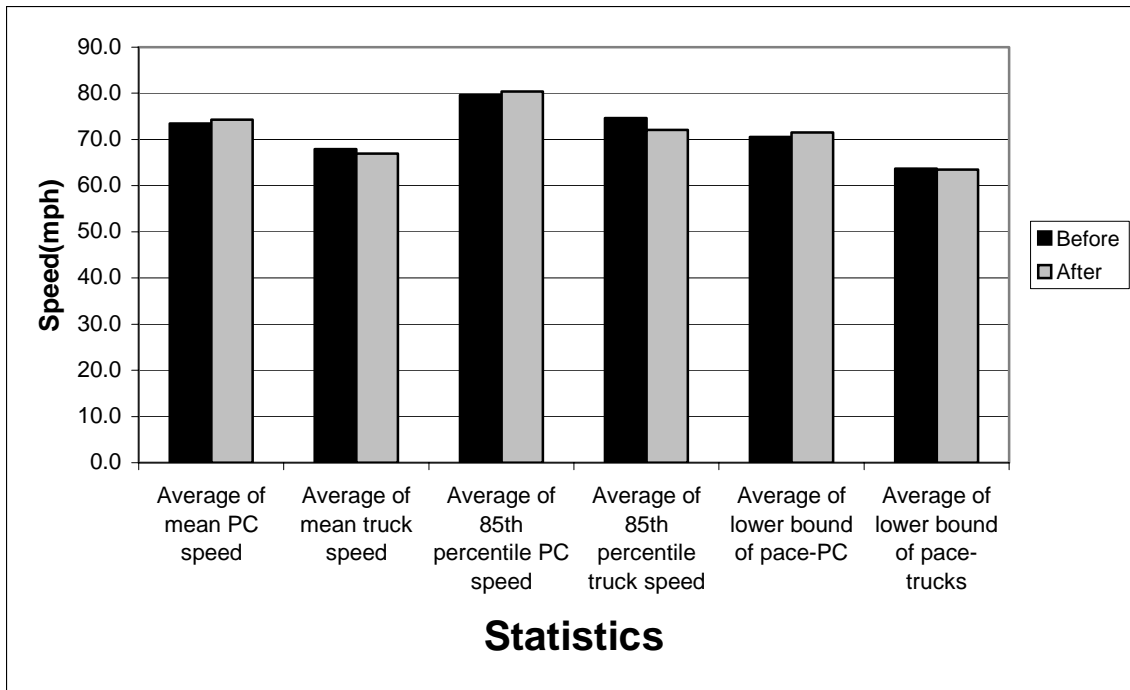


Figure 3. Speed changes before and after speed limit change

To know whether the changes in truck speed are real or are due to chance alone, a statistical test, t-test, is conducted. This test determines if the difference in mean speed data was significant when comparing the mean speeds at each site during each measurement period before and after July 1998.

Table 6 shows that the passenger car speeds increased by 0.85 mph which is statistically significant. However, as one can see this increase is quite small and does not contribute much to a definite conclusion. There is a 1.0-mile per hour reduction in truck speeds that is statistically significant but also is quite small.

Table 6. T-test to determine statistical significance in changes in passenger car and truck speeds

	Passenger Car Mean Speed (mph)		Truck Mean Speed (mph)	
	Before	After	Before	After
Mean	73.46	74.31	67.92	66.94
Variance	3.30	4.66	3.56	5.24
Number of Observations	24	159	24	159
Alpha	0.05		0.05	
t-Statistic	-2.08		2.30	
t-Critical	1.645		1.645	

Note: Alpha is the significance level, an estimation of the probability that the speed differences are due to chance alone. The t-critical value is a theoretical test statistic. The t-statistic value is the computed value for the given data. If the absolute value of t-statistic value is greater than the t-critical value, the apparent difference in mean values of the speeds is likely a real difference, not due to chance.

Pace is the ten-mile per hour speed range that encompasses the greatest number of vehicles. The greater the numbers of vehicles traveling in the ten mile per hour range, the more uniform the speeds, which reduces the potential for collisions. Table 7 shows the percentage of vehicles traveling in pace both before and after the speed limit change. The percentage of passenger cars in pace remained unchanged. However, the percentage of trucks in pace increased, indicating that the speed limit change helped to bring more uniformity to truck speeds. The issue of speed variation is discussed further below.

Table 7. T-test to determine the statistical significance in changes in passenger car and truck pace

	Proportion of Passenger Cars in Pace		Proportion of Trucks in Pace	
	Before	After	Before	After
Mean	0.620	0.629	0.596	0.716
Variance	0.001	0.003	0.0013	0.0094
Number of Observations	24	159	24	159
Alpha	0.05		0.05	
t-Statistic	-1.16		-11.274	
t-Critical	1.65		1.65	

Note: Alpha is the significance level, an estimation of the probability that the speed differences are due to chance alone. The t-critical value is a theoretical test statistic. The t-statistic value is the computed value for the given data. If the absolute value of t-statistic value is greater than the t-critical value, the apparent difference in mean values of the speeds is likely a real difference, not due to chance.

A t-test was conducted to determine whether the changes in 85th percentile speeds of passenger cars and trucks are statistically significant. Table 8 shows the details.

The 85th percentile speed of passenger cars increased slightly by 0.8 mph, which is statistically significant. However, the 85th percentile speed of trucks decreased by 2.5 mph, which is statistically significant and suggests that the change in truck speed limit has reduced the speed of the faster trucks.

Table 8. T-test to determine the statistical significance in changes in passenger car and truck 85th percentile speeds

	Passenger Car 85th percentile speed		Truck 85th percentile speed	
	Before	After	Before	After
Mean	79.63	80.35	74.63	72.1
Variance	1.81	3.05	3.2	2.93
Number of Observations	24	159	24	159
Alpha	0.05		0.05	
t-statistic	-2.34		6.49	
t-critical	1.96		1.96	

Has there been a change in traffic safety on Idaho’s interstate highways as a result of the change in the truck speed limit?

There are a variety of ways in which we can assert whether there has been an increase or decrease in safety as a result of the speed limit change. This analysis considers the following indicators of potential or real change in highway safety:

- Change in the standard deviation of speed, indicating a greater potential for vehicle conflicts
- Change in the differential between passenger car and truck speeds, again indicating a greater potential for vehicle conflicts
- The proportion of trucks exceeding the speed limit

- Change in the truck crash rate, indicating an actual decrease in highway safety

Finding #4: The standard deviation in vehicle speed did not change as a result of the change in the truck speed limit.

The dispersion of speeds is an indication of the relative safety of the traffic stream. The standard deviation of passenger car and truck speeds was computed for two sites on I-84, Cotteral and Yale (see Table 9 and Table 10). Figure 4 shows the before and after data for the Cotteral site. The data indicate that there was no identifiable change in the standard deviation of the vehicle speeds, either for passenger car or truck speeds, when comparing the before and after data.

Table 9. Mean speeds and standard deviations, I-84 Cotteral

Date	Mean Speeds (mph)			Standard Deviation of Speeds		
	Passenger cars	Trucks	All Vehicles	Passenger cars	Trucks	All Vehicles
8/2/97	75.0	68.3	72.9	6.60	5.95	7.12
11/2/97	75.2	68.4	72.3	6.55	6.01	7.16
2/2/98	74.6	68.2	71.4	7.44	6.31	7.62
5/2/98	75.3	68.8	72.8	6.55	5.84	7.03
8/2/98	75.6	67.3	72.9	6.52	4.91	7.19
11/2/98	75.8	67.1	72.1	6.59	4.86	7.29
2/2/99	74.6	66.2	70.3	7.89	5.78	8.06
5/2/99	75.7	67.2	72.3	6.61	4.82	7.28
8/1/99	76	67.6	73.1	6.5	4.9	7.2
11/1/99	76.1	67.5	72.3	6.5	4.8	7.2
2/1/00	75.9	66.9	71.2	6.9	5.3	7.6
5/1/00	75.3	67.1	72	6.8	4.8	7.3
8/1/00	76.4	67.7	73.3	6.4	4.7	7.2

Table 10. Mean speeds and standard deviations, I-84 Yale

Date	Mean Speeds (mph)			Standard Deviation of Speeds		
	Passenger cars	Trucks	All Vehicles	Passenger cars	Trucks	All Vehicles
8/1/97	73.6	65.7	71.2	7.36	6.82	8.06
11/1/97	73.7	65.3	70.1	7.39	7.75	8.62
2/1/98	72.0	65.0	68.7	9.31	7.65	9.24
5/1/98	73.5	65.9	70.6	7.41	6.68	8.02
8/2/98	65.6	60.8	64.3	15.21	10.59	14.26
11/2/98	73.8	64.6	69.9	7.53	6.00	8.30
2/2/99	71.9	62.1	66.8	9.81	8.72	10.48
5/2/99	73.9	64.6	70.4	7.53	6.08	8.35
8/1/99	74.3	65.1	71.3	7.4	6.2	8.3
11/1/99	74.7	63.9	70.1	7.7	7.6	9.3
2/1/00	73.7	64.5	69	8.6	6.6	9
5/1/00	61.8	58.7	60.6	8.5	7.1	8.1
8/1/00	74.2	64.7	71	7.8	5.9	8.5

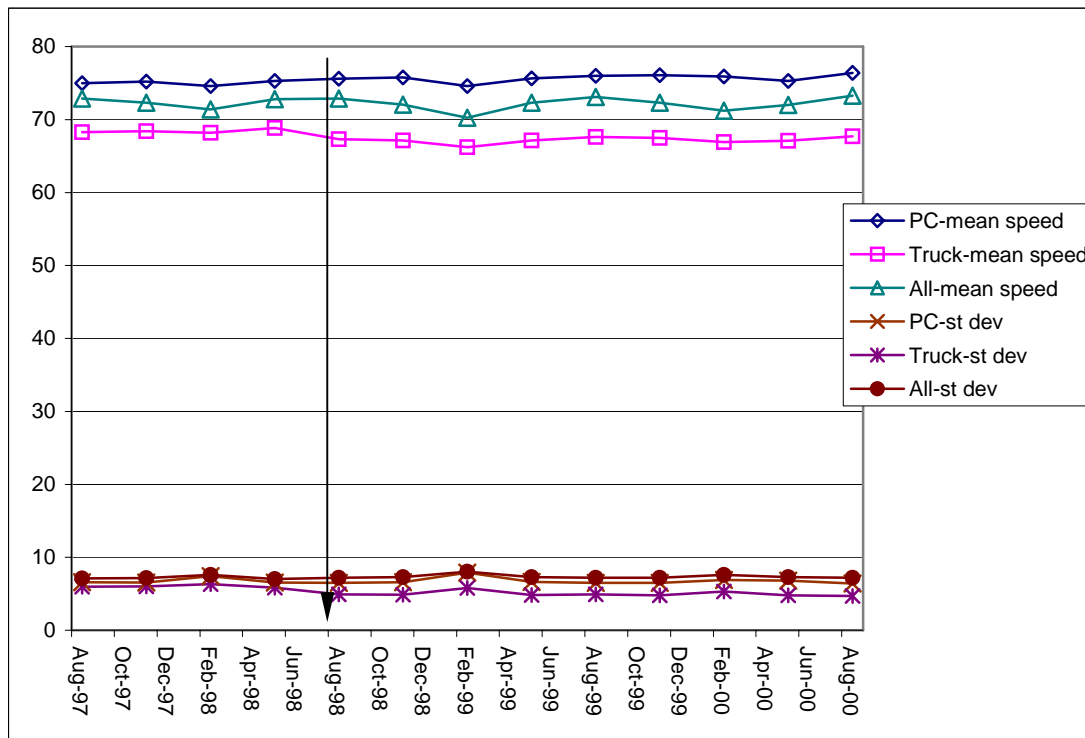


Figure 4. Variation of mean speeds and standard deviations, I-84 Cotteral

Finding #5: The differential between passenger car and truck speeds increased as a result of the change in the truck speed limit.

Speed differential between vehicle types is often an indicator of the potential for decreased safety. Table 11 shows that the mean differential between passenger cars and trucks was 5.5 mph before the speed limit change; this differential increased to 7.1 mph after the change. This change is statistically significant at the 0.05 significance level.

Table 11. T-test for speed differential

	Before	After
Mean	5.54	7.36
Variance	3.39	3.21
Number of Observations	24	159
Alpha	0.05	
t-statistic	-4.55	
t-critical	1.96	

Finding #6: The proportion of trucks violating the speed limit increased when the speed limit was changed.

Conformance to the speed limit may be an indicator of the relative safety of the highway. The percentage of heavy trucks exceeding the speed limit increased dramatically when the speed limit was reduced. This resulted from the large decrease in the speed limit (10 mph) and the small decrease in the speed of heavy trucks.

Figure 5 shows the percentage of trucks traveling at greater than 75 mph before July 1998 and greater than 65 mph after July 1998 at the site, Black Canyon. Before July 1998, only 10 to 20 percent of the trucks at the Black Canyon site traveled above 75 mph. After July 1998, between 60 and 75 percent of the trucks at this site traveled above 65 mph. The same conclusion can be drawn about the sites, Jeans Place and Hammett, from Figure 6 as well as the other sites for which data was collected but are not shown.

This increase in speed violations may indicate the need for increased enforcement or a more effective public information campaign.

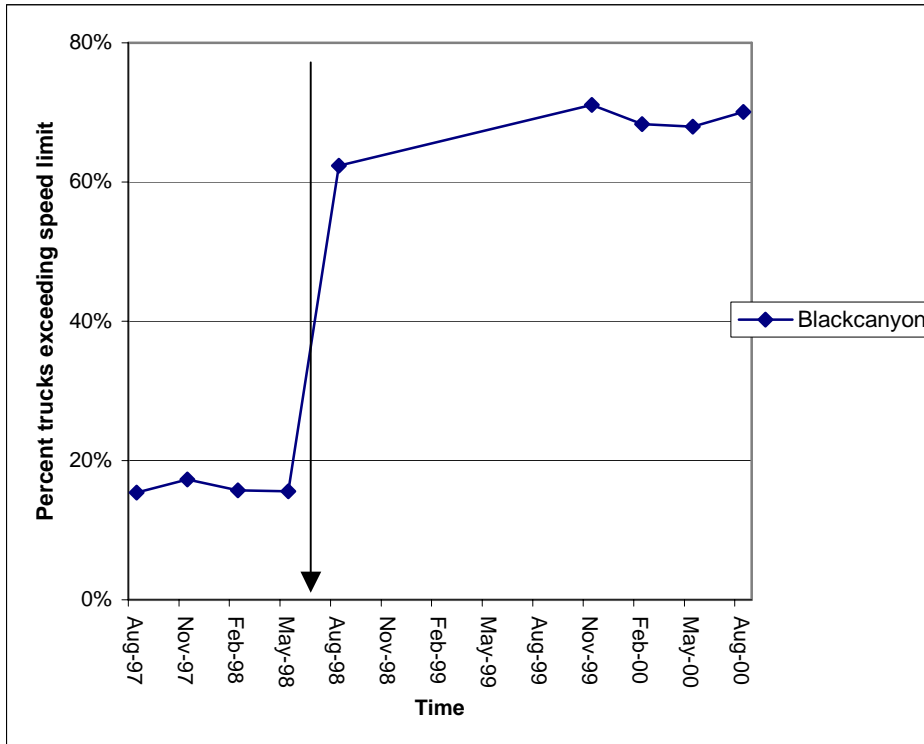


Figure 5. Percentage of trucks exceeding speed limit, ATR 123

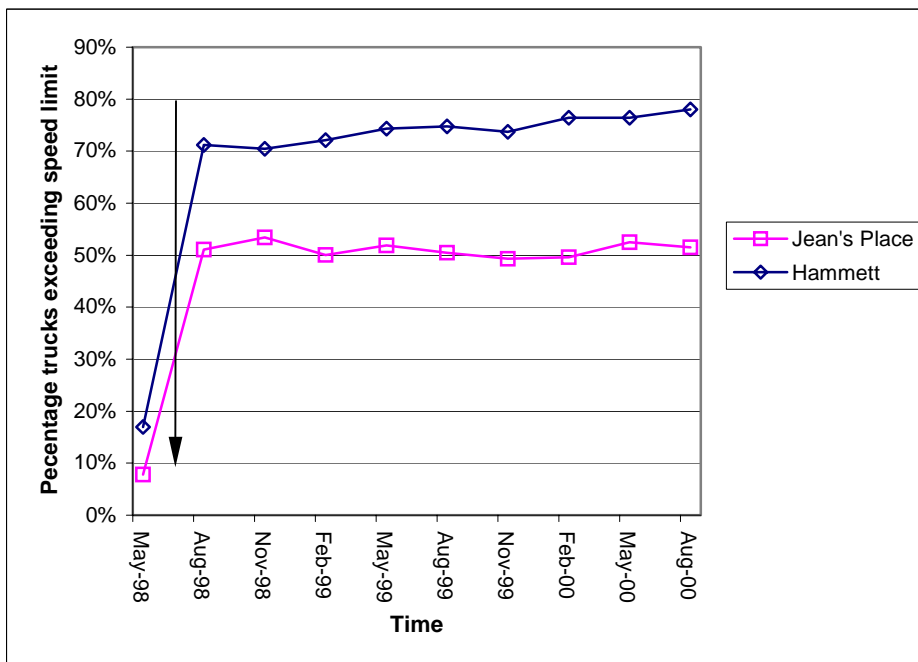


Figure 6. Percentage of trucks exceeding speed limit, ATR 2 and 71

Finding #7: The crash rates for all vehicles and for those crashes involving commercial vehicles did not change as a result of the speed limit change.

Figure 7 and Figure 8 show the collision data for all vehicles and for crashes involving commercial vehicles for the two years preceding the speed limit change and for two years after the speed limit change. While the number of data points is admittedly small, there is no systematic discernable effect of the speed limit change in the number of observed collisions.

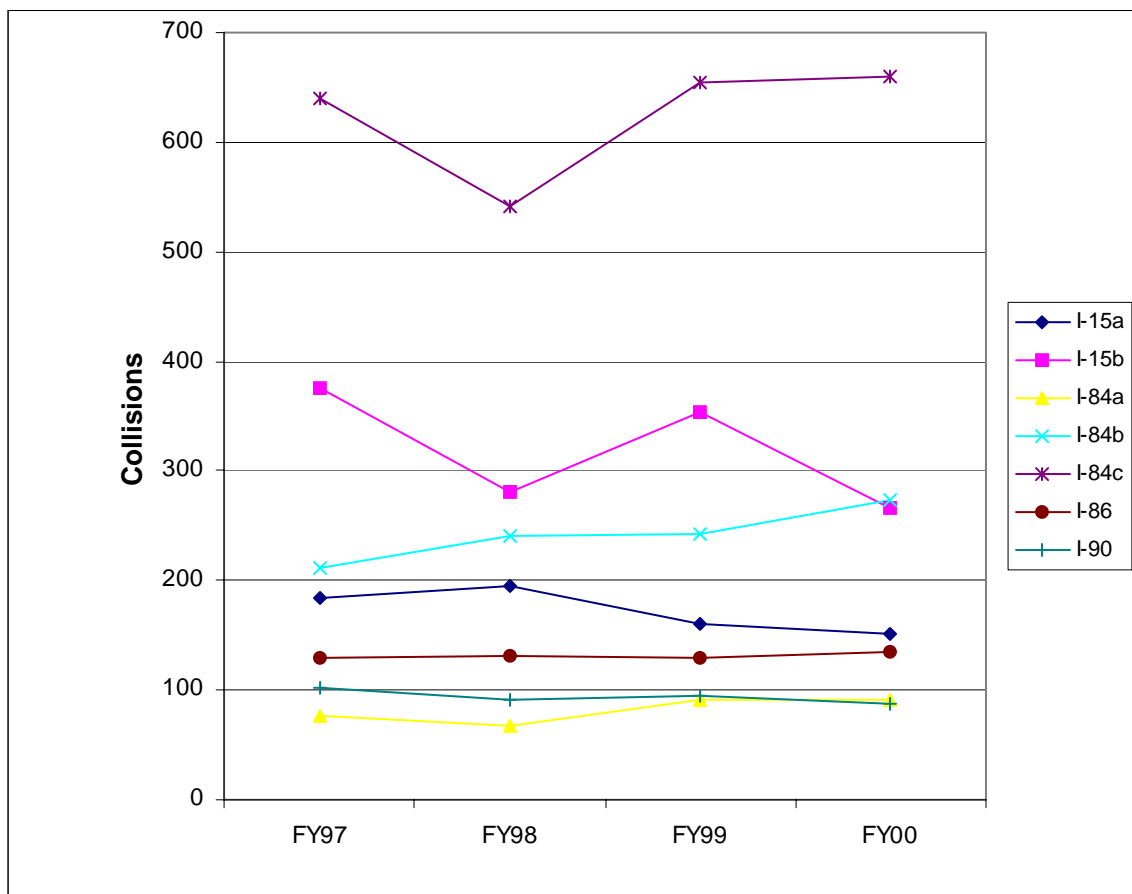


Figure 7. Collision data, all vehicles

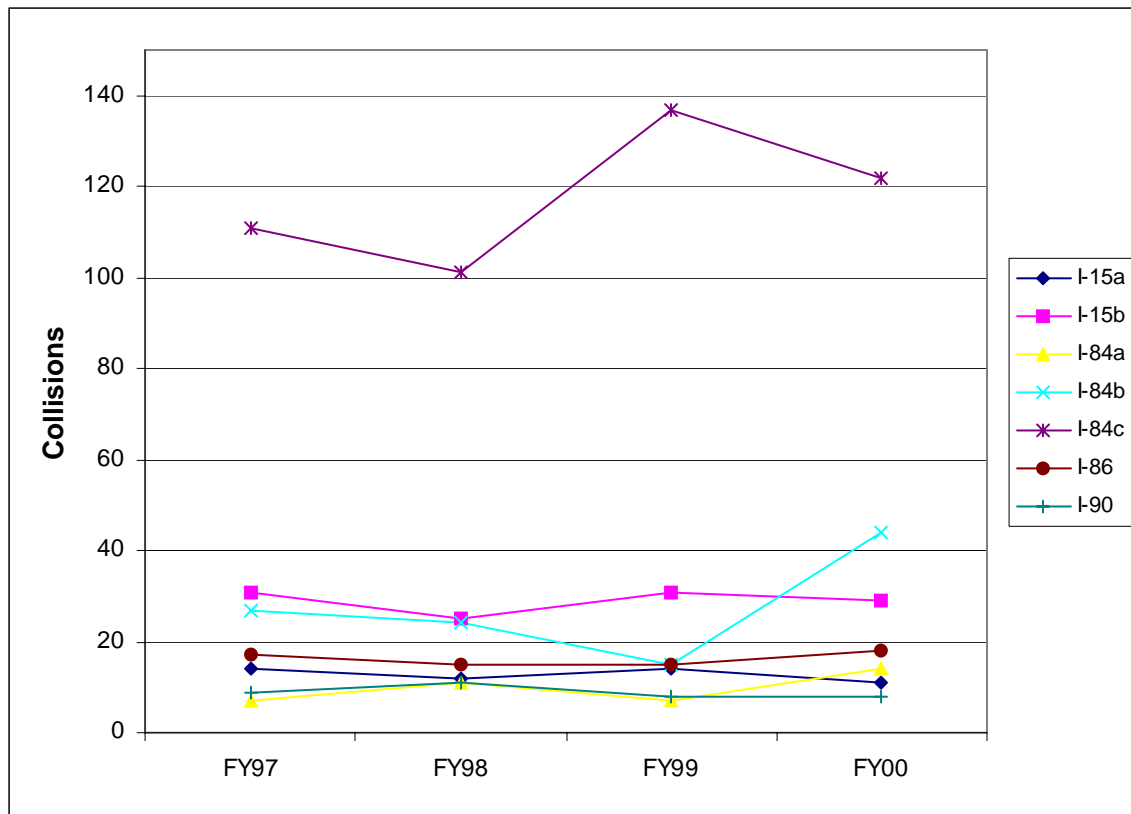


Figure 8. Collision data for commercial vehicles

DISCUSSION

The change in the truck speed limit has been in effect for more than two years. The trends that have been presented in this report show the changes that have taken place after two years of implementing the speed limit. Further changes may occur as time goes on.

This report summarizes the conclusions that can be drawn based on the speed and crash data that have been collected so far.

- Passenger car speeds increased from 73.5 mph to 74.3 mph. Though this change is statistically significant, one cannot come to a definite conclusion regarding this, as the difference between the speeds is less than 1 mph.
- Truck speeds declined slightly: mean speeds dropped by 1.0 mph, while 85th percentile speeds declined by 2.5 mph. While these changes are small, they are statistically significant and indicate that the travel speeds of the faster trucks have decreased.
- Speed differentials between trucks and passenger cars increased from 5.5 mph to 7.4 mph. Again, while this change is small, it is statistically significant.
- The proportion of trucks violating the speed limit increased significantly from about 10 to 20 percent before the speed limit change to between 60 and 75 percent after the change.
- The standard deviation of vehicle speeds did not increase including all vehicles, indicating that the overall uniformity in vehicle speeds remained unchanged.
- Crash data did not increase as a result of the speed limit change.

While the potential for a decrease in safety exists because of the speed limit differential, the data collected so far show that a real change in the safety has not occurred. The passenger car-truck speed differential increased slightly. But the standard deviation of the vehicle speeds did not increase. While the crash data is limited, there is no evidence that there is an increase in the number of trucks involved in collisions.

The Idaho Transportation Department should continue to monitor the effects of the speed limit change, using both the speed measurements and crash data. More definitive trends may appear as additional data are collected.