Report No. UT-04.23

CRASH AVOIDANCE PERFORMANCE HISTORY (CAPH)

Safety Performance Measures for UDOT Regions & Divisions

Prepared For:

Utah Department of Transportation
Research and Development Division

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UDOT RESEARCH & DEVELOPMENT REPORT ABSTRACT

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16. Abstract

The CAPH initiative is intended to aid UDOT managers in measuring the safety aspects of their programs. Most of these managers are traditionally not involved in direct safety activities, but manage activities that significantly affect the safety of our highways. Many UDOT functions have a profound influence on transportation safety, but we have not consistently and formally measured this influence. Specific performance measures for each UDOT program having an impact on safety are proposed through the CAPH effort. Programs can be improved such as snow removal, deer fence activities, slippery pavement decisions, commercial vehicle inspection, vehicle off-tracking, pavement marking programs, drainage control, glare screen, railroad crossings, construction zone traffic control, and rumble strips, just to name a few.

The information for these performance measures can be down-loaded in minutes using the existing Crash Data Delivery System. This system is the result of a research project aimed at developing a system for specific UDOT use. It allows extremely rapid down-load of accident information over the Internet from remote sites, and displays it on a map or in tabular form. All region and division managers responsible for these activities have received training on the use of this system through a research contract with iWorQ and InGeo Systems Inc. who developed the software.

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Introduction & Purpose

The CAPH initiative is intended to aid UDOT managers in measuring the safety aspects of their programs. Most of these managers are traditionally not involved in direct safety activities, but manage activities that significantly affect the safety of our highways. Many UDOT functions have a profound influence on transportation safety, but we have not consistently and formally measured this influence. Specific performance measures for each UDOT program having an impact on safety are proposed through the CAPH effort. Programs can be improved such as snow removal, deer fence activities, slippery pavement decisions, commercial vehicle inspection, vehicle off-tracking, pavement marking programs, drainage control, glare screen, railroad crossings, construction zone traffic control, and rumble strips, just to name a few.

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Basically there are two main ways that the Regions and Divisions can utilize the Crash Data Delivery System to accomplish these goals:

Project Level Analysis-

Safety enhancements in a corridor may be needed. This could be in conjunction with the main reason for a planned project. This database is a good tool to determine if a safety related aspect of an area is needed, and what improvement is the most appropriate. Any reduction in crashes due to the action can be measured in subsequent years. These could include rumble strips for run-off-the-road problems, brake test pullout sites, barrier to prevent head-on collisions, passing lanes, etc.

Program Level Analysis-

Crash data should be used to fine-tune specific programs to improve safety. Measures for this level tend to be related to changes in accident rates for the system rather than a single location. Total reductions in injuries and fatalities could also be good indicators of the effectiveness of a program enhancement.

Types of Analysis

NCHRP Synthesis 295 identifies eight analysis types that agencies often conduct as follows:

1. Before and after evaluations
2. Identification of hazardous locations
3. Cost-benefit analysis of countermeasures
4. Analysis of collision trends
5. Collision rate comparisons of features
6. Cross-sectional evaluations
7. Comparison group evaluations
8. Risk estimation/analysis/evaluations

Potential Benefits

This initiative will significantly improve decision-making within the Department. Knowledge will be improved related to planning snow plow efforts, when to maintain deer fence, which trucking firms to inspect, improved signing at problem areas, which traffic control plans are the most effective, and many others. A more productive and efficient use of UDOT manpower should emerge. There should be a reduction in accidents, fewer injuries, and a reduction in fatalities. The overall cost resulting from traffic accidents should be reduced.

End users of the software have provided information related to the potential benefits of the CAPH Program. Data were obtained for eight Utah DOT programs that have a direct impact on transportation safety. An analysis was conducted to determine the monetary value of these benefits. The results of this analysis are shown in Appendix A.

Some programs will benefit more than others. The benefits are related to the number of crashes related to the program, the number of accidents that can be reduced by utilizing the crash data, and the number of severe crashes that can be prevented. For the eight programs, the users estimate that the CAPH Program can reduce the total number of accidents in the State by about 1,000 per year. The number of injuries can be reduced by about 80, and about 3 fatalities can be prevented each year. This equates to about $15.8 to $30.2 million to society each year. These figures provide an added incentive for managers to utilize crash histories to make safety improvements in UDOT programs.

Performance Measures

Performance Measures should be established for most UDOT programs that have an affect safety. This is one way to measure the safety related aspects of each program from one year to the next.

Many measures are related to other factors beyond the manager=s control, such as mild or severe winters, fluctuations in deer herds and movements, etc. Two or three years may be needed in some instances to properly measure the results of project or program enhancements.

The following table lists some potential performance measures for various UDOT programs.

Recommended Performance Measures
for UDOT Regions and Divisions

Maintenance/Operations:	Measures	Possible Action	Lead
Deer Fence (existing)	-Deer hits per year -Severe deer related	-Conduct fence maintenance	Region
Deer Fence (new)	-Deer hits clusters -Severe deer related	-Recommend new fence	Region
Snow Removal	-Snow & ice clusters -Severe snow & ice	-Modify snow removal plan	Region
Fog Related Crashes	-Fog related clusters -Severe fog related	-Apply fog mitigation -Install fog warning system	Region
Materials/Pavement Mgt:	Measures	Possible Action	Lead
Slippery Pavement	-Number of accidents/yr -Accident rate -% Wet weather accid. -Number severe	-Post ASlippery When Wet@ -Seal early -Seal as scheduled	Region
Poor Drainage Areas	-Number of accidents/yr -Accident rate -% Wet weather accid -Number severe	-Post ASlippery When Wet@ -Schedule Spot Improvement -Remove ruts (slurry seal, lane-level, mill, grind)	Region
Construction:	Measures	Possible Action	Lead
Construction Zones	-Number of accidents -Accident rate -Compare with expected -Number severe	-Modify traffic control plans -Select specific plans for conditions & functional class	Complex
Worker Related Accidents	-Number worker related -Number severe	-Modify traffic control plans -Select specific plans for conditions & functional class	Complex
Structures:	Measures	Possible Action	Lead
Low Clearance Bridge Hits	-Number bridge hits/yr -Number severe	-Modify signing -Modify oversize vehicle routing plan -Reconstruct roadway/bridge	Complex

Narrow Bridge Accidents	-Number narrow bridge related accidents/yr -Number severe	-Modify signing -Modify truck routing plan -Reconstruct bridge	Complex
Commercial Vehicles:	Measures	Possible Action	Lead
Truck Brake Failures	-Number brake failure related clusters -Number severe	-Modify signing -Install brake check turnout -Install truck escape lane -Increase inspections on specific companies	Complex
Fatigue/Impaired Drivers	-Number fatigue related clusters -Number severe	-Increase driver log checks for specific companies	Complex
Triple Trailer Safety	-Number triple trailer related accidents/yr -Accident rate -Number severe -Number in inclement weather -Number at access points	-Modify approved routing -Increase driver reviews -Reprimand companies for dispatch policies -Relocate terminals to rural interchanges -Modify interchange design	Complex
Planning Programs:	Measures	Possible Action	Lead
Bicycle/Vehicle Accidents	-Number bicycle related clusters -Accident rate -Number severe	-Improve signing/delineation -Modify bicycle routing -Conduct media campaign	Complex & Region
Pedestrian/Vehicle Accidents	-Number pedestrian related clusters -Accident rate -Number severe	-Modify or add sidewalks -Improve pedestrian crossing -Automate crossing zones	Complex & Region
Railroad Crossing Accidents	-Number railroad related clusters -Accident rate -Number severe	-Modify signing -Improve crossing design -Recommend separated grade	Complex & Region

Data Issues

The information in the system is coded to a unique "Accident" number for each year of information. Examples of these factors are the accident type, severity, weather, time of day, location, etc.

Other factors are related to the "People" involved in the crashes. These factors are any injury done to each person, their age, seat belt worn, etc. Specific occupant information is not provided by this system. A specific request is required for this information.

Additional information is coded for the "Vehicles" involved in the crash. Examples of these are the vehicle type, model, and any vehicle defects observed. Contributing circumstances are also assigned to the vehicle to identify the cause of the incident. Some limited "Carrier" information is provided, such as the general cargo carried.

The number of years of data selected in a query should be a function of how common the crash type, if the highway section has undergone changes, and other factors. Obtaining sufficient data to make a reliable safety related decision without polluting it with inaccurate or old data is very important. One to three years is a good sample if the crashes are reasonably common. Five to ten years should be extracted for less common types of crashes.

The system includes crash records for "State Routes", and crash records for "Federal-Aid Local Routes". The route numbers for Sate Routes are four digit numbers, and the Federal-Aid Local Routes are six digit numbers. If a system search is desired on State Routes only, with the Local Route data omitted, the search must be entered with the six districts included. Local Route data does not contain a District value, and will not be included in the results. Any query done without the six Districts included could contain crash records on Local Routes. Site-specific searches should contain the unique state route number to narrow down the query.

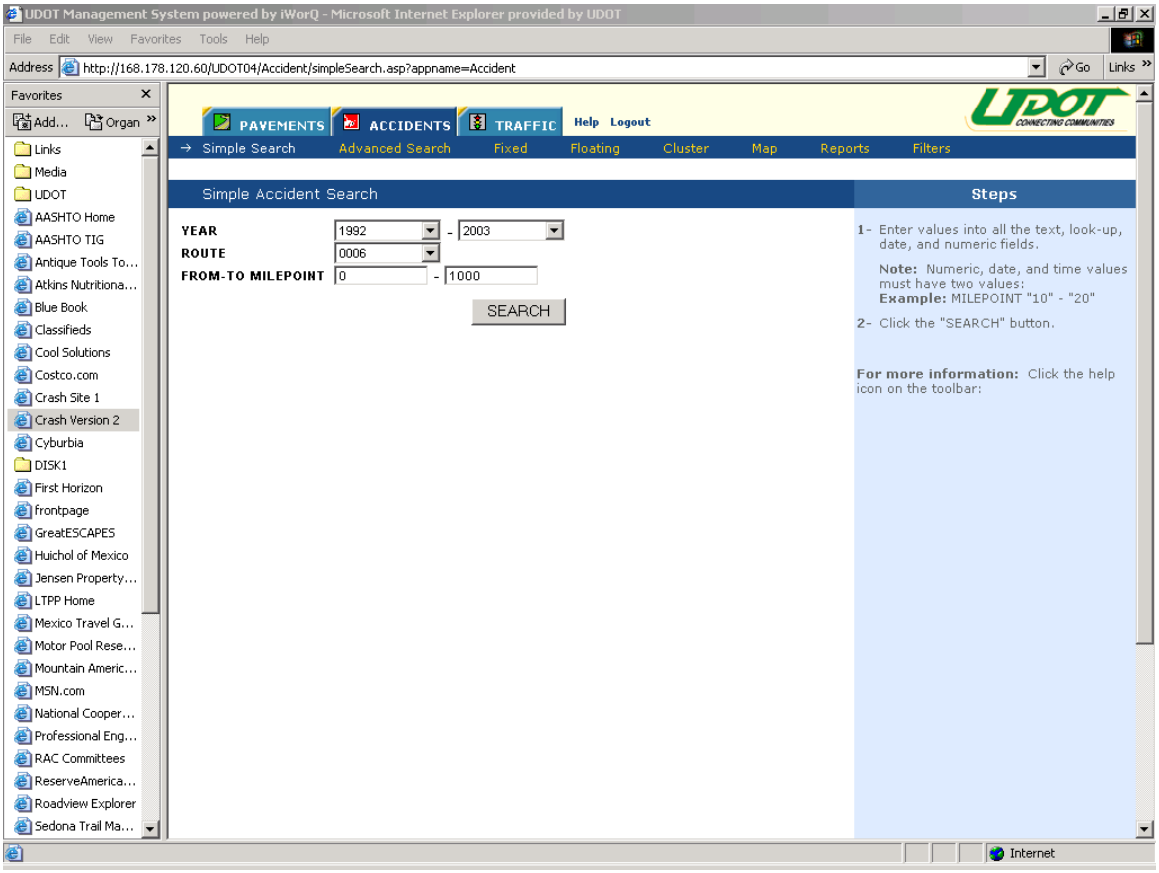
See Appendix A for possible uses, Appendix B for recommended performance measures, and Appendix C for the Crash Data Codes used in the system.

Location Reference System

All eleven years loaded onto the system are located using the "Green Book" system. The "Accumulated Milepoint" (from the beginning of the route), and the "Mileposts" (green numbered posts in the field) are located in a similar manner.

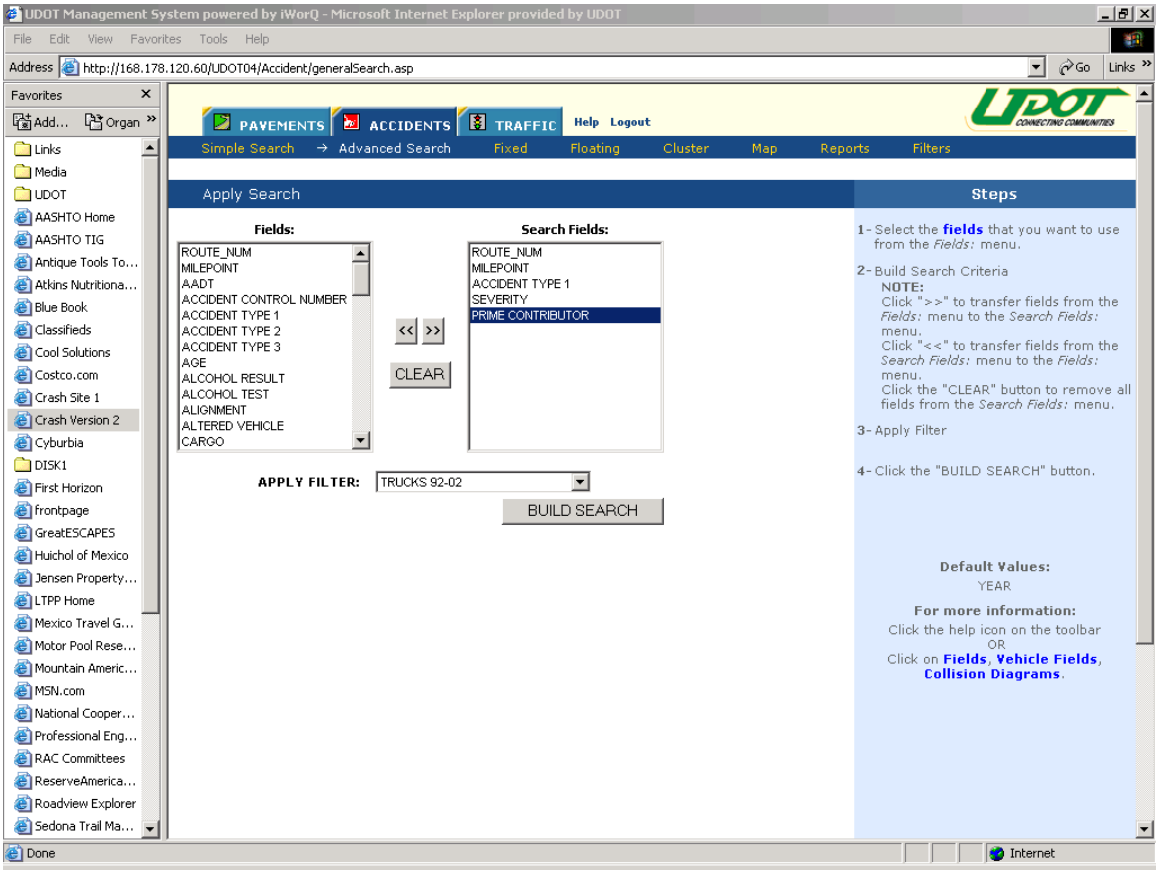
Simple Search

This search allows a quick down-load of any of the eleven years of data for one section of one route. All crash records for the years and section will be placed in the table. The "Info" button allows viewing of the crash records, vehicle data and people information. The table can be saved as a filter, shown on the map, saved to spreadsheet, or sent to a printer.



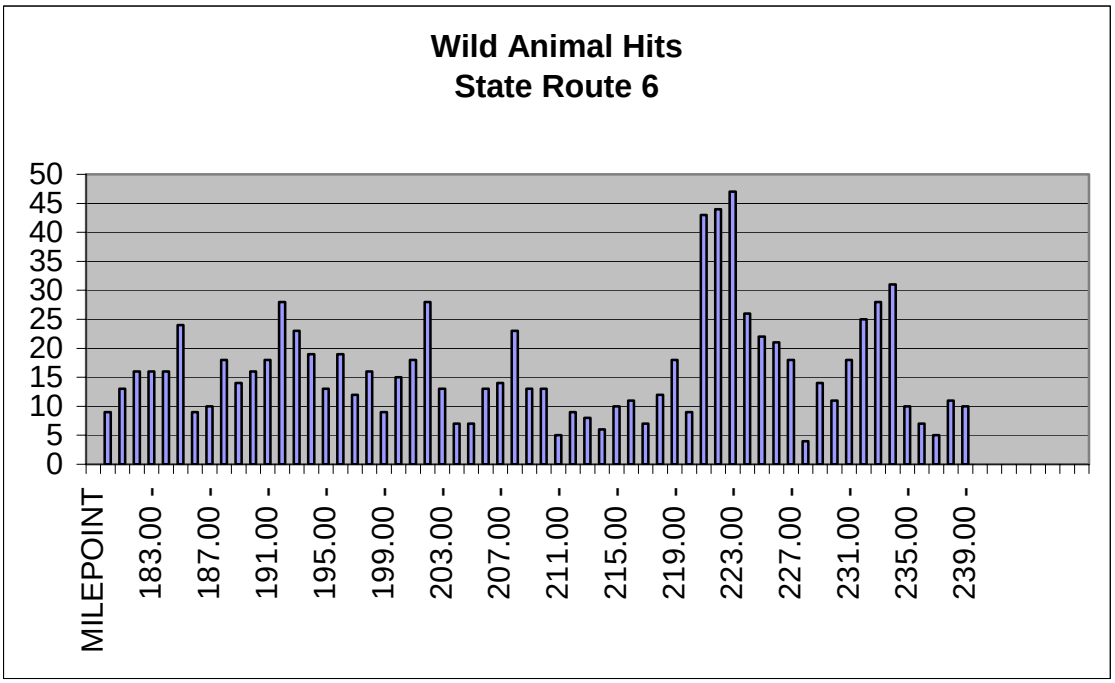
Advanced Search

Any variable contained in the database can be included in this search. Each line in the table will be a crash record as specified in the query. The resulting table can be processed as needed.



Fixed Segment Analysis

This search creates a table with the crashes in a given fixed segment for one section of one route. **This analysis shows high crash areas and can be used in spreadsheet to plot bar charts.**



Floating Segment Analysis

This is a special case of segment analysis in which segment length floats or moves sequentially by milepost. Both the segment and the distance the segment should float to generate the next line of data are specified. Also the minimum number of crashes that should be included are input. Crashes can be double counted if they meet the criteria for each segment. **This analysis is used for finding high crash areas.**

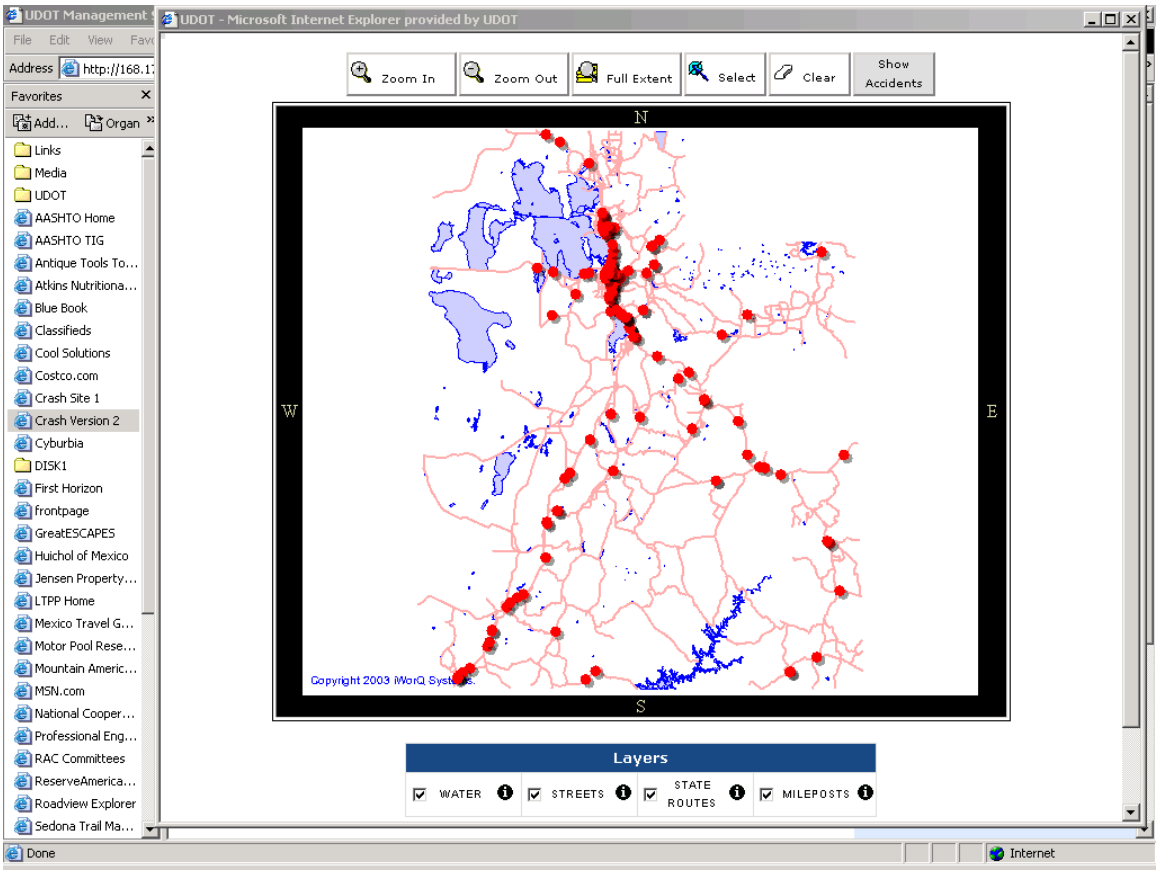
Cluster Analysis

A cluster analysis is a type of segment analysis and is similar to a floating segment or sliding analysis. The specified segment moves along the route until the next crash record is observed. A line of information is generated. Then it proceeds along the route to the next accident and does the same analysis. Crashes can be double counted if they meet the criteria for each segment. **This analysis is used to identify accident clusters.**

Map Searches

The Map function can be used to extract crash records form a given location. In this case the location does not need to be a linear section of highway. It will be defined as the view created with the Map tool. Using the "Zoom In" button the user can open a view to give the desired coverage.

Crashes in the window can be queried in two ways. All records for any years can be down-loaded using the "Year" function. Only data from a created filter can be displayed on the map by selecting the "Filter" function. **This application is used where the location is known, but the Route Number or Milepoint are not known. It also is used to extract data at intersections for more than one route with one search.**



Mapping Functions

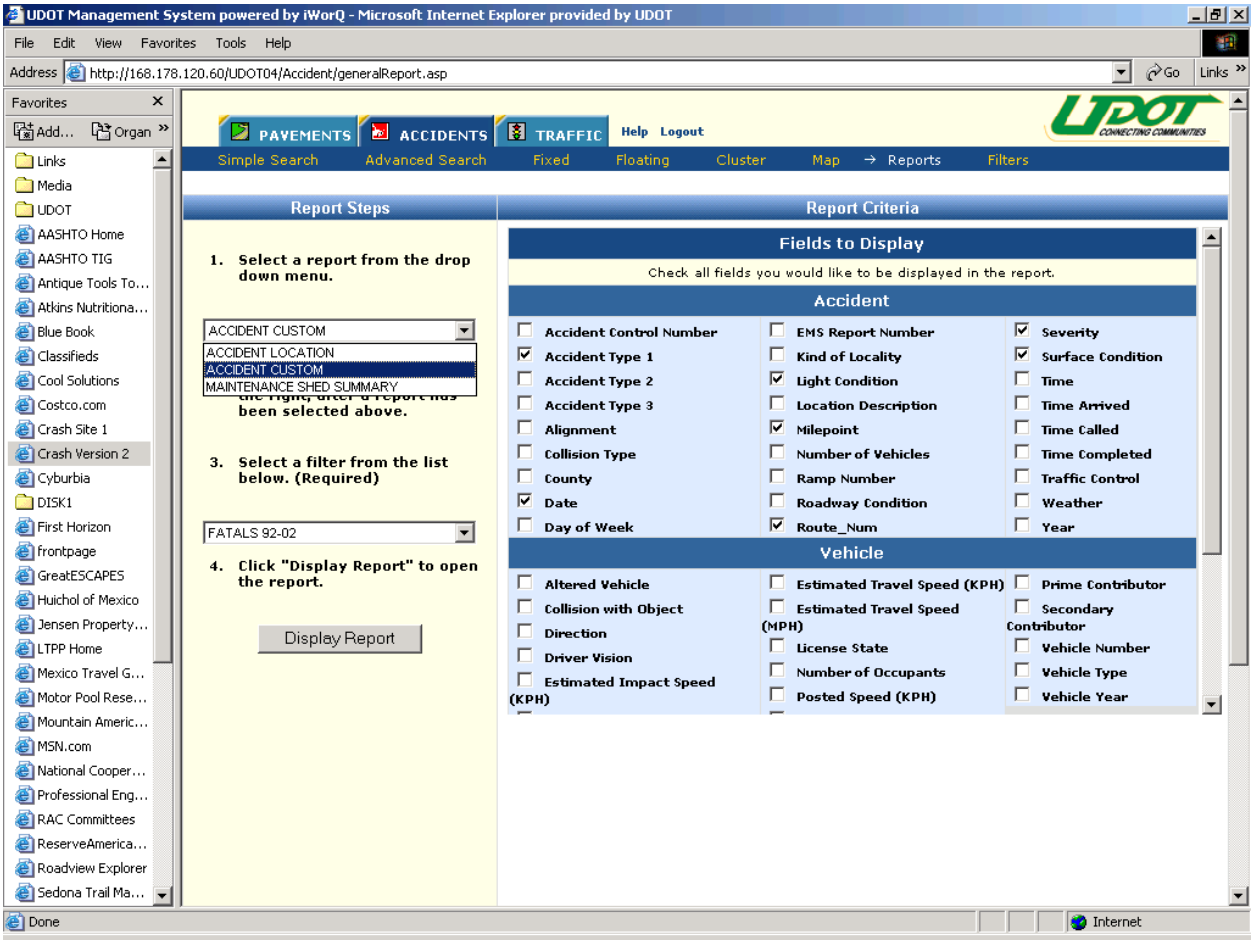
When a set of data is sent to the map it is located by the "Milepost". Data placed in tables or reports are located by "Accumulated Milepoint".
(local route mapping)

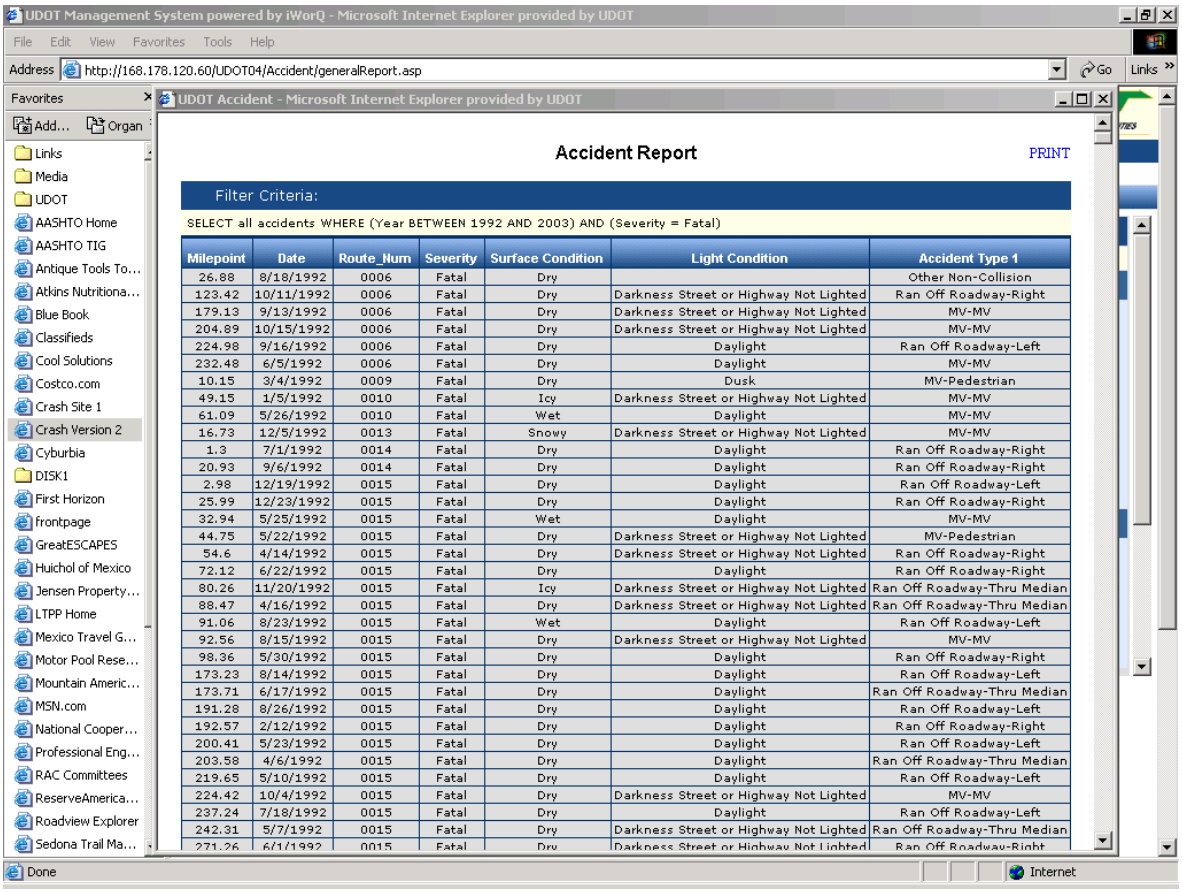
Reports of Crash Data

Three types of reports can be created. An "Accident Location" report provides the Accident ID, Date, Route, Milepoint, and Vehicles for any "Filter". An "Accident Custom" report can be created including any of the selected parameters in the system for any "Filter". A "Maintenance Shed Summary" gives a table for use at Semi-Annual Inspections.

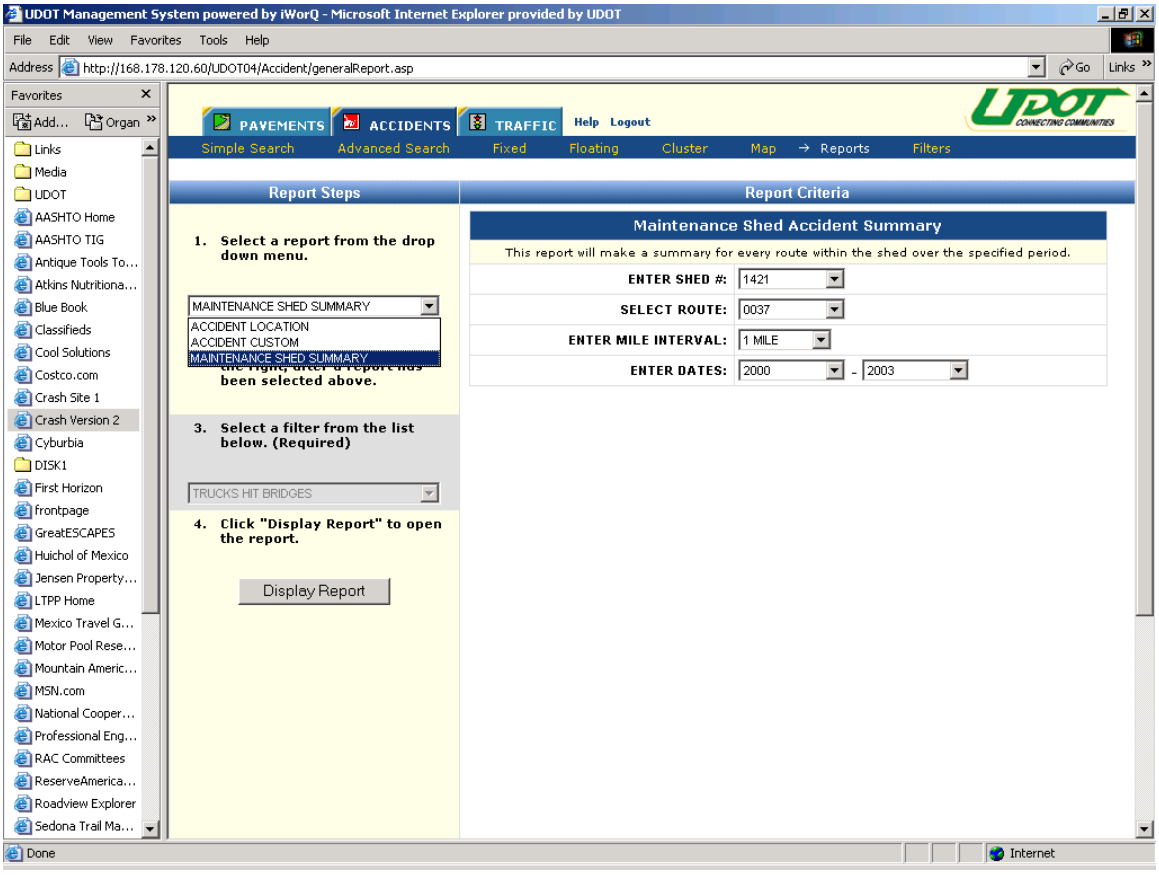
When reports are submitted for "Accident" related factors, a list of crashes will be generated. Each line in the table will be a unique set of crash records. If factors related to "People" are added to a report a line of data will be created for each person involved in the crash. Similarly, when "Vehicle" related information is included in a report each line will be for each vehicle in the crash records.

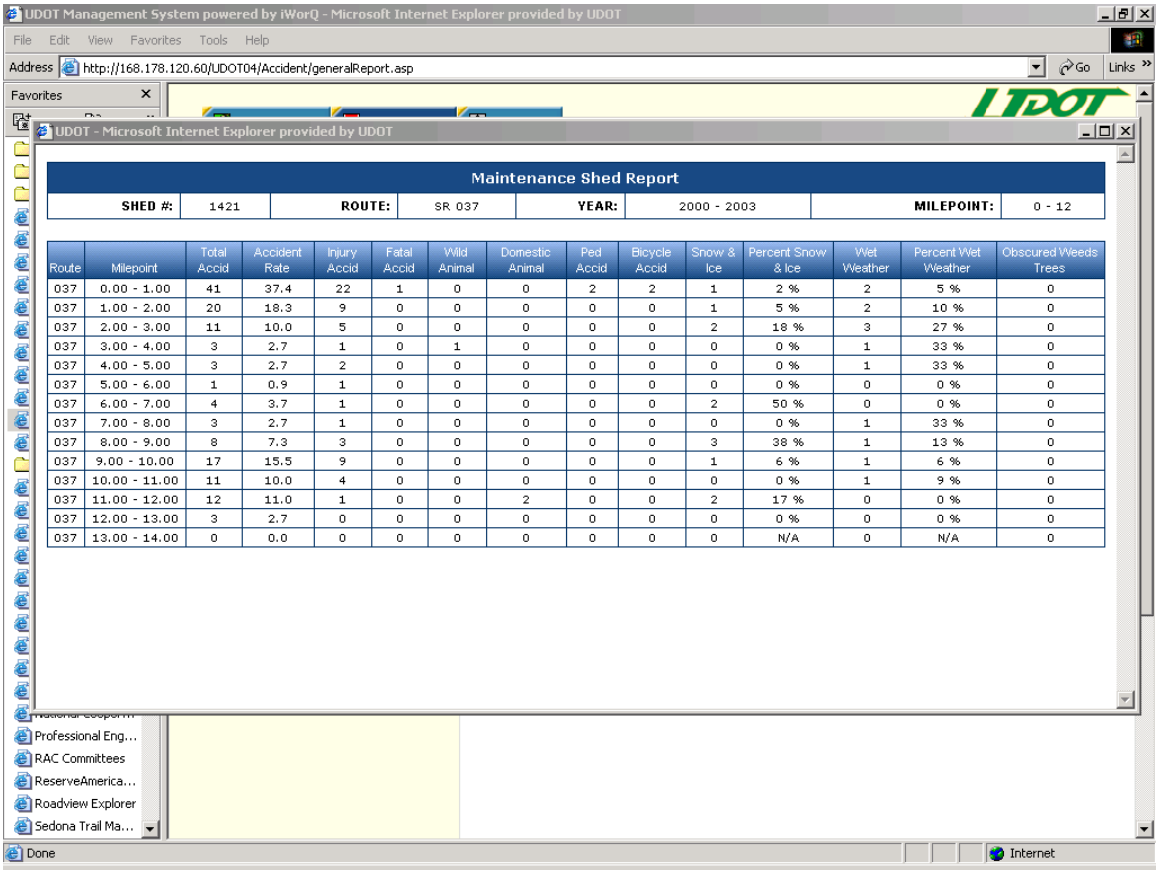
When "People" and/or "Vehicle" information is added to a report, it is advisable to include the Accident Control Number to identify one crash from another.




UDOT Management System powered by iWorQ - Microsoft Internet Explorer provided by UDOT
File Edit View Favorites Tools Help
Address http://168.178.120.60/UDOT04/Accident/generalReport.asp
Go
Links
Favorites
Add... Organ
Links
Media
UDOT
AASHTO Home
AASHTO TIG
Antique Tools To...
Atkins Nutritiona...
Blue Book
Classifieds
Cool Solutions
Costco.com
Crash Site 1
Crash Version 2
Cyburbia
DISK1
First Horizon
frontpage
GreatESCAPES
Huichol of Mexico
Jensen Property...
LTPP Home
Mexico Travel G...
Motor Pool Rese...
Mountain Americ...
MSN.com
National Cooper...
Professional Eng...
RAC Committees
ReserveAmerica...
Roadview Explorer
Sedona Trail Ma...
UDOT Accident - Microsoft Internet Explorer provided by UDOT
Accident Report
PRINT
Filter Criteria:
SELECT all accidents WHERE (Year BETWEEN 1992 AND 2003) AND (Severity = Fatal)
Milepoint Date Route_Num Severity Surface Condition Light Condition Accident Type 1
26.88 8/18/1992 0006 Fatal Dry Other Non-Collision
123.42 10/11/1992 0006 Fatal Dry Darkness Street or Highway Not Lighted Ran Off Roadway-Right
179.13 9/13/1992 0006 Fatal Dry Darkness Street or Highway Not Lighted MV-MV
204.89 10/15/1992 0006 Fatal Dry Darkness Street or Highway Not Lighted MV-MV
224.98 9/16/1992 0006 Fatal Dry Daylight Ran Off Roadway-Left
232.48 6/5/1992 0006 Fatal Dry Daylight MV-MV
10.15 3/4/1992 0009 Fatal Dry Dusk MV-Pedestrian
49.15 1/5/1992 0010 Fatal Icy Darkness Street or Highway Not Lighted MV-MV
61.09 5/26/1992 0010 Fatal Wet Daylight MV-MV
16.73 12/5/1992 0013 Fatal Snowy Darkness Street or Highway Not Lighted MV-MV
1.3 7/1/1992 0014 Fatal Dry Daylight Ran Off Roadway-Right
20.93 9/6/1992 0014 Fatal Dry Daylight Ran Off Roadway-Right
2.98 12/19/1992 0015 Fatal Dry Daylight Ran Off Roadway-Left
25.99 12/23/1992 0015 Fatal Dry Daylight Ran Off Roadway-Right
32.94 5/25/1992 0015 Fatal Wet Daylight MV-MV
44.75 5/22/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted MV-Pedestrian
54.6 4/14/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted Ran Off Roadway-Right
72.12 6/22/1992 0015 Fatal Dry Daylight Ran Off Roadway-Right
80.26 11/20/1992 0015 Fatal Icy Darkness Street or Highway Not Lighted Ran Off Roadway-Thru Median
88.47 4/16/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted Ran Off Roadway-Thru Median
91.06 8/23/1992 0015 Fatal Wet Daylight Ran Off Roadway-Left
92.56 8/15/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted MV-MV
98.36 5/30/1992 0015 Fatal Dry Daylight Ran Off Roadway-Right
173.23 8/14/1992 0015 Fatal Dry Daylight Ran Off Roadway-Left
173.71 6/17/1992 0015 Fatal Dry Daylight Ran Off Roadway-Thru Median
191.28 8/26/1992 0015 Fatal Dry Daylight Ran Off Roadway-Left
192.57 2/12/1992 0015 Fatal Dry Daylight Ran Off Roadway-Right
200.41 5/23/1992 0015 Fatal Dry Daylight Ran Off Roadway-Left
203.58 4/6/1992 0015 Fatal Dry Daylight Ran Off Roadway-Thru Median
219.65 5/10/1992 0015 Fatal Dry Daylight Ran Off Roadway-Left
224.42 10/4/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted MV-MV
237.24 7/18/1992 0015 Fatal Dry Daylight Ran Off Roadway-Left
242.31 5/7/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted Ran Off Roadway-Thru Median
271.26 6/1/1992 0015 Fatal Dry Darkness Street or Highway Not Lighted Ran Off Roadway-Right
Done
Internet

Shed summaries can be created using the “Maintenance Shed Summary” function. Reports can be generated for 0.1 mile, 0.25 mile, or 1.0 mile intervals.

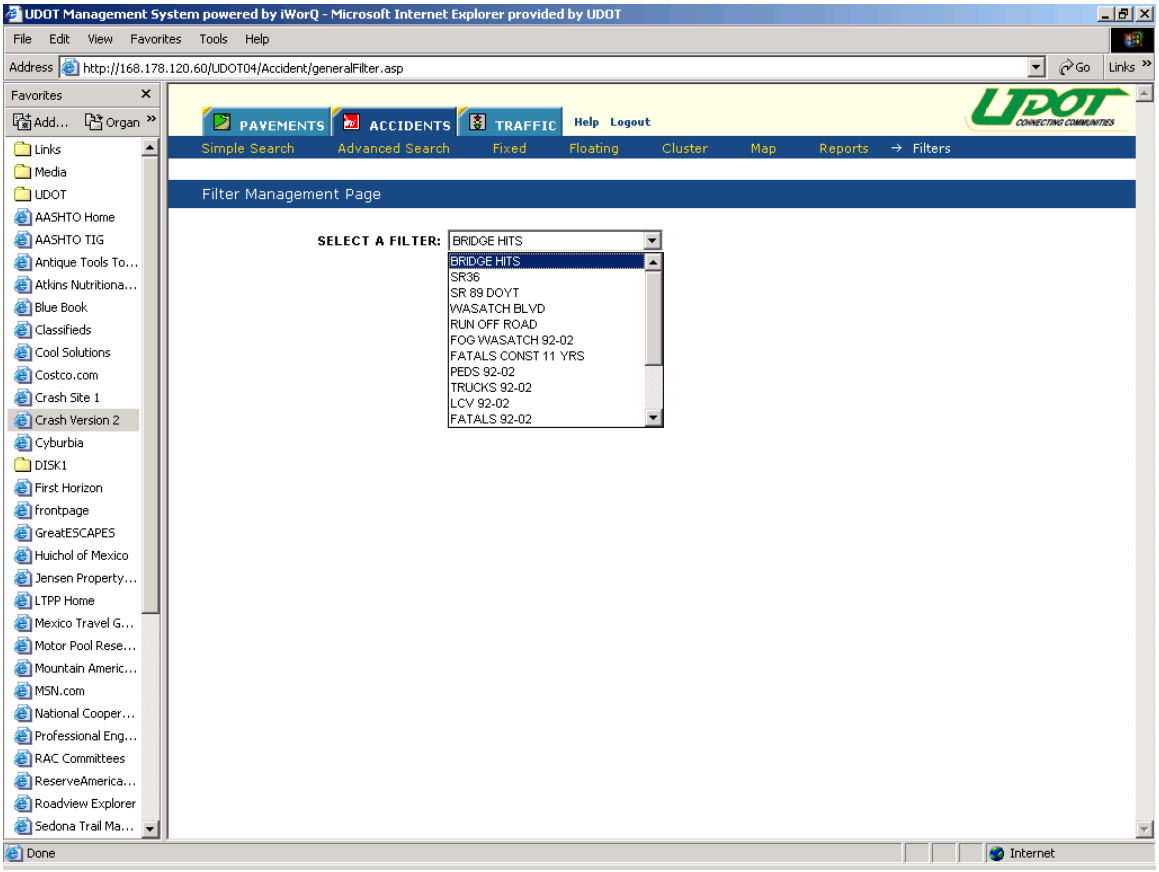




Route	Milepoint	Total Accid	Accident Rate	Injury Accid	Fatal Accid	Wild Animal	Domestic Animal	Ped Accid	Bicycle Accid	Snow & Ice	Percent Snow & Ice	Wet Weather	Percent Wet Weather	Obscured Weeds Trees
037	0.00 - 1.00	41	37.4	22	1	0	0	2	2	1	2 %	2	5 %	0
037	1.00 - 2.00	20	18.3	9	0	0	0	0	0	1	5 %	2	10 %	0
037	2.00 - 3.00	11	10.0	5	0	0	0	0	0	2	18 %	3	27 %	0
037	3.00 - 4.00	3	2.7	1	0	1	0	0	0	0	0 %	1	33 %	0
037	4.00 - 5.00	3	2.7	2	0	0	0	0	0	0	0 %	1	33 %	0
037	5.00 - 6.00	1	0.9	1	0	0	0	0	0	0	0 %	0	0 %	0
037	6.00 - 7.00	4	3.7	1	0	0	0	0	0	2	50 %	0	0 %	0
037	7.00 - 8.00	3	2.7	1	0	0	0	0	0	0	0 %	1	33 %	0
037	8.00 - 9.00	8	7.3	3	0	0	0	0	0	3	38 %	1	13 %	0
037	9.00 - 10.00	17	15.5	9	0	0	0	0	0	1	6 %	1	6 %	0
037	10.00 - 11.00	11	10.0	4	0	0	0	0	0	0	0 %	1	9 %	0
037	11.00 - 12.00	12	11.0	1	0	0	2	0	0	2	17 %	0	0 %	0
037	12.00 - 13.00	3	2.7	0	0	0	0	0	0	0	0 %	0	0 %	0
037	13.00 - 14.00	0	0.0	0	0	0	0	0	0	0	N/A	0	N/A	0

Filters

Information extracted from the database can be saved into a filter. Queries or reports can be created using filters to speed up the input or the variables needed as well as the sorting time needed by the system. The system allows the use of filters in all applications except "Simple Searches".



Examples of Filters

Commercial Vehicle filter- Twenty vehicle types are recommended for this filter as follows:

Truck and Trailer
Truck Tractor - Bobtail (Power Unit Only)
Tractor and Short Trailer
Commercial Bus
Truck and Mobile Home
Truck and 2 Short Trailers (95ft total length)
Truck and Longer Trailer (77ft total length)
Tractor - 2 Shorter Trailers (trailer up to 28ft each)
Tractor - 2 Trailers (95ft total length)
Tractor - 2 Long Trailers (permitted to 105ft freeway)
Tractor - Long Trailer - Short Trailer (98ft total length)
Tractor - 3 Shorter Trailers (permitted to 105 ft freeway)
Tractor and Long Trailer
Cargo Tank
Tractor w/ Tractor in Tow
Flatbed
Dump Truck
Concrete Mixer
Garbage/Refuse Truck
Auto Transporter

This filter will eliminate the need to enter each vehicle type into the search each time when truck related searches are desired.

Some users may want to create more than one filter using these vehicle classes. A ten-year filter would be useful for some applications, while a three year filter may be more appropriate for other queries. The same results can be obtained, however, by selecting only three years in the search while using the ten-year filter.

Other possible filters that can be created to reduce input time and processing time are as follows:

Fatal crashes
Injury & fatal crashes
Construction zone accidents
Wet weather related crashes
Snow & ice related crashes
Fog related crashes
Crashes at railroad crossings
Pedestrian hits
Bicycle-motor vehicle accidents
Wild animal hits
Domestic animal hits
Motorcycle related crashes
Alcohol related
Brake failures
Cell phone use related
Left turn related
Seat belt use
Speeding related

Recommendations

1. The Department should initiate this program has part of the Employee Performance Plans.

2. A first round of performance measures should be implemented and fine-tuned as needed. Performance measures developed should be statistically valid, and the data used must have an appropriate level of precision based on location. The Division of Traffic & Safety should review the selected measures, and provide input.

3. Modifications in performance measures over time are certainly appropriate based on the needs of decision-makers, and the results of program actions and adjustments.

4. Managers should be encouraged to share experiences from one region to another and between divisions. Solutions to many of the problems observed will require actions by more than one entity.

5. Successes and shortcomings of the CAPH Program should be recorded over time. Overall program goals should be modified by top leaders as needed.

Appendix A

Crash Avoidance Performance History (CAPH) Program Estimated Benefits

	Average Crashes/Yr	Range % Reduction	Ave Annual No. Reduced	Estimated Annual Benefits ($ x 1,000)
Snow & Ice Removal Plans:	T- 4,197	2 to 5%	84 - 210	
John Gunderson	P- 87%		73 - 183	$ 328 - 821
	I- 12%		10 - 25	$ 940 - 2,350
	F- 0.5%		0.4 - 1.0	$1,089 - 2,723
				$2,357 - 5,894
Deer Fence Maintenance & Placement:	T- 2,136	15 to 25%	320 - 534	
Lynn Bernhard	P- 96%		308 - 513	$1,383 - 2,303
	I- 4%		13 - 21	$1,222 - 1,974
	F- 0.1%		0.3 - 0.5	$ 817 - 1,362
				$3,422 - 5,639
Truck Brake Failures:	T- 38	5 to 10%	2 - 4	
Carrie Silcox	P- 74%		1 - 3	$ 4 - 13
	I- 24%		0 - 1	$ 0 - 94
	F- 2%		0 - 0.1	$ 0 - 272
				$ 4 - 379
Construction Zone Accidents:	T- 1,425	5 to 10%	71 - 143	
Darrell Giannonatti	P- 88%		62 - 125	$278 - 561
	I- 12%		9 - 17	$846 - 1,598
	F- 0.4%		0.3 - 0.6	$817 - 1,634
				$1,941 - 3,793
Domestic Animal Hits:	T- 441	10 to 20%	44 - 88	
Lynn Bernhard	P- 86%		38 - 76	$ 171 - 341
3 sites, 11 miles	I- 13%		6 - 11	$ 564 - 1,034
	F- 0.6%		0.3 - 0.5	$ 817 - 1,362
				$1,552 - 2,737

Tree, Crops & Weed Sight Obstruction:	T- 216	10 to 25%	22 - 54	
Lynn Bernhard	P- 74%		16 - 40	$ 72 - 180
	I- 25%		5 - 13	$470 - 1,222
	F- 0.5%		0.1 - 0.3	$272 - 817
				$814 - 2,219
Permitted Truck Accidents:	T- 794	5 to 10%	40 - 79	
Carrie Silcox	P- 81%		32 - 64	$ 144 - 287
	I- 17%		7 - 13	$ 658 - 1,222
	F-1.8%		0.7 - 1.4	$1,906 - 3,812
				$2,708 - 5,321
Slippery Pavement Evaluation:	T- 1,390	10 to 15%	139 - 209	
Gary Kuhl	P- 94%		131 - 196	$ 589 - 880
6 sites, 21 miles	I- 6%		8 - 12	$ 752 - 1,128
	F- 0.4%		0.6 - 0.8	$1,634 - 2,178
				$2,975 - 4,186

T- Total crashes

P- Property damage	$4,489	Incapacitating-	$228,568
I- Injury accident	$94,000	Nonincapacitating-	$48,333
F- Fatal accident	$2,723,000	Possible injury	$25,228

Estimated Benefits: **Total Eight Programs-** **$15.8 to 30.2 million per year**

Estimated Costs: **Region & Division Support-** **$300,000 per year**

Research Studies- **$79,000**

Benefit Cost Ratio for the CAPH Program: **51 to 98 for 10 years**

Program Users:

Region 1-	2	Safety Division-	6	ITS Division-	2	Research Division-	5
Region 2-	10	Maintenance Division-	3	Motor Carriers-	2	FHWA-	4
Region 3-	12	Planning Division-	5	Construction Division-	1	Utah Highway Patrol-	4
Region 4-	5	Risk Mgt-	2	Roadway Design-	1	Others-	6

Appendix B
Possible Uses of Crash Data
by Region and Division Personnel

Roadway Design:

- Cross-section deficiencies
- Left turn channelization & signals
- Horizontal clearance problems
- Guardrail installation
- Crash attenuator hits
- Pole break-a-way evaluation
- Glare screen requirements
- Speed zone analysis
- Access control feedback
- Rumble strip placement & maintenance
- Alignment & grade deficiencies
- Drainage deficiencies
- Jersey barrier effectiveness
- Pavement type factors
- Site distance factors
- Sign deficiencies
- Parking problems
- Vehicle off-tracking

Materials & Pavement Mgt:

- Bleeding pavement
- Obscured vision due to spray
- Polishing aggregates
- Drainage improvements
- Rutted pavement
- Asphalt vs concrete
- Loose aggregate crashes

Maintenance:

- Snow & ice removal plans
- Loose chip related
- Sign management
- Rejuvenation related
- Pot holes hit
- Rut related
- Tree and grass related
- Glare screen maintenance
- Fog mitigation
- Pavement marking plans
- Railroad crossing failures
- Wild animal hits
- Domestic animal hits
- Edge drop-off problems
- Traffic control evaluation
- Deer fence location & maintenance
- RWIS needs

Construction:

- Construction zone crashes
- Traffic control evaluation
- Construction zone speed criteria
- Worker related crashes

Planning:

- Bicycle route evaluation
- Motorcycle risks by corridor
- Emergency vehicle problems
- Emergency vehicle access
- School bus routing
- DUI related
- Developed vs rural
- Access management
- Pedestrian routes
- School zone evaluation
- Recreation trailer & boat issues
- Fog related crashes
- Road rage issues
- Deficient geometrics
- Passing lane needs

Commercial vehicle operations:

- Commercial vehicle routing
- Crash rates by corridor
- Access to systems
- Refuse truck issues
- Defective vehicle crashes
- LCV routing
- LCV snow & ice crashes
- Wind related crashes
- Non-divisible loads
- Severe commercial vehicle crashes
- Off-tracking problems
- Drug & alcohol use
- Inspection program feedback
- Crash rates by vehicle type
- Loose material spillage
- Over-height vehicle routing
- Brake check sites
- LCV access
- Driver fatigue incidents
- Load shift problems
- Hazardous spills
- Railroad crossing/CMV incidents
- Guardrail/J-barrier/attenuator performance
- Driver histories & insurance

Risk Management:

- Policy reviews
- Litigation information

ITS Applications:

- Advisory speeds at curves
- Adverse weather advisories
- Avalanche warning systems
- Cross wind warning systems
- School zone systems
- Incident detection systems
- Congestion detection systems
- Intelligent road studs
- Fog warning systems
- Railroad grade crossing systems

Appendix C

Crash Data Codes

ACCIDENT SEVERITY

1 PROPERTY DAMAGE
2 POSSIBLE INJURY
3 BRUISES AND ABRASIONS
4 BROKEN BONES OR BLEEDING WOUNDS
5 FATAL

DIRECTION

1 NORTH
2 SOUTH
3 EAST
4 WEST

DAY OF WEEK

1 MONDAY
2 TUESDAY
3 WEDNESDAY
4 THURSDAY
5 FRIDAY
6 SATURDAY
7 SUNDAY

TRAFFIC CONTROL

1 OFFICER OR WATCHMAN
2 FLAGMAN
3 TRAFFIC SIGNAL
4 TRAFFIC SIGNAL (FLASHING)
5 STOP SIGN
6 YIELD SIGN
7 RAILROAD GATES OR SIGNAL
8 OTHER (SPECIFY)
9 NO CONTROL PRESENT
A SLOW OR WARNING SIGN
B TRAFFIC LANES MARKED
C NO PASSING LANE
D ONE-WAY ROAD OR STREET
E CONSTRUCTION OR WORK AREA
F RAMP METERING (ACTIVE)
G HOV LANE
H SCHOOL CROSS ZONE – FLASHER ACTIVE
I SCHOOL CROSS ZONE – FLASHER INACTIVE OR NOT PRESENT
J PEDESTRIAN CROSSING ZONE

ROADWAY CHARACTERISTICS

1 STRAIGHT AND LEVEL
2 GRADE STRAIGHT
3 HILLCREST STRAIGHT
4 CURVE LEVEL
5 CURVE GRADE
6 CURVE HILLCREST
7 DIP STRAIGHT
8 DIP CURVE

WEATHER

1 CLEAR
2 RAINING
3 SNOWING
4 FOG
5 DUST
6 MIST
7 SLEET/HAIL
8 CLOUDY
9 WINDSTORM

SURFACE CONDITIONS

1 DRY
2 WET
3 MUDDY
4 SNOWY
5 ICY
6 OILY

ROADWAY CONDITIONS

1 HOLES OR RUTS IN SHOULDER
2 HOLES, RUTS, BUMPS IN ROADWAY
3 LOOSE MATERIAL
4 OBSTRUCTION NOT LIGHTED (DARKNESS)
5 OBSTRUCTION NOT MARKED (DAYLIGHT)
6 ROAD UNDER CONSTRUCTION
7 ROADWAY REPAIRS
8 OBSTRUCTION - PREVIOUS ACCIDENT
9 OTHER - SPECIFY IN REMARKS

LIGHT

1 DAYLIGHT
2 DAWN
3 DARKNESS STREET OR HIGHWAY NOT LIGHTED
4 DARKNESS STREET OR HIGHWAY LIGHTED
5 DUSK

LOCALITY

1 MANUFACTURING/INDUSTRIAL
2 SHOPPING/BUSINESS
3 RESIDENTIAL
4 SCHOOL
5 FARMS AND FIELDS
6 OPEN COUNTRY
7 CHURCH
8 PLAYGROUND
9 RAILROAD TRACKS

TYPE OF ACCIDENT

1	MV - PEDESTRIAN
2	MV - MV
3	MV - TRAIN
4	MV - BICYCLE
5	MV - ANIMAL (WILD)
6	MV - FIXED OBJECT
7	MV - OTHER OBJECT
8	OVERTURNED
9	RAN OFF ROADWAY - THRU MEDIAN
A	OTHER NON-COLLISION
D	MV - ANIMAL (DOMESTIC)
L	RAN OFF ROAD LEFT
R	RAN OFF ROAD RIGHT

BODY STYLE TYPE CODE

(CODES IN USE PRIOR TO 01/01/02)

01	PASSENGER CAR - REGULAR
02	PASSENGER CAR - COMPACT

(CODES IN USE EFFECTIVE 01/01/02)

01	NOT USED
02	PASSENGER CAR
03	PASSENGER CAR & HOUSE TRAILER
04	PASSENGER CAR & BOAT
05	PASSENGER CAR & OTHER TRAILER
06	PASSENGER CAR - PUBLIC OWNED
07	PICKUP OR SUV
08	PICKUP OR SUV & HOUSE TRAILER
09	PICKUP OR SUV & BOAT
10	PICKUP OR SUV & OTHER TRAILER
11	PICKUP OR SUV & PUBLIC OWNED
12	PICKUP WITH CAMPER
13	SINGLE UNIT ENCLOSED BOX (MIN 2 AXLES & 6 TIRES)
14	TRUCK & TRAILER
15	TRUCK TRACTOR-BOBTAIL (POWER UNIT ONLY)
16	TRACTOR & SHORT TRAILER
17	COMMERCIAL BUS
18	SCHOOL BUS
19	MOTORCYCLE
20	MOTORCYCLE - PUBLIC OWNED
21	MOTOR DRIVEN BICYCLE (SCOOTER OR MOPED)
22	AMBULANCE - NOT EMERGENCY
23	AMBULANCE - EMERGENCY
24	AMBULANCE - PUBLIC OWNED
25	FARM TRACTOR AND/OR EQUIPMENT
26	SPECIAL MOBILE EQUIPMENT (CONSTRUCTION, FIRE, UP&L, ETC.)
27	TRUCK & MOBILE HOME
28	OTHER, HORSE-DRAWN CARRIAGE (PLANE, ETC.)
30	ATV, 3 & 4 WHEELERS/SNOWMOBILE
31	TRUCK & 2 SHORT TRAILERS (95' TOTAL LENGTH)
32	TRUCK & LONG TRAILER (77' TOTAL LENGTH)
33	TRACTOR - 2 SHORT TRAILERS (TRAILER UP TO 28' EACH)
34	TRACTOR - 2 TRAILERS (95' TOTAL EACH)
35	TRACTOR - 2 LONG TRAILERS (PERMITTED TO 105' FREEWAY)
36	TRACTOR - LONG TRAILER-SHORT TRAILER (98' TOTAL LENGTH)
37	TRACTOR - 3 SHORT TRAILERS (PERMITTED TO 105' FREEWAY)
38	TRACTOR & LONG TRAILER
40	HIT & RUN VEHICLE
41	CARGO TANK
42	PASSENGER CAR W/ VEHICLE IN TOW
43	PICKUP W/ VEHICLE IN TOW
44	TRACTOR W/ VEHICLE IN TOW
45	MOTORHOME
46	MOTORHOME W/BOAT OR VEHICLE IN TOW
47	FLATBED/TOW TRUCK
48	DUMP TRUCK
49	CONCRETE MIXER
50	GARBAGE/REFUSE
51	AUTOTRANSPORTER
52	SNOWPLOW
60	UNKNOWN DESCRIPTION

CONTRIBUTING CIRCUMSTANCES

00	DID NOT CONTRIBUTE
01	SPEED TOO FAST
02	FAILED TO YIELD RIGHT OF WAY
03	DROVE LEFT OF CENTER
04	IMPROPER OVERTAKING
05	PASSED STOP SIGN
06	DISREGARD TRAFFIC SIGNAL
07	FOLLOWED TOO CLOSELY
08	MADE IMPROPER TURN
09	HAD BEEN DRINKING
10	UNDER THE INFLUENCE OF DRUGS
11	EYESIGHT DEFECTIVE UNCORRECTED
12	ASLEEP
13	FATIGUED
14	ILL
15	IMPROPER PARKING
16	IMPROPER LOOKOUT
17	FAILED TO SIGNAL
18	OTHER IMPROPER DRIVING
19	BRAKES DEFECTIVE
20	HEADLIGHT INSUFFICIENT OR OUT
21	HEADLIGHTS GLARING
22	OTHER LIGHTS OR REFLECTORS DEFECTIVE
23	STEERING MECHANISM DEFECTIVE
24	TIRES DEFECTIVE
25	WINDSHIELD NOT CLEAR

26	OTHER DEFECTIVE CONDITION OF VEHICLE
27	HIT AND RUN
28	DUI (ALCOHOL)
29	NON-COLLISION (FIRE)
30	COLLISION (FIRE)
40	STOLEN
41	NON-CONTACT VEHICLE INVOLVED
42	JACKKNIFE
43	DOWNHILL RUNAWAY
44	CARGO LOSS OR SHIFTED
45	EXPLOSION OR FIRE
46	SEPARATION OF UNITS
47	WRONG SIDE OF ROAD
48	WRONG WAY ON ONE WAY STREET
49	IMPROPER BACKING
50	IMMERSION
51	TOWED VEHICLE
52	VEHICLE ROLLING IN A TRAFFIC LANE
53	DRIVER USING CELL PHONE
54	OTHER DRIVER DISTRACTIONS
55	OBJECT IN ROADWAY
56	AGGRESSIVE DRIVING

DRIVER INTENT

01	GO STRAIGHT AHEAD
02	OVERTAKE (PASSING)
03	MAKE RIGHT TURN
04	MAKE LEFT TURN
05	MAKE U TURN
06	SLOW OR STOP
07	START IN TRAFFIC LANE
08	START FROM PARKED POSITION
09	BACK
10	REMAIN STOPPED IN TRAFFIC LANE
11	REMAIN PARKED
12	CHANGING LANES
13	MERGE OFF OR ONTO ROADWAY

DRIVER VISION

01	NOT OBSCURED
02	RAIN, SNOW, ETC. ON WINDSHIELD
03	WINDSHIELD OTHERWISE OBSCURED BY VEHICLE LOAD
04	VISION OBSCURED BY VEHICLE LOAD
05	"TREES, CROPS, ETC"
06	BUILDING
07	EMBANKMENT
08	SIGNBOARD
09	HILLCREST
13	OTHER
10	PARKED VEHICLES
11	MOVING VEHICLES
12	SUN OR HEADLIGHT GLARE

SAFETY EQUIPMENT

0	HELMET AND EYE PROTECTION USED
1	LAP BELT USED
2	LAP & SHOULDER BELT USED
3	BELTS NOT USED
4	BELTS NOT INSTALLED
5	CHILD RESTRAINTS USED
6	AIR BAG INFLATED WITH BELTS
7	AIR BAG INFLATED/WITHOUT BELTS
8	HELMET WORN
9	EYE PROTECTION USED
A	SHOULDER BELT ONLY
C	UNKNOWN
D	CHILD RESTRAINT USED IMPROPERLY
E	AIR BAG INFLATED WITH CHILD RESTRAINT USED
F	HELMET NOT WORN

OBJECT STRUCK

A	GUARDRAIL
B	GUARDRAIL END SECTION
C	UTILITY POLE
D	SIGN POST
E	DELINEATOR POST
F	BRIDGE CULVERT OR OTHER HIGHWAY STRUCTURE
G	CURB
H	CURB OR SAFETY ISLAND
I	FENCE
J	RIGID BARRIER (CONCRETE)
K	CRASH ATTENUATOR
L	DIRT ENBANKMENT/DITCH/BERM (MOUNTAINSIDE)
M	WILD ANIMAL
N	DOMESTIC ANIMAL
O	SNOW EMBANKMENT
P	MAILBOX OR FIRE HYDRANT
Q	TRAFFIC CHANNELIZATION DEVICE
R	TREE/SHURBBERY
S	BUILDING/OTHER STRUCTURE (Wall)
T	OTHER

PEDESTRIAN ACTION

00	NOT STATED
01	CROSSING AT INTERSECTION - WITH SIGNAL
02	CROSSING AT INTERSECTION - AGAINST SIGNAL
03	CROSSING AT INTERSECTION - NO SIGNAL
04	CROSSING AT INTERSECTION - DIAGONALLY
05	CROSSING NOT AT INTERSECTION
06	WALKING IN ROADWAY - WITH TRAFFIC
07	WALKING IN ROADWAY - AGAINST TRAFFIC
08	STANDING ON MEDIAN ISLAND IN CROSSWALK
09	OTHER STANDING IN ROADWAY
10	GETTING ON OR OFF BUS
11	GETTING ON OR OFF OTHER VEHICLE
12	PUSHING OR WORKING ON VEHICLE IN ROADWAY
13	OTHER WORKING IN ROADWAY
14	PLAYING IN ROADWAY
15	COMING FROM BEHIND PARKED CARS
16	HITCHING ON VEHICLE
17	LYING IN ROADWAY
18	VENDING IN ROADWAY
19	OTHER IN ROADWAY
20	NOT IN ROADWAY
21	RIDING IN ROADWAY WITH TRAFFIC
22	RIDING IN ROADWAY AGAINST TRAFFIC
23	WALKING TO OR FROM SCHOOL
24	WALKING ON SIDEWALK
25	RIDING ON SIDEWALK
26	CROSSWALK NOT AT INTERSECTION

INTERSECTION TYPE

A	STANDARD 4 LEGGED INTERSECTION
B	TEE INTERSECTION, LEG TO WEST
C	TEE INTERSECTION, LEG TO EAST
D	TEE INTERSECTION, LEG TO SOUTH
E	TEE INTERSECTION, LEG TO NORTH
F	5 LEGGED INTERSECTION, 5th LEG TO NORTH WEST
G	5 LEGGED INTERSECTION, 5th LEG TO NORTH EAST
H	5 LEGGED INTERSECTION, 5th LEG TO SOUTH WEST
I	5 LEGGED INTERSECTION, 5th LEG TO SOUTH EAST
J	WYE INTERSECTION, LEG TO SOUTH
K	WYE INTERSECTION, LEG TO NORTH
L	WYE INTERSECTION, LEG TO WEST
M	WYE INTERSECTION, LEG TO EAST
Z	TWO ROADS THAT INTERSECT INTO A NEW ROAD

COUNTY CODE

01	BEAVER
03	BOX ELDER
05	CACHE
07	CARBON
09	DAGGETT
11	DAVIS
13	DUCHESNE
15	EMERY
17	GARFIELD
19	GRAND
21	IRON

23 JUAB
25 KANE
27 MILLARD
29 MORGAN
31 PIUTE
33 RICH
35 SALT LAKE
37 SAN JUAN
39 SANPETE
41 SEVIER
43 SUMMIT
45 TOOELE
47 UINTAH
49 UTAH
51 WASATCH
53 WASHINGTON
55 WAYNE
57 WEBER

COLLISION TYPE

01 HEAD ON OPPOSITE DIRECTION - BOTH VEHICLES STRAIGHT
02 LEFT TURN OPPOSITE DIRECTIONS - ONE STRAIGHT, ONE TURNING LEFT
03 REAR END SME DIRECTION - BOTH VEHICLES STRAIGHT
04 REAR END SAME DIRECTION - ONE STRAIGHT, ONE TURNING RIGHT
05 REAR END SAME DIRECTION - ONE STRAIGHT, ONE TURNING LEFT
06 SIDE SWIPE OPPOSITE DIRECTIONS - BOTH STRAIGHT
07 SIDE SWIPE SAME DIRECTION - BOTH STRAIGHT
08 LANE CHANGE SAME DIRECTION - ONE STRAIGHT, ONE TURNING RIGHT
09 LANE CHANGE SAME DIRECTION - ONE STRAIGHT, ONE TURNING LEFT
10 LANE CHANGE SAME DIRECTION - BOTH TURNING LEFT

11 RIGHT ANGLE - BOTH VEHICLES STRAIGHT
12 RIGHT ANGLE - ONE STRAIGHT, ONE FROM RIGHT TURNING RIGHT
13 RIGHT ANGLE - ONE STRAIGHT, ONE FROM LEFT TURNING LEFT
14 RIGHT ANGLE - ONE STRAIGHT, ONE FROM RIGHT TURNING LEFT
15 LEFT TURN OPPOSITE DIRECTION - BOTH TURNING LEFT
16 OPPOSITE TURNS SAME DIRECTION - ONE TURNING LEFT, ONE TURNING RIGHT
17 SINGLE VEHICLE
18 BACKING
19 SIDE SWIPE SAME DIRECTION - BOTH TURNING RIGHT
20 APPROACHING AT AN ANGLE - BOTH TURNING RIGHT
21 APPROACHING AT AN ANGLE - BOTH TURNING LEFT
22 ONE STRAIGHT, ONE MAKING U-TURN
23 OPPOSITE TURNS OPPOSITE DIRECTION - ONE TURNING LEFT, ONE TURNING RIGHT
24 ONE STRAIGHT, ONE FROM LEFT TURNING RIGHT
25 APPROACHING AT AN ANGLE - ONE TURNING LEFT, ONE TURNING RIGHT
26 ONE MOVING, ONE PARKED

POSITION IN/ON VEHICLE

11 FIRST ROW DRIVER
12 FIRST ROW MIDDLE PASSENGER
13 FIRST ROW RIGHT HAND PASSENGER
21 SECOND ROW LEFT HAND PASSENGER
22 SECOND ROW MIDDLE PASSENGER
23 SECOND ROW RIGHT HAND PASSENGER
31 THRIRD ROW LEFT HAND PASSENGER
32 THIRD ROW MIDDLE PASSENGER
33 THIRD ROW RIGHT HAND PASSENGER

41 FOURTH ROW LEFT HAND PASSENGER
42 FOURTH ROW MIDDLE PASSENGER
43 FOURTH ROW RIGHT HAND PASSENGER
50 SLEEPER SECTION OF CAB (TRUCK)
51 OTHER PASSENGER IN ENCLOSED PASSENGER OR CARGO AREA
52 OTHER PASSENGER IN UNENCLOSED PASSENGER OR CARGO AREA (MOTORCYCLE)
54 TRAILING UNIT
55 RIDING ON VEHICLE EXTERIOR
88 UNATTENDED VEHICLE

ALTERED VEHICLE

(CODES IN USE EFFECTIVE 01/01/02)
1 ALTERED LIFT
2 ALTERED LOWERED
3 BODY
4 TINTED WINDOWS
5 OTHER
6 NONE

ALTERED VEHICLE

(CODES IN USE PRIOR TO 01/01/02)
1 SUSPENSION
2 BODY
3 TINTED WINDOWS
4 OTHER
5 NONE

DESCRIPTION OF CARGO

A GENERAL FREIGHT
B HOUSEHOLD GOODS
C HEAVY MACHINERY
D MOTOR VEHICLES
E GASES IN BULK
F LIVESTOCK
G SOLIDS IN BULK
H LIQUIDS IN BULK
I EXPLOSIVES
J REFRIGERATED FOODS
K EMPTY
L OTHER
M COMPRESSED GASES
N FLAMMABLE/COMBUSTIBLE LIQUIDS
O. FLAMMABLE SOLIDS; SPONTANEOUSLY COMBUSTIBLE, WATER REACTIVE
P OXIDIZERA
Q POISONOUS AND INFECTIOUS SUBSTANCES
R RADIOACTIVE MATERIALS
S CORROSIVES
T OTHER REGULATED MATERIALS (ORM)*