







































































MISSOURI STATE HIGHWAY PATROL TECHNICAL ACCIDENT INVESTIGATION REPORT

County:

Lewis

Date:

Time:

1230 hours

Location:

Driver:

Original Investigating Officer:

Trooper Anthony A. O'Brien, #810

Reconstructionist:

Sergeant Gregory K. Leftwich, #748

Date Reconstructionist Notified:

July 28, 2005

Date of Report:

July 28, 2005

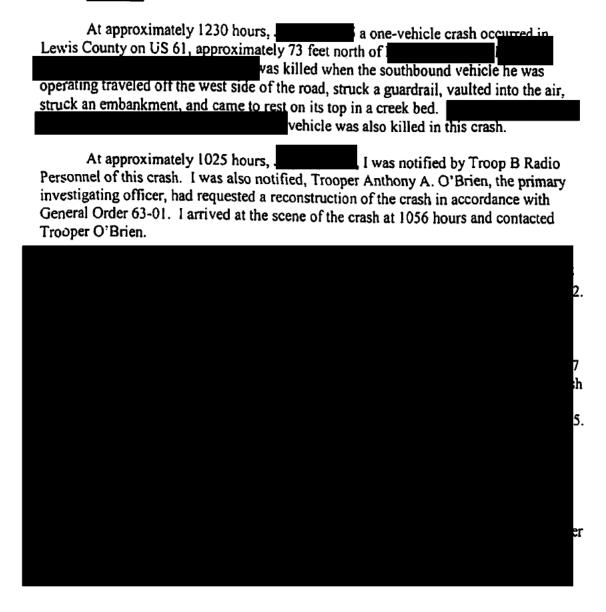
Reviewed By:

Sergeant G. W. Bergfeld, #106

Reviewed Date:

August 29, 2005

Synopsis



Environmental Factors

US 61 at the crash location is a and they cross Durgens Creek on separate bridges. The southbound lanes are level, have a slight left-hand curve, and are 23 feet 8 inches wide. The right shoulder is 10 feet 11 inches wide and the left shoulder is 8 feet 1 inch wide. The roadway is composed of concrete and the shoulders are composed of a bituminous material. The roadway and shoulders at the crash location appear to be well maintained with no noticeable defects.

Missouri Department of Transportation blueprints of the crash location are attached to this report.

This crash was estimated to have occurred at approximately 1230 hours of the climate was mild, the sky clear, and the temperatures in the mid 80's. Weather and roadway conditions were not factors in this crash.

Mechanical Factors

The odometer reading could not be obtained due to the damage incurred by vehicle #1 during the crash. The steering, suspension, and braking systems were intact and appeared to be in working order prior to the crash. Both front tires were Douglas Xtra Trac AW P185/75 R14's. The rear tires on Vehicle #1 were Cooper Trend Setter SE, P185/75 R14's. Upon my inspection, both front tires had 8/32 of an inch tread depth and were flat, this apparently occurring during the crash. The rear tires had 5/32 of an inch of tread depth. The left rear tire upon my inspection was flat however the right rear tire was still inflated. This vehicle is not equipped with driver or passenger side airbags. The driver and his passenger did utilize the seatbelts in this vehicle. The vehicle received severe damage to the entire vehicle especially the roof of the passenger compartment.

Vehicle #1 was towed from the scene by Robert's Garage of Ewing, Missouri and taken to their facility. Linspected the principal vehicle at the scene and at Robert's garage or

The mechanical condition of the principal vehicle was not a factor in this crash.



Scene Investigation

I made a thorough investigation of the crash scene or an analysis and August 1, 2005. Photographs of the scene and the principal vehicle were obtained and are attached to this report. Measurements of the crash scene were obtained by Trooper Anthony A. O'Brien and were recorded on his diagram contained in the Missouri Uniform Accident report, SHP-2N, which he completed during his investigation of the crash. A copy of the diagram completed by Trooper O'Brien is attached to this report.

Evidence at the crash scene indicated Vehicle #1 was southbound on US 61 approaching Bridge #A3148 which crosses Durgens Creek. Vehicle #1 went out of control and went into a critical scuff. The vehicle rotated clockwise and skidded off the west side of the road. The vehicle struck a guardrail as it vaulted into the air when it left the roadway. Vehicle #1 flipped through the air a distance of 157 feet and falling 20.7 feet before striking the south bank of Durgens Creek. Vehicle #1 then came to final rest on its top in the Creek bed facing east.

There were pre-impact tire marks left by the principal vehicle and it vaulted through the air in this crash. The following is a scientific assessment of the speed of the Walker vehicle. First, the coefficient of friction was determined for the roadway at the crash scene. Then measurements of two chords and middle ordinates of the yaw mark made by Vehicle #1 were obtained. The measurements of the chord, middle ordinate, and the coefficient of friction were then placed into critical speed formulas to determine a range for the speed of the Walker Vehicle prior to leaving the roadway. Sergeant Mike Mahon, Major Crash Investigation Unit, and I made measurements, with the use of a total station device, of the distance the Walker vehicle vaulted from the guardrail to where it landed in the creek bed. Sergeant Mahon then placed those measurements into a vault formula (Appendix II) to determine the speed the Walker vehicle was traveling when it vaulted.

The coefficient of friction (drag factor) of the roadway's surface was determined with the use of a drag tire. The tire was weighed and then pulled on the same surface and in the same direction vehicle #1 skidded. The same scale used to weigh the drag tire was used when the drag tire was pulled on the roadway's surface. The weight of the drag tire was 30 pounds. The amount of force needed to pull the drag tire on the roadway's surface in the same direction vehicle #1 skidded was 23 pounds. The coefficient of friction of US 61 at the crash location was determined to be .76.

f = Drag Factor

F = Force needed to pull the drag tire on the surface to be measured.

W = Weight of the drag tire

$$Formula$$

$$F = 23$$

$$W = 30$$

$$f = \frac{F}{W} = \frac{23}{30} = .76$$

The critical speed of vehicle #1 was determined from measurements of the yaw marks it made during the crash. A chord and middle ordinate measurement was obtained in the first third of the yaw mark after rear wheel crossover to determine the radius of the curved tire mark made by vehicle #1. A second chord and middle ordinate measurement were made farther into the skid to give a range in speed for vehicle #1. The Radius' and the Drag factor were then placed into the critical speed formula to determine vehicle #1's speed. The first chord measurement used was 30 feet and the middle ordinate was 2 inches (.16 feet). The drag factor or coefficient of friction from the above formula was .76.

Radius Formula

$$R = \frac{C^2}{8(m)} + \frac{m}{2}$$

R = Radius

C = Chord = 30

m = Middle Ordinate = .16

8 = mathematical constant

2 = mathematical constant

$$R = \frac{30^{2}}{8(.16) \div 2}$$

$$\frac{900}{R = 1.28 + .08}$$

$$R = 703.125 + .08$$

$$R = 703.205$$

The radius is adjusted by subtracting half of the vehicle's width from the existing radius to accommodate for the travel of the center of mass. The width of vehicle #1 is 5 feet.

$$R = 703.205 - 2.5 = 700.705$$

Critical Speed Formula

$$S = 3.86 \times [\overline{R(f)}]$$

S = Speed R = Radius = 700.705 f = Drag Factor = .76 3.86 = mathematical constant

$$S = 3.86 \times [\sqrt{700.705(.76)}]$$

$$S = 3.86 \times [\sqrt{532.5358}]$$

$$S = 3.86 \times 23.0767372$$

$$S = 89.07620561$$

A second chord and middle ordinate measurement were obtained from the yaw mark made by vehicle #1 during this crash. The second chord measurement used was 30 feet and the second middle ordinate was 2.5 inches (.20 feet). The drag factor or coefficient of friction was .76.

Radius Formula

$$R = 8(m) + 2$$

$$R = 8(.20) + 2$$

$$R = 8(.20) + 2$$

$$R = \frac{900}{1.6 + .1}$$

$$R = 562.5 + .1$$

$$R = 562.6$$

The radius is adjusted by subtracting half of the vehicle's width from the existing radius to accommodate for the travel of the center of mass. The width of vehicle #1 is 5 feet.

$$R = 562.6 - 2.5 = 560.1$$

Critical Speed Formula #2

S = 3.86 x [
$$\sqrt{R(F)}$$
]
S = 3.86 x [$\sqrt{560.1(.76)}$]
S = 3.86 x [$\sqrt{425.676}$]
S = 3.86 x 20.63191702
S = 79.6391997

The speed of vehicle #1 was determined to be from 89 to 79 miles per hour. Sergeant Mike Mahon used measurements taken from the vault of vehicle #1 and determined the speed to be 89 miles per hour (see Appendix II). The posted speed limit for US 61 at the crash scene is 65 miles per hour. Speed was a factor in this crash.

Findings

Vehicle #1 was southbound on US 61 approaching brid vehicle #1 went into a critical scuff and skidded off the west side of the road. The vehicle struck a guardrail as it vaulted into the air. The vehicle flipped though the air and struck the south bank of the vehicle #1 came to rest on its top in the creek bed facing east. The crash occurred or at approximately 1230 hours and was not discovered until approximately 0945 hours, July 28, 2005. Driver #1 and his passenger were killed during the crash.

Event Analysis

Investigation has shown that weather, roadway conditions, and mechanical conditions of the principal vehicle were not factors in this crash. There is no evidence to indicate was impaired at the time of the crash.

US 61 is posted at 65 miles per hour. The state of the st

Sergeant G.K. Leftwich, #748 Reconstructionist

Sergeant G.W. Bergfeld, #106 Reviewing Reconstructionist

Appendixes

Appendix I - Photo Log

Appendix II - Mathematical equations (4 pages).
Appendix III - Delorme Map locating crash area.

Appendix IV - Delorme Map locating crash area (magnified view).

Appendix V - Diagram of the crash scene.

Appendix VI - MoDOT blueprint of the roadway at the crash location.

Appendix VII - MoDOT blueprint of the roadway prior to the crash location.

Photograph Log

Date of Crash:

Location of Crash:

Driver #1:

Original Investigating Officer:

Trooper Anthony A. O'Brien, #810

Reconstructionist: Sergeant G.K. Leftwich, #748

Photographer:

Sergeant G.K. Leftwich, #748

The following is a log of the photographs taken at the crash scene location and the principal vehicle. The negatives are stored at the Missouri State Highway Patrol General Headquarters, Accident Records Section, in Jefferson City, Missouri.

- ı. Photo #2 - View of Vehicle #1 at final rest.
- 2. Photo #3 - View of the crash location looking north.
- 3. Photos #4 through #12 - Views of Vehicle #1 at the final rest.
- 4. Photos #13 through #19 - Views of the roadway at the crash location looking south.
- 5. Photos #20 through #22 - Views of the skid marks and damage to the guardrail at the crash location.
- 6. Photos #23 through #25 - View of the crash location looking south from the guardrail.
- 7. Photos #26 and #27 - Views of the crash location, looking north.
- 8. Photos #28 through #36 - Views of Vehicle #1 taken at Robert's garage in Ewing, Missouri.
- 9. Photo #37 - View of Vehicle #1's V.I.N.

C:\RECONSTRUCTIONS\20	05\0727B\0727B	Job Description:	
11:08:33		-	Page No.: 1
1 N: 0.000 E:			
100 N: 20.546 E:	-14.004 El:	98.876 D: RP	
	-32.718 El:		
102 N: 149.307 E:	-27.396 El:	100.154 D: TM	
103 N: 97.490 E:	-19.734 El:	100.806 D: TM	
104 N: 55.978 E:	-14.310 El:	101.593 D: TM	
105 N: 48.768 E:	-18.123 El:	100.625 D: TM	
106 N: 30.981 E:	-7.092 El:	101.059 D: TM	
107 N: 53.431 E:	-20.894 El:	103.646 D: GR	
108 N: 47.717 E:			
109 N: 42.353 E:	-15.401 El:	103.649 D: GR	
110 N: 37.121 E:			
111 N: 32.078 E:			
112 N: 26.781 E:			
113 N: 21.363 E:	-1.864 El:	103.702 D: GR	
114 N: 31.036 E:	-7.214 El:	101.034 D: MP	
	-18.284 El:	100.642 D: MP	
116 N: -113.718 E:	15.677 El:	82.900 D: MP	
	15.993 El:		
118 N: 20.552 E:	-14.013 El:	98.877 D: RM	
104 N: 55.978 E:	-14.310 El:	101.593 D: TM	
101 N: 196.848 E:	-32.718 El:	-99.331 D: TM	

2.262/142.069= 0.015921953 1.5 percent grade or 0.91 degrees

As Vehicle #1 scuffed across the left lane, right lane and the shoulder, it was traveling up a 1.5 percent grade or 0.9 degree.

The horizontal distance was measured from the center of the guard rail damage to the impact with the bank at the base of the small tree. That was a distance of 157.0'. The car fell 20.7' from 103.6' (height of the guardrail) to 82.9' (height of the base of the small tree). I ranged the takeoff angle from 0 to 29.9 degrees.

CASE NUMBER: None

* * SPEED W/ AIRBORNE * *

$$S = \frac{2.73 \times D}{\cos \Theta \times \sqrt{\pm h \pm (D \times Tan\Theta)}}$$

S = TreSpeedinMPH 2.73 = AConstant. D = TreDistance in Feet. h = The Height in Feet.

⊕ = The Departure Angle in Degrees.

S = 428.6100 0.9998 × √23.1806

S = 428.6100 0.9998 × 4.8146

S = 89.0414

RESULTS	:
The Speed in MPH is:	89.0414
The Velocity in FPS is:	130.5940

(NPUR	5:
The Distance in Feet is:	157.0000
The Height in Feet is:	20.7000
The Depart, Angle is:	0.9100

Sgt Midrad H. Mahon, § 298, GSS Missouri State Highway Patrol 599 South Mason Road St. Louis, Missouri, 63141 Phone 636-639-9017 Rax 636-639-1878

EMail intored.namon@nshp.dps.nragov

12411

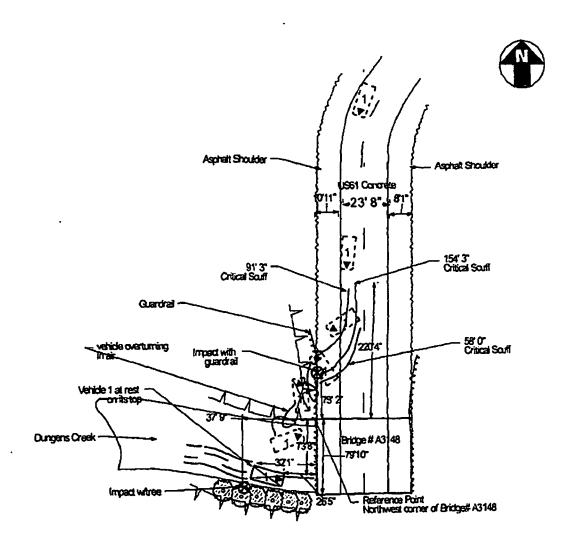
CASE NUME	set None				
INCREMENTATION CALC'S					
Dep Angle 0.0000	Speed 94.2062	Dep Argle 5.0000	Speed 77 7/06	Dep Angle 10.0000	Speed 62.5735
0.1000	93.6156	5.1000 5.1000	73.3406 73.0493 72.7691	10.1000	62.4113
12000	93.0244	5.1000 5.2000	72.7691	10,2000	62.4113 62.2554
0.3000 0.4000	92.4126	5.3000 5.4000	72.5007	10.3000	62.0957
). 500 0	91.8443	5.4000	72.2258	10.4000	61.9369 61.7798
D.6000	91.2538 90.7072	5.5000	71.97 [] 71.605/1	10.5000	61.6243
0.7000	90.1388	5.5000 5.6000 5.7000 5.8000	72.7697 72.5097 72.5258 71.9711 71.6954 71.4302 71.1834 70.9184	10.6000 10.7000 10.8000	61.4697
0.8000	89.6111	5.8000	71.1834	10.8000	61.4697 61.3228
0.9000 1.0000	89.0729 88.5631	59113	70.9184	10.9000 11.0000 11.1000 11.1000	61.1705
1.000	88.5631	6.0000	/U.0024	11.0000	61.0207
1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000 1.9000 2.1000 2.1000 2.2000 2.3000 2.4000 2.50000 2.50000 2.50000 2.50000 2.50000 2.5000 2.5000 2.5000 2.50	88.0337 87.5518	6.1000 6.2000	70.4244 70.1742	11.1000 44.2000	60.8777 60.7208
1.3000	87.0680	6.3000	69.9280	11.3000	60.5740
1.4000	87.0680 86.5651	6.3000 6.4000	69.6972	11.3000 11.4000	60,4348
.5000	86.1060 85.6209	6.5000 6.6000	69.4555 69.2166	11.5000	60.2911 60.1549
.6000	85.6209	6.6000	<u>69.2166</u>	11.5000 11.5000 11.6000 11.7000 11.8000 11.9000 12.1000 12.2000	60.1549
./WJ	85.1768 84.7072	6.7000 6.8000	68.9937 68.7602	77./000	60.0134 59.8700 59.7307 59.5986
	94.7072 94.2774	6000	68.5282	11.000	50.7707
	84.2774 83.8291	7,000	68.3130	12,0000	59.5986
1000	83.4050	7.1000	68.0862	12.1000	59.4672
.2000	83.4050 82.9722	7.2000	67.8620	12.2000	59.4672 59.3231
.3000	82.5679 82.1406	7.3000	67.6467	12,3000 12,4000	59.1945
24000	82.1406	7.4000	67.4413 67.2245 67.0080	124000	59.1945 59.0672 58.9405 58.8014 58.6767 58.5540
	81.7489 81.3409	7.5000 7.6000	67.2243 67.0000	125000	50.940
7000	80.9614	7.7000 7.7000	66 8033	12,7000	58.6767
.8000	80.5567	7.8000	66.8033 66.6050	12.8000	58.5540
.9000	80.1889	7.9000	66.3966 66.1966	12,9000	58.4231
.0000	80.9614 80.5567 80.1889 79.8052	8.0000	66.1966	13.0000	58.3023 58.1734
.1000	/9.44/2 20.0220	8.1000	65.9927 65.7962	12,5000 12,5000 12,7000 12,7000 12,8000 12,9000 13,1000 13,1000 13,2000	58.1/54
2000 2000	/9.0/ <i>2</i> 0 79.72/10	8.2000 9.2000	05.7902 SE 6070	15.2000	57 0367
2000	79.4472 79.0720 78.7249 78.3622	8am	65.6079 65.4166	13.4000	58.0544 57.9367 57.8108
.5000	78.0241 77.6706 77.3412 76.9967	6.9000 7.0000 7.1000 7.2000 7.3000 7.4000 7.5000 7.6000 7.7000 8.0000 8.1000 8.2000 8.3000 8.3000 8.4000 8.5000 8.5000 8.5000	65.2195	13.3000 13.4000 13.5000 13.6000 13.7000	57.6949 57.5717 57.4567 57.3360
.6000	77.6706	8.6000	65.2195 65.0315	13.6000	57.5717
7000	77.3412	8.7000	64.8456	13.7000	57.4567
.8000 .9000	76.9967 76.6940	8.8000	64.6548	13.8000	5/.5560
3000 0000	76.6840 76.3493	8.9000	64.4836 64.3017	13.9000 14.0000	57.2227 57.1099
1000	76.0364	9.0000 9.1000	64.1171	14 1000	56.9990
2000	75 7100	9.2000	63.9401	14.2000 14.3000 14.4000 14.5000	56.8817 56.7725
3000	75.4143 75.0959 74.7814	9.3000	63.7641	14.3000	56.7725
4000	75.0959	9.4000	63.5901	14.4000	56.6629
5000	74.7814	9.5000	63.4179	14.5000	56.5478
.6000 .7000	74.4968 74.1899	9.6000 9.7000	63.2475 63.0716	14,6000 14,7000	56.4413 56.3345
.7000 .8000	74.1899 73.9122	9.8000 9.8000	63.0716 62.9041	14.7000 14.8000	56.2222
.9000	73.6127	9.9000	62.7384	14.9000	56.1242
-~~	13.0121	3.300	UL.1 3UH	1-1-0000	J. 1276
			130-1		

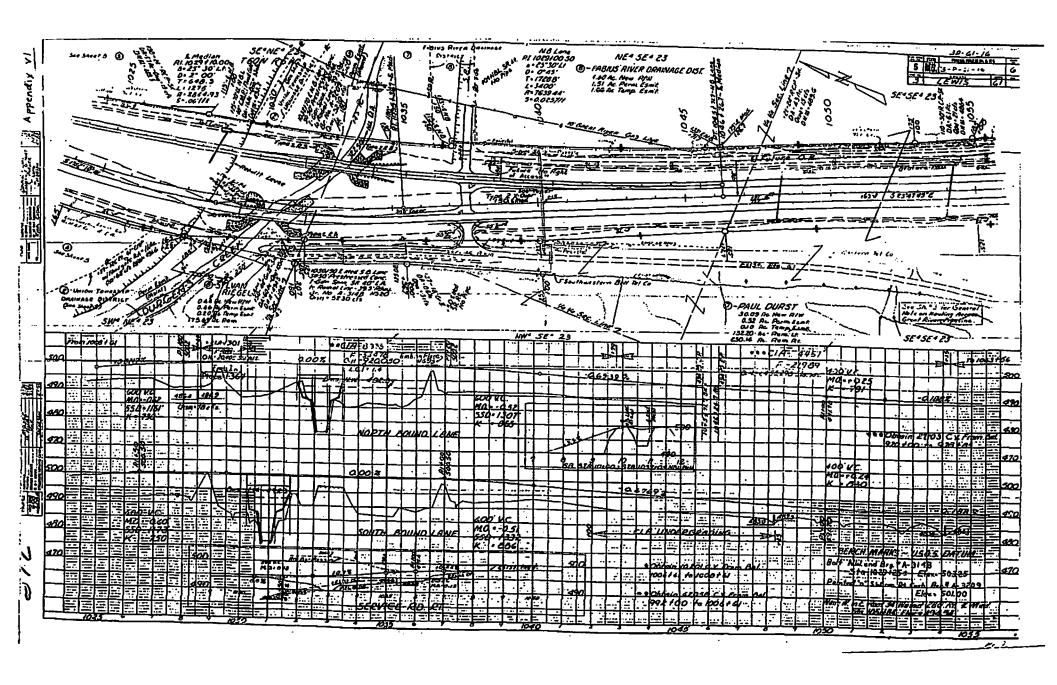
CASE NUMBER: None

INCREMENTATION CALC'S					
Dep Angle	Speed	Dep Angle	Speed	Dep Angle	Speed
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15.1000	55.9097 55.8078	20.1000	51.6354	25.1000	48.7599
5.2000	55.8078	20.2000	51.5652 51.4952 51.4309 51.3612 51.2930	25.2000	48.712
5.3000 5.4000	55.7055	20.3000	51.4952	25.3000 25.4000	48.670
5.4000	55.7055 55.6044 55.4985 55.3988	20.4000	51.4309	25.4000	48.620
5.5000	55.4985	20.5000 20.6000	51.3612	25.5000 25.6000	48.579
5.6000	55.3988	20.6000	51.2930	25.6000	48.529
5.7000	55.3066 55.2026	20.7000	51.2256 51.1577	25.7000	48.489
5.8000	55.2U26	20.8000	51.1577	25.7000 25.8000 25.9000	48.439
5.9000	55.1054 55.0092	20.9000	51.0906 51.0304	25.9000	48.400 48.357
6.0000	23.UU3Z	21.0000	51.0504	26.0000	40.33/
6.1000	54.9126	21.1000	50.9643 50.8983	26.1000	48.313 48.271
6.2000	54.8171 54.7470	21.2000	さいならなう EO 0704	26.2000	40.2/1
6.3000	54.7178	21.3000	50.8391	26.3000 26.4000	48.229 48.182
6.4000	54.6243 54.5312 54.4391	21.4000	50.7747 50.7062	20.4UU	40.102
6.5000	54.5512 EA 4704	21.5000	50.7062	26.5000	48.145
6.6000	24.4251 E4.2422	21.6000	50.6481	26.6000	48.104
6.7000	54.3473 54.2564	21.7000	50.5847 50.5281	26.7000	48.0639 48.0239
6.8000	24.2304 E4.46E0	21.8000	50.5287 FO 46FC	26.8000	48.UZ3:
5.9000	54.1659 F4.0764	21.9000 22.0000	50.4656 50.4045	26.9000	47,984 47,939
7.0000	54.0764 57.0033	22,000	50.4045 50.7475	27.0000 27.4000	47.559
7.1000	53.9933 53.9057	22.1000 22.2000	50.3435 50.2880	27.1000 27.2000	47.900 47.862
7.2000	33.3U3/ EZ 0477	22.2000	3U.400U 50.2222	27.2000 27.2000	47,00Z
7. 300 0 7. 400 0	53.8177 53.7307	22.3000 22.4000	50.2232 50.1691	27.3000 27.4000	47.823 47.785
7.5000	53.75U/ 53.6//6	22.4000	50.1091 50.1098	27.4000 27.5000	47.703
7.6000 7.6000	53.6446 53.5588 53.4746 53.3893	22.5000 22.6000	50.0507	27.5000 27.6000	47.747 47.710
7.7000 7.7000	53.47/K	22.2000 27.2000	49.99 3 0	27.7000	A7 675
7.8000 7.8000	53 3803	22,7000 22,8000	49.9405	27.7000 27.8000	47.675 47.638
7.9000	53.3123	22.9000	49.8836	27.9000	47 600
3.0000	53.3123 53.2229	23.0000	49.8836 49.8267	28.0000	47.602 47.5630
3.1000	53.1404	23.1000	49.7700	28.4000	47 527
3.2000	53.0648	23.2000	49.7146	28.1000 28.2000	47.527. 47.492
3.3000	52.9769	23.3000	49.6639	28.500	47.458
3,4000	52 9024	23.4000	49.6099	28.3000 28.4000	47.424
3.5000	52.8222	23:5000	49.5554	28.5000	47 386
3.6000	52.7429	23.5000 23.6000	49.5062	28.6000	47.3869 47.354
3.7000	52.8222 52.7429 52.6638 52.5856	23,7000	49.4525	28.7000	47.3210 47.2839
.8000	52.5856	23.7000 23.8000	49.4525 49.3995	28.8000	47,283
3.9000	52.5135	23.9000	49.3471	28.9000	47.253 47.217
.0000	52.5135 52.4306 52.3595 52.2835	23.9000 24.0000	49.3471 49.2949	28.9000 29.0000	47.217
1000	52.3595	24.1000	49.2428	29.1000 29.2000	47.190
1000 2000	52.2835	24.2000	49.1920	29,2000	47.190 47.154
3000	52.2077	24.3000	49.1412	29.3000	47,124
4000	52.1334	24,4000 24,5000	49.0956	29,4000	47.090
.5000	52.0587	24,5000	49.0456	29.5000	47.060
.6000	51.9905	24.6000	48.9963	29.6000	47,032
.7000	51.9168	24,7000	48.9470	29.7000	46 9987
9.8000	51.8452	24.8000	48.9035	29.8000	46,966
9.9000	51.7782	24.9000	48.8544	29.9000	46.9390
	* · · ***				
			7101		

Appendix III **DELORME** Street Atlas USA® 2004 CR 593 CR 588 CR 588 Approximate Area of Crash © 2003 DeLarme. Street Atlas USA® 2004. www.delorme.com 1" = 2.083.3 ft Data Zoom 13-0

Appendix V





Turn down

Not Caused
(not a GR end impact)

Rollover, Van Ited

MISSOURI STATE HIGHWAY PATROL TECHNICAL ACCIDENT INVESTIGATION REPORT

County:

Date:

Time:

Location:

Original Investigating Officer:

Trooper Anthony A. O'Brien, #810

Reconstructionist:

Driver:

Sergeant Gregory K. Leftwich, #748

Date Reconstructionist Notified:

July 28, 2005

Date of Report:

July 28, 2005

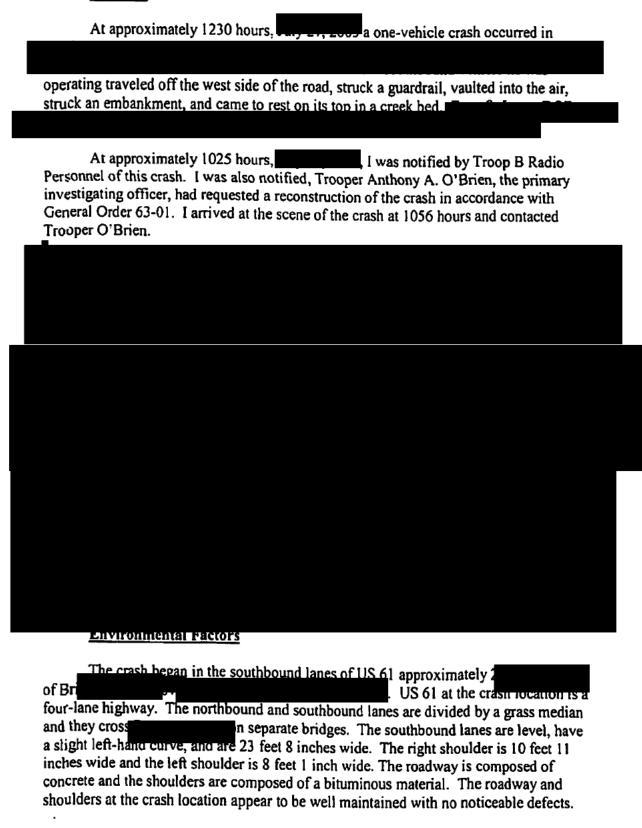
Reviewed By:

Sergeant G. W. Bergfeld, #106

Reviewed Date:

August 29, 2005

Synopsis



Missouri Department of Transportation blueprints of the crash location are attached to this report.

This crash was estimated to have occurred at approximately 1230 hours on The climate was mild, the sky clear, and the temperatures in the mid 80's. weather and roadway conditions were not factors in this crash.

Mechanical Factors

The odometer reading could not be obtained due to the damage incurred by vehicle #1 during the crash. The steering, suspension, and braking systems were intact and appeared to be in working order prior to the crash. Both front tires were Douglas Xtra Trac AW P185/75 R14's. The rear tires on Vehicle #1 were Cooper Trend Setter SE, P185/75 R14's. Upon my inspection, both front tires had 8/32 of an inch tread depth and were flat, this apparently occurring during the crash. The rear tires had 5/32 of an inch of tread depth. The left rear tire upon my inspection was flat however the right rear tire was still inflated. This vehicle is not equipped with driver or passenger side airbags. The driver and his passenger did utilize the seatbelts in this vehicle. The vehicle received severe damage to the entire vehicle especially the roof of the passenger compartment.

Vehicle #1 was towed from the scene by Robert's Garage of Ewing, Missouri and taken to their facility. I inspected the principal vehicle at the scene and at Robert's garage on

The mechanical condition of the principal vehicle was not a factor in this crash.

Human Factor

Scene Investigation

I made a thorough investigation of the crash scene on and 2005. Photographs of the scene and the principal vehicle were obtained and are attached to this report. Measurements of the crash scene were obtained by Trooper Anthony A.

O'Brien and were recorded on his diagram contained in the nich he completed during have been attached to this report.

A copy of the diagram completed by Trooper O'Brien is attached to this report.

approaching Vehicle #1 went out of control and went into a critical scuri. The vehicle rotated clockwise and skidded off the west side of the road. The vehicle struck a guardrail as it vaulted into the air when it left the roadway. Vehicle #1 flipped through the air a distance of 157 feet and falling 20.7 feet before striking the south bank of Durgens Creek. Vehicle #1 then came to final rest on its top in the Creek bed facing east.

There were pre-impact tire marks left by the principal vehicle and it vaulted through the air in this crash. The following is a scientific assessment of the speed of the Walker vehicle. First, the coefficient of friction was determined for the roadway at the crash scene. Then measurements of two chords and middle ordinates of the yaw mark made by Vehicle #1 were obtained. The measurements of the chord, middle ordinate, and the coefficient of friction were then placed into critical speed formulas to determine a range for the speed of the Walker Vehicle prior to leaving the roadway. Sergeant Mike Mahon, Major Crash Investigation Unit, and I made measurements, with the use of a total station device, of the distance the Walker vehicle vaulted from the guardrail to where it landed in the creek bed. Sergeant Mahon then placed those measurements into a vault formula (Appendix II) to determine the speed the Walker vehicle was traveling when it vaulted.

The coefficient of friction (drag factor) of the roadway's surface was determined with the use of a drag tire. The tire was weighed and then pulled on the same surface and in the same direction vehicle #1 skidded. The same scale used to weigh the drag tire was used when the drag tire was pulled on the roadway's surface. The weight of the drag tire was 30 pounds. The amount of force needed to pull the drag tire on the roadway's surface in the same direction vehicle #1 skidded was 23 pounds. The coefficient of friction of US 61 at the crash location was determined to be .76.

f = Drag Factor

F = Force needed to pull the drag tire on the surface to be measured.

W = Weight of the drag tire

$$Formula F = 23 W = 30$$

$$f = \frac{F}{W} = \frac{23}{30} = .76$$

The critical speed of vehicle #1 was determined from measurements of the yaw marks it made during the crash. A chord and middle ordinate measurement was obtained in the first third of the yaw mark after rear wheel crossover to determine the radius of the curved tire mark made by vehicle #1. A second chord and middle ordinate measurement were made farther into the skid to give a range in speed for vehicle #1. The Radius' and the Drag factor were then placed into the critical speed formula to determine vehicle #1's speed. The first chord measurement used was 30 feet and the middle ordinate was 2 inches (.16 feet). The drag factor or coefficient of friction from the above formula was .76.

Radius Formula

$$R = \frac{C^2}{8(m)} + \frac{m}{2}$$

R = Radius

C = Chord = 30

m = Middle Ordinate = .16

8 = mathematical constant

2 = mathematical constant

$$\frac{30^2}{R = 8(.16) \div 2}$$

$$\frac{900}{R = 1.28 \div .08}$$

$$R = 703.125 + .08$$

$$R = 703.205$$

The radius is adjusted by subtracting half of the vehicle's width from the existing radius to accommodate for the travel of the center of mass. The width of vehicle #1 is 5 feet.

$$R = 703.205 - 2.5 = 700.705$$

Critical Speed Formula

$$S = 3.86 \times [\sqrt{R(f)}]$$

S = Speed R = Radius = 700.705 f = Drag Factor = .76 3.86 = mathematical constant

$$S = 3.86 \times [\sqrt{700.705(.76)}]$$

$$S = 3.86 \times [\sqrt{532.5358}]$$

$$S = 3.86 \times 23.0767372$$

$$S = 89.07620561$$

A second chord and middle ordinate measurement were obtained from the yaw mark made by vehicle #1 during this crash. The second chord measurement used was 30 feet and the second middle ordinate was 2.5 inches (.20 feet). The drag factor or coefficient of friction was .76.

Radius Formula

$$R = \frac{C^{2}}{8(m)} + \frac{m}{2}$$

$$R = \frac{30^{2}}{8(.20)} + \frac{.20}{2}$$

$$R = \frac{900}{1.6} + .1$$

$$R = 562.5 + .1$$

$$R = 562.6$$

The radius is adjusted by subtracting half of the vehicle's width from the existing radius to accommodate for the travel of the center of mass. The width of vehicle #1 is 5 feet.

$$R = 562.6 - 2.5 = 560.1$$

Critical Speed Formula #2

S = 3.86 x [
$$\sqrt{R(F)}$$
]
S = 3.86 x [$\sqrt{560.1(.76)}$]
S = 3.86 x [$\sqrt{425.676}$]
S = 3.86 x 20.63191702
S = 79.6391997

The speed of vehicle #1 was determined to be from 89 to 79 miles per hour. Sergeant Mike Mahon used measurements taken from the vault of vehicle #1 and determined the speed to be 89 miles per hour (see Appendix II). The posted speed limit for US 61 at the crash scene is 65 miles per hour. Speed was a factor in this crash.

Findings

Vehicle #1 was southbound on US 6
went into a critical scuff and skidded off the west side of the road. The vehicle struck a
guardrail as it vaulted into the air. The vehicle flipped though the air and struck the south
bank Vehicle #1 came to rest on its top in the creek bed facing east.

The crash occurred on at approximately 1230 hours and was not discovered
until approximately 0945 hours,

Driver #1 and his passenger were killed
during the crash.

Event Analysis

Investigation has shown that weather, roadway conditions, and mechanical conditions of the principal vehicle were not factors in this crash. There is no evidence to indicate was impaired at the time of the crash.

US 61 is posted at 65 miles per hour was traveling between 80 and 89 miles per hour. For some unknown reason was not able to maintain complete control of his vehicle. In attention and excessive speed are the primary contributing factors in this crash.

Sergeant G.K. Leftwich, #748 Reconstructionist

Sergeant G.W. Bergfeld, #106 Reviewing Reconstructionist

Appendixes

Appendix I - Photo Log

Appendix II - Mathematical equations (4 pages).
Appendix III - Delorme Map locating crash area.

Appendix IV - Delorme Map locating crash area (magnified view).

Appendix V - Diagram of the crash scene.

Appendix VI - MoDOT blueprint of the roadway at the crash location.

Appendix VII - MoDOT blueprint of the roadway prior to the crash location.

Photograph Log

Date of Crash:

Location of Crash:

Driver #1:

Original Investigating Officer: Trooper Anthony A. O'Brien, #810

Reconstructionist: Sergeant G.K. Leftwich, #748

Photographer: Sergeant G.K. Leftwich, #748

The following is a log of the photographs taken at the crash scene location and the principal vehicle. The negatives are stored at the Missouri State Highway Patrol General Headquarters, Accident Records Section, in Jefferson City, Missouri.

- 1. Photo #2 View of Vehicle #1 at final rest.
- Photo #3 View of the crash location looking north.
- 3. Photos #4 through #12 Views of Vehicle #1 at the final rest.
- Photos #13 through #19 Views of the roadway at the crash location looking south.
- 5. Photos #20 through #22 Views of the skid marks and damage to the guardrail at the crash location.
- 6. Photos #23 through #25 View of the crash location looking south from the guardrail.
- 7. Photos #26 and #27 Views of the crash location, looking north.
- Photos #28 through #36 Views of Vehicle #1 taken at Robert's garage in Ewing, Missouri.
- 9. Photo #37 View of Vehicle #1's V.I.N.

C:\RECON	STRUCTIONS\20	05\0727B\0727B	Job Description:	
11:08:33			- 	Page No.: 1
1 N:	0.000 E:	0.000 El:	100.000 D: TS	
100 N:	20.546 E:	-14.004 El:	98.876 D: RP	
101 N:	196.848 E:	-32.718 El:	99.331 D: TM	
102 N:		-27.396 El:		
103 N:	97.490 E:	-19.734 El:	100.806 D: TM	
104 N:	55.978 E:	-14.310 El:	101.593 D: TM	
105 N:		-18.123 El:	100.625 D: TM	
106 N:		-7.092 El:		
107 N:	53.431 E:	-20.894 El:	103.646 D: GR	
108 N:	47.717 E:	-18.111 El:	103.600 D: GR	
109 N:		-15.401 El:	103.649 D: GR	
110 N:		-12.038 El:		
111 N:		-8.292 El:		
112 N:		-5.028 El:		
113 N:		-1.864 El:		
114 N:	31.036 E:	-7.214 El:	101.034 D: MP	
115 N:	48.601 E:	-18.284 El:	100.642 D: MP	
116 N:	-113.718 E:	15.677 El:	82.900 D: MP	
117 N:	-110.412 E:	15.993 El:	78.257 D: MP	
118 N:	20.552 E:	-14.013 El:	98.877 D: RM	
104 N:	55.978 E:	-14.310 El:	101.593 D: TM	
101 N:	196.848 E:	-32.718 El:	-99.331 D: TM	

2.262/142.069= 0.015921953 1.5 percent grade or 0.91 degrees

As Vehicle #1 scuffed across the left lane, right lane and the shoulder, it was traveling up a 1.5 percent grade or 0.9 degree.

The horizontal distance was measured from the center of the guard rail damage to the impact with the bank at the base of the small tree. That was a distance of 157.0'. The car fell 20.7' from 103.6' (height of the guardrail) to 82.9' (height of the base of the small tree). I ranged the takeoff angle from 0 to 29.9 degrees.

CASE NUMBER: None

* * SPEED W/ AIREORNE * *

$$S = \frac{2.73 \times D}{Cos \Theta \times \sqrt{\pm h \pm (D \times Tan\Theta)}}$$

S = The Speed in MPH. 2.73 = A Constant. D = The Distance in Feet.

2.73 × 157.0000

h = The Height in Feet.

 $\Theta = \text{The Departure Angle in Degrees}.$

S = 428.6100 0.9998 ×√23.1806

S = 428.6100 0.9998 × 4.8146

S = 89.0414

inputs:	
The Distance in Feet is:	157.0000
The Height in Feet is:	20.7000
The Depart. Angle is:	0.9100

RESULT	S:
The Speed in MPH is:	89.0414
The Velocity in FFS is:	130.5940

Sgt. Michael H. Marton. § 298, GSS Missouri State Highway Patrol 599 South Mascon Road St. Louis, Missouri, 63141 Phone 636-639-9017 Rax 636-639-1878

EMai: midrael.manor@nshpdps.magov

P261

CASE NUMBER: None **INCREMENTATION CALC'S** Dep Angle Dep Angle Speed Dep Angle Speed 94.2062 93.6156 93.0244 73.3406 73.0493 72.7691 62.5735 62.4113 0.0000 5.0000 10.0000 0.1000 0.2000 0.3000 5.1000 10.1000 62.2554 5.2000 10.2000 92.4126 91.8443 91.2538 5.3000 5.4000 5.5000 72.5007 72.2258 71.9711 10.3000 10.4000 10.5000 62.0957 0.4000 0.5000 61.9369 61.7798 0.6000 0.7000 61.6243 90.7072 5.6000 71.6954 10.6000 61.4697 90.1388 5.7000 5.8000 71.4302 10.7000 10.8000 89.6111 61.3228 0.8000 71.1834 0.9000 89.0729 88.5631 61.1705 61.0207 70.9184 5.9000 10.9000 6.0000 70.6624 70.4244 .000 11.0000 60.8777 .1000 88.0337 6.1000 11.1000 87.5518 70.1742 60.7208 60.5740 .2000 11.2000 6.2000 87.0680 86.5651 86.1060 85.6209 11.3000 11.4000 11.5000 11.6000 6.3000 6.4000 6.5000 1.3000 69.9280 4000 60.4348 69.6972 5000 60.2911 69.4555 69.2166 .6000 6.6000 60.1549 60.0134 59.8700 85.1768 84.7072 84.2774 83.8291 11.7000 11.8000 .7000 6.7000 6.8000 68.9937 68.7602 68.5282 .8000 59.7307 59.5986 .9000 6.9000 11.9000 68.3130 68.0862 ∞ 7.0000 7.1000 12,0000 59.4672 .1000 83.4050 121000 2.2000 2.3000 2.4000 2.5000 82.9722 7.2000 67.8620 12,2000 59.3231 7.3000 7.4000 7.5000 12,3000 12,4000 12,5000 82.5679 82.1406 67.6467 59 1945 67.4413 67.2245 59.0672 81.7489 58.9405 81.3409 26000 126000 7.6000 58.8014 67.0080 80.9614 7.7000 7.8000 7.9000 12,7000 12,8000 12,9000 2.7000 66.8033 58,6767 2.8000 80.5567 66.6050 58.5540 58.4231 66.3966 66.1966 65.9927 2.9000 80.1889 58.3023 58.1734 58.0544 13.0000 13.1000 79.8052 79.4472 8.0000 3.0000 .1000 8.1000 3.2000 79.0720 8.2000 65,7962 13.2000 78.7249 78.3622 78.0241 8.3000 8.4000 8.5000 13.3000 13.4000 13.5000 13.6000 3.3000 3.4000 65.6079 57.9367 65.4166 65.2195 65.0315 64.8456 64.6548 64.4836 57.8108 3.5000 57.6949 3.6000 8.6000 57.5717 77.6706 57.4567 57.3360 57.2227 .7000 .8000 77.3412 76.9967 76.6840 8.7000 13.7000 8.8000 13.8000 . 2000 8.9000 13.9000 76.3493 76.0364 75.7100 75.4143 75.0959 74.7814 64.3017 64.1171 63.9401 63.7641 63.5901 4.0000 4.1000 14.0000 14.1000 9.0000 57,1099 56.9990 9.1000 4.2000 4.3000 4.4000 56.8817 9.2000 14.2000 9.3000 14.3000 56.7725 9.4000 9.5000 14.4000 14.5000 56.6629 4,5000 63,4179 56.5478 74.4968 56.4413 4.6000 9.6000 63.2475 14.6000 63.0716 62.9041 62.7384 4.7000 4.8000 56.3345 74.1899 9.7000 14.7000 73.9122 9.8000 14.8000 4.9000 73.6127

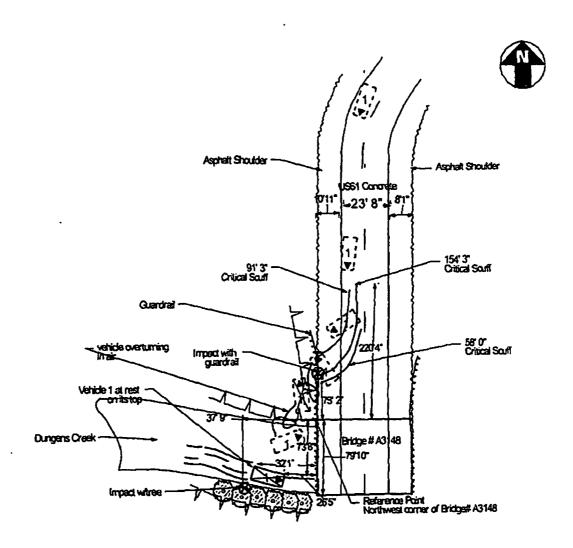
150-1

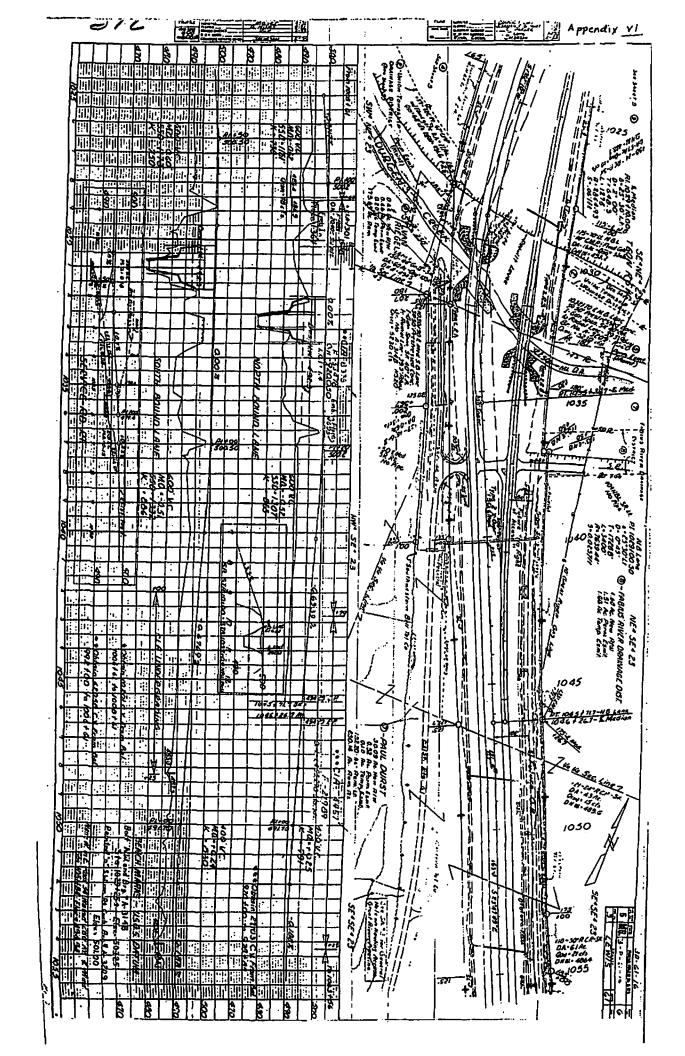
CASE NUMBER: None

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9097	20.1000	51 7064		
2070	20.1000	2:./007	25.0000	48.802
80/8 7055		51.6354 51.5652	25.1000 25.2000	48.7599
/055	20.2000	51.5652	25.2000	48.712. 48.670
NI VI/I	20.3000	51.4952 64.4200	25.3000 25.4000	48.620
1005	20.500	51.4309	25.4000	48.579
3988	20.6000	51.2930	25.6000	48,529
3066	20.7000	51.2256	25.7000	ፈጸ ፈጸዓ
2026	20,8000	51.1577	25.8000	48.439
1054	20.9000	51.0906	25.9000	48.400
JU9Z	21.000	51.0304	26.000	48.3578
5120 0474	21.7000	50.9545	20.1000	48.313° 48.2712
51/1 74 7 0	21.2000	JU.030J	20.2000 26.2000	48.271
7 170 6283	21.5000	50.0081 50.77/17	20.5000 26.4000	48.182
5312	21500	50.7062	26.5000	48.145
1391	21.6000	50.6481	26.6000	48.104
3473	21.7000	50.5847	26.7000	48.0639
256 4	21.8000	50.5281	26.8000	48.023
1659	21,9000	50.4656	26.9000	47.984
0764	22.0000	50.4045	27.0000	47.939
9933	22,1000	50.3435	27.1000	47.900
9UD/ 9477	22.2000	5U.288U	27.2000	47.862 47.823
91// 73 07	22.3000	50.2232 50.1601	27.3000 27.4000	47.785
7.507 RAAR	22.5000	50 1098	27.5000	47.747
5588	22 8000	50.0507	27.6000	47,710
4746	<i>22</i> 7000	49.9930	27.7000	47.675
3893	22.8000	49.9405	27.8000	47.638
3123	22.9000	49.8836	27.9000	47.602
2229	23.0000	49.8267	28.0000	47.563
14U4 2540	25.1000	49.7700	28.1000	47.527
J048 1760	25.2000	49./74b	28.200	47.4924 47.458
9/09 0004	23.5UU 27.6000	49.0059 40.6000	25.5000	47,438
7024 2000	23.4000 23.5000	43.0033 A0 555A	28.500	47.424° 47.3869
7429	23 AM	49 5062	28.600	47.354
638	23.7000	49.4525	28.7000	47.354 47.3210
5856	23.8000	49.3995	28.8000	47.283 47.253
5135	23.9000	49.3471	28.9000	47.253
1306	24.0000	49.2949	29.0000	47.217. 47.190
5595		49.2428	29.1000	47.190
終 り	24.2000		23.200	47.154
(U// 1224			23.300	47.124
1334 1607	24.4UU		23.400	47.090 47.060
.007 2005	24.3UU 24.6000		23.3000 20.8000	47.032
NES NES	24.7000	40.7703 AR 0A7A	29.000	46.998
2452	24800	40.5470 48.9035	23.700	46.966
7782	249000	48 8544	29.9000	46.9390
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	57075 57077 57	1054 2092 21,000 21,100 21,778 21,300 22,43 21,400 13,312 21,500 13,312 21,700 25,64 21,700 25,64 21,700 29,33 22,100 29,33 22,100 29,33 22,100 29,33 22,100 29,33 22,100 29,33 22,400 23,400 23,400 24,600 24,600 24,200 24,200 25,646 21,700 22,400 23,100 24,600 24,600 24,200 25,638 26,638 27,69 27,69 27,69 27,69 27,700 28,100 28,100 29,100 20,100	1034	21,778

Appendix III DELORME Street Atlas USA® 2004 CR 588 CR 588 Approximate Area of Cranti © 2003 DeLorme. Street Atlas USA® 2004. www.delorme.com 1" = 2.083.3 ft Data Zoom 13-0

Appendix V





Turn down

Not (aused (not a GR end impact)

Rollover, Van Ited