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**In-Vehicle Safety Advisory and
Warning Systems (IVSAWS)
DTFH61-90-R-0030**

Task B -- Final Report

**Under subcontract with:
Hughes Aircraft Company
Ground Systems Group
Fullerton, CA**

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16. Abstract This document constitutes the final report for the UMTRI subcontract for Task B - In-Vehicle Safety Advisory and Warning Systems (IVSAWS) (DTFH61-90-R-0030). This report describes the definition and prioritization of candidate advisory, safety, and hazard situations that could be affected by IVSAWS. Included are methods and rationale for situation selection, cases illustrating select crash situations, and a privatization of identified IVSAWS application scenarios.					
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TABLE OF CONTENTS

1.0	Introduction	1
2.0	Delineation of Contractor Tasks from RFP	1
3.0	Crash Scenarios Amenable to IVSAWS Technologies	2
3.1	Accident-involved or disabled vehicles	3
3.2	Crash site -- Police Activated	13
3.3	Disabled Truck at Roadside	13
3.4	School Bus or Other Special-Vehicle Hazard	18
3.5	Highway Construction Zones	25
3.6	Traffic Backups	25
3.7	"Mini-zones" Involving Roadside Work	44
3.8	Temporary Detour Routes	44
3.9	Multiple (Compounding) Hazardous Conditions	49
3.10	Supplemental Traffic Control Device	54
3.11	Railroad Grade Crossings	54
3.12	Signalling Emergency Vehicle Presence	54
4.0	Hierarchy Development for IVSAWS Application Situations	55
4.1	Crash data analysis	55
4.1.1	Accident involved or disabled vehicles	56
4.1.2	School-bus Involved	56
4.1.3	Highway Construction Zones	57
4.1.4	Multiple (compounding) hazardous conditions	57
4.1.5	Railroad grade crossings	58
4.1.6	Emergency vehicles	59
4.2	Hierarchy of IVSAWS Application Situations	59
4.3	Summary	64
5.0	Signalling Recommendations	65

In-Vehicle Safety Advisory and Warning Systems

Task B -- Final Report

1.0 Introduction

This document constitutes the final report for the UMTRI subcontract for Task B - In-Vehicle Safety Advisory and Warning Systems (IVSAWS) (DTFH61-90-R-0030). This report describes the definition and prioritization of candidate advisory, safety, and hazard situations that could be affected by IVSAWS. Included are methods and rationale for situation selection, cases illustrating select crash situations, and a privatization of identified IVSAWS application scenarios.

2.0 Delineation of Contractor Tasks from RFP

Identify candidate advisory, safety, and hazard situations, and using recent rural and urban highway accident data, develop ranking criteria to determine the severity of accidents; list them in a hierarchical order according to potential benefits to safety and traffic operations (i.e., operational performance and estimated relative frequency of occurrence)...Determine which situations could be helped by an IVSAWS. Refer to Chapter II, "The Highway Safety Problem" of FHWA/RD-81/124 Report for guidance.

Using the Manual of Uniform Traffic Control Devices (MUTCD) as a guide, develop ranking criteria and apply them to determine which warning and regulatory signs should be replicated within a motorist's vehicle to improve safety and traffic operations. Use human factor analysis to make a realistic determination of which messages shall affect the proper response given the attention needed for the driving process. To reduce driver annoyance, a method to defeat or defer frequently repeated messages shall be found.

As stated in the Task B workplan, FHWA report FHWA/RD-81/124 -- *Feasibility and Concept Selection of a Safety Hazard Advance Warning System* is inadequate for determining crash situations that could be ameliorated through implementation of IVSAWS technologies. To improve the state of knowledge about possible crash scenarios that could benefit from IVSAWS we held several group discussions involving experts in intelligent vehicle-highway systems (IVHS), highway design, crash data analysis, accident investigation and reconstruction, and human behavior.

The initial discussion focused on identifying crash data that could help pinpoint and rank crash situations that could be remedied by an IVSAWS technology. This first meeting began

with a brainstorming session to determine a few crash situations we believed could be affected by IVSAWS. This was done to provide sufficient background information for development of a data analysis and prioritization system. Results from the FHWA report (FHWA/RD-81/124) were reviewed and professional observations from the group members' experience were used to develop a short list of crash situations. From this discussion, it was determined that identifying crash situations amenable to IVSAWS applications and subsequently ranking these applications based on the analysis of extant crash data sets was infeasible. Existing computerized crash data sets provide insufficient data detail to conduct analyses that would provide the type of information necessary to identify crash situations amenable to IVSAWS technologies with sufficient specificity.

At this point it was determined that the best course of action was to convene group discussions to identify specific crash situations amenable to IVSAWS technologies using the experience and knowledge of the experts involved in the discussions. Once specific situation types had been identified, a review of detailed crash investigations was conducted to identify individual cases that would illustrate the general crash scenarios.

However, the use of mass statistical data was not abandoned altogether. Examination of crash data from the states of Michigan and Washington, as well as the 1988 General Estimates System (GES, a probability sample of all police-reported crashes occurring in the U.S.) was believed to be useful in helping to bound the number of crashes involving some scenarios. While insufficient detail is available in these data sets to examine all of the scenarios identified by the group discussions, scenarios represented by sufficient data were examined.

3.0 Crash Scenarios Amenable to IVSAWS Technologies

In general, it is our belief that IVSAWS technologies are best applied in situations in which the risk of a crash which is relatively high, the risk is known in advance, and the situation occurs infrequently. In addition, the severity of the crash which is risked would preferably be high. Further, IVSAWS technologies are well suited for sites with relatively high travel speeds that act to both reduce reaction time available for collision avoidance and increase crash severity.

In order for IVSAWS technologies to be maximally effective they should be applied in ways that reduce driver habituation effects. That is, the systems should be activated infrequently to avoid the situation of drivers ignoring frequently occurring warnings (spurious or real). It is equally important that warnings be issued only to vehicles that can benefit from the advanced warning. Reception of warnings by drivers who are not at risk will likely act to reduce the attention paid to all IVSAWS warnings, reducing their effectiveness.

In the discussion to follow, each of the IVSAWS application scenarios identified by the group discussions is detailed. For some of the scenarios, cases of specific crashes are provided illustrating the general crash scenarios.

3.1 Accident-involved or disabled vehicles

An advanced warning of a disabled vehicle ahead could prevent drivers from crashing into the disabled vehicle from the rear or prevent drivers from having to perform a radical avoidance maneuver that could force them into oncoming traffic or into some roadside obstacle like a ditch, utility pole, or tree. Such a system could be activated automatically via crash sensors similar to those used to activate airbags or the system could be activated manually by the driver. If IVSAWS was implemented so that the automatically-generated warning (activated by a crash) also sent out a distress signal to police (augmented with a vehicle location code), the system could effect a significant reduction in death and injury outcomes by reducing the response time for emergency medical treatment. Such a "mayday" signal could perhaps be sent only in crashes having a sufficient delta-V that serious injury to vehicle occupants was likely.

Such an automatically activated system may have been of benefit to reducing the crash trauma induced in the recent chain-reaction crashes in Tennessee and Utah which were caused in part by high travel speeds and limited sight distance which obscured vehicles disabled by previous crashes. Two cases involving collisions with disabled vehicles in the roadway follow to illustrate this application¹.

¹Cases are taken from crashes investigated by the UMTRI crash investigation team headed by Dr. Donald Huelke and sponsored by the Motor Vehicle Manufacturers Association. Cases were selected from over 500 reviewed representing crashes occurring in Washtenaw County, Michigan from 1986 through 1990 involving late-model cars in which at least one occupant was injured.

IVSAWS Application Case 1

Accident Involved or Disabled Vehicles

Case Vehicle (A): 1985 Volkswagen
Type: GTI, 2-Dr. HB
Driver: 16-Yrs., Male

Vehicle (B): 1975 Buick
Type: Regal, 2-Dr. Sedan
Driver: Unoccupied

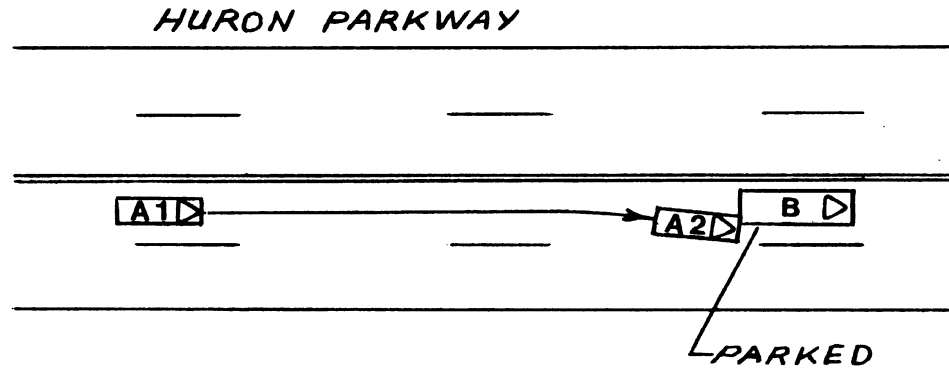
Situation

At about 1907 hours on Saturday, January 18, 1986, case vehicle (A) was traveling at an unknown speed in the left southbound lane of Huron Parkway, a 4-lane asphalt parkway on the eastside of Ann Arbor. Vehicle (B) had run out of fuel in the left southbound lane and was left unattended with its parking lights on, but not its 4-way flashers. Perhaps due to the fog and the low visibility of the parking lights, the driver of the case vehicle (A) failed to see vehicle (B) in time to avoid a collision. Even though case vehicle (A) veered to the right at the last instant it struck the rear right corner of vehicle (B). Both vehicles then lightly slapped together, but their final positions are unknown. At the time of impact (B) was parked and the impact speed of case vehicle (A) was estimated to be 48-58 kph.

CASE NO.: UM-2347-86
CASE VEH.(A): 1985 VOLKSWAGEN
TYPE: GTI, 2-DR. HB
DRIVER: 16-YRS., MALE
VEH. (B): 1975 BUICK REGAL

DATE/TIME: 1-18-86 / 1907 HRS.
WEATHER: FOG
ROAD SURFACE: WET
ROAD CONSTRUCTION: ASPHALT

← NORTH



State of Michigan

Department Name

LEIN Number

Department Complaint No.

OFFICIAL TRAFFIC ACCIDENT REPORT

ANN ARBOR POLICE

218

86-2638 E-20

DO NOT USE

UM-2344-86

Accident Location: County No. 81, City No. 89, Twp. No., Section No., Day of Week S M T W T F S, Accident Date: 01/18/86, Time 7:07 A.M., Name: HURON PKWY, Route No. 300, Intersection: WASHINGTON, Route Nos.

Weather: 2 Fog, Light: 4 Dark, Road Surface: 3 Wet, TOTAL LANES: 4, Divided: 1, Limited Access: 2, Construction Zone: Y, Investigated at Scene: Y, Total No. Vehicles: 2

Driver 1: State MI, Driver's License [redacted], DOB: 05/16/69, Hazardous Action Number 8, Citation Charge: VIOL. BASIC SPEED LAW, HBD: Y, Test: Y, Helmet: Y

Vehicle 1: Year 85, Make 141, Type 0, VIN 1NWD80173F447913, Removed to/by: SAKSTRUPS/SAKSTRUPS, Impact Severity: 2/5, Truck Cargo: N/A

Restraints by occupants pos. 2, 3, Name: [redacted], Address: [redacted], Pos. 3, Age 16, Sex M, Inj. Y, Helmet Y

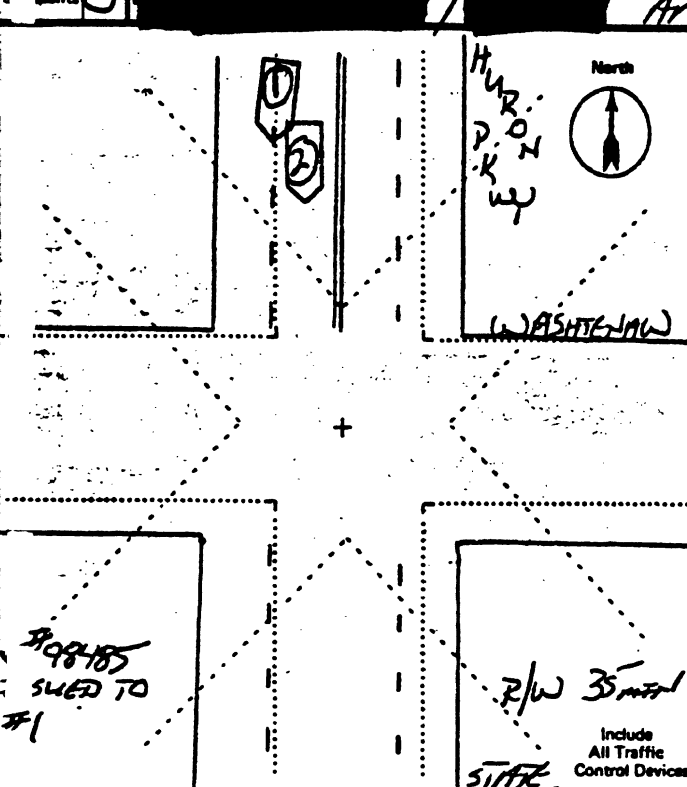
Witness 1: Local Use/Owner, Phone: SAME, Insurance Co. TRANSAMERICA, Agency Address: SOUTHWELLD, Injured taken to/by: REFUSED

Driver 2: State MI, Driver's License [redacted], DOB: [redacted], Hazardous Action Number, Citation Charge, HBD: Y, Test: Y, Helmet: Y

Vehicle 2: Year 86, Make 011, Type 0, VIN 4J57C5H136588, Removed to/by: SAKSTRUPS/SAKSTRUPS, Impact Severity: 4/5, Truck Cargo: N/A

Restraints by occupants pos. 2, 3, Name: Regal 219, Address: 453-112-547, 3872, Pos. 3, Age, Sex, Inj., Helmet Y

Witness 2: Local Use/Owner, Phone: [redacted], Insurance Co. AAA, Agency Address: ANN ARBOR, Injured taken to/by: N/A



ACCIDENT DESCRIPTION AND REMARKS (*Explain)
VEHICLE #2 HAD RUN OUT OF LANE & WAS PARKED (UNATTENDED) IN THE LEFT LANE. #2 HAD THE PARKING LIGHTS ON & SOME LIGHTS DID NOT WORK. #1 WAS S-B ON HURON PKWY & AFTER COMING AROUND THE LAST CURVE PRIOR TO WASHINGTON HAD CHANGED FROM THE CURB LANE TO THE LEFT LANE & DID NOT SEE #2 IN TIME TO STOP. #1 STATED HE WAS PROBABLY GOING A LITTLE TOO FAST. WITNESS DID OBSERVE #2 WITH THE LIGHTS ON AS HE PASSED THEN HEARD THE COLLISION.

Reported: 01/18/86, Time 7:09 A.M., Investigator: [redacted], Badge No., Damaged Property Other Than Vehicles: N/A, Photos by: Y0, Comp. Disposition: Open, Reviewer: 318, Name: N/A, Date: 01/23/86, Owner: N/A, Address:

IVSAWS Application Case 2

Accident Involved or Disabled Vehicles

Case Vehicle (A): 1987 Chevrolet
Type: Celebrity, 4-Dr. NB
Driver: 33-yrs, Male

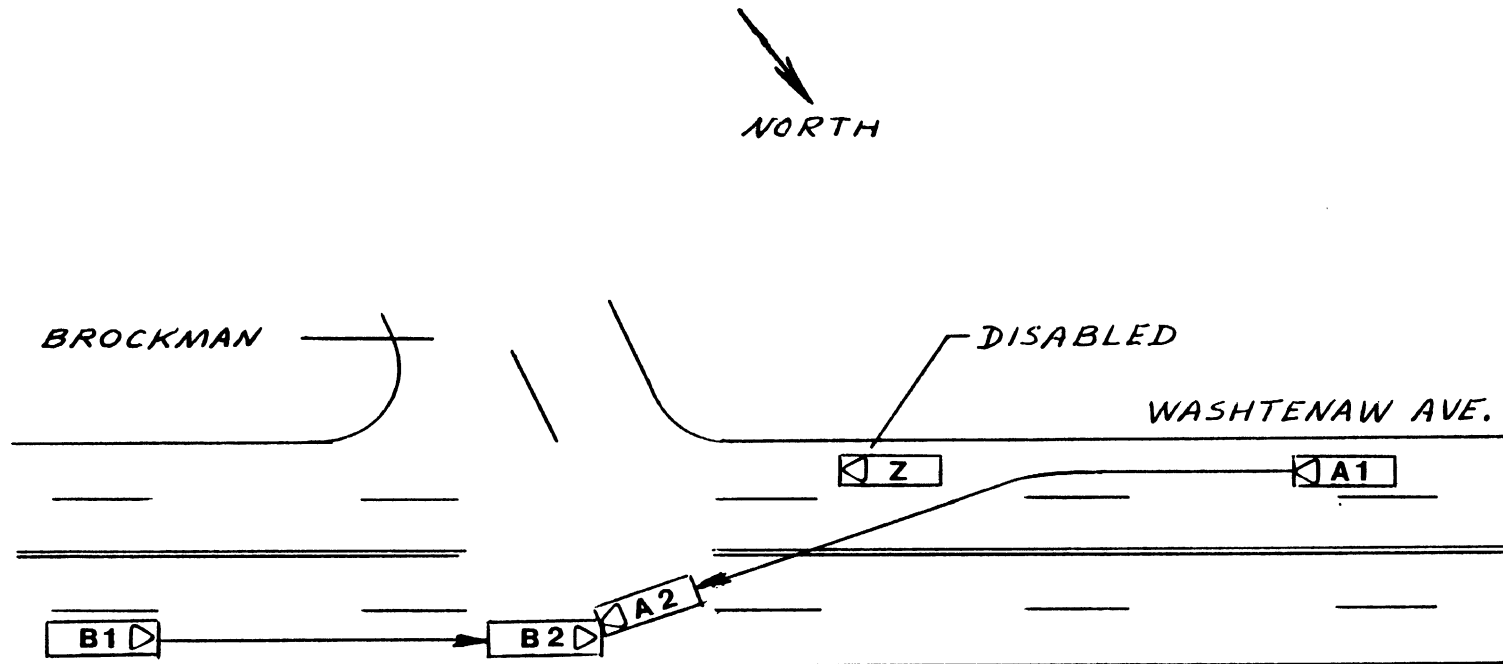
Vehicle (B): 1977 Chevrolet
Type: Impala, 2-Dr. Cpe.
Driver: 41-yrs., Male

Situation

On Friday, January 23, 1987, at about 1842 hours case vehicle (A) was southbound at a driver estimated speed of 56 kph uphill in the curb lane of Washtenaw Avenue, a 4-lane asphalt arterial roadway through the residential area of southeast Ann Arbor, Vehicle (B) was northbound at an unknown speed in the curb lane. Just prior to the intersection with Brockman, southbound vehicle (Z) was disabled in the curb lane. As case vehicle (A) approached the intersection, the driver did not realize that vehicle (Z) was disabled until the last instant. The driver made a sharp correction to the left causing case vehicle (A) to avoid vehicle (Z). Case vehicle (A) then crossed the centerline into the path of vehicle (B) where the two struck head-on. Both vehicles came to rest locked together, but their exact position is unknown. The impact of vehicle (B) was estimated to be 24 to 32 kph while that of case vehicle (A) was 28 to 36 kph.

CASE NO.: UM-2447-87
CASE VEH. (A): 1987 CHEVROLET
TYPE: CELEBRITY, 4-DR. NB
DRIVER: 33-YRS., MALE
VEH. (B): 1977 CHEVROLET IMPALA

DATE/TIME: 1-23-87/1842 HRS.
WEATHER: CLEAR
ROAD SURFACE: SNOWY
ROAD CONSTRUCTION: ASPHALT



State of Michigan Department Name *Ann Arbor Police* LEIN Number *218* Department Complaint No. *87-3321-E10*

OFFICIAL TRAFFIC ACCIDENT REPORT
 County No. *81* City No. *89* Twp. No. Section No. Day of Week *S M T W T S* Accident Date: Mo/Da/Yr *01-23-87* Time *6:42 A.M.*
 DO NOT USE *UM-2447-87*

Name *WASHINGTON* Route No. *BL 340525* 80 Mi. *(N) S E W* Intersection *BROCKMAN* Route Nos.

WEATHER: Clear or Cloudy 3 Rain, Fog 4 Snow
 LIGHT: Day 1 Street Lights 3, Dawn or Dusk 2, 4 Dark
 ROAD SURFACE: Dry 1, 3 Snowy or Icy, Wet 2, 4 Other
 TOTAL LANES: *4* (1 Divided, 2 Limited Access, Other)
 TOTAL NO. VEHICLES: *3* (Construction Zone N Investigated at Scene Y)

Vehicle Driver no. 1: State *IL*, Driver's License *[REDACTED]*, DOB: Mo/Da/Yr *05-26-53*, Hazardous Action No. *5*, Citation Charge, HBD N Y, Test N Y, Helmet Y N
 Driver's Name: *[REDACTED]*, Address: *[REDACTED]*, State *[REDACTED]*, Age *33*, Sex *M*, Inj. *A*

Year/Make/No./Type/Trailer/Bus: *87/0/31*, Yr/State: *87 MI*, VIN (Make Letters Larger Than Numbers) *1G1AWSR9H6155863*, Removed to/by *SAKSTRUP/SAKSTRUP*
 Haz. Citation Y N, Driver Re-exam Y N, Vision Obstruct. Y N, Vehicle Defect Y N, Veh. Drivable Y N, Fuel Leakage Y N, Vehicle Fire Y N, Impact Severity *4/2 1/5*, Truck Cargo: Y N, Cargo Spillage, Cargo Description

Restraints by occupants pos. 1 *104.9 188.3* Name *Celebrity* Address *252 NB 103-266-109* Pos. *1220* Age Sex Inj. Helmet Y N

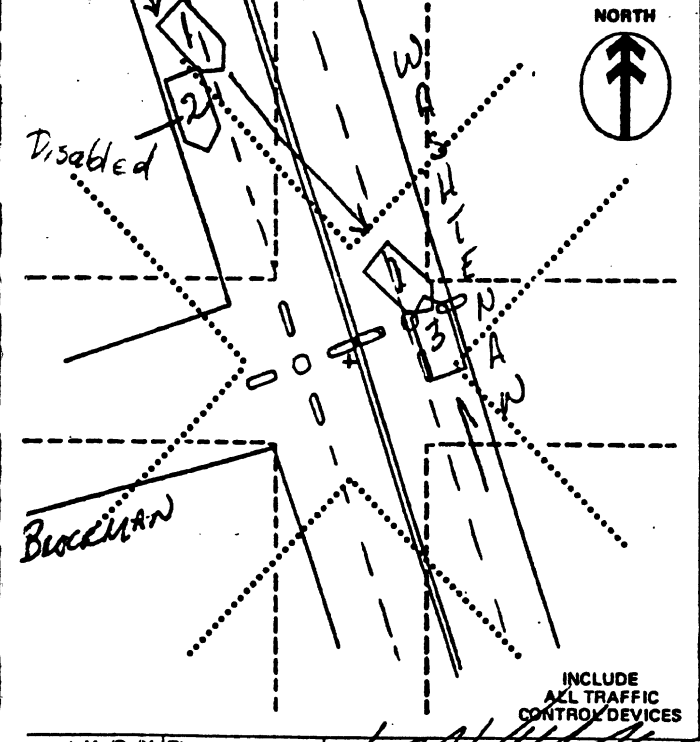
Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) *AVIS Rent-A-Car*, Insurance Co. *UNDETERMINED*, Agency Address, Injured taken to/by *UMHOSP/HVA*

Vehicle Driver no. 2: State *MI*, Driver's License *[REDACTED]*, DOB: Mo/Da/Yr *04-13-61*, Hazardous Action No. *0*, Citation Charge, HBD Y N, Test Y N, Helmet Y N
 Driver's Name: *[REDACTED]*, Address: *[REDACTED]*, State *[REDACTED]*, Age *25*, Sex *M*, Inj. *0*

Year/Make/No./Type/Trailer/Bus: *87/4/21*, Yr/State: *87 MI*, VIN (Make Letters Larger Than Numbers) *VL29G4B337696*, Removed to/by *SAKSTRUP/SAKSTRUP*
 Haz. Citation Y N, Driver Re-exam Y N, Vision Obstruct. Y N, Vehicle Defect Y N, Veh. Drivable Y N, Fuel Leakage Y N, Vehicle Fire Y N, Impact Severity *6 1*, Truck Cargo: Y N, Cargo Spillage, Cargo Description

Restraints by occupants pos. 1 Name *Ply Dealer* Address *2-A* Pos. Age Sex Inj. Helmet Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) *[REDACTED]*, Insurance Co. *AAA*, Agency Address *Ann Arbor*, Injured taken to/by



ACCIDENT DESCRIPTION AND REMARKS (*Explain)
 VEN#1 WAS SB ON WASHINGTON IN THE RIGHT LANE.
 VEN#2 WAS DISABLED AND DARK IN RIGHT LANE OF SB WASHINGTON.
 VEN#3 WAS NB ON BROCKMAN IN RIGHT LANE.
 DRIVER #2 RELATED HE HAD STOPPED AT RED SIGNAL (APPROX 3'-4' VERILG ID LINE) AND HIS VEHICLE HAD DIED - NO POWER AT ALL - NO LIGHTS OR FLASHERS.
 DRIVER #1 RELATED HE WAS APPROX 126' AT INTERSECTION AND OBSERVED LIGHT CHANGE AND VEHICLES MOVE AHEAD. HE OPEN

Reported: Mo/Da/Yr *1-23-87* Time *6:44 AM* Investigated by *[REDACTED]* Badge No. *[REDACTED]* Damaged Property Other Than Vehicle
 Photos by *[REDACTED]* Comp. Disposition *Closed* Reviewer *310* Person Advised of Damaged Traffic Control Device Name: *[REDACTED]* Date: Time: Owner Address

CIRCLE THE APPROPRIATE SELECTION

State of Michigan Department Name *Ann Arbor* LEIN Number *218* Department Complaint No. *81-3321-E10*

OFFICIAL TRAFFIC ACCIDENT REPORT

Country No. *81* City No. *09* Twp. No. Section No. Day of Week *S M T W T F S* Accident Date: Mo/Da/Yr *01-23-87* Time *6:42 P.M.*

Name *WASHINGTON* Route No. *BRIDGE US 27* Intersection *Blockman* Route Nos.

WEATHER: 1 Clear or Cloudy, 3 Rain, 2 Fog, 4 Snow
 LIGHT: 1 Day, 3 Street Lights, 2 Dawn or Dusk, 4 Dark
 ROAD SURFACE: 1 Dry, 3 Snowy or Icy, 2 Wet, 4 Other
 TOTAL LANES: 1 Divided, 2 Limited Access, 3 Other
 Y N Construction Zone, Y N Investigated at Scene

State *Oh* Driver's License [Redacted] DOB: Mo/Da/Yr *09-14-45* Hazardous Action No. *0* Citation Charge
 HBD Test *Y* Helmet *Y*

Year Make No. Type *77 Oldsmobile* VIN (Make Letters Larger Than Numbers) *1K47475336075* Removed to/by *SARSTRUP/SARSTRUP*

Y N Haz. Citation, Y N Driver Re-exam, Y N Vehicle Defect, Y N Fuel Leakage, Y N Vehicle Fire, Impact Severity *8 5*

Restraints by occupants pos. [Redacted]

Pos.	Age	Sex	Inj.	Helmet
3	32	M	B	Y
4	32	F	B	Y
6	35	F	C	Y

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) [Redacted] Insurance Co. *STATE FARM* Agency Address *1065 DO* Injured taken to/by *Ughared/HVA*

State Driver's License DOB: Mo/Da/Yr Hazardous Action No. Citation Charge HBD Test Helmet

Driver's Name First M. Last Address City State Age Sex Inj.

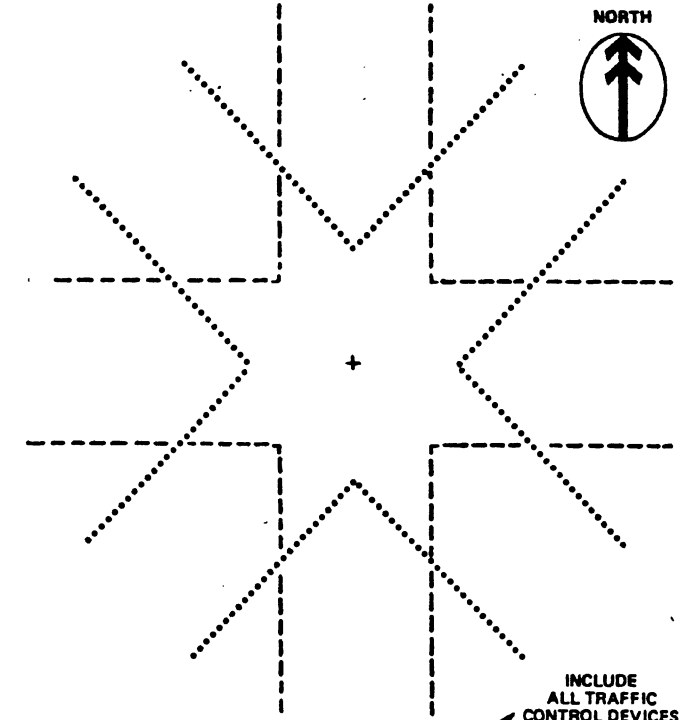
Year Make No. Type Trailer Reg. Yr/State VIN (Make Letters Larger Than Numbers) Removed to/by

Y N Haz. Citation, Y N Driver Re-exam, Y N Vehicle Defect, Y N Fuel Leakage, Y N Vehicle Fire, Impact Severity, Truck Cargo: Y N Cargo Spillage, Cargo Description

Restraints by occupants pos. [Redacted]

Pos.	Age	Sex	Inj.	Helmet
2				Y
3				Y
6				Y

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) *40-116-56.1* Insurance Co. *3643* Agency Address *1652* Injured taken to/by



ACCIDENT DESCRIPTION AND REMARKS (*Explain*)

SAID A VEHICLE IN FRONT OF HIM SWERVED AND HE THEN HIT A VEHICLE AND SWERVED TO LEFT - HE THEN WAS UNCLEAR OF EVENTS.

DRIVER'S RELATED OBSERVED AN ONCOMING VEHICLE SUDDEN SWERVE AND COME FORWARD HIM AT A 45° ANGLE HE ATTEMPTED TO TURN TO RIGHT AND THEN COLLIDED TO PLACE.

WITNESS DRIVING BEHIND VEH (RELATED) VEH SUDDENLY SWERVED TO LEFT ALONG DALK VEH 2 AND THEN WITNESS ALSO STRUCK VEH TX DRIVER #1 - 312-525-8196 O.U.T.C. WITH BE SQUARE ON DRIVER #1.

Investigator *[Signature]* Badge No. *day* Damaged Property Other Than Vehicle

Person Advised of Damaged Traffic Control Device Name: Date: Time: Owner Address

3.2 Crash site -- Police Activated

This application is similar to the previous one except that the deployment of the system differs. In this application, a transmitter is programmed and placed at the crash scene by police much like flares are currently deployed. Police could select an appropriate message to assist with traffic control at the crash scene. Once again, secondary collisions at the crash scene and crashes caused by avoidance maneuvers are the target of this IVSAWS application.

3.3 Disabled Truck at Roadside

In this application IVSAWS warning would be activated to supplement or replace reflectors at the roadside. This application would be particularly useful on primary and interstate highways where travel speeds are high. One case involving collisions with a disabled truck at the roadside follows to illustrate this application.

IVSAWS Application Case 3

Disabled Truck at Roadside

Case Vehicle (A): 1986 Ford

Type: Escort LX, 2-Dr. HB

Driver: 55-yrs., Female

Vehicle (B): 1977 Mack

Type: DM-800ST, Tractor-Trailer

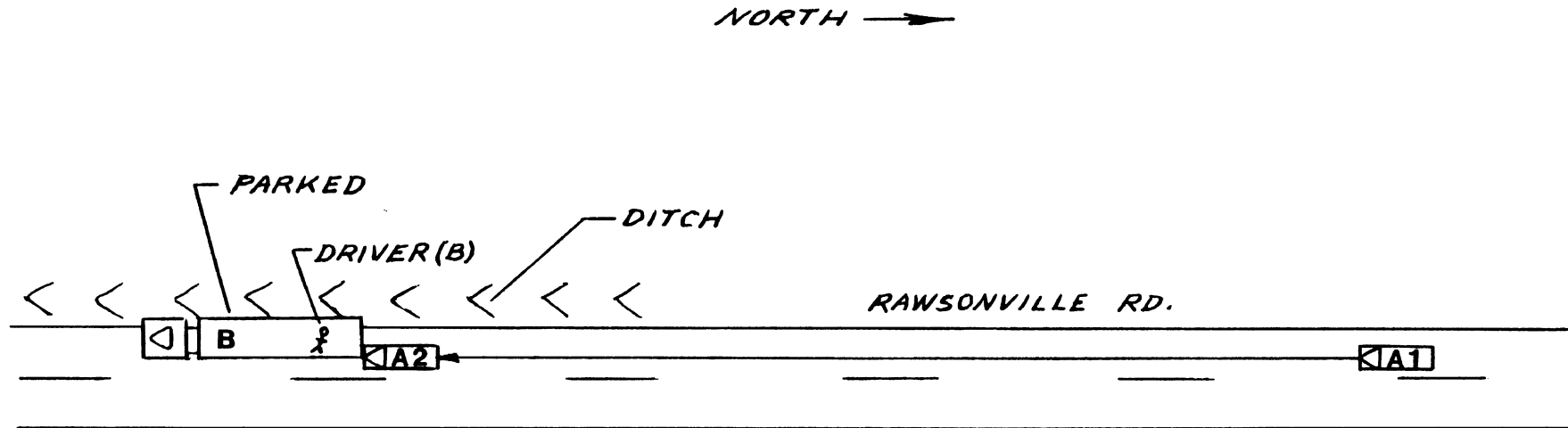
Driver: Unoccupied

Situation

At about 1310 hours on Monday, February 24, 1986, case vehicle (A) was southbound at a driver estimated speed of about 80 kph on Rawsonville Road, a 2-lane farm area road southeast of Willis. Southbound vehicle (B) had broken down and was parked along the west side of the roadway, but well into the southbound lane because there was a ditch on the west side of the road. The driver was underneath the semitrailer working on the brakes. The driver of case vehicle (A) did not recognize that vehicle (B) was parked and case vehicle (A) struck the rear left corner and dual wheels of the vehicle (B) semitrailer. Vehicle (B) was not available for inspection, but as stated above it was stopped at the time of impact and the speed of case vehicle (A) could not be estimated. However, by assuming a barrier type of impact a delta-v was calculated using only the damage of case vehicle (A). The calculated delta-v for the assumption was 32 kph.

CASE NO.: UM-2359-86
CASE VEH.(A): 1986 FORD
TYPE: ESCORT LX, 2-DR. HB
DRIVER: 55-YRS., FEMALE
VEH. (B): 1977 MACK TRACTOR-TRAILER

DATE/TIME: 2-24-86 / 1310 HRS.
WEATHER: CLEAR
ROAD SURFACE: DRY
ROAD CONSTRUCTION: ASPHALT



CIRCLE THE APPROPRIATE SELECTION

STATE

State of Michigan (Rev. 2-85) Department Name: STATE POLICE LEIN Number: 8102600 Department Complaint No.: 26-1266-86 Area: _____
OFFICIAL TRAFFIC ACCIDENT REPORT DO NOT USE
 County No.: 51 City No.: _____ Type: 02 Section No.: _____ Day of Week: S Accident Date: Mo/Da/Yr 2-24-86 Time: 1:10 A.M. P.M. UM-2359-86 Pseudo: _____
 Name: S.D. RANSWILLI Route No.: _____ Ft. M N E W Intersection: JUDD Route Nos.: _____
 Location: _____

WEATHER: 1 Clear or Cloudy 3 Rain 0 Day 3 Street Lights 0 Dry 3 Snowy or Icy 2 Fog 4 Snow 2 Dawn or Dusk 4 Dark 2 Wet 4 Other
 ROAD SURFACE: _____ TOTAL LANES: 2 1 Divided 2 Limited Access 3 Other
 Construction Zone: Y Investigated at Scene: Y TOTAL NO. VEHICLES: 2

State: MI Driver's License: _____ DOB: Mo/Da/Yr 3-22-30 Hazardous Action No.: 1 Citation Charge: CARELESS HBD: Y Test: Y Helmet: Y
 Driver's Name: _____ Address: YPSILANTI City: _____ State: _____ Age: 55 Sex: M Inj.: A
 Year: 86 Make: Y Type: 0 Trailer: _____ Reg: _____ Yr./State: 86 VIN: 1FA4M32E5GWA137948 Removed to/by: WILLIS & BURNION SURVEY
 Haz. Citation: Y Driver Re-exam: Y Vehicle Defect: Y Fuel Leakage: Y Impact: 1 Severity: 4 Truck Cargo: Y Cargo Spillage: _____ Class: _____
 Other Citation: Y Vision Obstruct.: Y Veh. Driveable: Y Vehicle Fire: _____ Cargo Description: _____

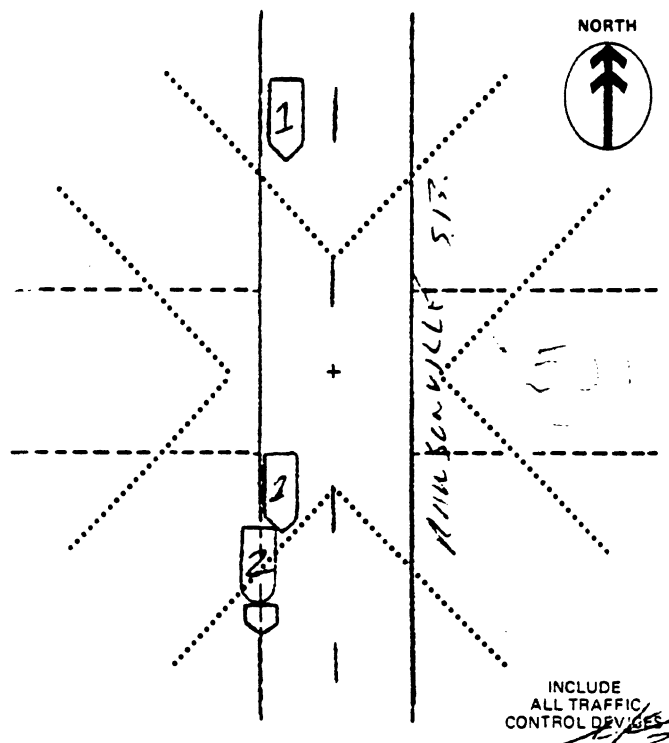
Trains by	Name	Address	Pos.	Age	Sex	Inj.	Helmet
1	DRIVER	_____					Y N
2							Y N
3							Y N
4							Y N
5							Y N
6							Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier): DRIVER Insurance Co.: UNK Agency Address: _____ Injured taken to/by: TR. Y. 7175 / HVA

State: _____ Driver's License: _____ DOB: Mo/Da/Yr _____ Hazardous Action No.: _____ Citation Charge: _____ HBD: Y Test: Y Helmet: Y
 Driver's Name: _____ Address: _____ City: _____ State: _____ Age: _____ Sex: _____ Inj.: _____
 Year: 77 Make: 2 Type: 78 Trailer: 0 Reg: _____ Yr./State: 86 VIN: 8C MED18675T11722 Removed to/by: R BK
 Haz. Citation: Y Driver Re-exam: Y Vehicle Defect: Y Fuel Leakage: Y Impact: 5 Severity: 2 Truck Cargo: Y Cargo Spillage: _____ Class: _____
 Other Citation: Y Vision Obstruct.: Y Veh. Driveable: Y Vehicle Fire: _____ Cargo Description: _____

Trains by	Name	Address	Pos.	Age	Sex	Inj.	Helmet
1							Y N
2							Y N
3							Y N
4							Y N
5							Y N
6							Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier): CITY DISPOSAL Insurance Co.: UNK Agency Address: _____ Injured taken to/by: TR. Y. 7175 / HVA



ACCIDENT DESCRIPTION AND REMARKS (*Explain)

DRIVER #1 STATED SHE DID NOT KNOW WHAT HAPPENED

DRIVER #2 STATED HIS TRUCKS BRAKES HAD LOCKED UP, HE WAS UNDER THE VEHICLE WHEN #1 HIT IT IN THE REAR

NOTE: VEHICLE #2 HAD NO 4-WAY FLASHERS ON.

Accid. Date: Mo/Da/Yr 2-24-86 File Class: 5300-1 Department Complaint No.: 26-1266-86

Accid. No. 26-1266-86 Date: Mo/Da/Yr 2-24-86 Time: 2:00 A.M. P.M. AM Investigators: SP1 MICHAEL P. W. 301 Badge No.: 301 Damaged Property Other Than Vehicle: NONE
 Comm. Division: _____ Reviewer: _____ Person Advised of Damaged Traffic Control Device: _____ Name: _____ Date: _____ Time: _____
 Owner: _____ Address: _____

3.4 *School Bus or Other Special-Vehicle Hazard*

Many special-use vehicles create hazards because of repeated stops or slow travel speeds relative to regular traffic. Crashes resulting from the operation of these vehicles may be the result of impacts with the special vehicle itself or with traffic backed up behind the vehicle or maneuvering around the vehicle. An IVSAWS system could provide drivers with a warning of the upcoming hazard in sufficient time to slow to react to the upcoming situation. Two cases follow to illustrate this application. One case involves a car striking a slowly moving snow-plow/salt truck on an interstate highway, the second involves a collision of a car with a civilian car used as a mail delivery vehicle.

IVSAWS Application Case 4

School Bus or Other Special-Vehicle Hazard

UNOFFICIAL - See 622, Act 300, P.A. of 1940
REPLETION: Required
VALUITY: Misdemeanor

CIRCLE THE APPROPRIATE SELECTION

"X" IF CORRECTED COPY

UB-10 (Rev. 9-85) State of Michigan Department Name ANN ARBOR POLICE LEIN Number 218 Department Complaint No. 90-57004 B20

OFFICIAL TRAFFIC ACCIDENT REPORT

County No. 81 City No. 89 Twp. No. - Section No. - Day of Week S M T W **F** Accident Date: Mo/Da/Yr 12/28/90 Time 6:45 AM

Name I-94 (W/B) Route No. 25 (M) N (E) W Intersection ANN ARBOR - SALINE RD Route No.

WEATHER Clear or Cloudy Rain Fog Snow
LIGHT Day Street Lights Dawn or Dusk Dark
ROAD SURFACE Dry Wet Snowy or Icy Other
TOTAL LANES 2 Divided Limited Access Other
 Construction Zone Investigated at Scene
TOTAL NO. VEHICLES 2

State MI Driver's License [REDACTED] DOB: Mo/Da/Yr 4/21/61 Hazardous Action No. 1 Citation Charge VIOLATION BASIC SPEED HSD Test Y N Y N Helmet Y N

Driver's Name First [REDACTED] M. Last [REDACTED] Address [REDACTED] City [REDACTED] State [REDACTED] Age 29 Sex M Inj. N

Year/Make No. Type Trailer Reg. 90/MI ZFAR P2252GAE2924 REMOVED TO BY NEW ANN/DEN ANN

Haz. Citation Driver Re-exam Vehicle Defect Fuel Leakage Vehicle Fire Other Citation Vision Obstruct. Veh. Drivable Veh. Fire

Impact Severity 1 5 Truck Cargo: Cargo Spillage Cargo Description

Restraints by occupants pos. Name Address Pos. Age Sex Inj. Helmet

1 2 3 [REDACTED] 32 FA Y N
4 5 6 [REDACTED] 22 FB Y N

Total occupants 3 Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) NONE Insurance Co. N/A Agency Address N/A Injured taken to/by UOPM/MVA

State MI Driver's License [REDACTED] DOB: Mo/Da/Yr 11/2/45 Hazardous Action No. 0 Citation Charge HSD Test Y N Y N Helmet Y N

Driver's Name First [REDACTED] M. Last [REDACTED] Address [REDACTED] City [REDACTED] State [REDACTED] Age 45 Sex M Inj. O

Year/Make No. Type Trailer Reg. 91/MI CA 257KGB15477 REMOVED TO BY STREET/OWNER

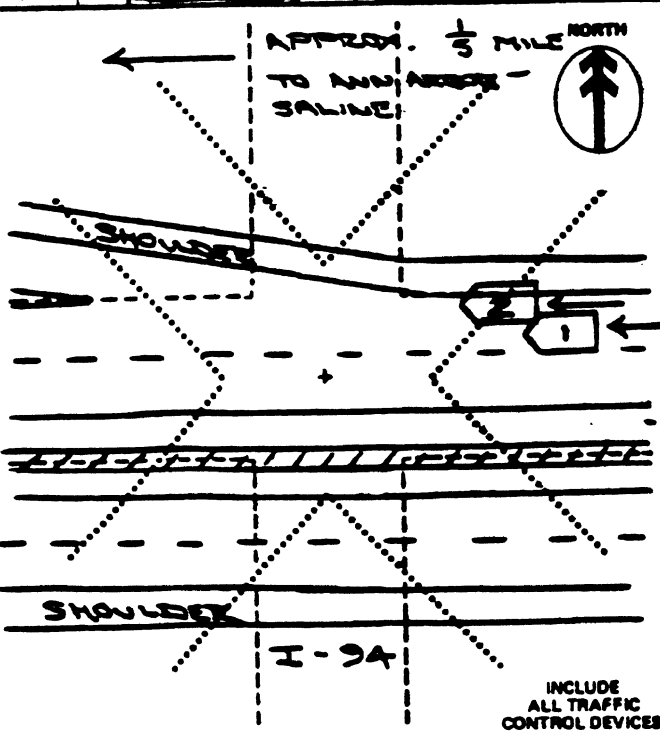
Haz. Citation Driver Re-exam Vehicle Defect Fuel Leakage Vehicle Fire Other Citation Vision Obstruct. Veh. Drivable Veh. Fire

Impact Severity 5 1 Truck Cargo: Cargo Spillage Cargo Description

Restraints by occupants pos. Name Address Pos. Age Sex Inj. Helmet

1 2 3 [REDACTED] Y N
4 5 6 [REDACTED] Y N

Total occupants 1 Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) WASTENAW CO. 688-1000 ANN ARBOR Insurance Co. GBE-INSURED Agency Address ANN ARBOR Injured taken to/by N/A



ACCIDENT DESCRIPTION AND REMARKS (*Explain)

VEHICLE NO. 2, A WASTENAW CO. SALT TRUCK, WAS TRAVELING W/B ON I-94 NEAR THE ANN ARBOR-SALINE RD. EXIT RAMP. VEH. NO. 2 HAD SNOW PARTIALLY ON THE SHOULDER AND PARTIALLY ON THE ROADWAY, ESCAPING SNOW ONTO THE SHOULDER ALONG THE NORTH SIDE.

VEHICLE NO. 1 STRUCK THE REAR OF VEHICLE NO. 2 AS VEH. 1 STARTED TO ENTER THE EXIT RAMP.

DRIVER NO. 2 ESTIMATED HIS SPEED AT 25-30 M.P.H. AT THE TIME OF IMPACT. HE STATED THAT HE

Reported: Mo/Da/Yr Time 12/28/90 0649 AM Investigators [Signature] Badge No. 136 Damaged Property Other Than Vehicle

Presses by Comp. Disposition [Signature] Reason [Signature] Person Advised of Damaged Traffic Control Device Date

Open Closed 3U Name: Date: Time:

8	STOLEN \$	2	2
27	PAGE OF DICTATION-R.M. TIME	<input type="checkbox"/>	REVIEWED BY
17	IS RECOVERED \$	17	NUMBER OF FOLLOW-UP ASSIGNED TO
	DATE	SEC	CLASS

NOTE: ACCIDENT INVESTIGATORS (SEE MEXLEY AND OR FREEDY) HAD RESPONDED TO THE SCENE OF THE ACCIDENT.

ISSUED FOR DWL'S (CR 90-57072) AND NO INSURANCE.

DISPOSITION: DRIVER NOT ISSUED VR K12421 FOR "VIOLATION OF WEXX LIP."

VIOLATIONS K12422 AND K12423 ALSO

OF WEXX LIP. DRIVER NOT ISSUED A CIT TO HIS

A CUT TO THE RT SIDE OF HER FOREHEAD AND COMPLAINING

CHAS AND HIS WIFE LIP FOREHEAD C. BARKES-YOUNG SUSTAINING

DRIVER NOT ISSUED A CIT TO HIS

INVESTIGATORS: ALL THREE SUBJECTS ESCAPED FROM VEHICLE NOT WERE TRAFFIC -

SPED AT 40 MPH.

INVESTIGATORS AND COULD NOT AVOID IMPACT. HE ESTIMATED HIS

VEHICLE NO. 2 BUT HAD STARTED TO SLIDE ON THE SHOULDER

ANN ARBOR - SHELBY RD. HE STATED THAT HE HAD OVERTAKEN

DRIVER NOT STATED THAT HE HAD PLANNED TO CUT AT

OPERATING LIGHTS REDUCED.

AN EXCELLENT SPEED. HE STATED THAT HE DID HAVE THE VEHICLE'S

ACCIDENT (CONT): DID OBSERVE VEHICLE NOT APPROACHING AT

NAME	R/S	AGE OR D.O.B./IMPLEMNT	ARREST DISPOSITION	HOME ADDRESS PLACE OF EMPLOYMENT & SHIFT	TR HOME/BUSS.
CLAWSON					
CLAWSON					

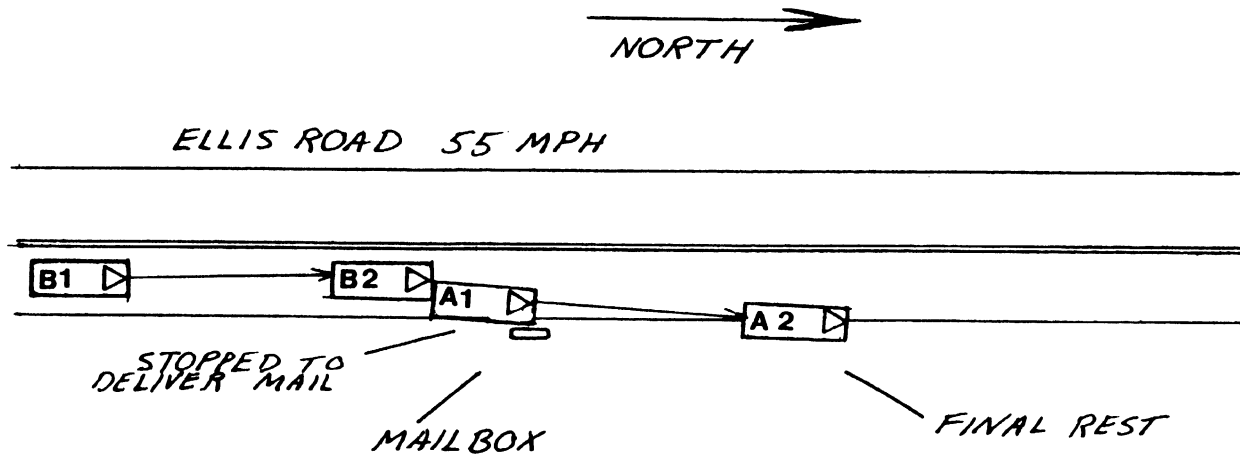
REPORTING OFFICER: [REDACTED] INCIDENT TYPE: [REDACTED]

IVSAWS Application Case 5

School Bus or Other Special-Vehicle Hazard

CASE NO.: UM-2812-90
CASE VEH. (A): 1989 OLDSMOBILE
TYPE: CUTLASS CIERA 4-DR. SEDAN
DRIVER: 64-YRS., FE MALE
VEH.(B): 1987 DODGE RAM PICKUP 4X2

DATE / TIME: 07-17-90 /1300 HRS.
WEATHER: CLEAR
ROAD SURFACE: DRY
ROAD CONSTRUCTION: ASPHALT



OFFICIAL TRAFFIC ACCIDENT REPORT

Washtenaw County Sheriff 181

70-21,931
DO NOT USE

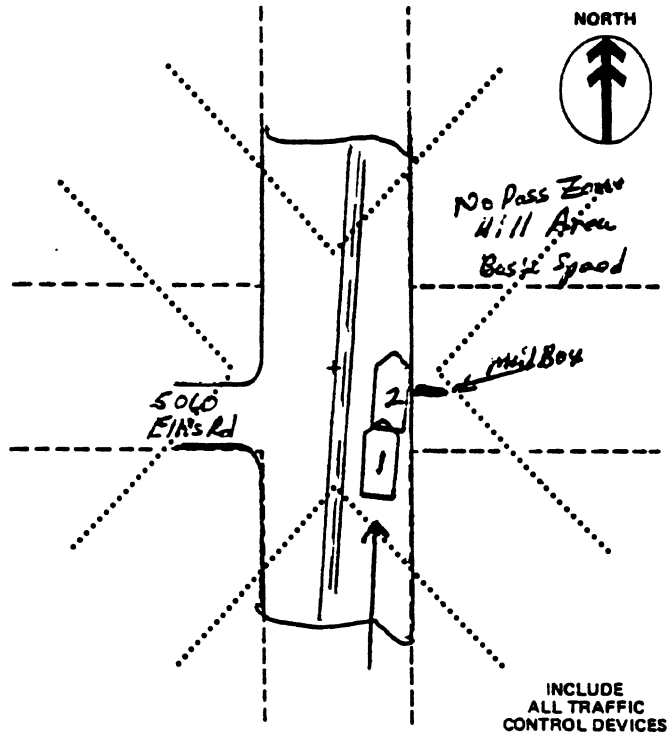
County No. 81 City No. 20 Twp. No. 19 Section No. 19 Day of Week S M T W T F S Accident Date: Mo/Da/Yr 7-17-90 Time 1:00 AM
Route No. 1/2 MI N (S) E W Intersection Margin Road Route Nos.
Weather: 1 Clear, 2 Fog, 3 Cloudy, 4 Rain, 5 Snow
Light: 1 Day, 2 Dawn or Dusk, 3 Street Lights, 4 Dark
Road Surface: 1 Dry, 2 Wet, 3 Snowy or Icy, 4 Other
TOTAL LANES: 2
TOTAL NO. VEHICLES: 2
Construction Zone: Y (N) Investigated at Scene: Y (N)

VEHICLE DRIVER NO. 1
State Mich Driver's License [redacted] DOB: Mo/Da/Yr 5-23-17 Hazardous Action No. 8 Citation Charge 77-61345 HBD Test Y (N) N Y (N) Heimet Y (N)
Driver's Name First M. Last Address City State Age Sex Inj. 73 M C
Year Make No. Type Trailer Reg. Yr/State VIN (Make Letters Larger Than Numbers) Removed to/by
87 2 2 6 0 [redacted] 90/mich 1 B 7 F D 1 4 H 9 H S 3 6 9 1 5 3 Willis / down Seneca / down
Y (N) Haz. Citation Y (N) Driver Re-exam Y (N) Vehicle Defect Y (N) Fuel Leakage Y (N) Vehicle Fire 2 1 3
Y (N) Other Citation Y (N) Vision Obstruct... Y (N) Veh. Drivable Y (N) Cargo Spillage Y (N) Cargo Description None

Total Occupants 1 Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) Same as driver Insurance Co. State Farm Ins Agency Address Ypsilanti Mich Injured taken to/by Refused

VEHICLE DRIVER NO. 2
State Mich Driver's License [redacted] DOB: Mo/Da/Yr 9-18-25 Hazardous Action No. 0 Citation Charge None HBD Test Y (N) N Y (N) Heimet Y (N)
Driver's Name First M. Last Address City State Age Sex Inj. 64 F B
Year Make No. Type Trailer Reg. Yr/State VIN (Make Letters Larger Than Numbers) Removed to/by
89 1 1 1 0 [redacted] 90/mich 2 G 3 A T S L W 7 K 2 3 5 4 1 6 5 6 Sakstups Towing / Week
Y (N) Haz. Citation Y (N) Driver Re-exam Y (N) Vehicle Defect Y (N) Fuel Leakage Y (N) Vehicle Fire 5 1 5
Y (N) Other Citation Y (N) Vision Obstruct... Y (N) Veh. Drivable Y (N) Cargo Spillage Y (N) Cargo Description N/A

Total Occupants 1 Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) Same as driver Insurance Co. AAA Agency Address A2 Mich Injured taken to/by St Joseph Hosp / HUA



ACCIDENT DESCRIPTION AND REMARKS (*Explain)
7-17-90
3/55
90-21,931
Vehicle #1 was going north on Ellis Road, and I didn't see it stop. He & truck was vehicle pushing it down the road.
Vehicle #2 was stopped making a mail deliver in a marked postal vehicle w/sign. This was a private car used for mail.

Reported: Mo/Da/Yr Time 7-17-90 1:04 AM Investigators R. Hill / E. Swenson Badge No. 99/507 Damaged Property Other Than Vehicle Mail Box
Person Advised of Damaged Traffic Control Device Name: Darren Panahi, 5060 Ellis Rd, Ypsilanti, MI 48197
Date: Time: Owner Address

3.5 *Highway Construction Zones*

IVSAWS transmitters could be deployed to accurately reflect the changing conditions at and around construction zones. Work crews could change the transmitted message to reflect current road conditions as work progresses and changes in character. In this way, drivers would be presented with the most timely information, reducing the likelihood that they will dismiss messages as not being pertinent.

3.6 *Traffic Backups*

IVSAWS transmitters could be deployed to notify drivers of impending traffic backups. This may not be practical for some recurrent traffic congestion problems. In recurrent situations the message may be so repetitive as to cause driver habituation, thus diminishing the value of the message. However, this application may be more practical in nonrecurrent traffic backup situations.

Traffic may backup as a result of a crash or other roadside or off-road event (via lane blockage or "gapers block"). In these cases, police or other emergency personnel may set up IVSAWS transmitters to inform up-stream traffic of the upcoming blockage. Another likely application is at locations on the highway where traffic backups are frequent, but are not so regular in occurrence that driver habituation becomes an issue. Such a location is at or near construction zones. A case describing a crash that occurred up-stream of a construction zone where traffic had backed up well in advance of the construction zone is described on the following pages.

IVSAWS Application Case 6

Traffic Backups

Case Vehicle (A): 1988 Dodge
Type: Ram Raider, 3-Dr. MPV
Driver: 18-yrs, Male

Vehicle (B): 1985 Freightliner
Type: COE 6 x 4 Tractor-Trailer
Driver: 49-yrs., Male

Vehicle (C): 1981 Pontiac
Type: Phoenix LJ, 5-Dr. HB
Driver: 51-yrs, Male

Vehicle (D): 1976 Chevrolet
Type: Camaro, 2-Dr. Coupe
Driver: 32-yrs., Female

Vehicle (E): 1986 Buick
Type: Electra Park Avenue, 4-Dr. NB
Driver: 46-yrs., Male

Vehicle (F): 1973 Dodge
Type: Motorhome
Driver: 64-yrs., Male

This is a multiple vehicle fatal crash with fire.

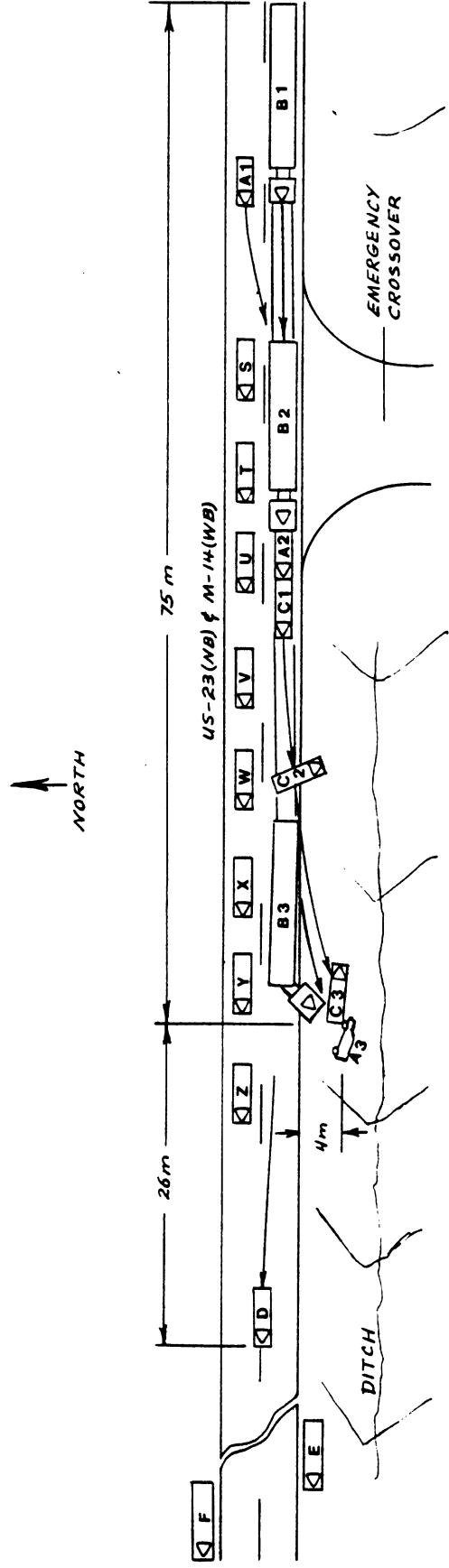
Situation

At about 0850 hours on Thursday, August 11, 1988, case vehicle (A) was reported to be traveling at an unknown speed in the right lane of US-23(NB)/M-14(WB), a 4-lane divided concrete expressway north of Ann Arbor. Vehicles (E), (D), (C) and (B) were westbound at unknown speeds in the left lane while vehicle (F) and other traffic (S) thru (Z) were westbound in the right lane. Due to construction ahead all traffic was stop-and-go except case vehicle (A) and vehicle (B). As case vehicle (A) approached this situation, it reportedly switched lanes abruptly in front of vehicle (B) and then had to slow down, but the driver of vehicle (B) was apparently not attentive enough and could not stop in time. Vehicle (B) struck the rear of case vehicle (A), which in turn struck the rear of stopped vehicle (C). Following the impact, vehicle (C) yawed to the left into the median while case vehicle (A) bounced into the air and ran off the median and rolled onto its right side. Both case vehicle (A) and vehicle (C) burst into flames and were consumed. Case vehicle (A) came to rest on its right side headed easterly about 4 meters into the median while vehicle (C) was on its wheels headed easterly just ahead of case vehicle (A) about 3 meters into the median. Following the initial impact, vehicle (B) began to

jackknife and then struck the rear of stopped vehicle (D). Vehicle (B) then slid to a stop with the front of the tractor just into the median headed southwesterly at the rear of vehicle (C). Vehicle (B) left about 75 meters of skid marks. Following impact, the left front of vehicle (D) struck vehicle (E) and bounced to the right where its left front corner was struck by vehicle (F) and then sideswiped by vehicle (F). Vehicle (D) came to rest headed west astride the center of the westbound lanes and 26 meters west of vehicle (B). Meanwhile, vehicle (E) came to a stop on the median shoulder and vehicle (F) stopped on the right shoulder; both an unknown distance west of vehicle (D). It is unknown whether or not vehicles (E) and (F) were moving at the time of impact, but it was reported that vehicle (D) was stopped at the time that it was struck. The impact speeds of vehicles (B), (C) or case vehicle (A) could not be determined.

CASE NO.: UM-2613-88
 CASE VEH. (A): 1988 DODGE
 TYPE: RAM RAIDER, MPV
 DRIVER: 18-YRS., MALE
 VEH. (B): 1985 FREIGHTLINER SEMI
 VEH. (C): 1981 PONTIAC PHOENIX
 VEH. (D): 1976 CHEVROLET CAMARO

DATE / TIME: 8-11-88 / 0850HRS.
 WEATHER: CLEAR
 ROAD SURFACE: DRY
 ROAD CONSTRUCTION: CONCRETE
 VEH. (E): 1986 BUICK ELECTRA
 VEH. (F): 1976 DODGE MOTOR HOME



State of Michigan Department Name Michigan State Police LEIN Number 026 Department Complaint No. 26-4348-88 Area Pseudo

OFFICIAL TRAFFIC ACCIDENT REPORT

County No. 81 City No. 01 Twp. No. 04 Section No. 04 Day of Week S M T W T F S Accident Date: Mo/Da/Yr 08/11/88 Time 8:50 A.M. P.M. UM-2613-88

Name West M-14 Route No. 3/4 (M) N S E (W) Intersection Nixon Rd. Route Nos.

WEATHER: 1 Clear or Cloudy 3 Rain 2 Fog 4 Snow
LIGHT: 1 Day 3 Street Lights 2 Dawn or Dusk 4 Dark
ROAD SURFACE: 1 Dry 3 Snowy or Icy 2 Wet 4 Other
TOTAL LANES: 2
1 Divided 2 Limited Access 3 Other
Y (N) Construction Zone Y (N) Investigated at Scene
TOTAL NO. VEHICLES: 6

State OH Driver's License [redacted] DOB: Mo/Da/Yr 07/16/39 Hazardous Action No. 8 Citation Charge Pends Pros. Rev. HBD Test Y (N) C Y (N) Helmet Y (N) A

Driver's Name [redacted] Address [redacted] City [redacted] State [redacted] Age 49 Sex m Inj. A

Year Make No. Type Trailer Reg. Yr/State VIN (Make Letters Larger Than Numbers) Removed to/by
85 3 2 8 3 [redacted] 89/OH 1FUEYCYB4FP255135 Triangle Tow/Same

Y (N) Haz. Citation Y (N) Driver Re-exam Y (N) Vehicle Defect Y (N) Fuel Leakage Y (N) Vehicle Fire 1 6
Y (N) Other Citation Y (N) Vision Obstruct. Y (N) Veh. Driveable
Truck Cargo: Freightliner COE 6X4T-T Class
Cargo Description: NONE/EMPTY 6

Restraints by occupants pos.	Name	Address	Pos.	Age	Sex	Inj.	Helmet
G 2 3	[redacted]	[redacted]	W	32	M		Y N
4 5 6	[redacted]	[redacted]	W	37	M		Y N
	[redacted]	[redacted]	W	24	M		Y N

Total Occupants 1 Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) [redacted] Insurance Co. Self-Insure Agency Address Toledo Injured taken to/by St. Joe/ HVA

State MI Driver's License P 625 367 098 290 DOB: Mo/Da/Yr 04/14/70 Hazardous Action No. 0 Citation Charge None HBD Test Y (N) A Y (N) Helmet Y (N) K

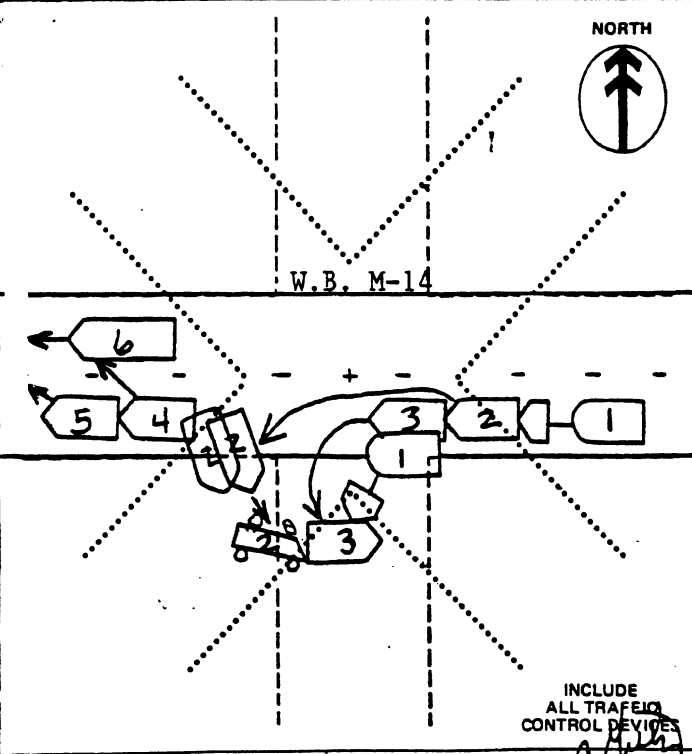
Driver's Name [redacted] Address [redacted] City [redacted] State [redacted] Age 18 Sex m Inj. K

Year Make No. Type Trailer Reg. Yr/State VIN (Make Letters Larger Than Numbers) Removed to/by
88 0 5 5 - [redacted] 89/MI JB7FJ43E3JJ001211 Triangle Tow/Same

Y (N) Haz. Citation Y (N) Driver Re-exam Y (N) Vehicle Defect Y (N) Fuel Leakage Y (N) Vehicle Fire 5 7
Y (N) Other Citation Y (N) Vision Obstruct. Y (N) Veh. Driveable
Truck Cargo: [redacted] Class
Cargo Description: [redacted]

Restraints by occupants pos.	Name	Address	Pos.	Age	Sex	Inj.	Helmet
H 1 2 3	[redacted]	[redacted]	W	22	M		Y N
4 5 6	[redacted]	[redacted]	W	30	F		Y N

Total Occupants 1 Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) [redacted] Insurance Co. Mich. Mutual Agency Address Ann Arbor Injured taken to/by UofM/ HVA



ACCIDENT DESCRIPTION AND REMARKS (*Explain)

SEE ADDITIONAL SUPP. UD-110

Drawing to left not to scale.
See additional drawing and information.

Semi: 79 Trail/mobile
Ser.# T93760 13,500#
Mod.# 011A-15AW

INCLUDE ALL TRAFFIC CONTROL DEVICES

Reported: Mo/Da/Yr 8-11-88 Time 9:00 A.M. P.M. Investigators Tpr. Gretz/Gray 620/849 Badge No. Damaged Property Other Than Vehicle N/A

Reviewed by Sgt. [redacted] Comp. Disposition Open Closed Person Advised of Damaged Traffic Control Device Name: N/A Date: Time: Owner Address

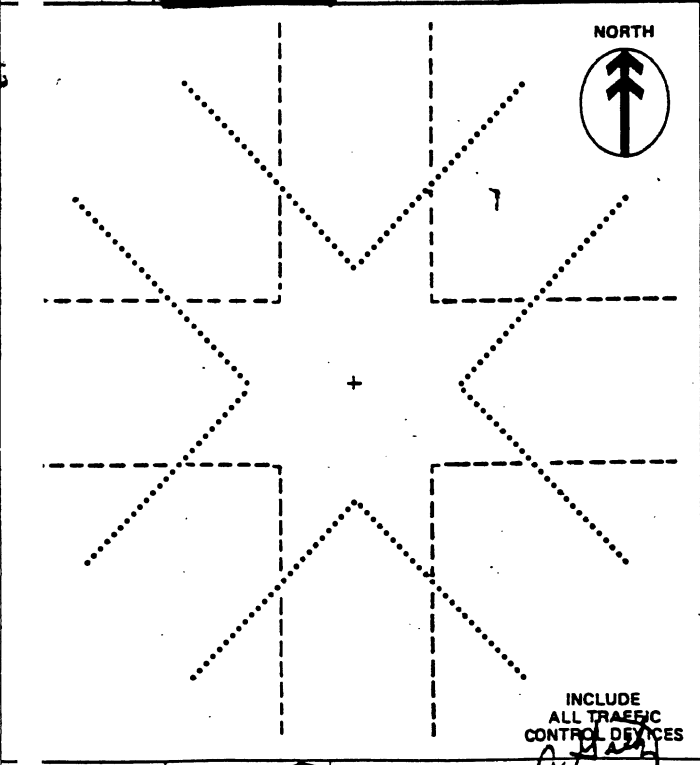
County No. 81 City No. Twp. No. 01 Section No. 04 Day of Week S M T W **F** S Accident Date: Mo/Da/Yr 08/11/88 Time 8:50 **A**M
 Name West M-14 Route No. 3/4 Ft. (M) N S E (N) Intersection Nixon Rd. Route Nos.
 WEATHER: 1 Clear or Cloudy 3 Rain 2 Fog 4 Snow
 LIGHT: 1 Day 2 Dawn or Dusk 3 Street Lights 4 Dark
 ROAD SURFACE: 1 Dry 2 Wet 3 Snowy or Icy 4 Other
 TOTAL LANES: 2
 1 Divided 2 Limited Access 3 Other
 Y (N) Construction Zone Y (N) Investigated at Scene
 TOTAL NO. VEHICLES: 6

State MI Driver's License [Redacted] DOB: Mo/Da/Yr 07/23/37 Hazardous Action No. 0 Citation Charge None HBD Test Y (N) Helmet Y (N)
 Driver's Name First M Last Address City State Age 51 Sex m Inj. A
 Year 81 Make No. 13 Type 1 Trailer Reg. 89/MI VIN (Make Letters Larger Than Numbers) 1G2A26855B6141602 Removed to/by Triangle Tow/Same
 Y (N) Haz. Citation Y (N) Driver Re-exam Y (N) Vehicle Defect Y (N) Fuel Leakage Y (N) Other Citation Y (N) Vision Obstruct. Y (N) Veh. Driveable Y (N) Vehicle Fire
 Impact Severity 5 | 7 Truck Cargo: Y N Cargo Spillage Cargo Description
 Restraints by occupants pos. Name Address Pos. Age Sex Inj. Helmet
 2 B3 [Redacted] As Above Port Phoenix 5 9 M A Y N
 4 B5 6 [Redacted] As Above 5 D. HB Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) Insurance Co. AAA Agency Address Ann Arbor Injured taken to/by U of M / HVA

State MI Driver's License [Redacted] DOB: Mo/Da/Yr 08/29/55 Hazardous Action No. 0 Citation Charge None HBD Test Y (N) Helmet Y (N)
 Driver's Name First M Last Address City State Age 32 Sex F Inj. A
 Year 76 Make No. 31 Type 1 Trailer Reg. 88/MI VIN (Make Letters Larger Than Numbers) 1Q87D6N537772 Removed to/by Triangle Tow/Same
 Y (N) Haz. Citation Y (N) Driver Re-exam Y (N) Vehicle Defect Y (N) Fuel Leakage Y (N) Other Citation Y (N) Vision Obstruct. Y (N) Veh. Driveable Y (N) Vehicle Fire
 Impact Severity 5 | 3 Truck Cargo: Y N Cargo Spillage Cargo Description
 Restraints by occupants pos. Name Address Pos. Age Sex Inj. Helmet
 1 2 3 [Redacted] As Above Canal Y N
 4 5 6 [Redacted] As Above Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier) Insurance Co. AAA Agency Address Ann Arbor Injured taken to/by U of M / HVA



ACCIDENT DESCRIPTION AND REMARKS (*Explain)
 See first page and Supp.
 Accid. Date - Mo/Da/Yr 8-11-88
 File Class 9300-1
 Department Complaint No. 26-4348-88
 Road Align. Traffic Road Loc. Acc. Type Where How Tags Road Def. 1 Veh. Def. 1 Vision Obs. 2 Veh. Def. 2 Vision Obs. MALI Coder File

Reported: Mo/Da/Yr Time 9:00 **A**M Investigators Tpr. Gretz/Gray Badge No. 620/849 Damaged Property Other Than Vehicle N/A
 Photos by 1 Comp. Disposition Open Closed Reviewer Person Advised of Damaged Traffic Control Device Name: N/A Date: Time: Owner Address

OFFICIAL TRAFFIC ACCIDENT REPORT

Michigan State Police 026

26-4348-88

County No.	City No.	Twp. No.	Section No.	Day of Week	Accident Date: Mo/Da/Yr	Time	<input checked="" type="radio"/> A.M. <input checked="" type="radio"/> P.M.
81		01	04	S M T W ① F S	08/11/88	8:50	

Name	Route No.	Ft.	Intersection	Route Nos.
West M-14		3/4 Mi. N S E W	Nixon Rd.	

WEATHER	LIGHT	ROAD SURFACE	TOTAL LANES	1 Divided 2 Limited Access 3 Other	Y <input checked="" type="radio"/> Construction Zone N <input checked="" type="radio"/> Investigated at Scene	TOTAL NO. VEHICLES
1 Clear or Cloudy 3 Rain 2 Fog 4 Snow	1 Day 3 Street Lights 2 Dawn or Dusk 4 Dark	1 Dry 3 Snowy or Icy 2 Wet 4 Other	2			6

State	Driver's License	DOB: Mo/Da/Yr	Hazardous Action No.	Citation Charge	HBD	Test	Helmet
MI		03/11/42	0	None	Y <input checked="" type="radio"/>		Y <input checked="" type="radio"/>

Driver's Name	First	M.	Last	Address	City	State	Age	Sex	Inj.
[Redacted]									

Year	Make No.	Type	Trailer	Reg.	Yr/State	VIN (Make Letters Larger Than Numbers)	Removed to/by
86	0111				89/Mi	1G4CW69B1G1415993	Driven

Y <input checked="" type="radio"/> Haz. Citation	Y <input checked="" type="radio"/> Driver Re-exam	Y <input checked="" type="radio"/> Vehicle Defect	Y <input checked="" type="radio"/> Fuel Leakage	Impact	Severity	Truck Cargo:	Class
Y <input checked="" type="radio"/> Other Citation	Y <input checked="" type="radio"/> Vision Obstruct.	Y <input checked="" type="radio"/> Veh. Drivable	Y <input checked="" type="radio"/> Vehicle Fire	1	1	Y N Cargo Spillage	

Restraints by occupants pos.	Name	Address	Pos.	Age	Sex	Inj.	Helmet
	Electra	4-9 NB					Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier)	Insurance Co.	Agency Address	Injured taken to/by
[Redacted]	AAA	Sterling Hgts.	None

State	Driver's License	DOB: Mo/Da/Yr	Hazardous Action No.	Citation Charge	HBD	Test	Helmet
ILL		11/07/23	0	None	Y <input checked="" type="radio"/>		Y <input checked="" type="radio"/>

Driver's Name	First	M.	Last	Address	City	State	Age	Sex	Inj.
[Redacted]									

Year	Make No.	Type	Trailer	Reg.	Yr/State	VIN (Make Letters Larger Than Numbers)	Removed to/by
76	3963				88/IL		Driven

Y <input checked="" type="radio"/> Haz. Citation	Y <input checked="" type="radio"/> Driver Re-exam	Y <input checked="" type="radio"/> Vehicle Defect	Y <input checked="" type="radio"/> Fuel Leakage	Impact	Severity	Truck Cargo:	Class
Y <input checked="" type="radio"/> Other Citation	Y <input checked="" type="radio"/> Vision Obstruct.	Y <input checked="" type="radio"/> Veh. Drivable	Y <input checked="" type="radio"/> Vehicle Fire	7	2	Y N Cargo Spillage	

Restraints by occupants pos.	Name	Address	Pos.	Age	Sex	Inj.	Helmet
							Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier)	Insurance Co.	Agency Address	Injured taken to/by
[Redacted]	Pekin	Clinton	None

NORTH
↑

1

ACCIDENT DESCRIPTION AND REMARKS (*Explain)

See first page and Supp.

Reported: Mo/Da/Yr	Time	Investigators	Badge No.	Damaged Property Other Than Vehicle
8-11-88	9:00	Tpr. Gretz/Gray		N/A

(Rev. 7-85)

MICHIGAN DEPARTMENT OF STATE POLICE

Original Date

Incident No.

8-11-88

26-4348-88

Date of Supplementary Report

Primary File Class

9300-1

Supplementary Incident Report

Additional Incident Page No. 4

To follow as page four after the page 3 UD-10

INFORMATION:

Undersigned while S.B. on US-23 was stopped by a motorist near the Plymouth Exit. Motorist advised a bad accident had just occurred near Nixon and M-14. The U/S advised the post of the information and with full emergency equipment departed for the accident location. This was approx. 8:58 Hrs am.

U/S while passing the E. Triple deck noticed a large amount of smoke and upon arrival at the scene noticed two vehicles on fire as well a one semi. on fire. Many civilians were standing around the area at which time one advised the U/S that there were still several people trapped inside one of the vehicles. At this time with use of an emergency blanket out of the patrol vehicle U/S attempted a rescue. As the U/S approached the burning vehicle and looked in it was obvious that I would not be able to render any assistance. This was 9:00 am.

Tpr. Gray had arrived at the scene at this time and Fire and HVA were dispatched. Sgt. Ezinga accident reconstructionist from Jackson was requested and did arrive at the scene. (40-100-88) Tpr. Gray interviewed the 4,5,6, vehicle in the accident as well as witnesses while the U/S interviewed the driver of the Semi who struck the K (death) vehicle. Vehicle 3 was also interviewed by the U/S.

INTERVIEW TRUCK DRIVER:

W/M 7-16-39

Vehicle 1985 Freightliner

Vin 1FUEYCYB4FP255135

Oh [redacted]

Nv [redacted]

[redacted] was read his Miranda Warnings per the dept issued card at 9:50 a.m same date at the scene. Herman advised he would cooperate and answer some questions for the U/S officer.

[redacted] advised he departed 2000 Sticklely Ave. Toledo Ohio 43615 at 8:00 a.m. empty and was enroute to Evert Michigan. [redacted] took US 23 up from Toledo. [redacted] advised he was running around 50-55 and noticed the traffic getting a bit heavy on the W.B. M-14. [redacted] advised it was still flowing good. [redacted] advised that he didn't notice the Blue vehicle (k) at first but then saw the blue vehicle cut in. At that point he noticed traffic back-up started to slow down then bingo struck the blue car. [redacted] advised he had about 5 to 10 feet in front of him and the blue vehicle. This occurred in the left of two lanes on W. M-14. [redacted] was going north on US23 at the split about 1/2 mile from the scene of the accident. When asked some time later to go over the details of the accident [redacted] advised "when I looked up he was there and bam I hit him". [redacted] further advised he struck his brakes prior to impact and at this point it appears so.

Investigated By

Tpr. Gretz

Reported By

[Handwritten Signature]

Reviewed By

Incident No.

File Class

MICHIGAN DEPARTMENT OF STATE POLICE <input type="checkbox"/> Supplementary Incident Report <input checked="" type="checkbox"/> Additional Incident Page No. <u>5</u>	Original Date 8-11-88	Incident No 26-4348-88
	Date of Supplementary Report	Primary File Class 9300-1

INTERVIEW TRUCK DRIVER CONTINUE:

█████ again advised he didn't think the blue car was in front of him for more than a few seconds. █████ did advise he noticed traffic slow down. The U/S went over the details just prior to the accident several times with Herman giving these two stories. When asked about the other vehicle involved in the fire the Burgandy vehicle with the child and parents in it █████ advised he didn't recall seeing that vehicle.

█████ appeared to be in good physical condition considering. █████ advised he recieved about 7 hrs of good sleep the night before and had not been drinking. █████ further advised he takes no drugs but was on (SP) Thermadone for his lungs. In the U/S opinion there was no sign of drug or alcohol use.

█████ was unable to recall what type of vehicle it was he struck or even the color. He just knew the vehicle on fire was the one we were talking about. It was also the vehicle he described as cutting in front of him etc. It should be noted at this point the U/S is using the color in the report not █████ (blue and burgandy)

ADDITIONAL:

The U/S did a driver inspection at the scene on █████ with the following results. Seatbelt not on. █████ advised it was. Seatbelt was under debris and very dusty also █████ had a Knee injury the belt use would have prevented.

Driver Log Book, a review indicated █████ was well within his hours and not in violation.

Drivers License, Class II good record.

Medical Cert. Current as of 1-18-88

REQUEST CHEMICAL TEST:

A chemical test was requested of █████ at 2:32 p.m. at St. Joes at which time █████ was given his Chemical Rights per DI-93. █████ advised yes he would give blood. Sample taken by RN █████ W/F 9-12-62. results pending.

INTERVIEW OCCUPANTS VEHICLE 3 Burgandy:

█████ W/M 7-23-37
See UD-10 for further.

█████ saw the truck in his mirror and advised he knew he was not going to stop. █████ also stated he was comming very fast. █████ doesn't speak English well.

█████ W/F 5-29-30
Saw nothing.

Incident No.

File Class

[Handwritten signature]

CHIGAN DEPARTMENT OF STATE POLICE

Original Date

8-11-88

Incident No.

26-4348-88

Supplementary Incident Report

Additional Incident Page No. 6

Date of Supplementary Report

Primary File Class

ADDITIONAL ACCIDENT INFORMATION:

To follow by Sgt. Ezinga out of Jackson
Accident drawing, Speed est. Pictures.

MOTOR CARRIER INVESTIGATION:

Officer M. Jones Ypsi Post. was called to the scene to check the mechanical
condition of the truck. Jones advised the mechanical condition was sound and
the brakes were working properly.

MEDICAL EXAMINER:

Dr. [redacted] of [redacted]
Tx. [redacted] arrived and pronounced subject dead.

PROPER ID OF SUBJECT:

Dental records were obtained by Tpr. Shaw and comparison was made by Dr. [redacted]
[redacted] and Dr. [redacted] of U of M pathology Tx. [redacted] H of [redacted] During
medical exam of the body positive I.D. was made.

PARENTS CONTACTED:

By Tpr. Gretz, Also See Tpr Shaw Supp.

FOLLOW-UP:

All follow-up to Tpr. Gray.

STATUS: Open

Investigated By

Tpr. Gretz

Reported By

Reviewed By

Incident No.

File Class

(Rev. 7-95)

MICHIGAN DEPARTMENT OF STATE POLICE <input type="checkbox"/> Supplementary Incident Report <input type="checkbox"/> Additional Incident Page No. <u>7.</u>	Original Date 8-11-88	Incident No. 26-4348-28
	Date of Supplementary Report	Primary File Class 9300-1

REPORTS: A FATAL MOTOR VEHICLE ACCIDENT

VICTIM: JAMES B PERKINS 18 yrs.

SUPPLEMENTAL INFORMATION:

On the above date, at approximately 9:00 am the undersigned officer and TROOPER: CARL GRETZ in separate patrol vehicles were s.b. US-23 near Plymouth rd. when an unknown motorist kept flashing his lights on and off to stop the officers. The motorist advised that there was a bad accident on w.b. M-14 near Nixon Rd., where there were several vehicles burning and people injured. Both officers responded.

Off in the distance as the officers were approaching, a large cloud of smoke could be seen in the area of M-14 and Nixon Rd.

ARRIVAL AT SCENE:

At the time the officers arrived, the Ann Arbor Twp. Fire department also arrived. All of W.B. M-14 traffic was completely stopped at the scene of the burning vehicle. There were many people walking around the area, and yelling at the officers that there were still people in the burning vehicles.

At this time, TPR: GRETZ, grabbed an emergency blanket from the patrol car trunk, ran it through standing water in the median to get it wet and ran back to the burning vehicles to attempt a possible rescue. Both officers realized at this time that there would be no more survivors of the two autos due to the vehicles now totally engulfed in flames.

Both officers checked the injured parties that were lying on the roadway not far from the vehicles for serious injuries. None seemed to be in any serious danger and were being treated by concerned citizens who stopped to help. Also moments later fire rescue was also checking the injuries.

During the time the fire department was extinguishing the flames on the three burning vehicles, people were advising that there were other people in the burning autos. A check of vehicle number 3 revealed that everyone had escaped, however in vehicle number 2 it was confirmed by both officers that one person did not escape and died in the vehicle. Vehicle number two was laying on its passenger side door. After the flames were extinguished, an emergency blanket was placed on the deceased to cover.

OFFICERS ACTIONS:

At about 9:10 the undersigned officer requested additional backup in regards to traffic assistance, a medical examiner and an accident reconstructionist.

SGT BILL DARNELL of the Ypsi post advised that at (9:16 AM) medical examiner [REDACTED] was enroute to the scene, and an accident reconstructionist from JACKSON STATE POLICE POST (SGT ROBERT EZINGA) was enroute.

TPR: CARL GRETZ is the officer in charge of handling the original report with TPR: GRAY assisting. TPR: GRETZ requested that the undersigned assist in obtaining witness information. At the beginning of the investigation, it was believed that there was only a four vehicle accident. As time went on at the scene, it was learned that there was an additional two more vehicles involved. TOTAL # of vehicles involved 6.

continued on next page...

Page	Investigated By TPR: GARRY GRAY/GRETZ	Reported By <i>[Signature]</i>	Reviewed By
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Incident No.

26-4348-28

File Class

13000-1

REV. 7-251

MICHIGAN DEPARTMENT OF STATE POLICE

Original Date

Incident No.

Supplementary Incident Report

8-11-88

26-4312-88

Additional Incident Page No. 8.

Date of Supplementary Report

Primary File Class

9300-1

WITNESS INFORMATION:

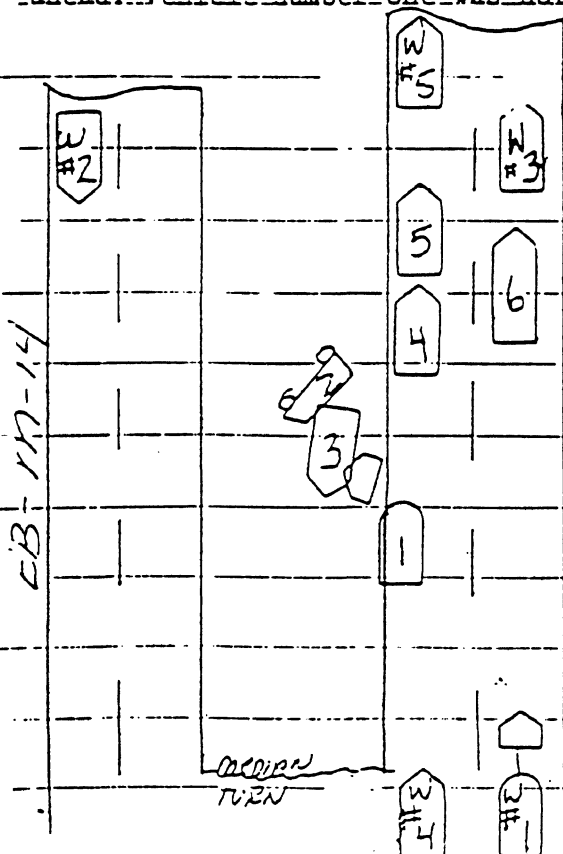
#1. [redacted] b/m of [redacted] Watts # [redacted], advised the following information;

MR. [redacted] stated that he was travelling in the right lane (slow lane) when he saw brake lights up ahead, traffic stopping. MR. [redacted] was driving a semi-tractor trailer rig.

Vehicle #1. was a short distance ahead of his rig, and MR. [redacted] stated that he knew the semi, (veh #1), wasn't going to stop in time. MR. [redacted] stated that he saw the semi hit his brakes and then he locked up both the tractor and trailer brakes. MR. [redacted] stated that at about the time he locked his brakes up, there was a huge explosion.

MR. [redacted] thought that the semi hit a car and possibly a Bronco type vehicle. [redacted] stated that the BRONCO type vehicle immediately burst into flames. [redacted] when asked what vehicle was hit first, he stated that he wasn't sure and that it all happened so fast. MR. [redacted] stated that he was almost stopped due to the traffic up ahead, he then pulled his rig to the shoulder and ran over to help. MR. [redacted] stated that his main concern now was the safety of people involved. [redacted] then advised that he helped in getting a trapped youth from the rear of vehicle number 3 which had just caught fire.

MR. [redacted] was asked as to the possible speed of vehicle number one, the semi. [redacted] stated that he didn't think the truck was exceeding the speed limit of 55 mph. but knew that he was travelling at a speed which would not enable him to stop in time due to the stopping traffic he observed up ahead. [redacted] was already braking for traffic ahead. Vehicle number one was not braking until it was too late.



The diagram to the left is the location of witness vehicles relative at the time of the crash.

- WITNESS VEHICLE W# 1 [redacted]
- WITNESS " W# 2 [redacted]
- Witness " W# 3 [redacted]
- WITNESS " W# 4 [redacted]
- WITNESS " W# 5 [redacted]

see additional pages.....

Rev. 7-85)

MICHIGAN DEPARTMENT OF STATE POLICE

Original Date

8-11-88

Incident No.

26-4348-88

 Supplementary Incident Report Additional Incident Page No. 9

Date of Supplementary Report

Primary File Class

9300-1

WITNESS INFORMATION: continued

Witness #2, [REDACTED] /m 12-28-50 of [REDACTED]
HOME TX [REDACTED] Work; [REDACTED] advised the following information;

MR. [REDACTED] stated that he was in the slow lane of e.b. M-14 when the accident occurred. MR. [REDACTED] SAID as he was e.b. he looked over to the w.b. lanes of M-14 because traffic was so heavy and backed up. MR. [REDACTED] Stated that he saw a burgundy vehicle in the fast lane at a complete stop. The next thing he saw was a black 4 wheel drive type vehicle (bronco type) get struck from the rear by a semi-truck. It burst into flames upon impact. [REDACTED] stated that the BRONCO spun and collided with the burgundy car. MR. [REDACTED] stated that from the impact, the forward momentum kept everything moving and it all happened so fast. MR. [REDACTED] pulled his vehicle to the shoulder, ran across the median and assisted in getting the trapped youth out of vehicle number 3. [REDACTED] stated the bronco was either stopped or doing the most 2 mph in backup.

WITNESS #3 interview:

[REDACTED] w/m 24 yrs of age 9-11-63 [REDACTED]
work [REDACTED] advised the following information.

[REDACTED] stated that he was travelling in the fast lane when he was approaching the traffic back-up. [REDACTED] said he was slowing down and traffic was possibly doing two mph. At this time [REDACTED] stated that he moved over to the right hand lane knowing traffic behind him was doing 50 also. Stated that he looked in rearview mirror and saw that the sem Veh #1) was really moving along. Only 50 ft away the semi showed no signs of slowing down and hit the vehicles. [REDACTED] stated that he was unsure of what vehicle was hit first but saw the BRONCO type vehicle flip several times and burst into flames. [REDACTED] stated that all of the vehicles ahead of the semi were either stopped or only crawling at 2 mph or so. [REDACTED] stated that he saw everything in his rearview mirror and the chain reaction after.

When asked to sum up what he saw that happened, [REDACTED] STATED: "The cars stopped, and the truck didn't".

WITNESS #4 interview;

[REDACTED] W/M age 22 6-7-66 of [REDACTED] Home Tx
[REDACTED] Work [REDACTED] advised the following information;

MR. [REDACTED] stated that he was w.b. M-14 and was almost positive he was directly behind vehicle number one (the semi) when the accident occurred. He too stated that everything happened so quickly. [REDACTED] saw that traffic ahead was starting to slow down. He further advised that the semi ahead of him, didn't seem to be slowing down at all, and then all of a sudden "CRASH". [REDACTED] was questioned about the speed of the semi, and he couldn't say for sure how fast, but knew that he wasn't going to stop in time. When questioned about brake lights from the semi, [REDACTED] stated that he didn't see any. [REDACTED] stayed at the scene to give assistance and witness information to the Investigating officers.

[REDACTED] stated that after fire rescue, and the undersigned officers were on the scene and many people were in the area, [REDACTED] had spoke with the driver of the semi. [REDACTED] asked a man if he was the driver of the semi and the man stated that he was. [REDACTED] stated the this man said, "I looked up, and just hit him."

WITNESS #5 interview;

continued on next page....

Investigated By
TROOPER: GARRY GRAY

Registered By
[Signature]

Reviewed By

MICHIGAN DEPARTMENT OF STATE POLICE

Original Date

8-11-88

Incident No.

26-4348-88

Supplementary Incident Report

Additional Incident Page No. 10

Date of Supplementary Report

Primary File Class

9300-1

WITNESS #5 interview;

[redacted] 30 4-17-58 of [redacted]
Work [redacted] advised the following information;

[redacted] advised the undersigned officer that she didnt see the sequence of events that led up to the collision, but she heard tires sqreeching and that she looked in her rearview mirror. [redacted] STATED that she saw the vehicle collide and the fire. She further stated that everything was approaching her, so she drove off onto the south shoulder to avoid being hit herself.

When asked about traffic conditions at the time, she stated that she was in stop and go traffic. [redacted] stated that she was one or two vehicles ahead of the Buick, vehicle number 5. After the scene settled, [redacted] went to the aid of the injured female in the orange Camaro, vehicle number 4.

ADDITIONAL:

The undersigned officer along with TPR: GRETZ, CLEARED THE SCENE and went to the U of M hospital to take statements from the driver of vehicle number 3 and number 4. TPR: GRETZ spoke with the [redacted] while TPR: GRAY Spoke with [redacted]

[redacted] stated that she didn't know what took place but all of a sudden was struck from behind and was tossed about inside of her car. She stated that if she didn't have her seat belt on, she really could have been hurt.

[redacted] suffered a badly bruised right hand, possibly broken, by the steering wheel.

STATUS:

OPEN, PENDS REPORT FROM JACKSON ACCIDENT RECONSTRUCTIONIST, PHOTO'S and review by prosecutors office.

Investigated By

TRCOPER: GARRY GRAY

Reported By

Garry Gray

Reviewed By

Incident No. 26-4348-88

SUPPLEMENTAL INCIDENT
REPORT Page 1

ORIGINAL DATE AUG 11, 1988	INCIDENT NO. 026 - 4348-88
SUPPLEMENTAL REPORT DATE AUG 11, 1988	FILE CLASS 93001

INCIDENT STATUS

0

OPEN

NATURE OF INCIDENT

FATAL TRAFFIC COLLISION

INFORMATION:

Undersigned officer was requested by TPRS GRAY & GRETE to assist with the investigation of this fatal traffic collision. Officer was requested to attempt to make contact with the registered owner of the vehicle containing the deceased driver in an attempt to identify the victim and notify next of kin.

INVOLVED VEHICLE:

1988 Dodge Raider 4dr. [REDACTED] 89/MI VIN# JB7FJ43E3JJ001211
Registered owner of the vehicle: [REDACTED]
[REDACTED]
[REDACTED]

CONTACT RESIDENCE:

Officer responded to the residence at [REDACTED] Superior Twp., to make contact with the registered owner of the vehicle regarding further investigation of this incident.

Officer arrived at the residence at approx. 12:00PM this date meeting with a female subject named [REDACTED]. This subject stated that [REDACTED] were both out of state on vacation in Mass. and that she is staying at the residence to watch the house while they are gone. Subject [REDACTED] stated that she is not related to the family but that she is a graduate student of MR. [REDACTED] who is a Professor at the University of Michigan.

Officer informed MS. [REDACTED] of the traffic collision and she stated that she believed the deceased victim is [REDACTED] son of the registered owner of the vehicle.

INTERVIEW SUBJECT [REDACTED]:

[REDACTED] WF 12-12-62
[REDACTED]
[REDACTED]
[REDACTED]

Subject [REDACTED] explained that she was house-sitting for the [REDACTED] while they were in Mass. visiting family. MS. [REDACTED] stated that the [REDACTED] son, [REDACTED] age 18, had remained

PAGE 1	INVESTIGATED BY TPR SHAW	REPORTED BY TPR [Signature]	REVIEWED BY
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ORIGINAL DATE AUG 11, 1988	INCIDENT NO. 026 - 4348-88
SUPPLEMENTAL REPORT DATE AUG 11, 1988	FILE CLASS 93001

home and had left this morning in the vehicle reportedly involved in this collision.

Subject [REDACTED] stated, that to the best of her knowledge, subject [REDACTED] had left the residence at approx. 9:00AM this date in the 1988 Dodge and that he was enroute to a stable in Ann Arbor where he horse is boarded. MS. [REDACTED] stated that she is unsure of the location of the stable, but stated that the name is Stoney Ridge Farm and that the phone number is [REDACTED].

Subject [REDACTED], when asked, stated that subject [REDACTED] was the only subject in the vehicle and that he was wearing horse riding clothes described only as a light brown pair of riding pants and boots. Subject [REDACTED] described [REDACTED] as a white male, age 18, approx. 6 foot in height, sturdy build, and blonde curly hair. Subject described the vehicle as a new Dodge 4 wheel which was brown or blue in color.

When asked, subject [REDACTED] stated that when [REDACTED] left the residence he appeared to be in a good state of mind and did not appear to be under the influence of any substance.

Subject [REDACTED] advised that the believed victim's mother and father were staying at the below listed location:
(MRS. [REDACTED]-sister's residence)
[REDACTED] residence

Nantucket, Mass. 02554
Res. TX# [REDACTED]

Subject advised that the [REDACTED] are to return home from their trip on Saturday August 13, 1988.

POSSIBLE IDENTITY OF DECEASED DRIVER:
[REDACTED] WM 4-14-70
[REDACTED]
[REDACTED]
[REDACTED]
MI OPS# [REDACTED]

FURTHER INVESTIGATION:
Officer made phone contact with the horse stable learning that believed victim [REDACTED] had not arrived at that location this date.

Officer, with the assistance of house-sitter [REDACTED], checked the residence in an attempt to locate the name of the family dentist to obtain dental records for identification purposes. Officer was unable to locate the name of the family dentist after making numerous calls to the U of M Employee's benefit office as well as contacting the insurance carriers direct. Officer did make contact with the family's dental insurance

PAGE 2	INVESTIGATED BY TPR SHAW	REPORTED BY [Signature]	REVIEWED BY
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Michigan Department of State Police

SUPPLEMENTAL INCIDENT REPORT Page 3

ORIGINAL DATE AUG 11, 1988	INCIDENT NO. 026 - 4348-88
SUPPLEMENTAL REPORT DATE AUG 11, 1988	FILE CLASS 93001

carrier, United of Omaha TX# [REDACTED] who advised that they could not get the required dentist information until 8-12-88.

Officer did make contact with the [REDACTED] family doctor who stated that he would check his records and attempt to locate the dentist and re-contact officer.

CONTACT WITH POST DESK:

Officer made phone contact with SGT. DARNELL at the Post to inform him of information obtained at this point. Officer further advised of the next of kin location and that a request to Mass. authorities would have to be made to deliver the death message once positive identification of the victim was obtained.

SGT. DARNELL advised that the [REDACTED] doctor had contacted the Post advising the name of the family dentist. SGT. DARNELL stated that he had contacted the dentist, [REDACTED], and made arrangements to have undersigned officer meet him at his office in Ann Arbor to obtain the dental records of [REDACTED]. SGT. DARNELL further requested that undersigned officer transport the dental records to the University of Michigan Hospital Morgue and turn same over to the Pathologist.

MS. [REDACTED] stated that she would remain at the residence pending positive identification of the victim and notification of the parents.

DENTAL RECORDS OF [REDACTED]

Officer responded to [REDACTED] D.D.S. office located at [REDACTED], Ann Arbor, Michigan (TX# [REDACTED]) at approx. 2:00PM to obtain the dental records of [REDACTED].

Officer met with the dentist and obtained the required records.

CONTACT U OF M HOSPITAL MORGUE:

Officer responded to the U of M Hospital Morgue meeting with Pathology personnel. Officer turned over the dental records to same along with information on the believed identity of the victim. Pathology advised that they would contact the Post once positive identification of the victim has been made.

CONTACT NEXT OF KIN:

Officer returned to the Post learning that SGT. DARNELL had sent a LEIN message to Nantucket Police in Mass. requesting that notification be made with the victim's next of kin. At approx. 5:30PM this date notification was made with MR. & MRS. [REDACTED] by the Mass. authorities. The Post was also notified at this time by U of M that the victim was positively identified as [REDACTED] by dental records.

PAGE 3	INVESTIGATED BY TPR SHAW	REPORTED BY 	REVIEWED BY
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Michigan Department of State Police

SUPPLEMENTAL INCIDENT REPORT Page 4

ORIGINAL DATE AUG 11, 1988	INCIDENT NO. 026 - 4348-88
SUPPLEMENTAL REPORT DATE AUG 11, 1988	FILE CLASS 93001

MR. [REDACTED], upon notification in Mass., phoned the Post and spoke with investigation officer GRETZ regarding some initial details of the collision.

ADDITIONAL INFORMATION:

The victim had left his residence on [REDACTED] Rd., just north of [REDACTED] and was enroute to [REDACTED], Chelsea, Michigan TX# [REDACTED], at the time of this collision. The most direct route for the victim from his residence would have been westbound on M-14 which would have taken him to the location of this collision.

STATUS:

Open pending further investigation.

PAGE 4	INVESTIGATED BY TPR SHAW	REPORTED BY <i>[Signature]</i>	REVIEWED BY
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3.7 *"Mini-zones" Involving Roadside Work*

Crashes may occur at roadside "mini-zones"--areas where roadside work is in progress for limited periods of time. Examples of these mini-zones include utility construction sites where utility vehicles are present in the roadway while work is in progress at or near the roadway itself. Presence of these zones could be announced to up-stream traffic via IVSAWS. We should note that conversations with the corporate safety directors of several Michigan utilities have suggested that crashes involving roadside utility crews and/or their vehicles are extremely rare events. However, further research into the number and nature of such crashes may shed more light on IVSAWS applicability in these situations. Unfortunately, available crash data are unsuitable for this level of detailed analysis.

3.8 *Temporary Detour Routes*

The IVSAWS applications on temporary detour routes take two basic forms. First, IVSAWS could serve to warn of special hazards that may be encountered on the detour. An example of this application can be found on the following pages describing a crash of a semi-trailer truck as it tried to negotiate a curve at excessive speed on an interstate highway detour. The second possible application deviates from IVSAWS as a safety warning system and, instead, serves to provide route guidance. Transmitters could be placed along a detour path (created because of construction, a massive accident, or other special event) to direct traffic so that drivers do not get lost. While this application deviates from the hazard warning application of IVSAWS, it capitalizes on an IVSAWS installation to obtain greater functionality as a public service.

IVSAWS Application Case 7

Temporary Detour Routes

Case vehicle (A): 1978 International

Type: CO-4070B, Tractor-Trailer

Driver: 40-yrs, Male

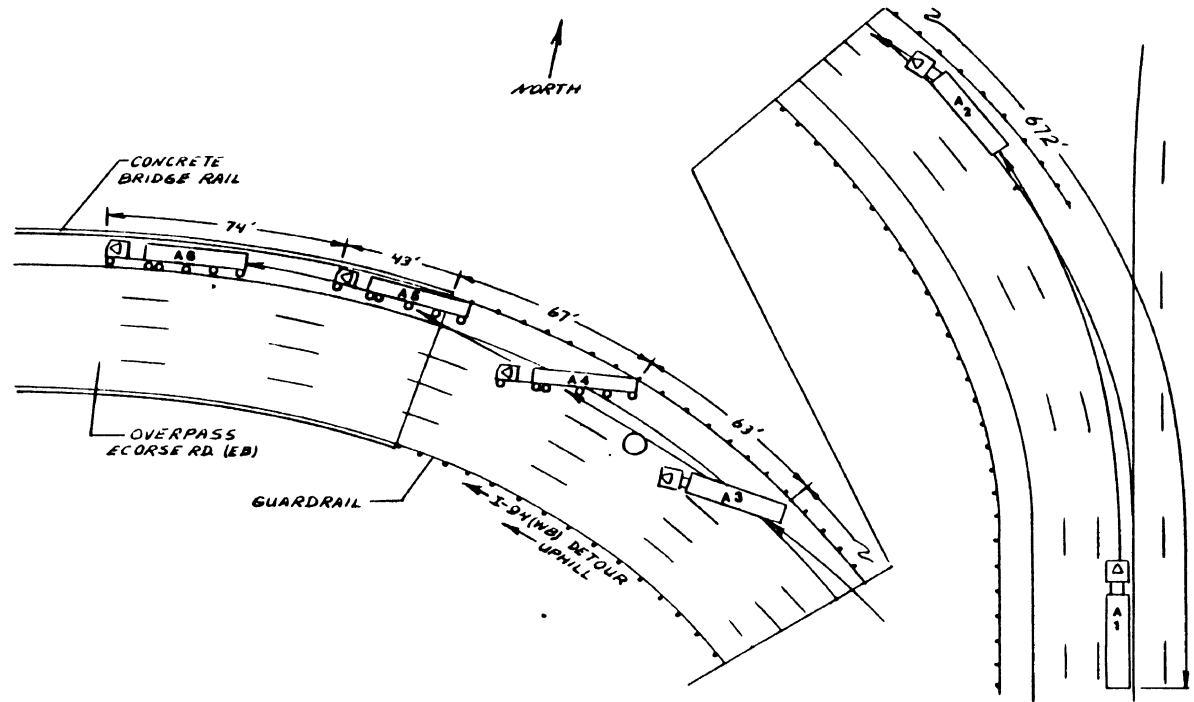
Situation

This is a fatal crash.

At about 0055 hours on Wednesday, February 4, 1987, case vehicle (A) was traveling at an unknown speed in the right lane of the 3-lane westbound I-94 detour route. There were two other lanes on the right than continued on to Ecorse Road. On a fairly sharp uphill curve to the left that went across an overpass, the case vehicle (A) was apparently traveling too fast and ran off the driving lane onto the right shoulder. The driver apparently attempted to return to the roadway too abruptly causing the case vehicle (A) to roll onto its right side. It then slid on its right side up the pavement and onto the right shoulder where it struck the guardrail. It was then directed on up along the guardrail where it struck the concrete rail of the overpass. The case vehicle (A) came to rest on its right side on the north shoulder near the center of the overpass. The rollover speed of the case vehicle (A) is unknown. The semitrailer contained two moderate (23,770 lbs total) weight rolls and one heavy (27,430 lbs) roll of stainless steel. The two smaller rolls remained in the semitrailer while the larger roll broke loose and came to rest in the center of the roadway.

CASE NO.: UM-2455-87
CASE VEH. (A): 1978 INTERNATIONAL
TYPE: CO-4070B, TRACTOR-TRAILER
DRIVER: 40-YRS., MALE

DATE/TIME: 2-4-87/0055 HRS.
WEATHER: CLOUDY
ROAD SURFACE: DRY
ROAD CONSTRUCTION: ASPHALT



UM-2455-87
STATE

PENALTY: Misdemeanor

CIRCLE THE APPROPRIATE SELECTION

10-10 (Rev. 9-85)	Department Name State of Michigan	LEIN Number 026	Department Complaint No. DO NO 26-766-87
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OFFICIAL TRAFFIC ACCIDENT REPORT				Michigan State Police		026	
County No. 81	City No.	Twp. No. 20	Section No. 11	Day of Week S M T F S	Accident Date, Mo./Da./Yr. 2-4-87	Time 12:55	A.M. XX

Name ON Temp. I-04 W/B N/R Willow Run Fwy		Route No. 11		Intersection 11/1 XXX OS E W Tyler Rd.		Route Nos.	
WEATHER 0 Clear or Cloudy 3 Rain 1 Day 3. Street Lights 0 Dry 3 Snowy or icy		LIGHT 2 Fog 4 Snow 2 Dawn or Dusk 0 Dark 2 Wet 4 Other		ROAD SURFACE 0 Dry 3 Snowy or icy 2 Wet 4 Other		TOTAL LANES 3	
<input type="checkbox"/> Divided <input type="checkbox"/> Limited Access <input type="checkbox"/> Other		<input type="checkbox"/> Construction Zone <input type="checkbox"/> Investigated at Scene		TOTAL NO VEHICLES 1			

State	Driver's License	DOB: Mo/Da/Yr 10-17-46	Hazardous Action No.	Citation Charge 1	HBD: Test 0	Helmet 0
Driver's Name	First	Last	Address	City	State	Age Sex In. 40 M Y

Year	Make No.	Type	Trailer	Reg.	Yr/State	VIN (Make Letters Larger Than Numbers)	Removed to/by
78	268	3			87 MI	E0327H3A19760	
Y N Haz. Citation		*Y N Driver Re-exam		*Y N Vehicle Defect		*Y N Fuel Leakage	
Y N Other Citation		*Y N Vision Obstruct		*Y N Ven. Driveable		*Y N Vehicle Fire	
Impact		Severity		Truck Cargo		Class	
				COIL STEEL		5	

Restraints by occupants pos.	Name	Address	Pos.	Age	Sex	In.	Helmet
1 2 3							Y N
4 5 6							Y N

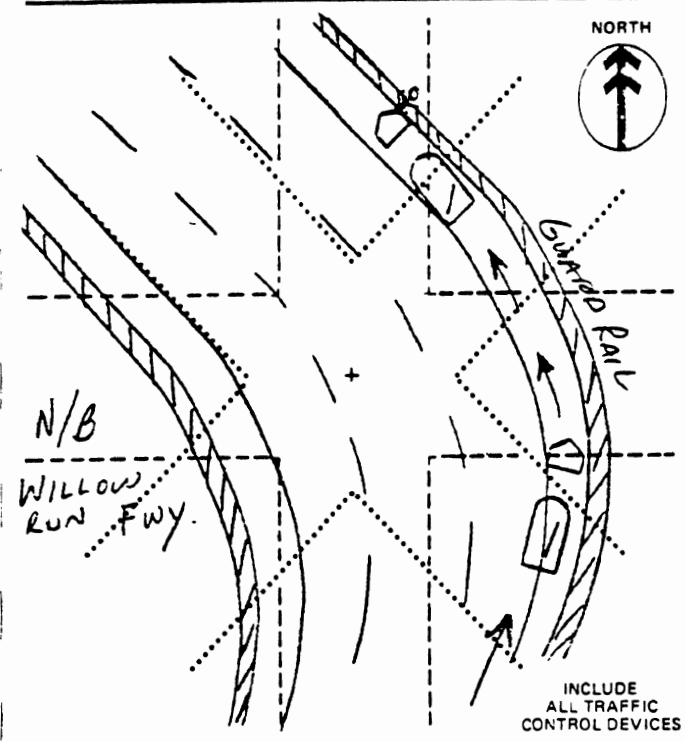
Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier)	Insurance Co.	Agency Address	Injured taken to by
1	Mich Mutual Oak Park MI	Woff/Wie Pontiac	

State	Driver's License	DOB: Mo/Da/Yr	Hazardous Action No.	Citation Charge	HBD: Test	Helmet
					Y N	Y N

Year	Make No.	Type	Trailer	Reg.	Yr/State	VIN (Make Letters Larger Than Numbers)	Removed to/by
Y N Haz. Citation		*Y N Driver Re-exam		*Y N Vehicle Defect		*Y N Fuel Leakage	
Y N Other Citation		*Y N Vision Obstruct		*Y N Ven. Driveable		*Y N Vehicle Fire	
Impact		Severity		Truck Cargo		Class	

Restraints by occupants pos.	Name	Address	Pos.	Age	Sex	In.	Helmet
1 2 3							Y N
4 5 6							Y N

Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier)	Insurance Co.	Agency Address	Injured taken to by



ACCIDENT DESCRIPTION AND REMARKS (Explain)

REPORTS A FATAL TRAFFIC ACCIDENT

Vehicle #1 was travelling on N/B Willow Run Freeway at the Ward Ramp. Vehicle #1 was entering a curve, with a posted 45mph speed. This area is temporary I-04 W/B. Due to the speed of vehicle #1 and the load of Coil Steel, Vehicle #1 tipped onto its right side upon entering into the curve. #1 then struck the guard rail, and continued to travel along the right side guard rail until coming to rest on the right shoulder. Driver of #1 was not wearing a seatbelt and partially left the cab. In leaving the cab, the driver of #1 struck his head causing death. Preliminary exam. of the vehicle shows that the trailer had defective brakes. There was a slight spill of fuel and oil. The slower speed is posted well in advance of the construction zone.

Reported: Mo/Da/Yr	Time	A.M. P.M.	Investigator's Name	Badge No.	Damaged Property Other Than Vehicle
1-87	1:05	PM	Paul H. Cameron #412	4657	Guard Rail
Reported by	Comp. Disposition	Reviewed by	Person Advised of Damaged Traffic Control Device	Date	Time
Cameron	Open	1-87	James Cameron	1-87	1:05

Accident Date: Mo/Da/Yr
2-4-87

File Class
9300-1

Department Complaint No.
26-766-87

Residence

Test

Intent

Direction

Obj. Hit

Situation

Cont. Cir

Residence

Test

Intent

Direction

Obj. Hit

Situation

Cont. Cir

Residence

Test

Intent

Direction

Obj. Hit

Situation

Cont. Cir

3.9 *Multiple (Compounding) Hazardous Conditions*

IVSAWS applications could be useful in reducing the problems caused by multiple hazards. Take the example of the semi-trailer truck crash while traveling at excessive speed through the curve. The curve was not a significant hazard when traveled at the posted speed, but became hazardous to a vehicle traveling at excessive speed. A system could be designed to relay a "slow-down" message to vehicles traveling at an excessive speed through a curve. The vehicle message system could monitor vehicle speed, and the message would be signalled only to drivers in vehicles which are traveling over a predetermined speed.

Systems which could take advantage of environmental sensors may signal drivers at sites (e.g., curves, bridges) which have become particularly hazardous because of changes in the conditions of the roadway (e.g., wet, ice, snow) or atmospheric conditions (e.g., fog). The increased reaction time afforded drivers by IVSAWS technologies may be especially helpful in these conditions where stopping distance or decision sight distance is reduced by weather or road conditions.

Other multiple-hazards involve road features which are somehow hidden from the driver because of horizontal or vertical curvature of the road or other obstacles. The case presented on the following pages describes a crash in which a car encountered a rough railroad grade after coming out of a curve at an excessive speed.

IVSAWS Application Case 8

Multiple (Compounding) Hazardous Conditions

Case Vehicle (A): 1989 Ford

Type: Probe GT 2-Dr. HB

Driver: 42-yrs., Female

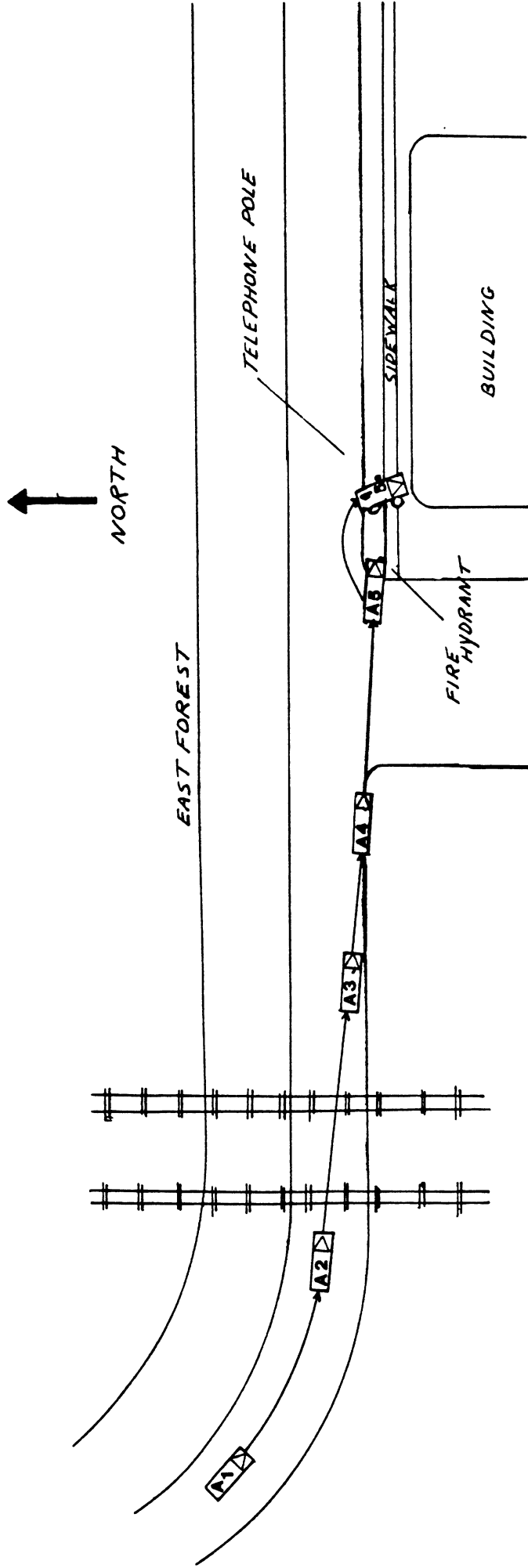
This is a fatal crash. The driver had been drinking and a chemical test was given; however, no results were obtained.

Situation

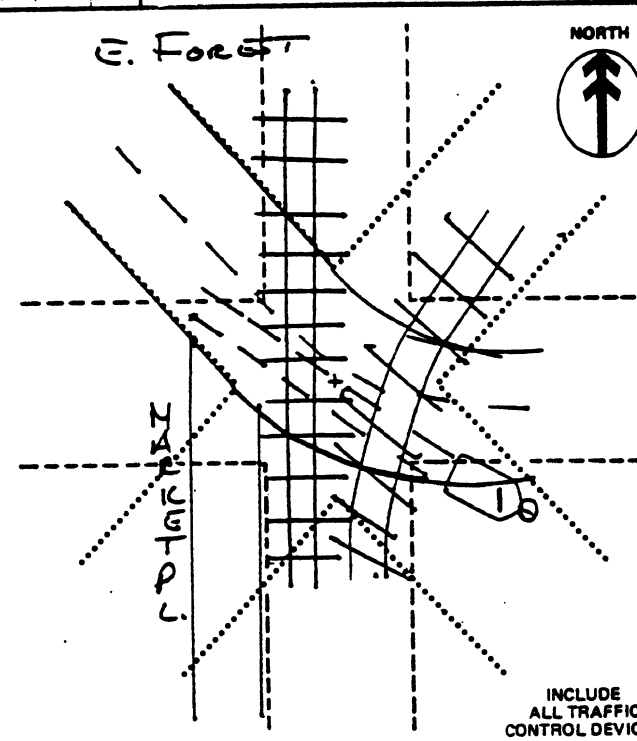
At about 0513 hours on Sunday, August 5, 1990, case vehicle (A) was eastbound at a high rate of speed on East Forest, a 2-lane asphalt roadway through a commercial area of Ypsilanti. When case vehicle (A) crossed two sets of very bumpy railroad tracks it went out of control, went up the curb and left the south edge of the roadway. It traveled off the road about 17 meters where it struck a fire hydrant head-on. The hydrant was broken off at the ground and flew about 5 meters where it struck the side of the building. Following the impact with the fire hydrant, case vehicle (A) rotated clockwise becoming partially airborne and struck a utility pole on the left side and roof. The case vehicle (A) rolled upwards with the roof contacting the pole seven feet above ground. The car came to rest at an angle against the pole.

CASE NO: UM-2820-90
CASE VEH. (A): 1989 FORD
TYPE: PROBE GT 2-DR. HB
DRIVER: 42-YRS., FEMALE

DATE / TIME: 08-05-90 / 0513 HRS.
WEATHER: CLEAR
ROAD SURFACE: DRY
ROAD CONSTRUCTION: ASPHALT



UD-10 (Rev. 9-85)		State of Michigan		Department Name Ypsilanti PD		LEIN Number 836		Department Complaint No. 90-12783		Area			
OFFICIAL TRAFFIC ACCIDENT REPORT				County No. 81 City No. 80 Twp. No. -		Section No. - Day of Week S M T W T F S		Accident Date: Mo/Da/Yr 8-5-90 Time 5:13 A.M.		DO NOT USE 10-2820-90			
Name E. Forest		Route No. 170		Ft. Mi. N S E W		Intersection Market Pl.		Route Nos.		Time			
WEATHER 1 Clear <input checked="" type="radio"/> Cloudy 3 Rain 2 Fog 4 Snow		LIGHT 1 Day 3 <input checked="" type="radio"/> Street Lights 2 Dawn or Dusk 4 <input checked="" type="radio"/> Dark		ROAD SURFACE <input checked="" type="radio"/> Dry 3 Snowy or Icy 2 Wet 4 Other		TOTAL LANES 2		1 Divided 2 Limited Access 3 <input checked="" type="radio"/> Other		TOTAL NO. VEHICLES 1		No. Units No. Inj. No. Killed	
State MI Driver's License [REDACTED] DOB: Mo/Da/Yr 10-8-47		Hazardous Action No. 8 Citation Charge		HBD <input checked="" type="radio"/> N Test <input checked="" type="radio"/> X Helmet <input checked="" type="radio"/> Y		Driver's Name First [REDACTED] M. Last [REDACTED] Address [REDACTED] City [REDACTED] State [REDACTED] Age 42 Sex F Inj. K		Year Make No. Type Trailer Reg. 89 0 6 1 Yr/State 90/MI VIN (Make Letters Larger Than Numbers) 1ZVBT22LXK5265966 Removed to/by 41 Water St./Ypsi Tow		Residence			
Y <input checked="" type="radio"/> N Haz. Citation Y <input checked="" type="radio"/> N Driver Re-exam Y <input checked="" type="radio"/> N Vehicle Defect Y <input checked="" type="radio"/> N Fuel Leakage Y <input checked="" type="radio"/> N Other Citation Y <input checked="" type="radio"/> N Vision Obstruct... Y <input checked="" type="radio"/> N Veh. Drivable Y <input checked="" type="radio"/> N Vehicle Fire		Impact Severity 1 7 Truck Cargo: N/A		Y <input checked="" type="radio"/> N Cargo Spillage		Class		Direction		Obj. Hit			
Restrains by occupants pos.		Name [REDACTED] Address [REDACTED]		Pos. 3 Age 31 Sex M Inj. A Helmet Y N		Situation		Cont. Cir.		Residence			
Total Occupants 2		Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier)		Insurance Co.		Agency Address		Injured taken to/by St. Joe's/HVA		Driver No. 2			
State MI Driver's License [REDACTED] DOB: Mo/Da/Yr		Hazardous Action No.		Citation Charge		HBD <input type="radio"/> Y Test <input type="radio"/> N Helmet <input type="radio"/> Y		Driver's Name First [REDACTED] M. Last [REDACTED] Address [REDACTED] City [REDACTED] State [REDACTED] Age [REDACTED] Sex [REDACTED] Inj. [REDACTED]		Residence			
Year Make No. Type Trailer Reg.		Yr/State		VIN (Make Letters Larger Than Numbers)		Removed to/by		Direction		Obj. Hit			
Y <input type="radio"/> N Haz. Citation Y <input type="radio"/> N Driver Re-exam Y <input type="radio"/> N Vehicle Defect Y <input type="radio"/> N Fuel Leakage Y <input type="radio"/> N Other Citation Y <input type="radio"/> N Vision Obstruct... Y <input type="radio"/> N Veh. Drivable Y <input type="radio"/> N Vehicle Fire		Impact Severity		Truck Cargo:		Y <input type="radio"/> N Cargo Spillage		Class		Situation			
Restrains by occupants pos.		Name		Address		Pos. Age Sex Inj. Helmet		Cont. Cir.		Residence			
Total Occupants		Local Use/Owner, Phone (If Veh. Type 7 or 8, List Carrier)		Insurance Co.		Agency Address		Injured taken to/by		Acid. Data: Mo/Da/Yr			



INCLUDE ALL TRAFFIC CONTROL DEVICES

ACCIDENT DESCRIPTION AND REMARKS (*Explain)

Vehicle #1 was going E/B on E. Forest at a high rate of speed. Vehicle became airborne while crossing the railroad tracks at E. Forest/Market Pl. and driver lost control of vehicle.

Vehicle first hit south curb and left the roadway and struck a fire hydrant. Hydrant was broken off the ground along with 4½' of iron pipe, (underground piping). Fire hydrant hit building and vehicle rolled roof first into telephone pole at a height of 7½'. Vehicle rotated counter-clockwise around pole and fell to ground at rest.

See supplemental drawing *** PENNING MSP ANALYSIS**

Reported: Mo/Da/Yr 8-5-90 Time 5:15 A.M.		Investigators Yek/Braunschneider Badge No. 123/176		Damaged Property Other Than Vehicle building (12 E. Forest) Fire Hydrant	
Photos by 123 Comp. Disposition Open Reviewer [REDACTED]		Person Advised of Damaged Traffic Control Device N/A Name: [REDACTED] Date: [REDACTED] Time: [REDACTED]		Owner MI Ladder/City of Ypsilanti Address [REDACTED]	

* Use Accident Description and Remarks area for explanation.

3.10 Supplemental Traffic Control Device

Changes in traffic control devices may surprise drivers who travel through the site very frequently, thus contributing to crashes. Changes may result from engineering initiatives (e.g., replacing a yield with a stop sign, removing a stop sign) or because of some unplanned event (e.g., traffic light maintenance, power failure at a traffic signal). IVSAWS technologies could be applied to inform drivers of changes in traffic control devices before they arrive at the area where driving decisions based on the changed traffic control device would be required.

3.11 Railroad Grade Crossings

Railroad grade crossings can be hazardous. Drivers often have difficulty judging the speed of the oncoming train, or may be unaware of the existence of the crossing. This is particularly true at night, in rural areas, at crossings without lights or gates. IVSAWS could be applied to remedy this hazard by mounting IVSAWS equipment on the engine, itself, signalling ahead to vehicles approaching the nearby crossing.

3.12 Signalling Emergency Vehicle Presence

IVSAWS could be applied to increase drivers' awareness of approaching emergency vehicles. While these vehicles are already equipped with auditory and visual signals (i.e., sirens and lights), IVSAWS technologies could be applied to increase drivers' awareness of the approach of such vehicles. These technologies might be best used in high density areas where there are many distractions obscuring the emergency vehicles' lights or sirens.

4.0 Hierarchy Development for IVSAWS Application Situations

The IVSAWS applications described in the previous section were ranked using a two-phase scheme. First, crash data were analyzed to determine the number and relative injury severity of crashes that occur involving each scenario. Because crash data were unavailable for six of the scenarios, this step was supplemented by a prioritization based on issues of practicality and perceived benefits that may be derived from each IVSAWS application situation.

4.1 *Crash data analysis*

Three crash-data sets were used to estimate frequencies of crash types that may be affected by the IVSAWS application scenarios. These data sets were the 1989 crash files from Michigan and Washington state, and the 1988 General Estimates System (GES) data produced by the National Highway Traffic Safety Administration, National Center for Statistics and Analysis. The Michigan and Washington state data sets are census files of police-reported crashes in the respective states. The reporting threshold for Michigan is property damage of at least \$200. For Washington, the reporting threshold is \$300. GES is a probability-based sample of crashes from the U.S. intended to be representative of all crashes nationwide.

The objective of the crash-data analyses was to generate accident and injury frequencies of accident types that are represented in the twelve IVSAWS applications described in the previous section. Data necessary to isolate many of these crash scenarios are not currently available. Much of the information required for this objective concerns the precrash situation, but the focus of most crash-data files has been on the crash itself and its outcome. Data collection in the past has focussed on crashworthiness, not crash avoidance. Consequently, it is not possible to estimate even broad crash frequencies for some crash types. Excluded crash types include "mini-zones," temporary detour routes, traffic backups, crashes which may be related to changes in traffic control devices, and, for the most part, crashes related to previous crashes. For the others, it has been possible to isolate crash scenarios which are either a subset or superset of the crash scenarios described earlier. These analyses are described in the following sections.

4.1.1 Accident involved or disabled vehicles

For this scenario, the analysis subset consisted of crashes in which a vehicle was stopped or disabled which were not intersection- or driveway-related. The purpose of the latter constraint was to eliminate crashes where a vehicle was stopped for a traffic light or stop sign. This subset identifies crashes involving vehicles stopped on the roadway where they would normally be expected to be moving.

In Michigan, there were 26,776 such crashes (6.4% of the 417,252 crashes in 1989). This subset had a lower proportion of fatal, A-level (serious), and B-level (moderate) injuries, and a higher proportion of C-level (minor) injuries than the crash data overall. Overall in Michigan, 13.9% of crashes involve C-level injuries as the worst injury in the crash. For this subset, 23.4% involved C-level injury as the worst injury. This crash scenario was overinvolved on limited-access, U.S., and State-numbered routes compared to all crashes.

Similar analyses were conducted for Washington state data. Although the specific code values used to generate the subset differed from those used for Michigan, roughly the same crash subset was isolated. For Washington, subset crashes consisted of those where one vehicle was stopped on the roadway and was struck by another traveling in the same direction. Intersection- and driveway-related crashes were again excluded. In Washington, there were 6,335 such crashes in 1989, 4.9% of the 128,000 total crashes. As in Michigan, C-level injuries were overrepresented and more serious injuries were underrepresented.

4.1.2 School-bus Involved

Michigan includes a data code for school-bus involved or influenced crashes. In 1989, there were 2,182 such crashes, 0.5% of the total. The school bus itself was physically involved in 1,606 of the crashes. In 54 crashes, a person boarding or exiting the bus was injured by another vehicle. The remaining 522 did not physically involve the bus, but the bus was reported to have influenced the crash by its stop. The profile of crash severity for school bus crashes was very similar to that of all crashes. Interestingly, school bus crashes were more likely to have occurred at an intersection than crashes overall. Over 60% (1,318) occurred at an intersection or driveway, compared to 53.3% for crashes overall.

School-bus involvement is also coded in the 1988 GES data. GES is designed to yield national estimates for different crash types, but 1988 was the first year of GES availability, and frequency estimates should be used with caution. For example, the GES estimate for the total number of fatal crashes in 1988 is 30,922. The census number from the Fatal Accident Reporting System (FARS) is 42,119. While the FARS figure is within the 95% confidence interval for the GES estimate, these differences illustrate the fact that there is a good deal of variance associated with GES estimates. The proportion of crashes involving school buses in the GES data is 0.58%, virtually the same as in Michigan. Crash severities are again similar to those in crashes overall.

4.1.3 Highway Construction Zones

The coding for highway construction zones in the Michigan data are widely considered to be unreliable, even within the Michigan Department of Transportation. Review of hard copies of police crash reports has shown that in many cases the construction zone was inactive or even nonexistent. With that caveat, there were 6,755 crashes (1.6% of the total) coded as occurring in construction zones. These crashes closely matched the severity profile of crashes overall. Daylight crashes, when a construction zone is typically active, were overrepresented compared to crashes overall (74.5% versus 61.4%).

4.1.4 Multiple (compounding) hazardous conditions

This is a particularly difficult set of crash scenarios to isolate in computerized crash data. In most cases, identifying such a crash requires detailed information about a sequence of events and/or the relationship between roadway features. The combination of hazards and their sequence is critical for meaningful analysis, but such information is not generally available in current crash data that focus more on crashworthiness rather than crash avoidance. Nevertheless, it is possible to isolate some broad categories of crashes that might fit this IVSAWS application. The first discussed is snowy or icy roads in combination with curves and/or grades (horizontal and vertical curves).

In Washington state there were 12,475 crashes (9.7% of the total) on snowy/icy roads in 1989. Crashes on curves were overrepresented, and the combination of a grade and curve was the worst, having twice the proportion of snowy/icy crashes than crashes overall. Specifically, 15.2% (1,900) of the snowy/icy crashes occurred on road segments with both curves and grades, while only 7.5% of all crashes in Washington state were on such road segments. The proportion of property-damage crashes for this crash scenario was higher than the proportion for crashes overall (64.0% versus 55.7%).

Another application of IVSAWS technology fitting this general scenario is to provide warnings at bridges when roads are snowy or icy. In Washington, 410 such crashes occurred (coding for Michigan on this scenario has been inconsistent and thus is not detailed). Although the overall crash risk is low, there could be payoff in identifying specific bridges with particularly hazardous conditions that would warrant an IVSAWS signalling application.

Fog is another weather hazard that can be compounded by road alignment. There were 2,868 crashes (6.8% of the total) occurring in foggy conditions in Michigan in 1989. Serious crashes were somewhat overrepresented among fog crashes. Fog crashes were found to occur more often on a curved portion of the road than crashes overall (7.4% versus 5.2%). IVSAWS application should probably focus on areas with severe recurrent fog problems.

4.1.5 Railroad grade crossings

Although car-train collisions are relatively infrequent events, they are usually more severe than other crashes. There were 279 such crashes in Michigan in 1989 (0.07% of the total). However, 26 (9.3%) resulted in at least one fatality compared to 0.4% for crashes overall. Although the rural-urban distinction is not captured with great precision in Michigan, it appears that rural areas are overrepresented, as are crashes in darkness.

In Washington state in 1989, there were 98 car-train collisions (0.08% of the total). As was the case in Michigan, these crashes tended to be more severe than average (6.1% involving at least one death versus 0.3% for all crashes). The urban-rural coding is better in Washington state data, and again rural areas were overrepresented. Almost 35% of car-train crashes occurred in rural areas compared to 21.4% for crashes overall.

4.1.6 Emergency vehicles

Michigan crash data includes a code for crashes involving emergency vehicles. In 1989, there were 1,679 crashes (0.4% of the total) involving ambulance, fire, or police vehicles. These crashes tended to be more severe than the average crash. The same proportion of crashes resulted in death, but nonfatal-injury crashes were overrepresented (34.8% versus 25%). Almost 75% of crashes involving emergency vehicles were coded as intersection crashes compared to 55.6% for crashes overall. Interestingly, almost 45% of emergency-vehicle-involved crashes were at intersection with both vehicles traveling in the same direction. Only 22.1% of crashes overall had that configuration. Another 34.1% of the emergency-vehicle-involved crashes were same direction, non-intersection.

4.2 Hierarchy of IVSAWS Application Situations

These analyses show that there is much we do know about crashes that might be prevented by IVSAWS application, but there is still more that remains unknown about these crashes. The following table provides ranks of the twelve IVSAWS situations detailed in this report according to the crash data and a final hierarchical ranking based on the crash data, professional estimates of crash occurrence (based on experience rather than hard data), and an understanding of how IVSAWS technologies might be implemented and used in the field. Following the table is a brief discussion of the rationale for the final IVSAWS application rankings.

Rankings of Possible IVSAWS Applications

IVSAWS Application	Crash Data Rank		Overall Rank
	Crash Freq.	Injury severity	
Signalling emergency vehicle presence	5	2-3	1
Railroad grade crossings	6	1	2
Multiple (compounding) hazardous conditions	3	2-3	2
Highway construction zones	2	5-6	3
Supplemental traffic control device	NA	NA	4
Crash site -- Police Activated	NA	NA	4
School bus or other special vehicle hazard	4	4	5
Temporary detour routes	NA	NA	5
Disabled truck at roadside	NA	NA	6
"Mini-zones" involving roadside work	NA	NA	7
Traffic backups	NA	NA	7
Accident-involved or disabled vehicles	1	5-6	8

IVSAWS applications were ranked based on actual crash exposure and overall utility of the IVSAWS application. The "overall" utility ranking was based on the number and severity of crashes, the number of transmitters that would need to be deployed, and the general applicability and utility of IVSAWS technology for affecting crashes in each scenario. Obviously, this final ranking criterion is subjective. The specific rationale for the ranking of each scenario is provided in the following section.

Rank 1: Signalling emergency vehicle presence. Crash data show this scenario represents a very small proportion of all crashes, but that injury severity from these crashes is greater than for crashes overall. The configurations of the crashes in the data analysis (i.e., predominately same direction-intersection, and same direction-nonintersection) suggest that drivers may not be aware of the presence of these vehicles as they approach, despite the lights and sirens. Thus, an IVSAWS message may provide them with additional information necessary to prevent a crash. The number of vehicles that would require IVSAWS transmitters is limited to the number of emergency vehicles in the population (presumably a manageable number). Full penetration of IVSAWS transmitters and/or receivers is not necessary for benefits of this application to accrue because these systems would provide a supplementary warning to sirens and lights. In addition, benefits of preventing emergency vehicle crashes go beyond the crash incident itself. That is, when an emergency vehicle is involved in a crash, some emergency need is not met in a prompt manner, perhaps resulting in unnecessary property loss or additional personal injury.

Rank 2: Railroad grade crossings. The probability of a car-train crash is quite low; however, the results of such crashes are disproportionately severe. The crash data also show that car-train crashes occur disproportionately at night in rural areas (many of which are probably unguarded crossings). This suggests that a supplemental warning could be effective in preventing these crashes. IVSAWS transmitters would only have to be installed on the lead engine of each train. This should not pose an unreasonably large burden. Messages transmitted from the trains could be totally unambiguous and standardized. There are also probable benefits on the train-side of the crash situation, especially when hazardous cargos are involved (i.e., special hazardous commodity codes could be encrypted onto the transmitted message).

Rank 2: Multiple (compounding) hazardous conditions. Crash data are not available for the majority of situations that fit this scenario, but the data that are available (i.e., fog, slippery conditions and vertical or horizontal curvature) are compelling. It is certain that there are many more crashes that involve multiple hazardous conditions than could be readily identified by the crash data. This is a rich domain for safety-and-traffic engineers who could tailor IVSAWS messages to suit the local problems. The number of sites for transmitter deployment need not

be excessively high. In fact, not every potential site should be instrumented. Sites should be selected based on identified needs from crash experience (of course, this would require adequate recordkeeping). Many of the multiple hazard scenarios are likely to include excessive speed as one of the compounding conditions. An IVSAWS system that relayed a warning only to vehicles traveling over some predetermined "safe" speed seem to constitute a valuable and practical application of IVSAWS deployment.

Rank 3: Highway construction zones. This is a valuable application of IVSAWS because construction zone crashes present a hazard not only to vehicles traveling through the zone, but also to workers in the zone. A significant number of crashes are reported to occur in construction zones, but not so many zones that transmitter deployment should be overly burdensome. Construction zones also present an ideal IVSAWS application opportunity because we know precisely where the site is, we know much about the hazards associated with the site, and the zone is not permanent, thus reducing possible habituation effects. In fact, as the characteristics of the zone change, it should be possible to change the characteristics of applicable warning messages, further reducing habituation.

Rank 4: Supplemental traffic control device. No crash data were available to describe the extent of the hazard these situations cause. However, it is not difficult to think of situations where signals or signs have been changed or disabled for one reason or another that have the potential for creating traffic conflicts. IVSAWS would serve as a supplement to existing signals, and thus it would represent an additional safety message to equipped vehicles. Unequipped vehicles should not be negatively affected by the lack of an IVSAWS warning. The safety value of such a system cannot be determined precisely in the absence of crash data, but the value for crash prevention is probably quite low.

Rank 4: Crash site -- Police activated. There is little to no crash data available to describe the potential for this application to prevent crashes. However, the potential for such a system to inform drivers of an upcoming crash site (and possible lane blockage, debris, etc.) is appealing. Such a system may involve the active deployment by officers in the field to select the message,

signal direction and strength, transmitter placement in the roadway, and perhaps other features. If the system was burdensome to the officers, they may not be prone to use the system. Such a system may be combined with the emergency vehicle alert system mentioned previously. If this was feasible, the utility of the total system would be enhanced. If this system required a separate transmitter, it would represent perhaps a doubling of the cost of IVSAWS installation to police agencies.

Rank 5: School-bus or other special vehicle hazard. Crash data showed that school bus crashes are relatively rare events, and it is unclear if additional signalling would be beneficial in preventing the few that do occur. Given the large number of busses that would have to be equipped, it is unclear if the cost (and problem with frequent and redundant signalling) is worth the benefit that may be derived. For other special vehicles such as rural mail carriers (see example in previous section), the utility of a IVSAWS system is less sure.

Rank 5: Temporary detour routes. No crash data are available to determine the threat to safety that is presented by temporary detour routes. In fact, temporary detours are themselves not threatening, but the conditions they create may be. Thus, these threats may be conceived as fitting into more specific IVSAWS applications. On the other hand, IVSAWS applications as markers for a temporary detour could be useful as temporary route-guidance technology. Until there is 100% market penetration, these IVSAWS route markers would have to be used as supplements to traditional detour markers.

Rank 6: Disabled truck at roadside. Specific data on the hazard created by disabled trucks at the roadside are not available. The most significant problem with this application is the large number of vehicles that would have to be equipped with a transmitter. In addition, IVSAWS information would only supplement existing use of flares and reflective triangles. It is unlikely that the benefits derived from the system would approach or exceed the costs of deployment.

Rank 7: "Mini-zones" involving roadside work. Through conversations with several utility companies it was determined that "mini-zones" do not create any special crash hazard. Therefore, IVSAWS application is unwarranted.

Rank 7: Traffic backups. No crash data are available describing the extent to which traffic backups create a significant traffic safety hazard. At best, this application is a subset of the construction zone or police-activated systems. Recurrent traffic backups are not suitable for IVSAWS application because of the potential for habituation effects.

Rank 8: Accident-involved or disabled vehicles. Although a large number of crashes seem to involve vehicles stopped in the roadway for some reason, the crash data are unclear on the reason why these vehicles were stopped. It is likely that many were stopped for reasons other than a crash or the vehicle being disabled. Even if all of these crashes did fit the original scenario, the cost of deploying an IVSAWS transmitter and receiver in every vehicle is likely to exceed the benefits derived from such deployment. This negative conclusion is strengthened when one considers that a higher than expected proportion of crashes involving vehicles stopped in the roadway involve minor injuries and a lower proportion of these crashes involve serious injuries.

4.3 *Summary*

In sum, it may be most useful to consider the 12 IVSAWS application situations described in this report as fitting into one of three priority categories. The highest priority category includes IVSAWS applications for:

- signalling emergency vehicle presence,
- railroad grade crossings,
- multiple (compounding) hazardous conditions, and
- highway construction zones.

These applications are most likely to provide a significant safety benefit and reasonably fit the IVSAWS application concept. The second tier of IVSAWS applications includes IVSAWS as:

- a supplemental traffic control device,
- police-activated crash site IVSAWS,
- school-bus or other special vehicle hazard signalling, and
- signalling at temporary detour routes.

These applications have only limited and highly speculative crash reduction potential. The lowest priority category includes IVSAWS for:

- disabled trucks at the roadside,
- traffic backups,
- "mini-zones", and
- accident-involved or disabled vehicles.

Each of these applications has even more limited or speculative crash reduction potential than the second priority situations, and the costs associated with equipping all heavy trucks and passenger vehicles are prohibitively high.

5.0 Signalling Recommendations

Replication of Manual of Uniform Traffic Control Devices (MUTCD) roadside signing is not a feasible signalling strategy for most of the IVSAWS applications identified in this report. There are only two cases in which existing MUTCD road signs might be reproduced directly in the vehicle (i.e., railroad grade crossings and supplemental traffic control devices). The use of icons similar to those used in MUTCD signs is clearly one strategy for IVSAWS signalling, and new icons could be developed to identify IVSAWS situations for which MUTCD icons do not currently exist. However, drivers would have to become acquainted with these new icons for them to be effective. It is probable that many drivers would not take the time necessary to become fully acquainted with the new icons prior to the time they may encounter them on the road. It is also probable that the drivers who could use the hazard information most (i.e., risky drivers) would be the least likely to learn icon meanings prior to driving. In this case, these drivers would only learn the new icon meanings while driving and encountering the hazardous

situations, severely diminishing the value of the icons during the "learning trials." In addition, IVSAWS situations should be relatively infrequent events, thus drivers would have few occasions to become acquainted with the new icons and their meaning. The IVSAWS message system should also be sufficiently flexible that it could be incorporated into developing driver information systems. These broader driver information systems will probably utilize information systems more sophisticated than icon replication, and the IVSAWS system should be developed with these upcoming technologies in mind. For these reasons, we do not recommend MUTCD replication or the development of similar icons for the IVSAWS situations identified earlier.

Signalling of IVSAWS situations should be based on thorough human factors research on both auditory and visual information transmission systems. It is recommended that in addition to somehow describing the hazardous situation ahead, signals should provide specific information on the behaviors drivers should employ or be prepared to employ to avoid a crash, rather than simply informing drivers of an upcoming hazard. This is still another reason why simple icon use is not a recommended strategy for IVSAWS signalling.

While messages could be conveyed via auditory systems only (e.g., voice synthesis), there may be a benefit to using an auditory signal to alert drivers of an upcoming IVSAWS message that would be transmitted visually. A visual message could remain available for the driver to attend to in his/her own time, and remain available for repeated reference. On the other hand, auditory transmission of IVSAWS warnings would be less visually distracting, permitting drivers to keep their eye on the road. An auditory system could also be developed which would be able to repeat messages upon driver request. The pros and cons of visual versus auditory systems or their combination are speculative at this point and the selection of the signalling system must be based on rigorous human factors and behavioral testing.