

# TZD East Central Workshop

## Collision Reconstruction



## Sergeant Kyle Backer SP2

- B.S. in Criminal Justice (Bemidji State)
- 2008: Clearwater County Sheriff's Deputy
- 2009: Minnesota State Trooper
  - 3<sup>rd</sup> Generation State Law Enforcement
  - 2009-2011 Marshall 2300
  - 2011-2020 St. Cloud 2600 (Dogwatch)
  - 2020-Current St. Cloud District Investigator
- 2015: Crash Reconstruction Specialist



# Minnesota State Patrol

- 11 Enforcement Districts Statewide
- Structured to eliminate motor vehicle crashes
  - Enforce the laws and rules related to the safety and use of highways
  - Educate stakeholders and public
  - Provide assistance to allied agencies
- Core Enforcement
  - Speed
  - Seatbelt
  - Impaired Driving
  - Distracted Driving



# Minnesota State Patrol

- Specialty Positions:
  - Public Information
  - Commercial Motor Vehicle (4700)
  - Criminal Interdiction (K9)
  - Special Investigations
  - Capitol Security and Executive Protection
  - Aviation
  - Training and Development
  - Recruitment
  - Collision Reconstruction

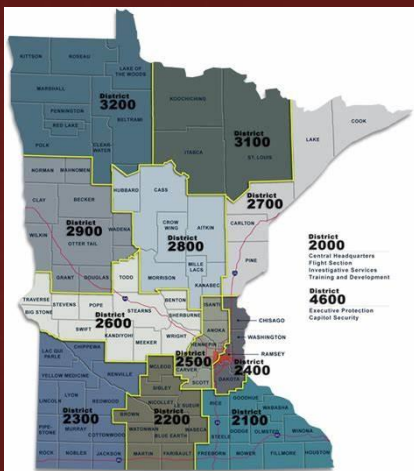


## Collision Reconstruction Specialist

- A CRS is intended to support the process of identifying the causal factors in serious/fatal motor vehicle crashes.
- The use of a CRS to assist in the investigation of such crashes is critical for successful criminal and civil court actions.
- CRS use law enforcement technology, LE investigative techniques and laws of physics to identify contributing factors in collisions.



## Collision Reconstruction Specialist



- Provide reconstruction services on State Highways and upon request to allied agencies
- In 2023, State Patrol CRS Investigated 71% of Minnesota Fatal Collisions
- In 2023, 33% of CRS investigations were for Allied Agencies
- Wright County Sheriff's Office and Minneapolis Police Department have Reconstruction Team.



## Collision Reconstruction Specialist

- **43 Members Statewide**
- **Certification:**
  - 120 hours basic crash investigation training
  - 80 hours advanced crash investigation training
  - Approximately 40 hours each for special equipment and program learning
  - 16 hours crash investigation training yearly refresh
  - Minimum of five comprehensive investigations per year

Metro CRS Team required to become accredited by Accreditation Commission of Traffic Accident Reconstruction (ACTAR) within 3 years of appointment



## 2023 Data

- **Investigated 426 serious or fatal injury collisions**
  - 153 Right-Angle (32%)
  - 85 Head On (18%)
  - 69 Pedestrian (14.5%)
  - 47 Rollover (10%)
  - 45 Rear-End (9.5%)
  - 62 Other (Motorcycle | Fixed-Object | Sideswipe) (16%)
- **Primary contributing factors:**
  - 1. Failure to yield right of way 189 crashes
  - 2. Illegal/unsafe speed 94 crashes
  - 3. Driver impairment 90 crashes
  - 4. Driver inattention/distraction 88 crashes
  - 5. Other 112 crashes

Note: Data obtained from self reported MSP application. A single collision may have multiple types and/or contributing factors therefore exceeding the total number of reconstructions for 2023. The crash type includes investigations which were started and determined to no longer warrant a complete reconstruction or were forensic maps only.

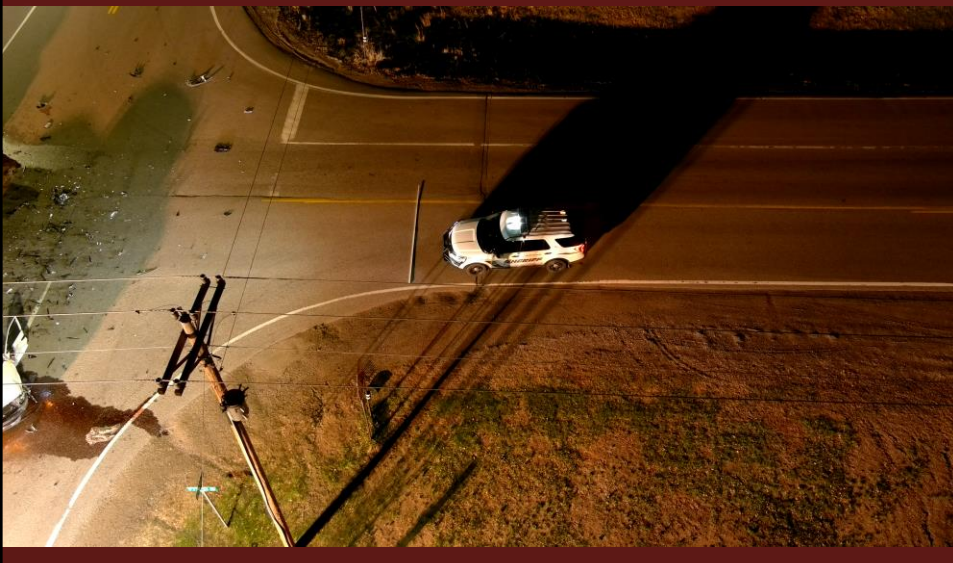


## Technology

- **Small Unmanned Aerial System (sUAS)**
  - Greatly decreases on-scene time compared to traditional equipment
  - Enhances open road policy and safety of LE and public
  - Uses photographs and videos generated from on-scene flights and special software programs to create a scaled forensic map.
  - Members are FAA Part 107 pilots

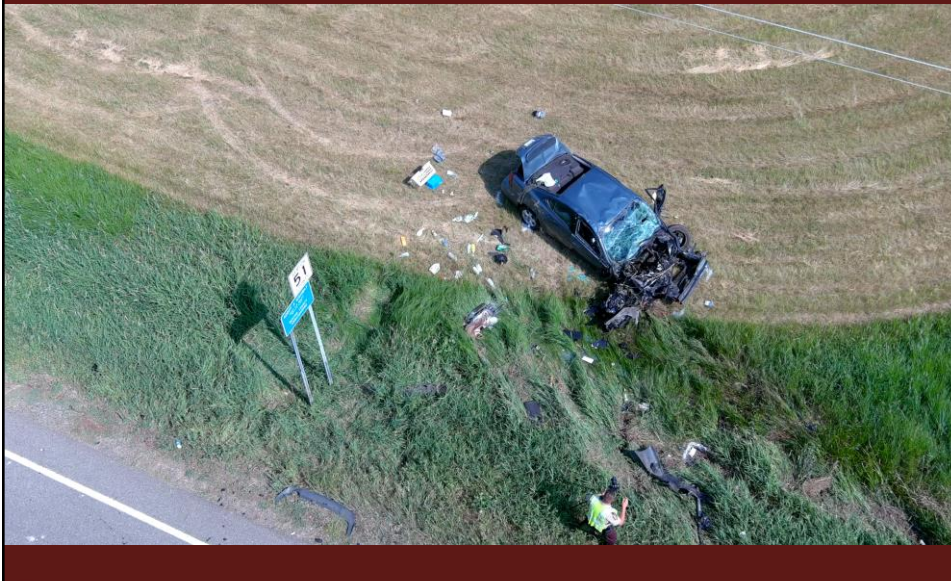


## sUAS Forensic Mapping





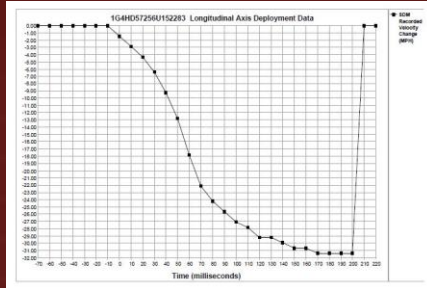
# sUAS Forensic Mapping







# Airbag Control Module



Pre-Crash Data (Most Recent Event - table 2 of 4)  
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Steering Input (deg)	Raw Manifold Pressure (kPa)	ECM ML	Yaw Rate (deg/sec)	Wheel Speed, LF (RPM)	Wheel Speed, RF (RPM)	Wheel Speed, LR (RPM)	Wheel Speed, RR (RPM)
-5.0	-2	18	Off	1	551	514	507	564
-4.9	-2	18	Off	1	539	511	601	549
-4.8	-3	18	Off	2	519	508	588	527
-4.7	-4	18	Off	2	500	506	595	515
-4.6	-5	20	Off	2	496	506	589	499
-4.5	-7	22	Off	3	468	504	595	458
-4.4	-10	26	Off	4	452	599	576	477
-4.3	-13	29	Off	4	445	591	570	462
-4.2	-22	32	Off	5	442	571	562	458
-4.1	-33	36	Off	5	458	536	535	444
-4.0	-46	38	Off	5	498	426	500	419
-3.9	-49	42	Off	4	534	352	470	458
-3.8	-49	44	Off	5	560	292	440	397
-3.7	-55	40	Off	5	569	268	438	414
-3.6	-52	40	Off	6	581	210	415	409
-3.5	-71	43	Off	7	569	245	371	373
-3.4	-83	42	Off	6	519	250	383	390
-3.3	-94	35	Off	10	498	211	383	395
-3.2	-103	30	Off	13	503	287	379	387
-3.1	-111	26	Off	15	505	263	372	387
-3.0	-118	23	Off	17	496	384	369	384
-2.9	-125	22	Off	20	454	388	363	375
-2.8	-135	21	Off	24	426	354	357	367
-2.7	-152	21	Off	28	396	368	349	354
-2.6	-163	20	Off	32	434	296	323	309
-2.5	-167	20	Off	37	416	61	300	275

Pre-Crash Data

Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Accelerator Pedal Position (percent)	79	79	79	88	100
Vehicle Speed (MPH)	57	58	60	62	66
Engine Speed (RPM)	3520	3584	3648	3712	4032
Percent Throttle	89	89	89	97	100
Brake Switch Circuit State	OFF	OFF	OFF	OFF	OFF

Driver's Belt Switch Circuit Status	UNBUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED



# LE Investigation

- Current Collision Investigation Techniques
  - Driver | Passenger | Witness Statements
  - Video Surveillance
  - Cell Phone Examiner Programs
  - Social Media Review
  - Vehicle Infotainment Systems
  - Toxicology or ME Autopsy Reports







## Environmental Factors


- Crashes are almost always contributed to motor vehicle operator error.
  - Speed
  - Distraction
  - Impairment
  - Improper collision avoidance
- BUT.....Engineering factors (roadway design) and/or environmental factors (weather, topography, sun position) are typically investigated.



## Case Study

### 24601973


- June 5th, 2024 at 5:42 pm
- Highway 24 at 675th Avenue | Forest City Township | Meeker County
- A Chevrolet Cruze was southbound on 675th Ave making a left (eastbound) turn onto State Highway 24. 675th Ave is a controlled T-intersection at State Highway 24. A Hyundai Entourage was westbound on State Highway 24. The driver of the Chevrolet did not stop yield and travelled into the path of the Hyundai. The vehicles made contact in a right angle (broadside) style crash.
- The juvenile driver of the Chevrolet died.



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## Case Study

# 24601973

- **Investigative Steps:**
  - Driver and Witness Interviews
    - Driver:
      - Didn't remember collision
    - Witness:
      - He was parked in a field approach on the west side of 675th Ave near the intersection.
      - He witnessed a small four door car (later determined to be Falling's Chevrolet Cruze) pass him on the road.
      - He witnessed the Chevrolet Cruze make a "quick stop" at the intersection.
      - Believed the Chevrolet Cruze only slowed down to approximately "ten miles an hour" before proceeding into the intersection



## Case Study

# 24601973

- **Investigative Steps:**
  - Cell Phone Analysis
    - Driver's phone was open in Google Maps with active Route to St. Cloud, MN
  - Forensic Mapping
    - Scale Diagram of Scene for Speed and Time-Distance Calculations
  - EDR data collection
    - -5.0 seconds 14 mph | -2.5 seconds 7 mph | 0.0 seconds 16 mph
    - -5.0 Seconds Brake On | -3.5 seconds Brake Off
    - -1.0 Second Accelerator Pedal 99%
  - Vehicle Inspections
    - No Mechanical Defects | Owner Statements and Mechanical Inspection



## Case Study

# 24601973

- **Investigative Steps:**
  - Conservation of Linear Momentum Speed Analysis
    - The calculated range of minimum impact speeds of the Chevrolet Cruze was 17mph-19mph.
    - The calculated range of minimum impact speeds of the Hyundai Entourage was 61-70mph.
  - Time Distance Analysis
    - The Hyundai Entourage was approximately 308-354 feet from the intersection when the Chevrolet Cruze was at the stop bar line prior to entering the intersection. The Hyundai Entourage would have been visible to the Chevrolet Driver on State Highway 24 when they were at the stop bar line.



## Case Study

# 24601973

### ■ Investigative Steps:

- Engineering and Environmental Investigation
  - NOAA Solar Calculator (Sun position was not a factor)
- Roadway Engineering
  - A visibility study was conducted.
  - The study revealed a raised berm and tall grass in NE corner of intersection created a clear line of sight obstruction.
  - The obstruction occurred when a vehicle traveling west on State Highway 24 was approximately 600 feet east of the intersection.
  - A vehicle traveling west on State Highway 24 would not be visible for approximately one second to a vehicle legally stopped at the stop sign on 675th Ave.



## Case Study

# 24601973





## Case Study

# 24601973

### ■ Investigative Steps:

- Engineering and Environmental Investigation
  - Met with MnDOT traffic engineer John Hager to conduct a field review of the intersection.
  - Field review obtained a sight distance using MnDOT road design manual processes.
  - The calculated minimum sight distance value at 55mph for a passenger car is 607 feet.
  - We obtained a sight distance much greater than the required distance but it did not accurately reflect the conditions of the crash due to a recent mowing of the grass in the ditch.



## Case Study

# 24601973

### ■ Investigative Steps:

- Engineering and Environmental Investigation
  - According to U.S. Department of Transportation traffic safety manuals, a stop bar line should be placed at the desired stopping point and in no case more than 30 feet or less than 4 feet from the nearest edge of the intersecting roadway. The stop bar on 675th Ave was set back 40 feet from the edge of the road to State Highway 24.



## Case Study

# 24601973

### ■ Conclusion:

- Visual obstruction was no factor for a driver of a vehicle on 675th Ave who statutorily proceeded into the intersection cautiously after stopping.
- Driving an additional 10 feet from the painted stop bar/stop sign completely removed the visual obstructions.
- The driver of the Chevrolet did not stop as required at the entrance to a through highway. They failed to yield to the Hyundai who was approaching the intersection so closely on the through highway to constitute an immediate hazard.



## Questions?