

A small white and maroon propeller airplane with registration N2118A is parked on a tarmac at dusk. The aircraft is positioned in front of a large hangar with a corrugated metal roof. The sky is dark with some clouds, and the hangar's lights are visible. The text "South Dakota Highway Patrol Aviation Unit" is overlaid in white on the image.

# South Dakota Highway Patrol Aviation Unit

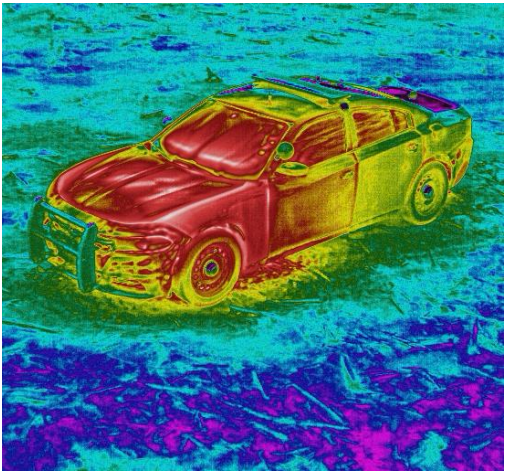
Trooper Sarah Schumacher

# Introduction

- Pilot since 2005
- B.S. in Aviation from South Dakota State University
- Airplane Single and Multi-Engine Land, Instrument airplane, CFI, CFII, MEI, Remote Pilot
- FAA Safety Team Representative and FFAST “Drone Pro”
- Law Enforcement: dispatcher from 2013-2015, SDHP Academy Class 59 in 2016
- Grew up in Watertown, living in Pierre, SD since 2017









Best traffic stop ever!!



Sir I'm giving you  
a citation today.







# History of Aviation in South Dakota Highway Patrol

- 1960's – Speed enforcement began. SDHP leased a Super Cub. Pilots and spotters utilized stop watches to determine speed over distances.
- 1970's –Speed enforcement continued. In the late 1970's, SDHP purchased a used Cessna 182 Skylane.



- 1981 – SDHP replaced the Skylane with a new Cessna 182 Skylane RG.
- Late 1980s – “Drug War”, the SDHP started working counter-drug operations including marijuana identification and eradication.
- 1995 – SDHP added OH-58C Bell Helicopter for marijuana eradication, emergency relays, natural disaster response, etc.
- 2007 – SDHP purchases 2004 Cessna T206 to replace the aging 182 Skylane RG.
- 2014 – SDHP purchases first FLIR system and fits to both helicopter and airplane.







# SDHP Aviation Unit Today

- Average of 353 hours flown a year over 81 different “unique” missions, increasing every year
- 81% of use is directly related to missions/enforcement, rest is training and transportation and emergency relays.
- Over the last 3 years, HP500 has utilized 60/75 (80%) of public airports in the state for enforcement or services







## What we actually “do”

- Traffic enforcement (speed, stop sign, passing zone, following too closely)
- Traffic complaints
- Aggressive/reckless driving/DUI
- Search and rescue
- Pursuit management
- Drug interdiction
- Emergency response/relay
- Tactical overwatch
- Traffic control, fire spotting, etc
- High profile events



# Why an airplane?

- SD is a BIG state ~77,000 square miles
- Helicopters are limited by weight, range, speed
- Helicopters are very high liability
- Helicopters require significantly more maintenance, which means more down time and more money
- Cessna T206 is a good balance of speed, payload, range and simplicity

# HP500

- 2007 Cessna T206
- Turbocharged 310 horsepower Lycoming IO-540
- Configured for pilot plus 3, can add rear seating for pilot plus 5
- Extended-range fuel tanks = 117 gallons of fuel (~6.5 hours-10 hours)
- TKS ice protection





# Airport Operation selection

- Main considerations:
  - Runway surface
  - Weather reporting/winter maintenance
  - VFR only or IFR approaches available
  - Fuel, hangar, services available
  - Proximity to operations
  - Easy in and out

# Easy Changes

- Issue and update NOTAMs regularly, especially for runway conditions and closures.
- Weather reporting and runway information is critical



# South Dakota Highway Patrol Aviation Unit





What everyone  
thinks the Aviation  
Unit is like



What the Aviation Unit is  
actually like





## Tactical Flight Officer Program (TFO)

- Specialized training in systems and techniques
- Thermography training
- Aerial Search and Rescue training



## TFO Training Program

- TFO's must possess a variety of skills:
  - Ability to work in and around small aircraft
  - Good spatial orientation
  - Location, location, location!
  - Law enforcement tactics – MFF, SWAT, Use of Force





## FLIR 230-HD

- thermal imaging system, utilizes “day time”, “low light” and “Infra-red” camera sensors
- Purchase and installation was approximately \$500,000 in 2014 for “sensor pod”, aircraft mounting, monitors and controllers, radio upgrades, weight and balance changes for helicopter and airplane
- This is where the SDHP began shifting from primarily speed enforcement towards “tactical” enforcement.



## What is Forward Looking Infra-Red? (IR)

- A thermal, or infrared camera, is a non-contact device that detects infrared energy (heat) and converts it into a visual image.
- That image is interpreted by the operator.



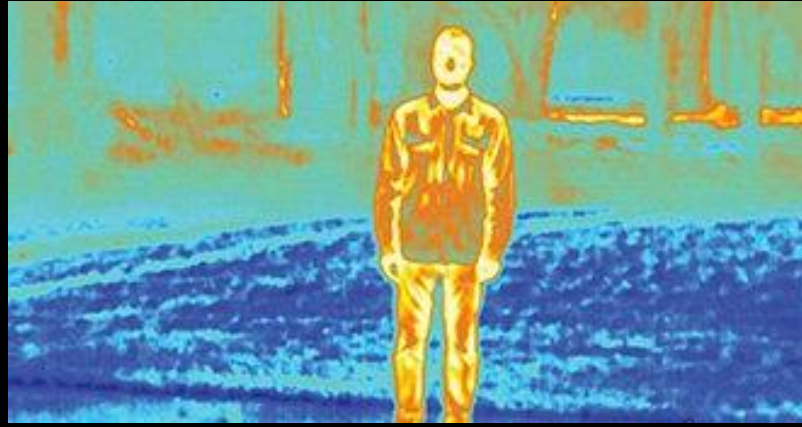
## Different functions

We utilize different:

- Color palettes
- Settings
- Sensors

To achieve our goal. Tracking a vehicle on a drug interdiction operation is different from searching for a suspect after a pursuit, which is different from a high-risk fugitive warrant.



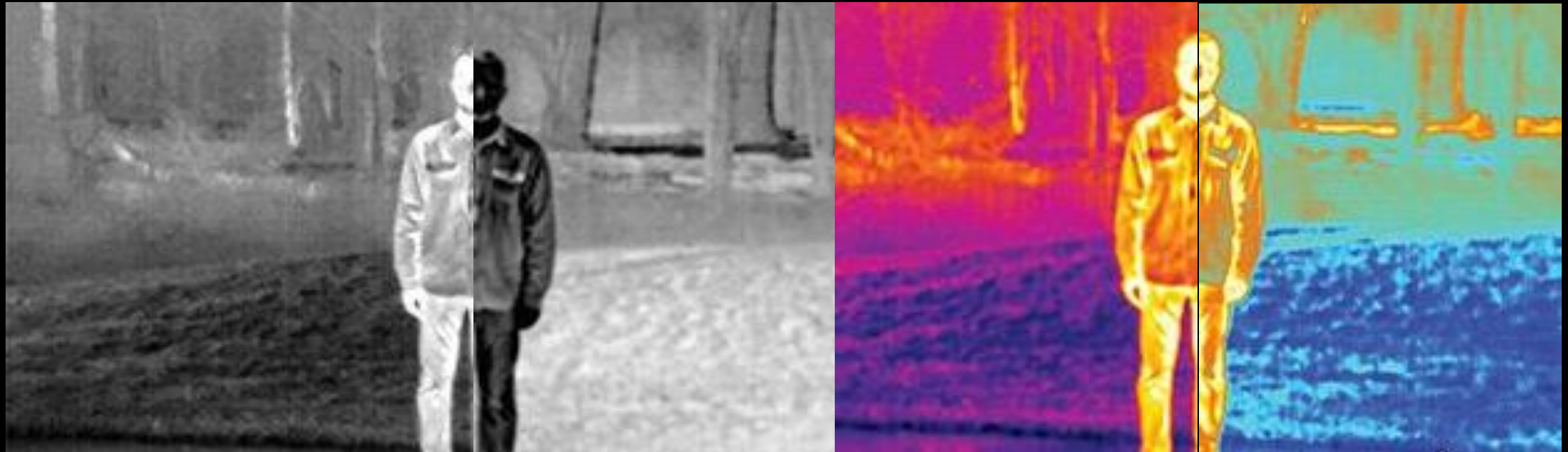


IR color palettes

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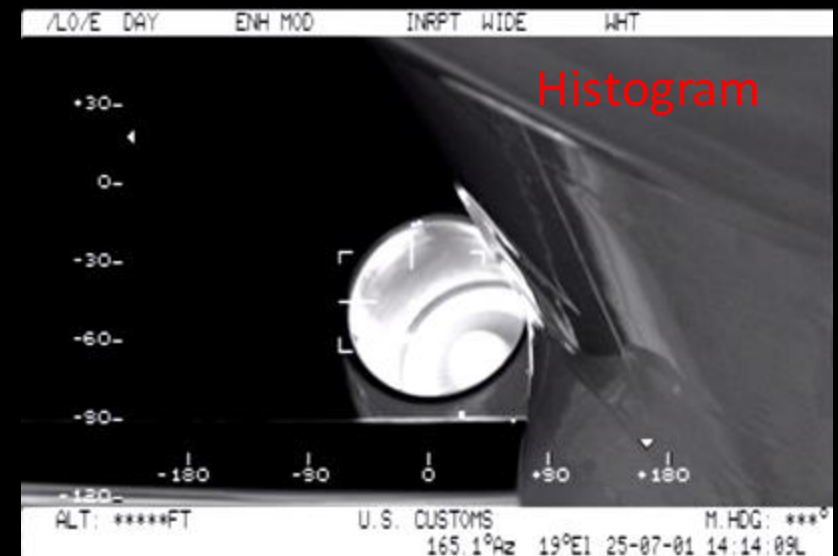


Different color palettes allow different details to “pop” on an image. This is especially important in low-contrast situations



# Histogram

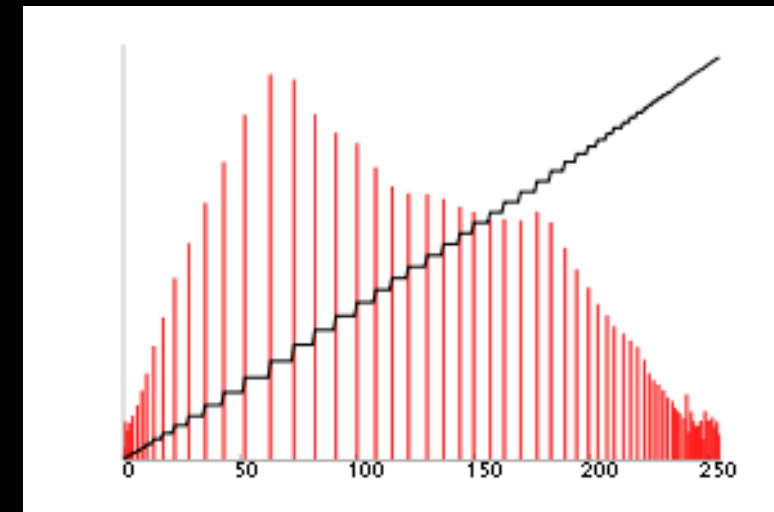
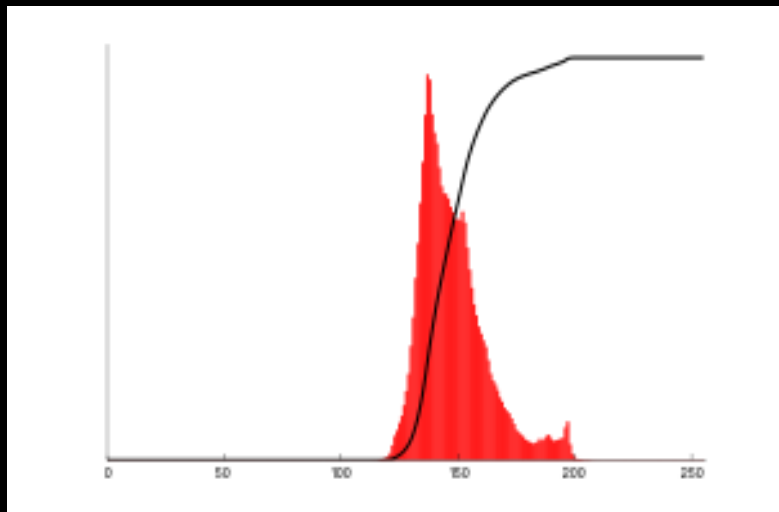
- Graphical depiction of amount of “light” in an image – can be over-exposed (washed out) or under-exposed (too dark)
- Histogram increases contrast of an image – adjusts the intensity of the whites/blacks
- Useful for IR images where there is both light and dark in the same image – shows different detail





# Histogram Examples

- Washed out
- Too much gray – not enough true black and white



# Digital Detail Enhancement





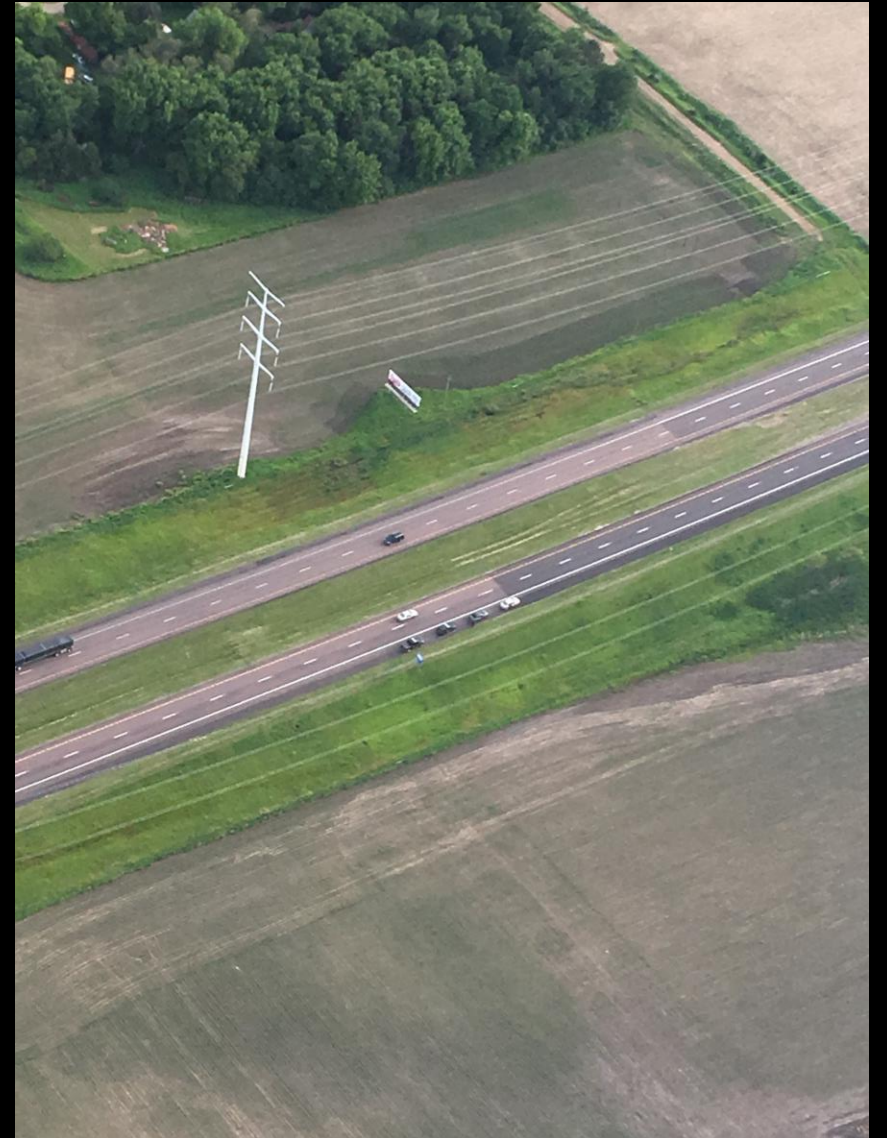
# Aircraft Missions

- SDHP airplane flies year round, in all seasons and all weather conditions
- Operates in and out of 60/75 public airports in SD
- Examples of missions include:
  - Traffic enforcement
  - Motor carrier enforcement
  - Pursuit management
  - Drug Interdiction
  - Traffic control
  - Tactical overwatch

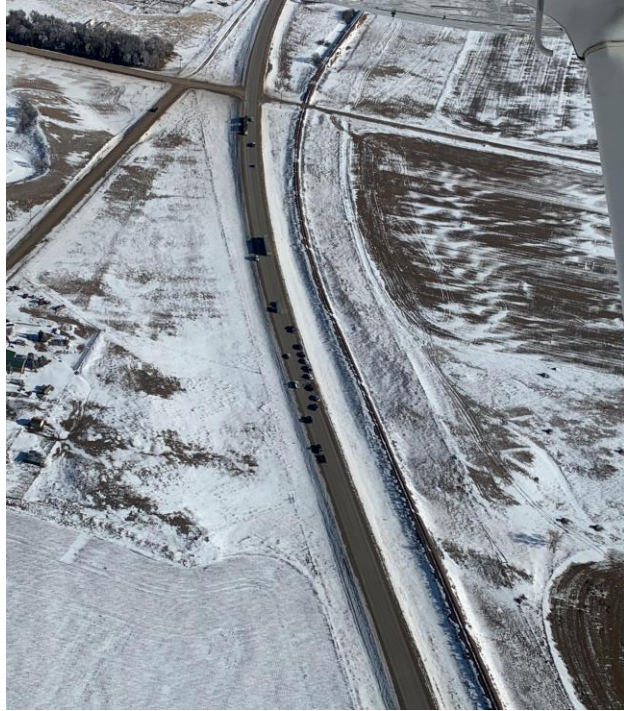
# Traffic Enforcement

*“putting cars on the side of the road”*

- Stop sign violation, speeding, passing, reckless/aggressive driving, traffic complaints, following too closely, move over violations, DUI enforcement
- SDHP Aircraft has made multiple DUI and drug arrests from the air by observing violations and getting a trooper in position to stop vehicle.







## Pursuit Management





# High Speed Pursuits

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- Vehicle pursuits are a very high liability law enforcement function.
- Pursuits can last anywhere from a few seconds to 2+ hours in South Dakota.
- Aircraft allows units in pursuit to slow down and fall back while aircraft follows the vehicle. This decreases dangerous driving behavior of driver and LEO
- Low risk of aircraft being out-run by suspect
- If aircraft is tracking and vehicle stops, crashes, or occupants run on foot, we are already in position to react.



# Sport bike pursuit – Sioux Falls



# Checkpoint Pursuit – Sioux Falls





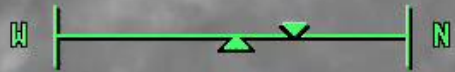
CRAFT POSITION  
07-NOV-2019  
LOCAL: 00:28:36  
43° 54' 51.02" N  
99° 37' 30.07" W  
ELEV: 1109 M  
HDG: NO DATA

LOS: 0.0°T

TARGET POSITION

AF  
CORR  
IR  
WHITE HOT

INS NOT STARTED



AUTO  
1.8X  
AT

GFP search

CRAFT POSITION  
07-NOV-2019  
LOCAL: 00:30:05  
43° 54' 45.63" N  
99° 37' 17.43" W  
ELEV: 1100 M  
HDG: NO DATA

LOS: 0.0°T

TARGET POSITION

AF  
CORR  
IR  
WHITE HOT

INS NOT STARTED



AUTO  
1.8X  
AT

GFP search

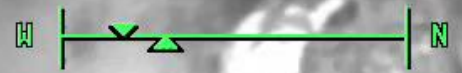


CRAFT POSITION  
22-MAR-2020  
LOCAL: 14:48:02  
43° 36' 44.23" N  
97° 18' 57.57" W  
ELEV: 871 M  
HDG: 214.4° M

LOS: 135.7° M  
19 | 20 | 21 | 22 | 23

TARGET POSITION

AF  
CORR  
IR  
BLACK HOT



INS NAV 0.2°

AUTO  
GPNT

Pursuit search



Pursuit/Stolen Vehicle search

CRAFT POSITION  
14-OCT-2019  
LOCAL: 11:41:13  
43° 41' 22.23" N  
98° 26' 59.58" W  
ELEV: 838 M  
HDG: 141.1° M

LOS: 60.4°M

TARGET POSITION

12 | 13 | 14 | 15 | 16

AF  
CORR  
IR  
WHITE HOT

INS NAV 0.2°



AUTO  
GPNT



CRAFT POSITION  
03-MAR-2020  
LOCAL: 07:18:13  
43° 24' 26.41" N  
103° 24' 27.08" W  
ELEV: 1947 M  
HDG: 201.4° M

LOS:110.9°M  
\$ 19 20 21 22

TARGET POSITION

AF  
CORR  
COLOR

INS NAV 0.5°



-32°

271°

AUTO  
GPNT

Interdiction track and stop

**Department of Justice**

U.S. Attorney's Office

District of South Dakota



FOR IMMEDIATE RELEASE

Thursday, February 25, 2021

## **U.S. Attorney's Office Announces 37 People Indicted in Large-Scale Meth Trafficking Network in Operation Say Uncle**

United States Attorney Ron Parsons announced that 37 people have been federally indicted as part of OCDETF *Operation Say Uncle*. OCDETF stands for Organized Crime Drug Enforcement Task Forces, which is a “keystone of the Attorney General’s strategy to reduce the availability of illicit narcotics throughout the United States using a prosecutor-led, multi-agency approach to combat transnational organized crime.” OCDETF identifies, disrupts and dismantles drug traffickers, money launderers, and transnational criminal organizations.

Federal prosecutors in Rapid City, South Dakota, working cooperatively with law enforcement agencies across the State, federally charged 37 defendants with drug-related offenses, despite the challenges imposed on the criminal justice system and law enforcement officers everywhere by COVID-19. The South Dakota Attorney General’s Office charged nine persons with state offenses as part of the same Operation. The charges allege the defendants conspired with each other to bring multiple pounds of methamphetamine into Western South Dakota beginning in 2019 and continuing into 2020.

Agencies involved in this effort include the South Dakota Division of Criminal Investigation, Drug Enforcement Administration, U.S. Marshals Service, Bureau of Alcohol, Tobacco, and Firearms, Rapid City Police Department, Pennington County Sheriff’s Office, Internal Revenue Service, U.S. Postal Inspection Service, Federal Bureau of Investigation, South Dakota Highway Patrol, Deadwood Police Department, Lawrence County Sheriff’s Office, Spearfish Police Department, Homeland Security Investigations, and Oglala Sioux Tribe Department of Public Safety. Outside of South Dakota, agencies assisted from the Reno County (KS) Drug Enforcement Unit, Billings (MT) Drug Task Force, Wyoming

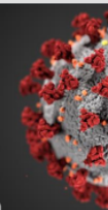


### DEPARTMENT OF JUSTICE ACTION CENTER

- Report a Crime
- Locate a Prison, Inmate, or Sex Offender
- Submit a Complaint
- Report Waste, Fraud, Abuse or Misconduct to the Inspector General
- Register, Apply for Permits, or Request Records
- Identify Our Most Wanted Fugitives
- Report and Identify Missing Persons
- Contact Us

### REPORT COVID-19 CRIME

Contact the National Center for  
Disaster Fraud Hotline:  
866-720-5721 or  
[Justice.gov/DisasterComplaintForm](https://Justice.gov/DisasterComplaintForm)





CRAFT POSITION  
22-MAY-2020  
LOCAL: 21:37:18  
44° 47' 21.82" N  
100° 39' 28.02" W  
ELEV: 895 M  
HDG: 246.8° M

LOS:169.4°M

TARGET POSITION

23 24 25 26

AF  
CORR  
COLOR

INS NAV 0.2°



9°

285°

AUTO

GPNT

North Oahe – Stranded boater



CRAFT POSITION  
22-MAY-2020  
LOCAL: 21:42:17  
44° 46' 6.60" N  
100° 39' 31.93" W  
ELEV: 806 M  
HDG: 99.2° M

LOS: 4.9°M

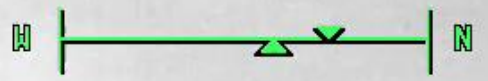
TARGET POSITION

08 | E | 10 | 11 | 12  
| | | | |  
|



AF  
CORR  
IR  
BLACK HOT

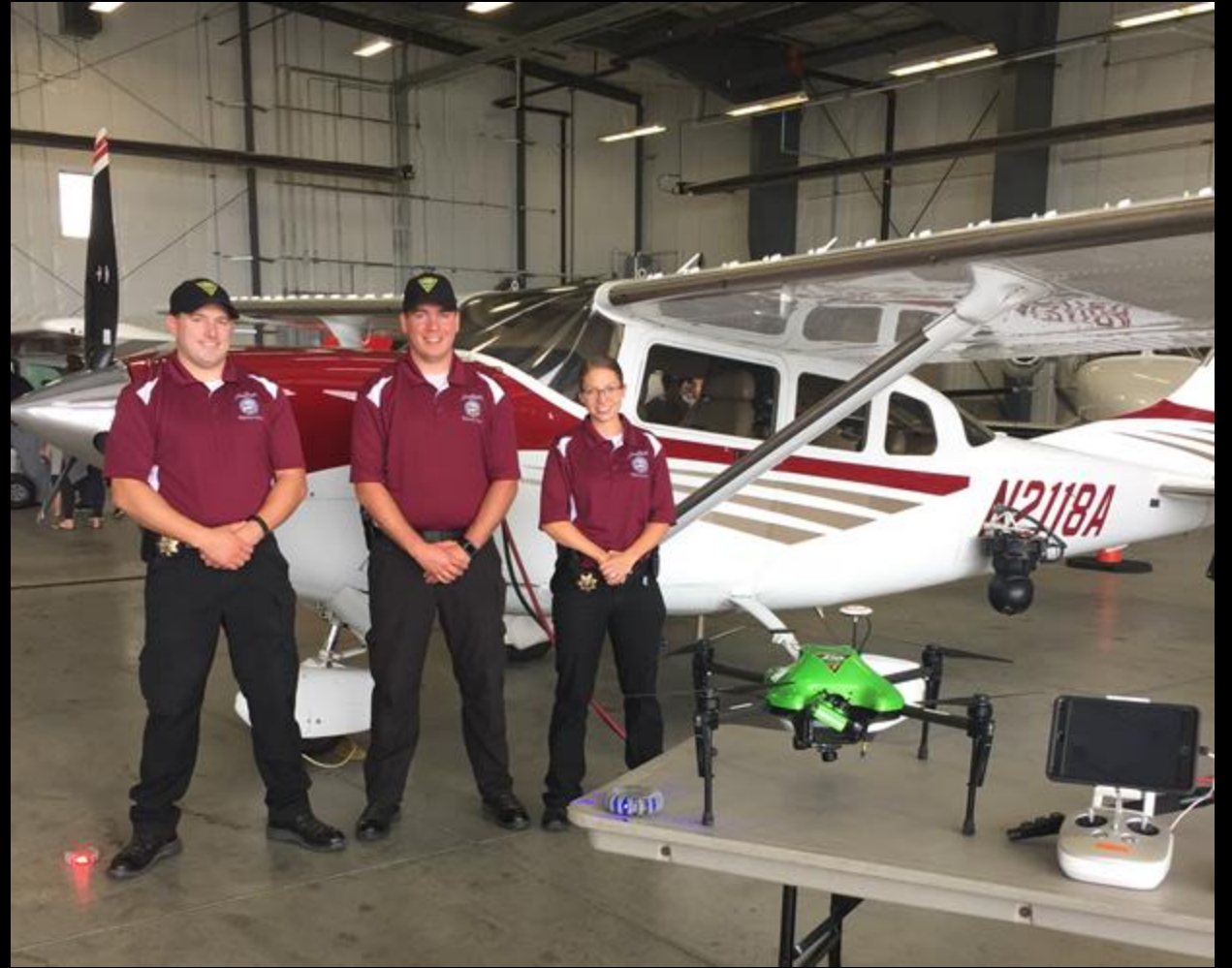
INS NAV 0.2°



AUTO  
1.8X  
AT

# SDHP UAS Program History

- 2016 – Started with 2 Sentera Omni Inspect drones with FLIR, 4 RPIC's
- 2020 – Added 2 Autel Evo II
- 2021 – Added 8 more Autel Evo II Pro 6K/Dual 640 drones
- 18 RPIC's throughout the state

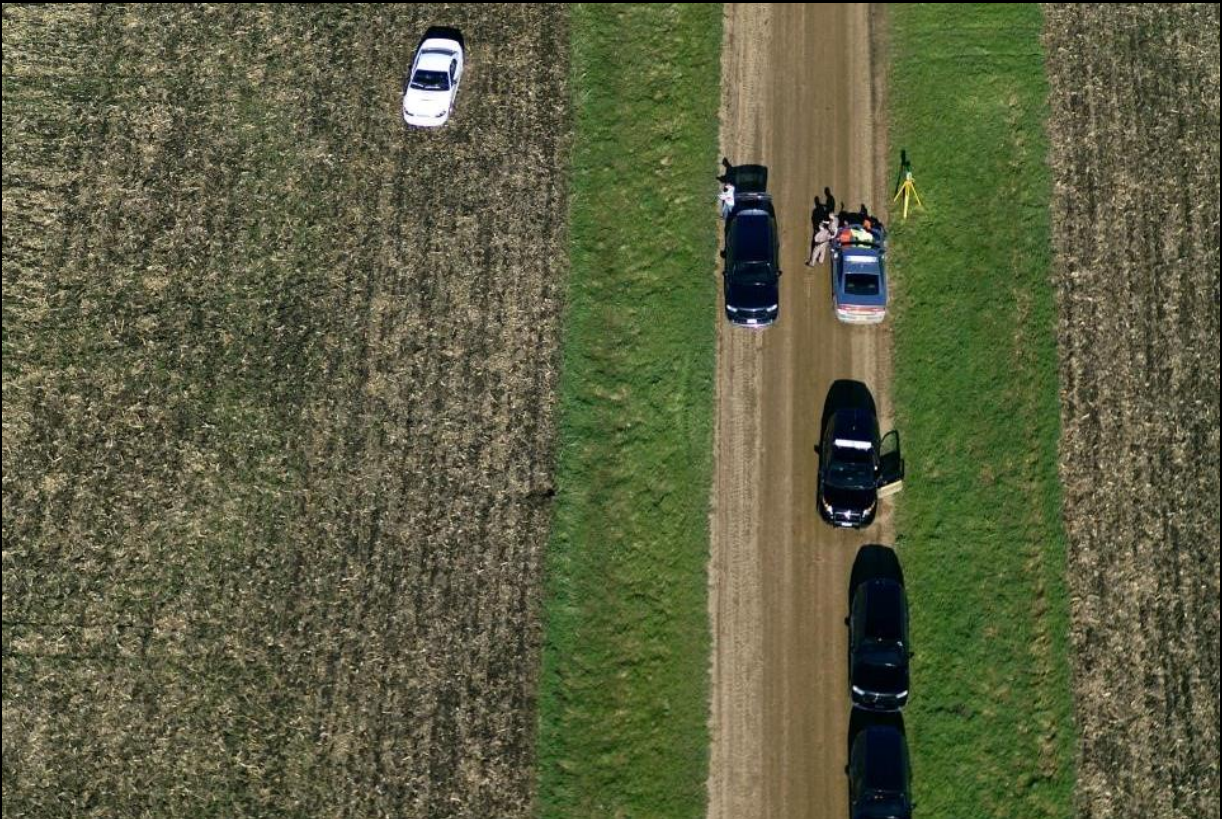




## 2016 – Sentera Omni Inspect

- 2 units, 4 operators (Sioux Falls and Rapid City)
- Zenmuse XT FLIR system
- Primary uses: tactical overwatch, searches, disaster assessment, crash and crime scene photos





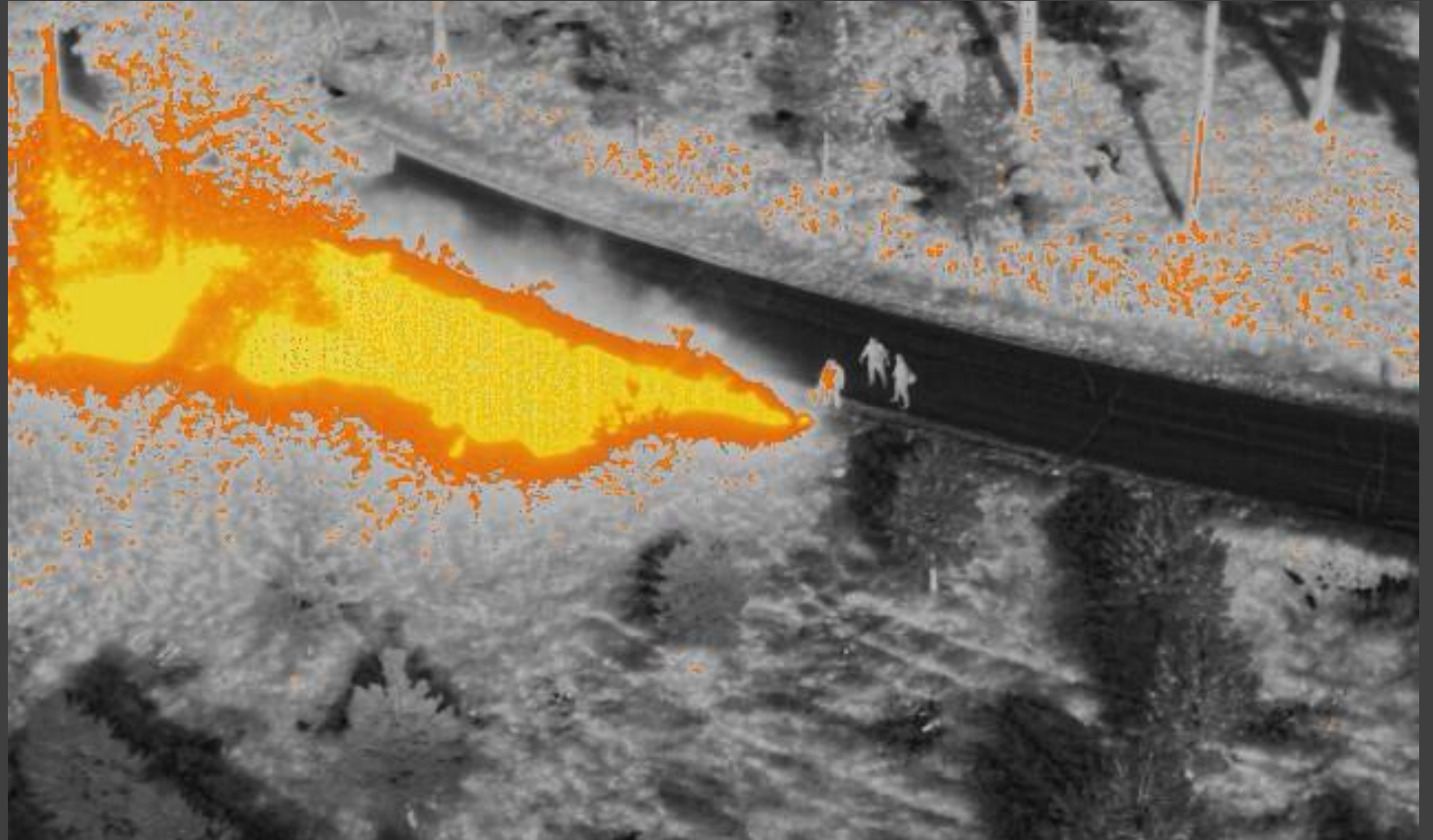


# Autel Evo II

- 2020-2021
- 10 units: 7 Pro 6K Rugged, 3 Dual 640 Thermal Rugged
- 18 Remote Pilots
- Primary use: crash and crime scene photography, mapping, reconstruction
- Additional uses: Tactical overwatch, searches, firespotting, disaster assessment, etc

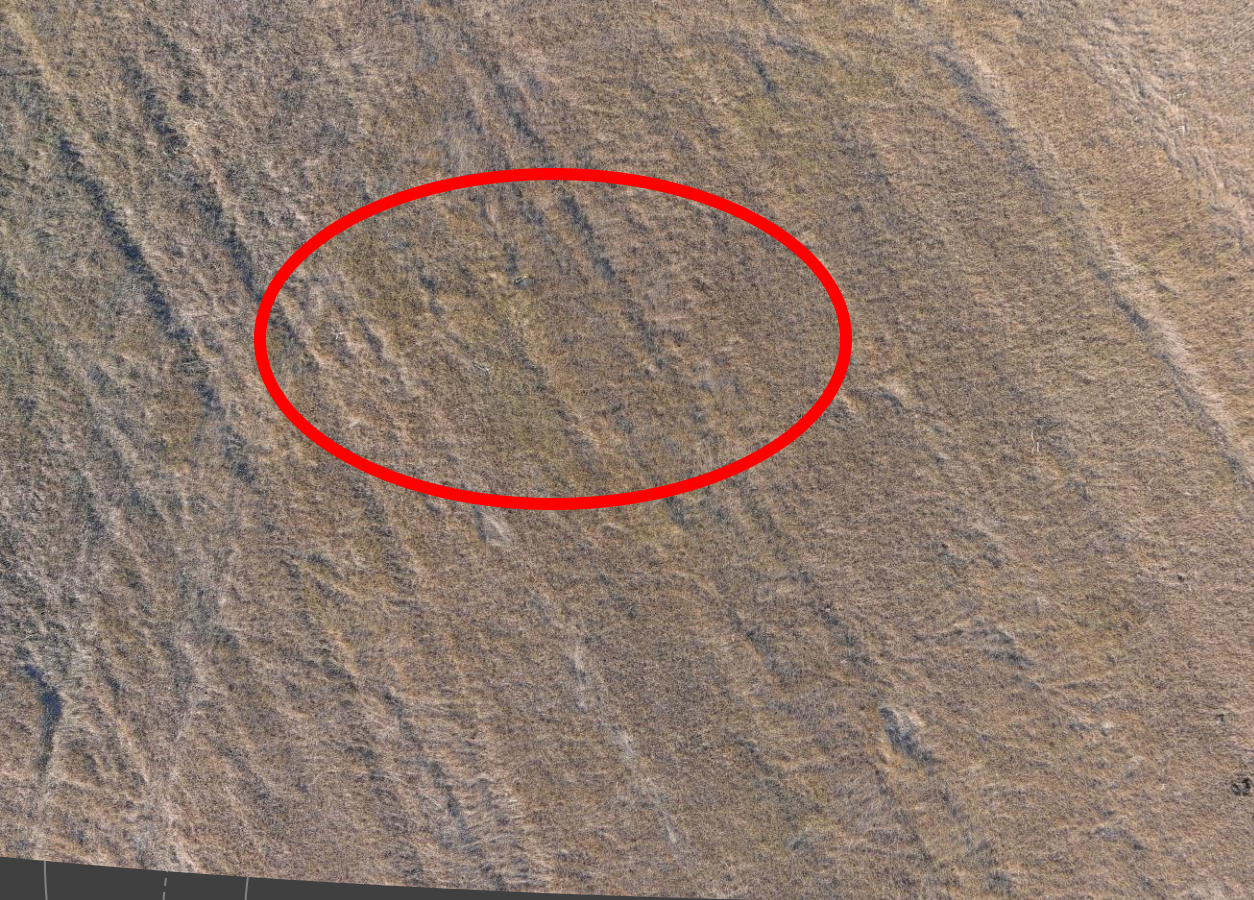






Autel Evo II Dual 640  
(Thermal)

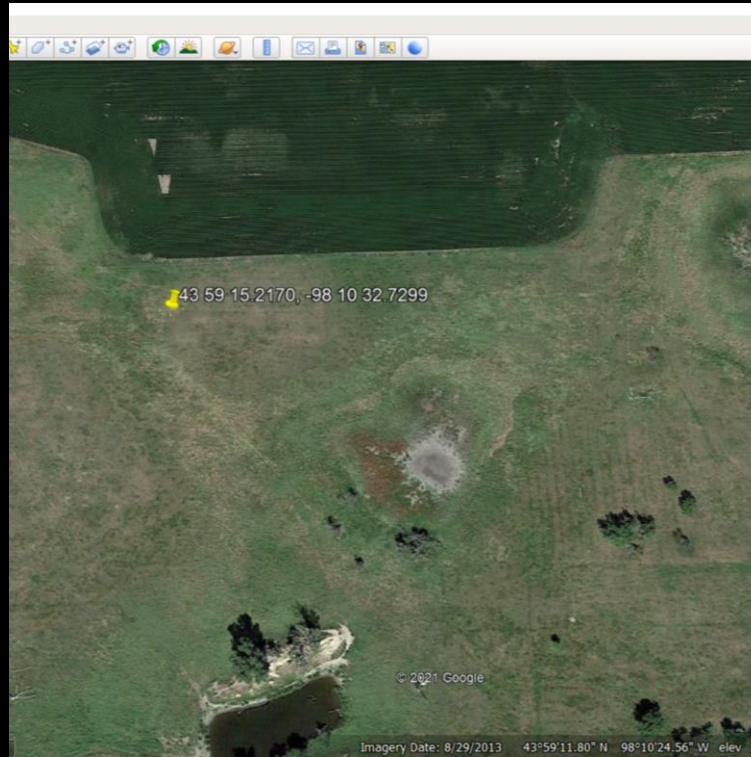
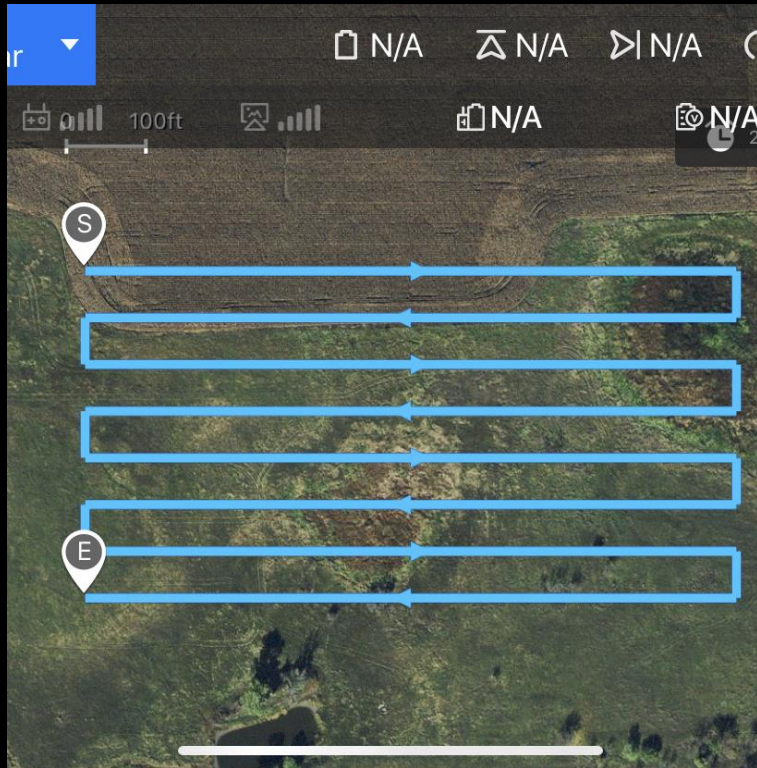




# Autel Evo II Pro 6K

- Assist South Dakota DCI with search for human remains
- Altitude = 70 feet

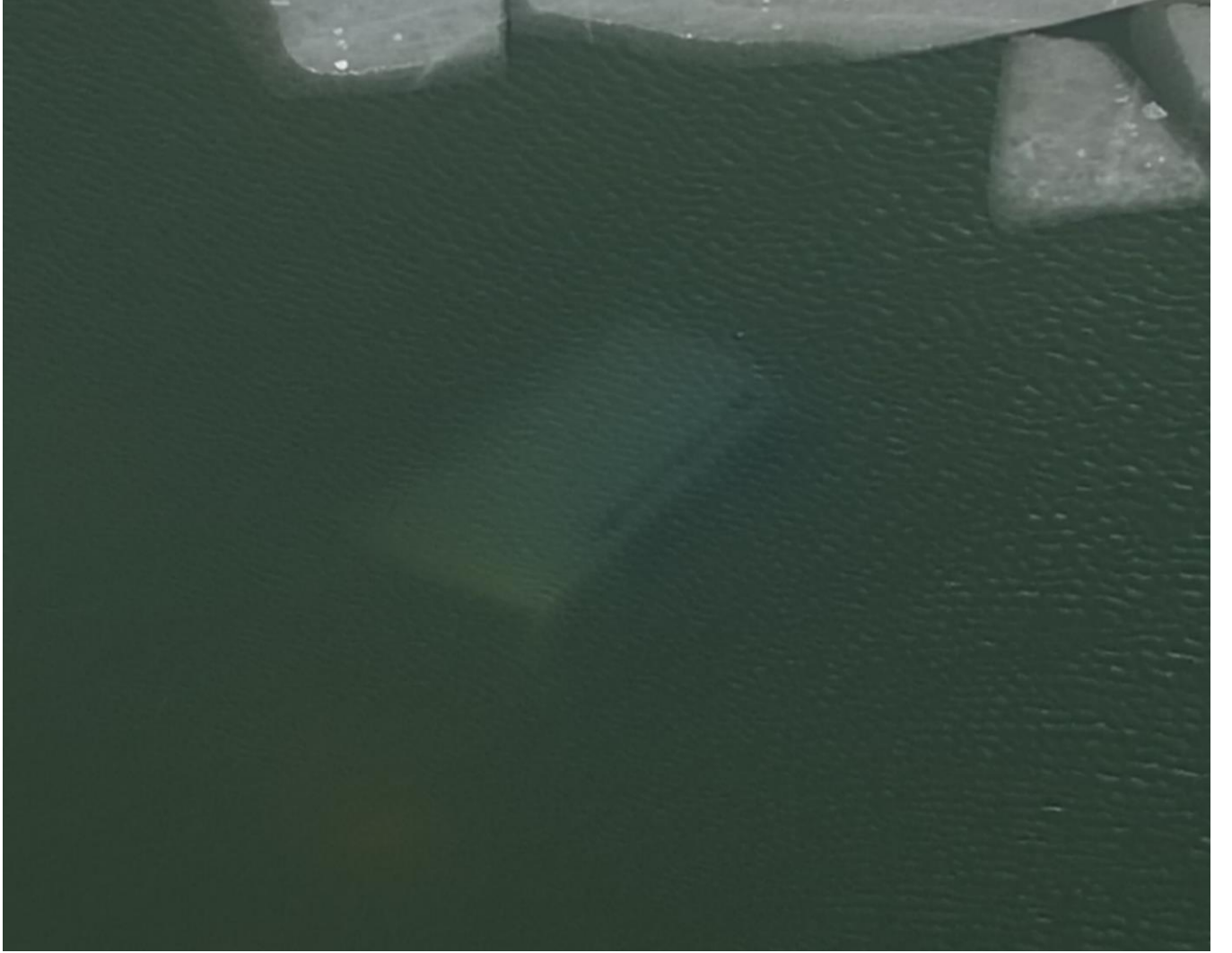




Property	Value
Exposure program	Normal
Saturation	Normal
Sharpness	Normal
White balance	Auto
Photometric interpretation	
Digital zoom	
EXIF version	0221
GPS	
Latitude	43; 59; 15.2170000000042194
Longitude	98; 10; 32.7299999999813807
Altitude	384.31
File	
Name	MAX_1229.jpg
Item type	JPG File
Folder path	C:\Users\pspr1hp156\Desktop
Date created	03/30/2021 1:51 PM
Date modified	03/30/2021 1:51 PM

## Search Options

- Very good for searching small areas
- Program rectangular, polygon, and waypoint missions and fly autonomously
- Can record continuous video or take photos with overlap
- All photos are geo-referenced



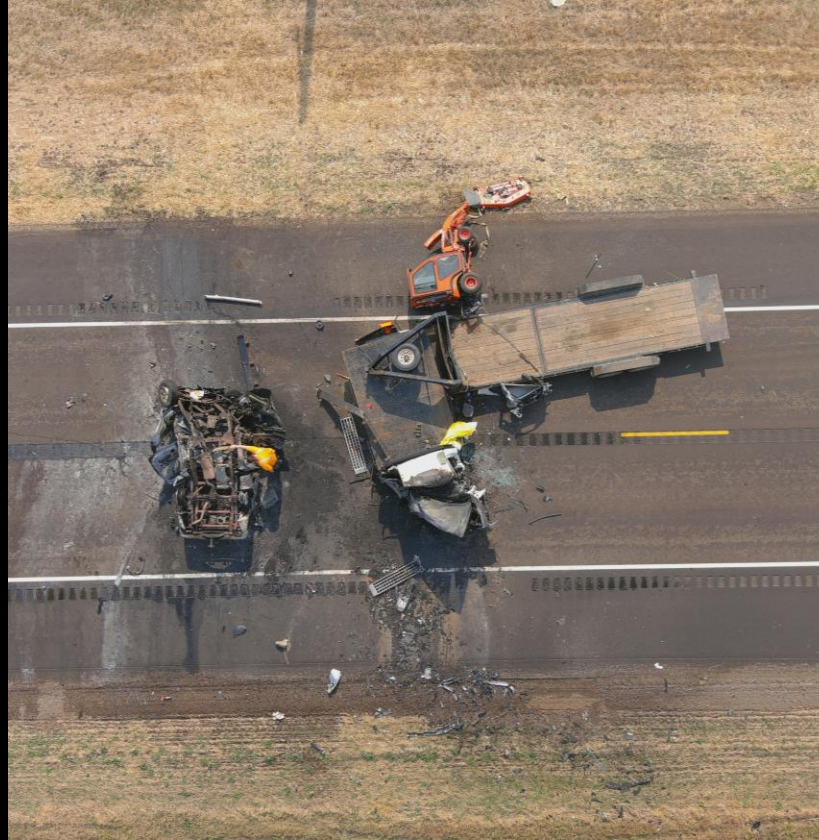


# Crash Scene Reconstruction

- SDHP reconstructs approximately 90% of serious injury and fatality crashes in South Dakota.
- Prior to 2021, all reconstructions were done with a Leica Total Station or a 3D Scanner.
- Drones can save a lot of time, money, and help prevent secondary crashes







## Pix4D Introduction

- <https://youtu.be/U7DzH5fHVtY>



# Crash Reconstruction





**Create**

Home

Map View

**rayCloud**

Volumes

Mosaic Editor

Index Calculator

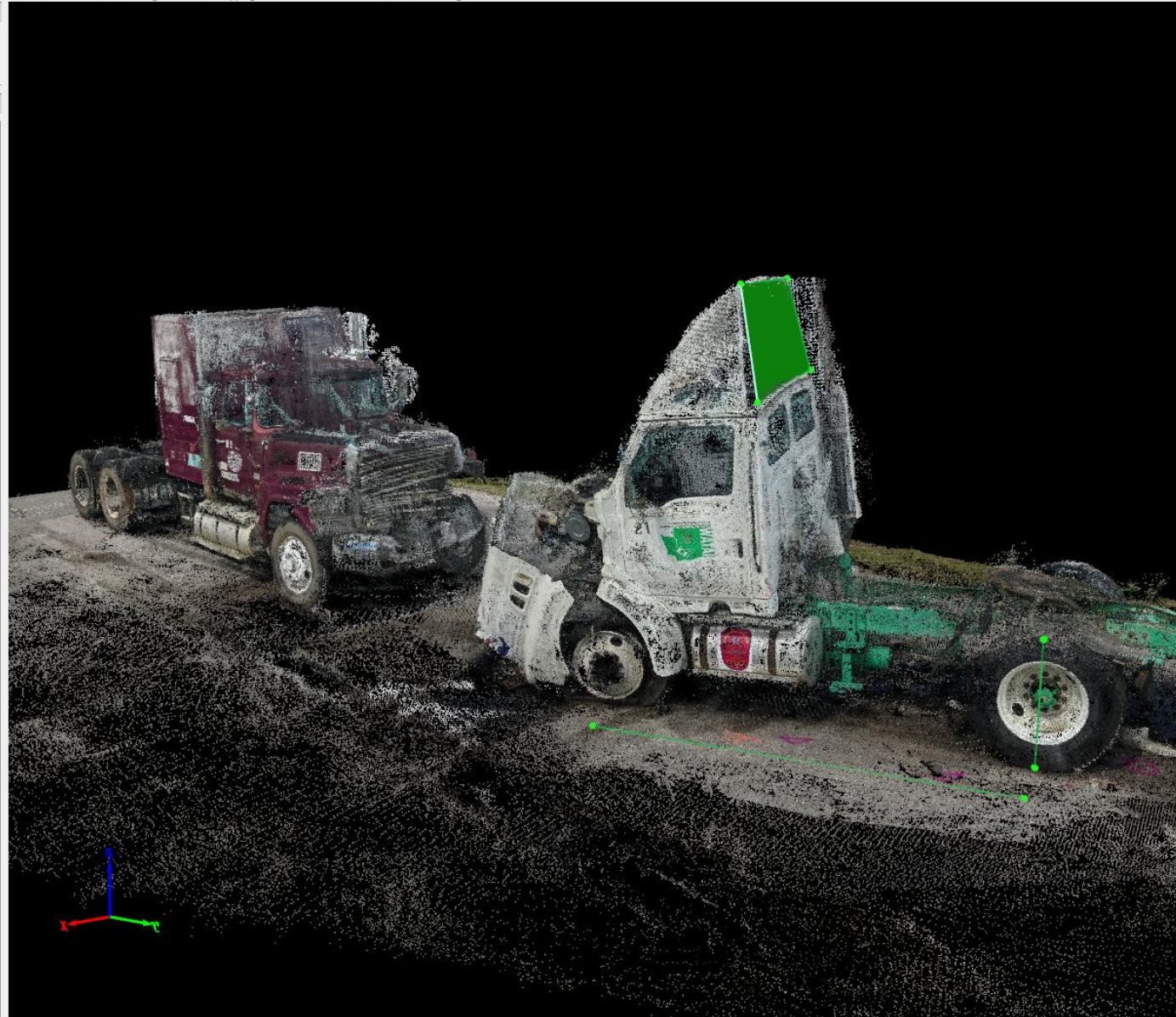
**Layers**

- Cameras
- Rays
- Tie Points
  - GCPs / MTPs
  - Automatic
- Processing Area
- Point Clouds
  - Densified Point Cloud
    - Display Properties
      - Point Size
      - Shader  Screen Aligned Quads
- Point Groups
  - Unclassified
  - Deleted
- Triangle Meshes
- Objects
  - Polylines
    - Display Properties
    - Polyline 1
    - Polyline 2
    - Polyline 3
    - Polyline 4
    - Polyline 5
    - Polyline 6
    - Polyline 7
    - Polyline 8
  - Surfaces
    - Display Properties
    - Surface 3
    - Surface 4
  - Animation Trajectories
    - Display Properties
    - Animation Trajectory 1
  - Orthoplanes
  - Scale Constraints
    - Display Properties
    - Scale 1
  - Orientation Constraints

Processing

Log Output

Processing Options



Properties

**Selection**

**Surface 3 (Surface)**

Number of Vertices: 4

**Measurements**

Terrain 3D Length [m]:	35.44	error n/a
Projected 2D Length [m]:	25.29	error n/a
Enclosed 3D Area [m <sup>2</sup> ]:	73.10	error n/a
Projected 2D area [m <sup>2</sup> ]:	14.50	error n/a

Use for DSM and triangle Mesh

Copy to Clipboard Apply Cancel Help

**Images**

Image Size Zoom Level

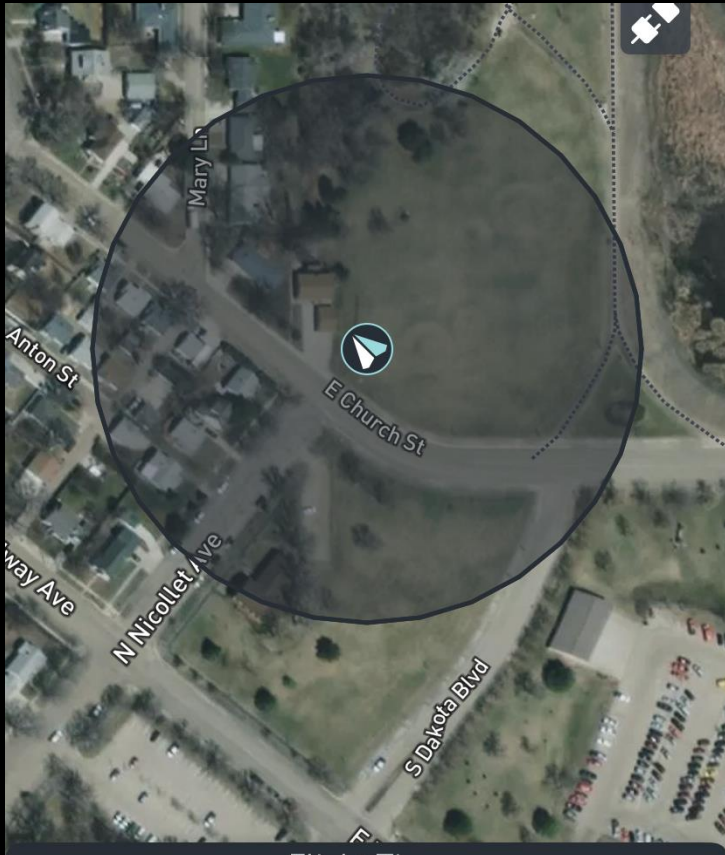




- 2 paths – Part 107 or COA
- Preferred Part 107
  - Certification test
  - Insurance requirements/Risk Management
  - Waiver options/accessibility
  - LAANC

Why Part 107?

AIRMAP – Allows remote pilot to plan and autonomously file flight plans within controlled airspace



#### FAA LAANC

##### PIR

CONTROLLED AIRSPACE ⓘ

Authorization Pending Submission

You will be notified with authorization status after submission

Swarm operations are not supported.

Automatic approvals obtained via LAANC are not valid in Class E Surface Area airspace when the weather ceiling is less than 1,000 feet.



#### Rules you should review

No operations from a moving aircraft.

"Due to relatively lower minimums for VFR traffic in Class E airspace, additional situational risks limit the validity of automatically approved authorizations provided via LAANC. Specifically, automatic approvals obtained via LAANC are not valid in Class E Surface Area when the weather ceiling is less than 1,000 feet."

Ensure that the small unmanned aircraft complies with

LAANC – Low Altitude Authorization and Notification Capability – allows access to controlled airspace at and below 400'

- Real-time approval for flights



The screenshot displays a flight simulator interface. On the left, a map shows the Aberdeen, SD area with various airports and navigation aids. The right panel shows the NOTAM list for KABR, including details for future, today, and last 30 days.

**Map Details:**

- Time: 12:10 PM CDT
- Location: Aberdeen, SD
- Map features: HP186, 171c, 353, 133, 171c, 353, 133, 171c, 353, 133

**NOTAM List for KABR:**

Category	NOTAM Description	Effective	Expires	Duration
FUTURE	ABR NAVIGATION ILS RUNWAY 31 RENEY LOM <b>OUT OF SERVICE</b> . ABR 03/081	Mar 15, 10:00 AM CDT (in 21h22m)	Mar 15, 12:00 PM CDT	2h00m
TODAY	ABR AIRSPACE UAS WI AN AREA DEFINED AS .25NM RADIUS OF 452640N0982614W (.5NM W APPROACH END RUNWAY 35) SFC-100FT ABOVE GROUND LEVEL. ABR 03/083	Mar 14, 1:00 PM CDT (in 0h22m)	Mar 14, 2:00 PM CDT	1h00m
LAST 30 DAYS	ABR AD AP BIRD ACTIVE INCREASED MIGRATING GEESE. ABR 03/002	Mar 4, 8:59 AM CST (Active)	Apr 30, 6:59 PM CDT (in 47 days)	
OLDER	ABR INSTRUMENT APPROACH PROCEDURE ABERDEEN RGNI. ABERDEEN, SD.			

**Map Data:**

- Distance Next: 1 kts
- ETE Dest: 1,735'
- Groundspeed: 1 kts
- GPS Altitude: 1,735'
- Track: 125°M

NOTAM example for UAS Operation within airport airspace /ABR