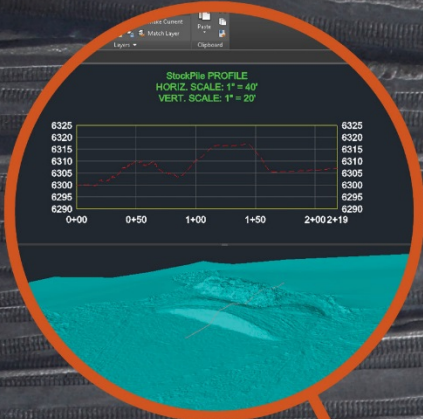


Unmanned Aerial Systems (UAS): What We Learned in our First Year as a Commercial Operator

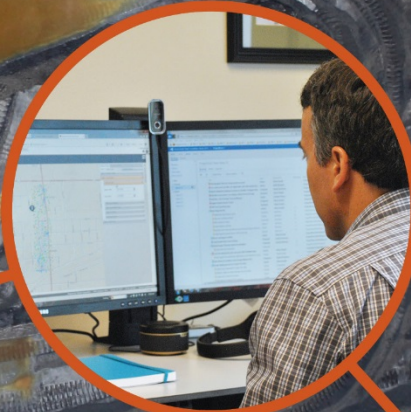


33rd Annual Meeting of the
American Society of Mining
and Reclamation, June 2016

Trihydro established our Unmanned Aerial Systems (UAS) program to:



Provide high value data to our clients



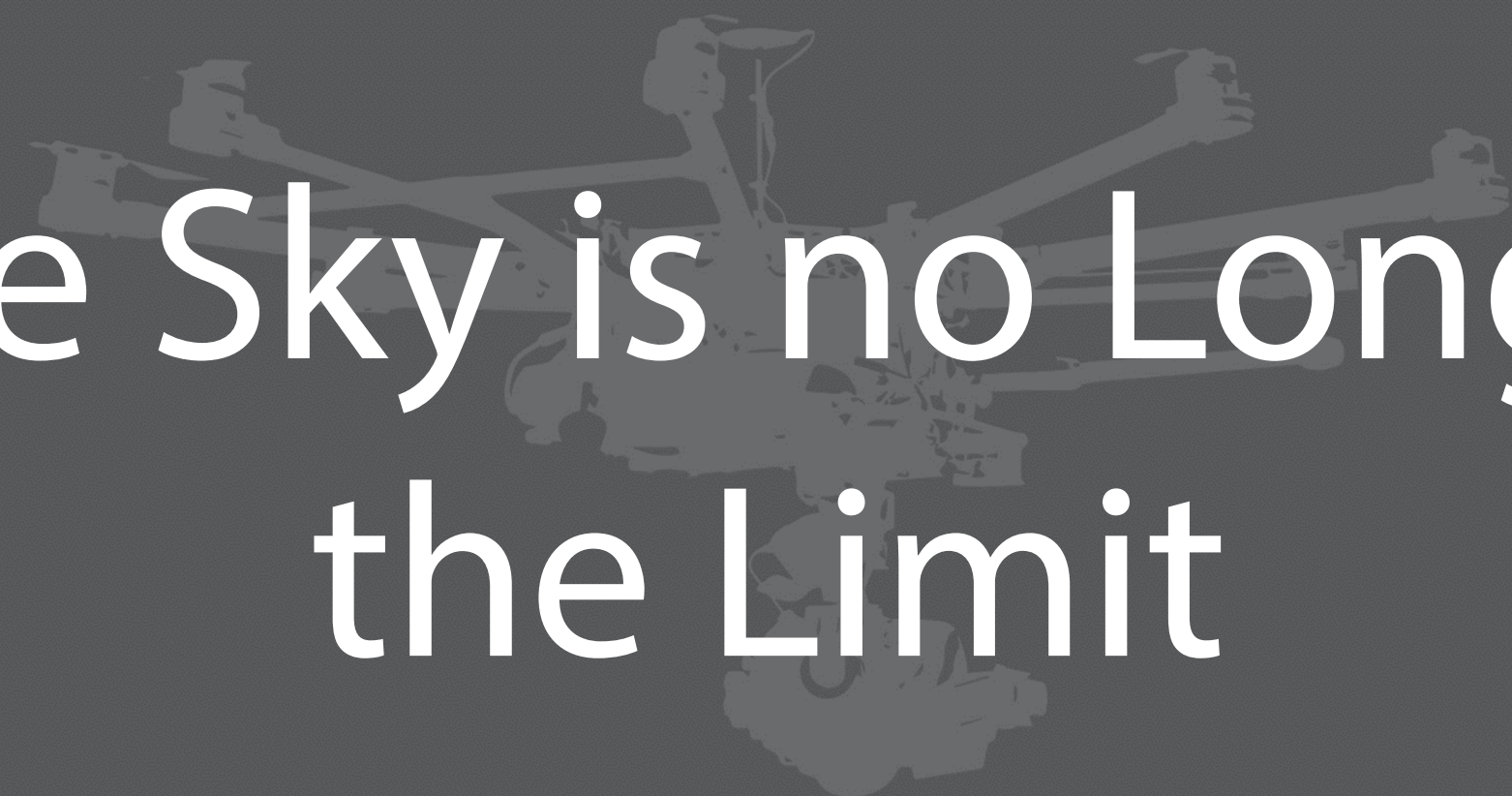
Encourage innovation inside and outside Trihydro



Offer a safer way to collect data on high-risk sites

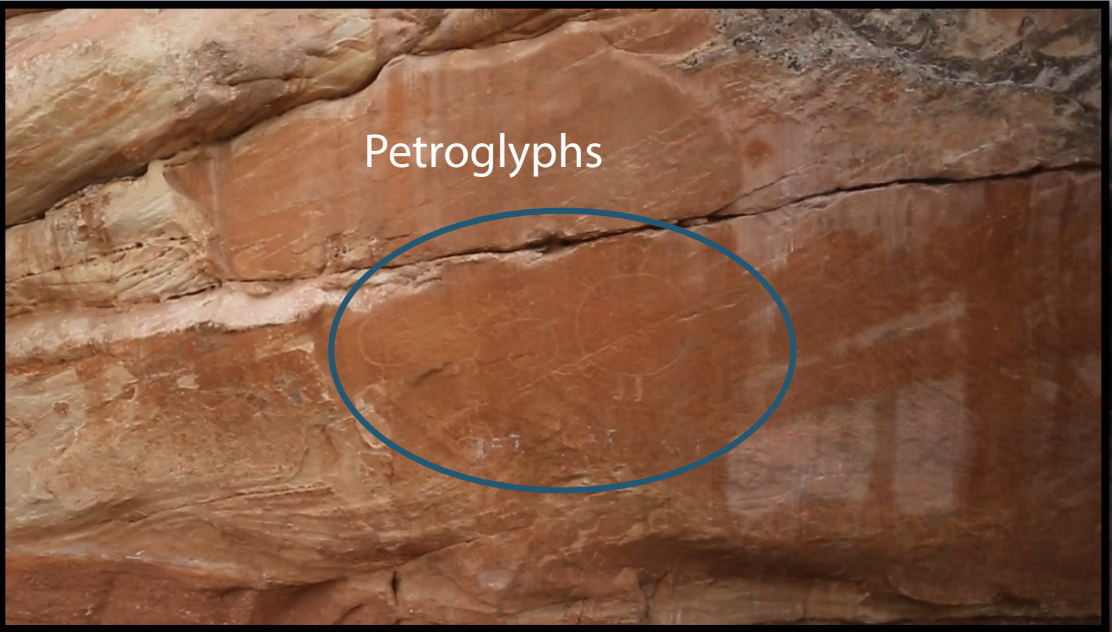


Provide new opportunities for employees



The Sky is no Longer
the Limit

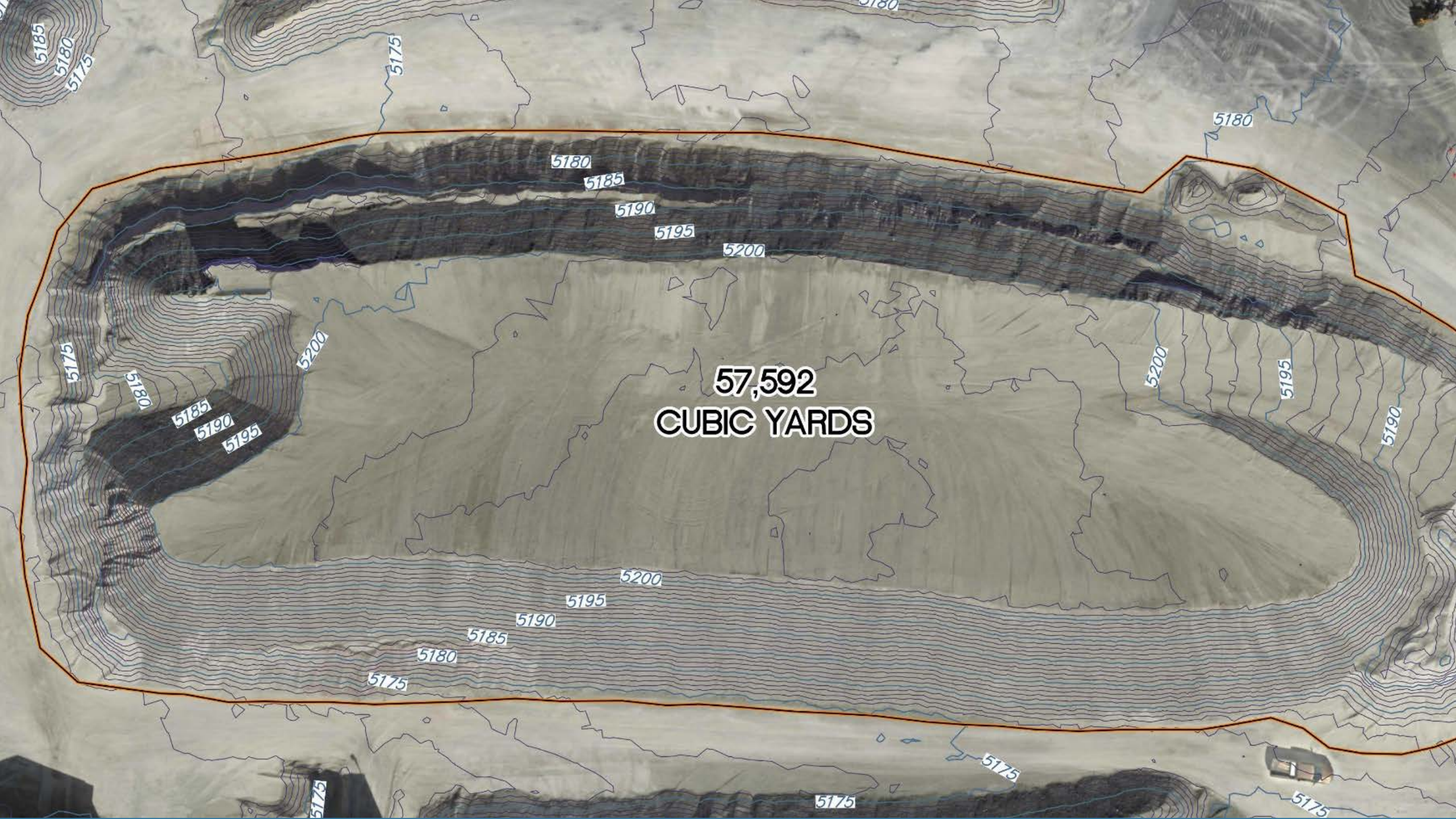












**57,592
CUBIC YARDS**



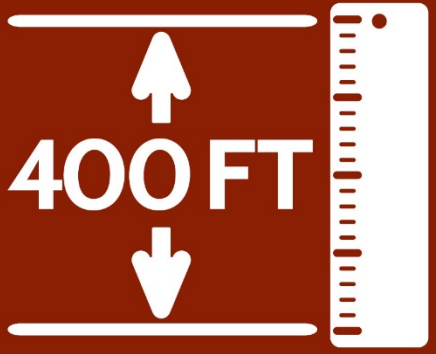
A faint, grayscale background image of a person, likely a personification of justice, holding a pair of scales. The person is standing and facing forward, with their arms extended to hold the scales. The image is centered and serves as a backdrop for the text.

Not Everyone Plays by the Rules

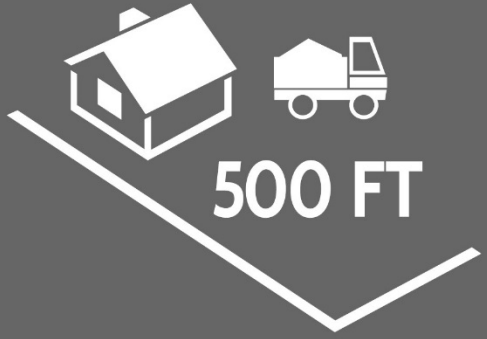
(but they should)

Commercial UAS Requirements (changes coming soon...)

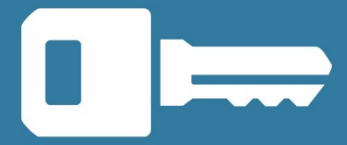
- ✓ FAA Section 333 Exemption (specific to UAV)
- ✓ Operations and Maintenance Program
- ✓ Pilot-in-Charge (minimum sport pilot certificate)
- ✓ Trained Observer
- ✓ UAS Liability Insurance
- ✓ Licensed Technical Professionals



The FAA places the following restrictions on all commercial UAS operators



PRIVATE PROPERTY





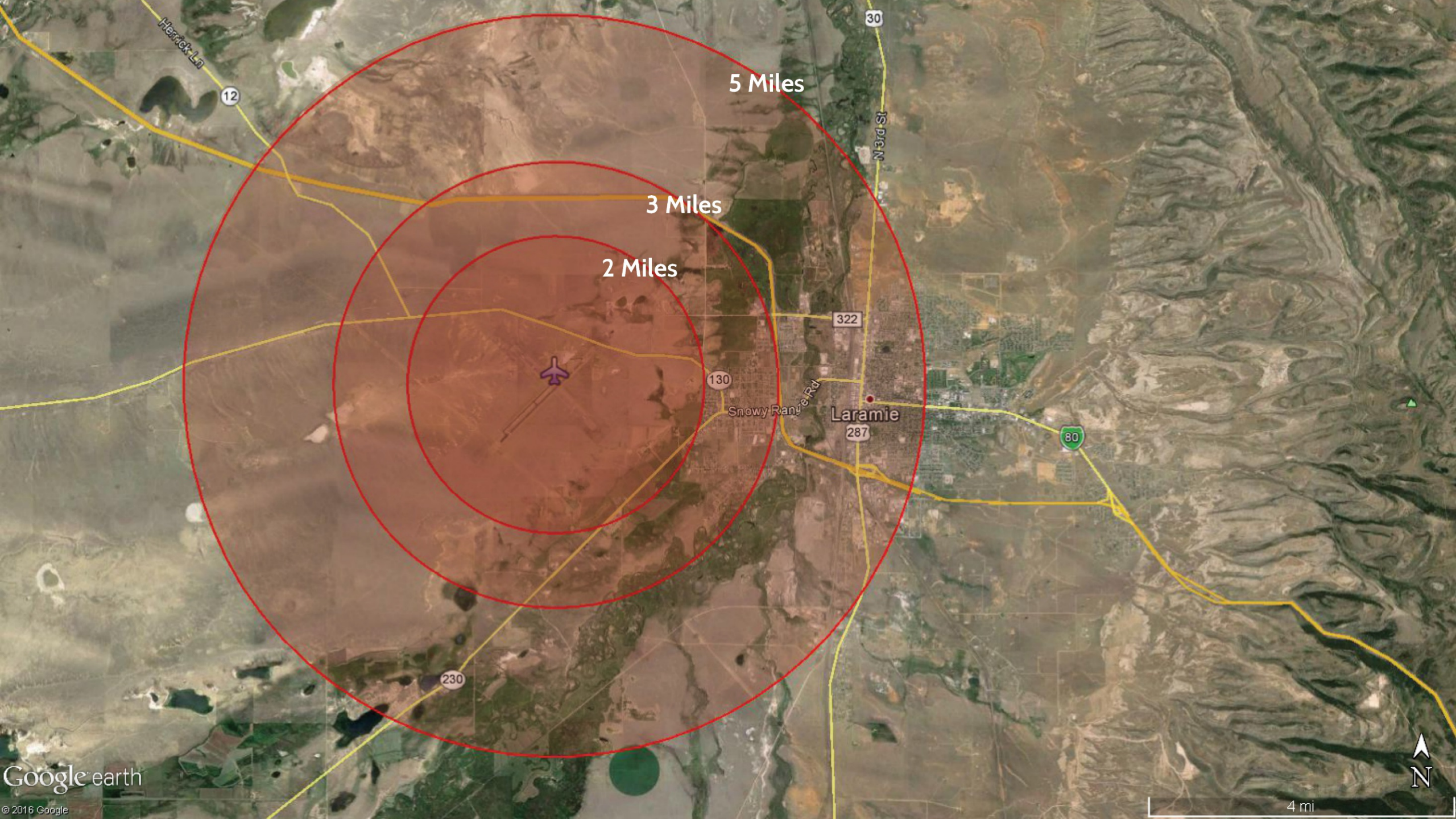
Why Does it Matter?





A faint, stylized illustration of a figure holding a scale of justice, overlaid with a drone silhouette. The figure is positioned in the center, holding a scale of justice. The drone silhouette is positioned behind the figure, with its arms extending outwards. The background is a dark gray color.

UAS is not always the
best Tool



5 Miles

3 Miles

2 Miles



Laramie





287

31st St

34th St

32nd St

33rd St

4th St

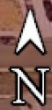
Palmer Dr

9th St

Boswell Dr

Google earth

© 2016 Google



400 ft

dji

Current point flight time: 00:00:00
 Total flight time: 00:00:00
 Total estimated time of one way: 00:34:40
 Total distance of one way: 10.704km

To Home(M):0.0
 To Target(M):0.0
 Altitude(M):0.0
 H.Speed(M/S):0.0
 V.Speed(M/S):0.0
 MotorVoltage(V):0.0

AirSpeed m/s
 vertical speed m/s
 7 meter



dji EDITOR

Editing Mission

- 0
- 1
- 2
- 3
- 4
- 5
- 6

1.Way point properties

| | |
|----------------------|--------------------|
| Latitude | 46.3262687700966 |
| Longitude | -111.6205536711 |
| Altitude | 80 |
| TurnMode | Adaptive_Bank_Turn |
| Forward_Flight_Speed | 8 |
| HeadingDegree | 360 |
| HoldTime | 3 |

Latitude
Latitude of the selected way point.

+ - CLEAR SAVE OPEN
 +1 +10 -1 -10
 CANCEL UPLOAD GO

Project Evaluation



- Location (restrictions)
- Obstacles (buffer zones)
- Project size/site configuration
- Data/sensor requirements
- Anticipated weather conditions
- Budget (min. 2-person crew)



One Size does not
Fit all Sites





Well-Defined Processes
are Important

Preflight Checklist

Date: 4-8-16
Takeoff Time: 11:05

Observer: Dan M...
Location: Top... Weather: NY

| Specification | Detail | PIC Initials |
|--|---|--------------|
| Actual Weather Conditions | Look around for cloud conditions. | |
| Verify No Rapidly Approaching Storm Systems | 23 F to 100 F | |
| Ambient Air Temperature | may affect battery performance | |
| Check Density Altitude | Be aware of high altitude, high temp conditions | |
| Actual Wind Conditions | Peak gusting velocity | |
| Actual VFR Conditions | Visual Line of Site and Cloud Clearances. | |
| Before Takeoff | Operational | |
| Comm. Radios | If applicable | |
| Contact ATC | Clear | |
| Obstacles & Power Lines | Clear | |
| Perimeter (100m) | Connection/Unobstructed/Direction | |
| Equipment Check | Load Flight Plan | |
| Antennas (Flight Controller, Gimbal Receiver, iOSD, Video TX, Data Link) | ON | |
| Link | Lens Cap, Clean Lens | |
| GCS | Installed | |
| Monitor/Goggles | Required settings for gimbal | |
| Camera | Check | |
| SD Card (Camera) | Check all axis' | |
| Camera Power | Nose Direction for Course Lock | |
| Verify Camera Mode | All switches & Throttle = DOWN | |
| | ON | |

DJI S1000+ TAKEOFF CHECKLIST

Date: 4-8-16
Takeoff Time: 11:50

Observer: Dan M...
Location: Top... Weather: NY

| Specification | Detail | PIC Initials |
|--|---|--------------|
| Actual Weather Conditions | Look around for cloud conditions. | |
| Verify No Rapidly Approaching Storm Systems | 23 F to 100 F | |
| Ambient Air Temperature | may affect battery performance | |
| Check Density Altitude | Be aware of high altitude, high temp conditions | |
| Actual Wind Conditions | Peak gusting velocity | |
| Actual VFR Conditions | Visual Line of Site and Cloud Clearances. | |
| Before Takeoff | Operational | |
| Comm. Radios | If applicable | |
| Contact ATC | Clear | |
| Obstacles & Power Lines | Clear | |
| Perimeter (100m) | Connection/Unobstructed/Direction | |
| Equipment Check | Load Flight Plan | |
| Antennas (Flight Controller, Gimbal Receiver, iOSD, Video TX, Data Link) | ON | |
| Link | Lens Cap, Clean Lens | |
| GCS | Installed | |
| Monitor/Goggles | Required settings for gimbal | |
| Camera | Check | |
| SD Card (Camera) | Check all axis' | |
| Camera Power | Nose Direction for Course Lock | |
| Verify Camera Mode | All switches & Throttle = DOWN | |
| | ON | |

DJI Multi-Rotor Post Flight Checklist

Date: 4/8/16
Landing Time: 1:05 PM

| Specification | Detail | PIC Initials |
|--|--|--------------|
| Copter Power | OFF; RED Lead Int | |
| Copter Battery | Remove | |
| Antennas (Flight Controller, Gimbal Receiver, iOSD, Video TX, Data Link) | Connection/Unobstructed/Direction | |
| GCS | Store antennas and Computer | |
| Monitor | OFF | |
| Camera | Lens Cap, Clean Lens | |
| SD Card (Camera) | Remove and Download | |
| Camera Power | OFF | |
| Te Power Off | Both UAV and Camera TX | |
| Check motor | Signs of deterioration or looseness | |
| Check G | Securely installed | |
| Check G | Check for cracks, tracks, or rough edges | |

DJI S1000+ TAKEOFF CHECKLIST

Date: 4/8/15
Takeoff Time: 12:50

Observer: Dan M...
Location: Top... Weather: NY

| Specification | Detail | PIC Initials |
|--|---|--------------|
| Actual Weather Conditions | Look around for cloud conditions. | |
| Verify No Rapidly Approaching Storm Systems | 23 F to 100 F | |
| Ambient Air Temperature | may affect battery performance | |
| Check Density Altitude | Be aware of high altitude, high temp conditions | |
| Actual Wind Conditions | Peak gusting velocity | |
| Actual VFR Conditions | Visual Line of Site and Cloud Clearances. | |
| Before Takeoff | Operational | |
| Comm. Radios | If applicable | |
| Contact ATC | Clear | |
| Obstacles & Power Lines | Clear | |
| Perimeter (100m) | Connection/Unobstructed/Direction | |
| Equipment Check | Load Flight Plan | |
| Antennas (Flight Controller, Gimbal Receiver, iOSD, Video TX, Data Link) | ON | |
| Link | Lens Cap, Clean Lens | |
| GCS | Installed | |
| Monitor/Goggles | Required settings for gimbal | |
| Camera | Check | |
| SD Card (Camera) | Check all axis' | |
| Camera Power | Nose Direction for Course Lock | |
| Verify Camera Mode | All switches & Throttle = DOWN | |
| | ON | |

DAILY TAILGATE SAFETY MEETING

NOTE: A new tailgate meeting must be conducted if conditions, location, or personnel change.

Date: 4/8/16
Project Name: VAS MAPPING
Current Objective/Description: VAS MAPPING
Time: 10:10
a.m. p.m.
Client: TRIHEDRO

Commitment to Safety

- I will protect myself for me, my family, Trihydro, clients, and contractors by watching for and mitigating risky behaviors, exercising stop-work authority to prevent incidents and injuries and by complying with Trihydro and client policies, procedures, and IASA/LAS.
- I understand that safety is my personal responsibility and that working safely is a key component in providing quality work.

I will drive defensively and "slow down" appropriately to work at a pace that will allow me to efficiently and safely.

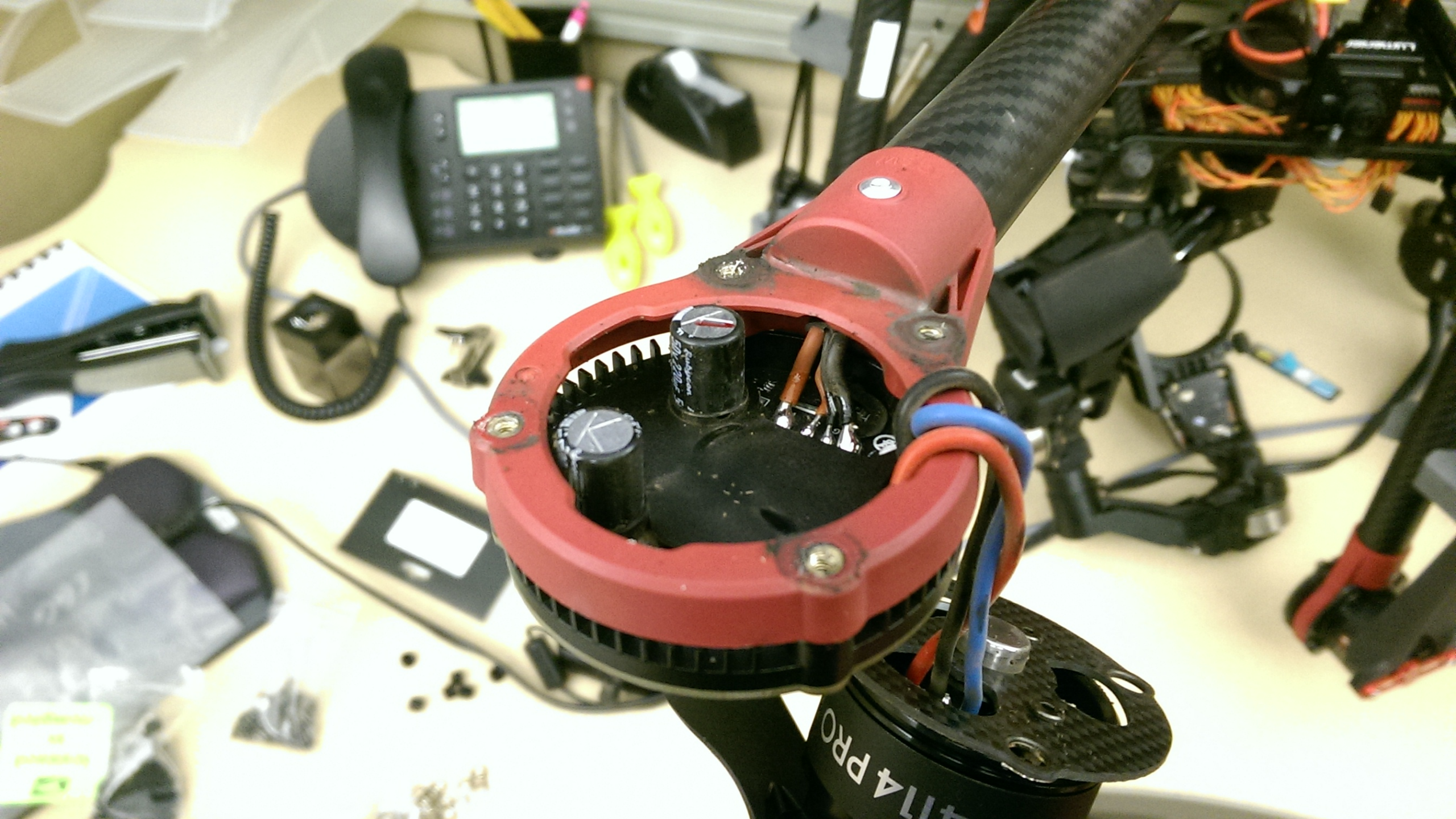
I am self-accountable for my safety and the safety of my coworkers, contractors, and clients.

Authority (SWA) - "E"







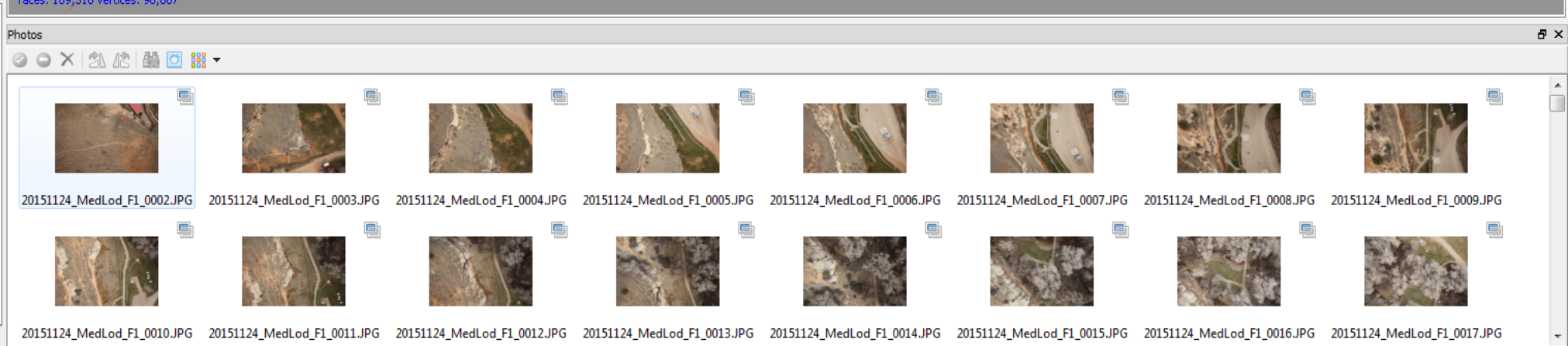
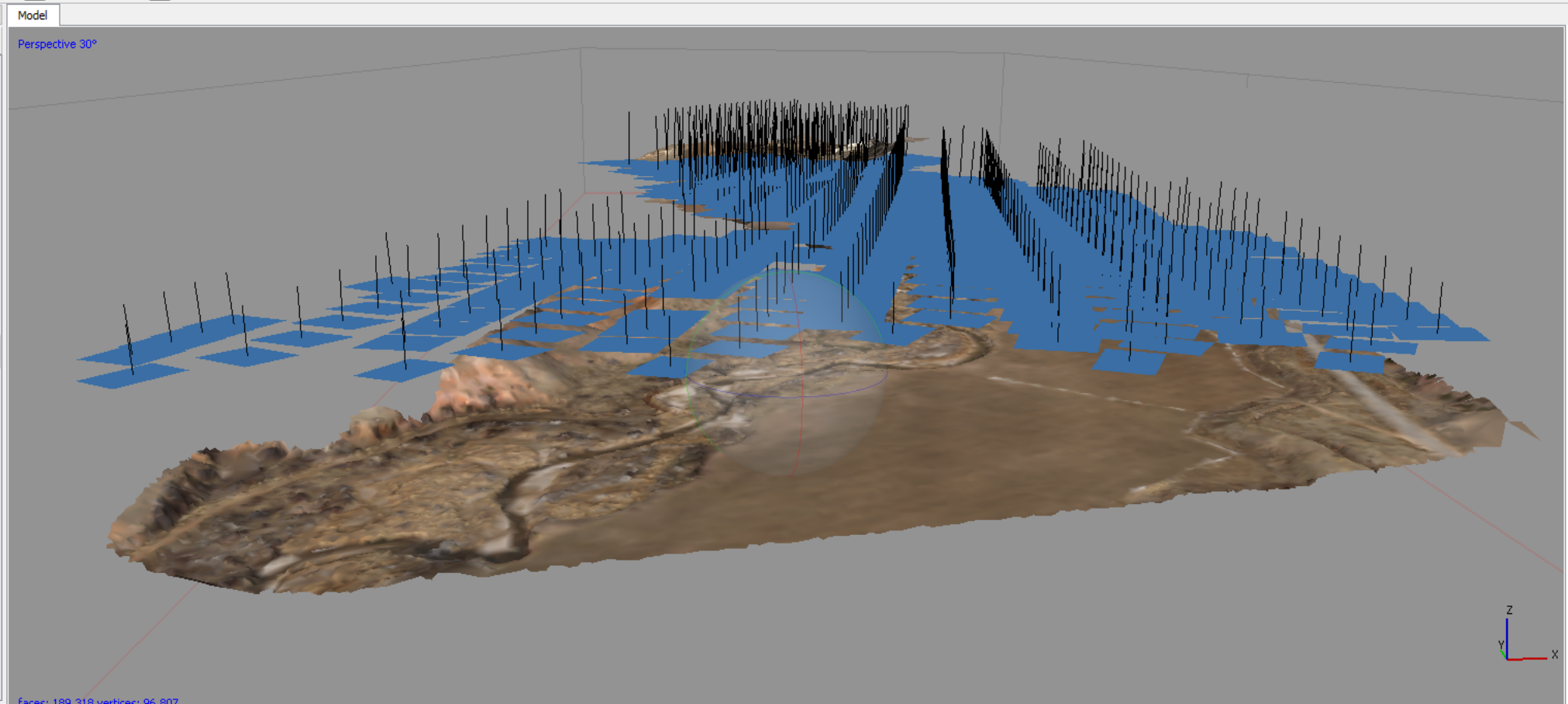




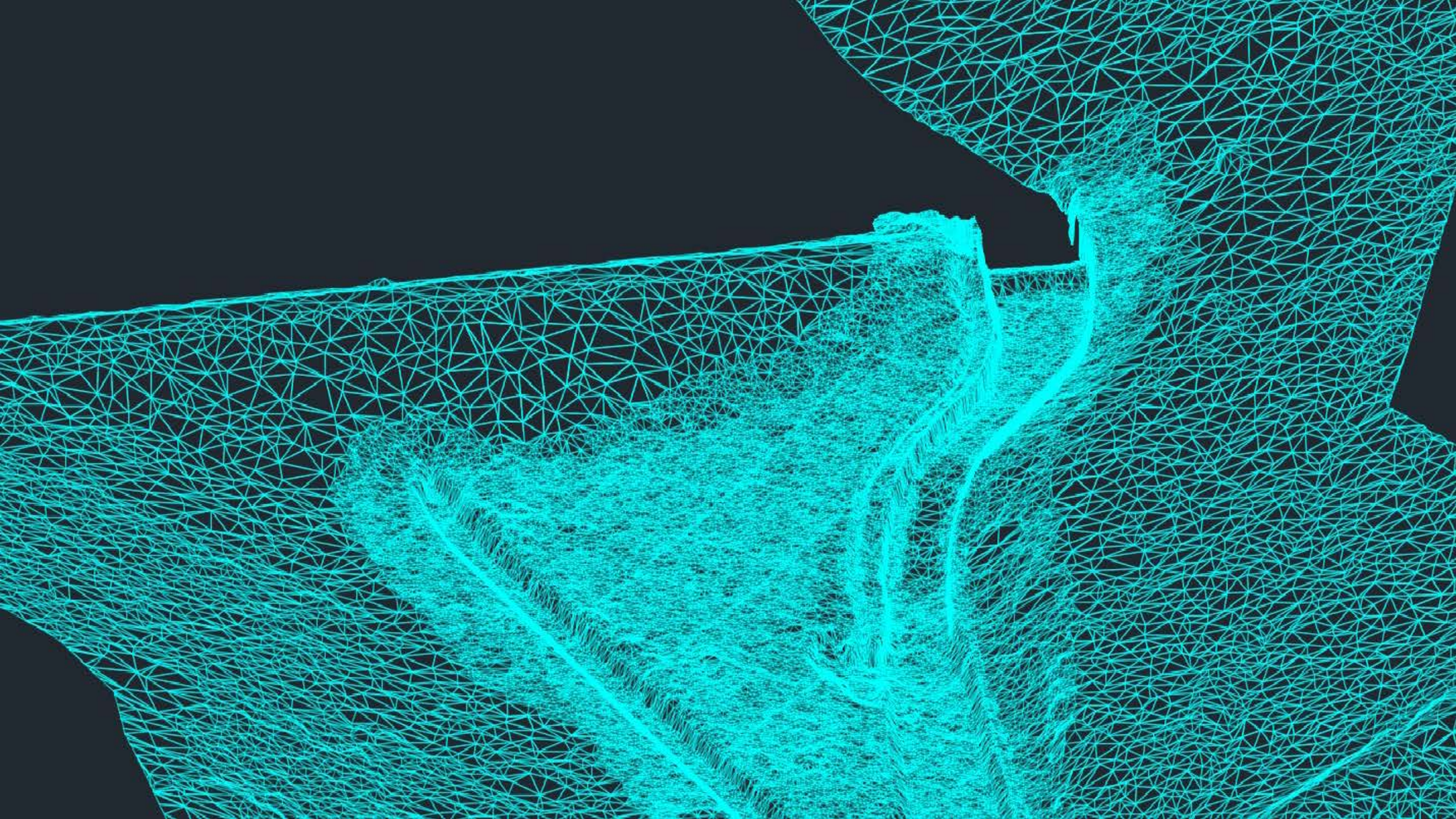
Whoa.

Look at all this Data!

- Workspace
- 20151124_MedLod_F4_0266.JPG
 - 20151124_MedLod_F4_0267.JPG
 - 20151124_MedLod_F4_0268.JPG
 - 20151124_MedLod_F4_0269.JPG
 - 20151124_MedLod_F4_0270.JPG
 - 20151124_MedLod_F4_0271.JPG
 - 20151124_MedLod_F4_0272.JPG
 - 20151124_MedLod_F4_0273.JPG
 - 20151124_MedLod_F4_0274.JPG
 - 20151124_MedLod_F4_0275.JPG
 - 20151124_MedLod_F4_0276.JPG
 - 20151124_MedLod_F4_0277.JPG
 - 20151124_MedLod_F4_0278.JPG
 - 20151124_MedLod_F4_0279.JPG
 - 20151124_MedLod_F4_0280.JPG
 - 20151124_MedLod_F4_0281.JPG
 - 20151124_MedLod_F4_0282.JPG
 - 20151124_MedLod_F4_0283.JPG
 - 20151124_MedLod_F4_0284.JPG
 - 20151124_MedLod_F4_0285.JPG
 - 20151124_MedLod_F4_0286.JPG
 - 20151124_MedLod_F4_0287.JPG
 - 20151124_MedLod_F4_0288.JPG
 - 20151124_MedLod_F4_0289.JPG
 - 20151124_MedLod_F4_0290.JPG
 - 20151124_MedLod_F4_0291.JPG
 - 20151124_MedLod_F4_0292.JPG
 - 20151124_MedLod_F4_0293.JPG
 - 20151124_MedLod_F4_0294.JPG
 - 20151124_MedLod_F4_0295.JPG
 - 20151124_MedLod_F4_0299.JPG
 - 20151124_MedLod_F4_0300.JPG
 - 20151124_MedLod_F4_0301.JPG
 - 20151124_MedLod_F4_0302.JPG







What we Learned in our First year as a Commercial UAS Operator...

- ✓ UAS have tremendous upsides and almost unlimited applications.
- ✓ Follow the rules. Rules are good.
- ✓ Get UAS insurance.
- ✓ Evaluate each project before committing to UAS.
- ✓ Select the appropriate UAS for each site.
- ✓ Be prepared for data. Lots of data.



QUESTIONS?

CONTACT:

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