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Ontario

Report

Calder Property

Drone Magnetometer Survey

Prepared for:

C. Villeneuve Construction Co. Ltd.

By:

UAV Timmins
204-70C Mountjoy Street North
Timmins, ON
P4N 4V7

September 25, 2017

Table of Contents

Introduction

Calder Property is held by C. Villeneuve Construction Co. Ltd.
UAV Timmins was hired on a contract basis to carry-out a magnetometer survey across the property.

In August 2017, Calder Property was surveyed using a state-of-the-art ***drone magnetometer system***. Prior to the magnetic survey, drone was used to generate a ***3D model*** of the terrain. Air photos collected across the property were further used to generate a detailed ***air photo mosaic***.

- The 3D terrain model was used for designing the drone magnetometer grid and as an aid for interpreting magnetic data.

- The air photo mosaic was used as an aid for interpreting magnetic data, general planning and to identify cultural features within the survey.

Property Description

Claim Number **4273996** is a 2-unit claim located in Calder Township, Porcupine Mining Division, approximately 80km driving distance from Timmins.

Refer to ***Figure 1*** (Location and Access map) for more detailed claim location.

Access

The property was accessed from Timmins by travelling north on Hwy655 to the intersection with Hwy 11, then East on Hwy11 to the property, as shown on ***Figure 1*** (Location and Access map).

Nearby Deposits

Calder property sits 42km NNW of the Bradshaw Gold Deposit (MDI42A11NE00007) and 46km North of Kidd Creek Mine (MDI42A11NW00002).

The location of Bradshaw Deposit and Kidd Creek Mine are included on ***Figure 1*** (Location and Access map).

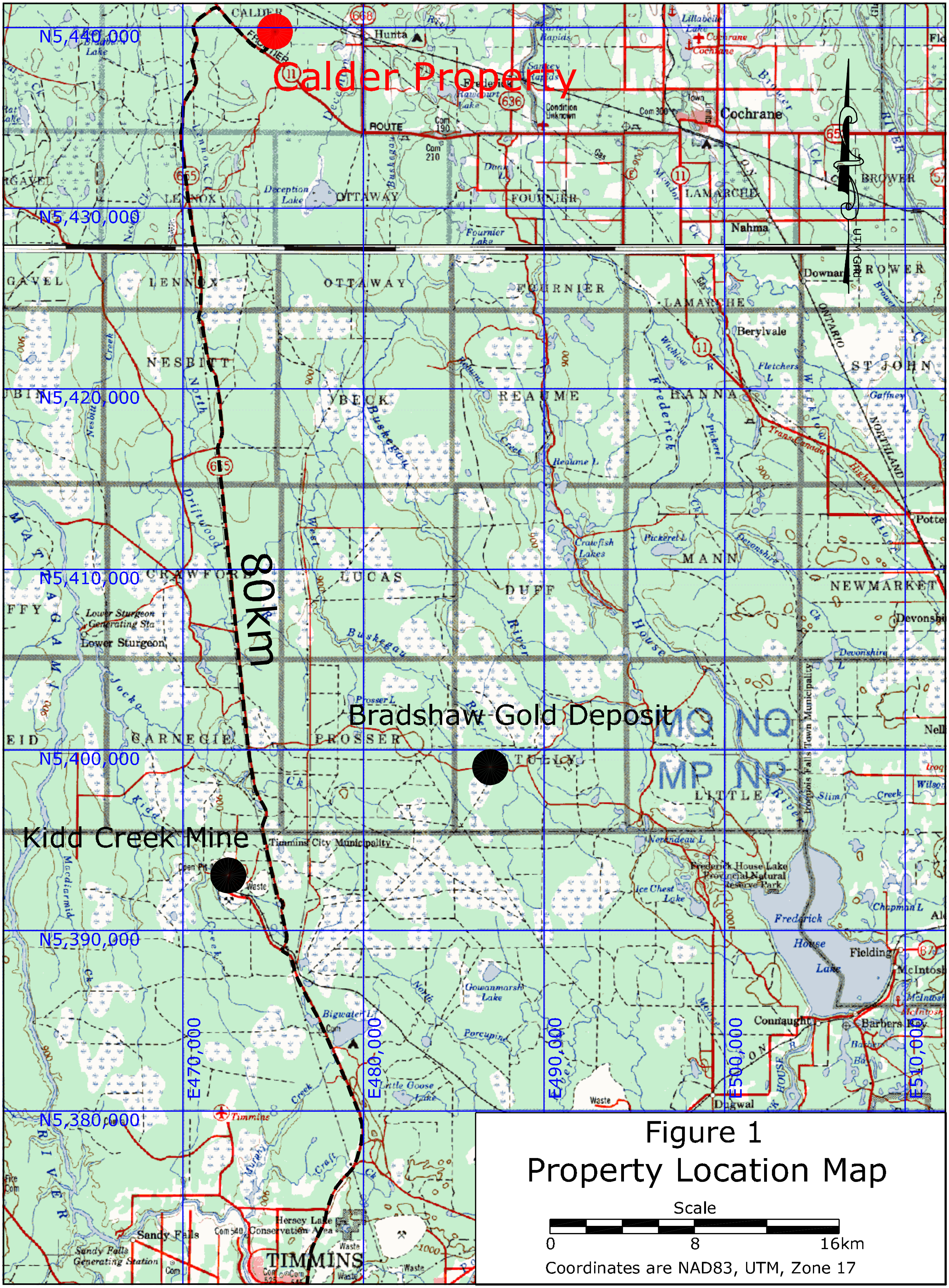


Figure 1
Property Location Map

Work Program - Overview

The work program is summarized in 8 steps below;

1) Survey the property using drone to generate a 3D digital surface model (DSM) and high-resolution air photo mosaic. Ground control points (GCPs) were installed on the ground prior to survey.
2) Survey GCP locations to centimeter accuracy using Ashtec GPS.
3) Process the drone survey to generate DSM and air photo mosaic.
4) Use DSM to identify obstacles to avoid during mag survey.
5) Use air photo mosaic to identify a suitable take-off / landing spot for drone mag survey.
6) Drone magnetometer grid was designed and flown at an altitude of **32** metres above take off (ATO), in order to clear tallest trees.
7) Process magnetic data and generate colourized contour map.
8) Use the high-resolution air photo mosaic to identify cultural features that could affect mag readings.

Work Program - Details

Drone Survey (Step 1 above)

Calder Property was flown on August 21, 2017 using a DJI Matrice 600 Pro hexacopter drone. A total of 141 digital air photos were taken in a grid pattern across the property.

Air photo images were processed using Pix4D software to generate a ***digital surface model*** (DSM) and high-resolution air photo mosaic.

Ground control points (GCPs) were installed on the ground prior to survey. GCPs are 8” spikes marked by a 1m X 1m florescent target. They are used as precise control points during processing by Pix4D.

Specifications for the M600 drone are found in ***Appendix 1***.
A list of 141 air photo images is provided in ***Appendix 2***.

Survey GCP locations (Step 2 above)

GCP locations were surveyed on August 23, 2017 using Ashtec survey-grade GPS receivers.

Data collected on GCP1 was processed using CSRS (Canadian Spatial Reference System) online PPP utility. GCP2 and GCP3 were post-processed to sub-centimetre accuracy using Ashtec software.

Resulting GCP coordinates are provided below.
Coordinates are NAD83, UTM, Zone 17.
Elevations are in datum CGVD2013.

GCP1
N5439754.87 E475044.67 El. 285.68

GCP2
N5440022.82 E475304.86 El. 290.17

GCP3
N5439844.94 E475348.86 El. 295.85

Specifications for Ashtec Promark 2 receivers are found in ***Appendix 3***.

Process drone survey (Step 3 above)

Pix4D software was used to generate the DSM and air photo mosaic. Surveyed GCP locations were used to accurately position the DSM and air photo mosaic.

Elevations derived from the DSM, along with the air photo mosaic are shown in ***Figure 2***.

Figure 2

Calder Property

Surveyed Aug 21, 2017

Scale

0 20 50 100m

291.20 Take-off / Landing location for drone magnetometer survey

313.26 Obstacle (tall trees) to avoid during magnetometer survey

GCP1 Ground Control Point surveyed Aug 23, 2017
(control point coordinates included in report)

Coordinates are NAD83, UTM, Zone 17 (CSRS)
Elevations are CGVD2013 (CSRS)

DSM used to identify obstacles (Step 4 above)

Elevation data from the DSM was contoured using Quicksurf software. Within the extents of Calder Property, terrain elevations vary between **278.89m** and **313.26m** (Elevations expressed in CGVD2013 datum).

Seven of the tallest trees are plotted on ***Figure 2***.
The small (magenta) blips within tree markers are DSM contour lines generated by Quicksurf. Contouring was constrained to highlight features between elevations 313.26m and 310.0m.

Take-off / Landing spot (Step 5 above)

The air photo mosaic was used to identify a suitable take-off / landing spot, to be used for drone magnetometer survey.

The DSM was used to obtain accurate elevation of the landing spot (291.20m), as shown on ***Figure 2***.

Drone Magnetometer grid (Step 6 above)

The drone magnetometer grid was designed and flown at **32m** above take off (ATO).

313.26m Elevation – Tallest tree
291.20m Elevation – Take-off / Landing spot

22.06m - difference

A safety margin of ***10m*** altitude was added.
Altitude for the magnetometer grid was set at ***32m*** ATO.

Figure 2 presents above elevations on 1 map.

Establishing the lowest-possible grid altitude using DSM and air photo mosaic provides highest-possible resolution for the drone magnetic survey. This degree of planning would not be possible using resources such as Google Earth or publicly-available elevation models.

Mag Data (Step 7 above)

The magnetometer survey was flown on August 25th and 26th, 2017.
A Geometrics G856AX proton procession magnetometer was operated as a base station throughout the survey to provide diurnal correction.

The drone magnetometer system operated by UAV Timmins, consists of a lightweight Geometrics MFAM (Micro Fabricated Atomic Magnetometer) adapted to fly on DJI M600 drone.

Figure 3 presents a colourized, total field contour map.
Figure 4 presents the flight path (grid).
Figure 5 presents posted mag readings.

Figures 3, 4 and 5 are presented in sequence on the next 3 pages of this report

Specifications for MFAM are found in ***Appendix 4***.
Specifications for M600 drone are found in ***Appendix 1***.
Specifications for G856AX are found in ***Appendix 5***.
System components are summarized in ***Appendix 6***.

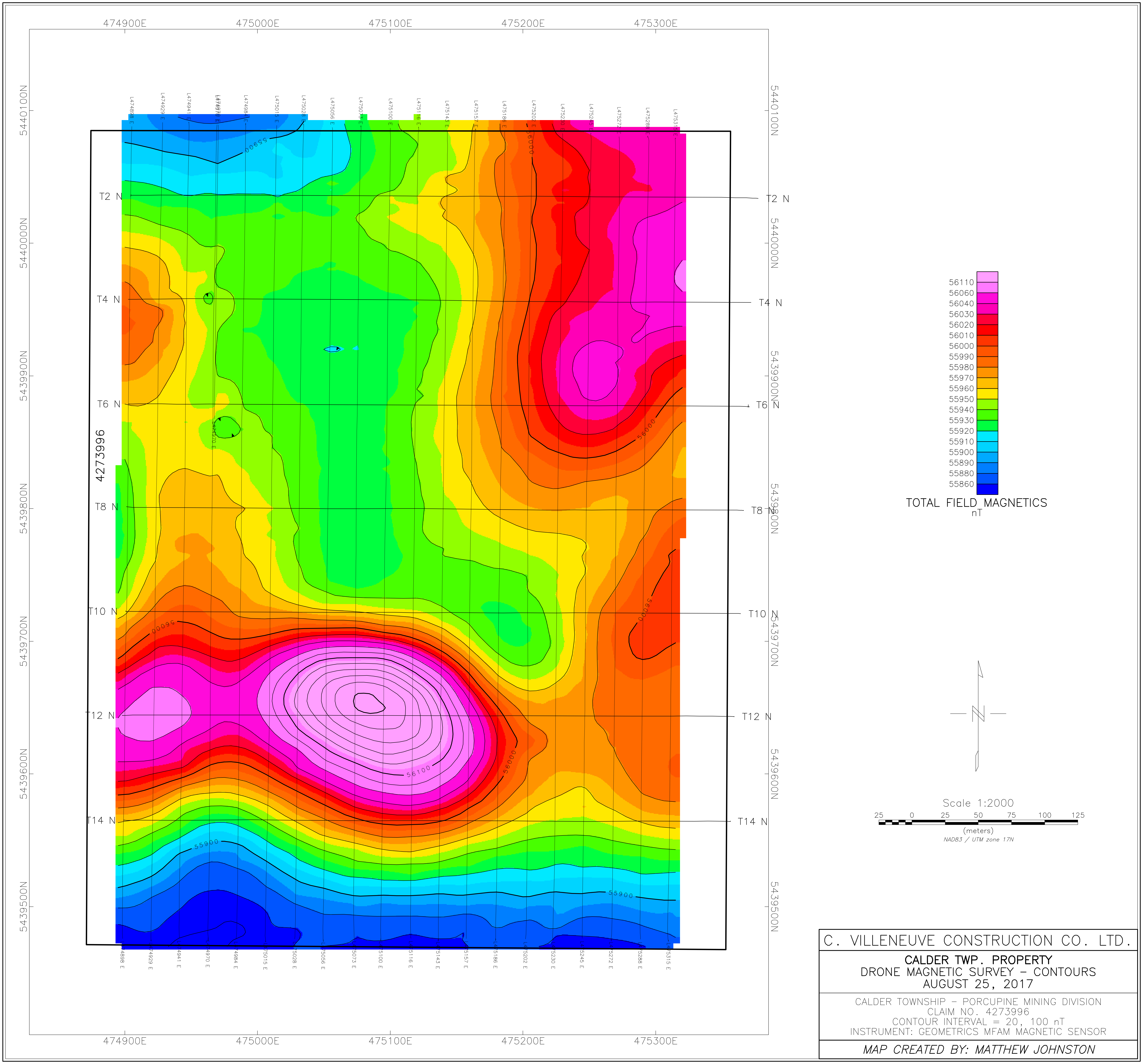
Cultural features identified from air photo mosaic (Step 8 above)

Figure 6 identifies four (4) cultural features that could affect magnetometer readings. Features were identified from the high-resolution air photo mosaic. The 4 features are addressed in ***Results / Interpretation*** section below.

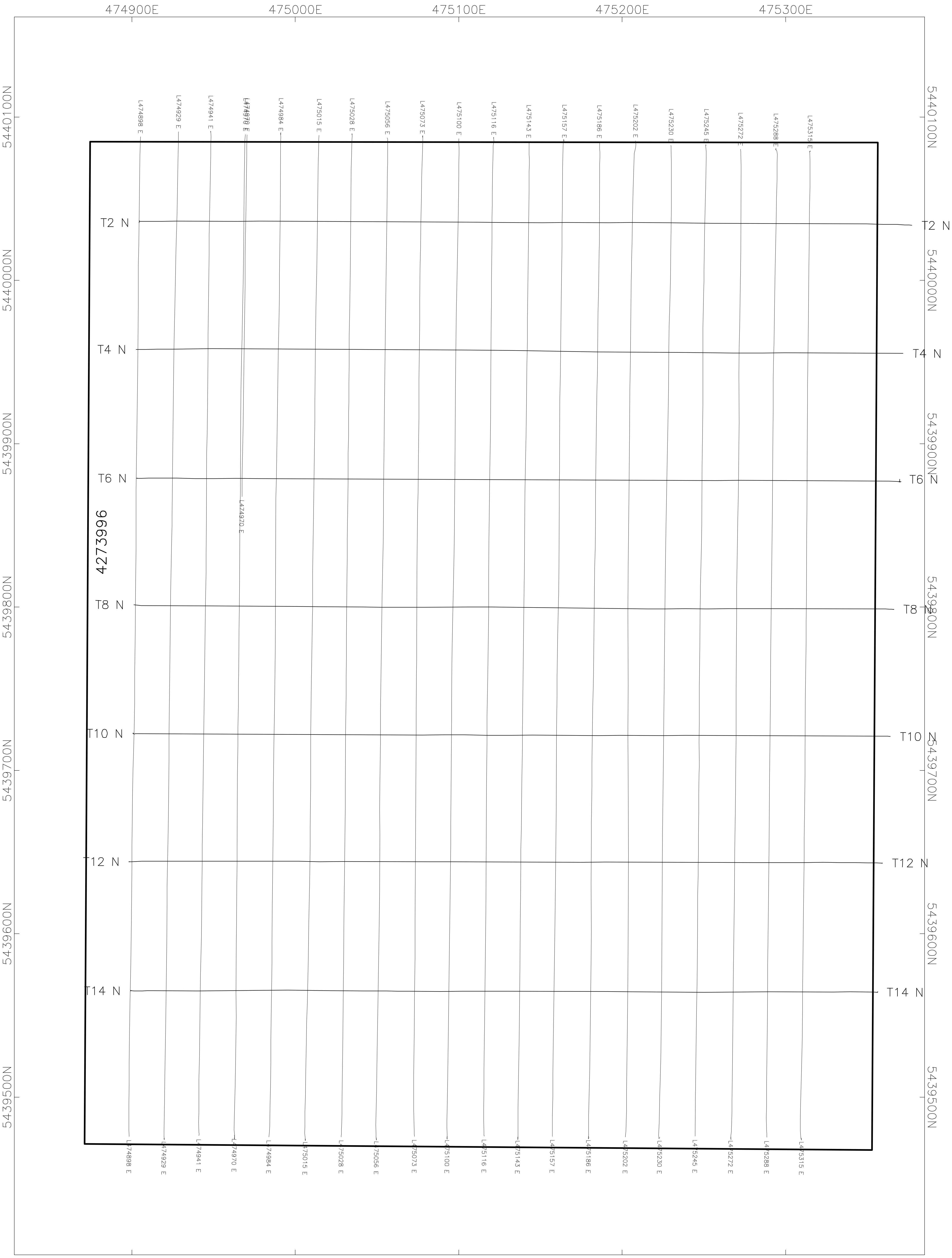
Work Dates and Supervision

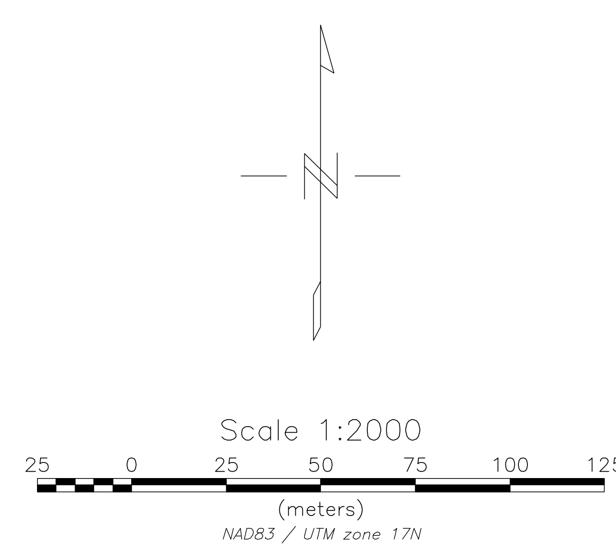
08-21-17 – Installed ground targets (GCPs)
08-21-17 – Drone air photo mapping
08-23-17 – Surveyed ground targets using Ashtec Promark 2 GPS
08-24-17 – Process drone mapping / computer work
08-25-17 – Magnetometer survey (tie lines)
08-26-17 – Magnetometer survey (grid lines at 25m spacing)
08-28-17 – Data processing. Process mag data
08-29-17 to 09-22-17– Report writing and prepare figures

All field work and report preparation was handled by Kevin Cool. Author qualifications are included in ***Appendix 7***.



474900E
475000E
475100E
475200E
475300E
5440100N
5440000N
5439900N
5439800N
5439700N
5439600N
5439500N
T2 N
T4 N
T6 N
T8 N
T10 N
T12 N
T14 N
4273996
55900
56000
56100
56110
56060
56040
56030
56020
56010
56000
55990
55980
55970
55960
55950
55940
55930
55920
55910
55900
55890
55880
55860
TOTAL FIELD MAGNETICS
nT
Scale 1:2000
25 0 25 50 75 100 125
(meters)
NAD83 / UTM zone 17N
C. VILLENEUVE CONSTRUCTION CO. LTD.
CALDER TWP. PROPERTY
DRONE MAGNETIC SURVEY - CONTOURS
AUGUST 25, 2017
CALDER TOWNSHIP - PORCUPINE MINING DIVISION
CLAIM NO. 4273996
CONTOUR INTERVAL = 20, 100 nT
INSTRUMENT: GEOMETRICS MFAM MAGNETIC SENSOR
MAP CREATED BY: MATTHEW JOHNSTON



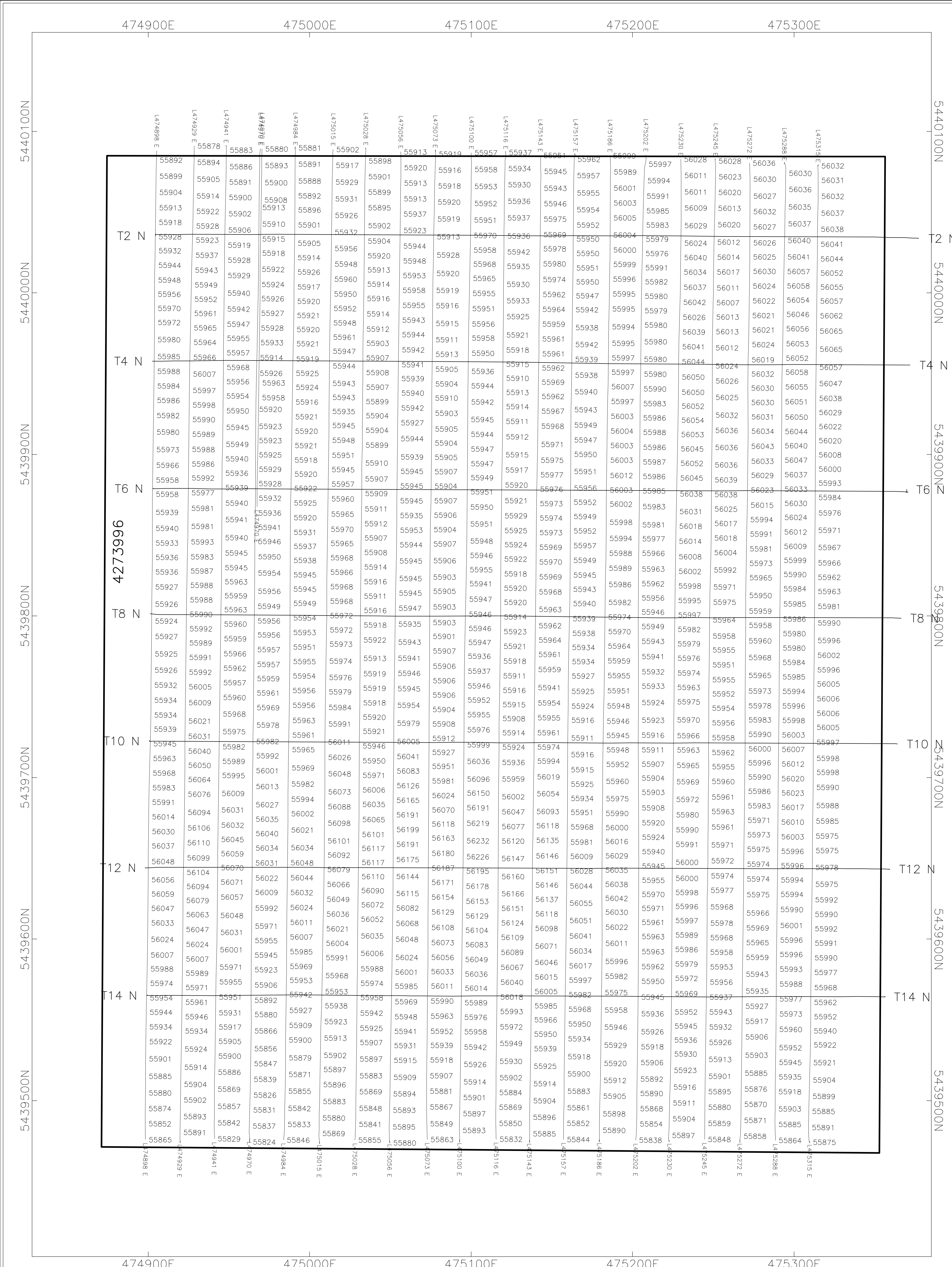


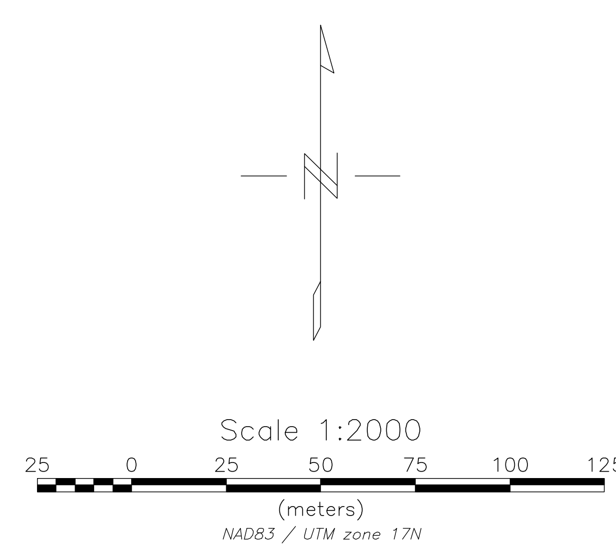
C. VILLENEUVE CONSTRUCTION CO. LTD.

CALDER TWP. PROPERTY
DRONE MAGNETIC SURVEY – FLIGHT PATH
AUGUST 25, 2017

CALDER TOWNSHIP – PORCUPINE MINING DIVISION
CLAIM NO. 4273996
NAD 83 ZONE 17
INSTRUMENT: GEOMETRICS MFAM MAGNETIC SENSOR

MAP CREATED BY: MATTHEW JOHNSTON





C. VILLENEUVE CONSTRUCTION CO. LTD.

CALDER TWP. PROPERTY
DRONE MAGNETIC SURVEY - POSTED DATA 10 Hz.
AUGUST 25, 2017

CALDER TOWNSHIP - PORCUPINE MINING DIVISION
CLAIM NO. 4273996
MAGNETIC REFERENCE FIELD: 56000 nT.
INSTRUMENT: GEOMETRICS MFAM MAGNETIC SENSOR

MAP CREATED BY: MATTHEW JOHNSTON

Grid Information

The final magnetometer survey consists of 20 north-south grid lines (length 615m) at 25m spacing and 7 east-west tie lines (length 480m) at 79m spacing. The total distance flown over the entire survey was 15,660m (15.7km).

Results / Interpretation

An obvious magnetic-high sits at N5439650 / E475075.
Weighing-in the DSM (elevated topography at same location) this magnetic feature likely indicates elevated bedrock, or at least thinner overburden.

Supporting this interpretation, is a weaker / broad magnetic-high that appears to coincide with the stripped and cleared area in NE corner of the property.

The culvert at N5439569 / E474871 did not have any effect on mag data.

The culvert at N5439938 / E475242 sits within the broad magnetic-high on NE corner of property.

The 2 parked vehicles (shown on ***Figure 6***) also sit within the same, broad magnetic high on NE corner of property.

Magnetic-low areas (Southern edge of property and NW area) likely indicate bedrock depressions and / or thicker overburden.

Figure 7 presents above features on 1 interpretive map.

Recommendations

Future exploration should focus on the obvious magnetic-high feature that appears to coincide with elevated topography.

Exposed bedrock and / or thinner overburden conditions would allow better access for sampling and geological mapping.

Figure 6
Calder Property
Surveyed Aug 21, 2017

Scale
0 20 50 100m

Culvert — Cultural / ferrous object identified from air photo mosaic

GCP1 — Ground Control Point surveyed Aug 23, 2017
(control point coordinates included in report)

Coordinates are NAD83, UTM, Zone 17 (CSRS)
Elevations are CGVD2013 (CSRS)

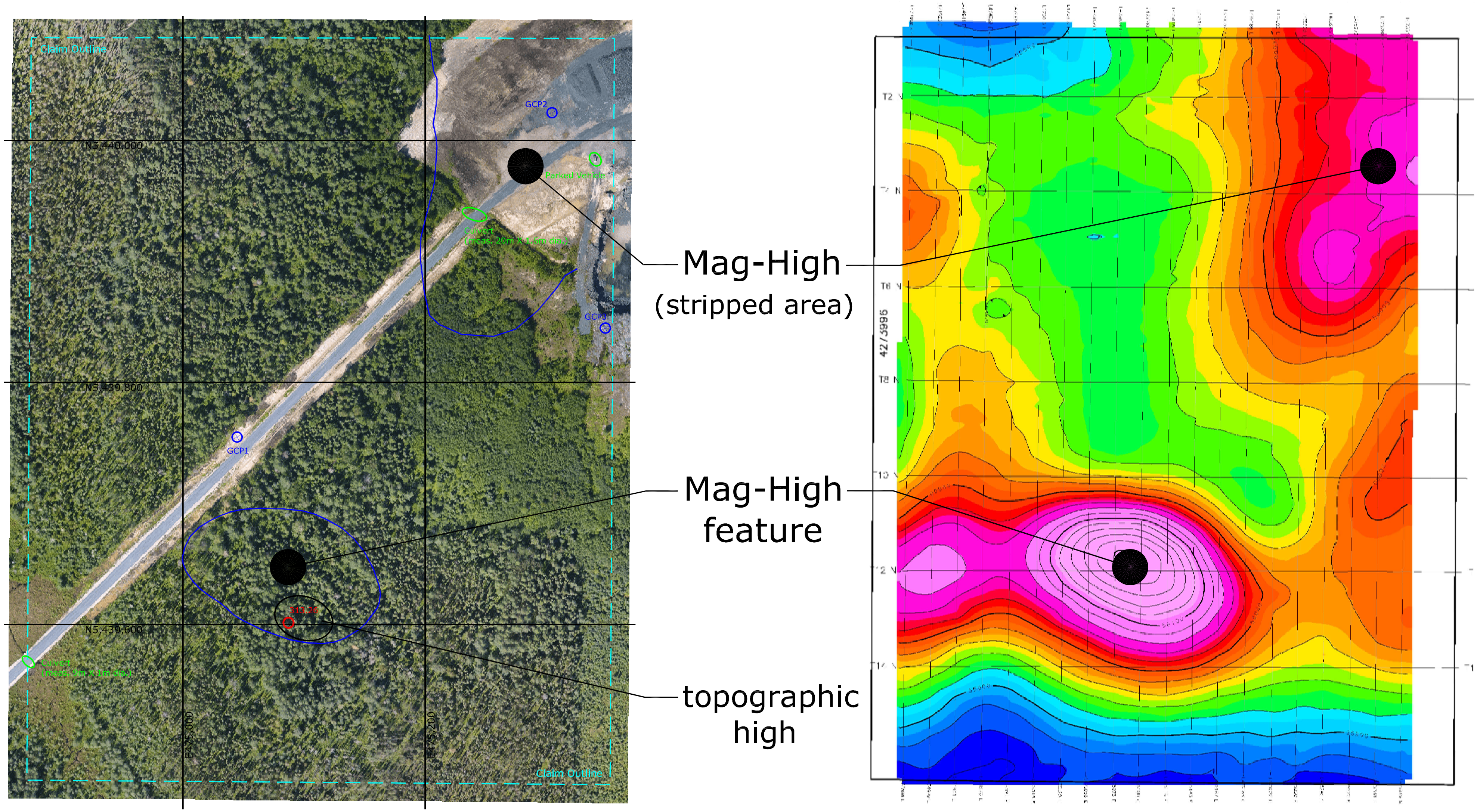


Figure 7
Interpretive Map

Scale

0 40 100 200m

Coordinates are NAD83, UTM, Zone 17 (CSRS)
Elevations are CGVD2013 (CSRS)

Appendix 1 - DJI Matrice 600 Pro Specifications

Specifications

• Aircraft	
Diagonal Wheelbase	1133 mm
Dimensions	1668 mm × 1518 mm × 727 mm with propellers, frame arms and GPS mount unfolded (including landing gear) 437 mm × 402 mm × 553 mm with propellers, frame arms and GPS mount folded (excluding landing gear)
Weight (with six TB47S batteries)	9.5 kg
Weight (with six TB48S batteries)	10 kg
Max Takeoff Weight Recommended	15.5 kg
Hovering Accuracy (P-GPS)	Vertical: ±0.5 m, Horizontal: ±1.5 m
Max Angular Velocity	Pitch: 300°/s, Yaw: 150°/s
Max Pitch Angle	25°
Max Wind Resistance	8 m/s
Max Ascent Speed	5 m/s
Max Descent Speed	3 m/s
Max Speed	40 mph / 65 kph (no wind)
Max Service Ceiling Above Sea Level	2170 propellers: 2500 m, 2195 propellers: 4500 m
Hovering Time* (with six TB47S batteries)	No payload: 32 min, 6 kg payload: 16 min
Hovering Time* (with six TB48S batteries)	No payload: 38 min, 5.5 kg payload: 18 min
Flight Control System	A3 Pro
Supported DJI Gimbals	Ronin-MX; ZENMUSE™ Z30, Zenmuse X5/X5R, Zenmuse X3, Zenmuse XT, Zenmuse Z15 Series HD Gimbal: Z15-A7, Z15-BMPCC, Z15-5D III, Z15-GH4
Retractable Landing Gear	Standard
Operating Temperature	14° to 104° F (-10° to 40° C)
• Remote Controller	
Operating Frequency	920.6 MHz to 928 MHz (Japan); 5.725 GHz to 5.825 GHz, 2.400 GHz to 2.483 GHz
Max Transmission Distance	FCC Compliant: 3.1 mi (5 km), CE Compliant: 2.2 mi (3.5 km) (Unobstructed, free of interference)
Transmitter Power (EIRP)	10 dBm @ 900M, 13 dBm @ 5.8G, 20 dBm @ 2.4G
Video Output Port	HDMI, SDI, USB
Operating Temperature	14° to 104° F (-10° to 40° C)
Battery	6000 mAh LiPo 2S
• Charger (Model: MC6S600)	
Voltage Output	26.1 V
Rated Power	600 W
Single Battery Port Output Power	100 W
• Standard Battery (Model: TB47S)	
Capacity	4500 mAh
Voltage	22.2 V
Battery Type	LiPo 6S
Energy	99.9 Wh
Net Weight	595 g
Operating Temperature	14° to 104° F (-10° to 40° C)
Max Charging Power	180 W
• Optional Battery (Model: TB48S)	
Capacity	5700 mAh
Voltage	22.8 V
Battery Type	LiPo 6S
Energy	129.96 Wh
Net Weight	680 g
Operating Temperature	14° to 104° F (-10° to 40° C)
Max Charging Power	180 W

CE1313 RoHS

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

HDMI

DJI incorporates HDMI™ technology. The terms HDMI and HDMI High-Definition Multimedia Interface, and the HDMI Logo are trademarks or registered trademarks of HDMI Licensing LLC in the United States and other countries.

* Hovering time is based on flying at 10 meters above sea level in a no-wind environment and landing with a 10% battery level.

Download the detailed user manual at:
www.dji.com/matrice600-pro

※ This content is subject to change without prior notice.

Appendix 2 - List of 141 air photo images used to prepare air photo mosaic

DATADRIVE1 (E:) ▸ Calder 200m ▸ 101MEDIA

DJI_0001	DJI_0002	DJI_0003	DJI_0004	DJI_0005	DJI_0006
DJI_0007	DJI_0008	DJI_0009	DJI_0010	DJI_0011	DJI_0012
DJI_0013	DJI_0014	DJI_0015	DJI_0016	DJI_0017	DJI_0018
DJI_0019	DJI_0020	DJI_0021	DJI_0022	DJI_0023	DJI_0024
DJI_0025	DJI_0026	DJI_0027	DJI_0028	DJI_0029	DJI_0030
DJI_0031	DJI_0032	DJI_0033	DJI_0034	DJI_0035	DJI_0036
DJI_0037	DJI_0038	DJI_0039	DJI_0040	DJI_0041	DJI_0042
DJI_0043	DJI_0044	DJI_0045	DJI_0046	DJI_0047	DJI_0048
DJI_0049	DJI_0050	DJI_0051	DJI_0052	DJI_0053	DJI_0054
DJI_0055	DJI_0056	DJI_0057	DJI_0058	DJI_0059	DJI_0060
DJI_0061	DJI_0062	DJI_0063	DJI_0064	DJI_0065	DJI_0066
DJI_0067	DJI_0068	DJI_0069	DJI_0070	DJI_0071	DJI_0072
DJI_0073	DJI_0074	DJI_0075	DJI_0076	DJI_0077	DJI_0078
DJI_0079	DJI_0080	DJI_0081	DJI_0082	DJI_0083	DJI_0084
DJI_0085	DJI_0086	DJI_0087	DJI_0088	DJI_0089	DJI_0090
DJI_0091	DJI_0092	DJI_0093	DJI_0094	DJI_0095	DJI_0096
DJI_0097	DJI_0098	DJI_0099	DJI_0100	DJI_0101	DJI_0102
DJI_0103	DJI_0104	DJI_0105	DJI_0106	DJI_0107	DJI_0108
DJI_0109	DJI_0110	DJI_0111	DJI_0112	DJI_0113	DJI_0114
DJI_0115	DJI_0116	DJI_0117	DJI_0118	DJI_0119	DJI_0120
DJI_0121	DJI_0122	DJI_0123	DJI_0124	DJI_0125	DJI_0126
DJI_0127	DJI_0128	DJI_0129	DJI_0130	DJI_0131	DJI_0132
DJI_0133	DJI_0134	DJI_0135	DJI_0136	DJI_0137	DJI_0138
DJI_0139	DJI_0140	DJI_0141			

Appendix 3
Ashtec Promark2 Specifications

Specifications

Table 1.1 lists performance and physical specifications for the ProMark2 system.

Table 1.1 Performance and Physical Specifications

Parameter	Specification
GPS survey mode supported	Static, Stop-and-go, kinematic
Survey accuracy (RMS) - Static	Horizontal: 0.005m + 1 ppm Vertical: 0.010m + 2 ppm
Survey accuracy (RMS) – Stop-and-go	Horizontal: 0.012m + 2.5 ppm Vertical: 0.015m + 2.5 ppm
Navigation accuracy (RMS)	<3 m with external antenna (with WAAS) 5 m with internal antenna (with WAAS)
Survey point spacing - Static (vector length)	Up to 20 kilometers Over 20 kilometers possible during periods of low ionospheric activity
Survey point spacing – Stop-and-go (vector length)	Up to 10 kilometers
Observation time - Static	20 to 60 minutes typical, depending upon vector length
Observation time – Stop-and-go	15 seconds typical
Initialization time – Stop-and-go	15 seconds on known points 5 minutes on initializer bar
GPS satellite channels	10
WAAS/EGNOS satellite channels	2
GPS satellite elevation mask	10 degrees
Recording interval	1 – 999 seconds
Operating temperature range	-10 to +60 degrees C
Battery type	2 AA, 1.5 VDC alkaline or lithium, or Rayovac® IC3 rechargeable. Other rechargeable batteries are not recommended.

Appendix 4 - MFAM Specifications

Conventional Commercial Magnetometer

Above: Sensor Package Using MFAM Technology

REVOLUTIONARY SENSOR TECHNOLOGY

Geometrics has recently announced a revolutionary new line of magnetometer products based on recent research in miniaturizing atomic clocks and magnetometers

Advances by Geometrics allow for a 10-fold reduction in size and power consumption without sacrificing performance. New devices soon to be on the market are only about 15cc in size, and require only 2W per sensor. Manufacturing technologies for an additional 10-fold reduction in size and power consumption are in development, and will reach the market in another 18 months.

Recent advances in laser technology and MEMS fabrication techniques, supported by the Defense Advanced Research Projects Agency (DARPA) and the Strategic Environmental Research and Development Program (SERDP) , have led to miniaturized components for atomic clocks and magnetometers. Using its long experience in building field-rugged magnetometers, Geometrics has recently achieved the breakthroughs necessary in sensor and electronics design to bring cost-effective, reliable products to market.

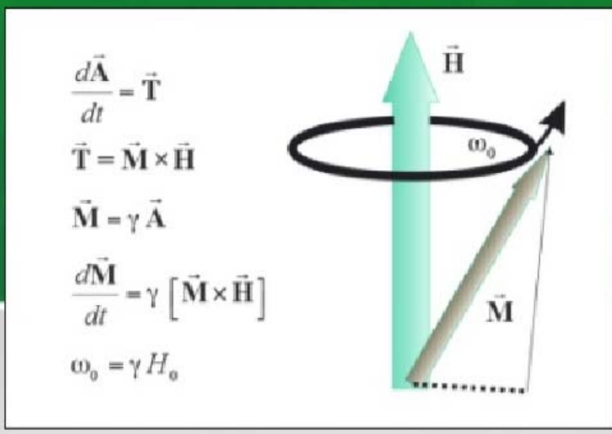
Sensor used on this project

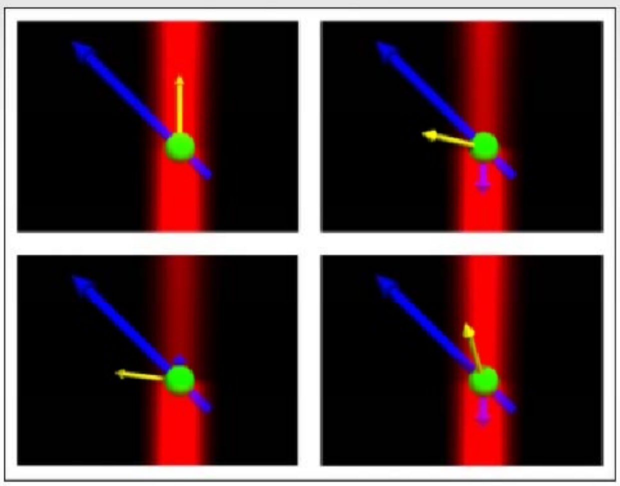
	First Generation	Second Generation	Third Generation
Sensitivity	1 pT / √Hz	2 pT / √Hz	5 pT / √Hz
Power Consumption	2W	1W	0.5W
Size	15cc	1cc	1cc

This advancement in sensing technology will make an enormous impact on sensing and detection applications. Many applications could benefit from lower cost, lower power sensors. Some applications will use a relatively small number of sensors, and others will create demand for a huge number of sensors. These applications and the required production technology must be carefully choreographed for the successful launching of this technology.

> NEXT: Atomic Magnetometers

How Atomic Magnetometers Work





Processing atoms modulate the intensity of a light beam. This is the basic principle of the operation of an atomic magnetometer. The blue arrow represents the magnetic field, while the yellow arrow represents the magnetic moment. At top left, the moment is parallel to the light beam, and does not absorb the light. As the moment precesses, or rotates, around the magnetic field arrow, it absorbs varying amounts of light, thereby modulating the amplitude of the beam.

Atomic magnetometers work by measuring the precession frequency of certain atoms in a magnetic field. Atoms with a magnetic moment may be visualized as spinning tops. A spinning top's angular momentum precesses around the gravitational field vector. Similarly, an atom's magnetic moment precesses around the magnetic field vector, with a frequency proportional to the magnetic field being measured. Since frequency is a quantity that is easy to measure to very high precision, the atomic precession frequency, and therefore the magnetic field, may be determined to very high precision.

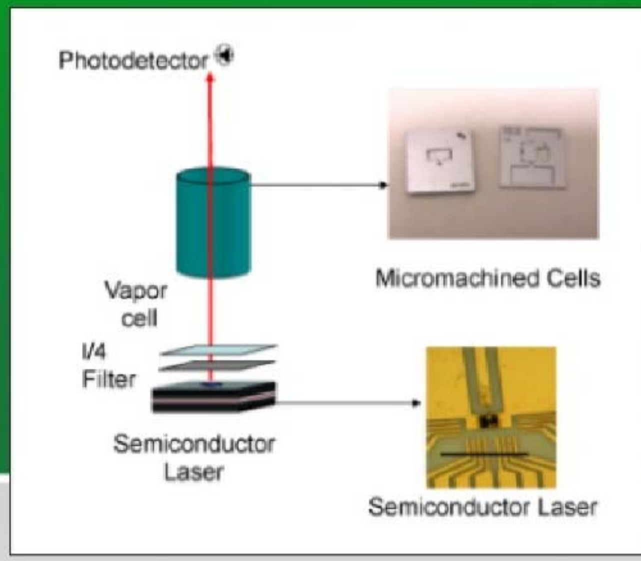
Individual alkali atoms have intrinsic magnetic moments due to their unpaired electron. In a gas, however, these moments are all randomly aligned and therefore cancel each other out at the macroscopic level. In a magnetometer, therefore, the first step required is to create a macroscopic magnetic moment through the mechanism of optical pumping. By shining polarized light through the gas, the magnetic moments of individual atoms tend to become aligned in the same direction (along the light path) and hence a measurable magnetic moment is obtained.

The precession of this magnetic moment around the magnetic field in turn affects the absorption of the light shining through the gas. As the moments precess away from the light direction, they tend to absorb more of the light. In this manner, the frequency of the atomic precession may be measured by the effect it has on the intensity of the light passing through the gas.

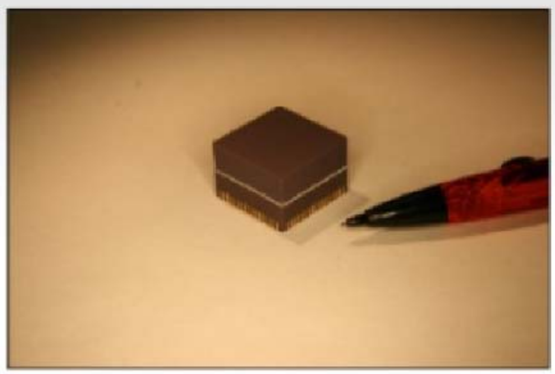
> NEXT: MEMS Technology

MEMS Technology

The components of an atomic magnetometer consist of a cell containing an alkali element such as cesium, a source of light of the proper wavelength, and a photocell to detect the intensity of the light. Advances in MEMS fabrication have led to the ability to inexpensively create 1mm cubic volumes of cesium gas. Laser diode technology was used to create devices efficiently emitting light of the proper wavelength. MEMS packaging techniques can bring these components into the required arrangement at low cost in high volume.



Wafer Processing



MFAM Prototype

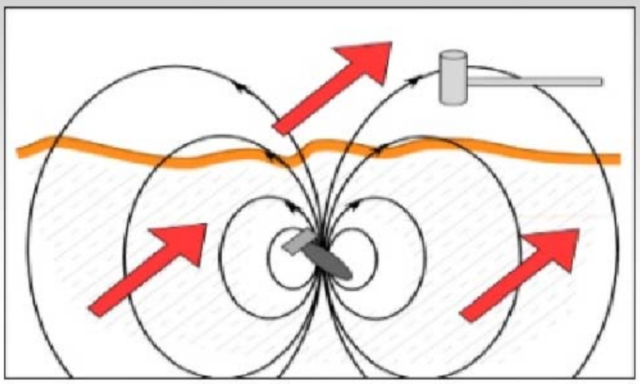
Photos courtesy of Texas Instruments

> NEXT: Advantages

Why Atomic Magnetometers?

Magnetometers have important applications in geophysics and object detection. Ferrous objects or mineral bodies may be passively detected through their influence on the Earth's magnetic field.

Magnetic fields have both a magnitude and direction. Atomic magnetometers are sensitive only to the strength of the magnetic field. Other magnetic sensors, such as fluxgates or magneto-restrictive sensors, are also sensitive to the direction of the magnetic field. Those devices make good compasses, but are poor choices to measure minute differences in the magnetic field from a moving platform. Atomic magnetometers, also known as optically pumped magnetometers, are used almost exclusively when high sensitivity is required from moving platforms.



The Earth itself is effectively the transmitter in magnetometer sensing. Its magnetic field is altered by the presence of ferrous material. These alterations, or anomalies, are detected by a magnetometer.

> NEXT: Applications

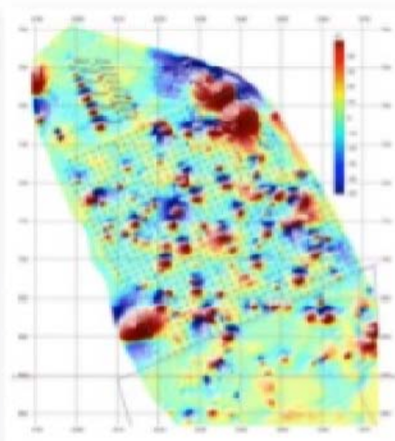
Applications

UXO Detection

Former gunnery ranges and offshore locations in the U.S. and elsewhere contain unexploded ordnance items that were fired for target practice or improperly disposed. A traditional approach to locating such items is known as "Mag and Flag," where operators using crude magnetometers sweep over an area, locating anomalies by the sound the instrument makes, and placing a flag in the location of an anomaly.

More modern is the "Digital Geophysics" method, where data is gathered over the field, stored, and later analyzed. Maps and tables are then made of the anomaly locations.

While digital geophysics provides a more accurate and comprehensive mapping of targets, its drawback is that the process takes several days. A real-time instrument could pinpoint anomalies in real time, yet be as light-weight and low-power as the simple "Mag-and-Flag" devices.



Tunnel Detection and Perimeter Security

Tunnels crossing national borders or the perimeter of secure installations are another problem that can be addressed by magnetometers. The tunnels themselves are difficult to detect, but activity within the tunnels often creates or disturbs the magnetic field and can readily be detected. For this application, long arrays of magnetometers are required in order to cover the entire perimeter of an installation or along a border. Clearly, devices need to be small, low power, and less expensive for this application.

Unattended Ground Sensors

Unattended Ground Sensors are systems used by the military for monitoring purposes. Such systems may contain a camera, seismic sensors, magnetometers, and other devices to detect movement. These devices require extremely low power sensors, as they may be required to operate over a long period of time. The communications and processing systems may be of a slightly larger power consumption, as they may be placed in a sleep mode when no activity is present. The sensors themselves, however, must operate continuously, and therefore require a very low power consumption. As advances in communications and processing capabilities are made, it is envisioned that these devices could be broadcast from airborne platforms in large quantities to monitor potentially hostile territory. This would provide a market for a huge number of sensors, which would drive their production cost down.

Unmanned Vehicle Deployment

There is increasing interest in Unmanned Aerial Vehicle (UAV) platforms for carrying sensors across survey areas. Such vehicles offer the potential for high productivity, greater safety, and significantly lower cost over other survey methods. Clearly, MFAM sensors would greatly increase the practicality of UAV platforms, due to their smaller size, causing less interference with the aerodynamics of the flight platform, and their lower power requirement, greatly reducing the battery size and weight.

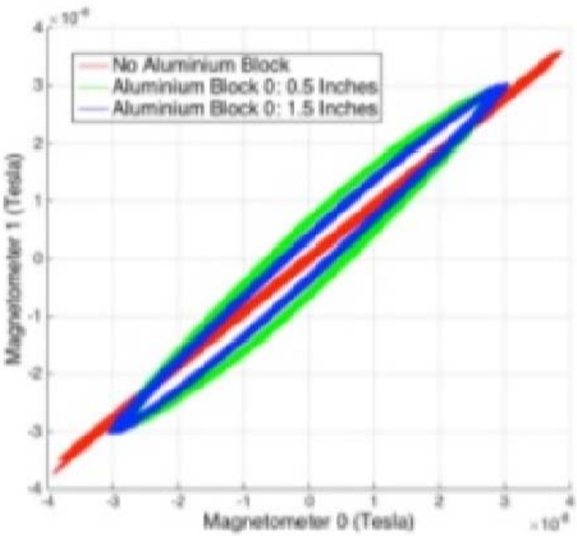
Eddy Current Measurement

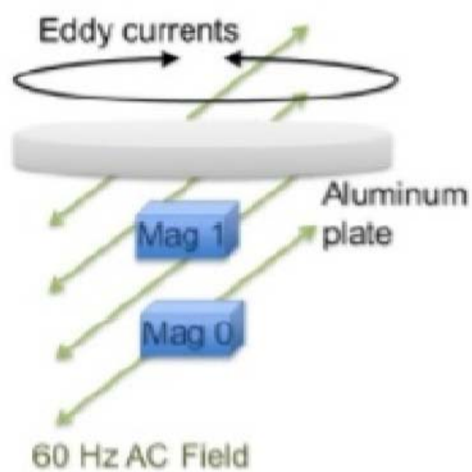
The MFAM sensors also provide exceptional spatial and temporal resolution. We now have the technology to revolutionize magnetic sensing. Here are some examples of the amazing performance benefits of the small size of these sensors.

These sensors output field readings at 1000 Hz. This leads to some fascinating observations. For instance, waveforms from power lines can be fully observed and filtered, if desired, not just aliased into a lower frequency. Such aliasing typically produces strange artifacts and noise. We can even measure eddy currents in non-magnetic materials using the ever-present 60 Hz noise as a transmitter.

Changing magnetic fields induce eddy currents in conductive objects. These induced currents produce magnetic fields that are out-of-phase with the field causing them. By making measurements of the out-of-phase component of the magnetic field, we can measure the eddy current. This allows for the sensing of even non-ferrous conductors, something not typically associated with magnetometers.

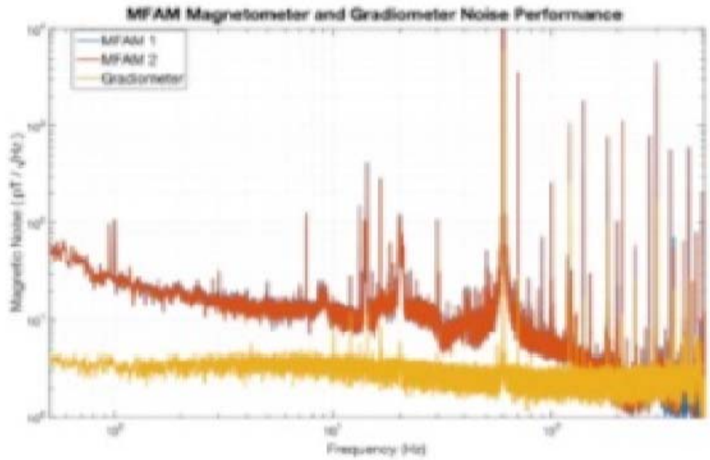
The graph on the left shows the output of one sensor plotted on the horizontal axis, and the other sensor along the vertical axis. This produces Lissajous patterns according to the relative frequency and phase of the two readings. In this case the frequencies are the same, so we get a circular pattern if the two signals are perfectly out of phase, and a line if they are in phase. Elliptical patterns are the result of something in between. We can clearly see the effect as the phase difference between the two signals (caused by the eddy currents) grows larger.





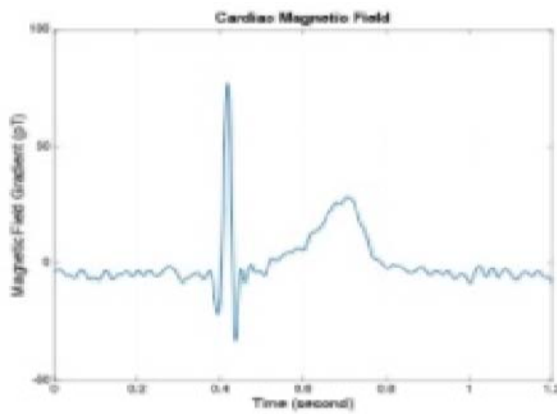
Noise Cancellation in Unshielded Environments

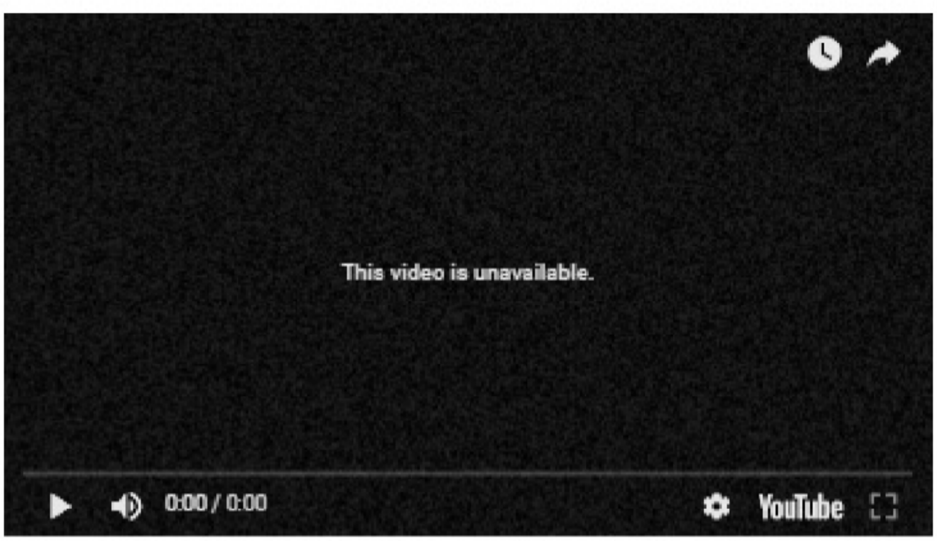
The two sensors can be positioned as close to each other as physically possible. This is made possible by the small size of the sensors and the complete absence of any cross talk between them. This close positioning allows for the measurement and subtraction of background noise to previously unheard of levels. You can reduce the background noise and make measurements to the 1 pT level, even without magnetic shielding!



MCG Signal Measurement

One amazing application of this is the measurement of heart MCG signals. We have demonstrated such measurements in our offices, measuring our own heartbeat signatures. By simply placing one sensor near the heart, and the other sensor on top of the first for background subtraction, magnetic fields from the heart may be measured. Better signal-to-noise ratios are obtained by stacking the data from about 100 heart beats.





APPENDIX 5

Magnetometer Specifications
Geometrics G-856AX

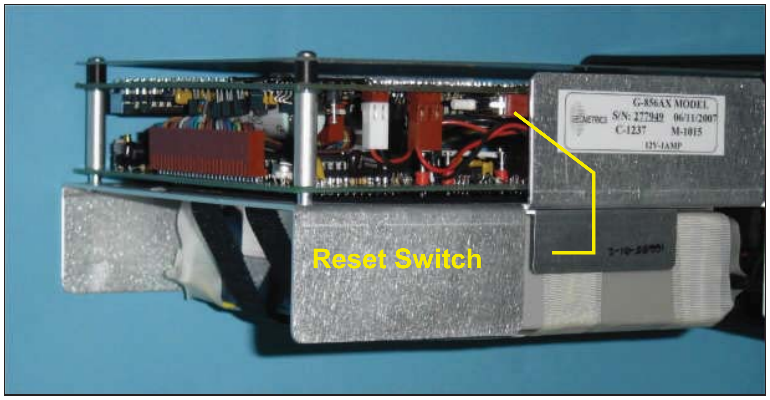


Figure 23. Internal reset switch.

Specifications

- Displays - Six digit display of magnetic field to resolution of 0.1 gamma or time to nearest second. Additional three-digit display of station, day of year, and line number.
- Resolution - Typically 0.1 gamma in average conditions. May degrade to lower resolution in weak fields, noisy conditions or high gradients.
- Absolute accuracy - One gamma, limited by remnant magnetism in sensor and crystal oscillator accuracy.
- Clock - Julian clock with stability of 5 seconds per month at room temperature and 5 seconds per day over the temperature range of -20 to +50 degrees Celsius.
- Tuning - Push button tuning from keyboard with current value displayed on request. Tuning range 20 to 90 μT.
- Gradient - Tolerates gradients to 1800 gammas/meter. When high Tolerance gradients truncate count interval, maintains partial reading to an accuracy consistent with data.
- Cycle Time - Complete field measurement in three seconds in normal operation. Internal switch selection for faster cycle (1.5 seconds) at reduced resolution or longer cycles for increased resolution.
- Manual Read - Takes reading on command. Will store data in memory on command.
- Memory - Stores more than 5700 readings in survey mode, keeping track of

time, station number, line number day and magnetic field reading. In base station operation, computes for retrieval but does not store time of recording designated by sample interval, allowing storage of up to 12,000 readings.

- Output - Plays data out in standard RS-232 format at selectable baud rates. Also outputs data in real time byte parallel, character serial BCD for use with digital recorders.

- Inputs - Will accept an external sample command.

- Special - An internal switch allows:
  - adjustment of Functions polarization time and count time to improve performance in marginal areas or to improve resolution or speed operation
  - three count averaging
  - choice of lighted displays in auto mode.

- Physical -
  - Instrument console: 7 x 10 ½ x 3 ½ inches (18 x 27 x 9 cm), 6 LB (2.7 kg)
  - Sensor: 3 1/2 x 5 inches (9 x 13 cm), 4 LB (1.8 kg)
  - Staff: 1 inch x 8 feet (3cm x 2.5m), 2 LB (1kg)

- Environmental: Meets specifications from 1 to 40°C. Operates satisfactorily from -20 to 50°C.

- Power - Depending on version, operates from internal rechargeable Gel-cells or 9 D-cell flashlight batteries . May be operated from external power ranging from 12 to 18 volts external power. Power failure or replacement of batteries will not cause loss of data stored in memory.

- Standard system (P/N 16600-02) components:
  - Sensor (P/N 16076-01) and sensor cable (P/N 16134-01)
  - Console (P/N 16601-01)
  - Staff, one top section (P/N 16535-01), two middle sections (P/N 16536-01) and 1 bottom section (P/N 16537-01)
  - Carry harness (P/N 16002-02)
  - Two sets of rechargeable batteries (P/N 16697-01) and battery charger (P/N 16699-01)
  - Carrying case (P/N 16003-01)
  - Download cable (P/N 16492-01)
  - Hardcopy operation manual (P/N 18101-02)
  - Magnetometer CD (P/N 26648-01)

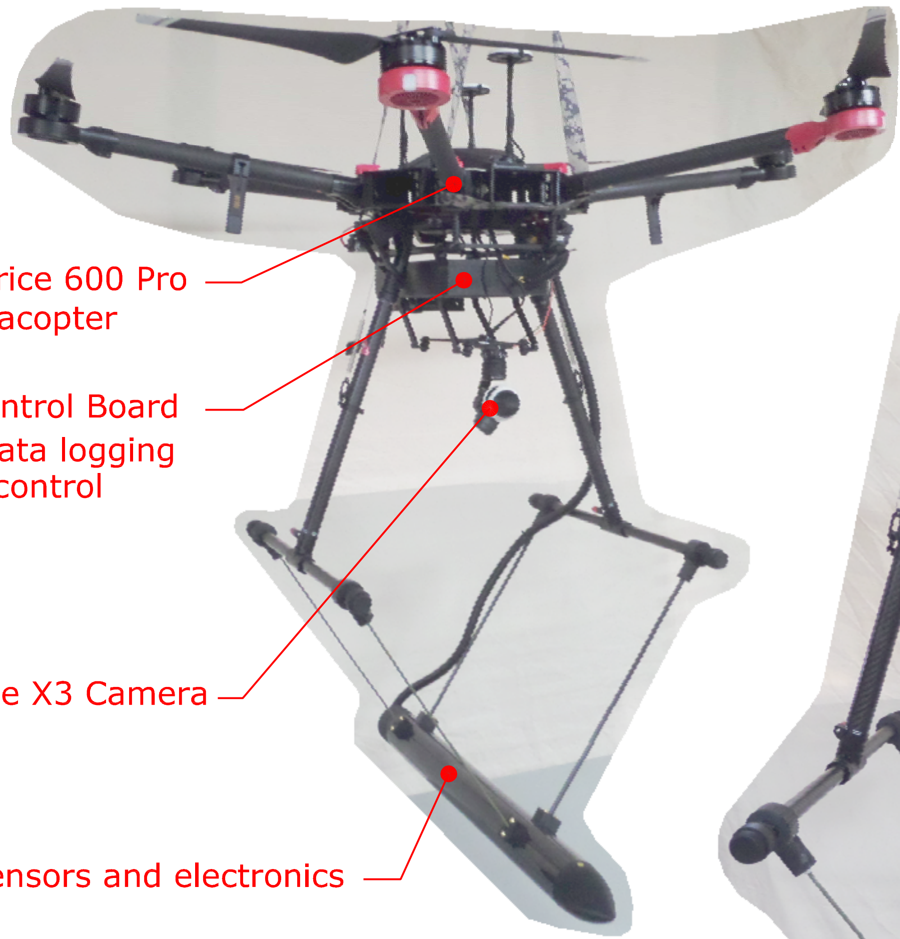
- Optional accessories:
  - Tripod kit for base-station operation (P/N 16708-02)
  - Gradiometer kit (P/N 166651-01)
  - Gradiometer carry/storage case (16003-01)

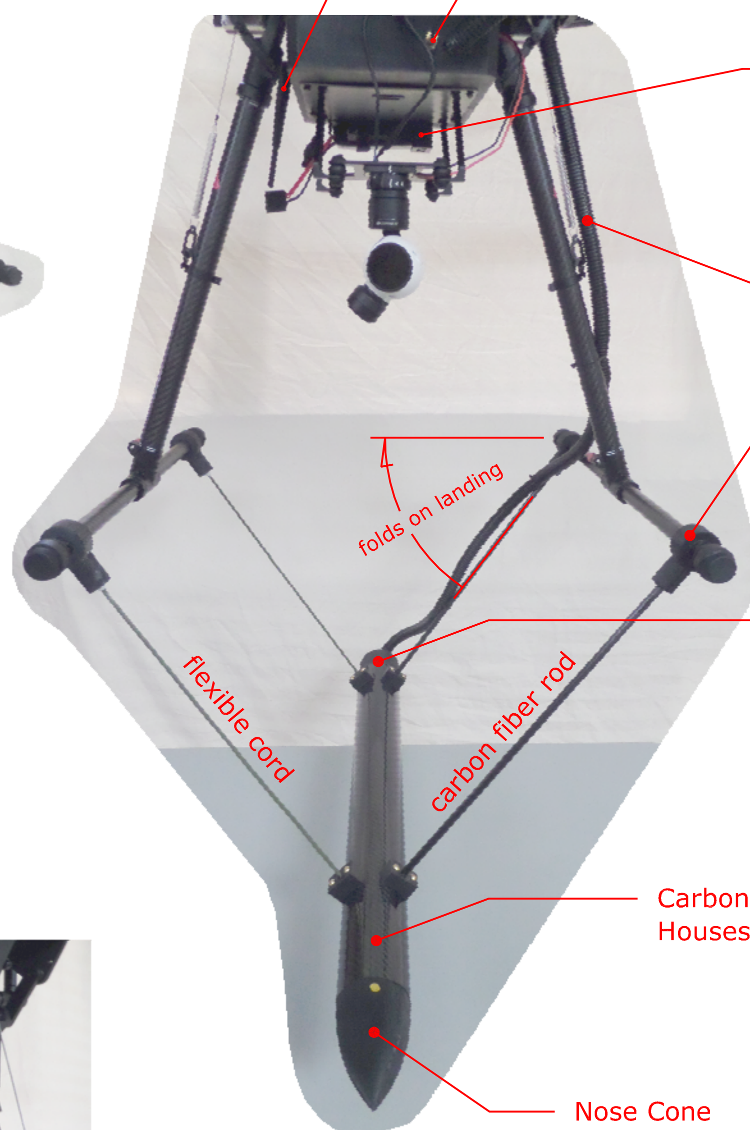
APPENDIX 6

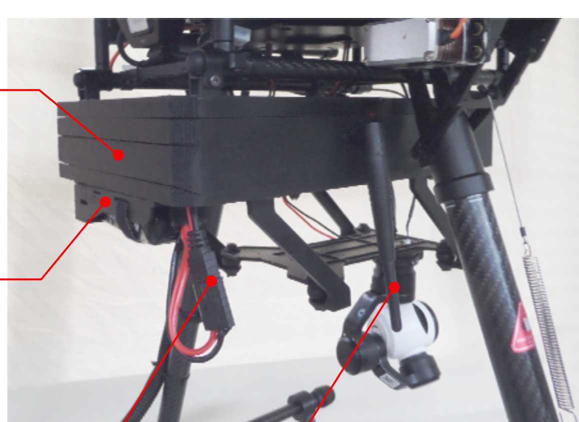
Drone Magnetometer System Components

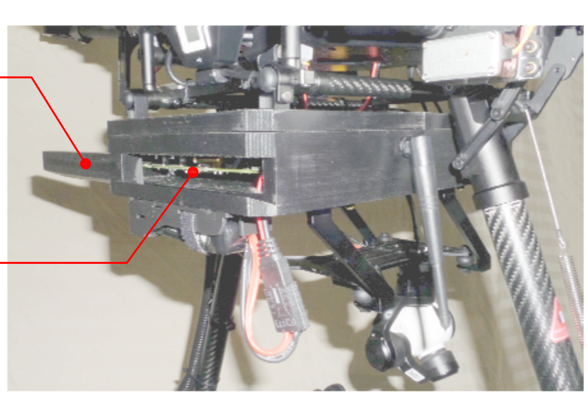
Drone Magnetometer System

Developed by UAV Timmins









System Features:

DJI Matrice 600 Pro hexacopter adapted to carry Geometrics lightweight MFAM magnetometer.

The M600 drone has an operating range of 5 kilometers.
Geometrics MFAM system is attached to the drone using carbon fiber components.
Reduced weight, aerodynamics and careful weight distribution allow flight times of 30+ minutes.

Above system is currently being operated by UAV Timmins in Northern Ontario (Canada).
Email contact: coolkevin305@gmail.com.

Appendix 7

Author: Kevin Cool   Revised June, 2014   **Date corrected from previous version: Rev1Dec28/2008*

Qualifications and Experience

1982 Graduated from Timmins High and Vocational School

1983 Studied photography at Humber College, Toronto, Ontario

1984 to 1988 Worked for family owned transportation business in Moosonee, Ontario

1988 to 1990* Studied Survey at Northern College, South Porcupine, Ontario

1990* Graduated with Survey Engineering Technician Diploma

1990* to 2001

Owned and operated General Surveys and Exploration based in Timmins, Ontario. The company provided contract survey, computer and information management services to the exploration and mining industry. Software includes Acad, Gemcom and Surpac, with specialization in using computers for the mining and exploration industry.

Work included volumetric survey of land areas to be used as tailing basins, where computerized 3D models were utilized. Diamond drillhole, underground engineering and mechanical design/construction surveys were common contracts for mining and exploration companies. Significant accomplishments include the design and construction of the 110km winter road from Attawapiskat to the Victor Project.

Clients included;

DeBeers Canada Exploration (Monopros), Southernera Resources, Dome Exploration, Placer Dome Detour Lake, Musselwhite and Dome Mines, Exall Glimmer Mine, Claude Rundle Gold Mine, TVX Mines' projects in Northern Greece, Moneta Porcupine Mines, Black Pearl Minerals, St. Andrew Goldfields, Battle Mountain Gold, Pentland Firth, Kinross Gold, Band-Ore Resources, McKinnon Prospecting and many other companies and individual prospectors.

2000 to 2005

Began collaborative work with Brian K. Polk (Polk Geological Services) and established a private exploration company called Big Red Diamond Company. This small company began to stake property near Attawapiskat and Coral Rapids. Eventually the survey business was put aside to focus full time on diamond exploration.

Big Red Diamond Company entered into a Joint Venture with a private company owned by Dr. Charles Fipke of Kelowona, B.C. on a group of properties near DeBeers' Victor Project in the Attawapiskat region. Dr. Fipke is the renowned geologist who found Canada's first diamond mine, the Ekati Mine in Northwest Territories.

Since 2001 the author has been exposed to all aspects of diamond exploration including;

Claim staking, field work, camp construction, airborne and ground magnetometer survey, planning and management of large scale geophysical programs, planning, management and interpretation of regional and property scale sampling programs.

Exposure to the industry includes training and field work under the discretion of Dr. Fipke. Introduction to kimberlite mineral identification from Dr. Fipke was expanded by personal research and study, which continues to current and lead to the establishment of True North Mineral Laboratories in Timmins, Ontario.

Advanced analysis, beyond the stage of heavy mineral separation, or observation using binocular microscope, is handled by other certified analytical laboratories, such as *CF Minerals*, of Kelowona, B.C.

2002

Big Red Diamond Company became a publicly traded corporation.

The author is one of the co-founders of Big Red Diamond Corporation, which trades on the TSX Venture Exchange under the symbol DIA.

The author continues to actively stake mining claims and process sample material for private and public companies.

2005 to 2009

Established True North Mineral Laboratories, at 475 Railway Street, Timmins, Ontario and added Actlabs-Timmins in early 2006. Lab processes, equipment setup and procedures are now supervised by Actlabs, based in Ancaster, Ontario.

The management and employees of True North Mineral Laboratories / Actlabs-Timmins, receive ongoing support and training directly from Actlabs - Ancaster. The laboratory processes fall under Actlabs certification, providing analysis is carried out by the main facility in Ancaster. In this capacity, True North Mineral Laboratories acts as a preparation facility for Actlabs and is qualified to handle material preparation prior to direct analysis by Actlabs.

2009 to 2011

Sold prep facility to Cattarello Assayers Inc., who now operate a gold fire assay facility at 475 Railway Street, Timmins. True North Mineral Laboratories opened a small, private facility at 68 Bruce Avenue, South Porcupine in early 2011.

True North Mineral Laboratories utilizes the services of Actlabs and CF Mineral Research, for projects where an accredited laboratory is required. True North Mineral Laboratories continues to offer a wide range of field services to the exploration Industry.

2011 to Current

True North Mineral Laboratories Inc. changed names to ***UAV Timmins*** in June, 2014.

UAV Timmins provides aerial mapping services to mining and exploration companies, along with geochem sampling and other services.

Report Completion Date

Report was completed on September 25, 2017.