UAS for Magnetometry Mapping

PRESENTED BY CRAIG CLOUET AND CRAIG SCHIFFERNS

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Agenda

01 Magnetic Survey Overview

02 UAV Integration

03 Methodology

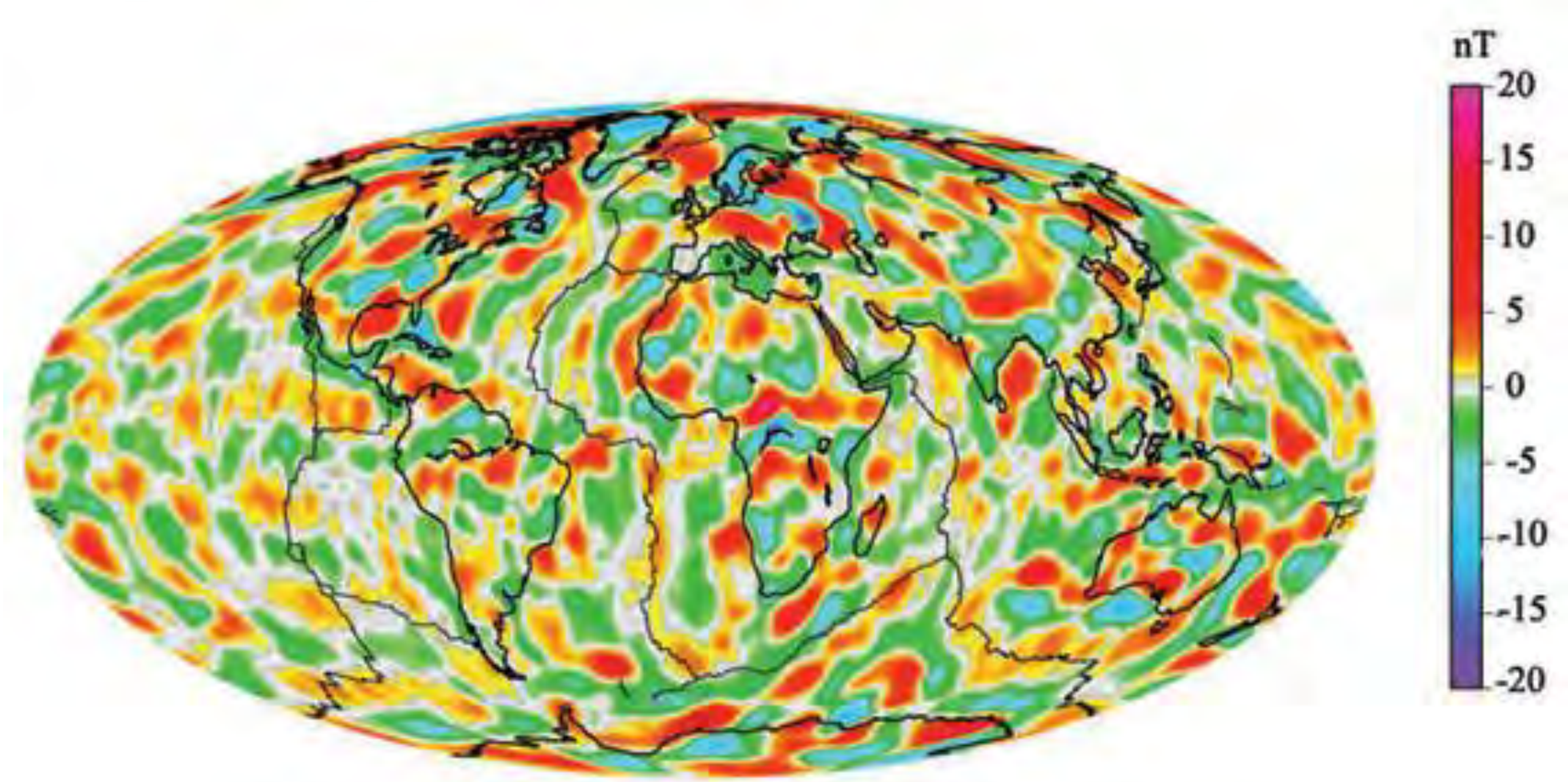
04 Ex. 1 Well Head Survey

05 Ex. 2 Magnetometry in Hawaii

01 Magnetometry Overview

Overview

What is Magnetometry?



Overview

What is Magnetometry?

- Remote sensing method that uses a device to measure magnetic field readings, with corresponding GNSS locations
- Traditionally deployed on foot, plane or helicopter. Recently, drone mounted sensors have been growing in popularity

What applications is Magnetometry used for?

Common applications include locating abandoned oil and gas infrastructure, UXO (unexploded ordnances), mineral exploration, archaeology surveys, and geologic assessments

What are the benefits of UAV Magnetometry?

- Collect more data in less time
- Survey hazardous sites (i.e. challenging terrain or UXO) from a safe location

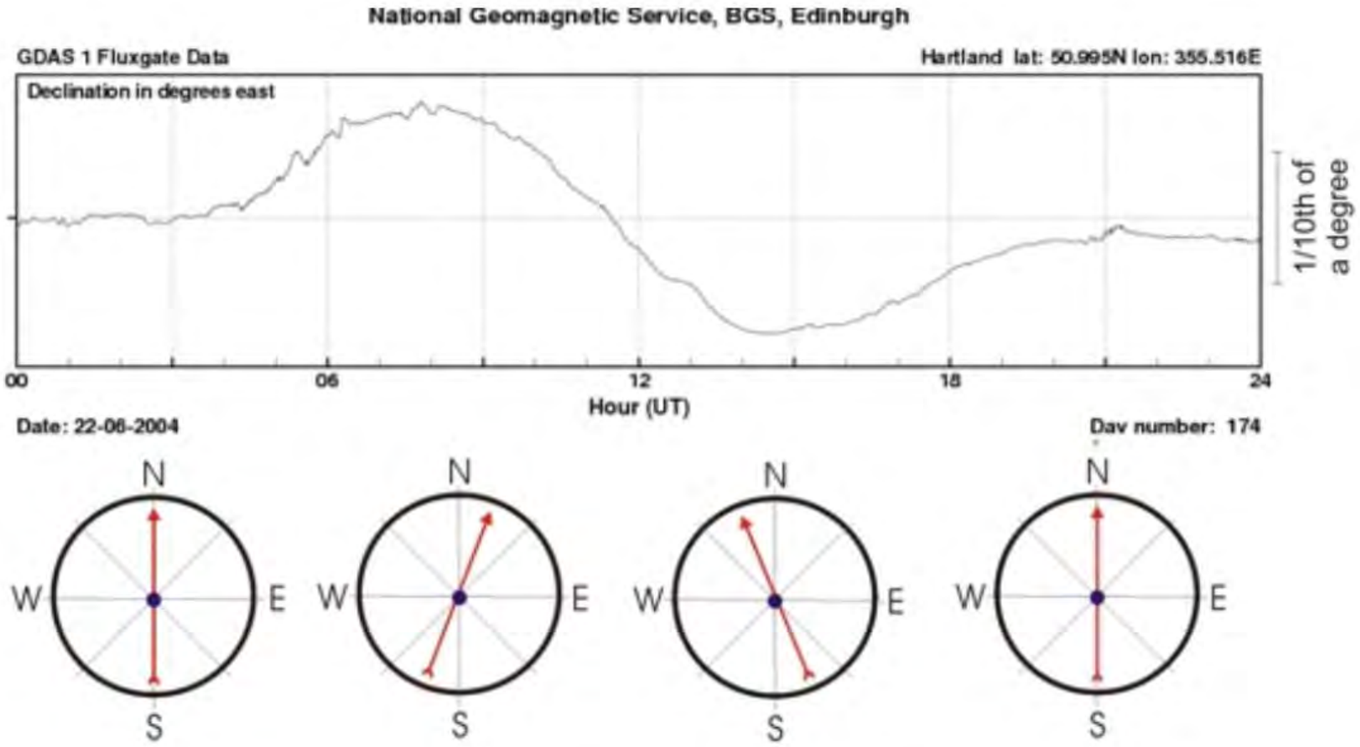
Overview

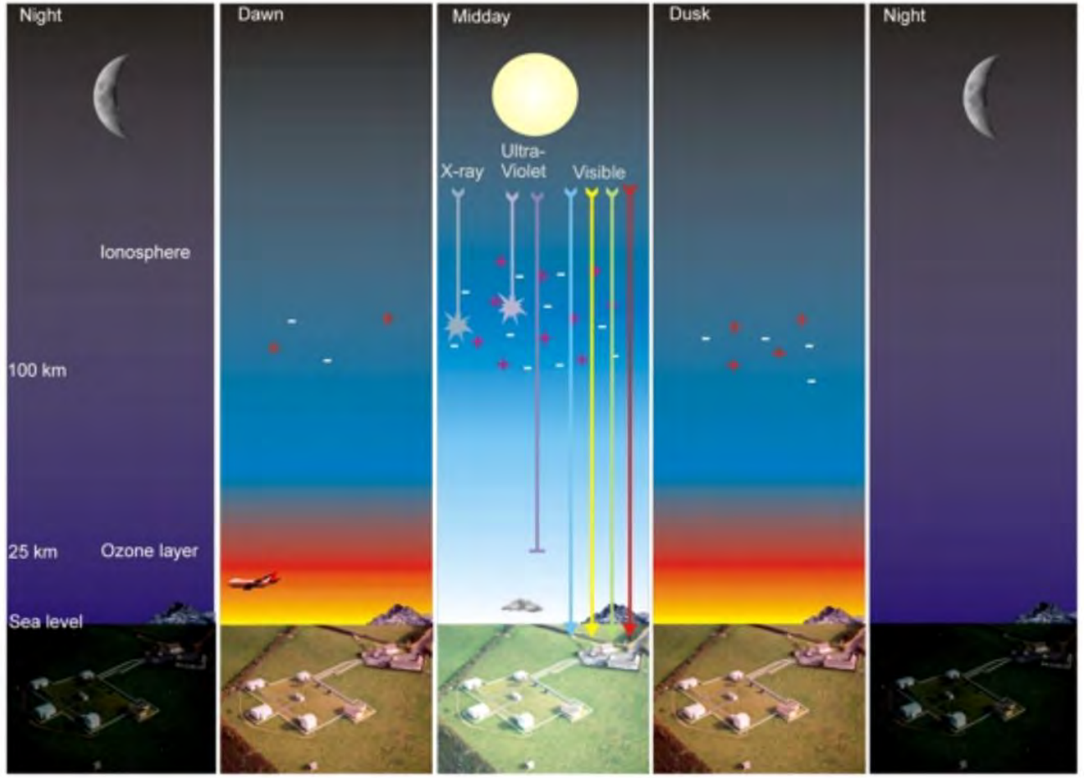
Magnet Variation

Variations in Earth's Magnetic Field

- **Secular Variation:** The magnetic axis undergoes a periodic change because of its spin around its own axis from east to west. The time cycle of this variation is 960 years.
- **Eleven-year Sunspot Cycle:** Once in every eleven years, the earth faces the sunspot which is a region of the strong magnetic field. Thus the magnetic activity of the earth is very much influenced by this variation.
- **Daily and Annual Variation:** The ultraviolet rays from the sun ionize the earth's atmosphere. As a result of which the current is generated which further produces the magnetic field. This is the result of daily and annual variations.
- **Lunar Variations:** Apart from the sun, the moon also influences the magnetic activity of earth. Due to the tidal motions of the earth's ionized layer during a lunar eclipse, there is variation in earth's magnetic field. This variation is the Lunar Variation.
- **Irregular and Aperiodic Variation:** During a particular period of time when the solar activity of the sun is more active, the radiations from the sun ionize the atmosphere of the earth. This causes current when the earth revolves around its own axis resulting in the magnetic field.

Daily Magnetic Variation





02 UAV Integration

MagArrow

- Geometrics MagArrow airborne Magnetometer
- Laser pumped cesium vapor (Cs133 non-radioactive) total field scalar magnetometer
- 1000hz sampling rate
- Integrated GNSS antenna
- Output is a binary file that’s easily converted into CSV

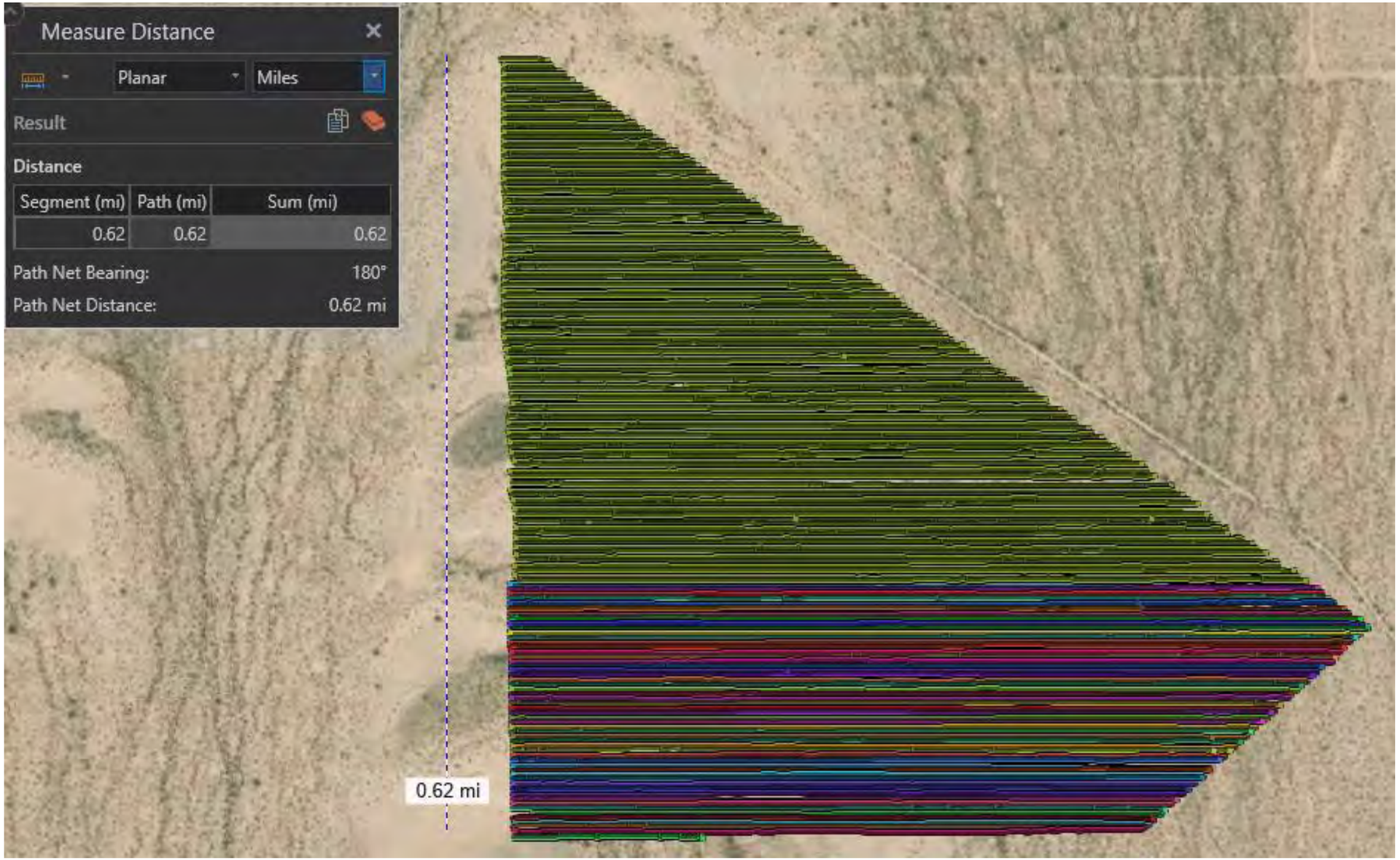
Base Station

- A Geometrics G-857 base station magnetometer
- Runs the complete duration of data acquisition.
- Records magnetic data and date/time at pre set intervals (1-5 second intervals typically)
- Date/Time data is used to match with UAV acquired magnetic data

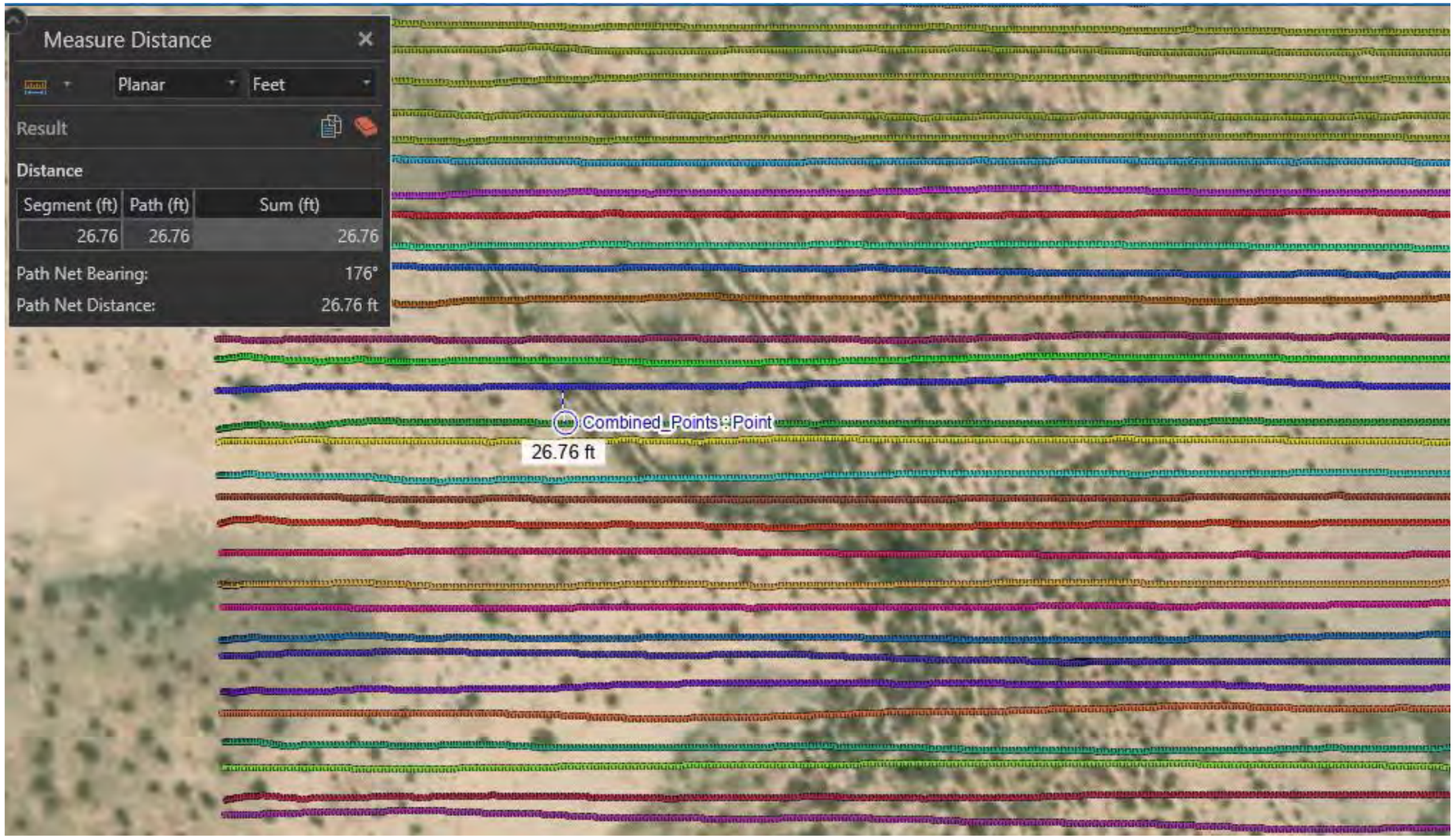
03 Methodology

- Preprogrammed flight lines using drone navigation software (DJI, UGCS etc.) to insure consistent straight transects
- Flight time is about 20 mins per set of batteries
- Data downloads and checks in-between battery swaps

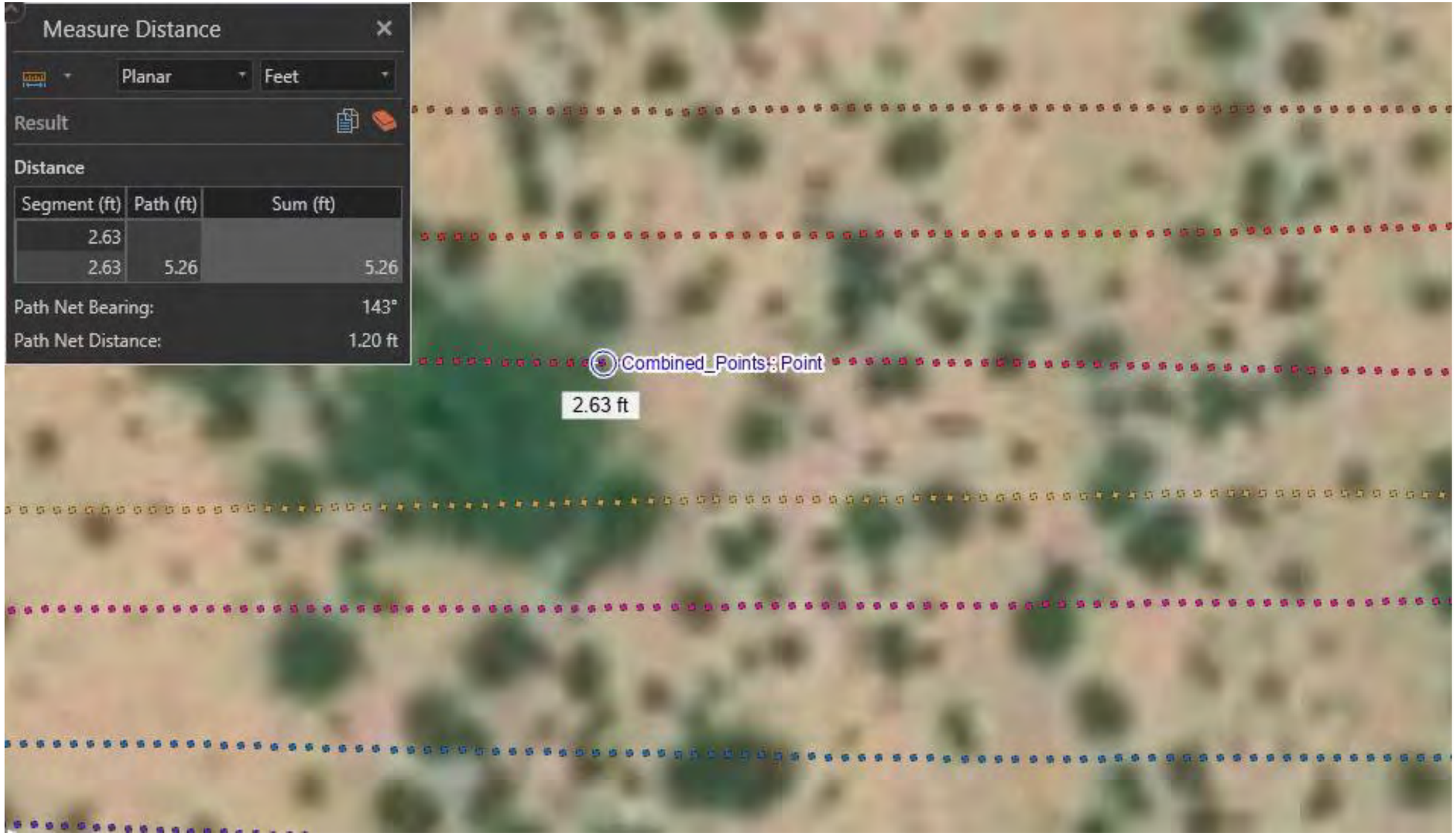
Flight Lines



Flight Lines

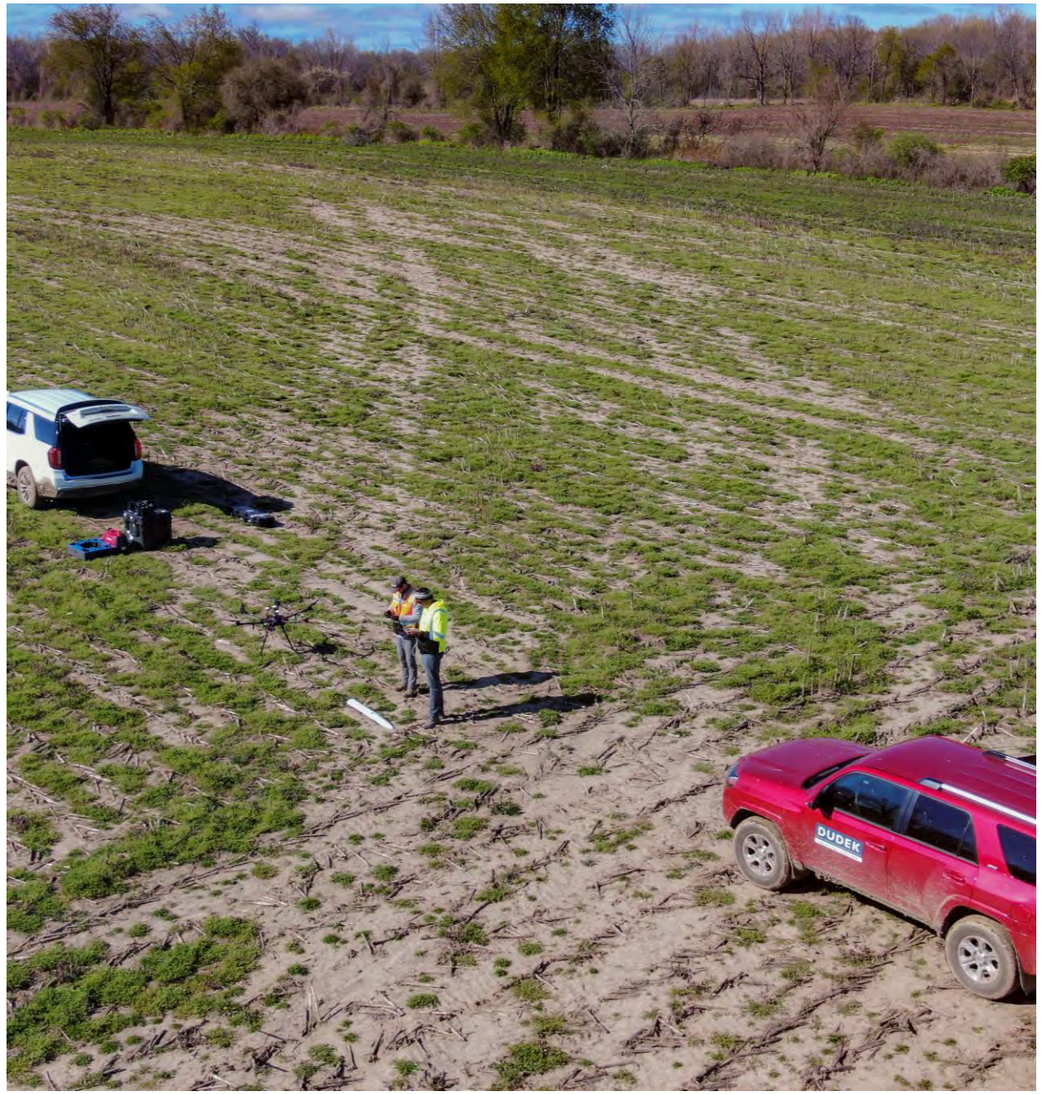


Flight Lines

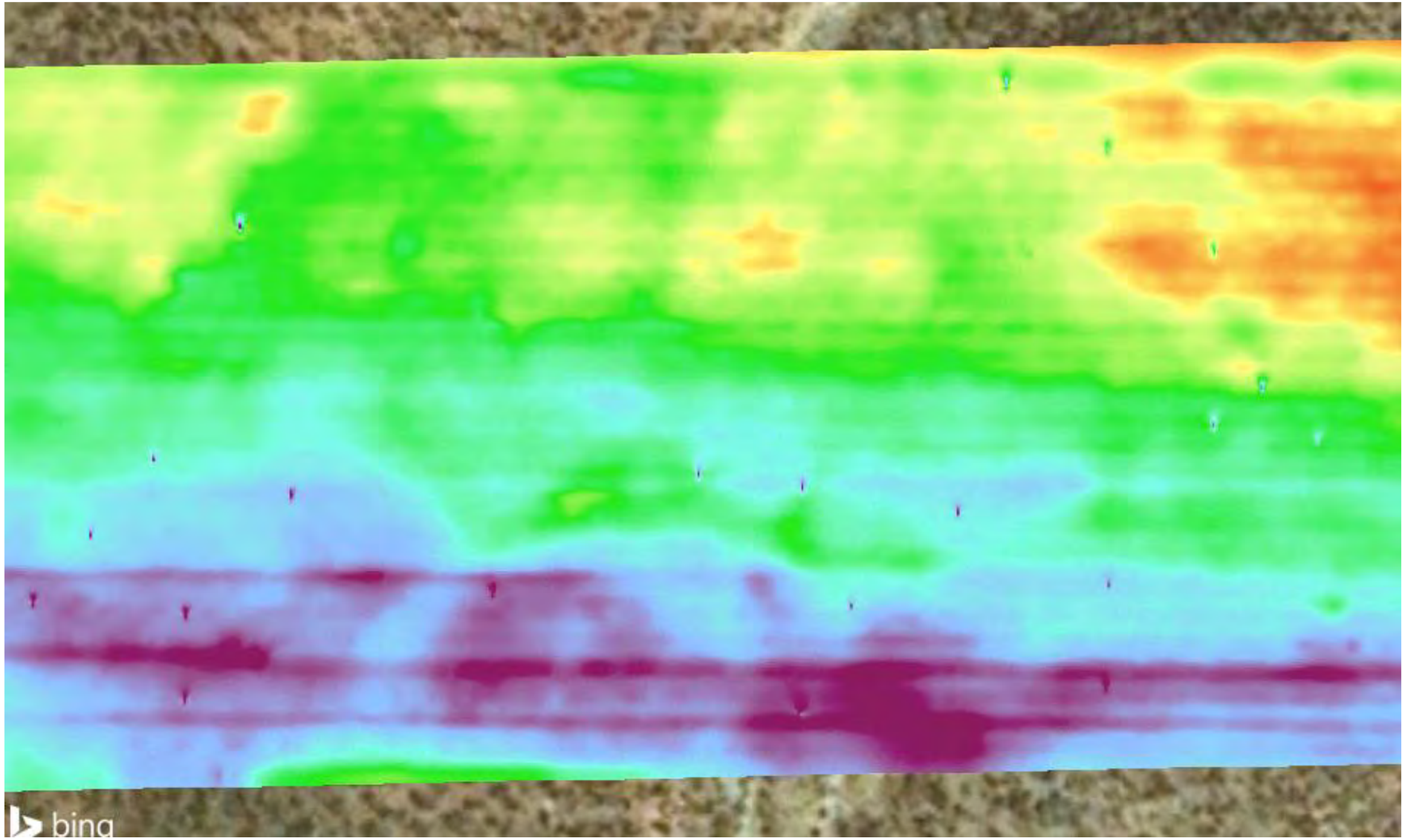


Post Processing

- Binary files are converted CSVs
- Trimming flight lines and variously despiking procedures and corrections are performed using geophysical processing software (i.e. Oasis Montaj)
- For multiday projects, merging of the various acquisitions is required before data is ready for raster interpolation (gridding)



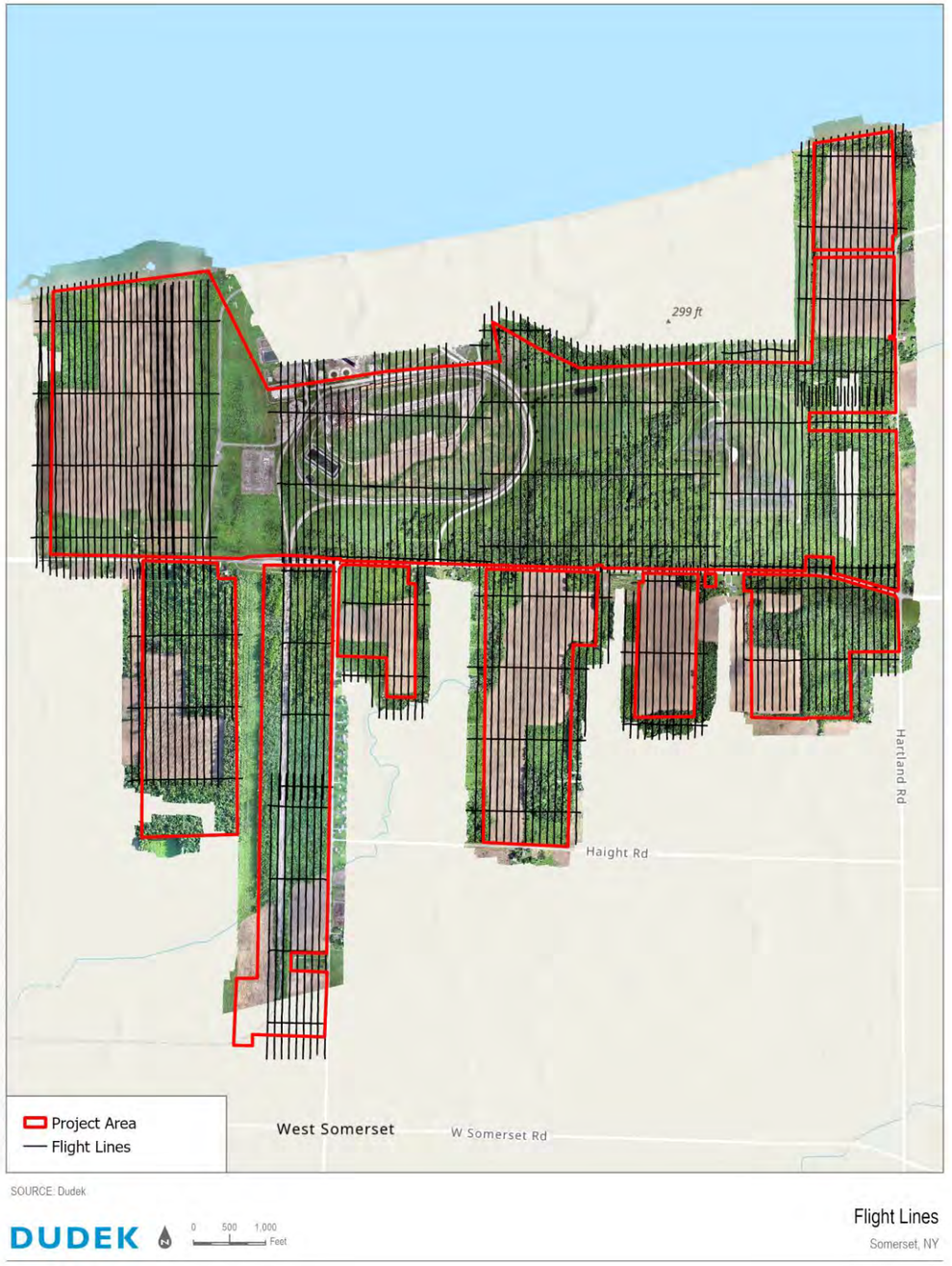
Raster Interpolation



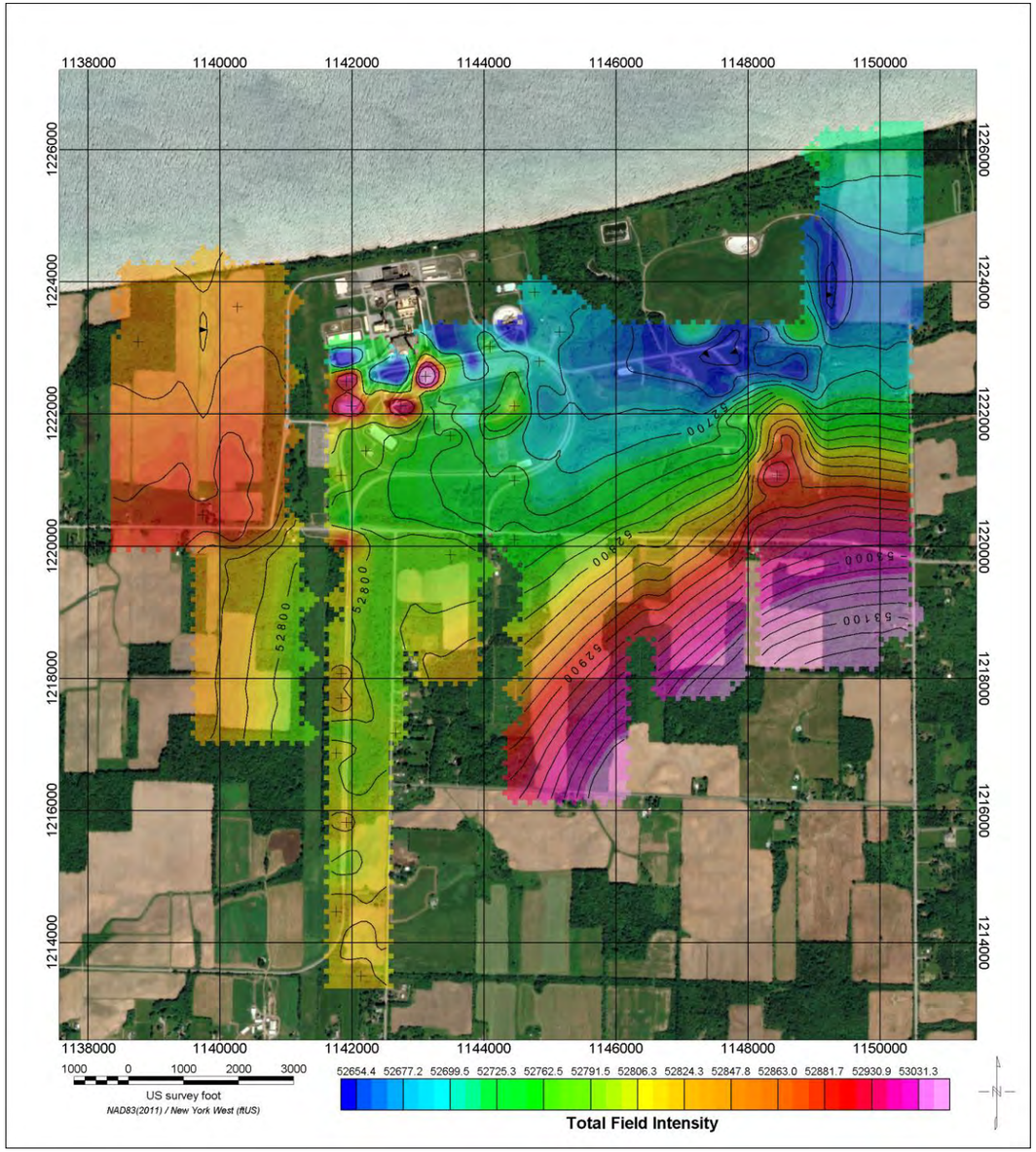
04 Well Head Survey

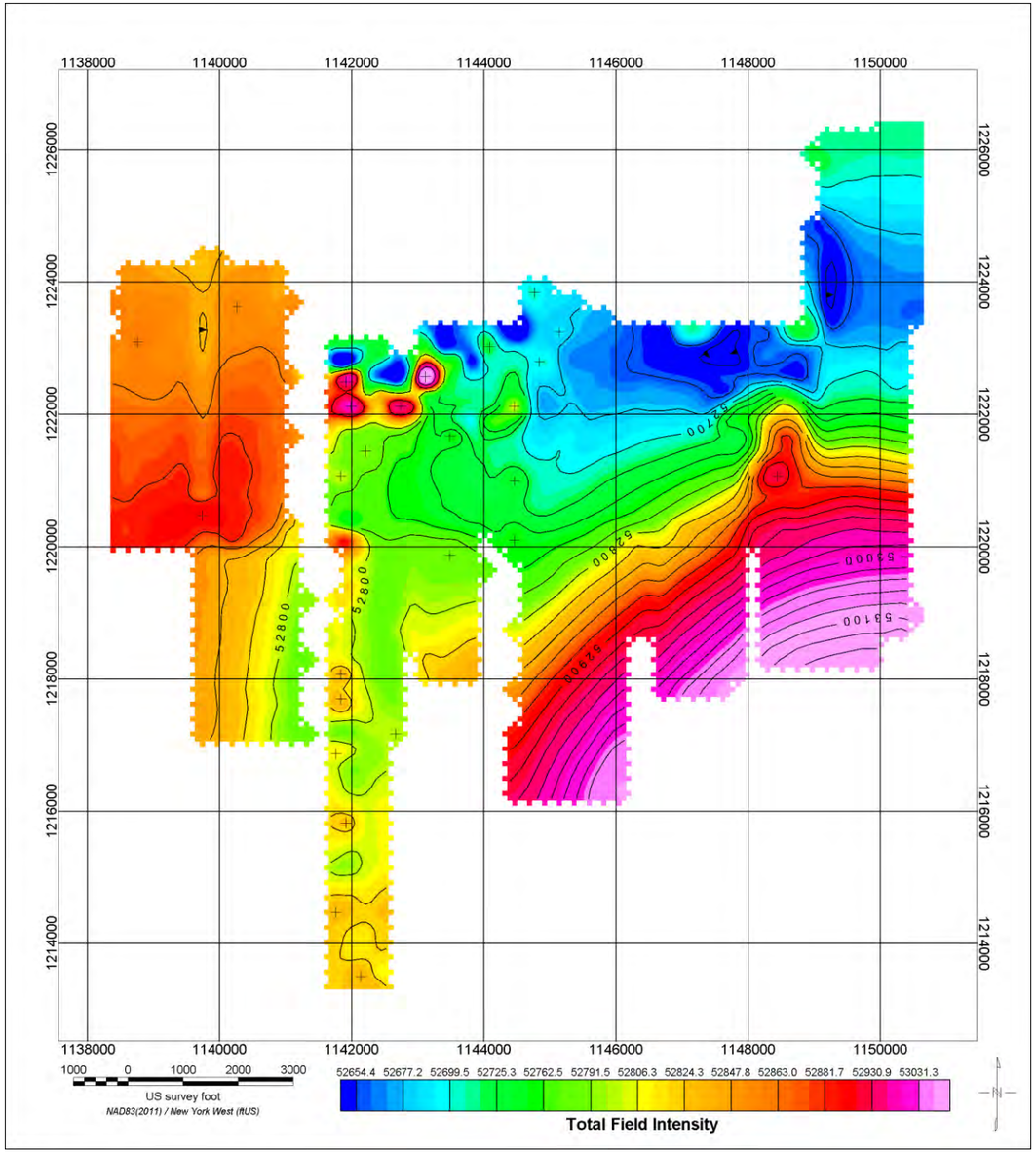
Abandoned Well Location

- 1400 acres in New York state
- Abandoned Well survey for pre construction compliance
- 83 flights over eight days of flight ops

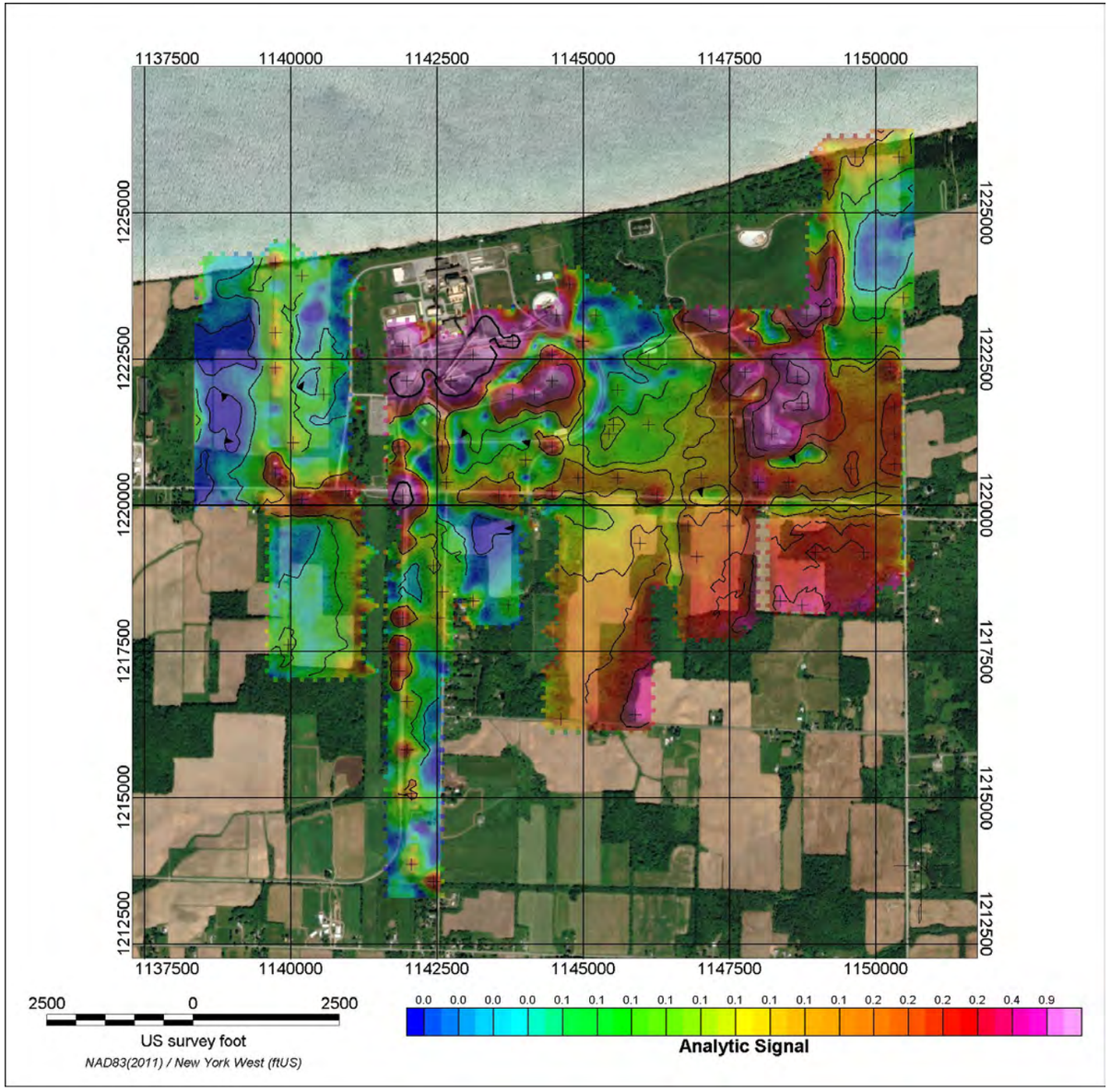


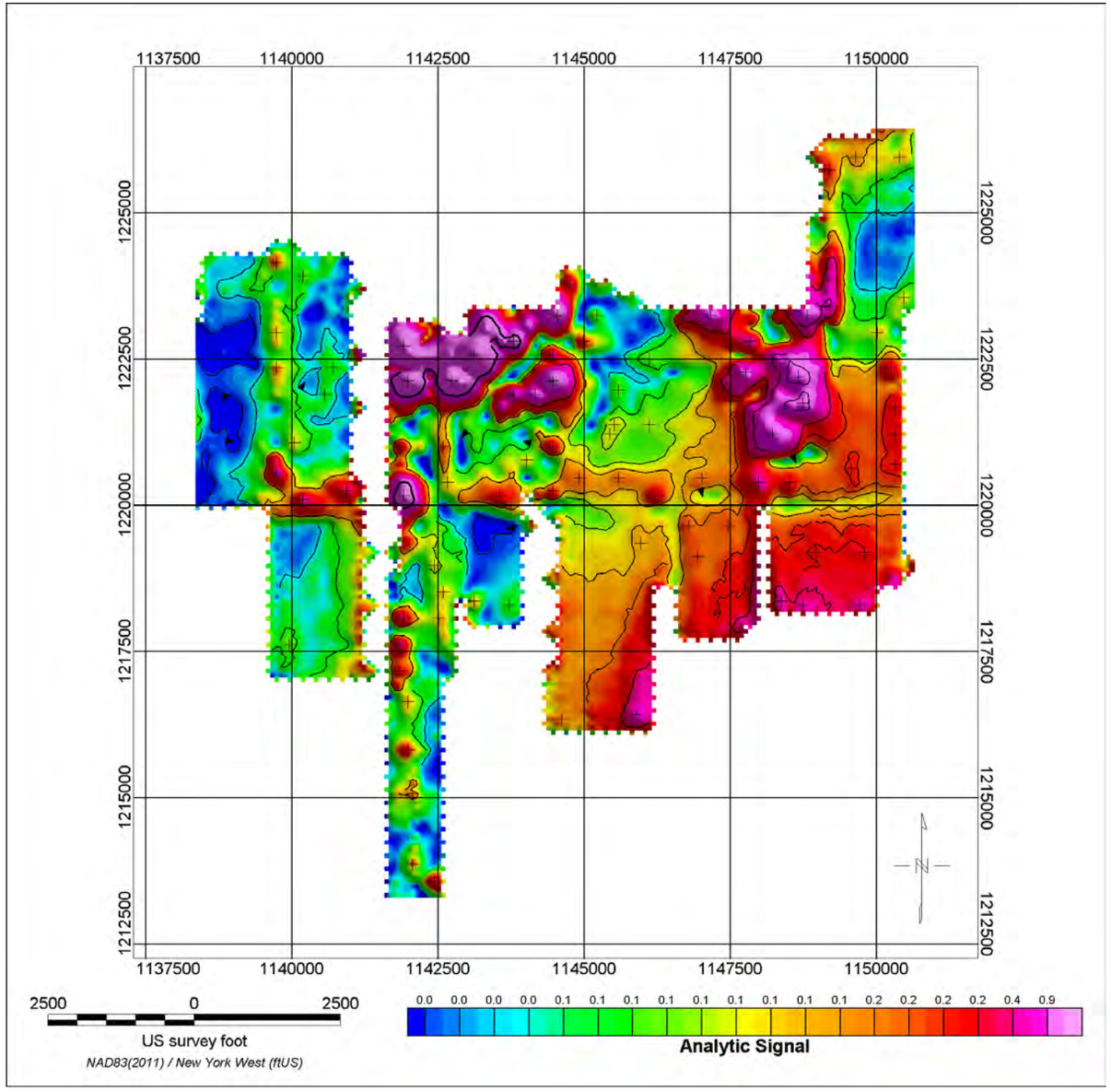
Magnetic Intensity



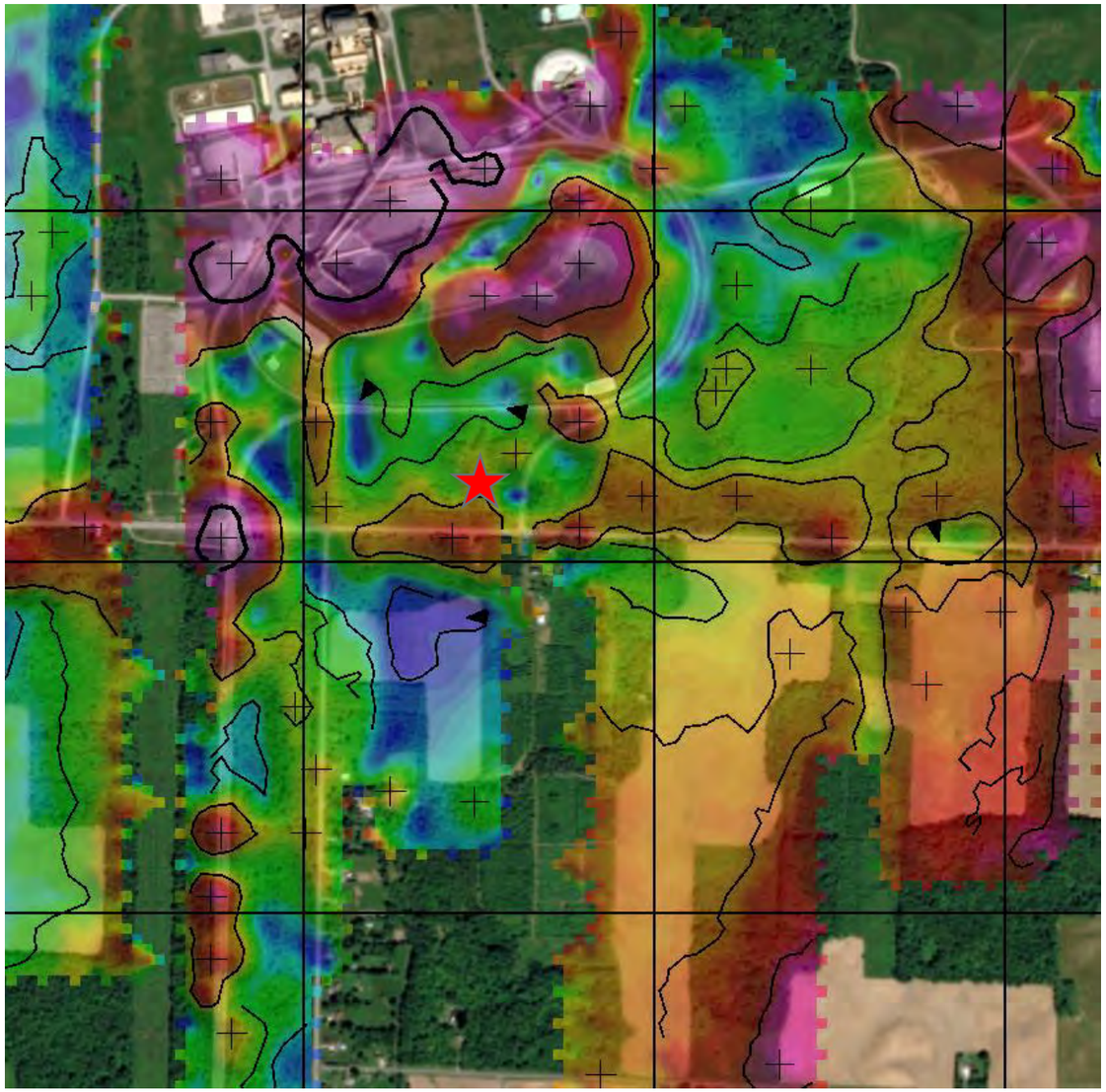


Analytic Signal

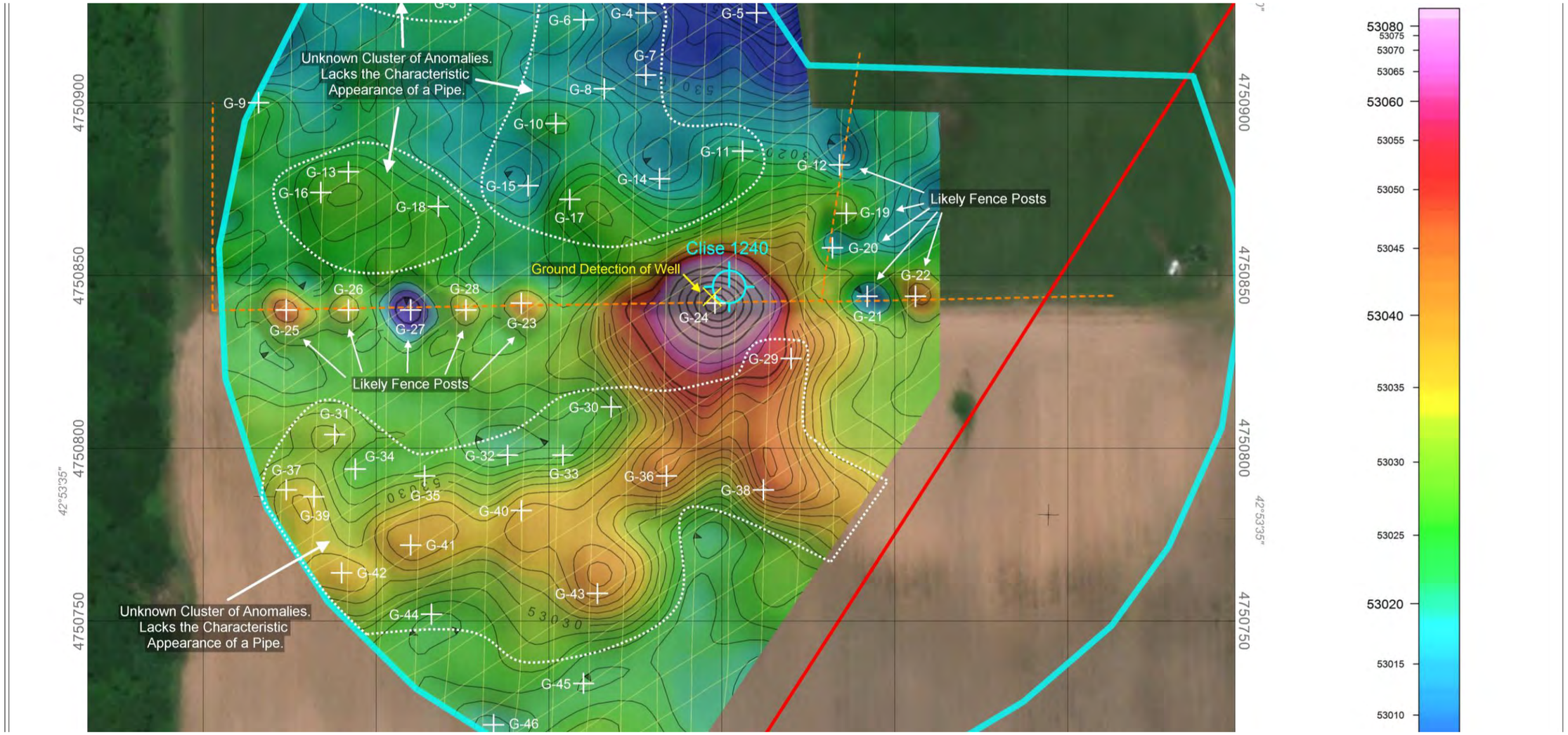




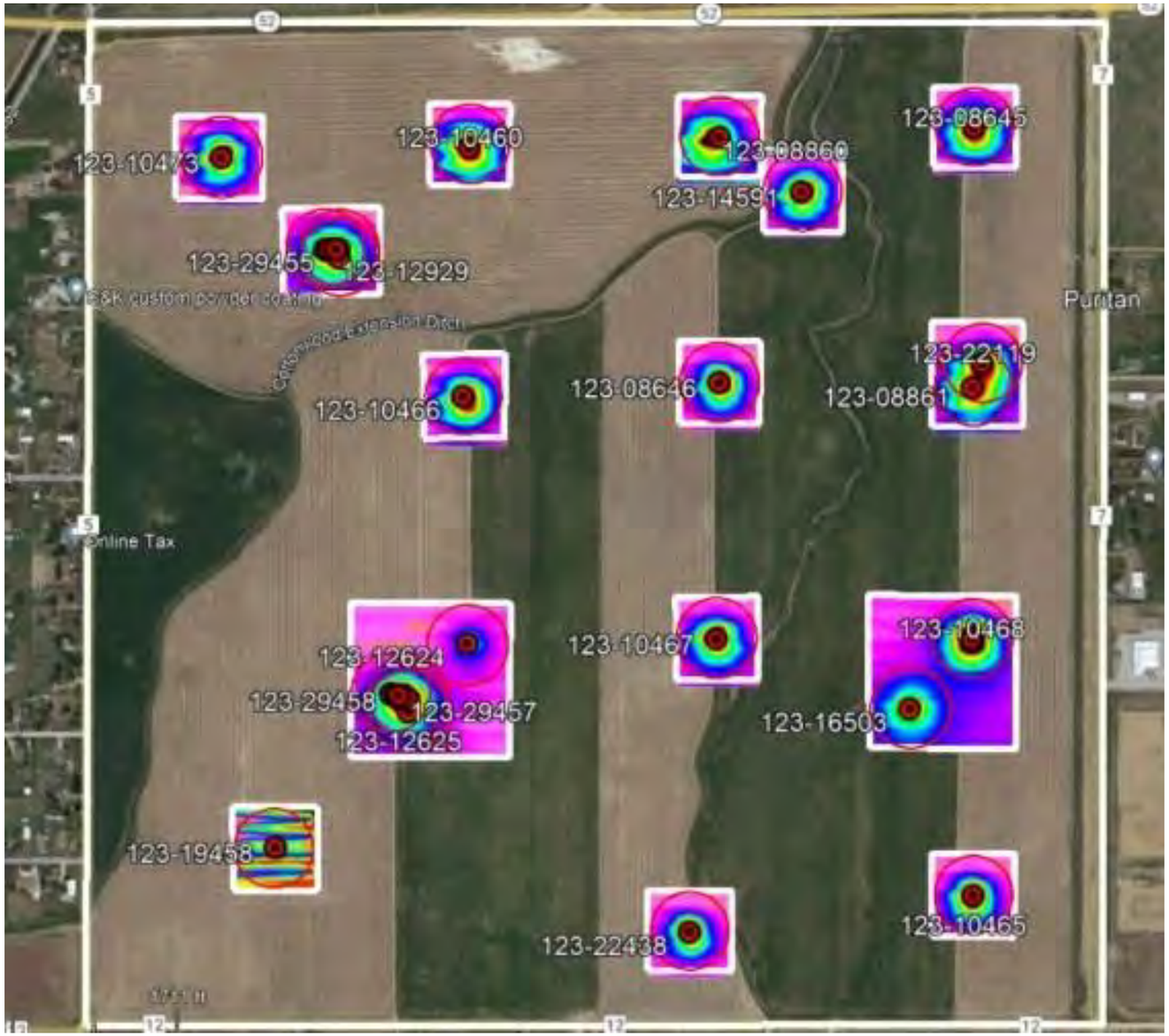
Possible Well Head



Well Head Analytic Signal Profile



Well head Example

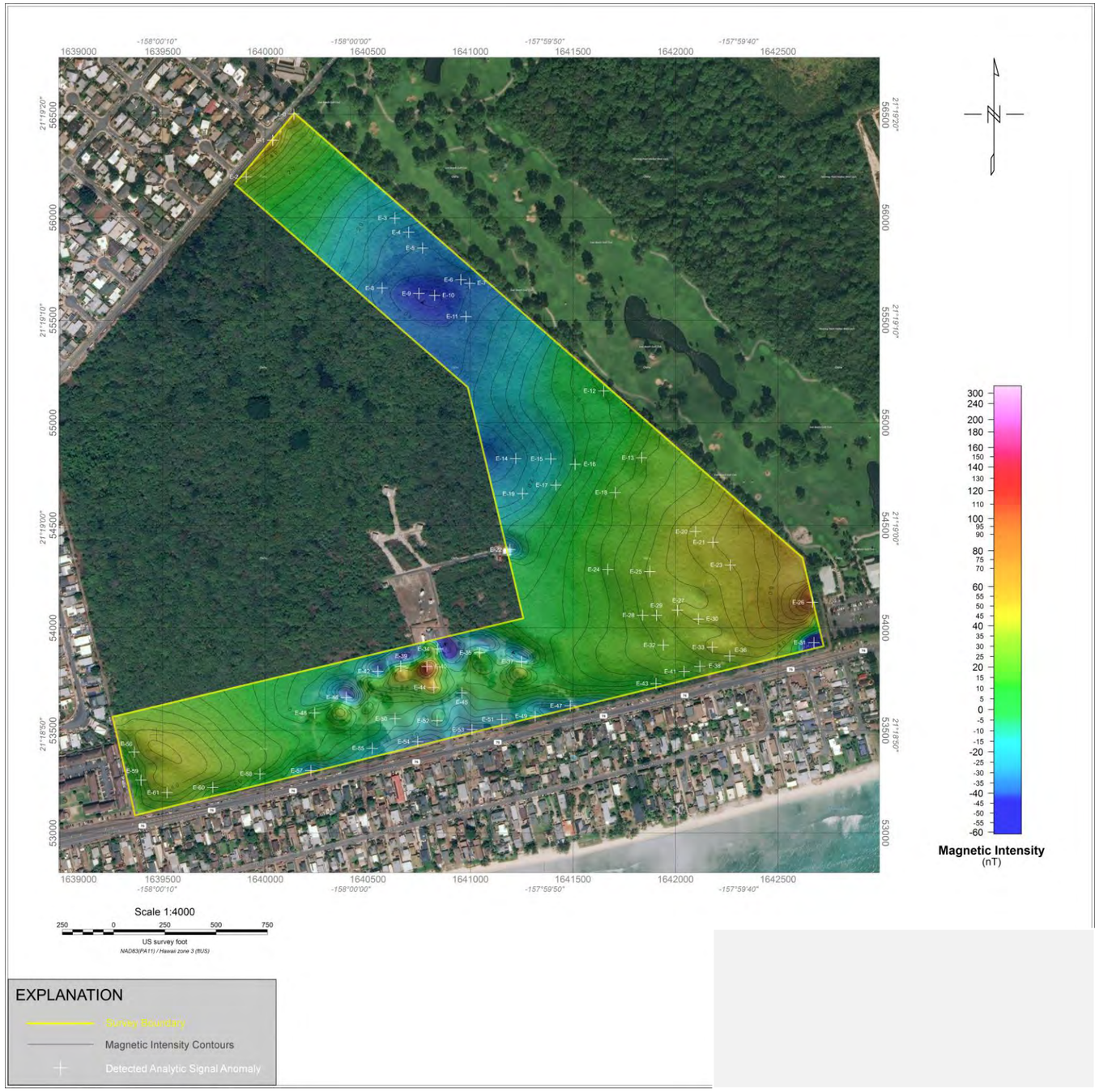


05 Magnetometry in Hawaii

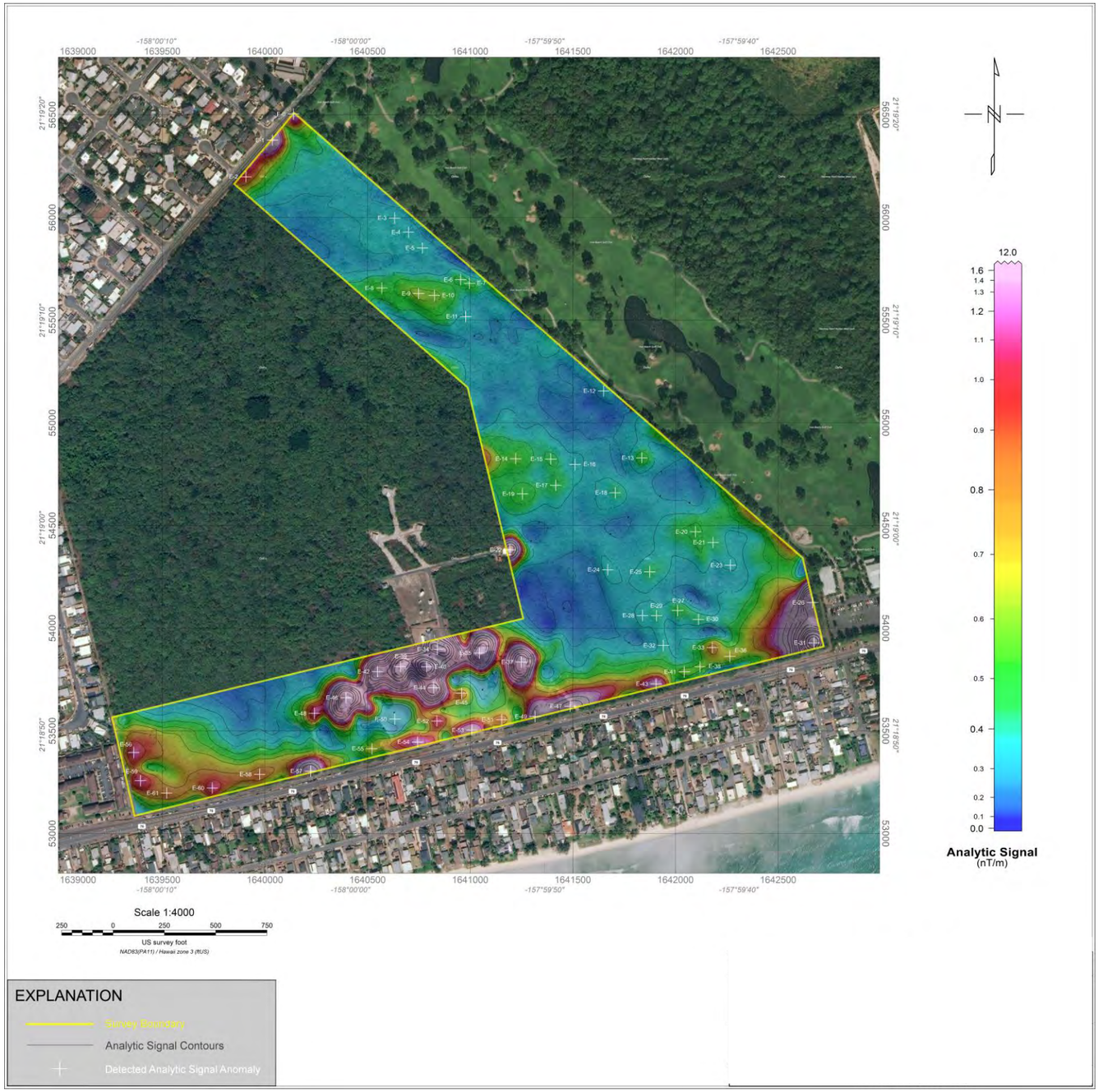
Hawaii Example

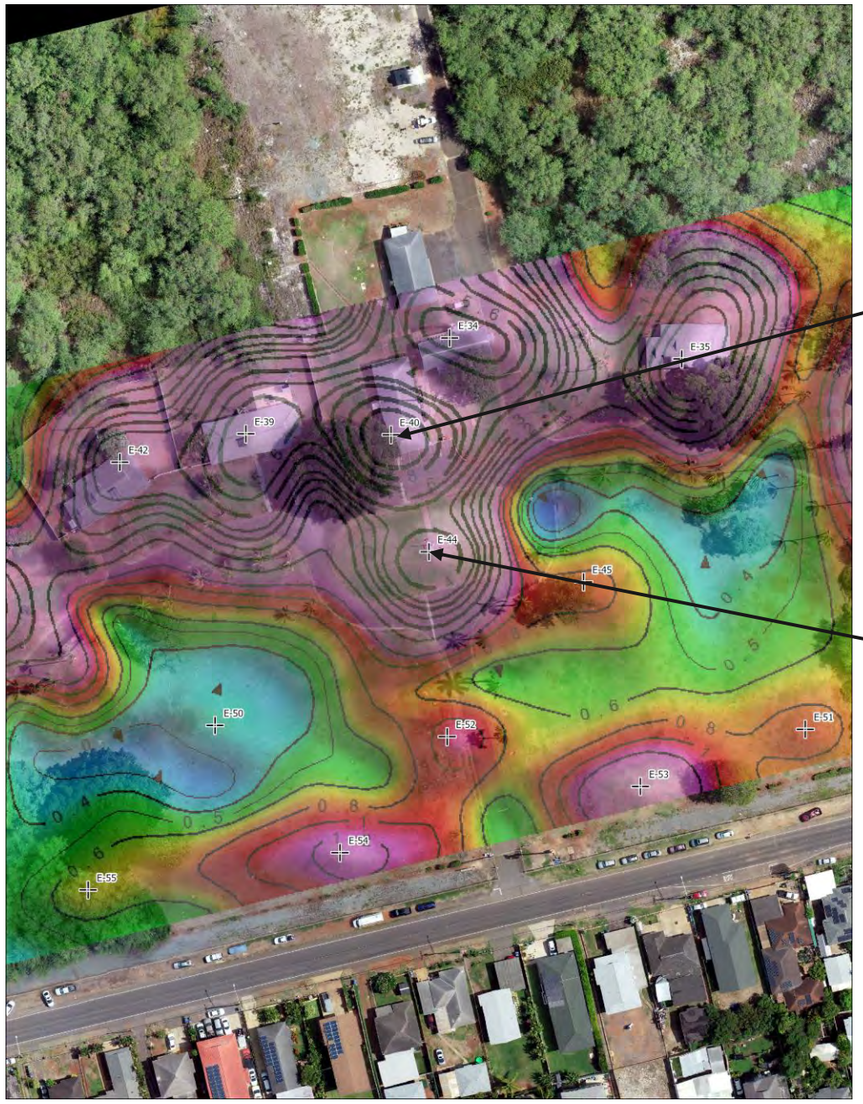
- Approximately 100 acres
- Thick vegetation would be challenging for a conventional ground survey

Magnetic Intensity



Analytic Signal

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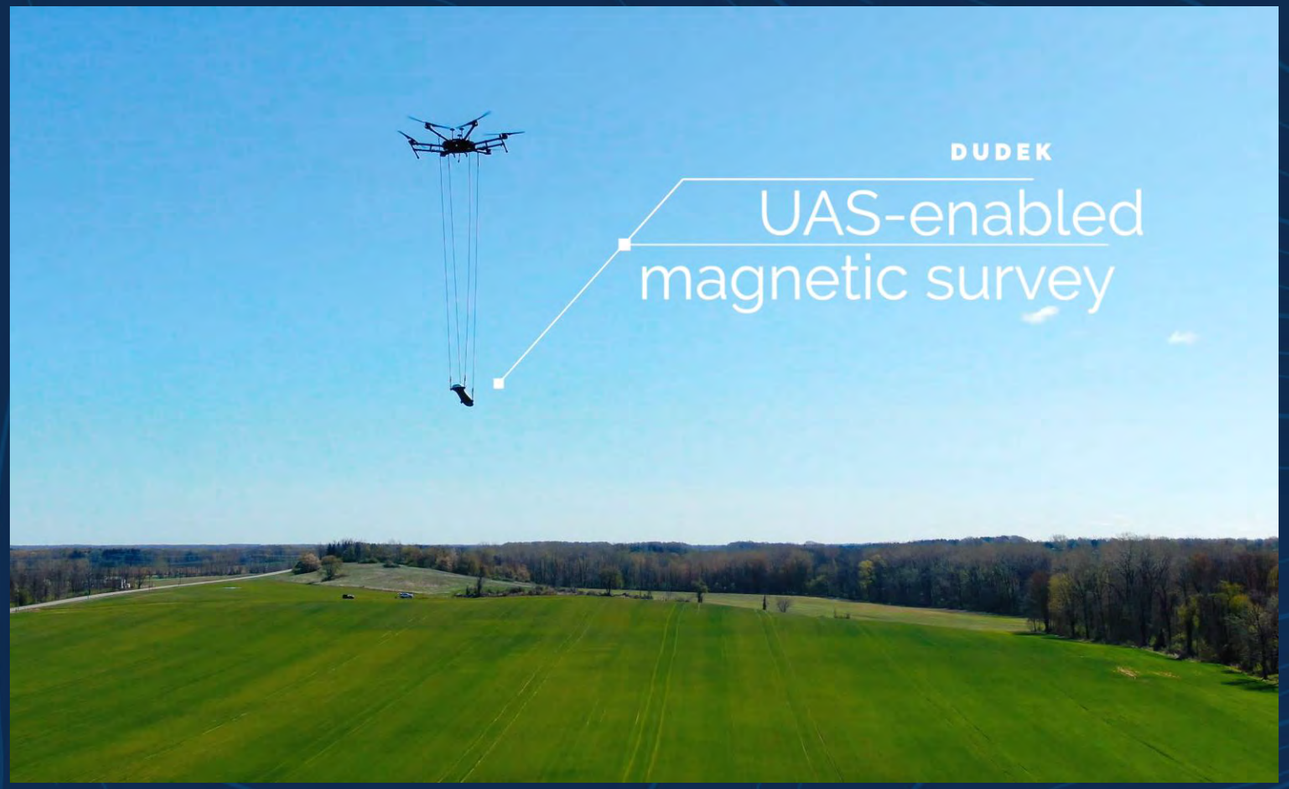
PACIFIC TSUNAMI
WARNING CENTER

Summary

- UAS are a great platform for Magnetometer surveys
- Recently, drone mounted sensors have been growing in popularity replacing traditionally sensors deployed by foot, plane or helicopter
- UAS Mag surveys are suited for locating abandoned oil and gas infrastructure, UXO (unexploded ordnances), mineral exploration, archaeology surveys, and geologic assessments
- Collection of the data requires ground based calibration
- UAS surveys for hazardous sites (i.e. challenging terrain or UXO) from a safe location



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