

Using Drone Magnetometry to Locate Four (4) Abandoned Wells Before Lunch



Ronald S. Bell

Senior Geophysicist & geoDRONEologist

Presented at the

26th International Petroleum Environmental Conference

Oct 7, 2019 - San Antonio, TX



A Brief Summary Bio (of the world's only geoDRONEologist)

years in the geoscience industry: 40+

formal education: B.S. Applied Physics, Michigan Technological University, course work in geology

informal education (aka “practical experience”):

acquired, processed, visualized and interpreted a large volume of ground, airborne, and borehole geophysical data for resource exploration (ground water, minerals, hydrocarbons, and geothermal) as well as environmental & engineering site subsurface characterization.

geoDRONEology: 5 years of applying drones for geoscientific mapping

Talking Points

Defining the Problem

Evaluating the Site

Assessing the Options

Deciding on the Approach

Making up the Plan

Executing the Site Scan

Analyzing the Results

Tagging the Location

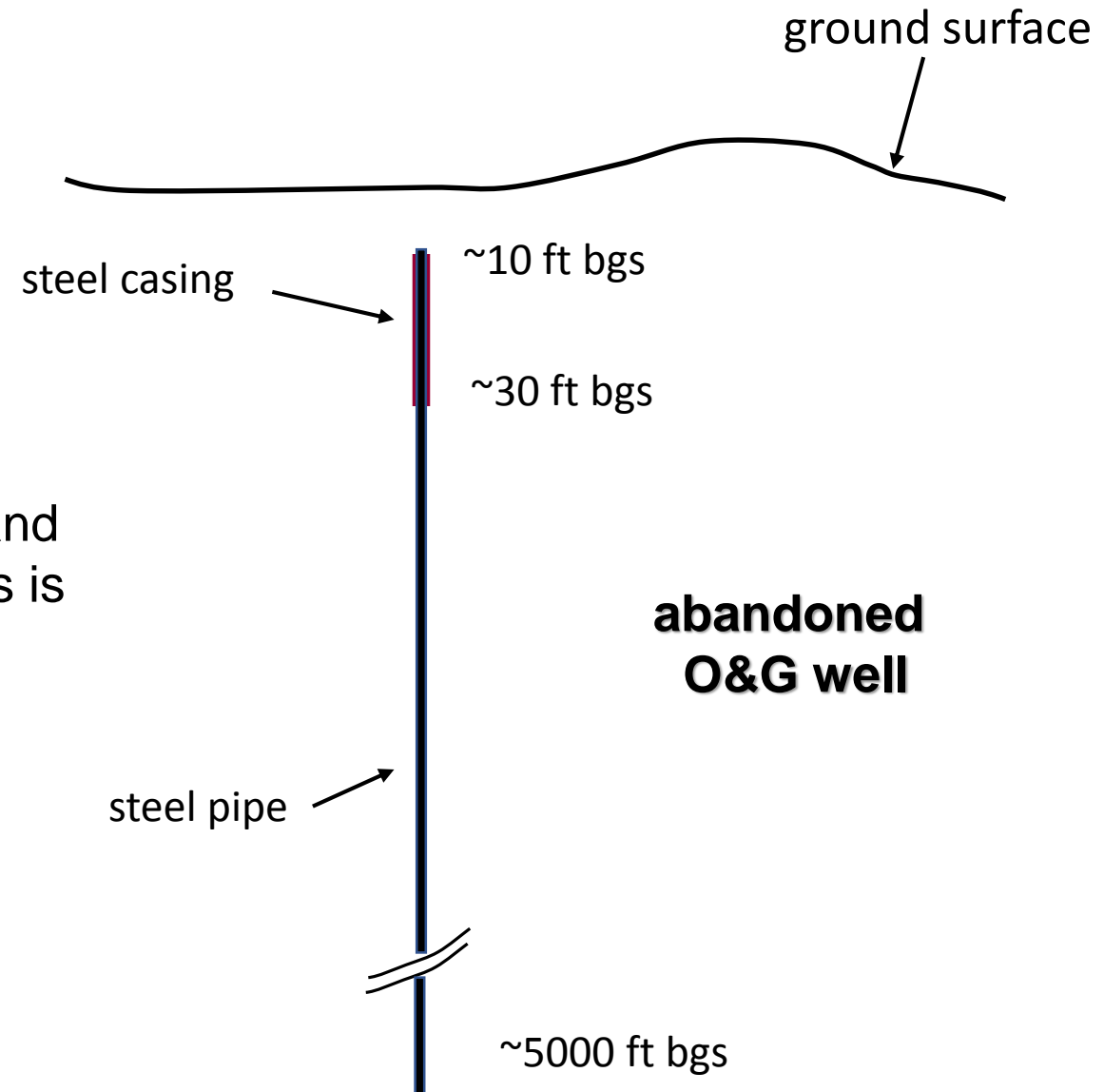


Defining the Problem

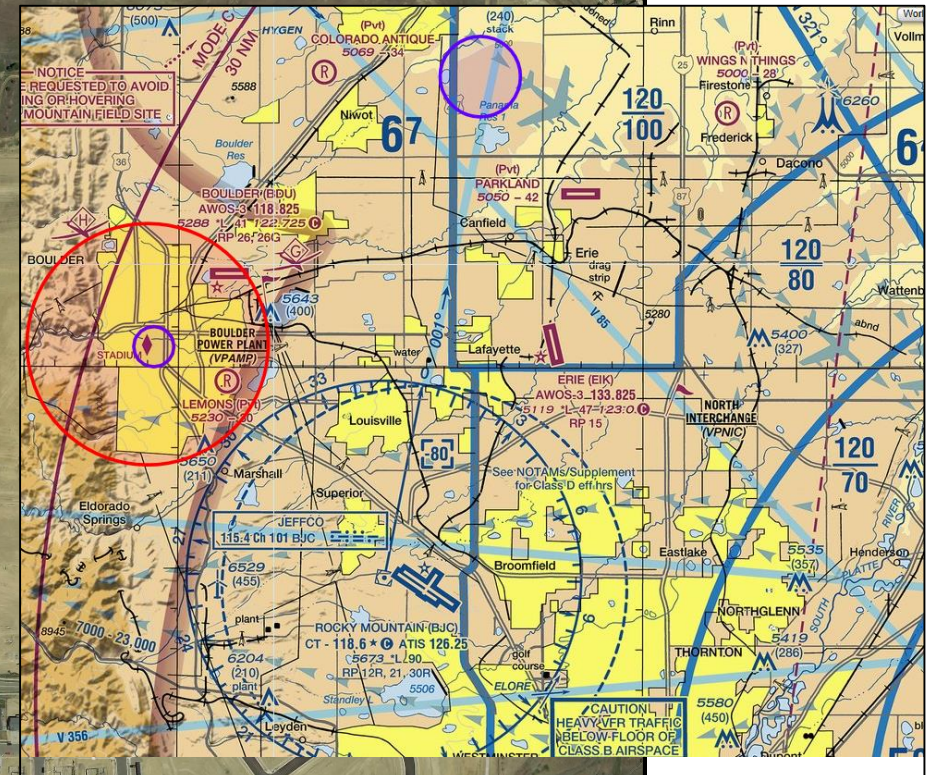
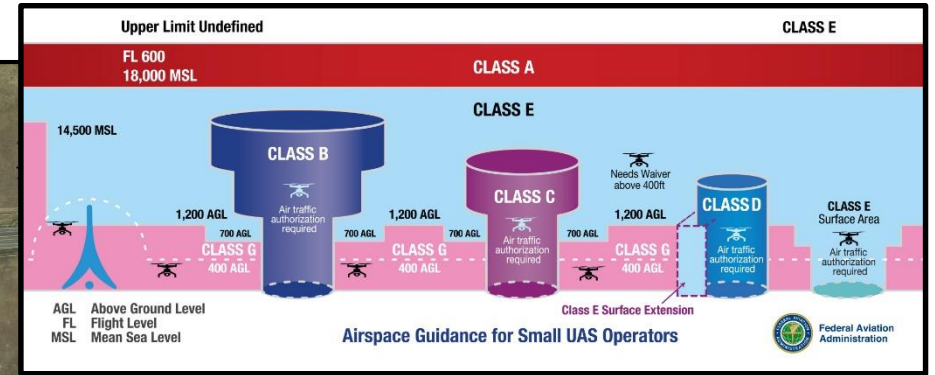
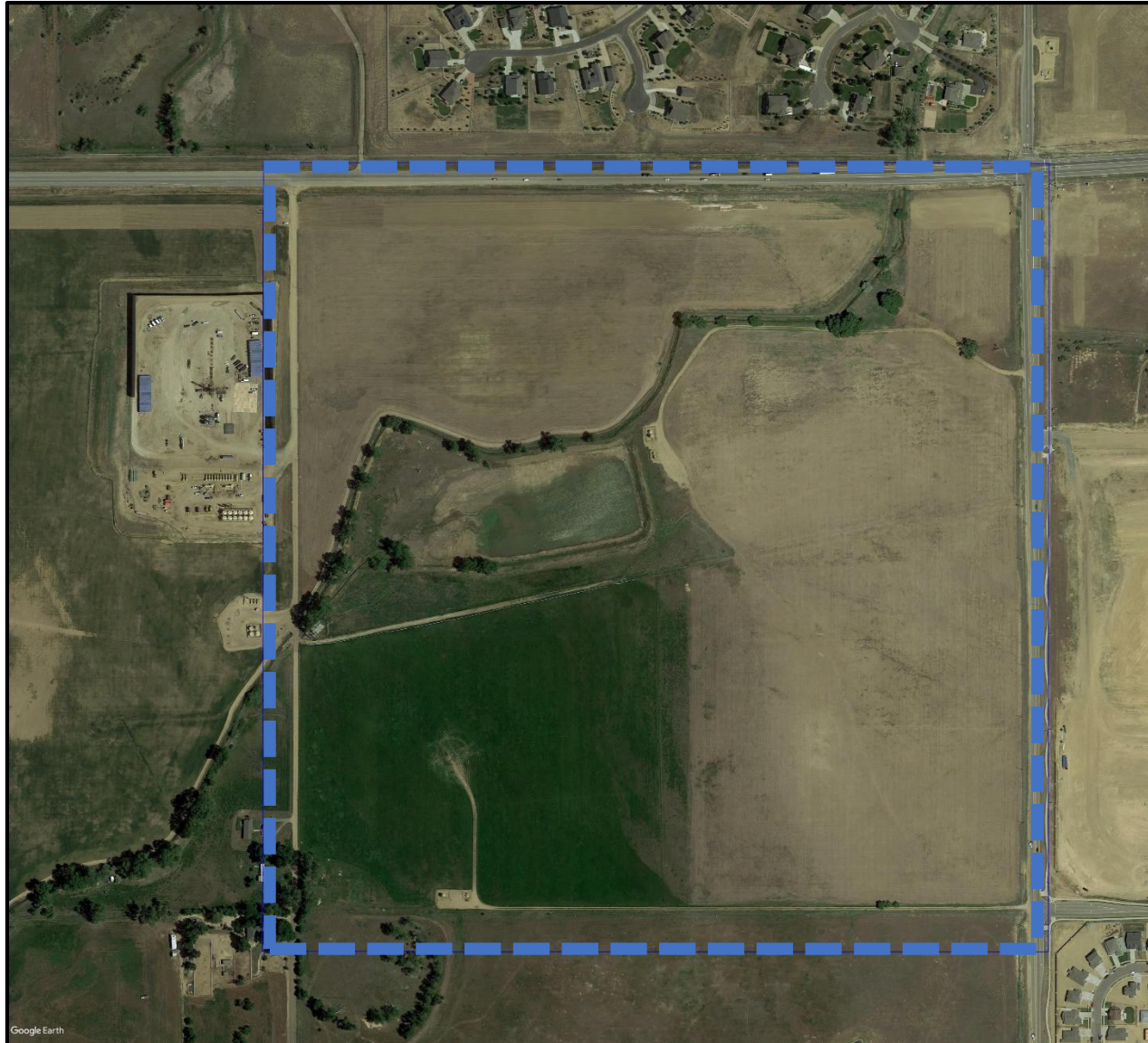
Objective is to precisely locate a vertically oriented cylinder made of **steel** extending into the subsurface. Typically, the top segment has been cut off ~10 ft below the ground surface with no indication of well at the surface.

The well location information available in Colorado Oil and Gas Conservation Commission (COGCC) for older wells is quite often inaccurate.

The client wishes to locate four (4) abandoned wells.



Evaluating the Site

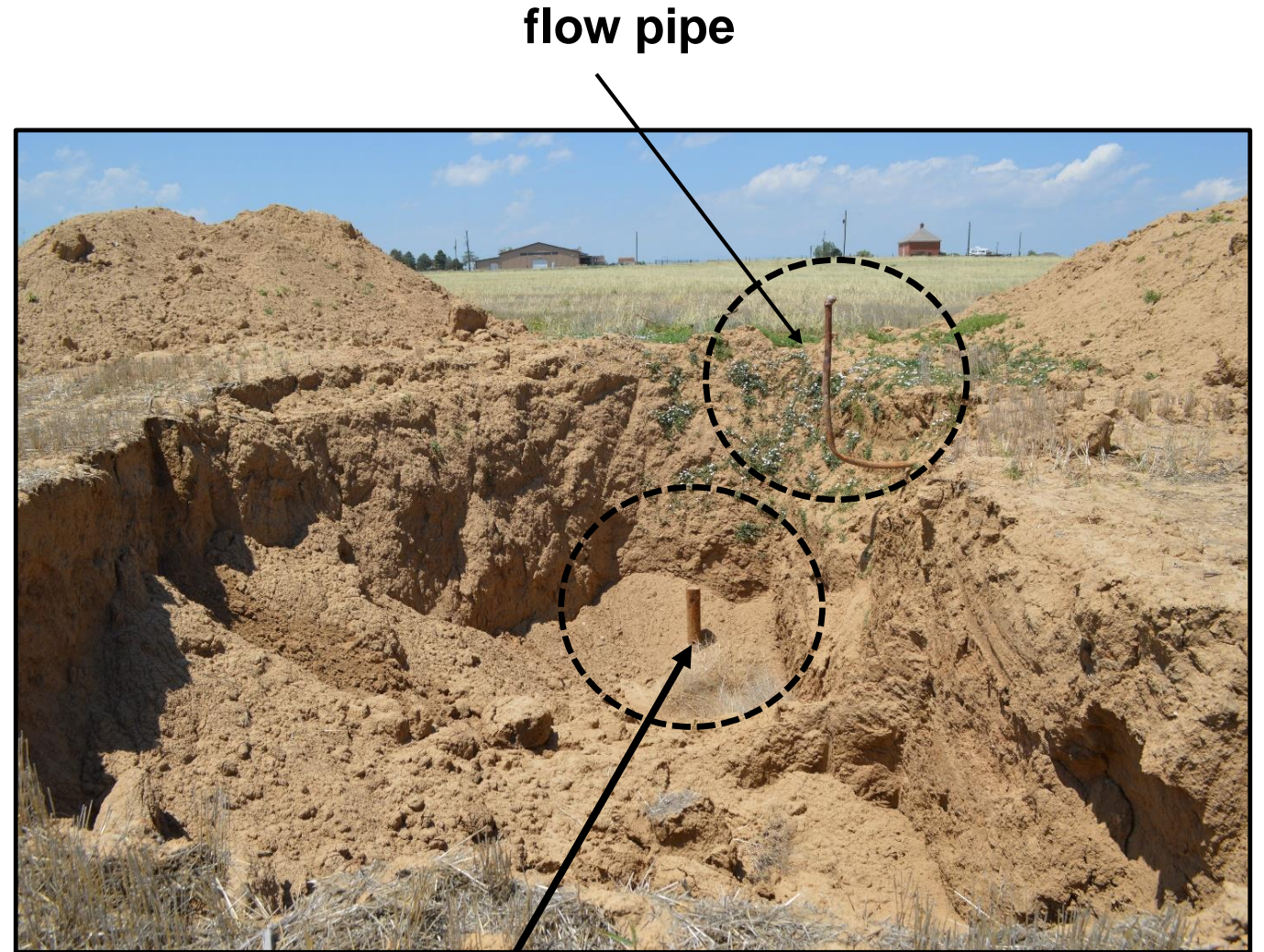


Assessing the Options

- Excavate until it is found
- Remotely sense the subsurface using a geophysical method

Applicable Geophysical Methods

- ★ ➤ Magnetometry
- Electromagnetic Induction
- Ground Penetrating Radar
- Electrical Resistivity



flow pipe

abandoned well



Why does magnetometry work?

The earth's magnetic field preferentially concentrates in material of higher magnetic susceptibility. (aka induced magnetization)

Well casings and pipe made of steel - a ferromagnetic material with a very high intrinsic magnetic susceptibility - will cause a magnetic anomaly.

The vertical orientation of the well and length of the well casing and pipe results in a uniquely circular and often high amplitude magnetic anomaly.

Horizontal orientation of a pipeline results in a series of dipolar – positive and negative anomalies.

Deciding on the Approach

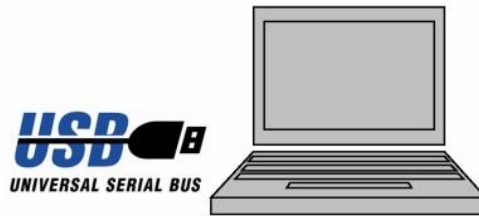
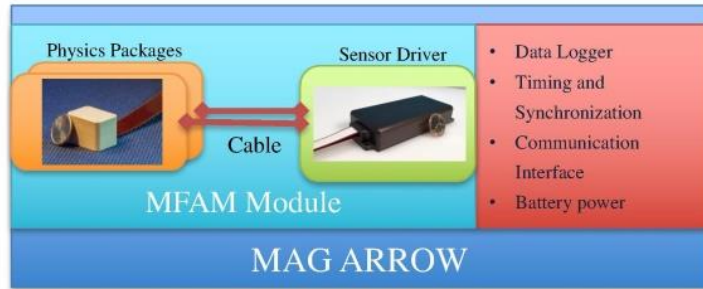
MagArrow™



GPS Location
and Timing



Wi-Fi Comm.
and Data QC



Configuration and Data Offload



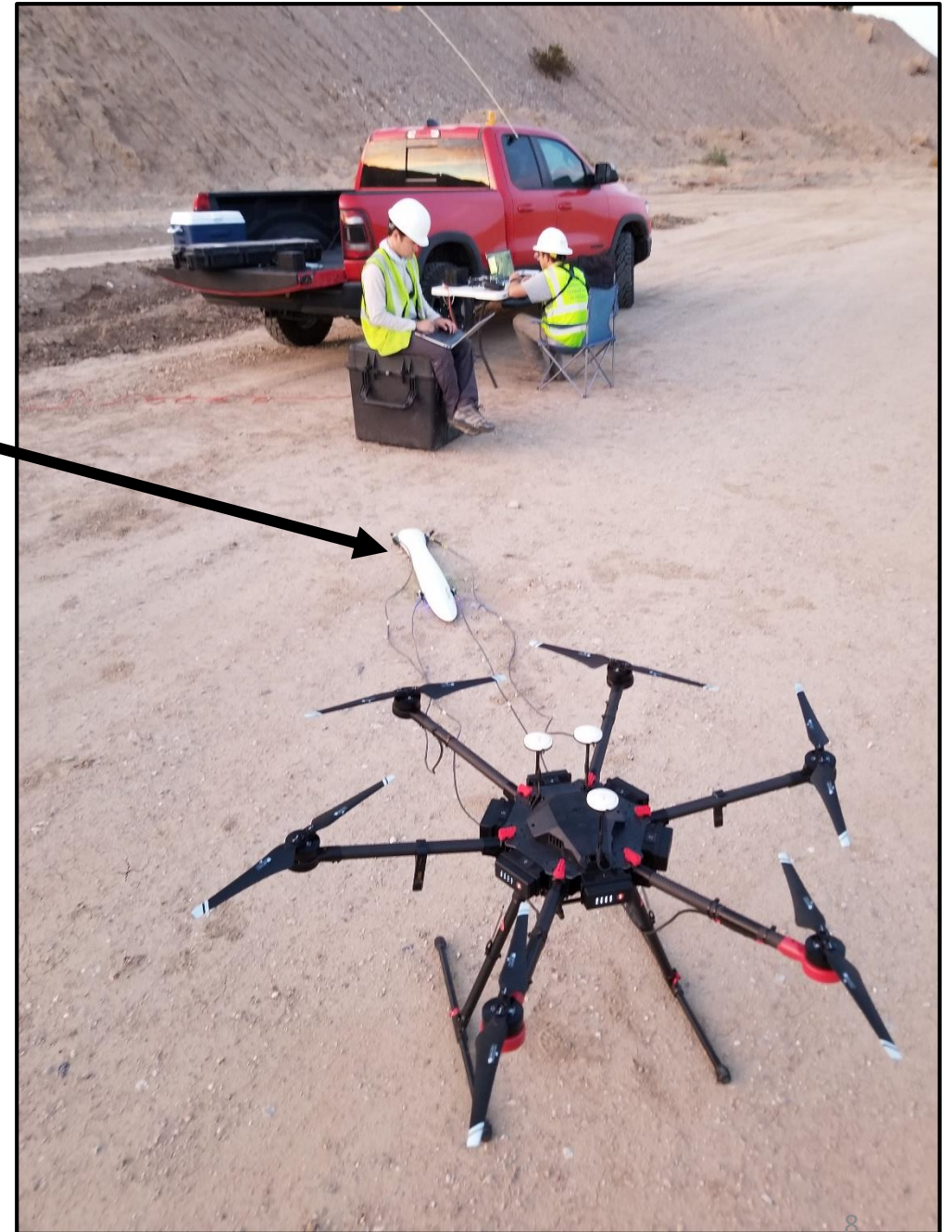
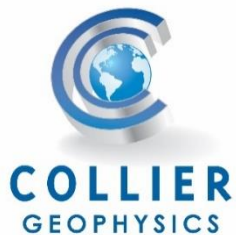
Low Power

Light Weight

High Sensitivity

Drone Compatible

Readily Deployable



Factors impacting the success of a drone enabled magnetic survey for precisely locating abandoned wells.

- Air Space Restrictions
- Weather
- Site Accessibility
- Line Spacing
- Sensor Altitude
- Well Construction
- Non-vertical well
- Casing & pipe integrity
- Buried pipe and debris

Making up the Plan

flight blocks: 4

area: 300 ft by 300 ft

Locate: ~ centered on COGCC
lon & lat

line spacing: ~30 ft

tie line spacing: ~ 30 ft

of FOSL: 1 

FOSL= Flight Operation Staging Location



~ 2600 feet

Executing the Site Scan



Total flight time: 20 min

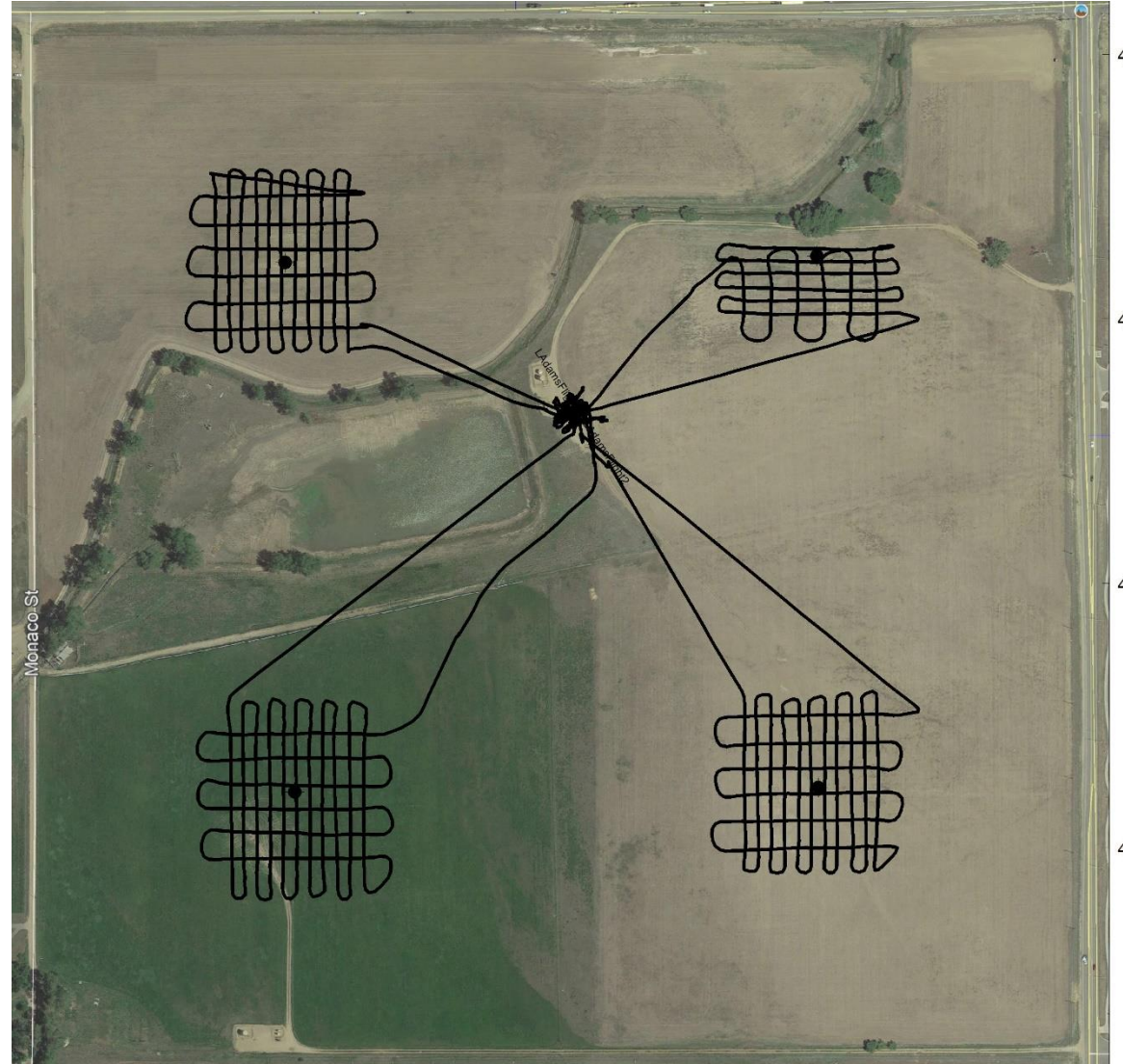


Total flight time: 40 min



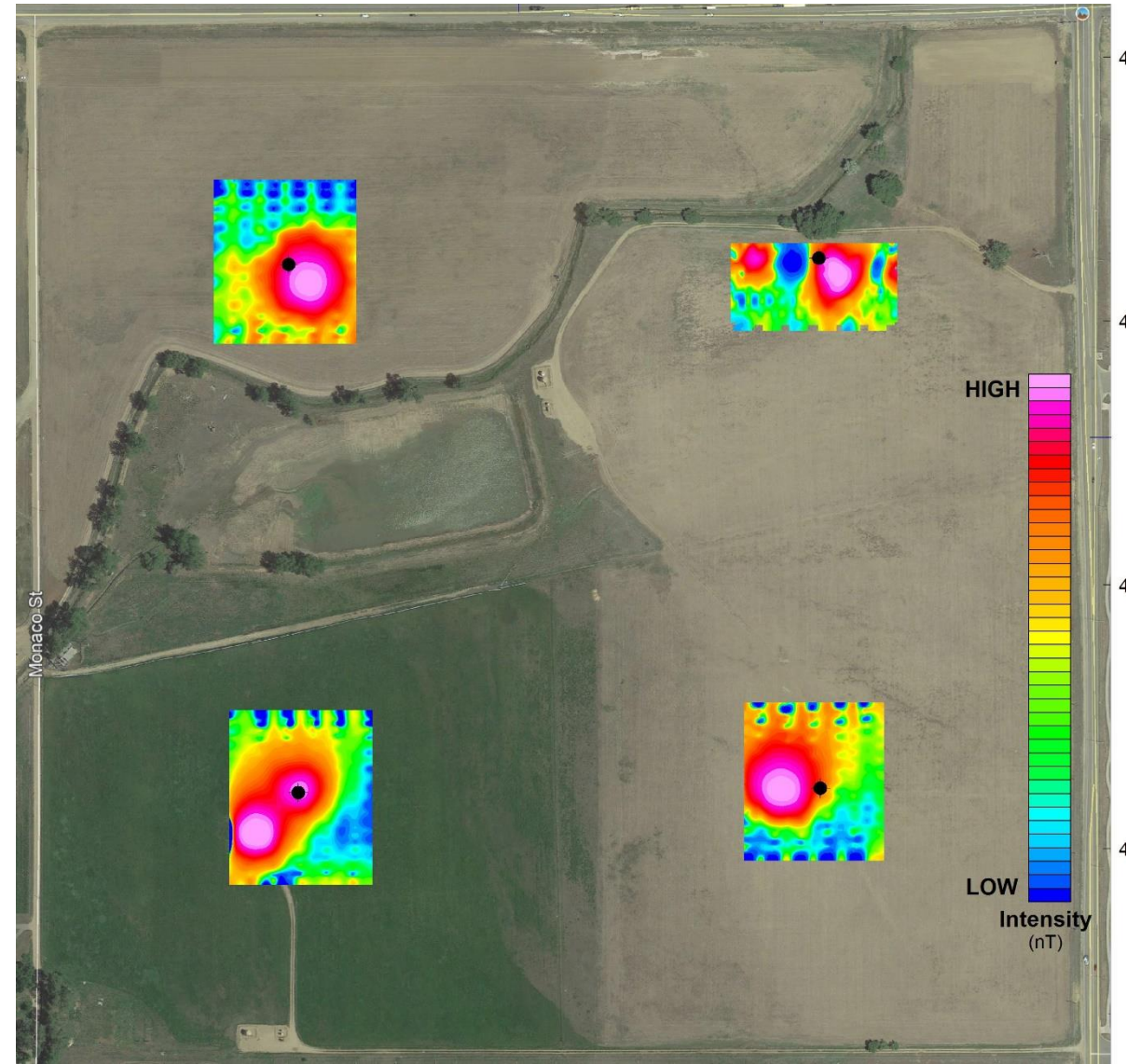
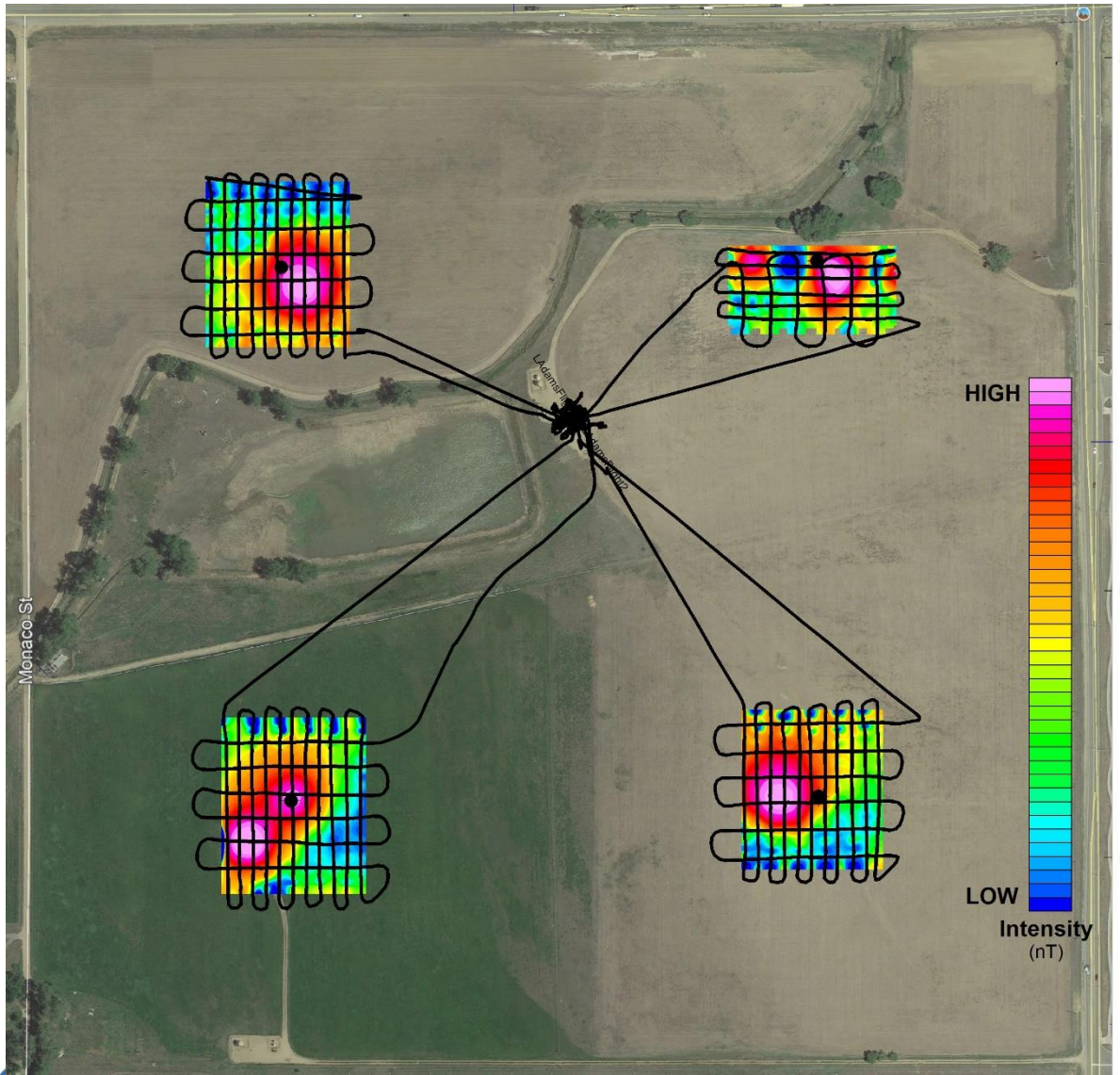


Total flight time: 60 min



Total flight time: 75 min





Total Magnetic Intensity

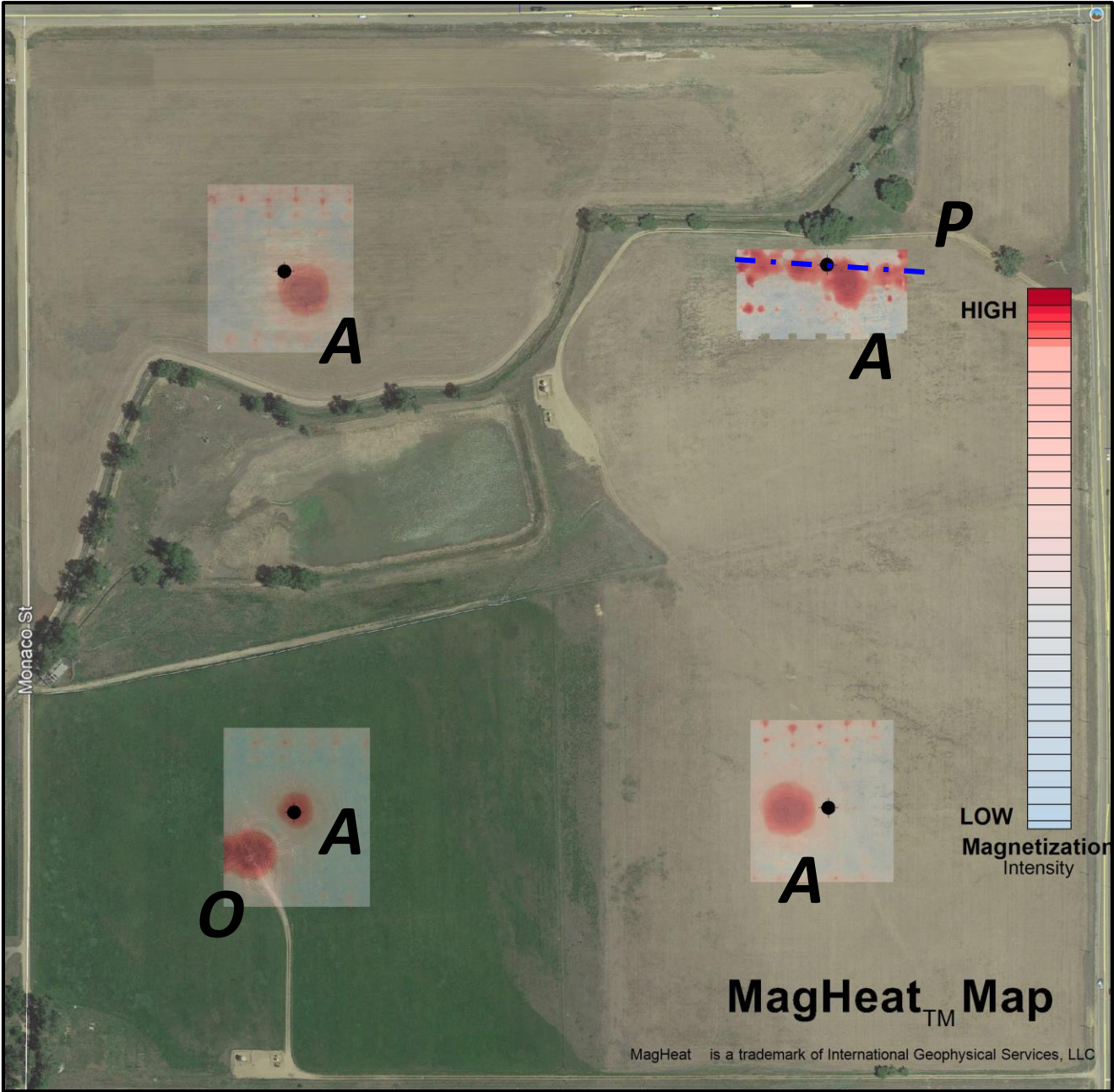
Analyzing the Results

A abandoned well

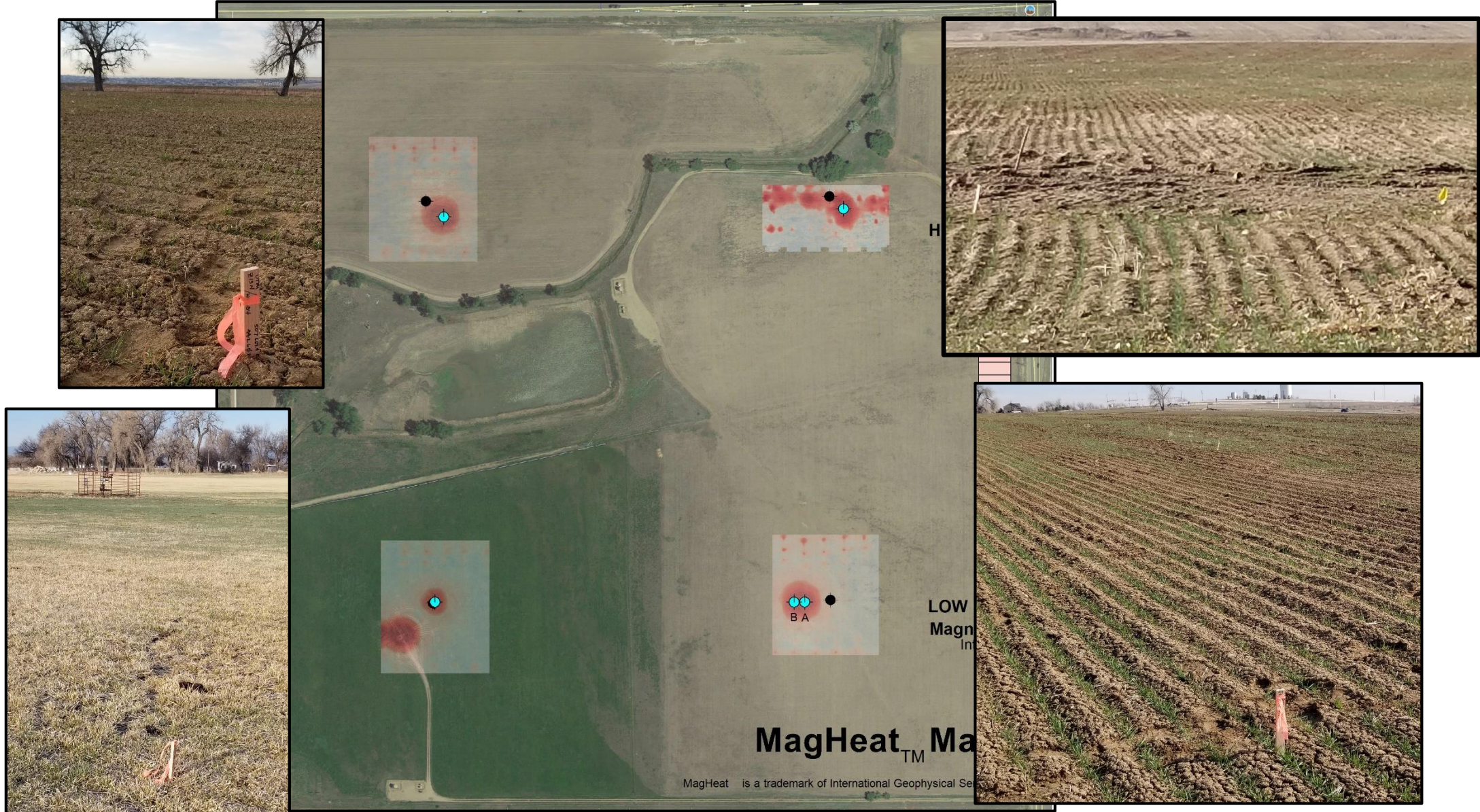
P buried pipeline

O operating well

● COGCC well location



Tagging the Location



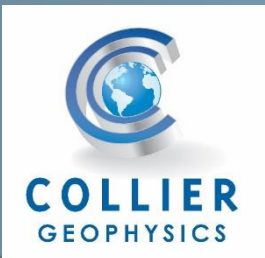
● MagHeat well location

● COGCC well location



Thank you for your attention.

Questions?



For more information, contact:

Ron Bell

Senior Geophysicist
& geoDRONEologist

Tel #: 720-220-3596

Email: ron@collierconsulting.com

Lakewood, CO - 720-487-9200

Austin, TX - 512-995-6995

West Bend, WI - 239-896-0576

Stephenville, TX - 254-968-8741



COLLIER
GEOPHYSICS

Geotechnical * Environmental * Resource Exploration