RETTEW

BURIED SUBMARINE DETECTION SURVEY
~FIVE-ACRE CLIENT-DESIGNATED PROPERTY
RANCOCAS CREEK ENVIRONS

DELRAN TOWNSHIP, BURLINGTON COUNTY, NEW JERSEY

September 20, 2024

Prepared for:

Black Laser Learning
23 Cove View Lane
Arrowsic, ME 04530

Prepared by:

RETTEW Field Services, Inc.
3020 Columbia Avenue
Lancaster, PA 17603

RETTEW Project No. 0105301165

RETTEW
We answer to you.
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E-mail: rettew@rettew.com ● Web site: rettew.com
Engineers
Environmental Consultants
Surveyors
Landscape Architects
Safety Consultants

September 16, 2024
Revised September 20, 2024

Vince Capone
Black Laser Learning
23 Cove View Lane
Arrowsic, ME 04530

RE: Report for: Buried Submarine Detection Survey
~Five-Acre Client-Designated Property
Rancocas Creek Environs, Riverside, NJ
RETTEW Project No. 0105301165

Dear Vince:

On September 11, 2024, RETTEW Field Services, Inc. (RETTEW) conducted a reconnaissance geophysical survey to locate a suspected buried submarine in a tributary of Rancocas Creek. The survey covered the southern bank of Rancocas Creek, east of the railroad tracks (see **Figure 1**). Data were collected over thirty-seven acres in two flight directions at a single elevation.

SURVEY METHODS

To efficiently map potential ferrous metal targets, RETTEW performed an airborne magnetic survey using a Geometrics MagArrow MFAM magnetometer mounted on an unmanned aerial vehicle (UAV). Magnetic surveys measures variations in the Earth's naturally occurring magnetic field. When magnetically susceptible materials (such as iron or iron-rich steel) or hard-magnetized materials (e.g., magnetite, cast iron or other forged or heated materials) are present, they can alter the ambient magnetic field, resulting in either enhanced or suppressed readings of Earth’s magnetic field intensity.

Magnetic surveys generally record the “total field intensity” of the ambient magnetic field at grid stations or along profiles. At mid-northern latitudes (e.g., New Jersey), a single compact ferrous target typically produces a paired high-low (or “dipole”) anomaly, with a north-south separation between the anomaly peak and trough. Hard-magnetized items may produce dipole (paired high/low) or monopole (isolated high or low) anomalies.

The airborne magnetic data were recorded using a Geometrics MagArrow MFAM. Data were collected automatically at 100 readings per second (1000 Hertz or Hz) along profiles spaced approximately 50 feet apart, at an elevation of about 100 feet above ground level. MFAM sensors can detect a 1-ton target from up to 100 feet or more and can detect larger targets from even greater heights.

The MagArrow features an aerodynamic, lightweight carbon fiber shell with internal electronics, including two magnetic sensors, high-precision global navigation satellite systems (GNSS), and internal memory for wirelessly downloading position, altitude, and magnetic data to a field computer. The MagArrow operates independently of the UAV and its software.

The collected aeromagnetic data were corrected for diurnal variations to produce the residual magnetic field intensity. These data were gridded using the statistical moving average routine in SURFER by Golden Software. The residual magnetic field intensity was then contoured, as shown in **Figure 2**. This figure also summarizes the MAG survey's signal response, with a single target identified in the southwest corner of the survey area. Note that the large anomaly in the northwest corner of the survey area is due to ferrous metal from the railroad bridge.

RESULTS AND CONCLUSIONS

Figure 2 depicts the magnetic survey results. The contoured data reveal two magnetic anomalies in the survey area. The largest anomaly, located in the northwest corner, is attributed to the railroad bridge and its significant ferrous metal content. The second anomaly, in the southwest corner is smaller in footprint and magnitude. This anomaly is considerably smaller than the bridge anomaly, but still deviates significantly from the average field intensity across the entire survey area. A profile slice through the anomaly (see inset on **Figure 2**) indicates a peak deviation from background of nearly 20 nanoTeslas (nT).

Figure 3 reproduces a well-known nomogram[1] that predicts the intensity of magnetic anomalies for various targets as a function of distance from the sensor. The line for a hypothetical one ton of iron indicates an anomaly intensity of 2 nT (= 2 gammas) for a sensor height of 100 feet. Assuming that the anomaly magnitude would scale linearly with mass, the southwest anomaly with an intensity of nearly 20 nT would represent a target mass of roughly 10 tons. The exact amount of ferrous metal in the submarine has been estimated to be around 5 tons; however, the condition of the metal and its hard magnetization and magnetic susceptibility are unknown, so the target mass can only be roughly estimated. Coordinates for the anomaly peak, in State Plane 1983 - New Jersey FIPS 2900 (US feet), are indicated on **Figure 2**. The target appears to be a monopole rather than the typical dipole anomaly that would be expected for a magnetically susceptible target at the latitude of New Jersey. It is possible that either the other peak of a dipole anomaly lies to the south outside the survey area, or that hard magnetization of the target produces a monopole anomaly. Ground truthing should begin at the peak and move southward in case the aerial magnetic response only detected the negative field of a dipole response. If the anomaly is an actual dipole, the target would be centered at the inflection point between the positive (offsite) and negative (see **Figure 2**) peaks.

LIMITATIONS

The survey described above was completed using standard and/or routinely accepted practices of the geophysical industry, and the equipment employed represents, in RETTEW's professional opinion, the best available technology. RETTEW does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen site-specific conditions. We will notify you of such limitations or conditions, when they are identifiable.

We have enjoyed and appreciated the opportunity to have worked with you. If you have any questions, please do not hesitate to contact the undersigned.

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[1] Breiner, S. (1973). Applications manual for portable magnetometers (Vol. 395). Sunnyvale, California: Geometrics.

Sincerely,

Charles H. Rhine, MSc, PG
Senior Geophysics Project Manager
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Felicia Kegel Bechtel, MSc, PG
Senior Geophysical Advisor
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Enclosures
Figure 1: Data Coverage Map
Figure 2: Residual Magnetic Response
Figure 3: Magnetic Anomaly Nomogram

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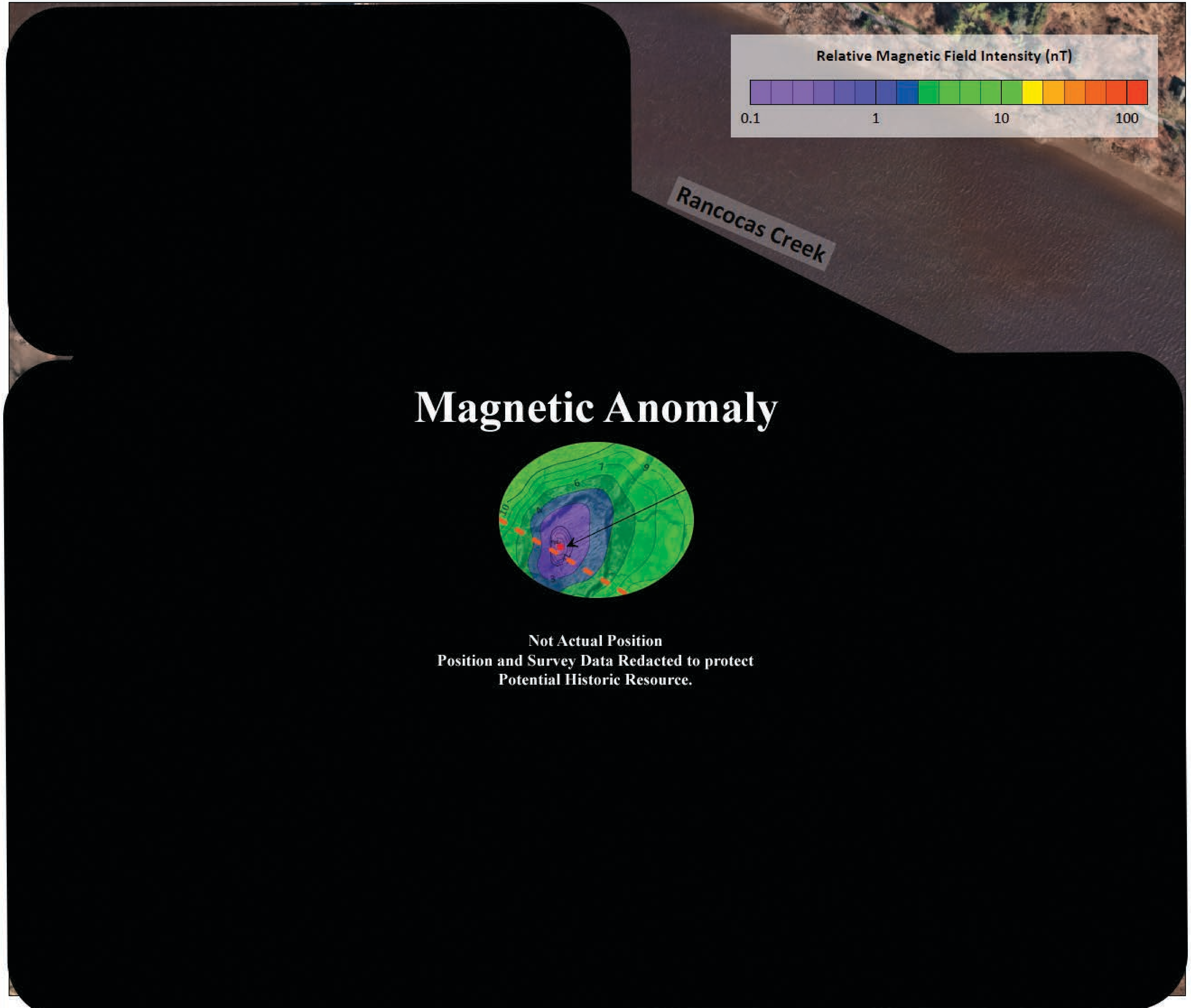

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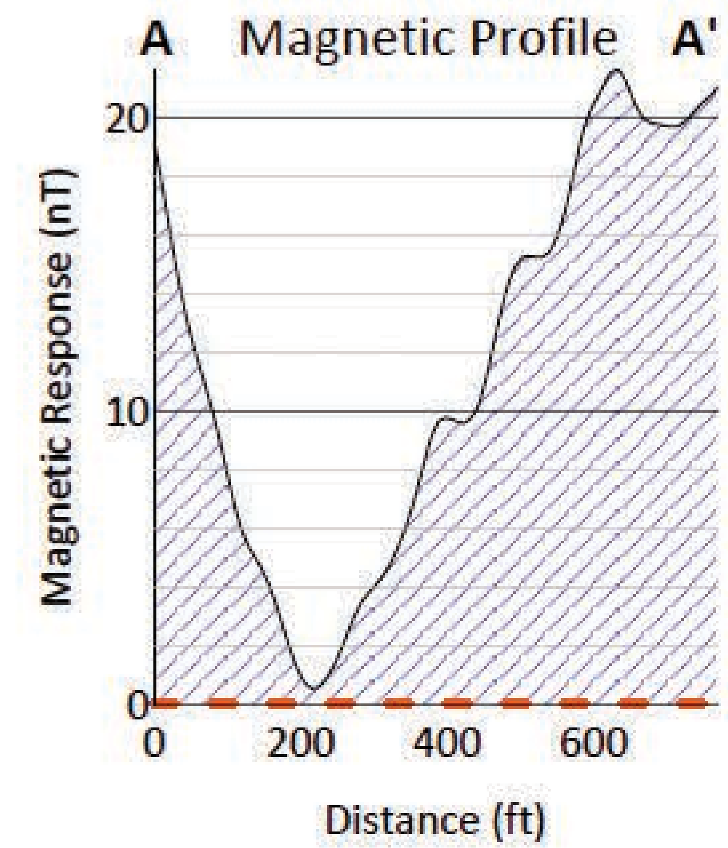

Notes:

Image from Nearmap, February 27, 2024.

Data from Geometrics MagArrow MFAM magnetometer at approximately 100-feet.

State Plane 1983 - New Jersey FIPS 2900 (US feet).

Figure 2: Residual Magnetic Response

Rancocas Creek Environs

DELRAN TOWNSHIP

BURLINGTON COUNTY, NJ

RETTEW[SM]

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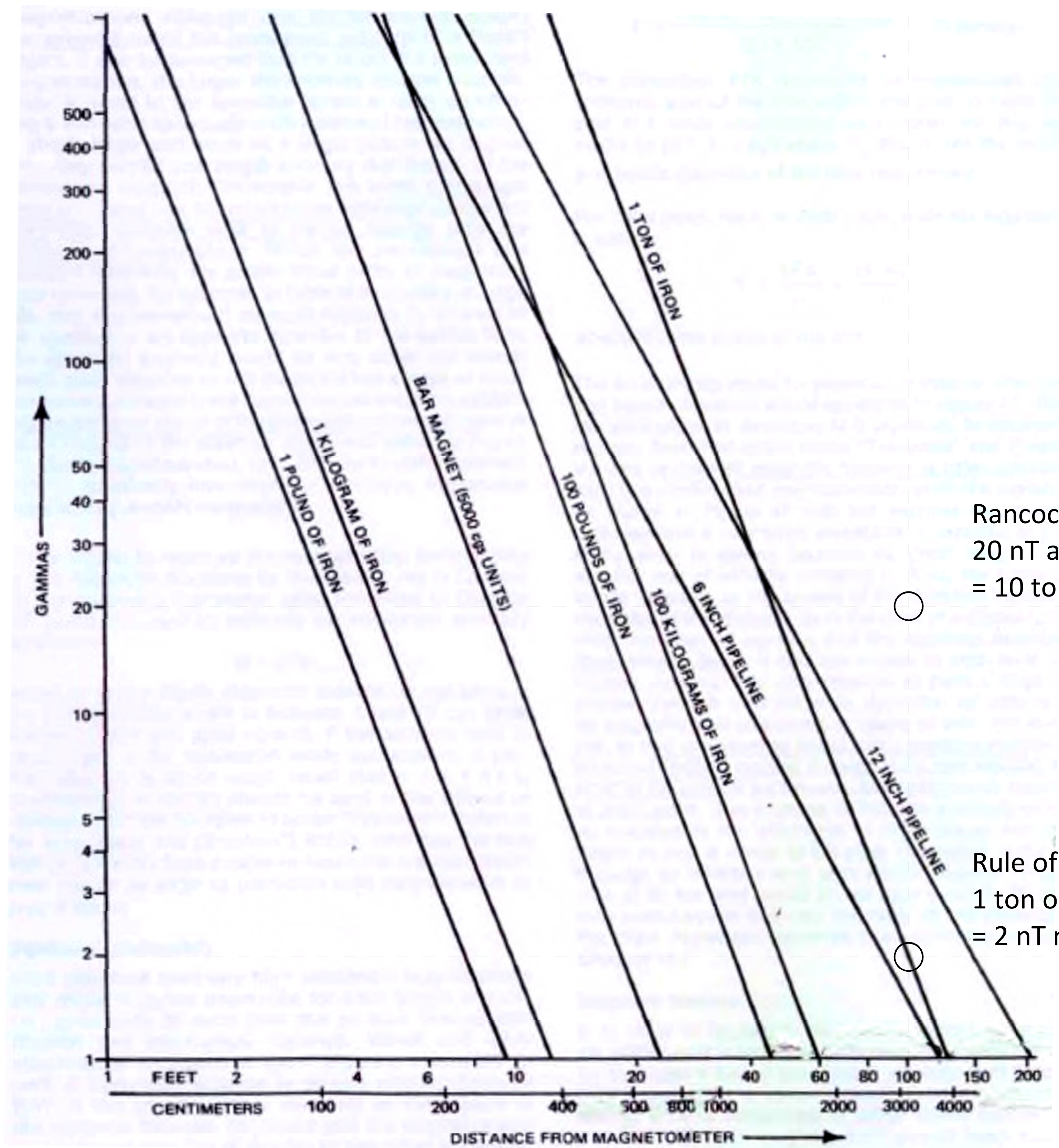
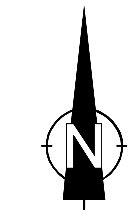
SURVEY DATE:	09/11/2024
RETTEW No.:	0105301165
REVIEWED BY:	FKB
DRAWN BY:	CHR
REVISION DATE:	09/20/2024
SCALE:	Graphical
FIGURE NO.	2 of 3



Rancocas Creek Anomaly:
20 nT anomaly
= 10 tons of iron (?)

Rule of Thumb:
1 ton of iron at 100 feet
= 2 nT magnetic anomaly



Notes:

Nomogram modified after Breiner, S. (1973). Applications manual for portable magnetometers (Vol. 395). Sunnyvale, California, Geometrics

1 Gamma = 1 nanoTesla

Figure 3: Magnetic Anomaly Nomogram

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FIGURE NO.	**3 of 3**