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MINISTÈRE
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**BRE_AO5 AREA
EXPORT CABLE
GEOPHYSICAL AND UXO SURVEY**

**BRE_LsM_TEC_51_RESULTS
REPORT – GEOPHYSICAL-
UXO SURVEY – AO5 EC
AREA_1.1_A**





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RESULTS REPORT

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ABBREVIATIONS

AAA	Anti-Aircraft Artillery
ADCP	Acoustic Doppler Current Profiler
ALARP	As Low as Reasonable Practicable
cm	Centimetre
CoG	Center of Gravity
CSAZ	Cesium Sensor Active Zone (Software)
DEMOB	Demobilisation
DGEC	Direction générale de l'énergie et du climat
DP	Dynamic Positioning
DPR	Daily production report
DTM	Digital Terrain Model
EC	Export Cable
EGN	Empirical Gain Normalization
FLO	Fisheries Liaison Officer
GEO	Geophysicist
GI	Borehole location
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRS	Geodetic Reference System
h	Hour
IGRF	International Geomagnetic Reference Field
INERIS	L'Institut national de l'environnement industriel et des risques
INS	Inertial Navigation System
JSF	EdgeTech Sonar data file format
Kg	Kilogram
KHz	kilohertz
LAT	Low Astronomical Tide


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ABBREVIATIONS

LMA	Luftmine A
LMB	Luftmine B
LSA	Land Service Ammunition
m	Meters
M	Minutes
MAG	Magnetometer
MBES	Multibeam echosounder
mm	Millimetre
MMO	Marine Mammals Observation
MOB	Mobilisation
MRU	Motion Reference Unit
nT	nanoTesla
OSS	Offshore substation
OWF	Offshore windfarm
PC	Party Chief
PEP	Project Execution Plan
POB	Personnel On Board
PPP	Precise Point Positioning
PPS	Pulse Per Second
PPSU	Pulse Power Supply Unit
pUXO	Possible unexploded ordnance
QA	Quality Assurance
QC	Quality Control
QGIS	Quantum GIS (Software)
QHSE	Quality, Health, Safety and Environment
REPCO	Report Coordinator
RGB	Red, green, blue
ROTV	Remotely operated towed vehicle


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ABBREVIATIONS

ROV	Remotely Operated Vehicle
RTE	Réseau de Transport d'Electricité
RTK	Real Time Kinematics
s	Second
SHOM	Service hydrographique et océanographique de la Marine
SIT	Surrogate Item Trials
SRF	Ship's Reference Frame
SSS	Side Scan Sonar
SVP	Sound Velocity Profiler
SVS	Sound Velocity Sensor
TBC	To be confirmed
TXT	Standard text document file format
UHR	Ultra-High Resolution
USBL	Ultra-Short Base Line
UTC	Universal Time Coordinated or Coordinated Universal Time
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
VRF	Vertical Reference Frame
VSAT	Very Small Aperture Terminal
WGS84	World Geodetic System 1984
WT	Work time

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1. INTRODUCTION

1.1. PROJECT OVERVIEW


Tecnoambiente carried out a geophysical survey over the proposed BRE_AO5 lot located in Morbihan, in the south of Brittany, close to western coast of Belle-Île-en-Mer and the southern coast of Île de Groix. The site is under consideration for a windfarm and offshore substation (Figure 1-1). This report summarises the survey operations and presents the results of the survey for the export cable area.

The dimensions of this area of interest are variable, being an area perpendicular to the coast with a length of 50 km, and with a corridor width of a minimum length of 1 km and a maximum of 4 km. According to the SHOM bathymetry, the site is located in water depths ranging from 0 to -100 m. The spatial surface this area represents is about 93.74 km² (Figure 1-2).

The objective of this report is to present the data obtained in the geophysical/UXO phase of the BRE_AO5 work area, focusing only on the Export Cable (EC).

The surveys of the UXO boxes within the export cable area of BRE_AO5 was carried out along the proposed route of the windfarm export cable from the offshore substation. A total of 50 UXO boxes were surveyed within the export cable corridor (EC). Figures 1-3 to 1-7 indicate the locations of these boxes

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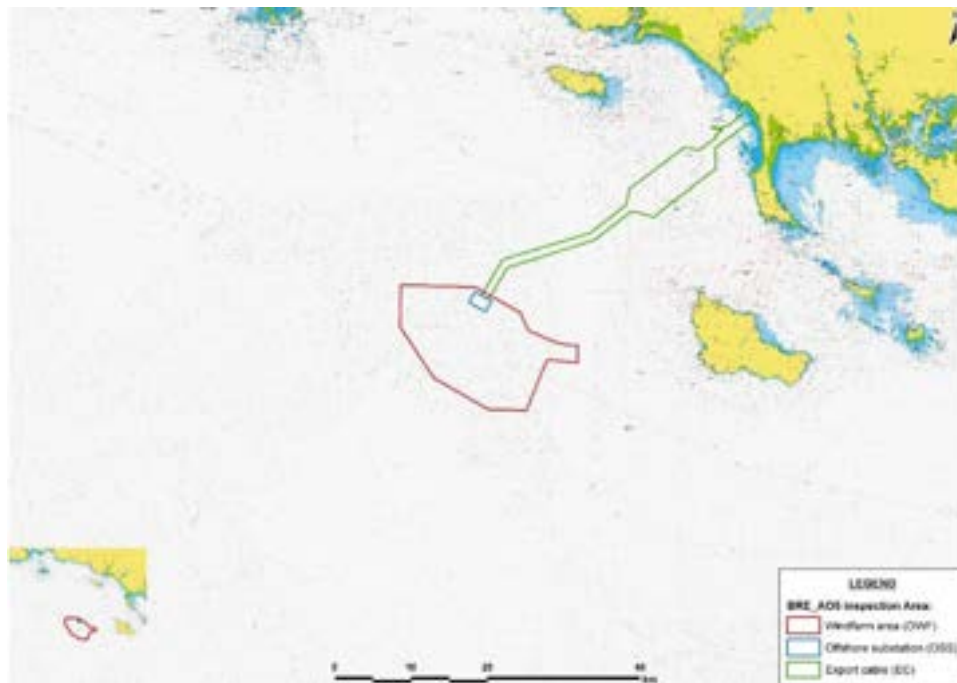


Figure 1-1: BRE_AO5 Survey area.

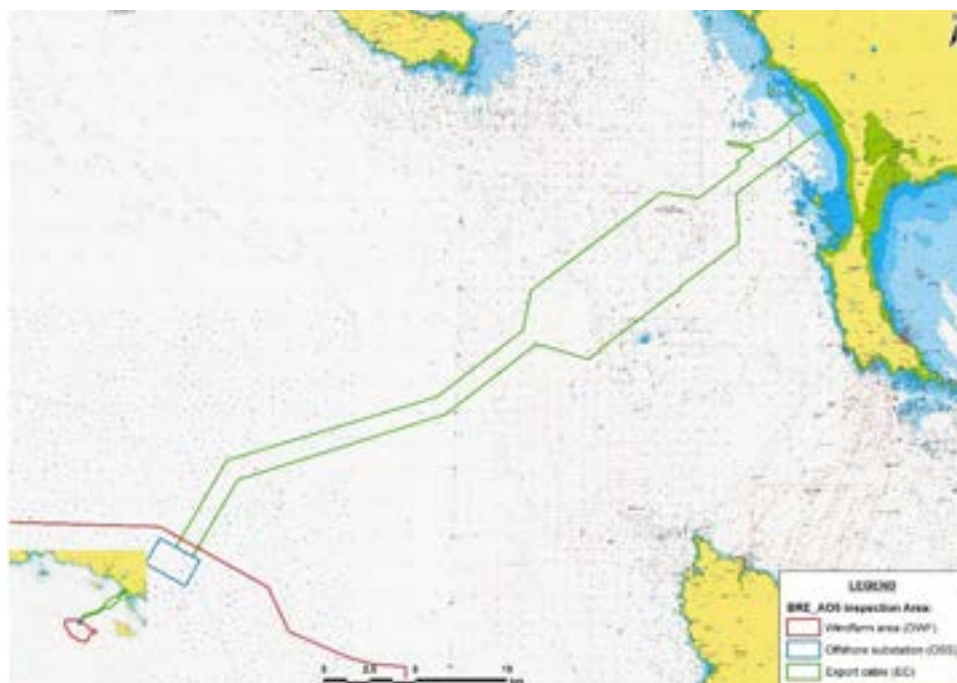






Figure 1-2: Windfarm area (OWF), Offshore Substation (OSS) and Export cable (EC) in the BRE_AO5 Survey area.

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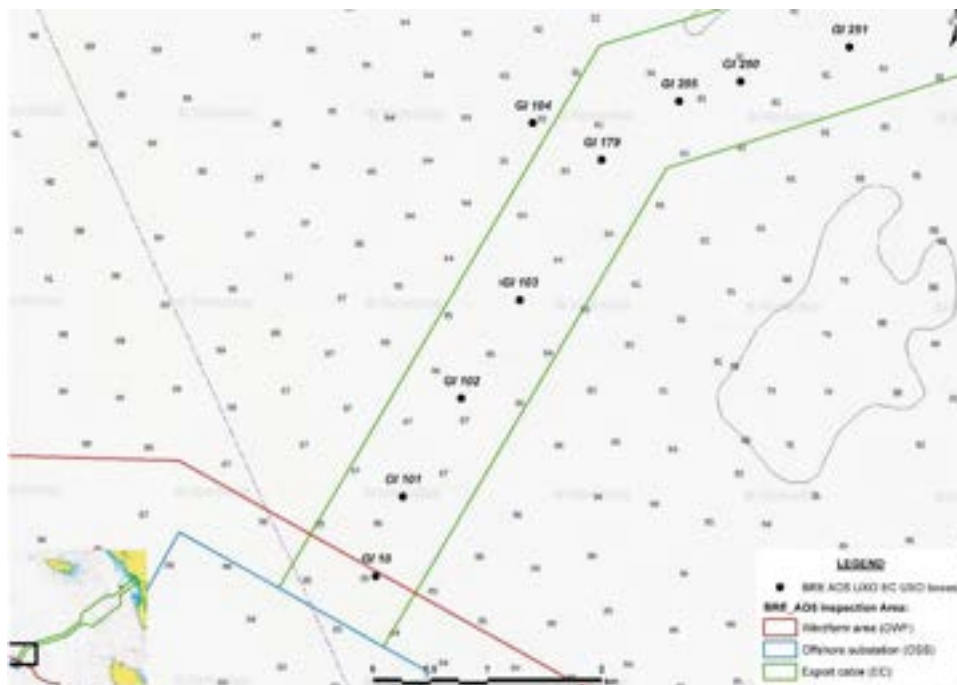


Figure 1-3: UXO boxes location and distribution at the BRE_AO5 Export cable area – Block 1.

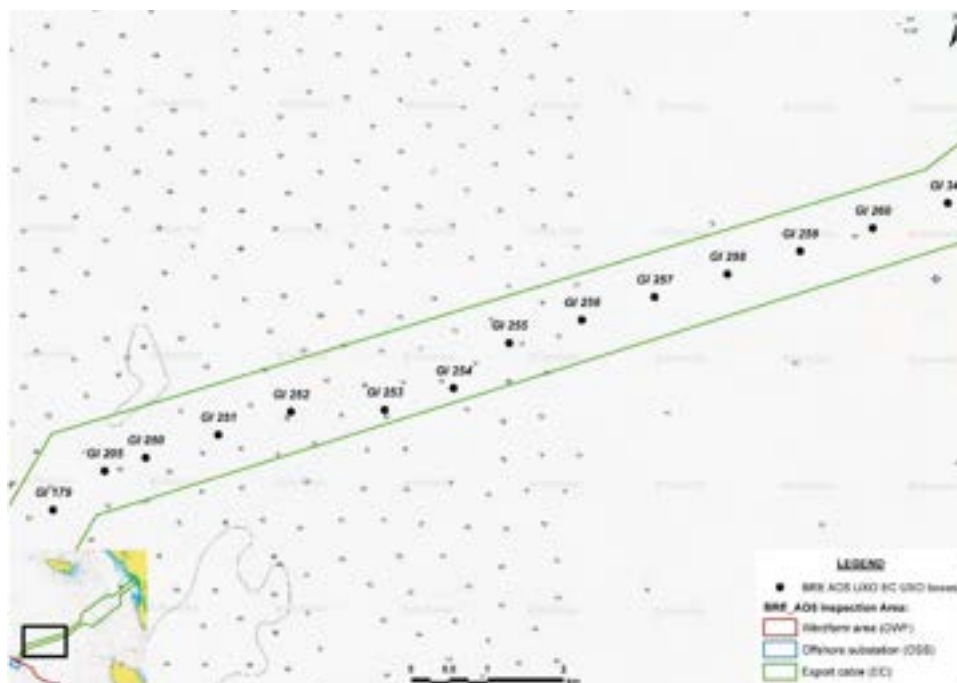






Figure 1-4: UXO boxes location and distribution at the BRE_AO5 Export cable area – Block 2.

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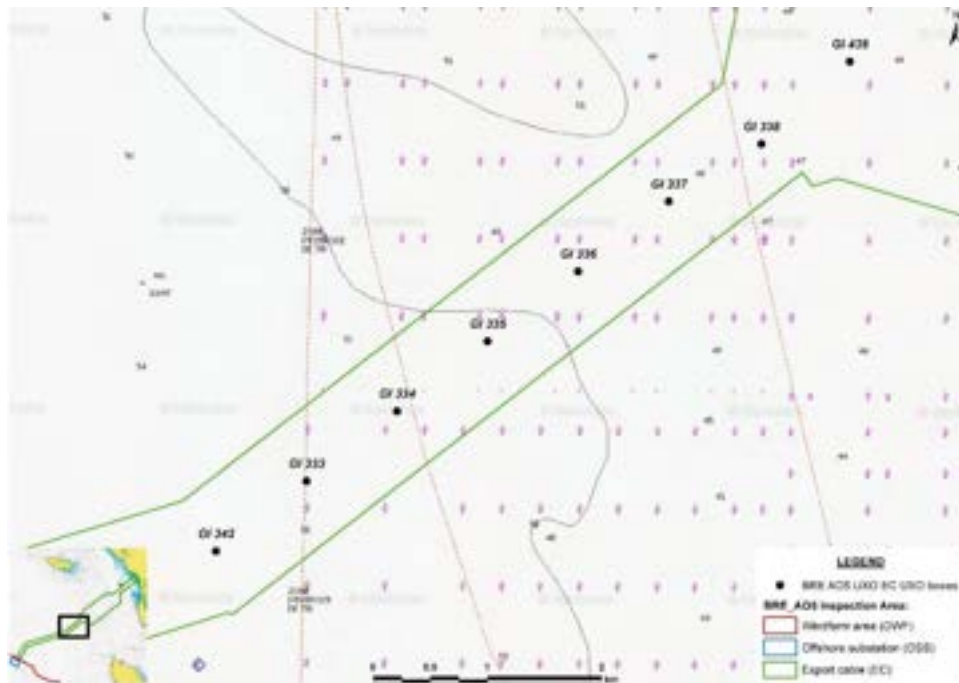


Figure 1-5: UXO boxes location and distribution at the BRE_AO5 Export cable area – Block 3.

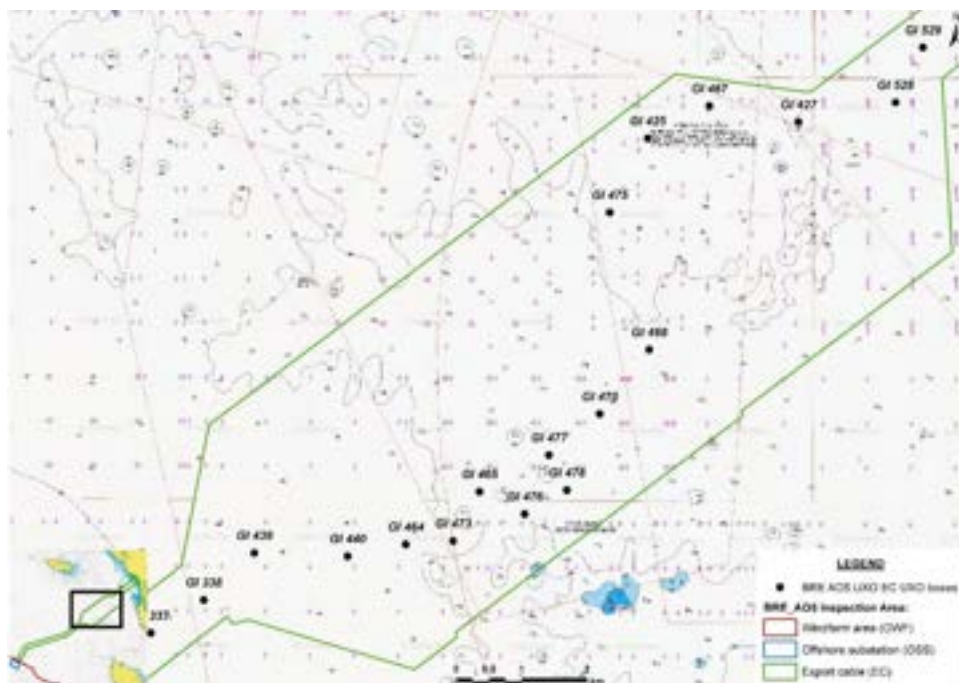



Figure 1-6: UXO boxes location and distribution at the BRE_AO5 Export cable area – Block 4.

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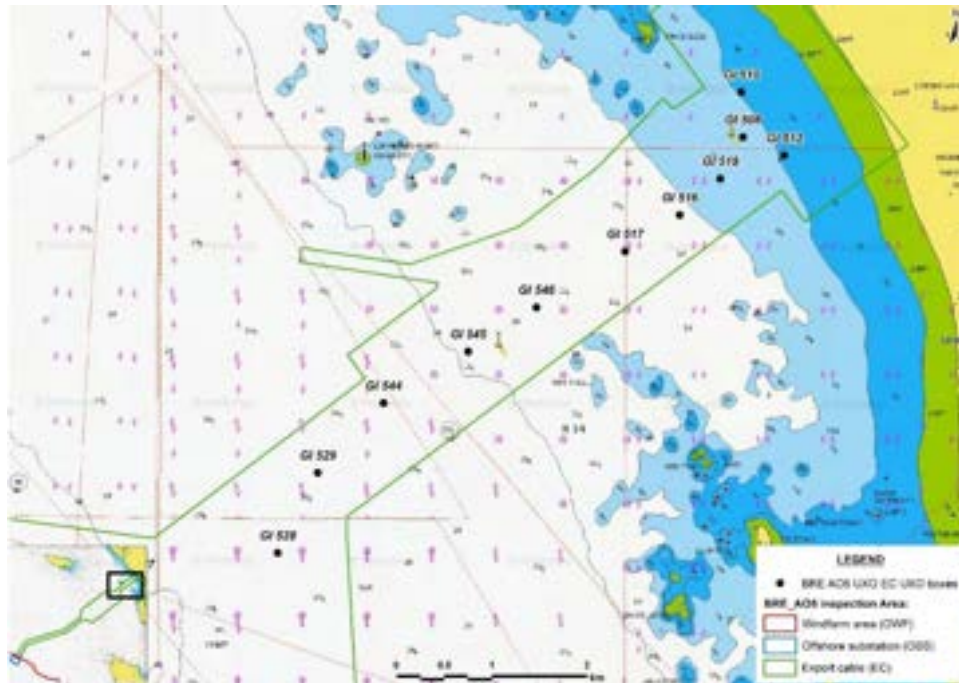



Figure 1-7: UXO boxes location and distribution at the BRE_AO5 Export cable area – Block 5.

Each of the UXO boxes comprises an area of approximately 30m x 30m (900 square meters), with a run in / run out length of 400 metres utilised to optimise the acquisition of the magnetometer data. Figure 1-10 provides an example of the UXO survey boxes and Figure 1-11 illustrates the survey line plan layout at 6m separation.

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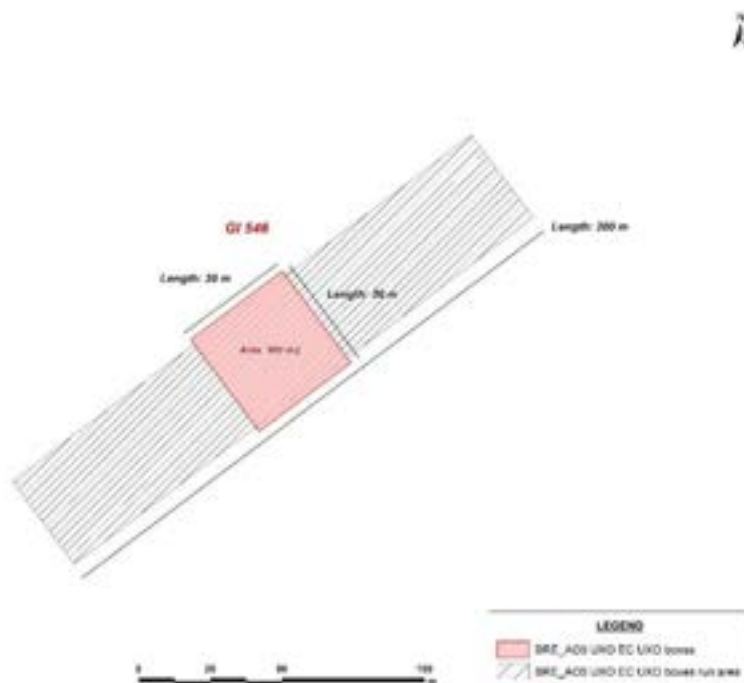


Figure 1-8: Example of UXO boxes dimensions at the BRE_AO5 Export Cable area (EC).

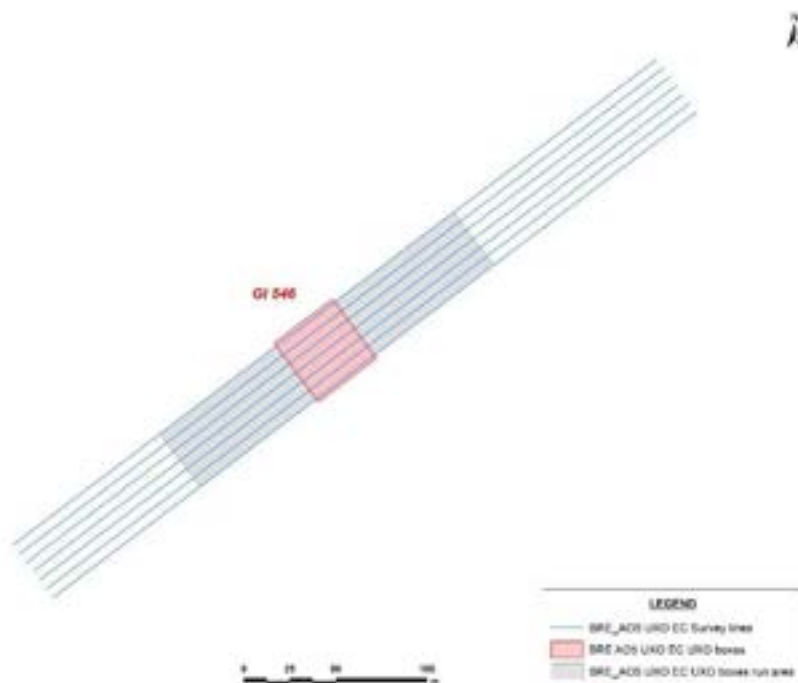



Figure 1-9: Example of UXO boxes survey line plan at the BRE_AO5 Export Cable area (EC).

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1.2. SCOPE OF WORKS

The objective of the site survey was to perform a geophysical and UXO survey over the proposed UXO GI points (Borehole locations) on the EC route area, comprising MBES, SSS and MAG datasets. The purpose of this was to:

- To define the final location of the GI points on the proposed box
- To detect magnetometer anomalies, and side scan and MBES contacts
- To review proposed borehole locations for geohazards

The main purpose of the study was to provide an ALARP certificate for intrusive geotechnical sampling over the BRE_AO5 EC area.

Although originally scoped for 50 UXO boxes, a total of 55 UXO boxes were surveyed within the export cable corridor (EC) due to the addition of 5 extra UXO boxes on the experimental route in the northern sector of the export cable and in the nearshore area. These additional locations have been reported in a separate document.

1.3. GEODETIC PARAMETERS





1.3.1. Survey datum

These parameters are detailed below.

Table 1: Datum parameters table

DATUM	
Survey Datum:	WGS 84
Spheroid	GRS 1980
Semi-Major Axis (a)	6,378,137.000

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DATUM	
Semi-Minor Axis (b)	6,356,752.31424
Inverse Flattening (1/f)	1/298.257223563

Table 2: Projection parameters table.

PROJECTION	
Projection	UTM
False Easting	500000
False Northing	0
Latitude of Origin	0°00'00.000000"
Central Meridian	3°00'00.000000"
UTM Zone	30 N
Scale Factor on CM	0.9996
Units:	Meters





1.3.2. Vertical datum

Vertical datum used by the Qinsy software is LAT Bathyelli v2 geoid published by the SHOM in December 2013. The Bathyelli LAT (SHOM 2013) is a surface based on the GRS 1980 spheroid. The same geoid model was used for the AO5 area during the 2021 survey.

1.3.3. Tidal reduction

To carry out the survey as accurately as possible, Tecnoambiente utilised MarineStar PPP corrections via satellite signal. When using an accurate GNSS system (RTK correction), the tidal corrections are carried out in real-time through Qinsy computations, as shown in Figure 1-12.

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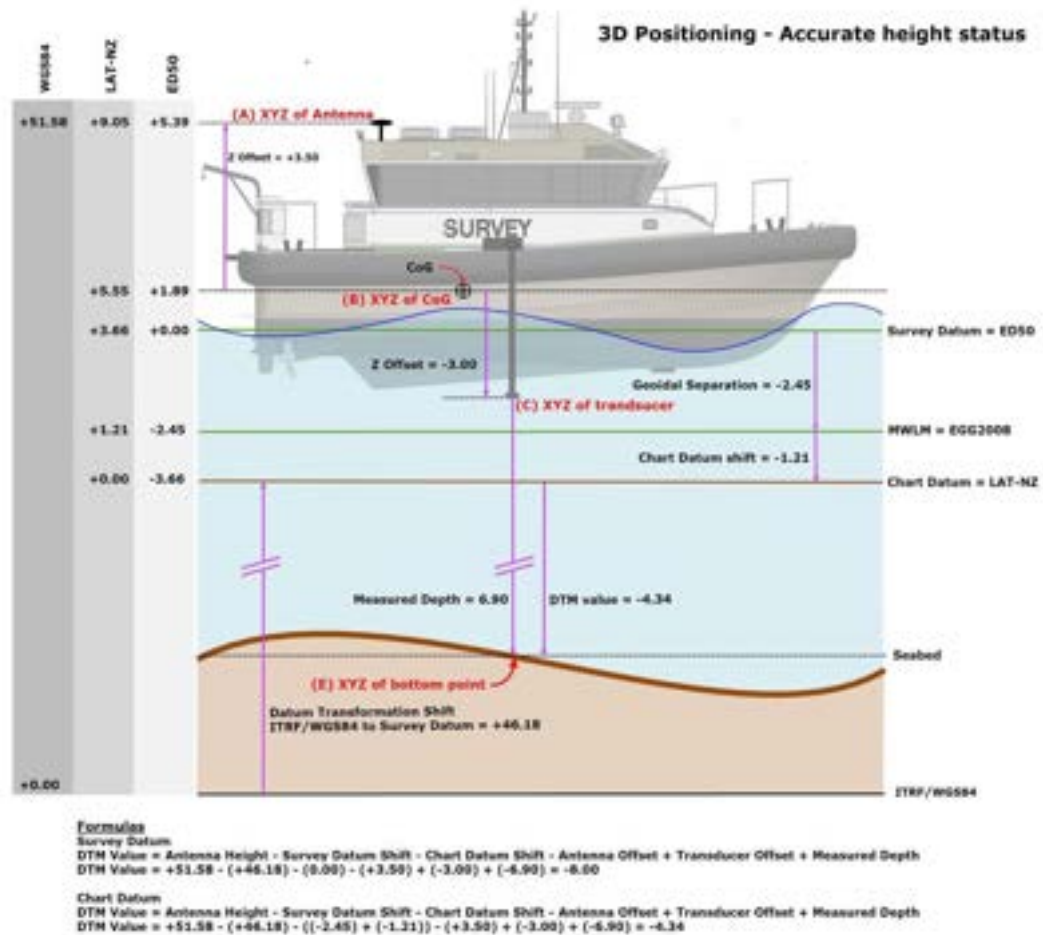






Figure 1-10: Qinsy method for accurate height calculation.

The separation between the WGS84 ellipsoid (GRS80) and the vertical datum is a model called Bathymetry v2. This comprises a set of surfaces, each of which defines the separation of one vertical datum from the WGS84 ellipsoid. If corrections drop out, they can be applied during post processing.

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2. GEOPHYSICAL DATASET

2.1. QA/QC CHECK

The processed values obtained from the onboard processing team during the survey are checked before the ALARP certificate phase. This quality control check of the input data validates the quality of the processing method. Here is the QA/QC for the measurements made:

- QC0: check of the geophysical value
- QC1: Check of the sensor position
- QC2: Check of the altitude of sensor and dynamic coverage
- QC3: Check of the noise
- QC4: Check of the speed and sampling frequency

2.2. SIT SURVEY





The calibration test (SIT) was carried out using ferrous surrogates, weighing 10 kg, 25 kg and 50 kg, in order to be consistent with historical data (Ref 01), considering the lowest detectable magnetic signal and the largest ammunition size. This test makes it possible to estimate the precision of the survey positioning, the amplitude of the signal to be sought and the detectability distance.

After mapping an area to make sure it was clear of potential targets, the surrogates were immersed. Several altitudes were utilised to undertake the calibration test above the surrogate: 3 m, 5 m, and 6 m (Figure 2-1). Each of the three surrogates were detectable at all altitudes (Ref 05); however, the amplitude of the signal at the 6 m altitude for the 10kg weight was found to be only 0.8 nT/m, well under the used cut-off of 2 nT/m.

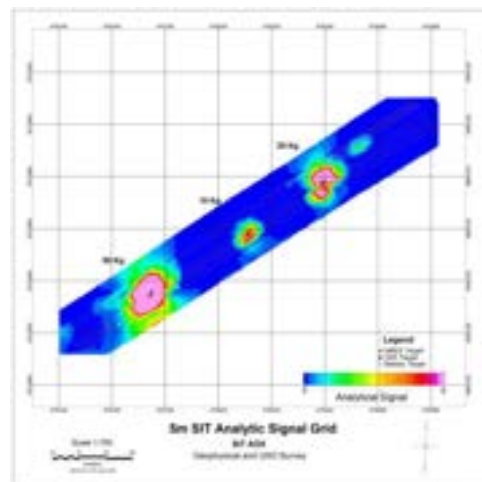
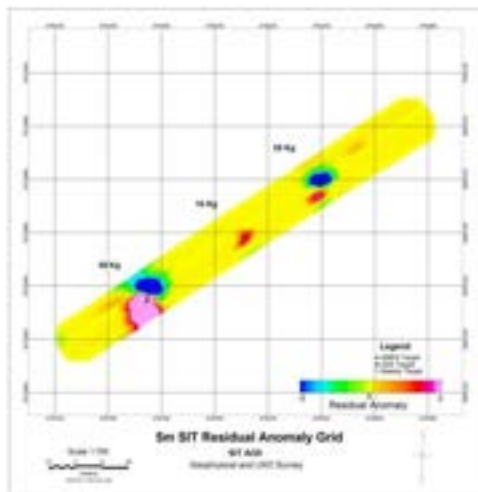
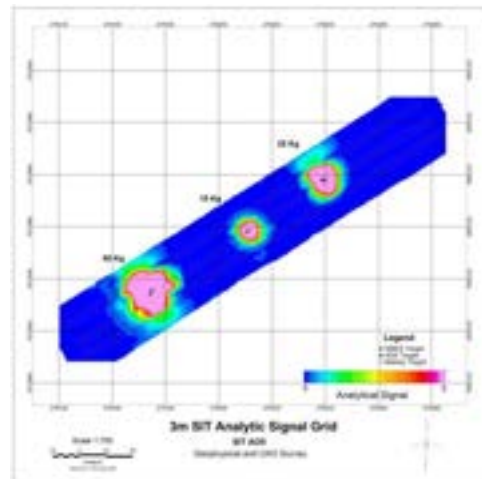
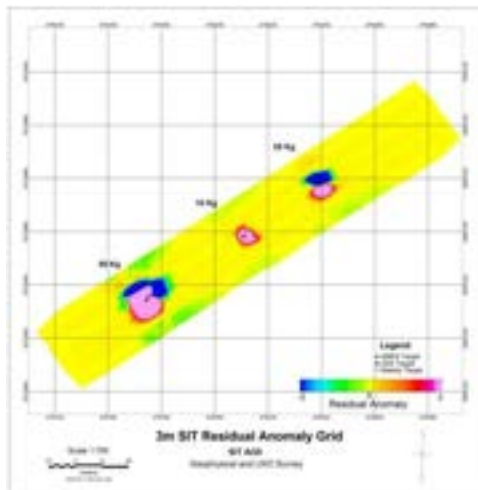
From these SIT data we were able to estimate:

- The uncertainty of the survey at 2.5 m average (Table 3, 4 and 5)


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- A detection range of 6 m for a ferrous mass superior to 25 kg
- A detection range of 4 m for a ferrous mass of about 10 kg



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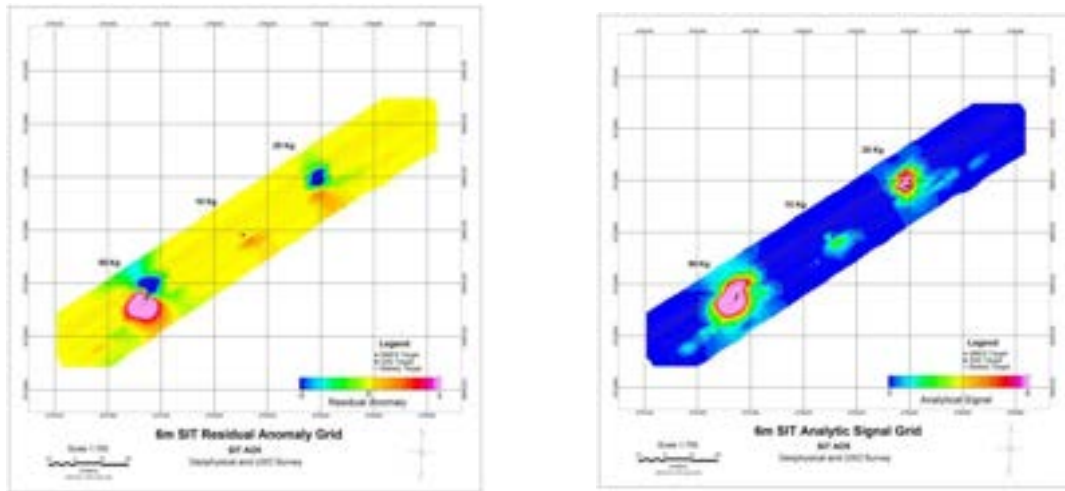


Figure 2-1: Result from the SIT, Residual field, and Analytic signal at 3m and 6 m altitude.

Table 3: Position verification of 10 Kg item.

	Source	Easting (m)	Northing (m)	Δ Easting (m)	Δ Northing (m)	Total Deviation (m)
10 Kg Surrogate Item	SSS position	479210.87	5272858.14	N/A	N/A	N/A
	Blakely test @ 3m	479211.5	5272859.0	0.63	0.87	1.08m
	Blakely test @ 5.0m	479212.50	5272857.50	1.64	0.64	1.72
	Blakely test @ 6.0m	479213.00	5272856.00	2.13	2.14	3.01

Table 4: Position verification of 25 Kg item.

	Source	Easting (m)	Northing (m)	Δ Easting (m)	Δ Northing (m)	Total Deviation (m)
25 Kg Surrogate Item	SSS position	479239.83	5272877.72	N/A	N/A	N/A
	Blakely test @ 3.0m	479239.5	5272879.00	-0.33	1.28	1.32
	Blakely test @ 5.0m	479239.00	5272880.00	0.81	2.27	2.41
	Blakely test @ 6.0m	479238.00	5272878.50	1.83	0.76	1.99

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Table 5: Position verification of 72 Kg item.

	Source	Easting (m)	Northing (m)	Δ Easting (m)	Δ Northing (m)	Total Deviation (m)
50 Kg Surrogate Item	SSS position	479174.40	5272834.28	N/A	N/A	N/A
	Blakely test @ 3.0m	479174.00	5272835.00	0.40	0.26	0.47
	Blakely test @ 5.0m	479174.50	5515835.50	0.1	0.72	0.81
	Blakely test @ 6.0m	479173.00	5272832.50	1.40	1.78	2.24

3. DATA ACQUISITION

3.1. SURVEY ACQUISITION SCHEME


To ensure full coverage of the UXO boxes within the study area of the export cable area, data acquisition during the survey was carried out as follows:

Table 6: UXO data acquisition scheme information

Methodology	Survey lines	Range
Multibeam echosounder system (MBES)	6 m	75 m
Side Scan Sonar (SSS)		100 m
Gradiometer (MAG)		8 m

The following figure shows the basic data acquisition scheme for the UXO phase

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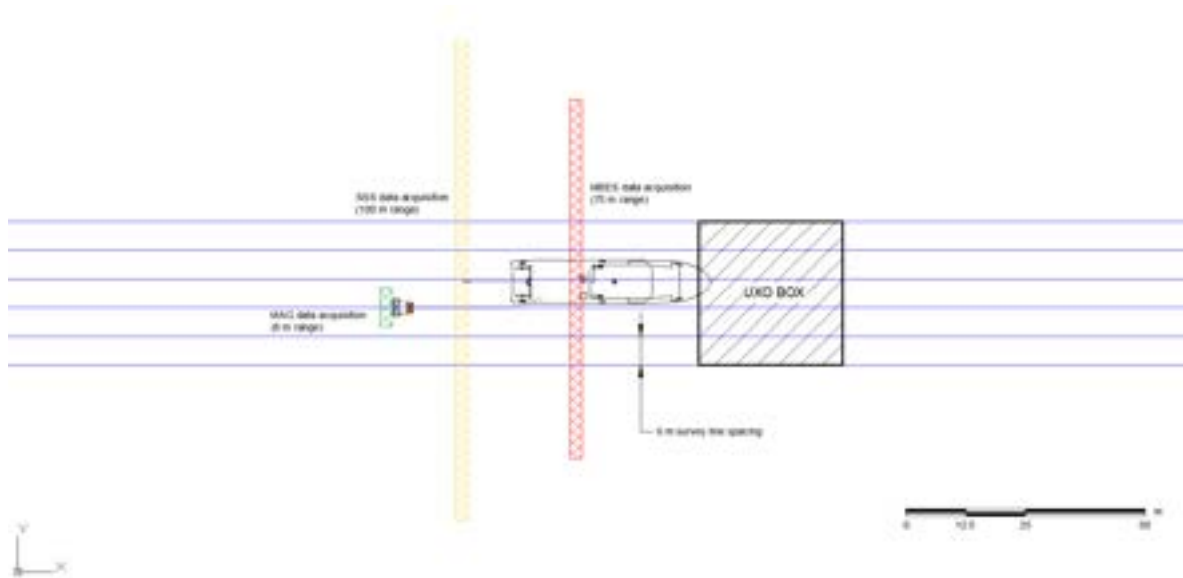


Figure 3-1: UXO data acquisition scheme.


The data acquisition of the three methodologies is performed not only in the target area, but the acquisition is extended to adjacent areas. This is done for two main reasons: on one hand, the line plan covers a larger area as a run-in/run-out zone to stabilize the sensors on the seabed; and on the other hand, to cover a larger area than the target area and thus obtain more data in case the UXO box has to be moved to a quieter area if necessary.

3.2. MULTIBEAM ECHOSOUNDER

The objective of this phase of data acquisition is the detection of possible MBES targets lying on the seabed. Due to the coverage requirements of gradiometer data acquisition, this required total coverage of the seabed within each of the UXO boxes, and hence a survey line spacing of 6 metres was utilised.

During data acquisition, the vessel's master must follow previously programmed routes along the project lines, shown on the computer screen (Helmsmann indicator). If the actual course deviates from the programmed route by more than a specified amount, or when there

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is a problem with a peripheral, such as a loss of GPS corrections, the vessel master is warned by the use of visual and audible alarms.


While the master follows the navigation lines, the acquisition module of the hydrography program captures all of the position data sent by the GPS, the raw values of the movement reference unit (Hydrins III) and the heading of the equipment; to correct the location of the soundings sent by the multibeam echosounder. This correction is made for each transmission pulse in real-time.

Parallel to data entry, data acquired by the equipment and peripherals are synchronized. This process is carried out by Qinsy and is complemented by the input of the time and the pulse per second (PPS) provided by the MRU, so that all data is time synchronised.

The guidelines followed by Tecnoambiente during the surveying for MBES data acquisition are as follows:

- IT-CM-36 SVP Deployment Recovery, Rev1.0
- IT-CM-01. Guidelines for Hydrography Project management, 5
- IT-CM-04. Bathymetric survey, 1
- IT-CM-14 Survey Basics Guidance, 1
- IT-CM-15 Online Surveying procedure, 3

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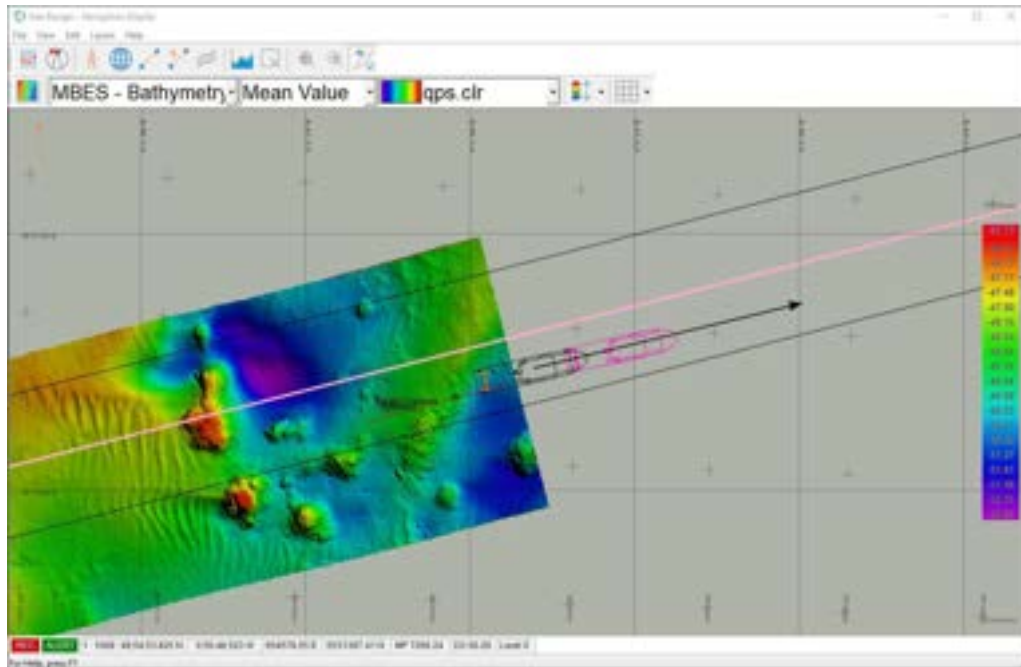



Figure 3-2: MBES bathymetry data acquisition with the Qinsy software.

During data acquisition, limits were applied to reduce soundings noise. These limits in the recording correspond to static gates of the equipment software that reduce the acquired registers noise, in accordance with statistical calculations of vertical uncertainty.

During the processing phase of acquired data, the lines on the screen are processed, in order to manually correct any noise that appears in the records. Noise is produced by multiple factors such as, multipath in position, air bubbles, cetaceans, motor interference from the vessel, etc., in the digital register of soundings. To make certain of the complete removal of any noise in the soundings, spike filters and spline filters were applied.

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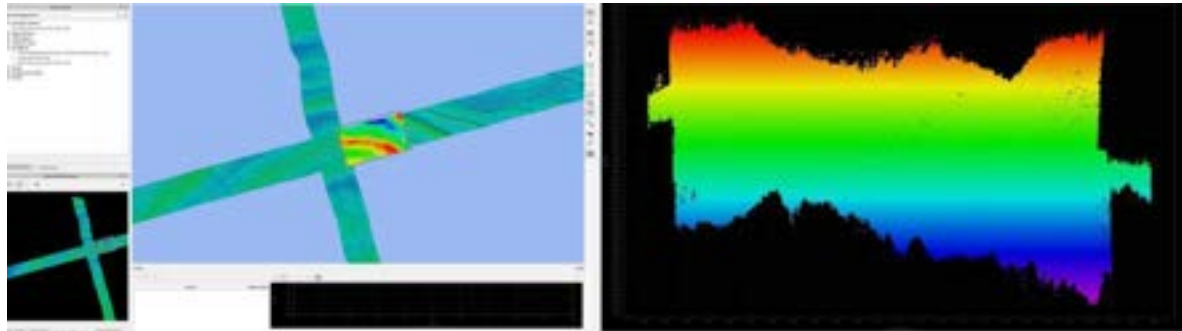


Figure 3-3: Processing screen of MBES bathymetry data with the Qimera software.

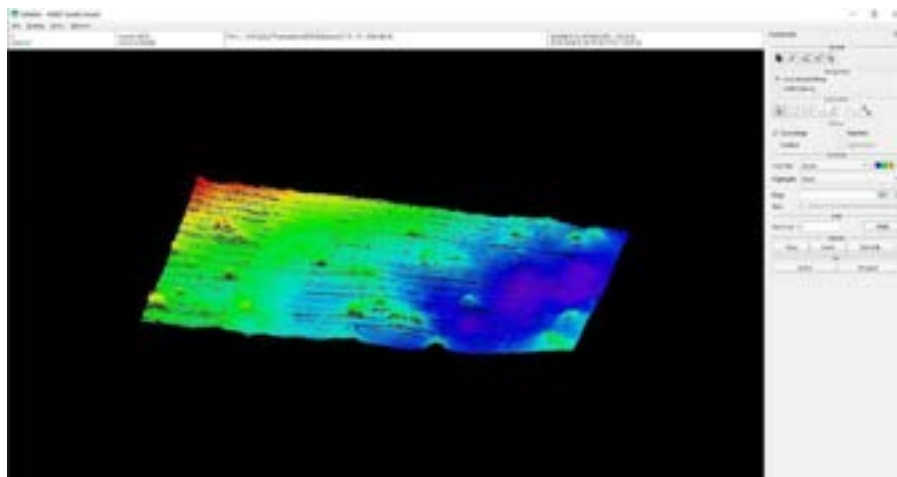



Figure 3-4: 3D image of the MBES bathymetry processing.

Once any possible existing errors in the records were deleted, a digital model of the terrain with 0.25 x 0.25 m grid size was produced, with a minimum cell size to obtain the maximum resolution of the seabed.

Digital terrain models (DTM) are created in Qimera. Once done, the DTM's are exported as 32bits RGB Geotiff, for each of the UXO boxes.

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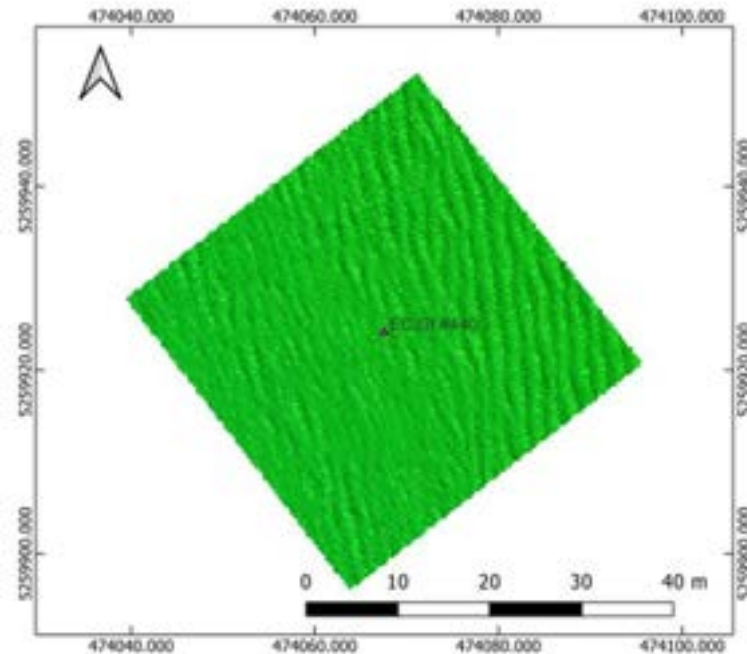


Figure 3-5: Example of the bathymetric data for GI 440.


3.3. SIDE SCAN SONAR – UXO SURVEY

The objective of this phase of data acquisition is the detection of possible sonar targets lying on the seabed. Due to the coverage requirements of gradiometer data acquisition, this required total coverage of the seabed within each of the UXO boxes, and hence a survey line spacing of 6 metres was utilised.

A side scan sonar system comprises a processing unit connected through a cable to a wet unit that transmits and receives acoustic energy. Side scan sonar can determine seabed morphology and configuration by means of acoustic signals. It can also determine its composition, identifying different seabed strata as hard (rocky or consolidated), soft or sedimentary, as well as identifying areas of seagrass.

Side scan sonar systems can work in different frequency ranges: systems working in high frequencies, (between 500 kHz and 900kHz) offer higher resolution but lower ranges, with

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systems working in low frequencies (100 kHz), offer lower resolution but higher ranges. For this survey, a frequency of 900KHz was utilised. The reflection of the signal coming from the seabed is detected by the same transducers, amplified, and transmitted to the control unit, and recorded and displayed on the computer screen, providing an acoustic map. With this data, it is possible to identify different seabed morphologies, together with the visualization of any seabed objects.

When the vessel is underway, the winch operator can start deploying cable until the fish gets to the desired working depth of about 6 m above the seabed.


The guidelines followed by Tecnoambiente during the surveying for SSS data acquisition are:

- IT-CM-01. SBL-SSS,1
- IT-CM-21. SSS Launch and Recovery, 0
- IT-CM-13. Geophysical Data Acquisition. General Procedure, 2
- IT-CM-14. Survey Basics Guidance, 0
- IT-CM-15. Online Surveying procedure, 3
- IT-CM-18. USBL Pole Deployment, 1

Once the SSS data were acquired and then exported into JSF format, the files are imported into the SonarWiz 7 software. Channels 3 and 4 were used for recording the high frequency data.

After data importation into the SonarWiz 7 software, an initial navigation correction was made for each imported file, applying smoothing filters to avoid errors in the heading of the tow fish. The track position was smoothed using a mean value of 300 pings.

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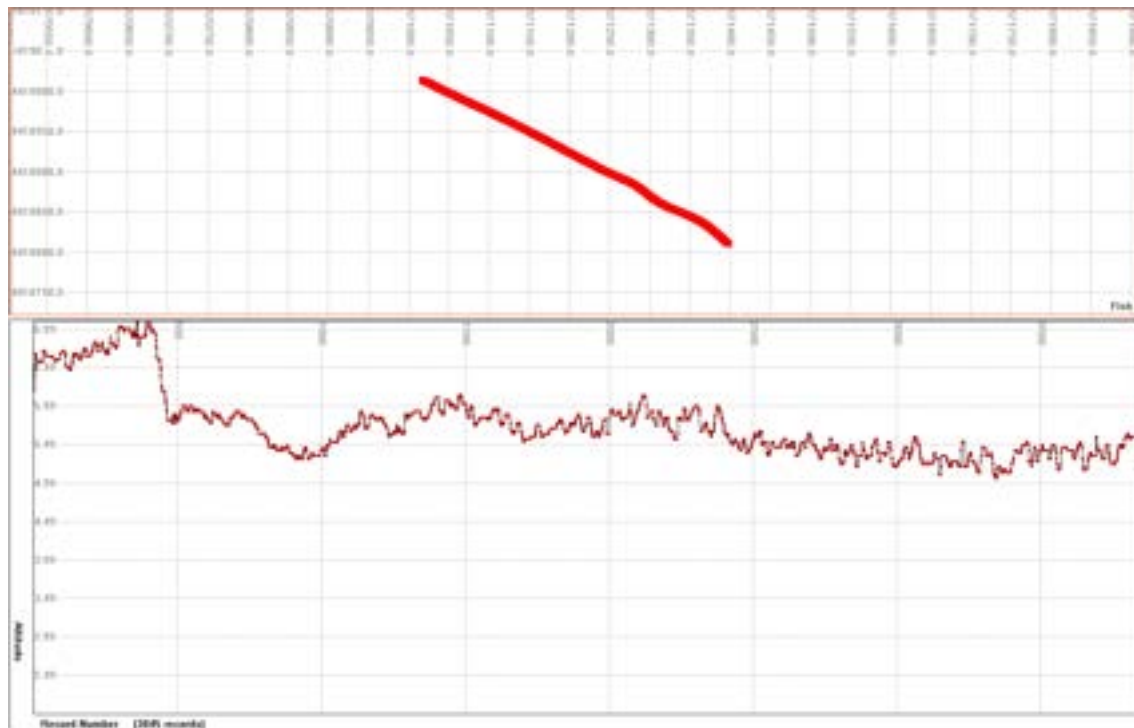



Figure 3-6: Navigation editor in SonarWiz 7.

After the aforementioned corrections were implemented, the water column for each file was eliminated, by applying the bottom-tracking acquired during the survey, as shown in Figure 3-7. If bottom-tracking of the tow fish failed during the survey, it was done automatically by applying filters or by drawing the seabed manually during post-processing. This enables slant range corrections for the digital data to be as accurate as possible.

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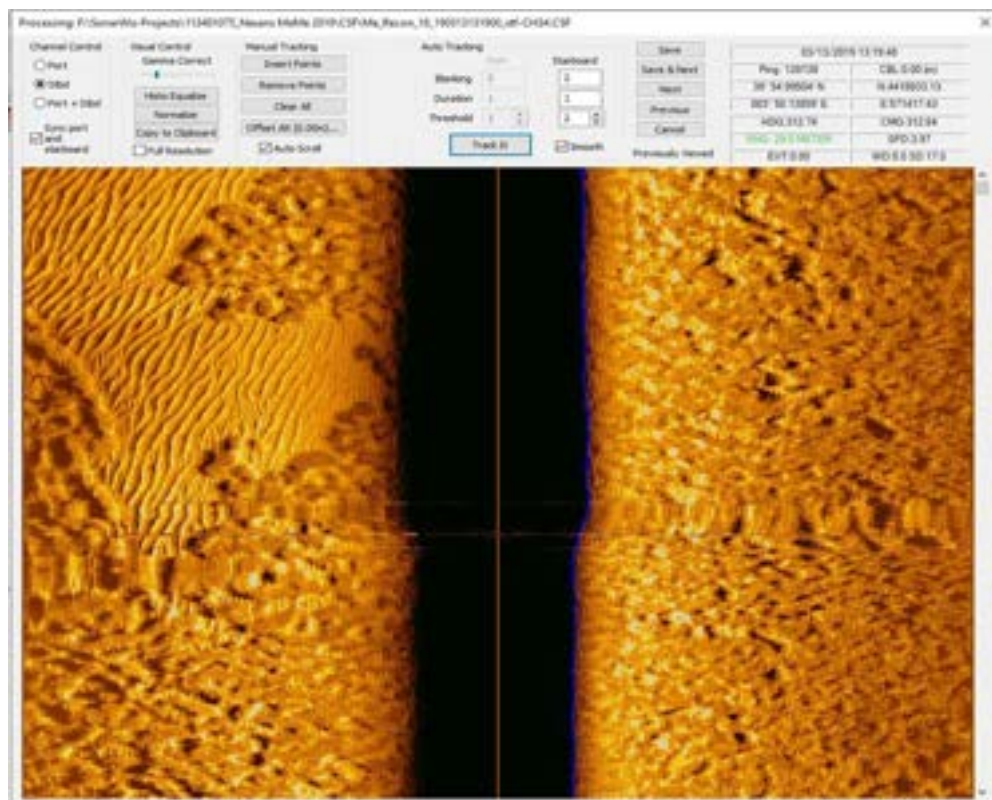


Figure 3-7: Bottom tracking processing drawn in blue in the SonarWiz software.


The following steps during SSS processing in the SonarWiz 7 software are the application and enabling of the EGN filter, and the enabling of the de-stripe filter.

At this point during data processing, a processed MBES geotiff is imported into the project. Using the MBES information, rotations to the SSS file are applied, in order to match feature orientations seen in the MBES data. Where necessary, a move offset can be applied to the SSS file, in order to match features within the MBES data.

Any observable contact within the area of interest is picked and its dimensions are measured.

The final processing step is the export of the sonar files into a GIS software package, where all of the information is integrated and a sonar mosaic is generated. This is carried out by

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converting the JSF files into 32bits RGB Geotiff images, to obtain georeferenced images of the processed data, with a resolution of 0.1 m.

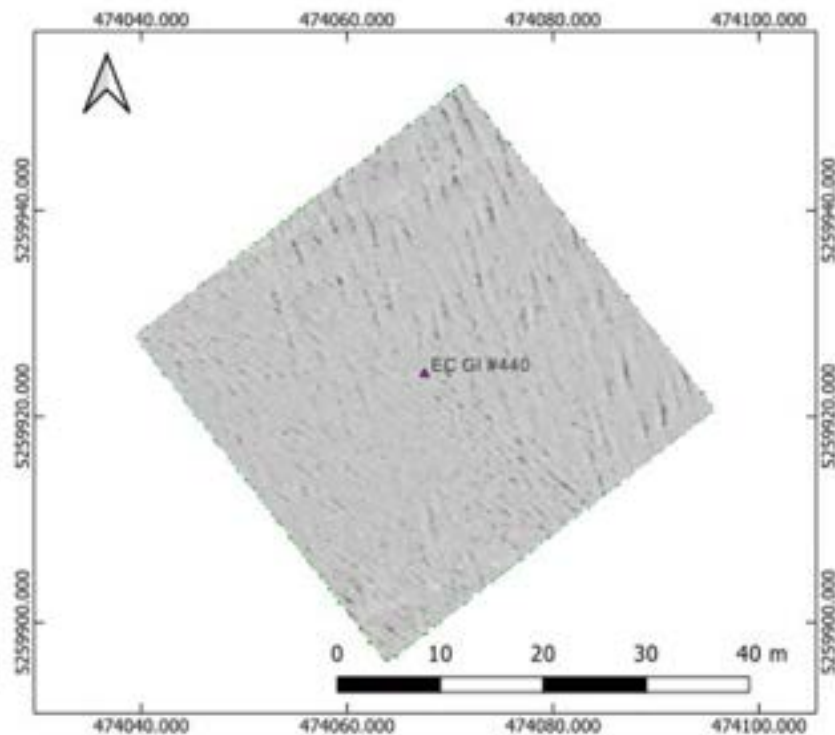


Figure 3-8: Example of the side scan sonar data for GI 440.


The guidelines followed by Tecnoambiente during the surveying for SSS data processing are:

- IT-CM-01. SBL-SSS,1
- IT-CM-27. SSS Processing procedure, 0

3.4. GRADIOMETER – UXO SURVEY

Magnetometer data were recorded using four Geometrics G-882 magnetometers fitted in a custom frame and spaced 1.1 metres apart, horizontally. Survey line spacing was set at 6

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metres. The frame has an automated bottom tracking function, allowing it to keep a fixed height above the seabed. After merging in Qinsy, all raw data were timestamped and output as .txt files were recorded for each magnetometer (Mag 1, Mag 2, Mag 3, and Mag 4).



Figure 3-9: ROTV with the fixed frame system for MAG acquisition.

The guidelines followed by Tecnoambiente during the surveying for MAG-UXO data acquisition are the following ones:


- IT-CM-25. UXO Mooring Procedures, 0
- IT-CM-18. USBL Pole Deployment, 1
- IT-CM-26. UXO Scanfish Launch and Recovery, 0

Data was processed, using the UXO Marine Mag module from OASIS software.

Positioning and altitude data were corrected to eliminate outliers (despiked), then filtered, and smoothed. Incorrect positions were removed, and the positions were filtered using a non-linear filter. All altitudes greater than 4 m were removed from the database.

The magnetometer data were corrected to eliminate aberrant values (“despiking”). They were also interpolated, but were also slightly smoothed, so as not to lose the weaker components of the signal.

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The magnetometer values were then processed, in order to compensate for variations in the altitude of the fish (increase in the signal when the magnetometer approaches the seabed). The magnetometer values were recalculated at a constant virtual altitude of 3 m above the seabed. The altitudes were smoothed, using a B-Spline filter. Processed positions and altitudes were then exported, to calculate dynamic coverage.

Finally, the long-wavelength component of the Earth's magnetic field was calculated using several successive non-linear filters. This long wavelength component includes diurnal variations, geological variations, and noise, as well as the International Geomagnetic Reference Field (IGRF). This was then eliminated from the data set, resulting in a residual component, comprising primarily anthropogenic magnetic anomalies.

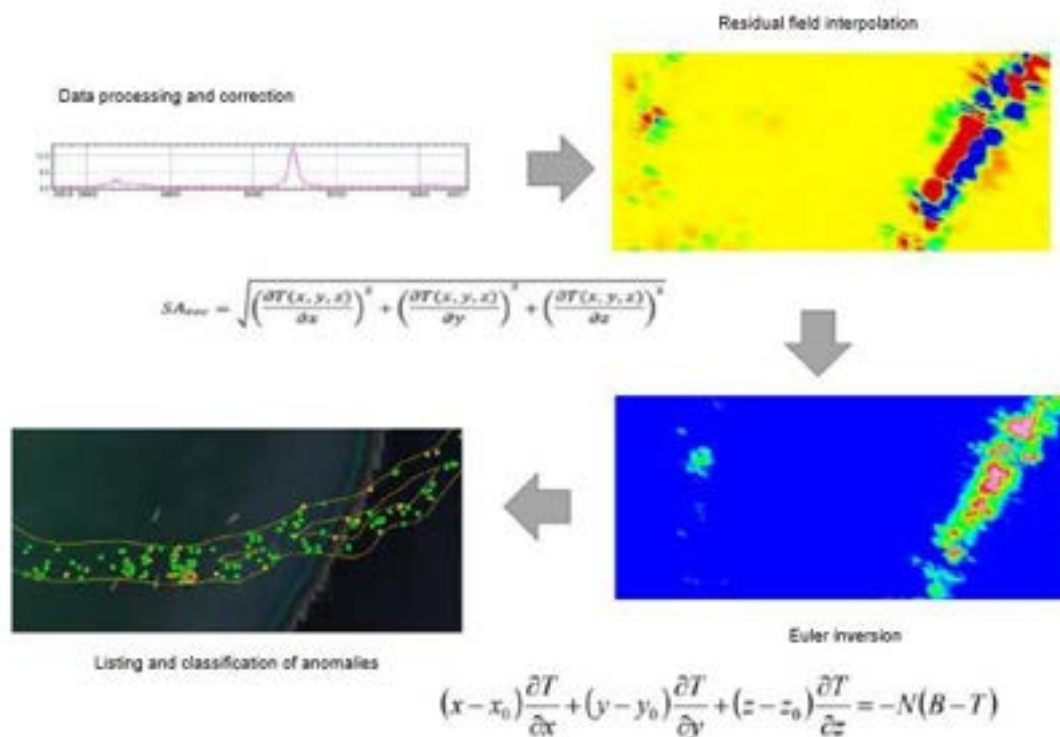



Figure 3-10: Processing workflow of magnetometer data.

A 2D map of the magnetic anomalies within the survey area was produced by interpolating these data, using a 0.25 m grid and 5 m blanking distance. The amplitude of the analytic

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signal was calculated using a 3D grid. The analytic signal is utilized for the mapping of structures and for the more precise positioning of any targets.

The results of the magnetometer measurements are included as two maps:

- A map of the residual magnetic field (in nT)
- A map of the analytical signal (in nT/m)

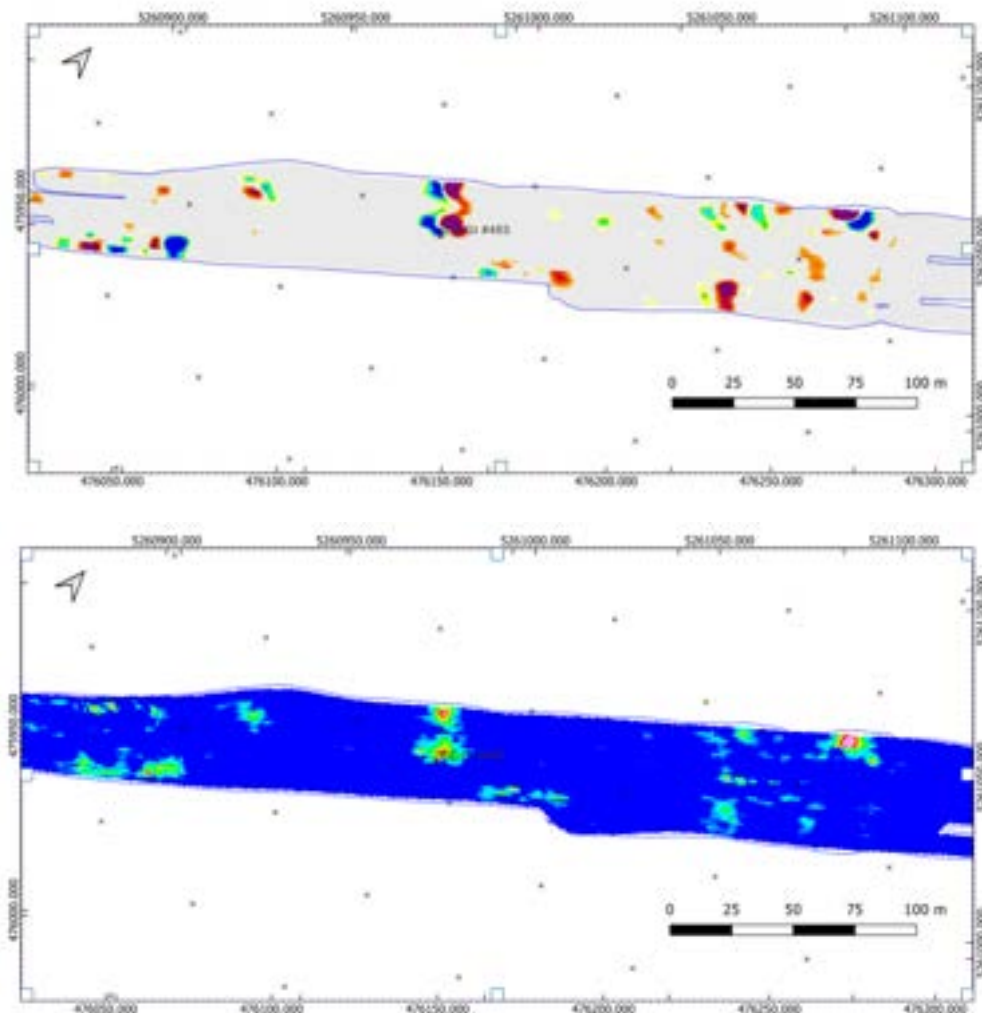






Figure 3-11: Residual field and analytic signal chart examples for position GI465.

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The magnetometer coverage depended on the spacing width of the surveyed lines and the height above seabed of the measuring device, making it possible to ensure the detection of an object at any point, by knowing the distance between the measuring sensor and the object. The requirements of the Scope of Work were met throughout the surveyed areas, i.e. detection of a 25 kg ferrous mass at a depth of 2 m and a maximum detection distance of 6 m (Penella 1982).

The dynamic coverage was calculated for a detection range (Δ) determined by the mass of the smallest object we were looking for and the depth below seabed of the soil intrusive activity.

The detection radius (d) under sensor was then calculated for each point, using the formula:

$$d = \sqrt{\Delta^2 - (alt + DBSF)^2}$$

Where:

Δ = Detection range


DBSF= Depth below seafloor

alt= Altitude of sensor

For the detection range of 6 m and depth of 2 m defined for this survey, the formula is defined as follows:

$$d = \sqrt{6^2 - (alt + 2)^2}$$

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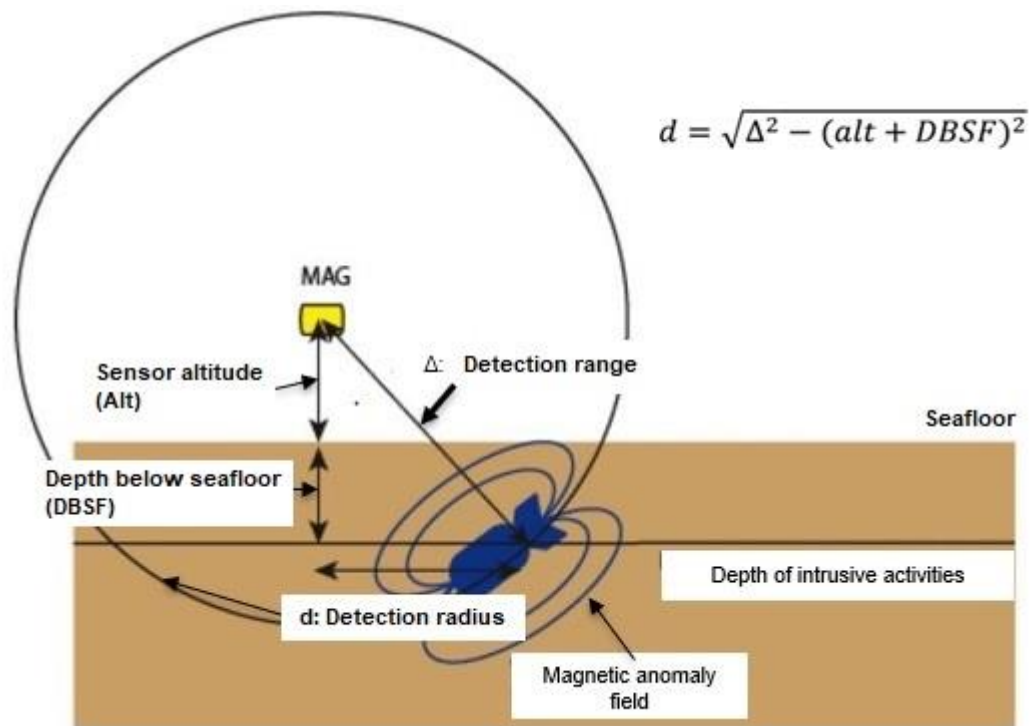






Figure 3-12: Dynamic coverage calculations.

This means that for each point of data, a circle of detection with radius d is drawn around this point. The data were opened within a GIS software package (QGIS). Drawing these circles in the GIS software, using a buffer of detection ranges, enables us to map the detection coverage and identify any data gaps.

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4. RESULTS





4.1. COVERAGE AREA

The survey took place over the EC GI boxes for a magnetometer coverage of 5000 m².

Table 7: Magnetometer coverage area (centroid of the GI box).

BOX	MAGNETOMETER SURVEY AREA WITH 100% DYNAMIC COVERAGE (m ²)
GI100_A	100
GI101	100
GI102	100
GI103	100
GI104_A-B	100
GI179_A	100
GI205	100
GI250	100
GI251	100
GI252	100
GI253	100
GI254_A	100
GI255	100
GI256	100
GI257	100
GI258	100
GI259	100
GI260_A	100
GI333	100
GI334_A	100
GI335_A	100
GI336	100
GI337_A	100
GI338	100
GI342_A	100
GI425	100
GI427	100

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BOX	MAGNETOMETER SURVEY AREA WITH 100% DYNAMIC COVERAGE (m²)
GI439_A	100
GI440_A	100
GI464_A	100
GI465_A	100
GI467	100
GI468	100
GI470	100
GI473	100
GI475_A	100
GI476	100
GI477	100
GI478_A	100
GI508_A	100
GI510_A	100
GI512	100
GI516_A	100
GI517	100
GI519_A	100
GI528_A	100
GI529	100
GI544	100
GI545_A	100
GI546	100
TOTAL	5000

4.2. ANOMALY PICKING

4.2.1. Magnetic anomalies

Visualization of the residual field map (in nT) makes it possible to locate any dipole anomalies present. The map analysis threshold (sensitivity of the display via the adjustment

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of the colour scale) is very important to validate the interpretation. By gradually decreasing the analysis threshold, it is possible to image anomalies of lower intensity. After analysis of the data, anomalies were manually picked, using the colour scale presented in Figure 4-1



Figure 4-1: Colour scale and threshold used for analysis of magnetic anomalies.

Anomalies were also detected automatically from the analytical signal grid with a 1.0 nT/m threshold (grid value cut-off of 1nT/m).

To execute the survey more efficiently, in the EC corridor, GI locations were linked by running longer lines.





For the EC corridor, longer survey lines were acquired, in order to survey several GI locations in a row. Using this method, the clearance strategy was to define quiet areas within a kilometre of the vicinity of the each of the theoretical proposed GI locations and therefore, the magnetic anomalies were not plotted along the whole of the route. Consequently, in line with the above methodology, a list of magnetic anomalies has not been issued, as they would not be exhaustive on the surveyed zones.

This methodology had two main objectives:

- To reduce the survey time and amount of line turns.
- To have the possibility of moving the locations several meters away of any obstructions or magnetic anomaly to ensure the clearance for geotechnical locations.

When a contact or obstruction was detected within the GI box, this could be moved

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to a magnetically quiet and free of obstruction area. Therefore, no contact list has been issued as the final locations are fully cleared.

4.2.2. MBES and side scan sonar anomalies

MBES and side scan sonar data were only analysed on 30 m x 30 m area around the original GI box locations, or around the alternative GI box locations. Thirty-three (33) side scan sonar contacts and forty-five (45) bathymetric contacts were detected along the EC survey corridor (Appendixes II and III)

4.3. DISCRIMINATION OF pUXO TARGETS


Magnetic anomalies indicate the presence of ferrous elements at or below the seabed. This is true for most types of unexploded ordnance (UXO).

Any magnetic anomaly can therefore correspond to a potential UXO

Therefore:

- Any side scan sonar or MBES contact with a magnetic signature is considered as pUXO.
- The shapes and lengths of side scan sonar and MBES contacts were analysed carefully for discrimination as non-UXO.
- Side scan sonar and MBES contacts without magnetic signatures and without any corresponding shape and length criteria are considered as non-UXO. But as these contacts correspond to potential obstructions on the seabed, they were mapped without any avoidance area indicated on the ALARP certificate maps.

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5. AVOIDANCE DISTANCES

Following the analysis, we are looking for as low as reasonably practicable (ALARP), areas that can be considered clear of any pUXO. The avoidance criteria have been defined following the UXO threat and risk assessment, with geotechnical investigation risk mitigation strategy recognised and the desktop studies (**Ref. 01**):

Thus, the avoidance distance can be calculated as follows (Figure 5-1):

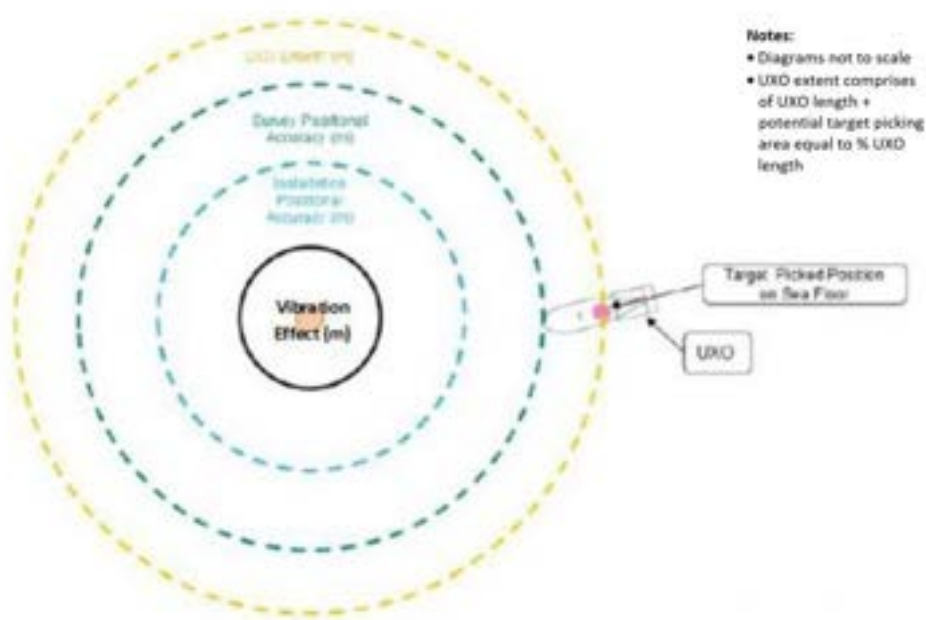



Figure 5-1: Avoidance distances.

$$\text{Avoidance distance} = \text{Geotechnical tool width} + \text{Vibration effect distance} + \text{Geotechnical tool positioning accuracy} + \text{UXO survey accuracy} + \text{Ammunition length}$$

The effect of the generation of seismic waves during vibro-driving or pile driving has to be considered in the case of geotechnical drilling or pile driving. These machines generate a wide variety of seismic waves (pressure, Rayleigh, shear) (Study report DRS17-164706-

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11171B, INERIS) that can trigger UXO detonation. This effect need not be considered for other geotechnical work, such as jack up or anchor installation.

In order to reduce the safety buffer to the necessary distance, a precise calculation of avoidance distance was explained and detailed in a Technical advisory note (Ref. 07) for the EC corridor. The calculation considers the following elements:

$$\begin{aligned}
 &\text{Avoidance distance: Vibration effect (6m) + Geophysical survey accuracy distance (1.9m)} \\
 &+ \text{Geotechnical frame (1.25m) + Geotechnical survey accuracy (1m) + UXO extent (3.12m)} \\
 &= 13.27\text{m}
 \end{aligned}$$

A safety buffer of 13.5 m for EC corridor is to be employed from any isolated magnetic anomaly.





This was achieved through geospatial processing by QGIS software.

Firstly, the areas that could not be considered as clear of any pUXO are mapped, grouping the pUXO targets (magnetic anomalies and/or sonar and MBES contacts) and potential saturated areas. Afterwards, the “avoidance areas” were mapped with an avoidance zone of 13.5 metres radius (a 13.5 m safety buffer around the anomaly) away from all the potential UXO (pUXO) anomalies or any saturated or excluded areas. This avoidance area was also applied from the edge of the dataset inwards, towards the centre of the survey area.

The free space between these avoidance areas and the detection surface and the survey limits was then mapped, and a workable area was obtained. This defined the outline of the ALARP certificate (Figure 5-2).

When no ALARP zone was identified (Figure 5-3), an alternative location for the GI box was proposed.

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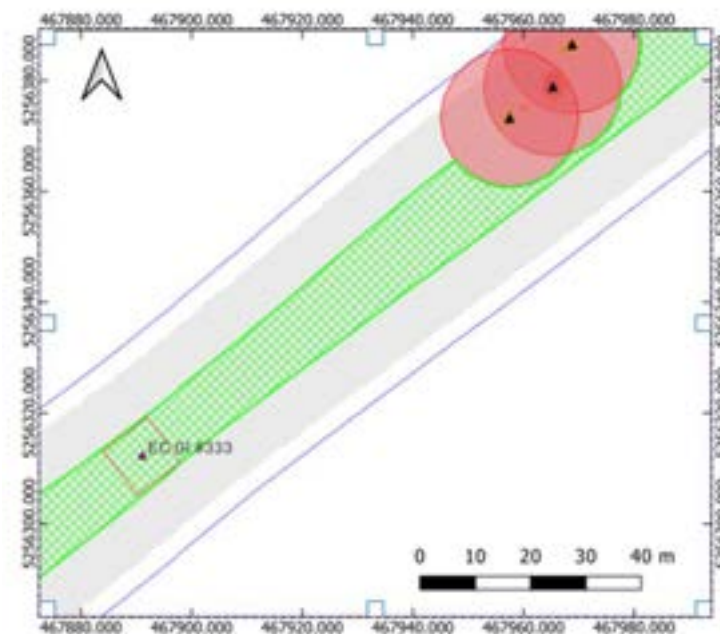


Figure 5-2: Case where the GI boxes location are not impacted or little impacted by avoidance areas: an ALARP zone is defined (in green)

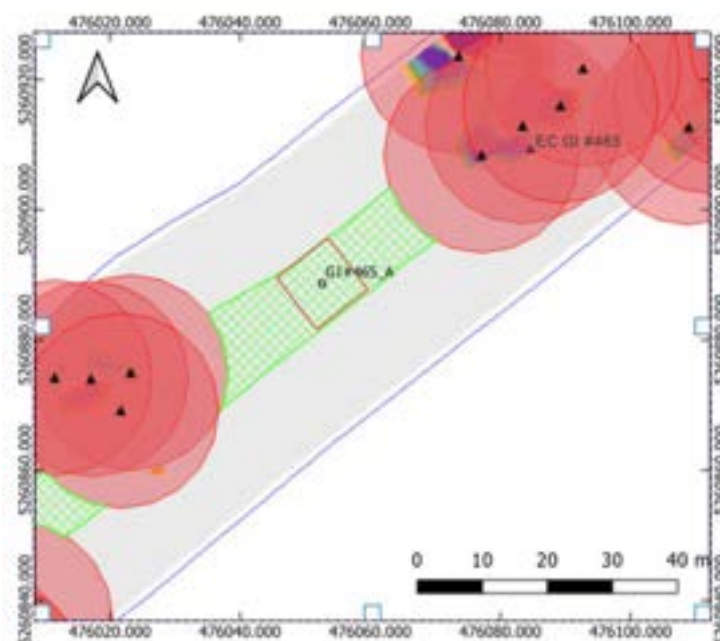


Figure 5-3: Case where the GI boxes location are largely or completely impacted by avoidance areas and an alternative location is proposed

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Figure 5-4: Legend of the ALARP maps.


6. CONCLUSION

ALARP areas of 5,000 m² were identified for the 50 GI locations. Alternative locations had to be identified for 21 of the GI locations (Table 8). These alternative locations are indicated in grey in Table 8.

Table 8: Final ALARP workable areas and GI box location.

ID	GI box	Easting UTM30N	Northing UTM30N	Workable area (m ²)
1	GI100_A	453398,26	5248048,43	100
2	GI101	453631,04	5248742,99	100
3	GI102	454141,81	5249602,27	100
4	GI103	454652,58	5250461,56	100
5	GI104_A	454669,42	5251837,40	100
6	GI104_B	454764,54	5251981,67	100
7	GI179_A	455378,89	5251700,86	100
8	GI205	456045,00	5252195,00	100
9	GI250	456582,39	5252367,00	100
10	GI251	457535,77	5252667,49	100
11	GI252	458489,16	5252967,99	100
12	GI253	459716,00	5252993,00	100
13	GI254_A	460633,41	5253281,70	100
14	GI255	461349,32	5253869,47	100
15	GI256	462302,70	5254169,96	100
16	GI257	463256,08	5254470,45	100
17	GI258	464209,46	5254770,95	100


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ID	GI box	Easting UTM30N	Northing UTM30N	Workable area (m²)
18	GI259	465162,84	5255071,44	100
19	GI260_A	466115,90	5255373,51	100
20	GI333	467890,95	5256312,12	100
21	GI334_A	468683,03	5256922,00	100
22	GI335_A	469475,12	5257531,53	100
23	GI336	470265,62	5258143,51	100
24	GI337_A	471058,90	5258751,66	100
25	GI338	471867,03	5259255,78	100
26	GI342_A	467098,22	5255703,38	100
27	GI425	478656,80	5266307,37	100
28	GI427	480962,89	5266556,48	100
29	GI439_A	472642,77	5259972,16	100
30	GI440_A	474171,83	5259964,17	100
31	GI464_A	474957,15	5260106,53	100
32	GI465_A	476052,65	5260888,74	100
33	GI467	479601,26	5266801,57	100
34	GI468	478679,15	5263079,70	100
35	GI470	477921,34	5262096,27	100
36	GI473	475678,37	5260158,43	100
37	GI475_A	478075,46	5265189,01	100
38	GI476	476775,94	5260569,07	100
39	GI477	477147,24	5261469,51	100
40	GI478_A	477422,61	5260933,29	100
41	GI508_A	487327,70	5271213,71	100
42	GI510_A	487349,34	5271609,49	100
43	GI512	487759,68	5271020,00	100
44	GI516_A	486673,54	5270379,81	100
45	GI517	486089,43	5270014,92	100
46	GI519_A	487060,71	5270804,85	100
47	GI528_A	482311,96	5266829,54	100
48	GI529	482866,20	5267696,15	100
49	GI544	483556,80	5268425,69	100
50	GI545_A	484445,76	5268963,15	100
51	GI546	485159,36	5269427,64	100

Total	5000
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REFERENCES

In accordance with:

- Letter the “*Inspection des poudres et explosifs*” of the French Ministry of Defence and the “*Direction générale du Travail*” of the French Ministry of Labour of September 18th, 2013, relating to pyrotechnic clearance carried out on civil land.
- Decree No. 2014-381 of March 28, 2014, regulatory part Art. R.733-1 to 16 and legislative part Art. L. 733-1 to 3.

In reference to:

- Decree No. 2005-1325 of October 26, 2005, amended from the Ministry of Defence relating to the safety rules applicable during work in the context of a pyrotechnic clearance site and the two implementing decrees.

Ref.01. Unexploded Ordnance Threat and Risk Assessment with Risk Mitigation Strategy: *8811_UXOTARA_with_RMS_AO5 Brittany_DNVGL_Client Draft_V1.0*

Ref.02. Project AO5 De-risk Surveys Scope Of Work: *SOS-01 - Scope Of Service AO5*

Ref.03. Employer’s Requirements Marine Operations: *SVY-ERS-03 – Survey Specification*

Ref.04. Specification for UXO Survey Verification Test RTE Export Cables: *ERS-03-A – SVT Specification*

Ref.05. UXO Surrogate Items report: *SIT report – AO4 and AO5 geophysical and UXO survey*





Ref.06. BRE_AO5 Area - Geophysical and UXO survey - Mobilization Report: *BRE_TEC_21_Mob report - AO5 survey 2022_1.2*

Ref.07. Technical advisory note - Avoidance distance AO5

Pennella 1982 Magnetometer techniques in the detection of projectiles Final Report, TR239, Naval explosive ordnance technology center





Rapport d’étude DRS 17-164706-11171-B, Impact des vibrations sur la stabilité des carrières souterraines, INERIS, 2017.

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APPENDIX I – LIST OF THE MAGNETIC ANOMALIES DETECTED





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None. Intentionally left blank.





For more information see section 4.2.1 of this report.

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APPENDIX II – LIST OF THE SIDE SCAN CONTACTS DETECTED

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Nb	Target ID	Easting UTM30N (m)	Northing UTM30N (m)	Status
1	AO5-EC_SSS-01	461339.46	5253850.79	
2	AO5-EC_SSS-02	461360.59	5253863.57	
3	AO5-EC_SSS-03	461362.13	5253856.35	
4	AO5-EC_SSS-04	462297.94	5254164.72	
5	AO5-EC_SSS-05	463246.61	5254451.55	
6	AO5-EC_SSS-06	463276.05	5254466.86	
7	AO5-EC_SSS-07	463256.19	5254489.53	
8	AO5-EC_SSS-08	463257.75	5254486.85	
9	AO5-EC_SSS-09	464210.58	5254757.66	
10	AO5-EC_SSS-10	465157.04	5255050.99	
11	AO5-EC_SSS-11	477915.64	5262095.47	
12	AO5-EC_SSS-12	477914.82	5262110.64	
13	AO5-EC_SSS-13	477906.89	5262098.09	
14	AO5-EC_SSS-14	477931.84	5262092.10	
15	AO5-EC_SSS-15	477937.08	5262091.61	
16	AO5-EC_SSS-16	477930.95	5262088.10	
17	AO5-EC_SSS-17	477930.19	5262095.54	
18	AO5-EC_SSS-18	477915.58	5262097.95	
19	AO5-EC_SSS-19	477915.37	5262107.26	
20	AO5-EC_SSS-20	479597.00	5266782.94	
21	AO5-EC_SSS-21	482438.59	5266847.38	
22	AO5-EC_SSS-22	480951.42	5266541.01	
23	AO5-EC_SSS-23	478675.45	5263083.82	
24	AO5-EC_SSS-24	478692.53	5263072.49	
25	AO5-EC_SSS-25	478065.68	5265164.79	
26	AO5-EC_SSS-26	477161.97	5261473.43	
27	AO5-EC_SSS-27	477155.44	5261471.38	
28	AO5-EC_SSS-28	477147.28	5261466.90	
29	AO5-EC_SSS-29	484442.27	5268962.39	
30	AO5-EC_SSS-30	484453.23	5268959.50	
31	AO5-EC_SSS-31	484430.63	5268975.07	
32	AO5-EC_SSS-32	484438.81	5268947.41	
33	AO5-EC_SSS-33	484455.49	5268970.71	

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APPENDIX III – LIST OF THE MBES CONTACTS DETECTED

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Nb	Target ID	Easting UTM30N (m)	Northing UTM30N (m)
1	AO5-EC_MBES-01	457528.31	5252664.16
2	AO5-EC_MBES-02	457526.76	5252668.42
3	AO5-EC_MBES-03	464213.18	5254789.04
4	AO5-EC_MBES-04	464218.80	5254775.08
5	AO5-EC_MBES-05	464209.72	5254756.55
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16	AO5-EC_MBES-16	477940.46	5262101.81
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25	AO5-EC_MBES-25	478684.29	5263081.46
26	AO5-EC_MBES-26	478682.00	5263103.71
27	AO5-EC_MBES-27	478675.90	5263097.26
28	AO5-EC_MBES-28	478678.54	5263062.41
29	AO5-EC_MBES-29	478692.53	5263093.45
30	AO5-EC_MBES-30	478666.41	5263074.95
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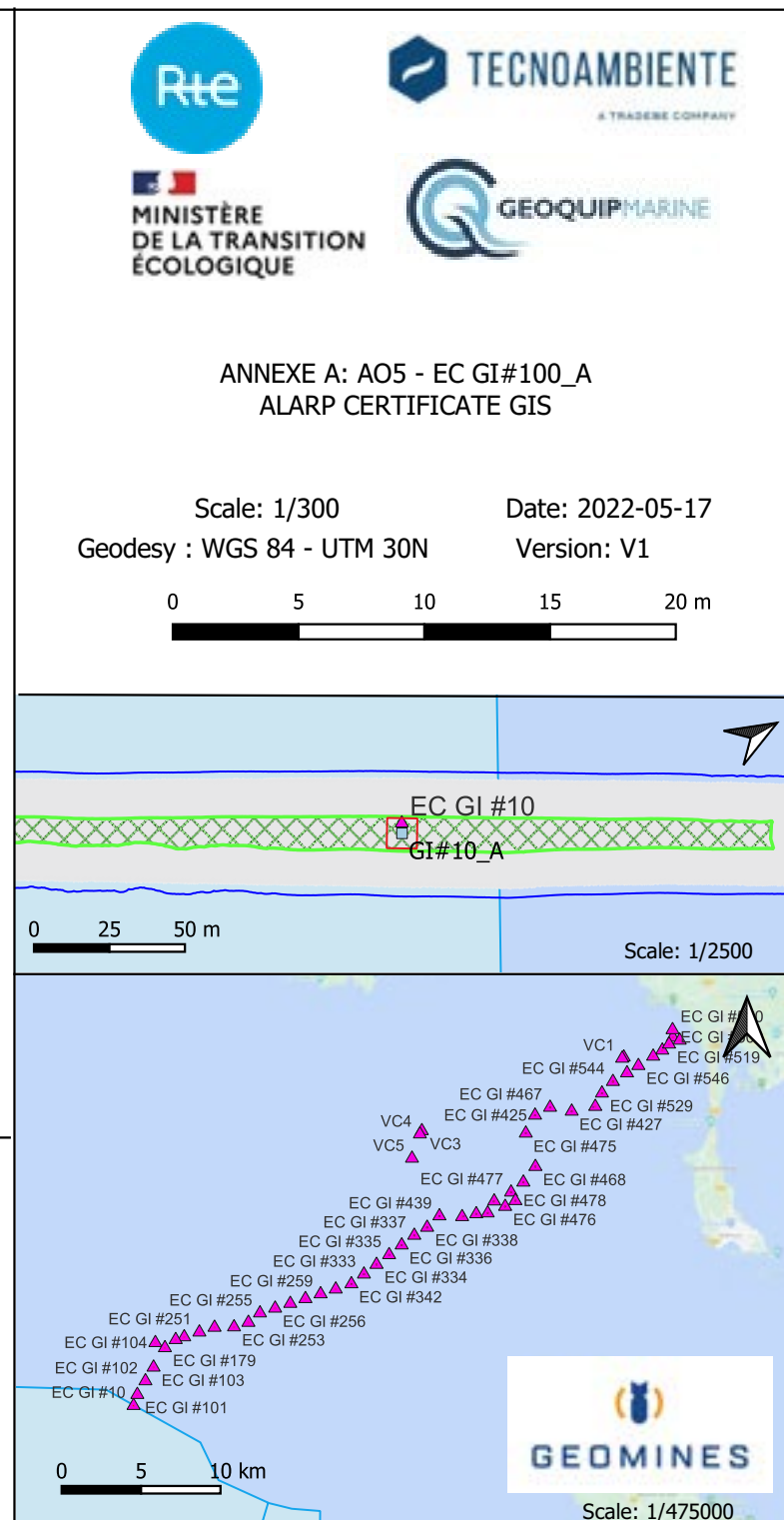
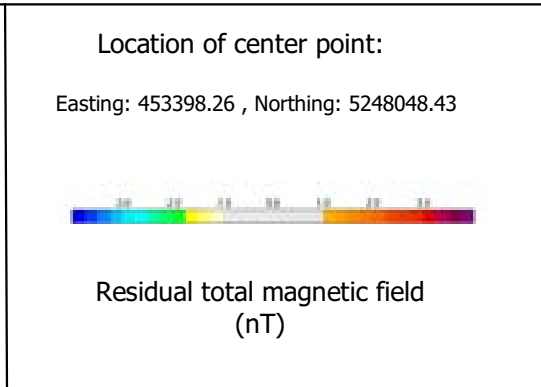
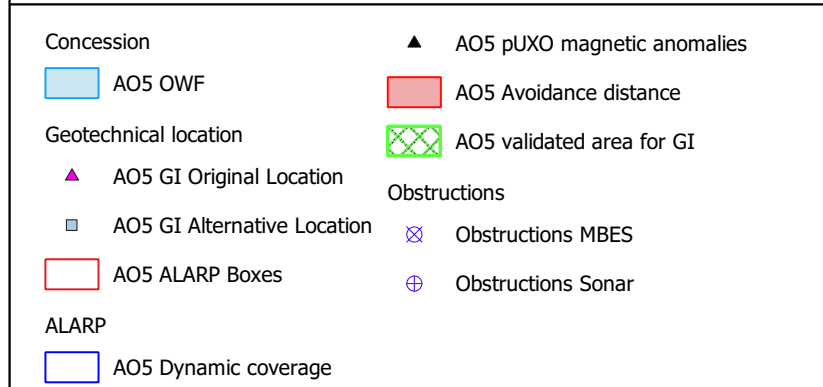
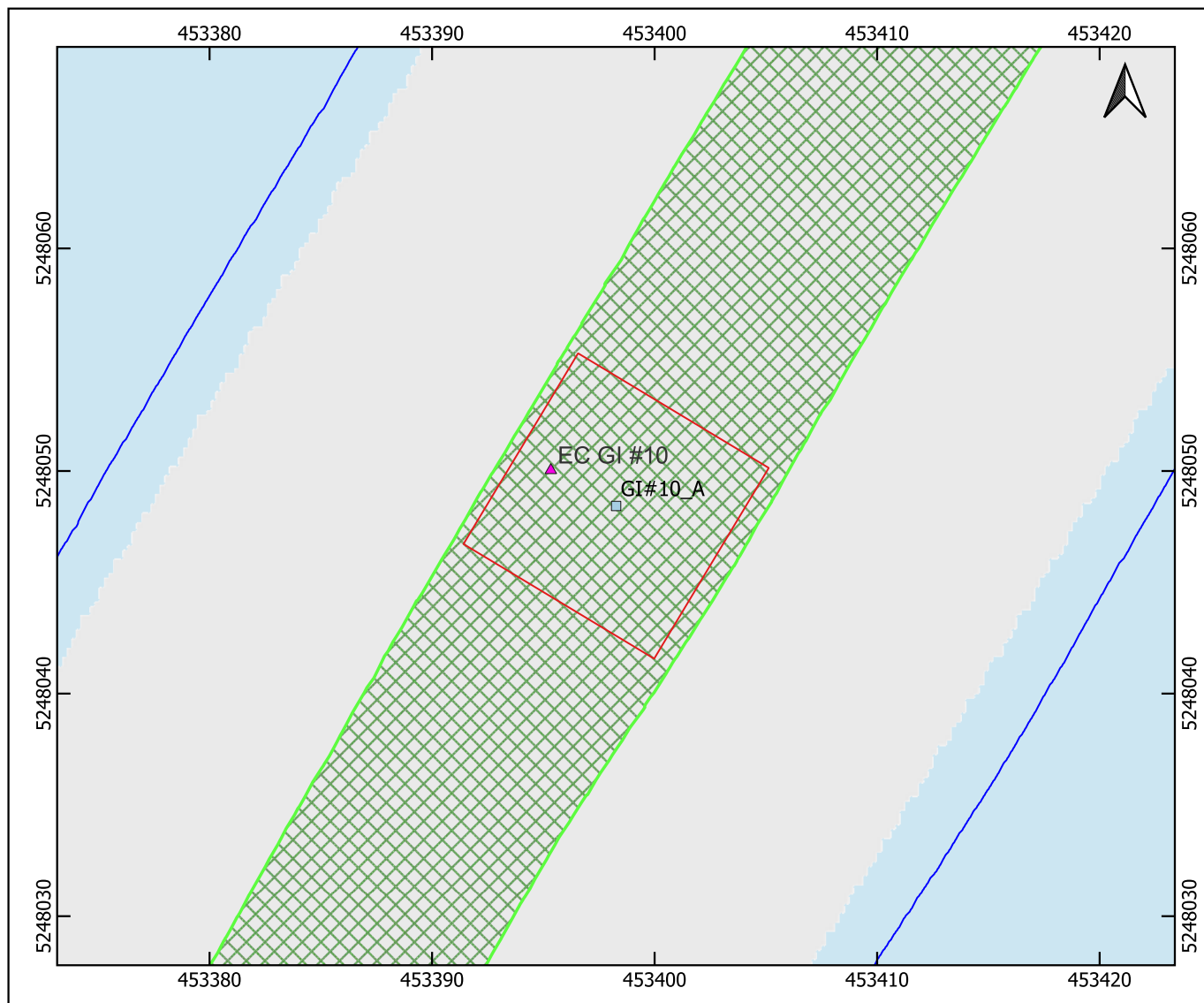
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39	AO5-EC_MBES-39	478093.24	5265167.09
40	AO5-EC_MBES-40	478049.87	5265179.59
41	AO5-EC_MBES-41	478061.54	5265164.23
42	AO5-EC_MBES-42	477154.50	5261467.80
43	AO5-EC_MBES-43	483566.56	5268413.52
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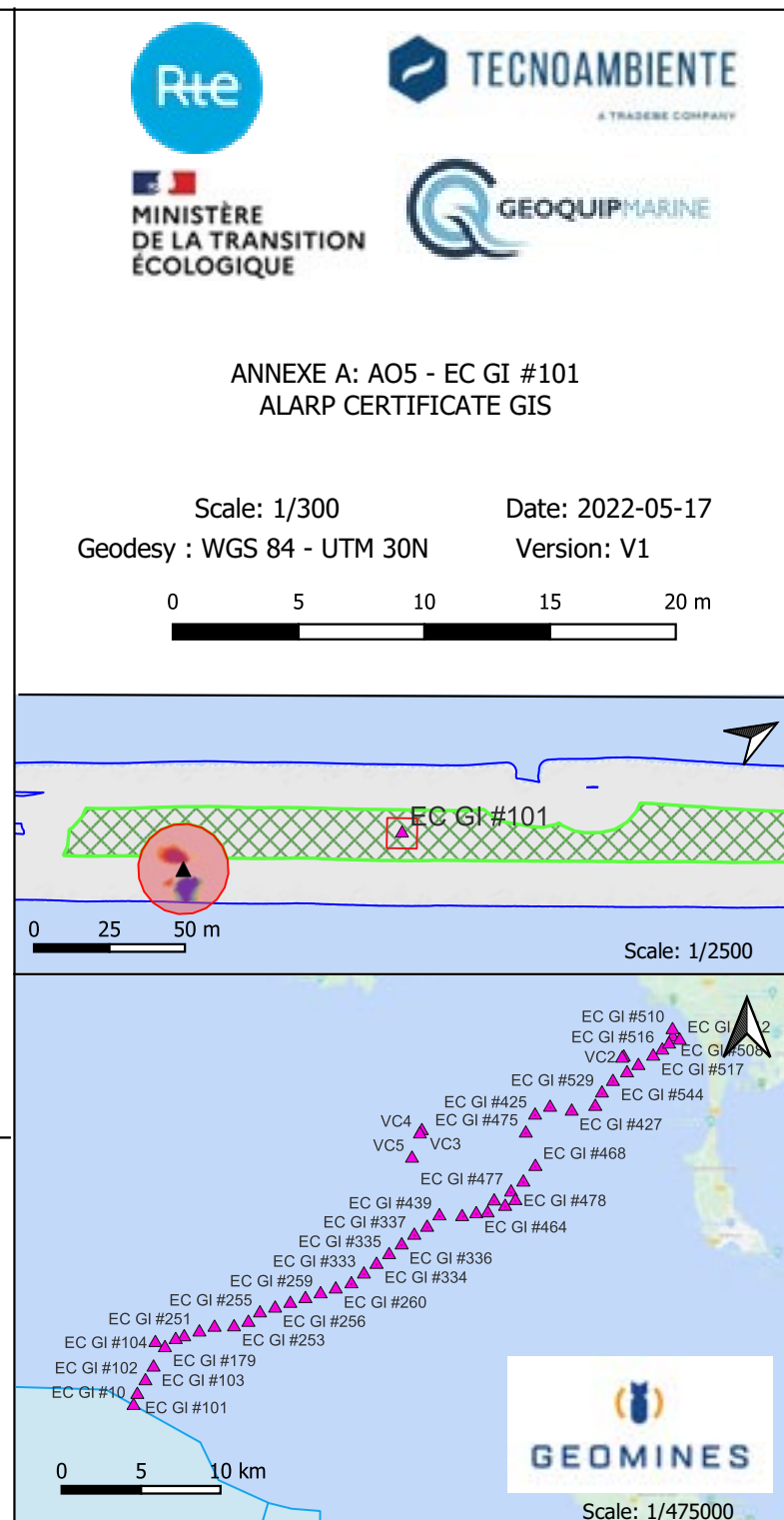
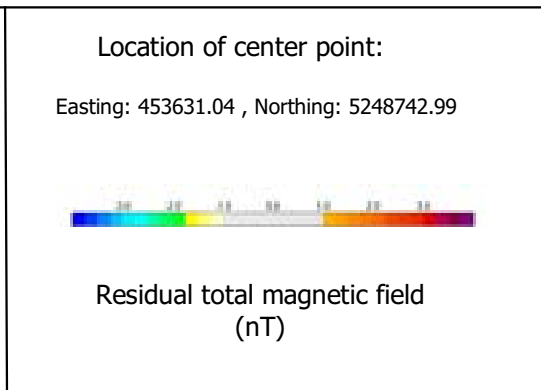
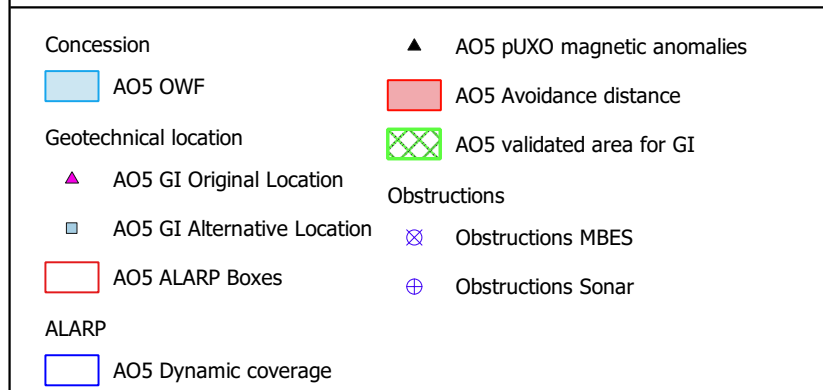
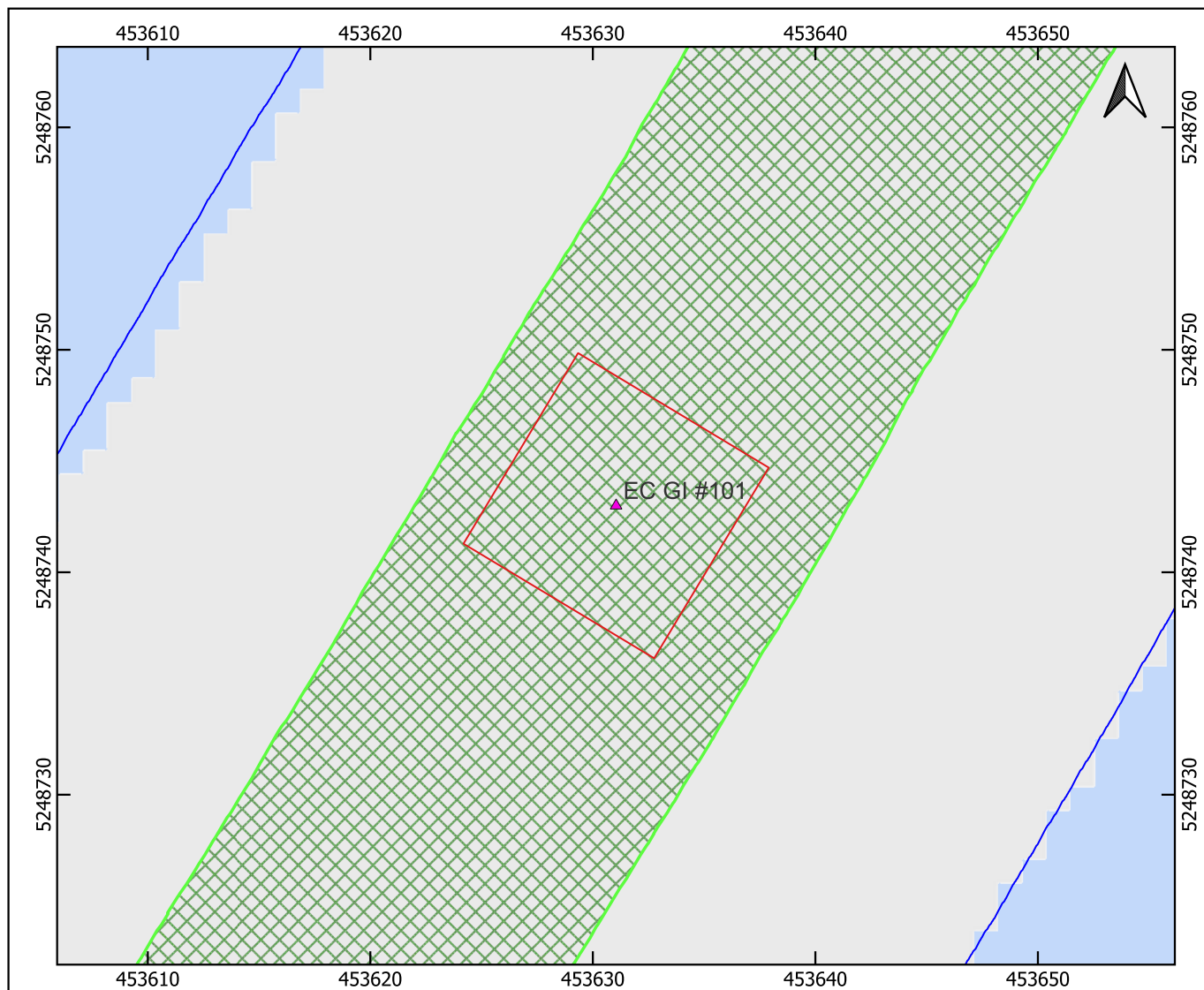
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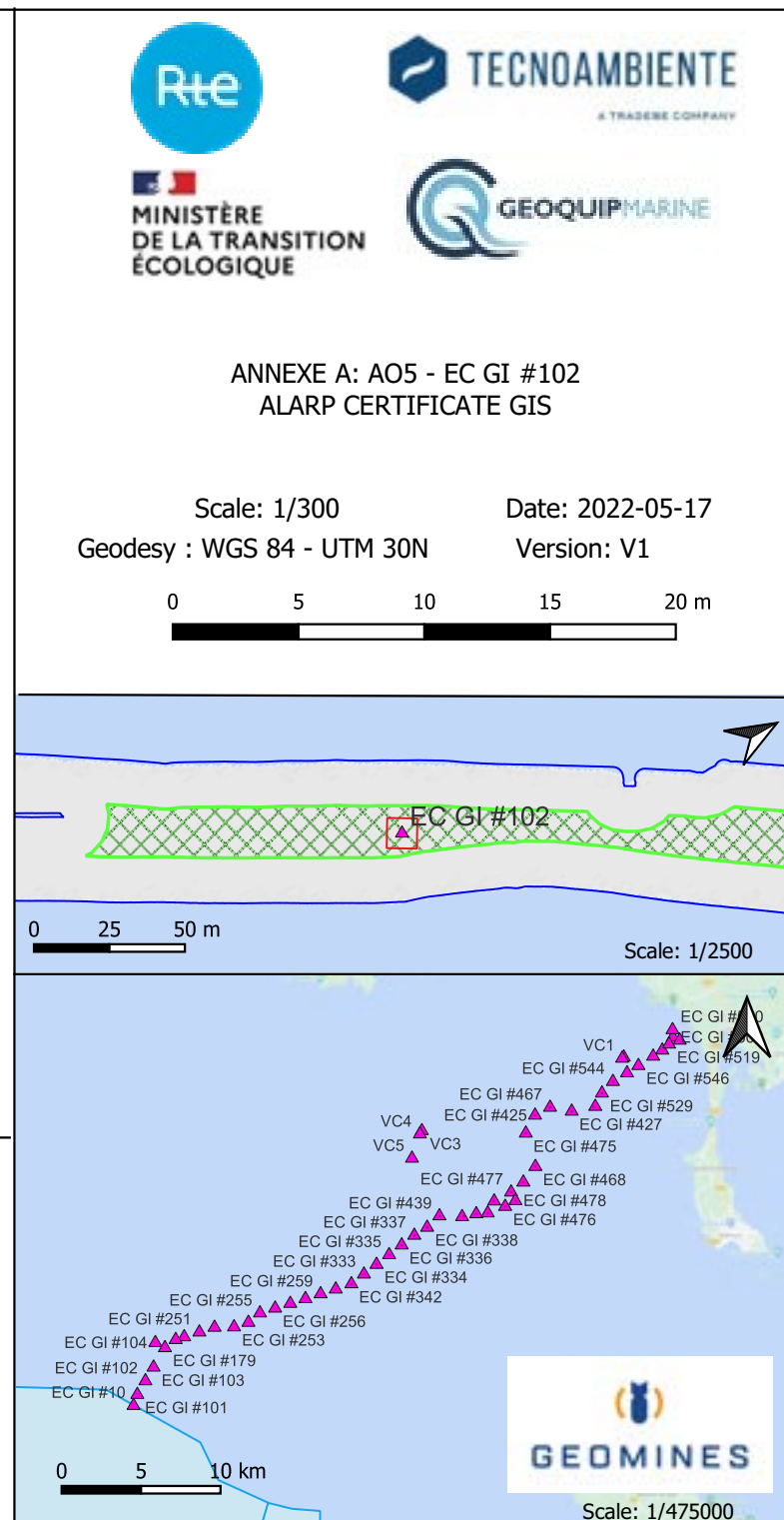
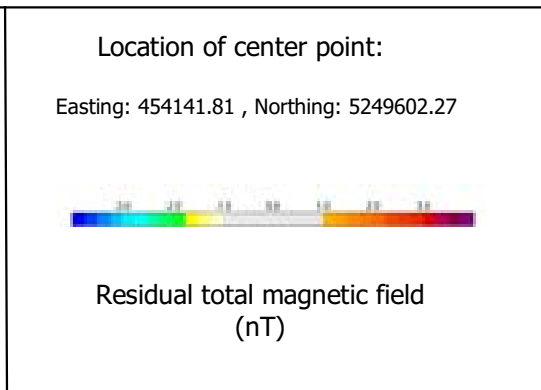
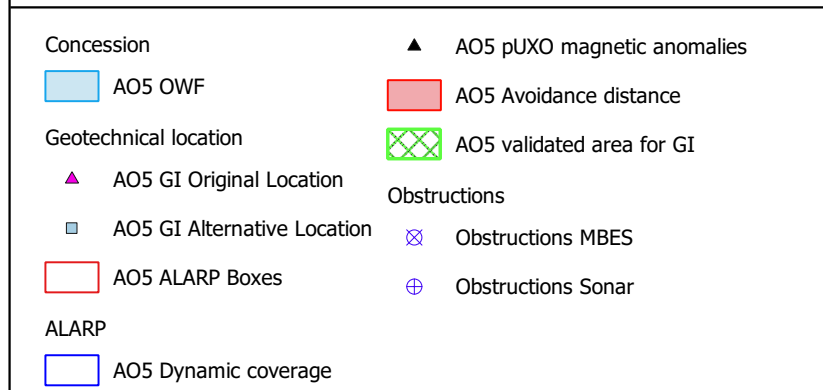
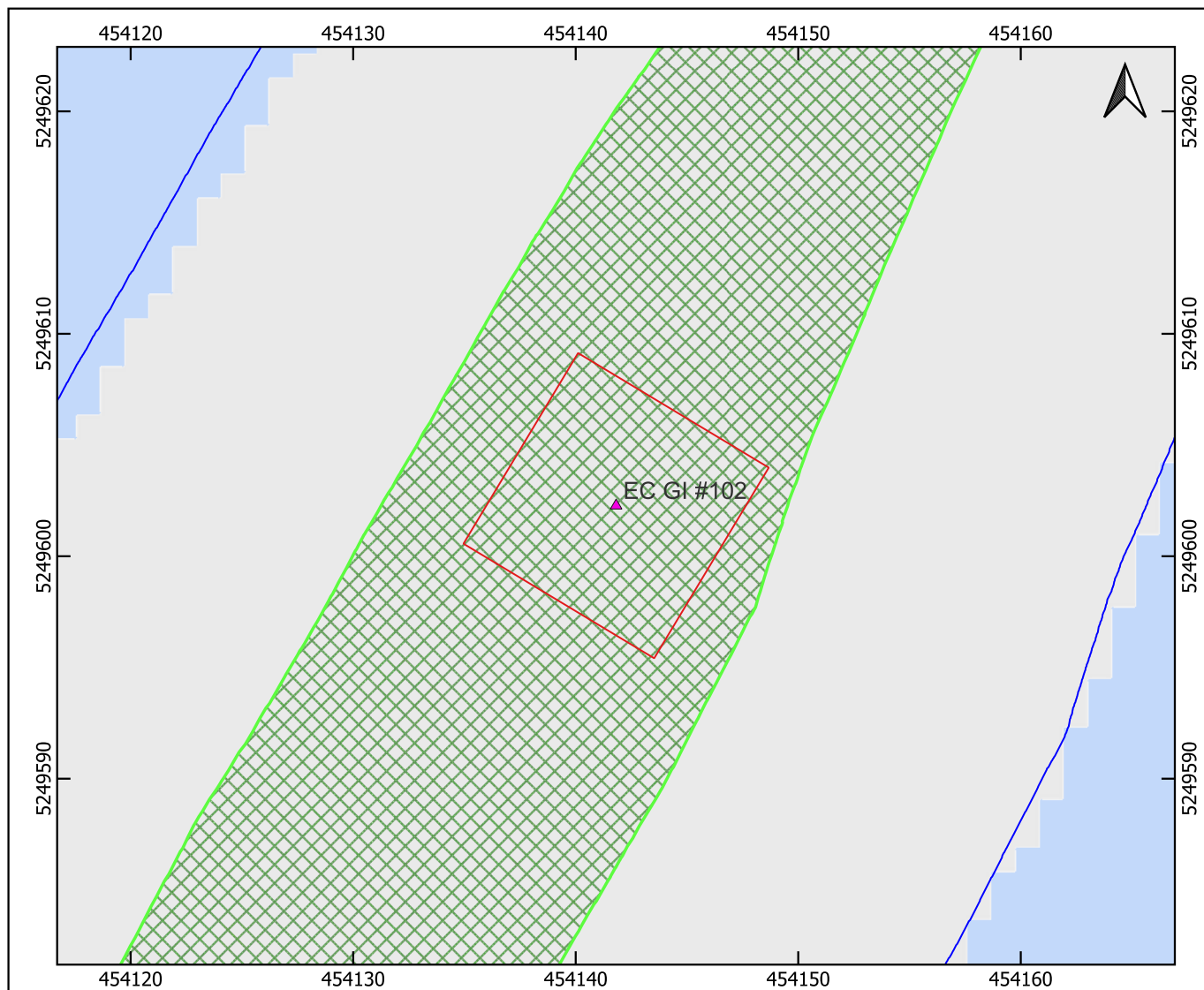
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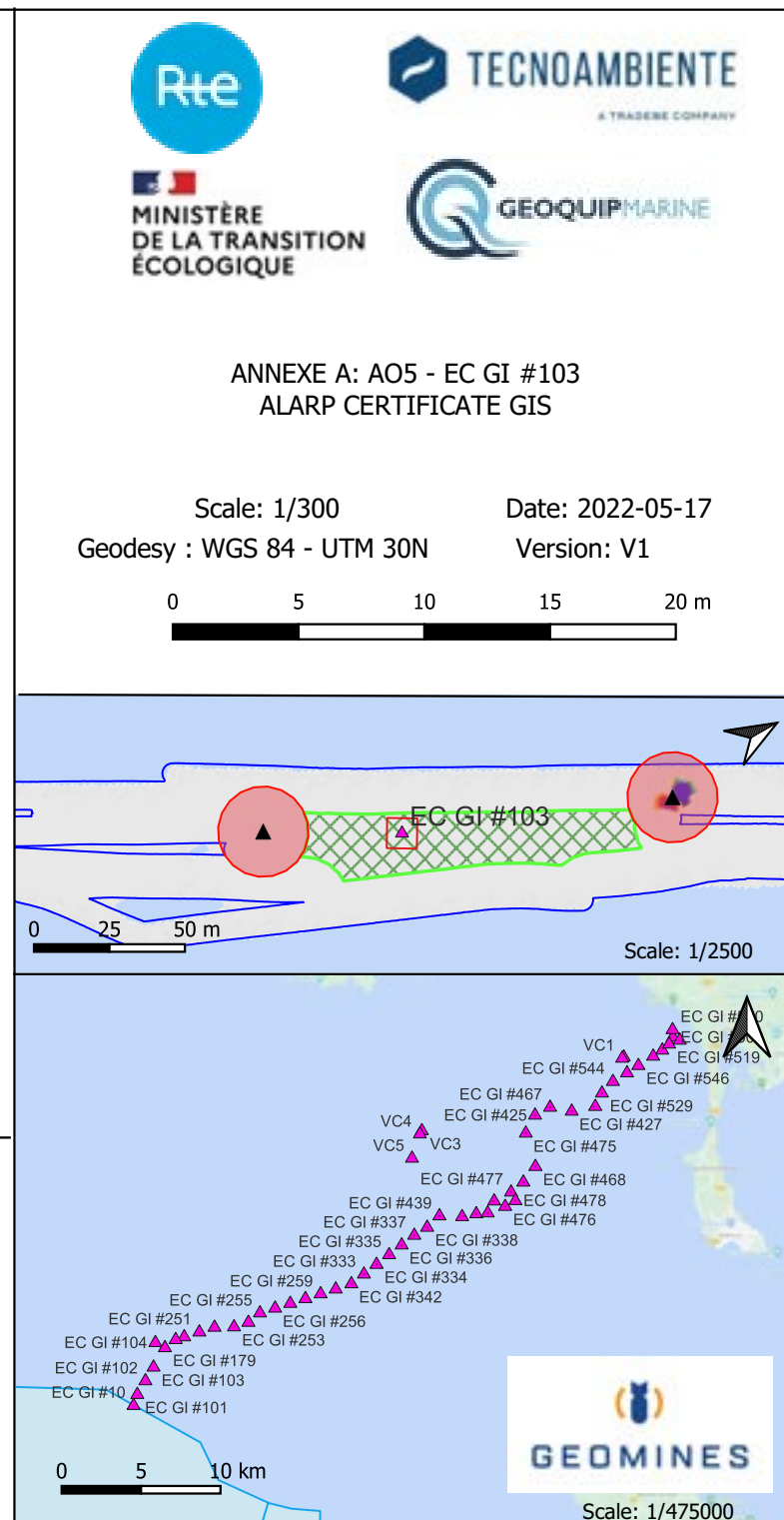
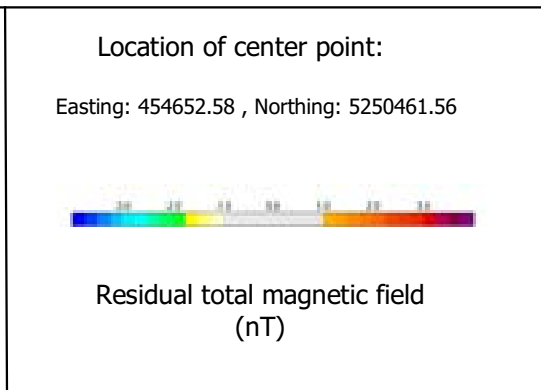
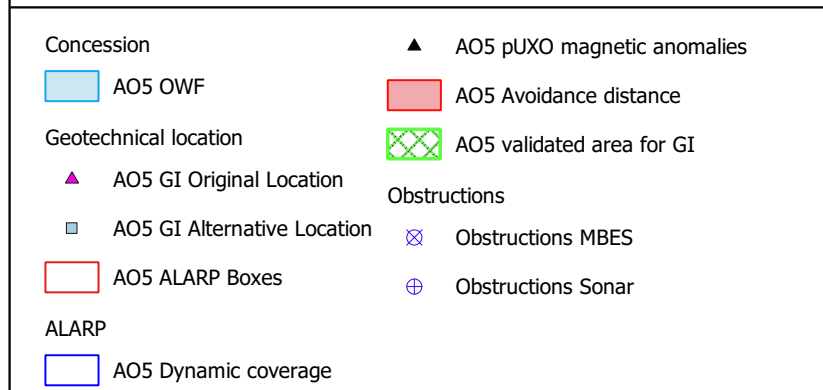
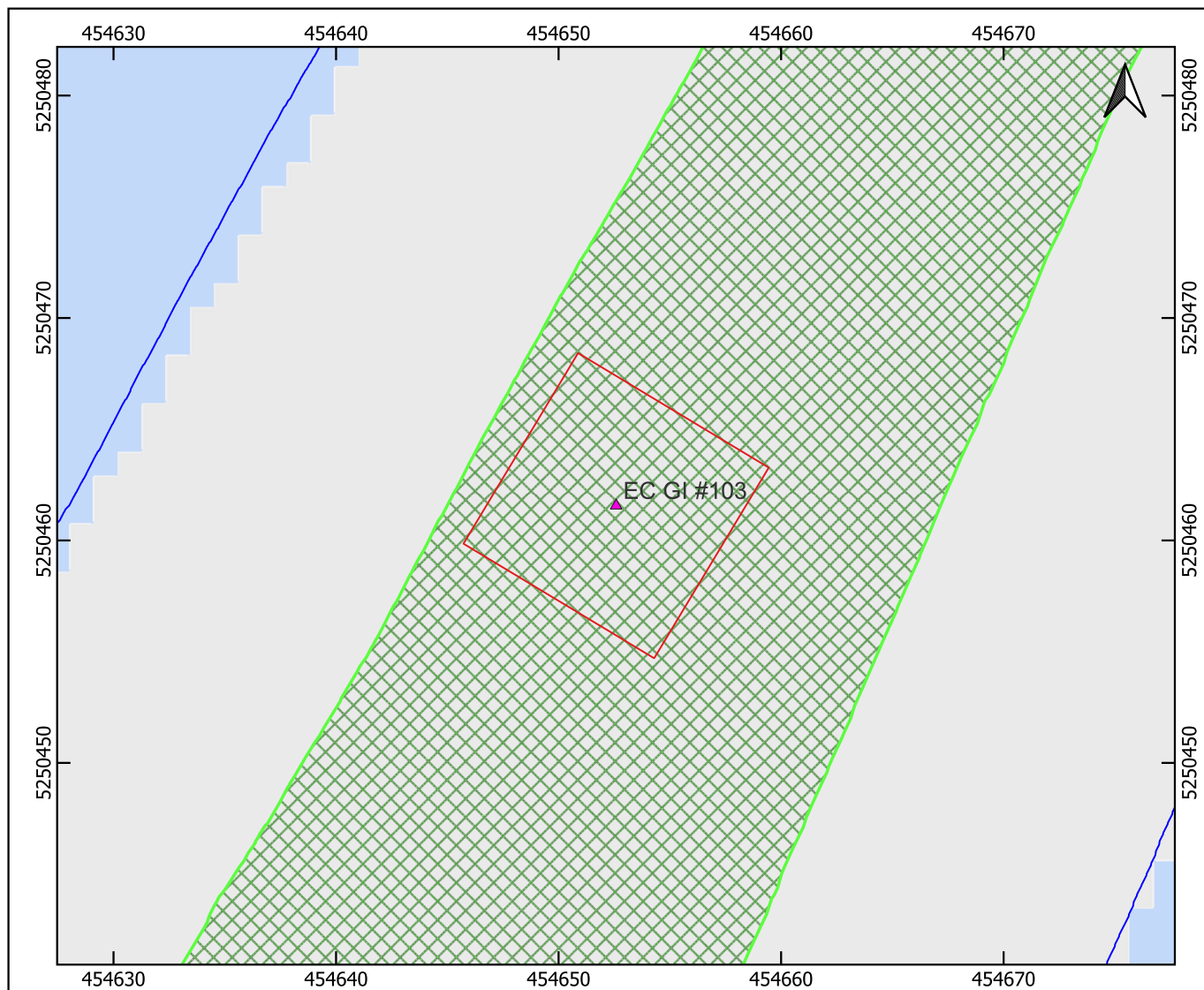
APPENDIX IV – ALARP CERTIFICATE MAPS

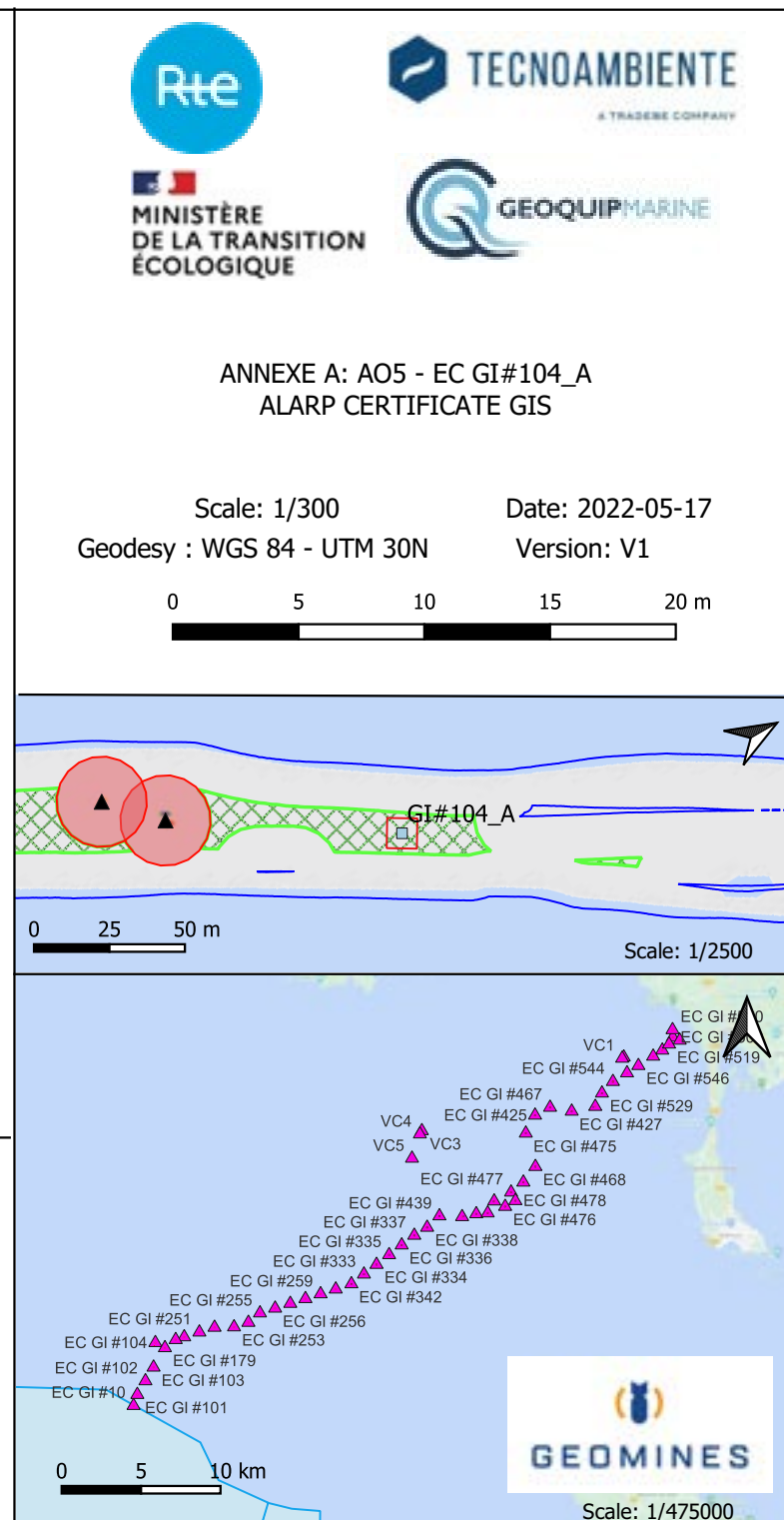
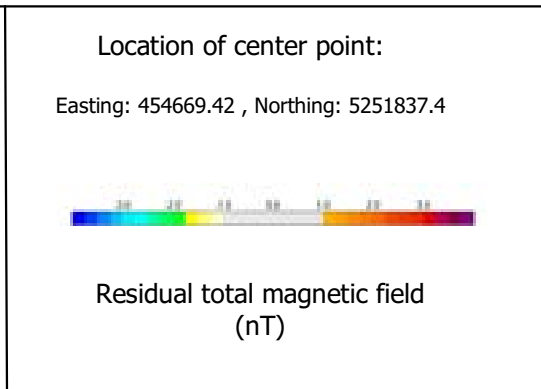
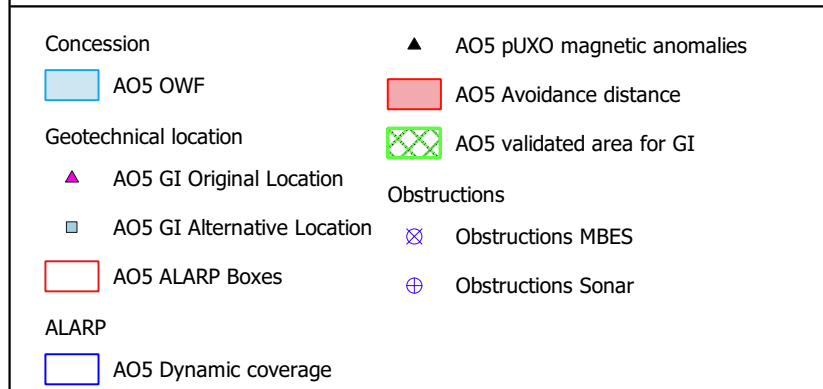
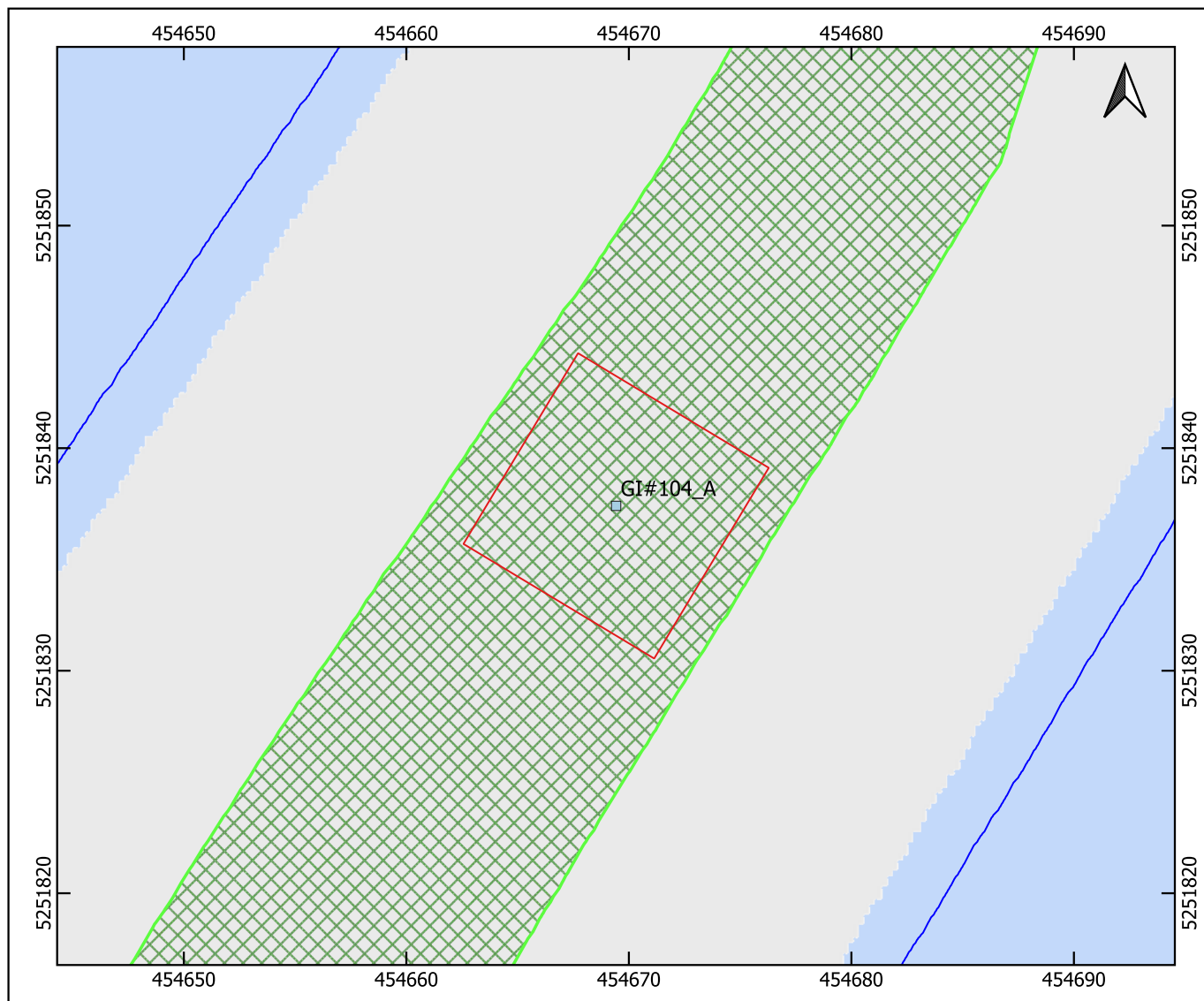
Confidentiality	<i>Diffusion restreinte (restricted)</i>	Pages	<i>Page 51 of 52</i>
Issue date	29/11/2022	Document uncontrolled when printed/downloaded	

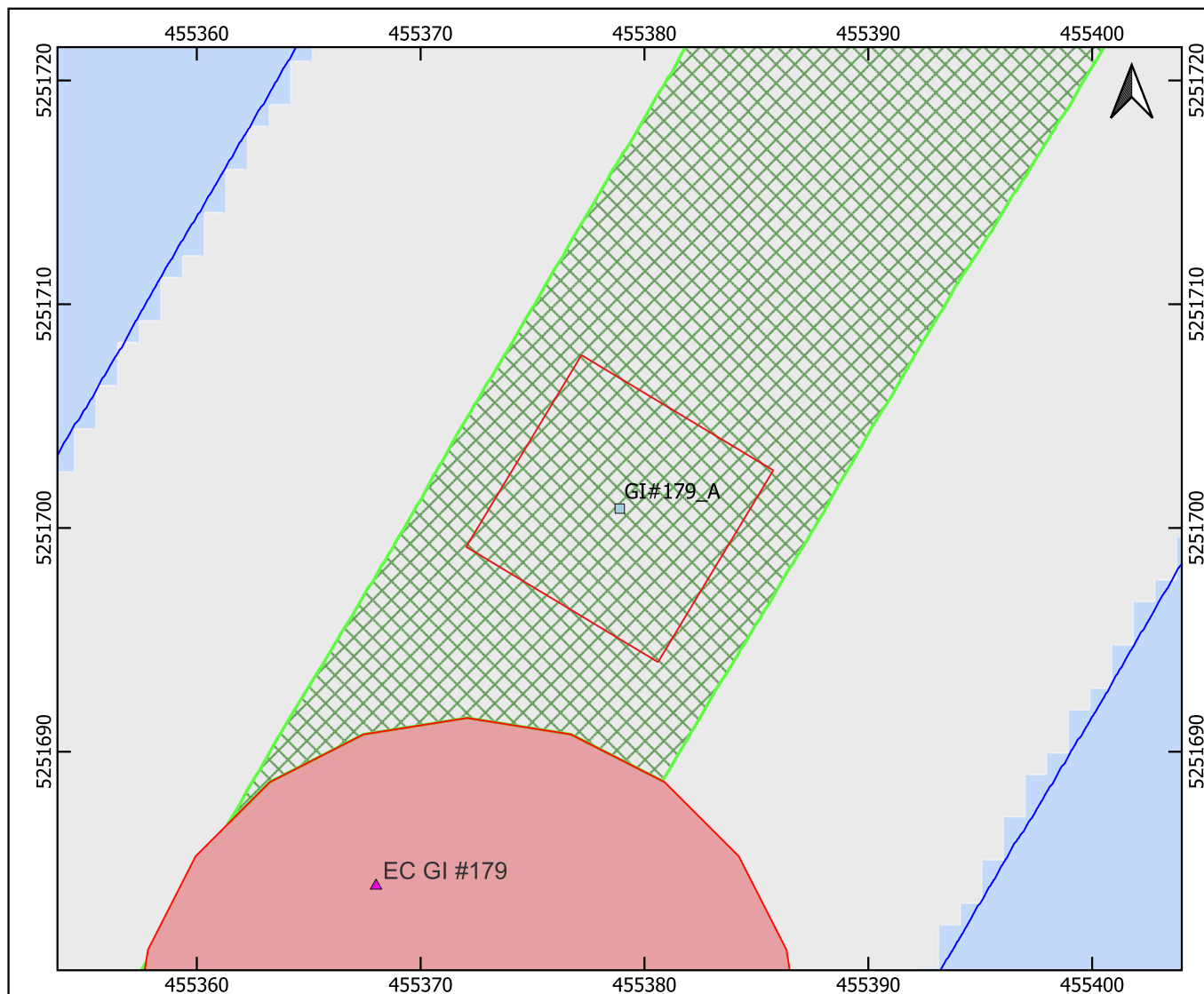












- Concession
- AO5 OWF
- Geotechnical location
- AO5 GI Original Location
 - AO5 GI Alternative Location
 - AO5 ALARP Boxes
 - AO5 Dynamic coverage
- AO5 pUXO magnetic anomalies
- AO5 Avoidance distance
 - AO5 validated area for GI
- Obstructions
- Obstructions MBES
 - Obstructions Sonar

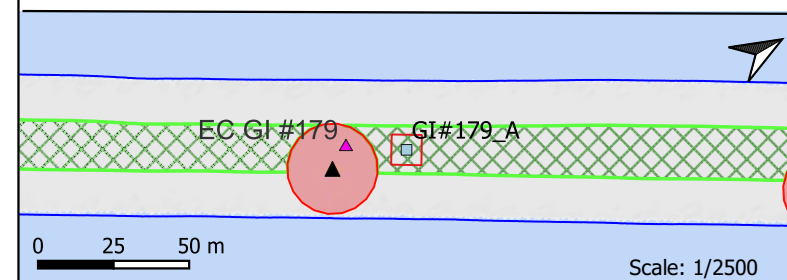
Location of center point:
Easting: 455378.89 , Northing: 5251700.86

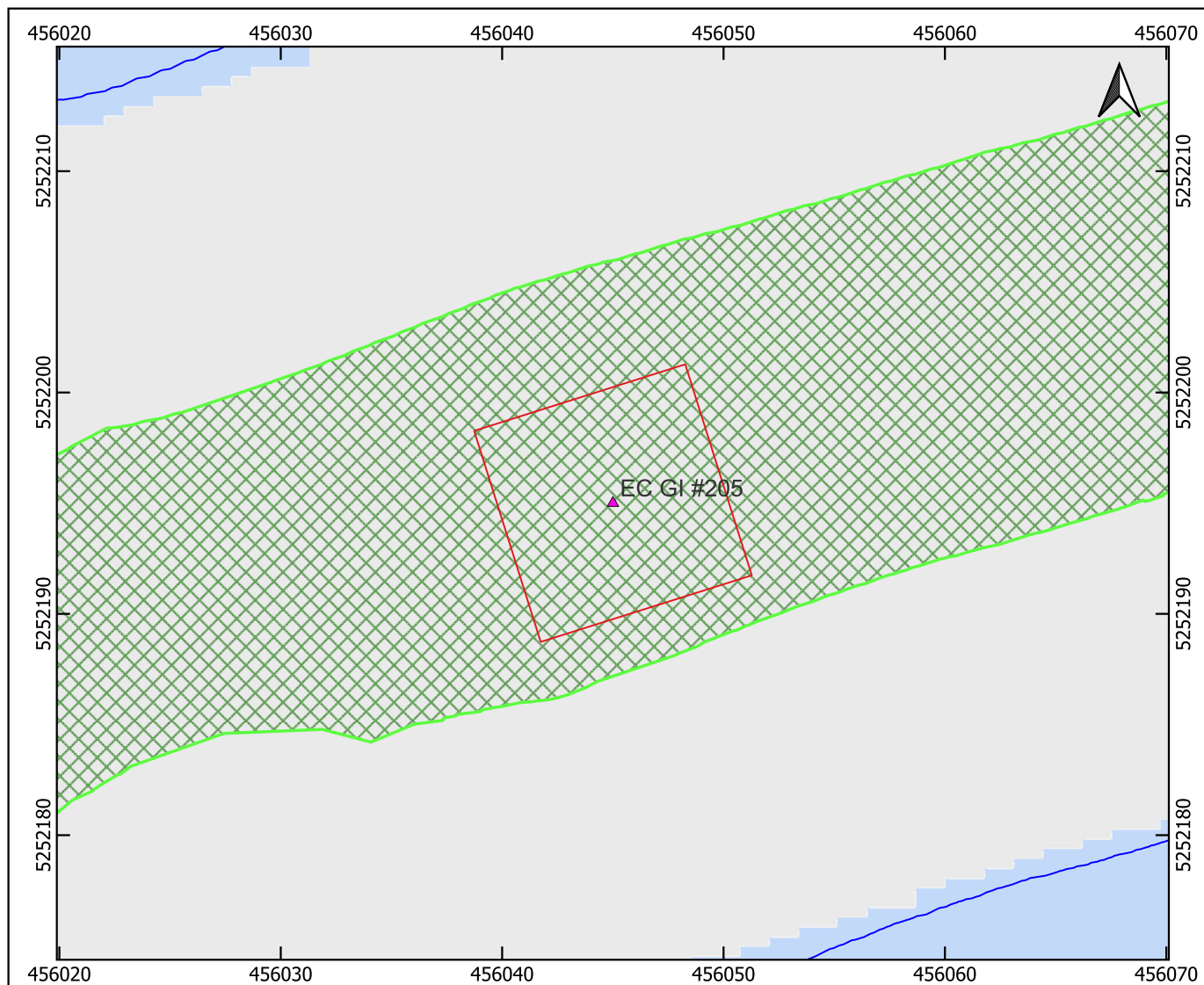
Residual total magnetic field (nT)



ANNEXE A: AO5 - EC GI#179_A ALARP CERTIFICATE GIS

Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1





- | | |
|-------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| ■ AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:
Easting: 456045 , Northing: 5252195

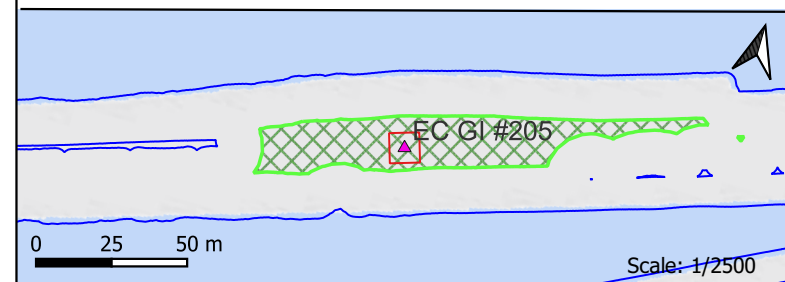
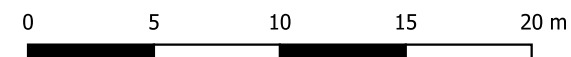


Residual total magnetic field (nT)

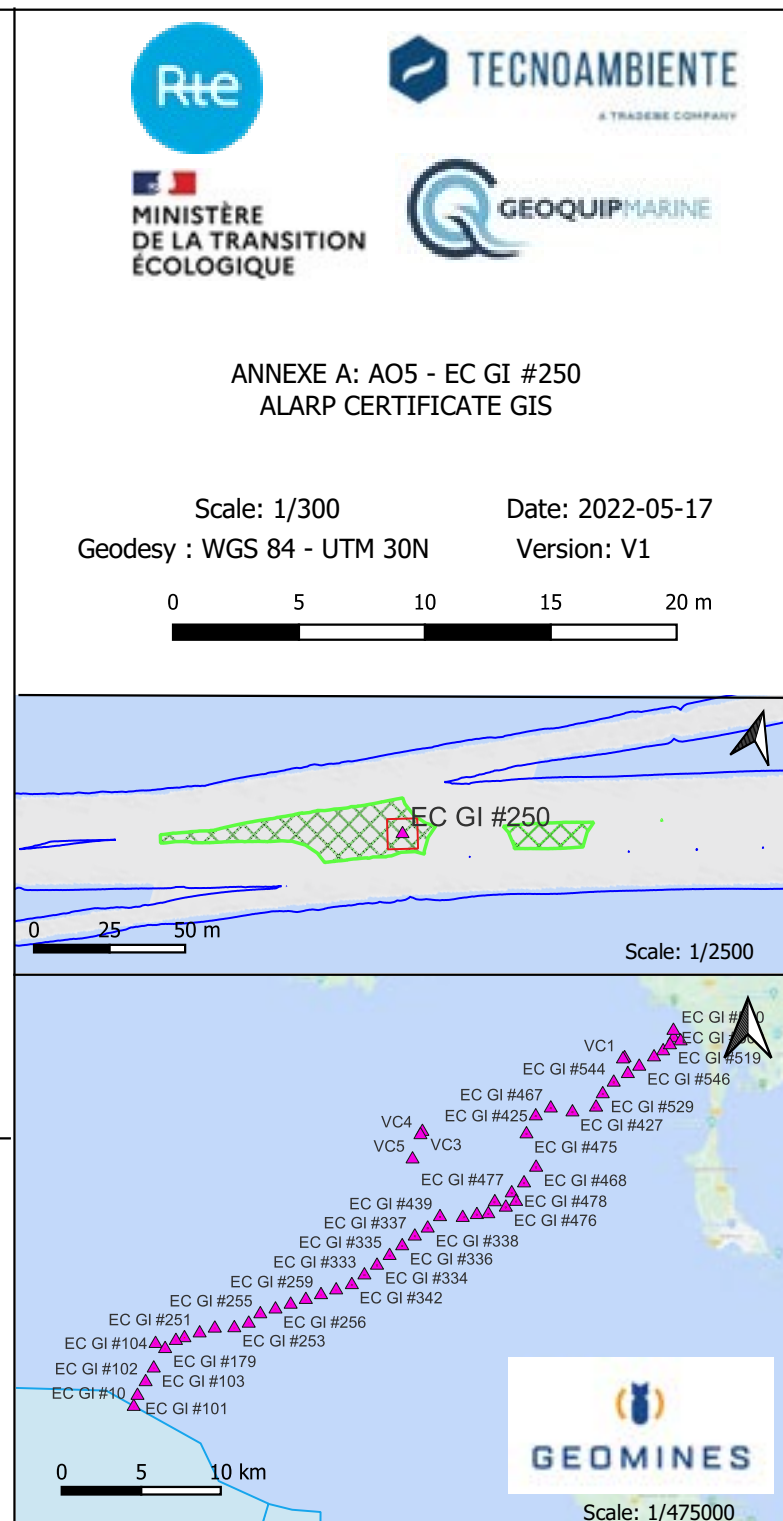
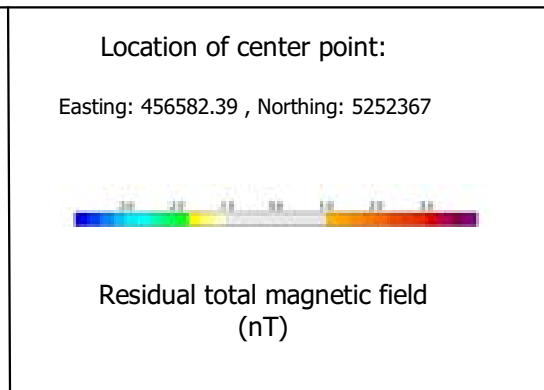
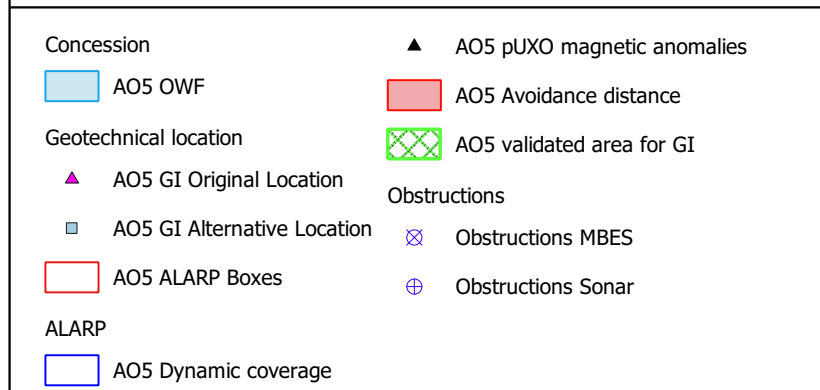
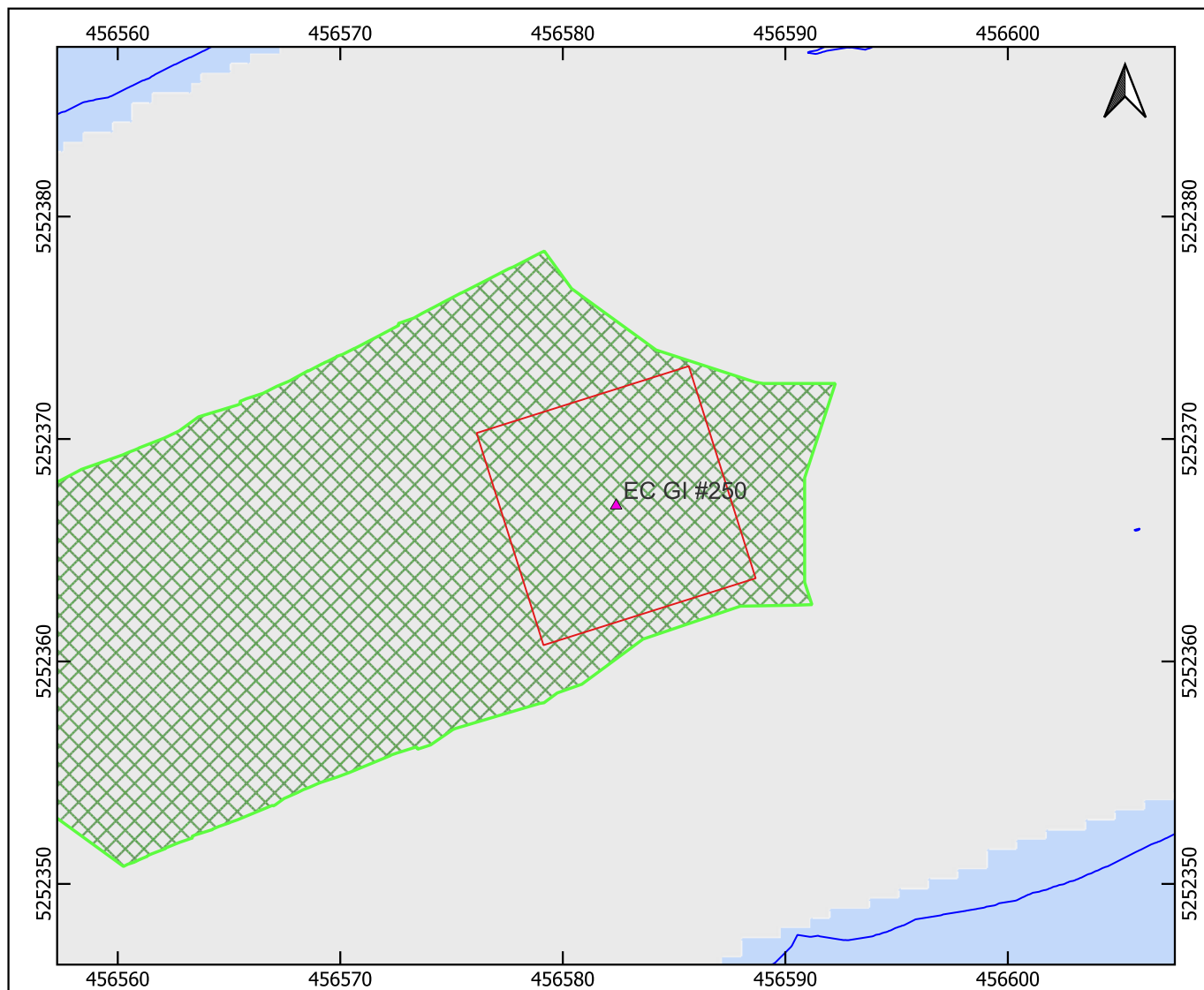


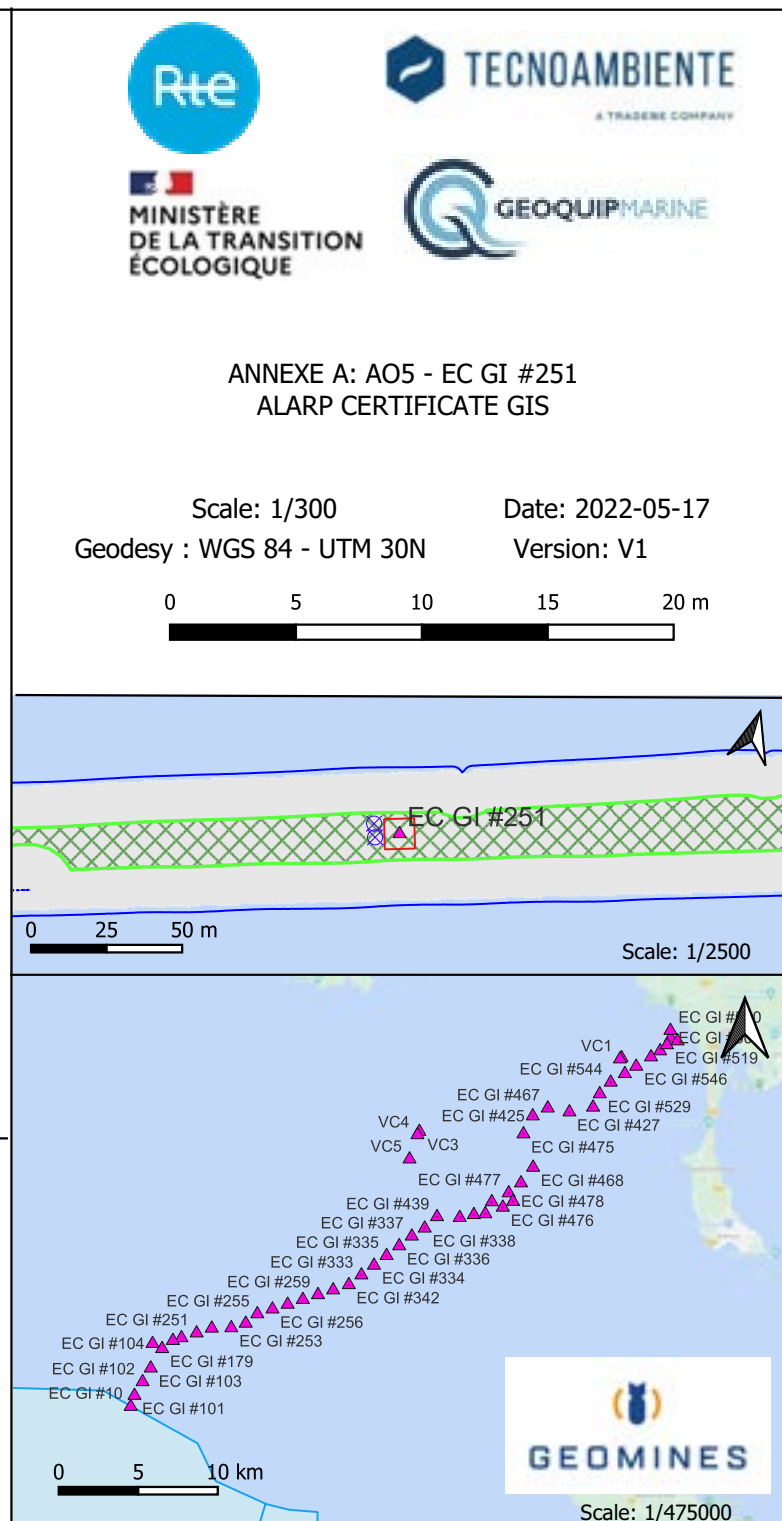
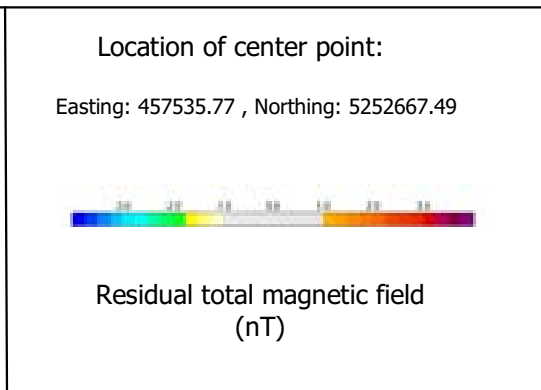
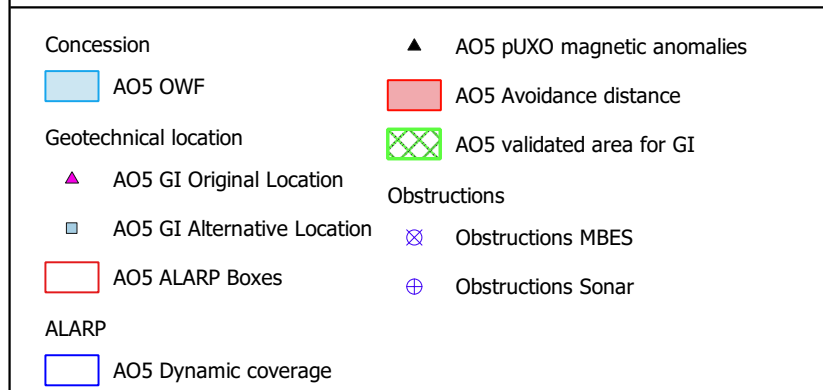
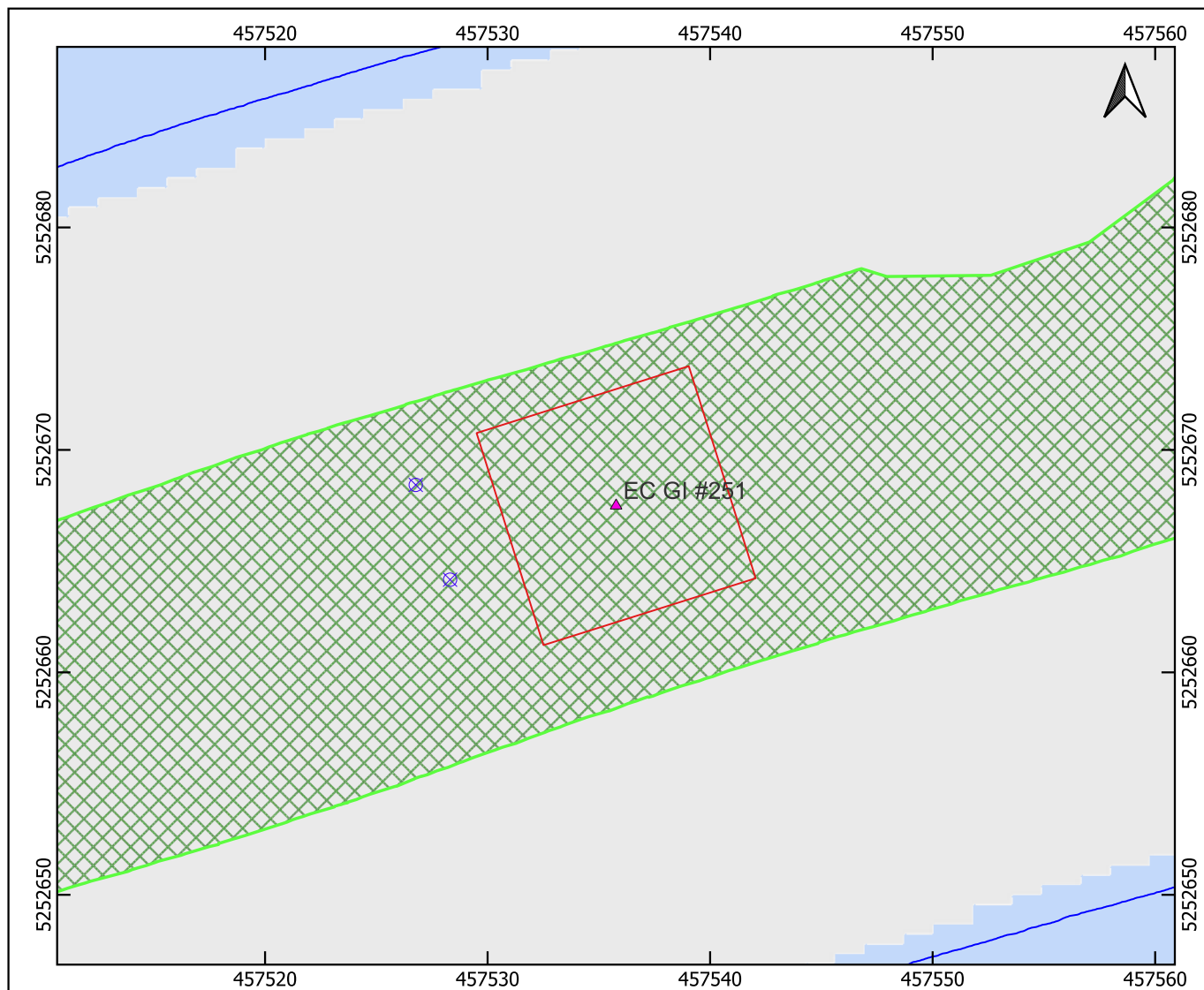
ANNEXE A: AO5 - EC GI #205 ALARP CERTIFICATE GIS

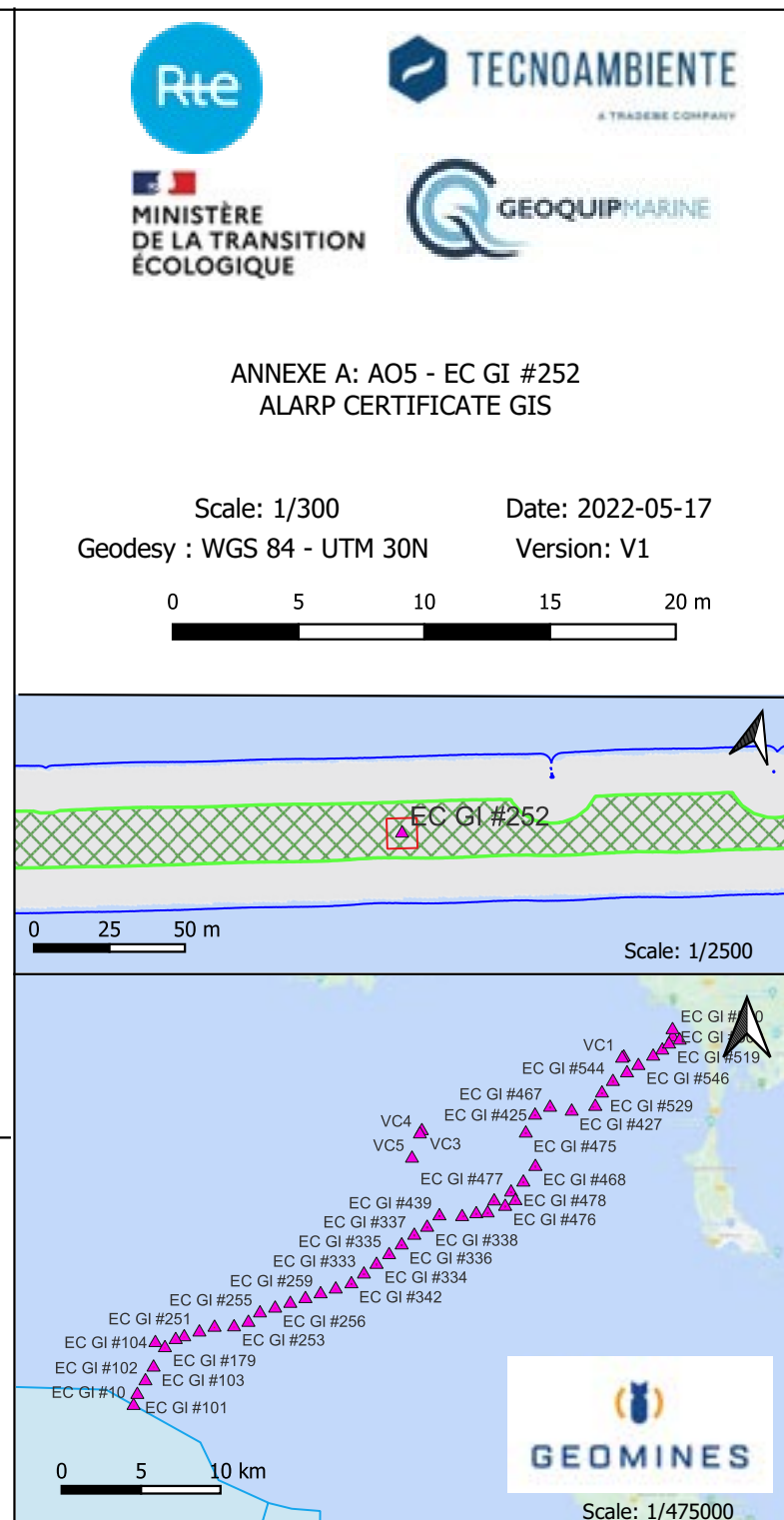
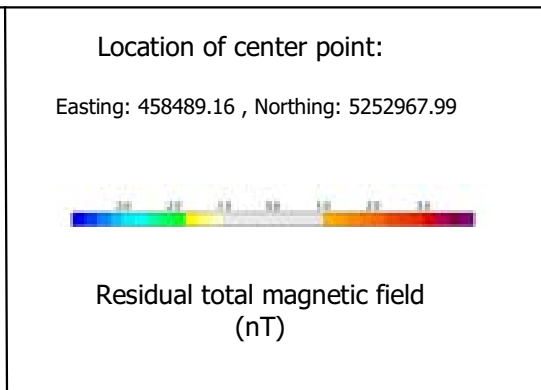
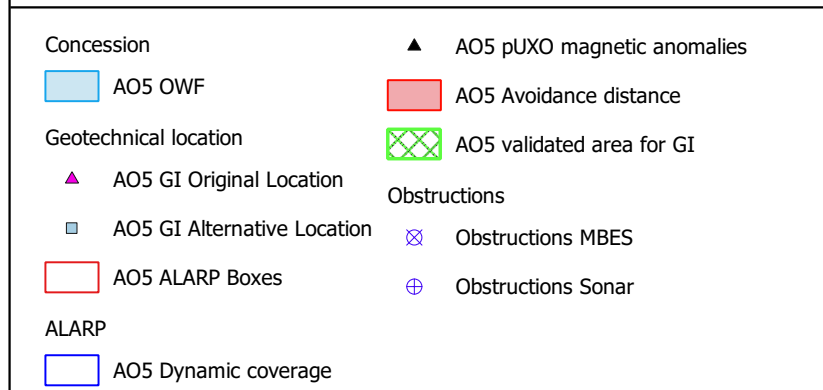
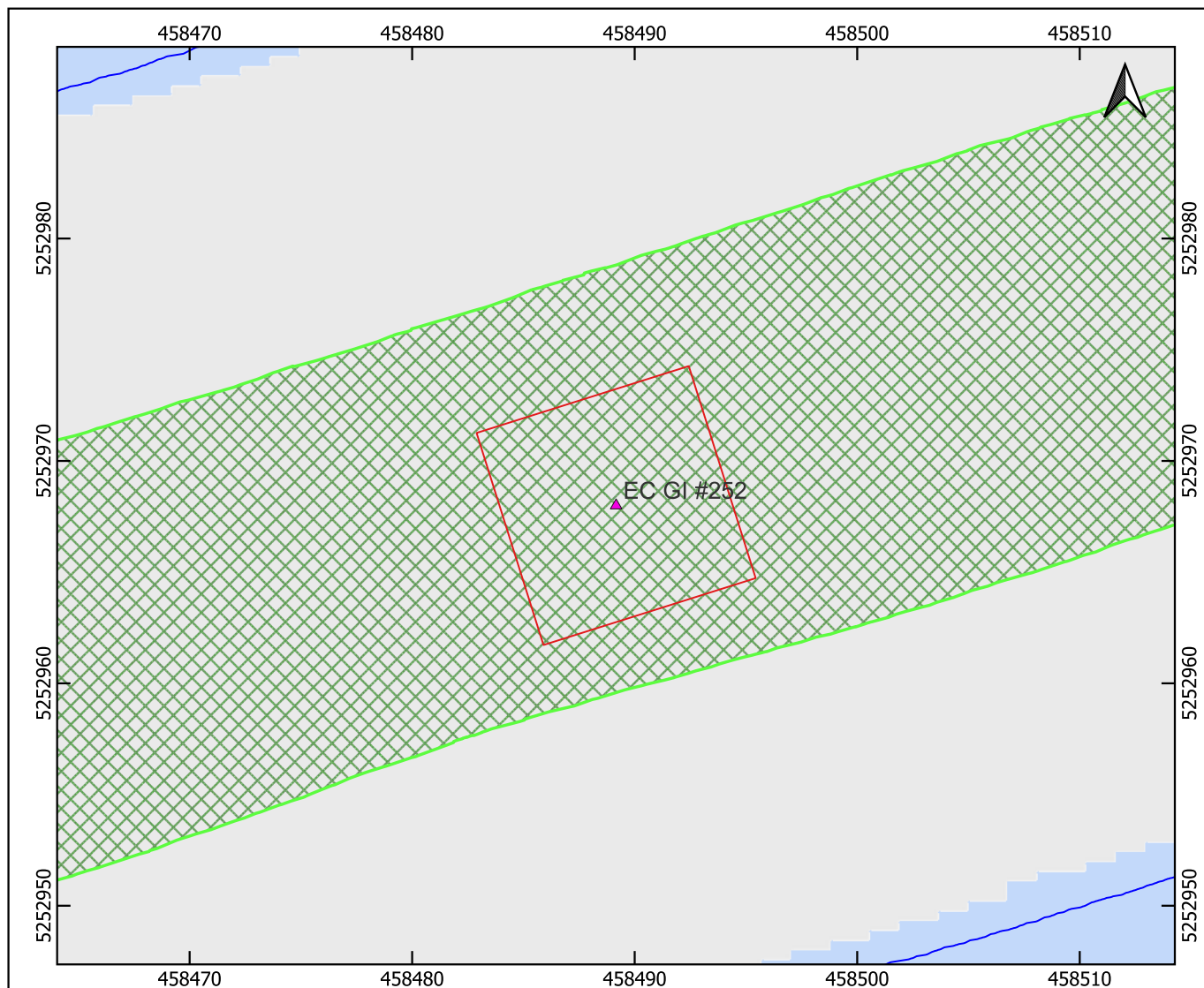
Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1

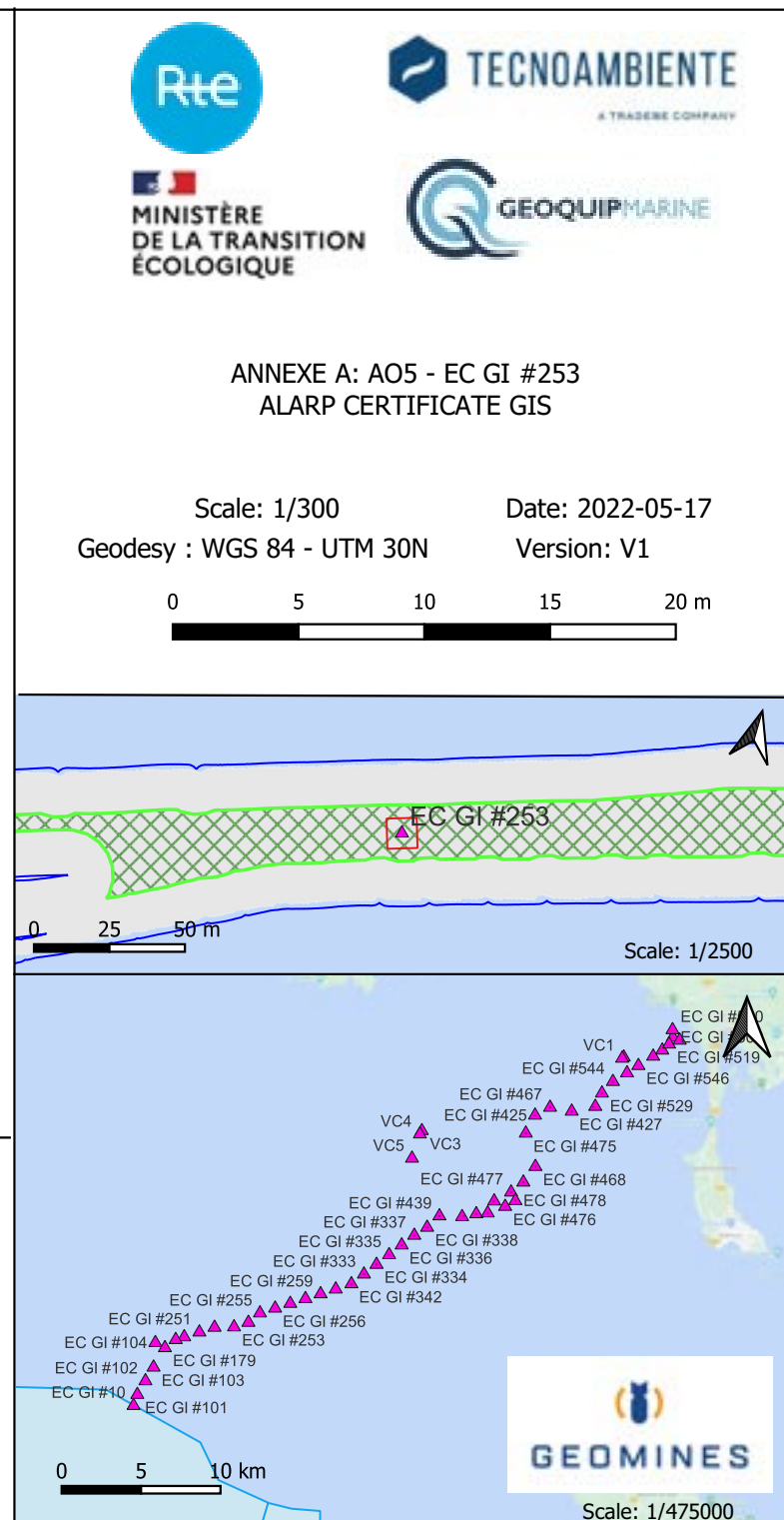
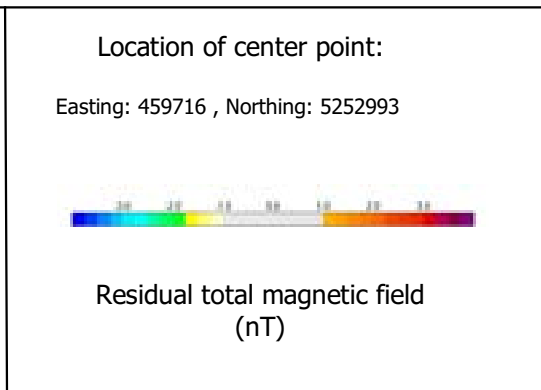
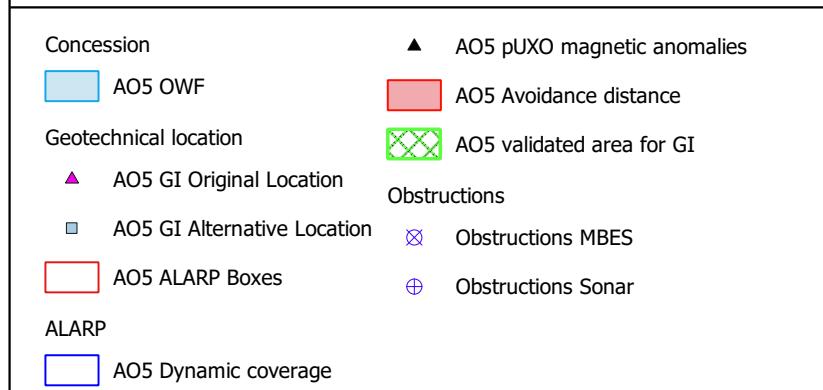
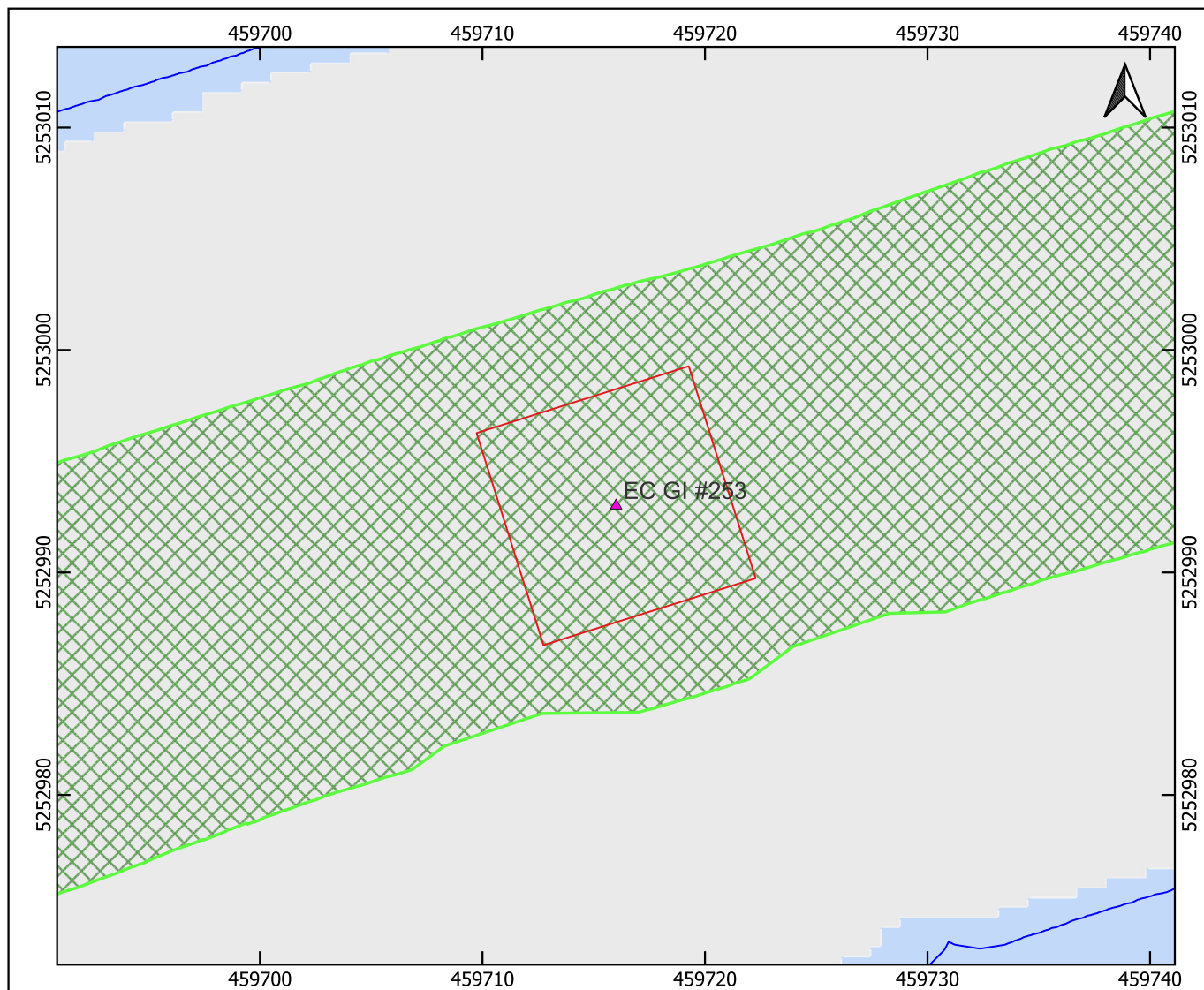


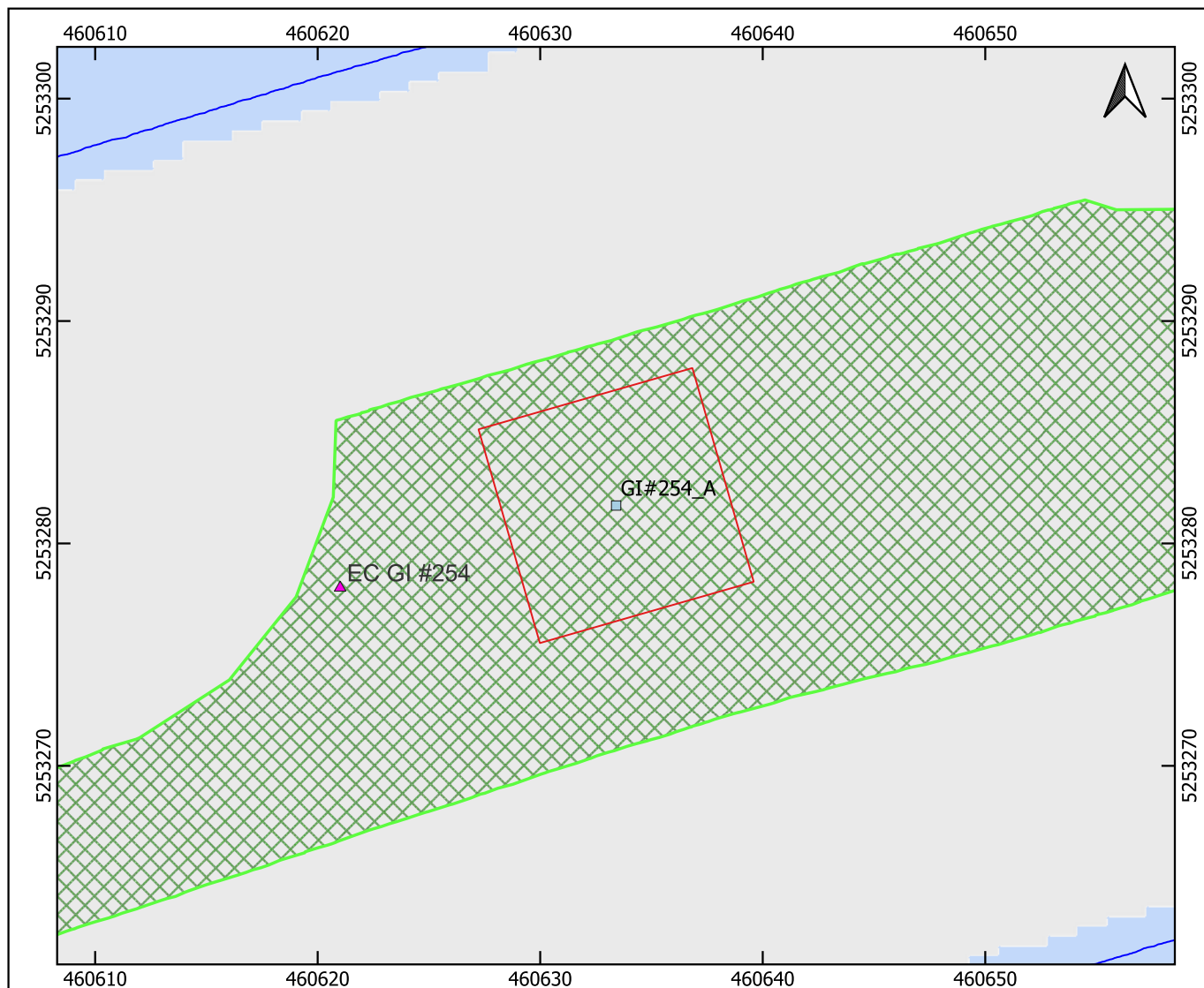
Scale: 1/475000











- | | |
|-------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| ■ AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:
Easting: 460633.41 , Northing: 5253281.7

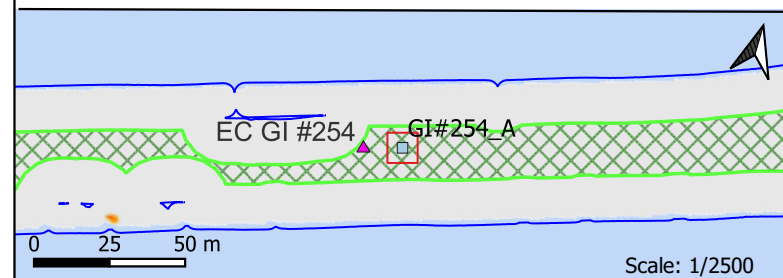
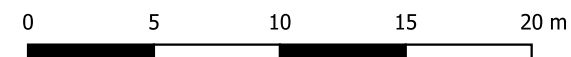


Residual total magnetic field
(nT)

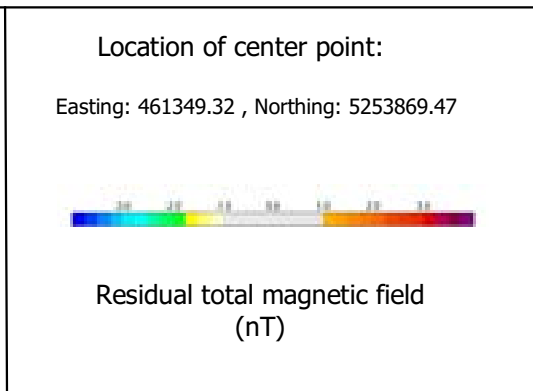
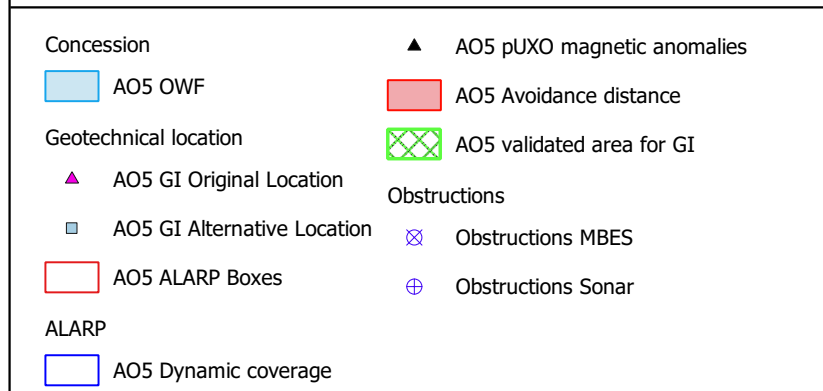
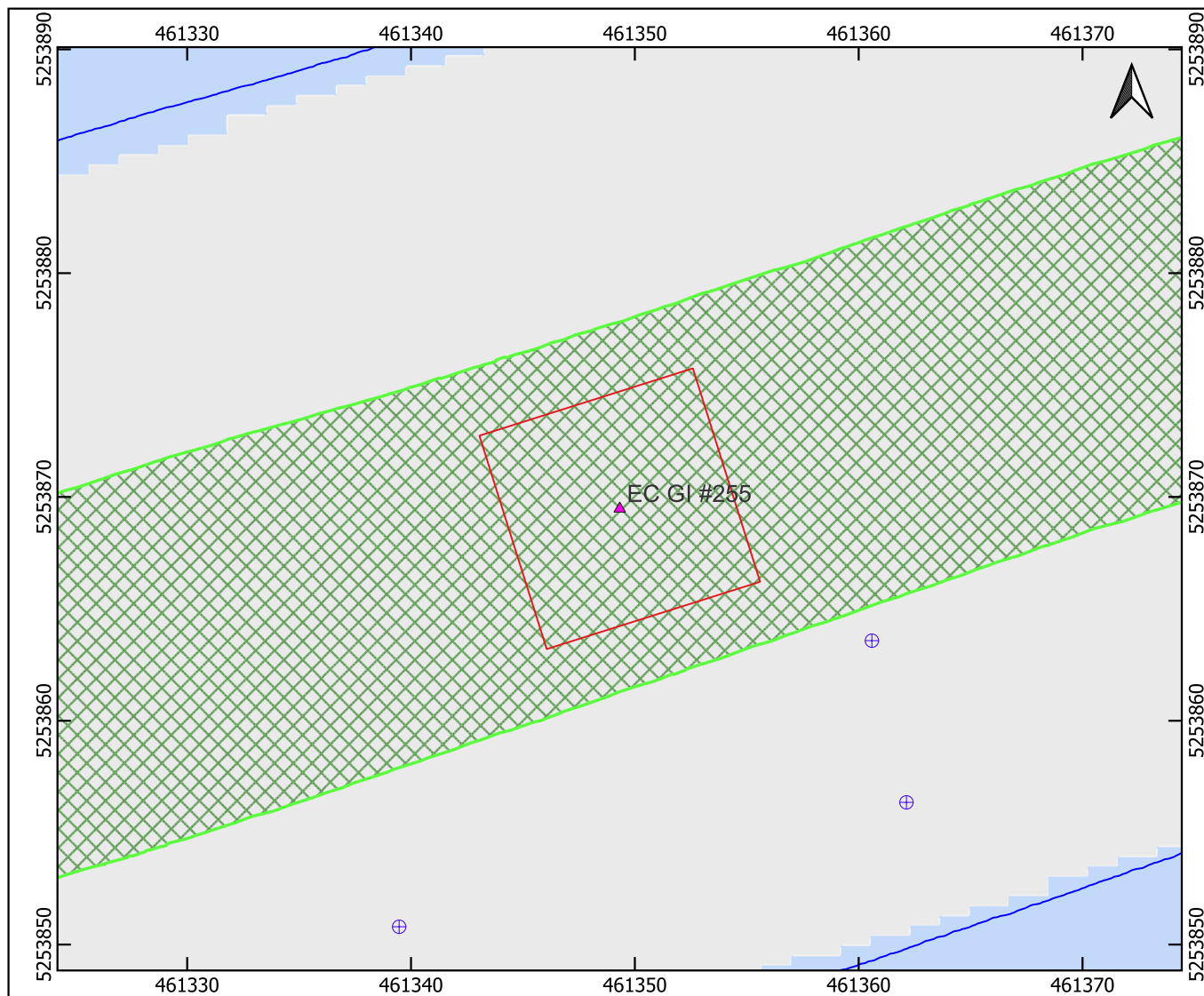


ANNEXE A: AO5 - EC GI #254_A ALARP CERTIFICATE GIS

Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1



Scale: 1/475000



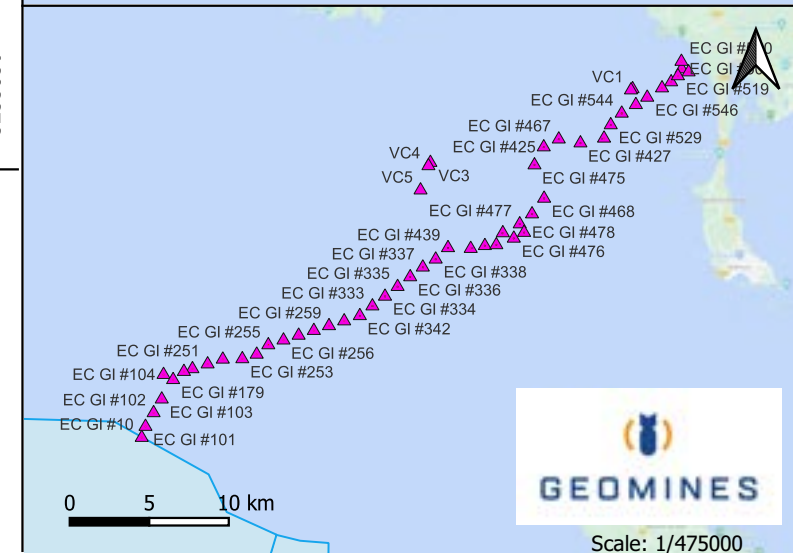
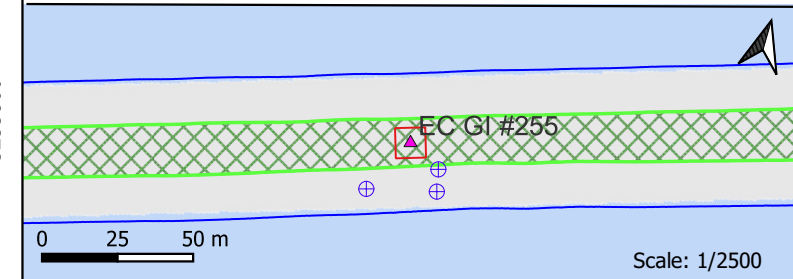
ANNEXE A: AO5 - EC GI #255
ALARP CERTIFICATE GIS

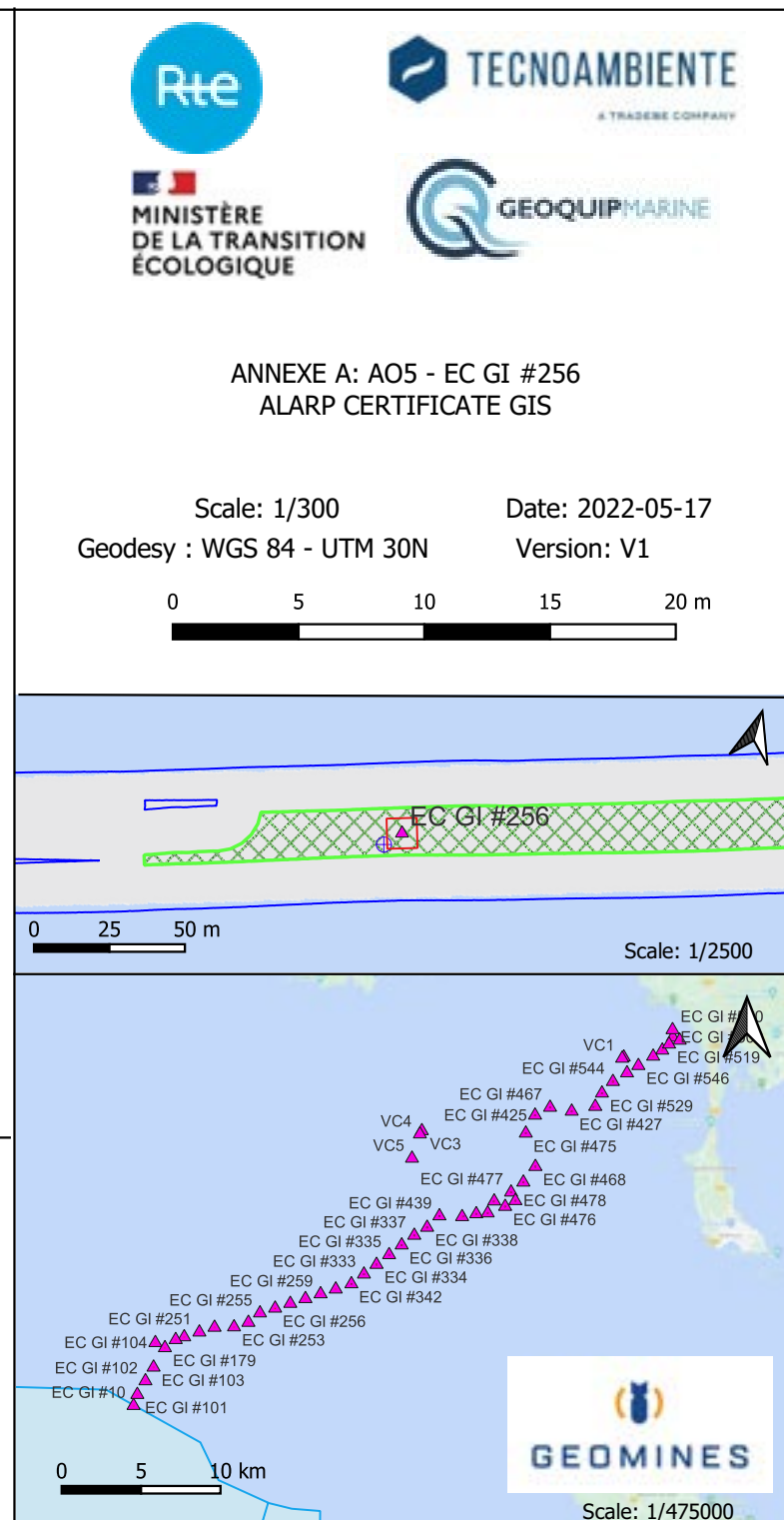
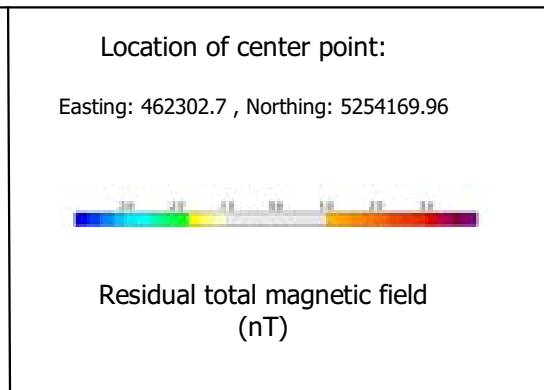
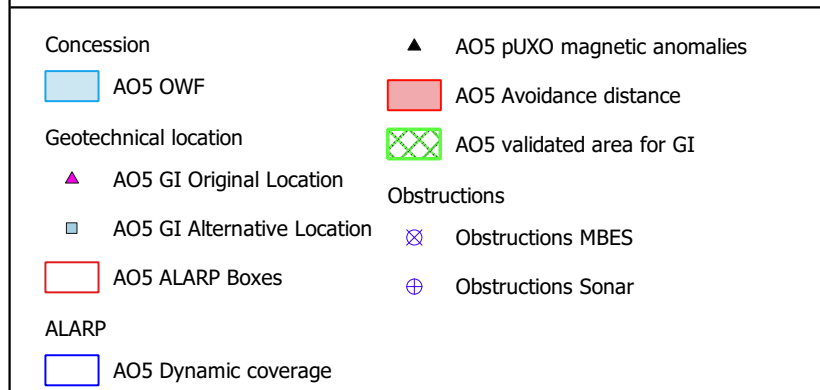
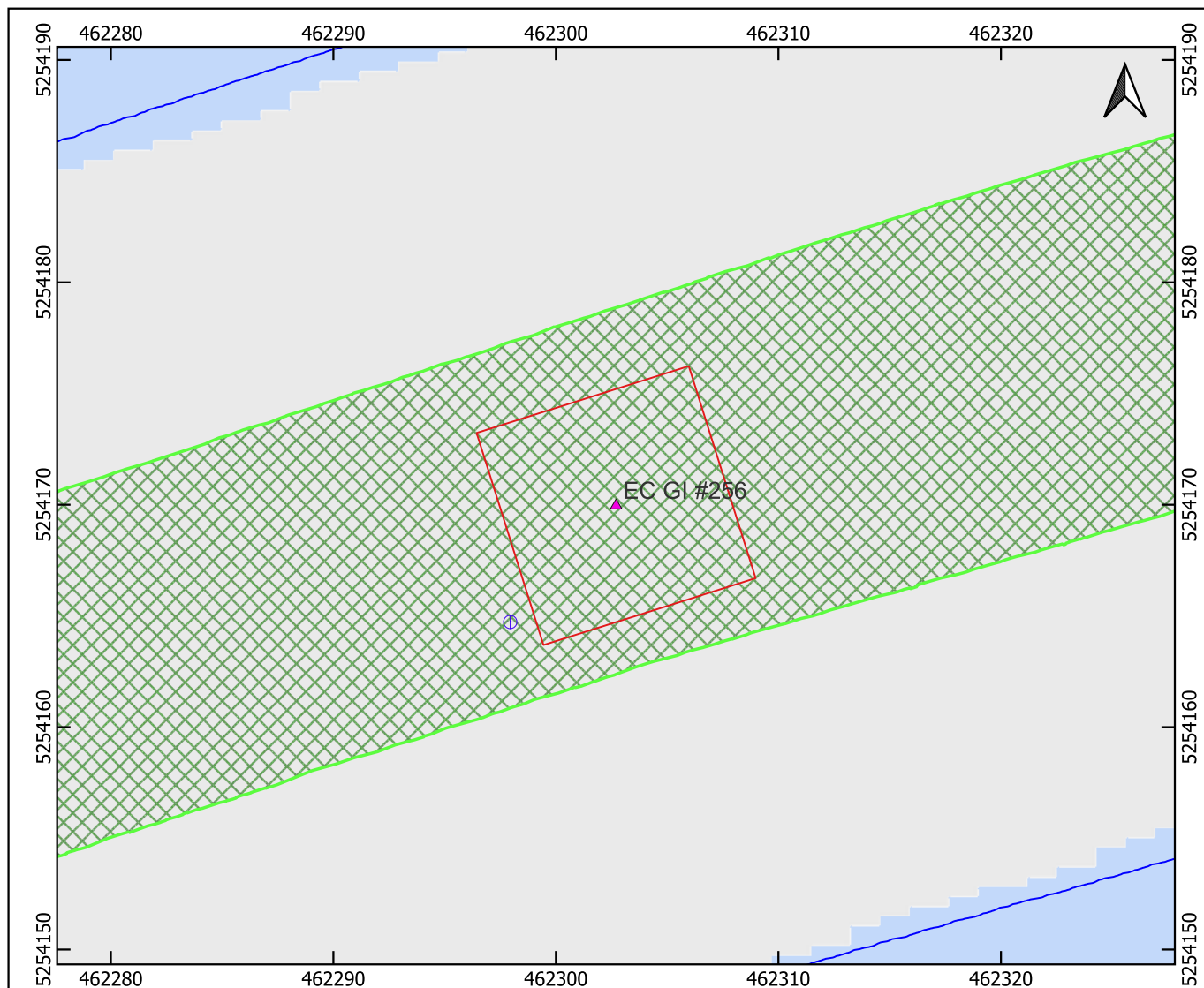
Scale: 1/300

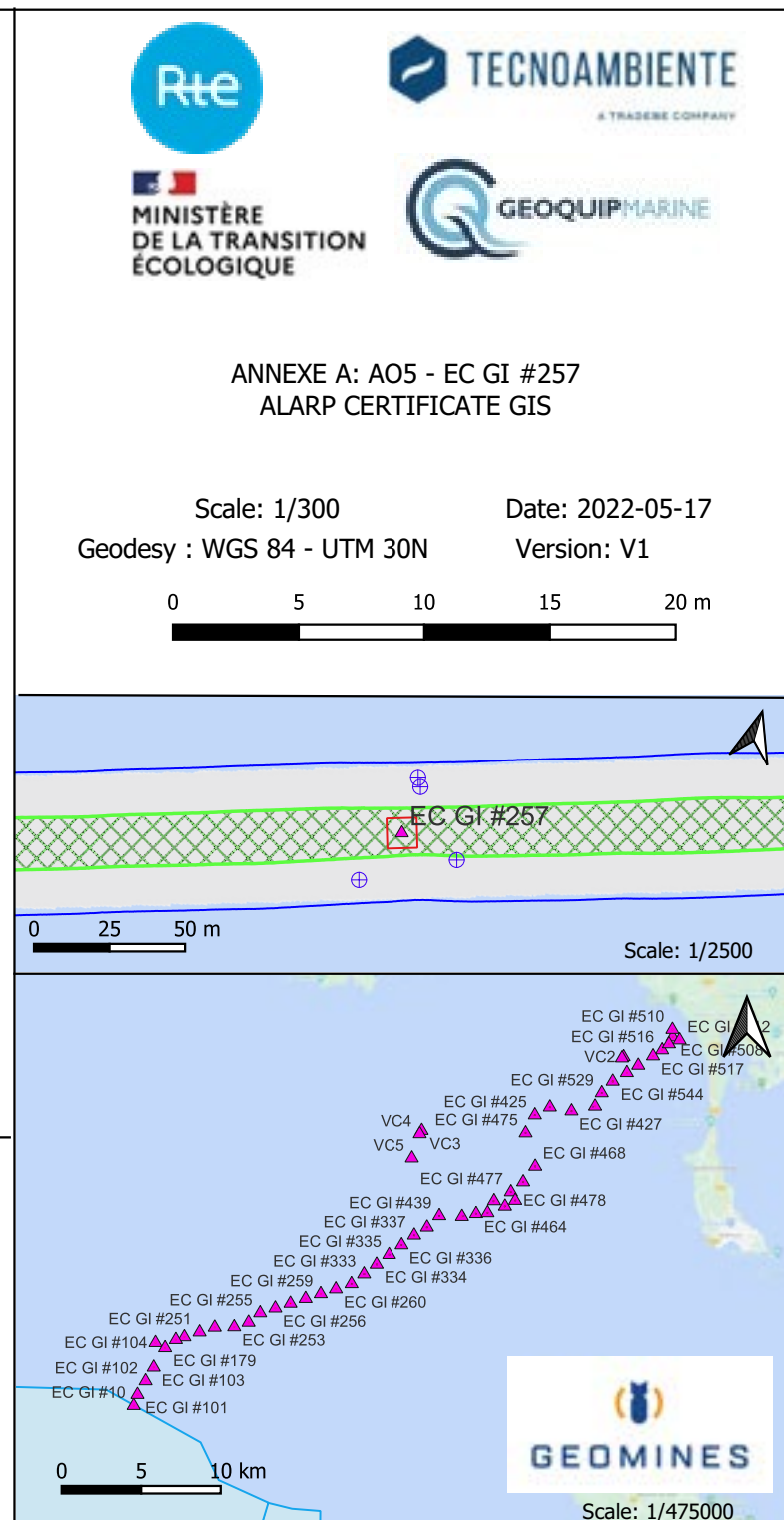
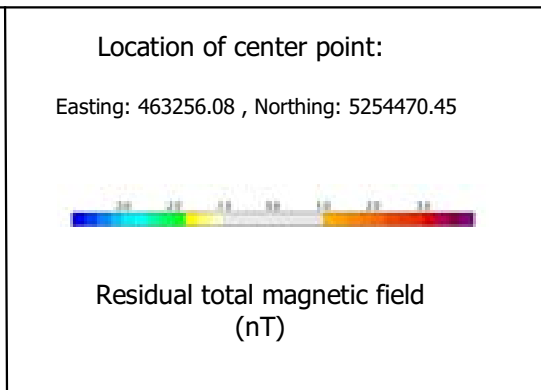
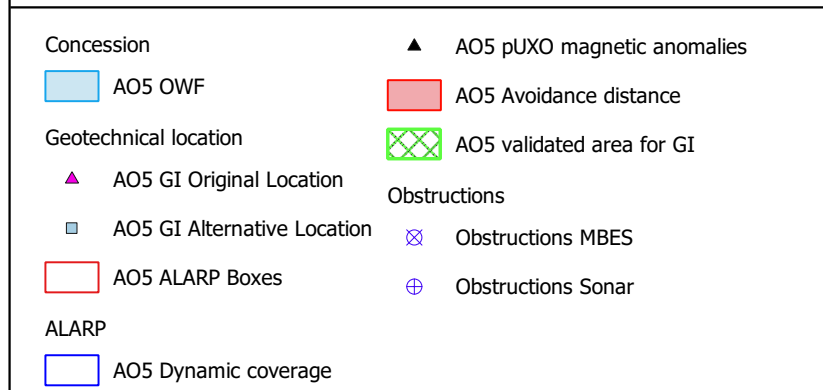
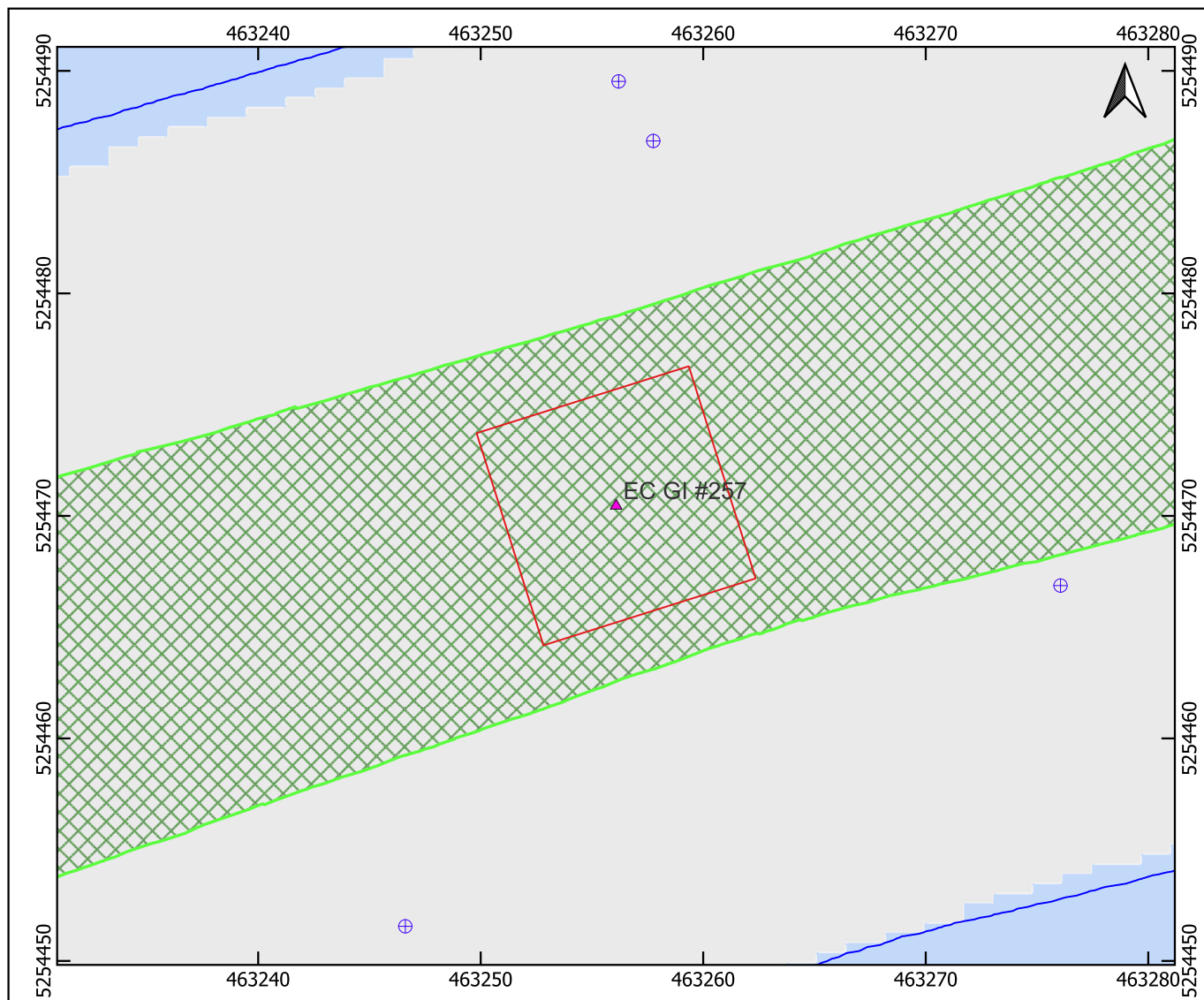
Date: 2022-05-17

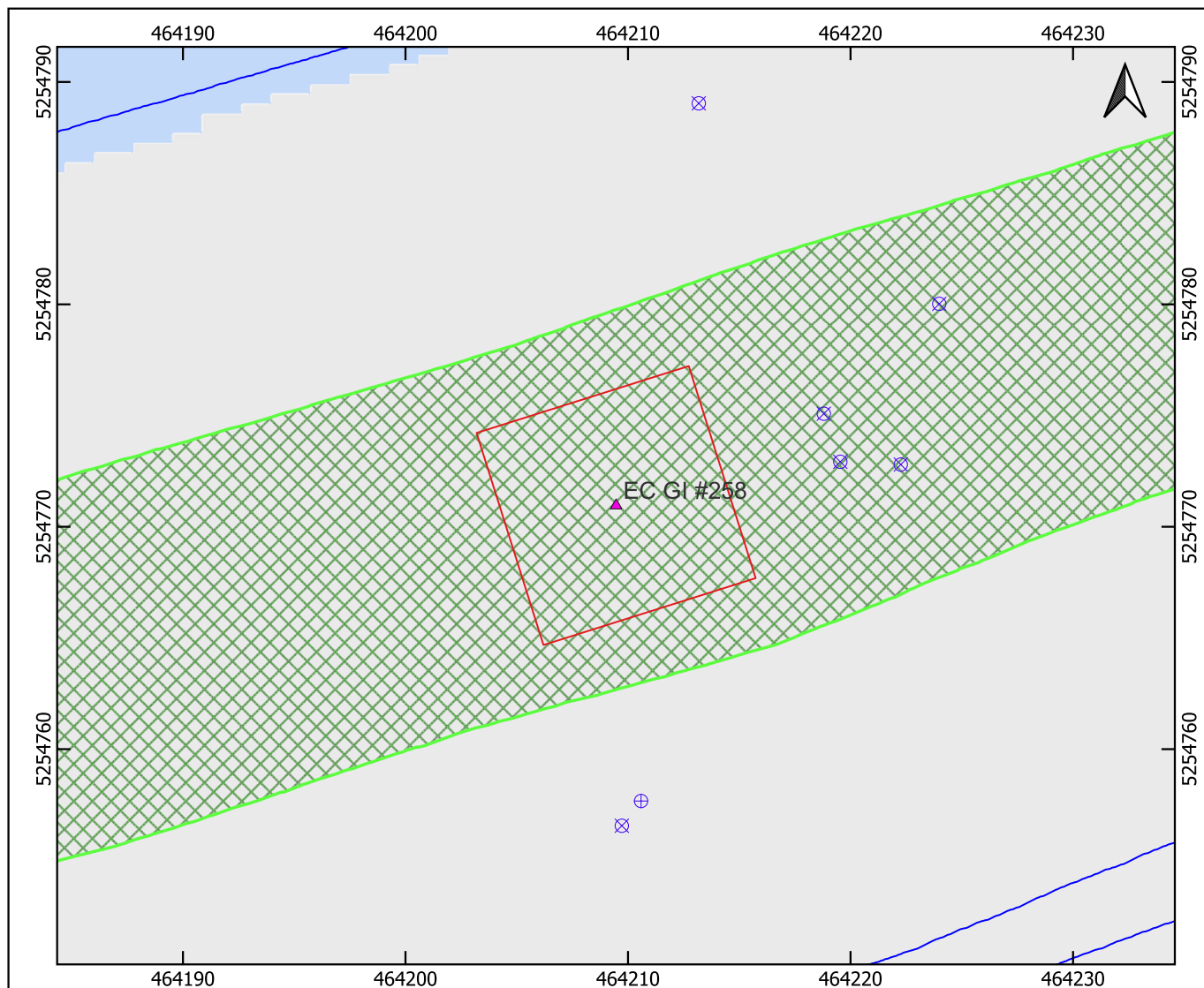
Geodesy : WGS 84 - UTM 30N

Version: V1









- Concession
- AO5 OWF
- Geotechnical location
- AO5 GI Original Location
 - AO5 GI Alternative Location
- ALARP
- AO5 ALARP Boxes
 - AO5 Dynamic coverage
- AO5 pUXO magnetic anomalies
- AO5 Avoidance distance
 - AO5 validated area for GI
- Obstructions
- Obstructions MBES
 - Obstructions Sonar

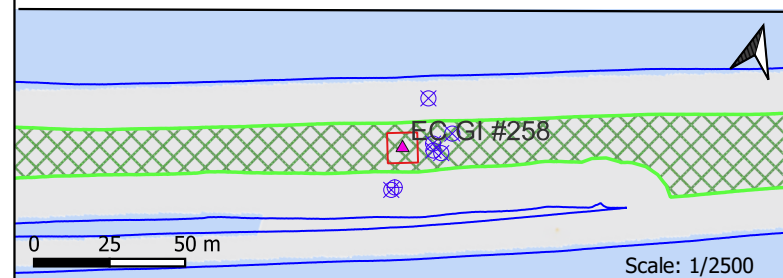
Location of center point:
Easting: 464209.46 , Northing: 5254770.95

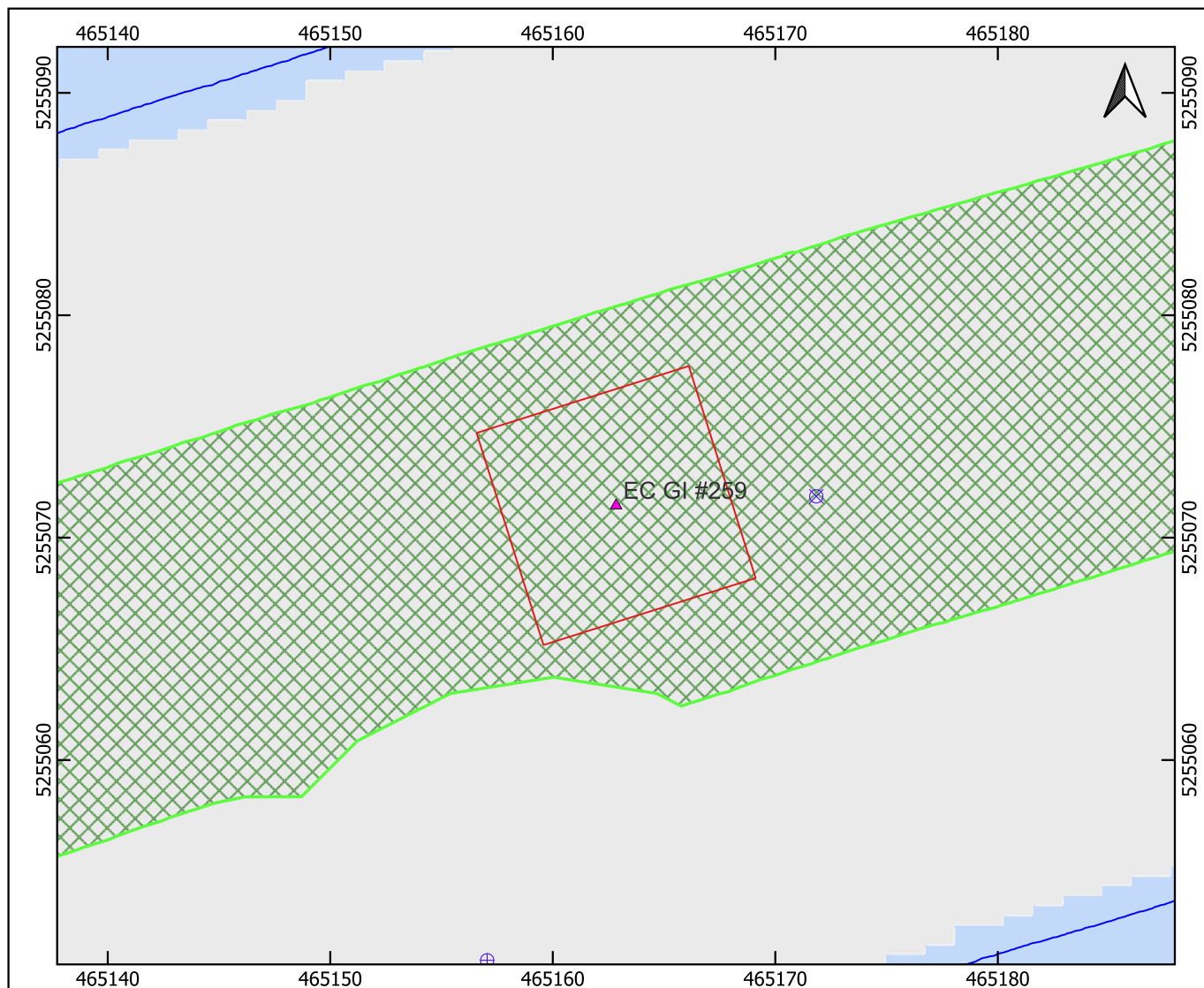
Residual total magnetic field (nT)



ANNEXE A: AO5 - EC GI #258 ALARP CERTIFICATE GIS

Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1





- | | |
|------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:
Easting: 465162.84 , Northing: 5255071.44

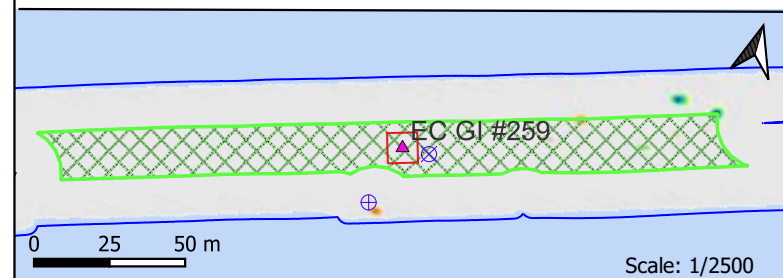
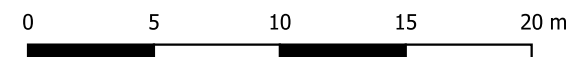


**Residual total magnetic field
(nT)**

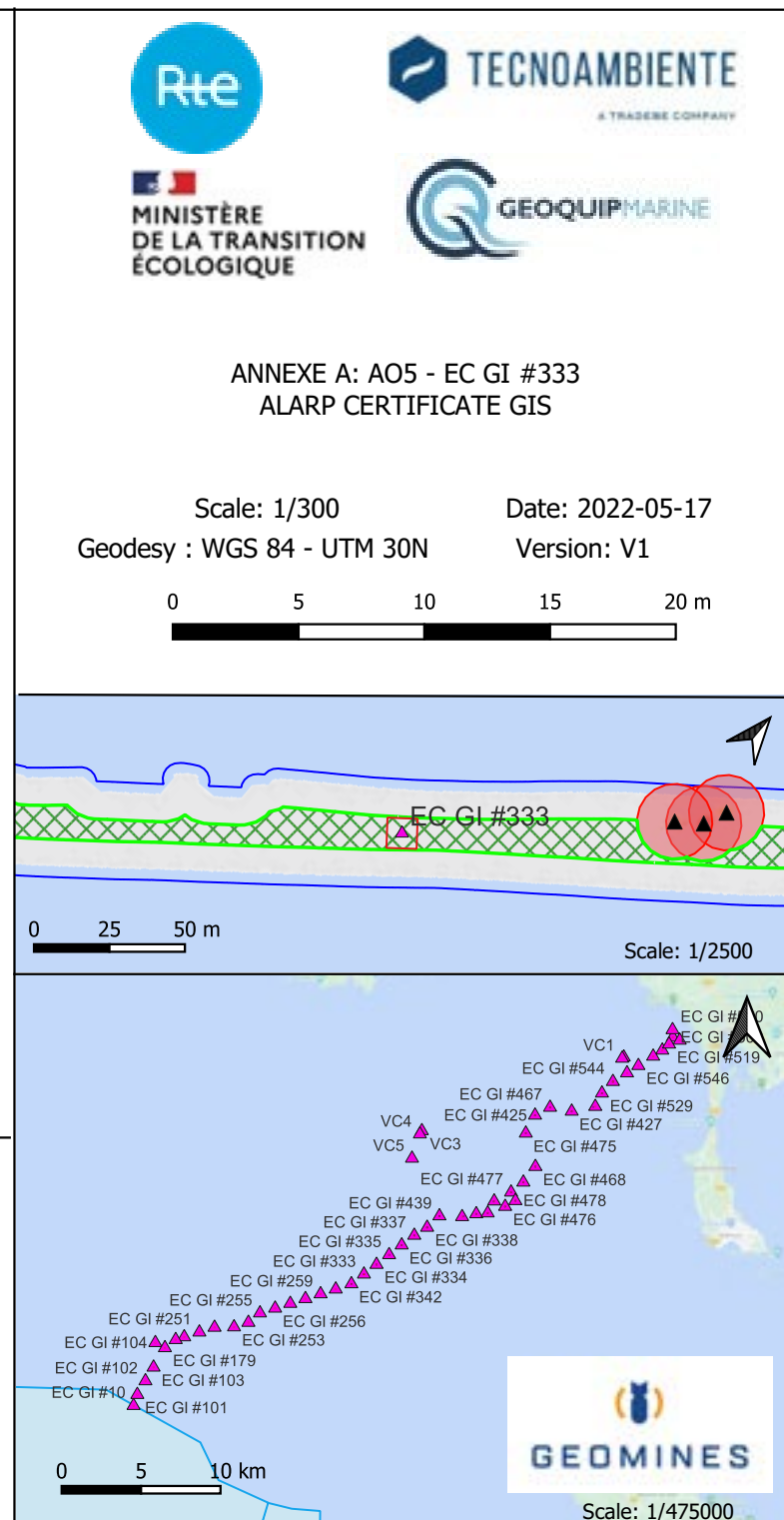
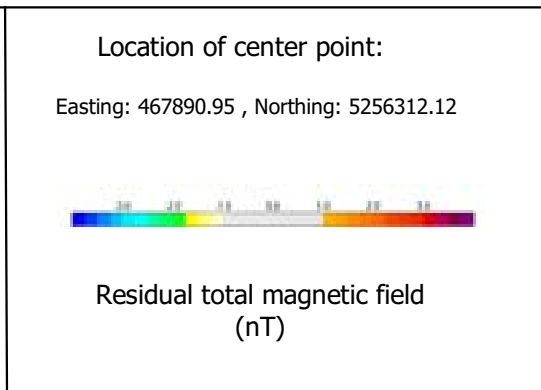
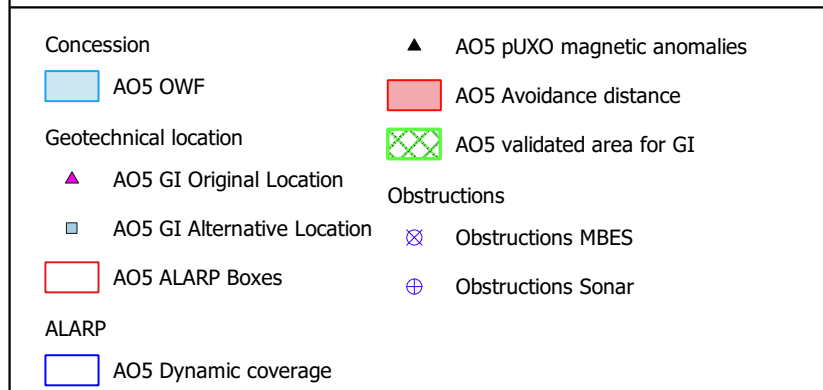
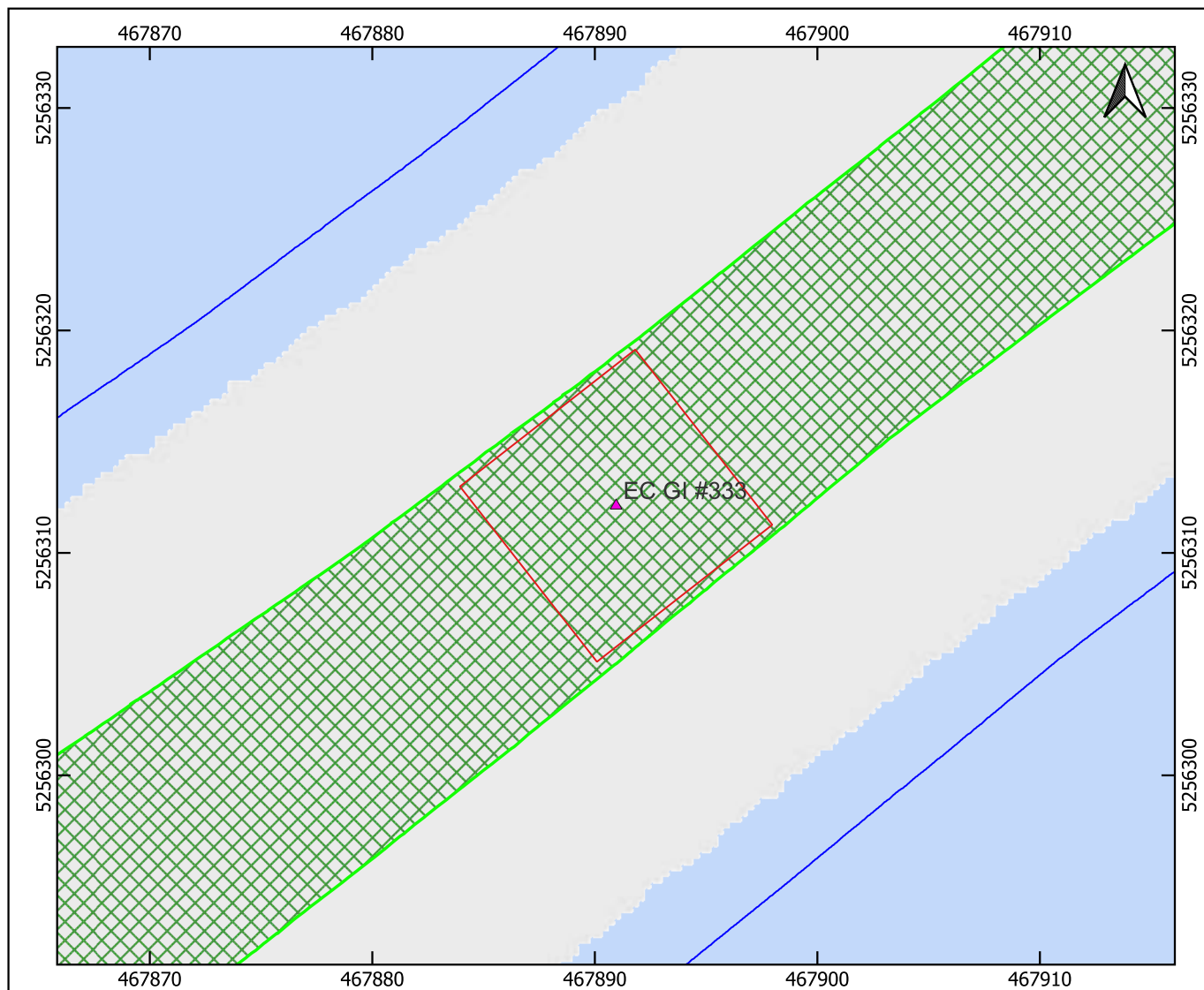


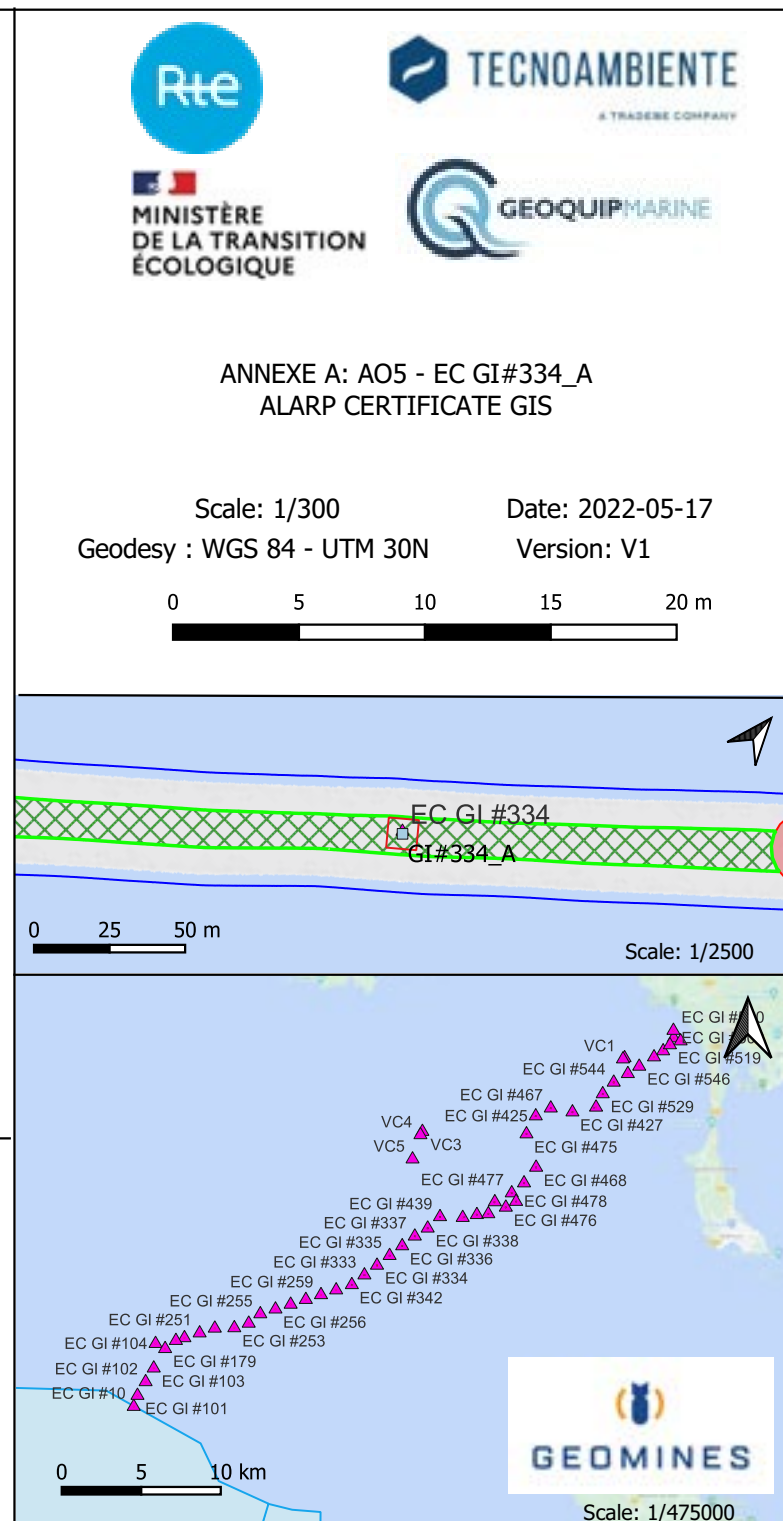
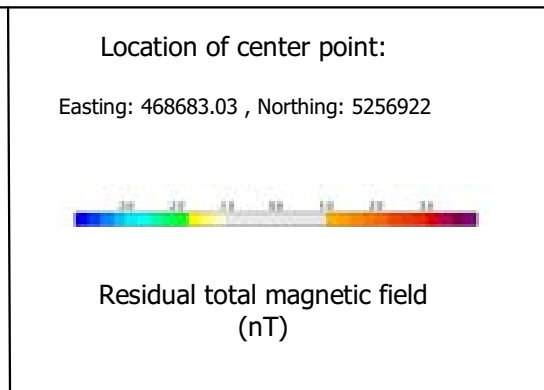
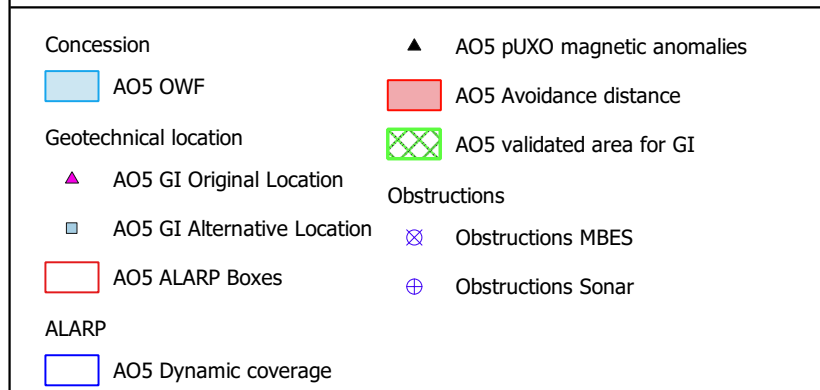
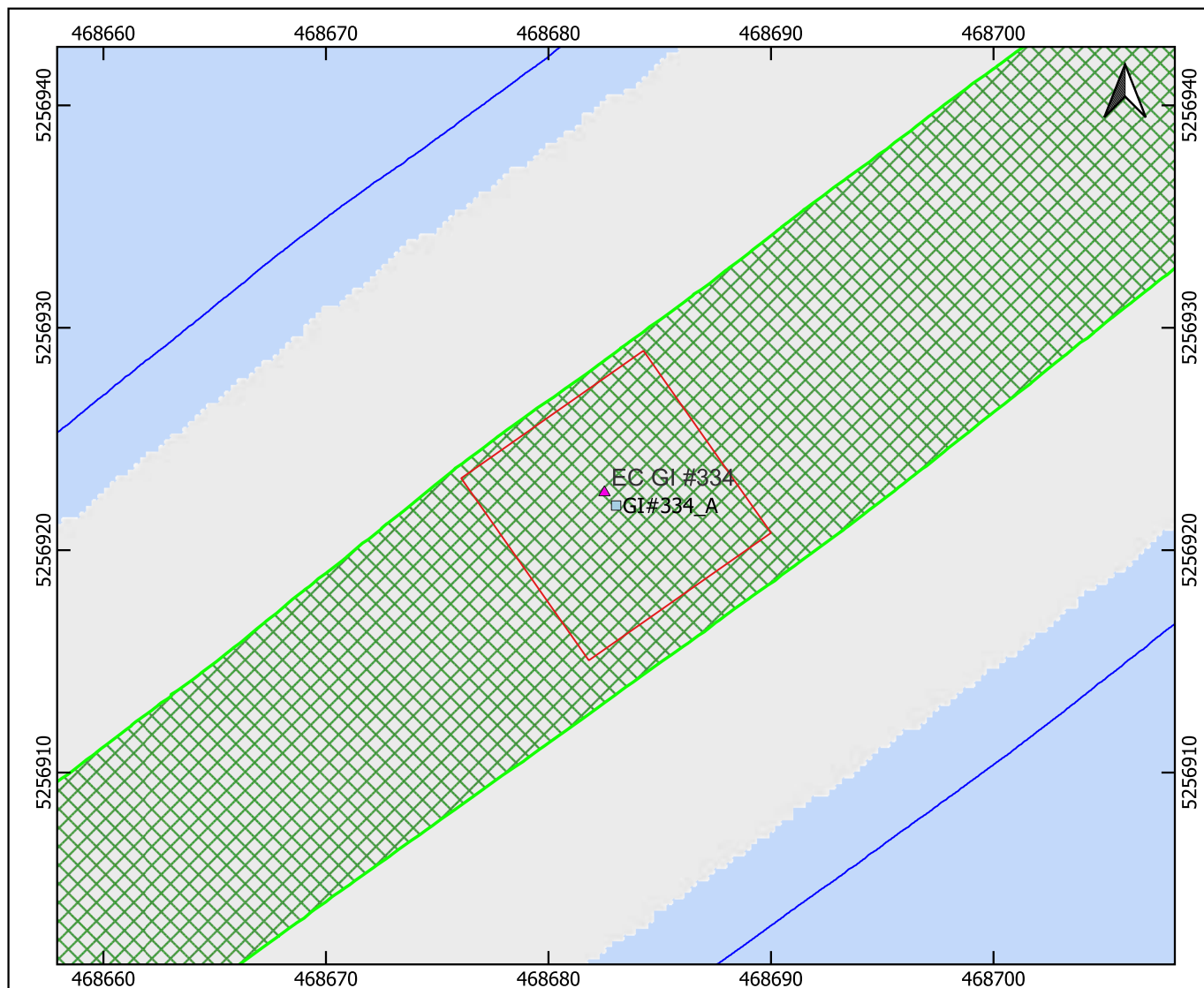
ANNEXE A: AO5 - EC GI #259 ALARP CERTIFICATE GIS

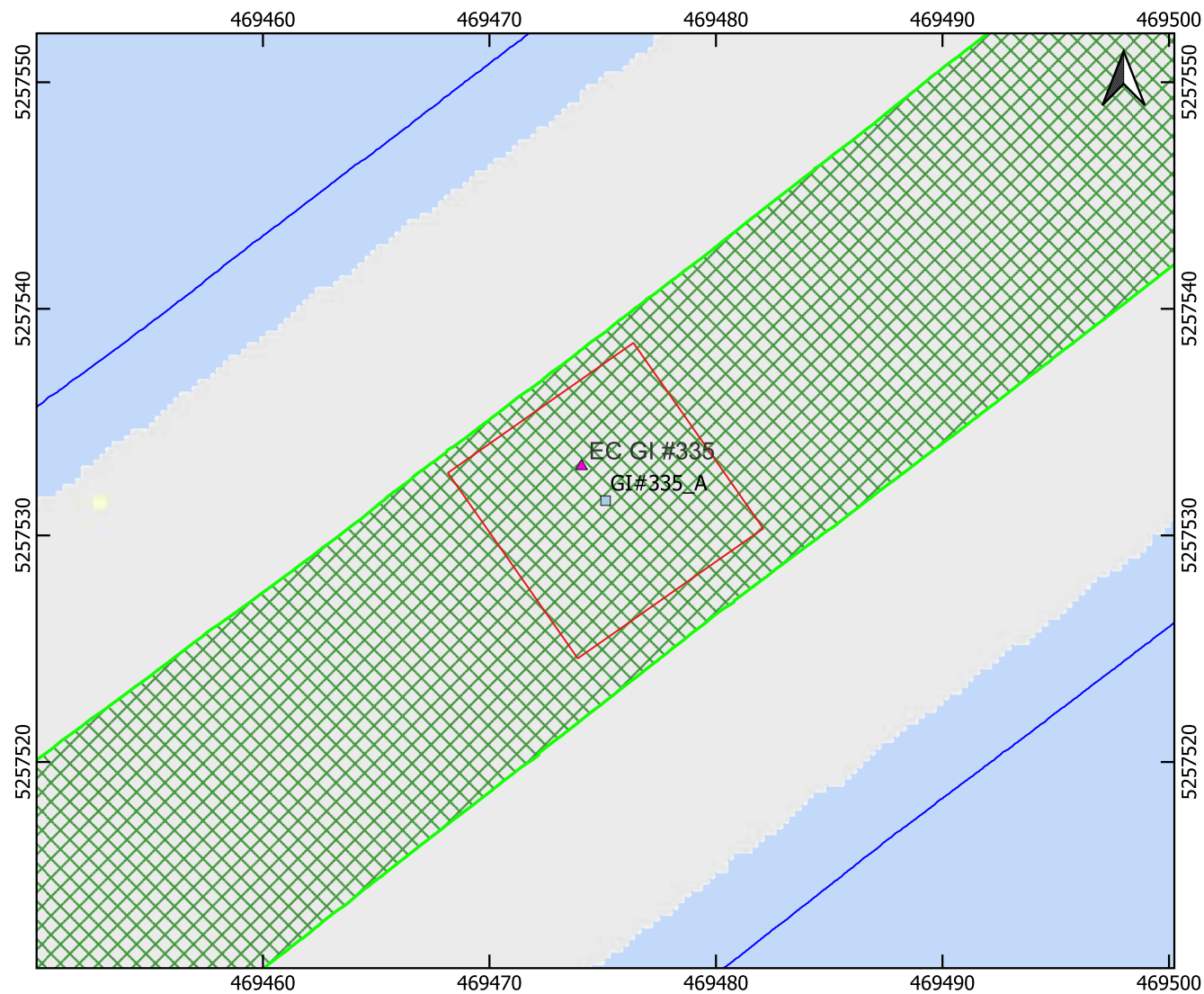
Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1



Scale: 1/475000

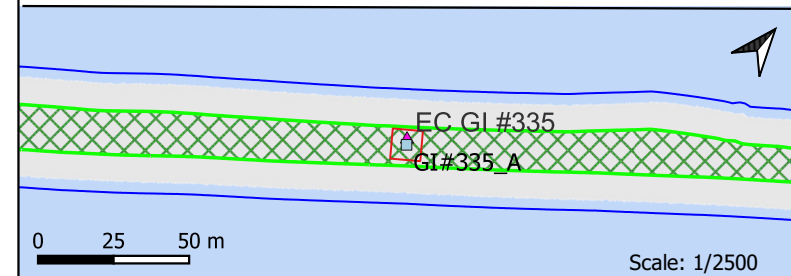
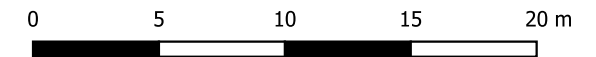






ANNEXE A: AO5 - EC GI#335_A
ALARP CERTIFICATE GIS

Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1




Concession

AO5 OWF

Geotechnical location

A05 GI Original Location

A05 GI Alternative Location

 AO5 ALARP Boxes

ALARP

AO5 Dynamic coverage

▲ AO5 pUXO magnetic anomalies

 A05 Avoidance distance

 AO5 validated area for GI

Obstructions

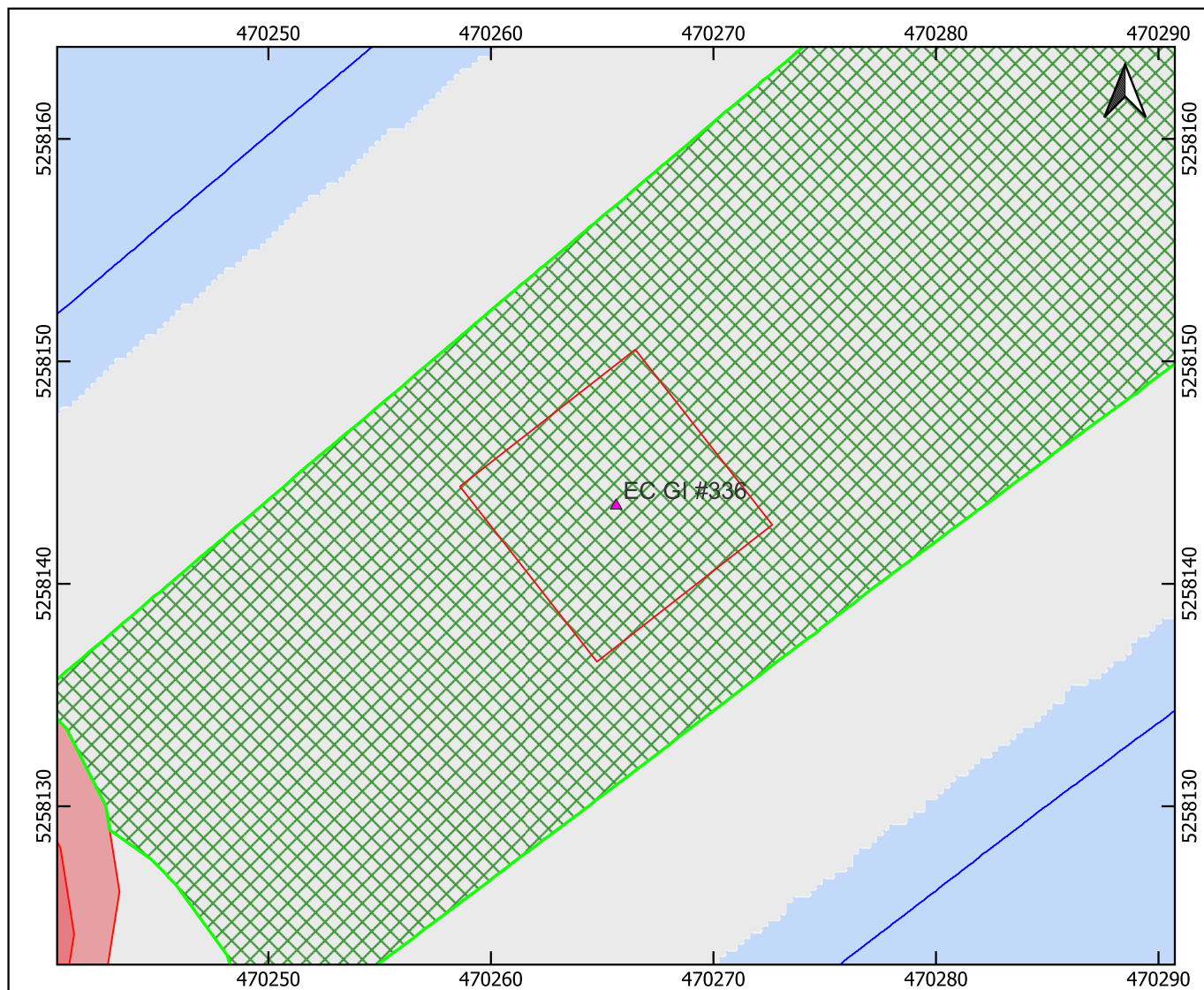
Obstructions MBES

Obstructions Sonar

Location of center point:

Easting: 469475.12 , Northing: 5257531.53

Residual total magnetic field
(nT)



- | | |
|-------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| ■ AO5 GI Alternative Location | ⊗ Obstructions MBES |
| AO5 ALARP Boxes | ⊕ Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:
Easting: 470265.62 , Northing: 5258143.51

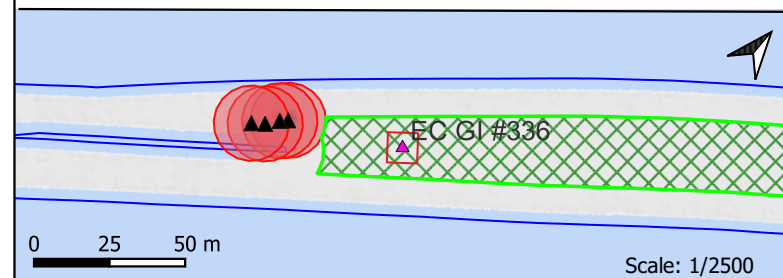
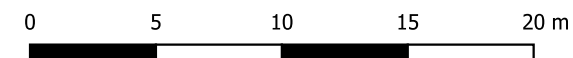


Residual total magnetic field
(nT)

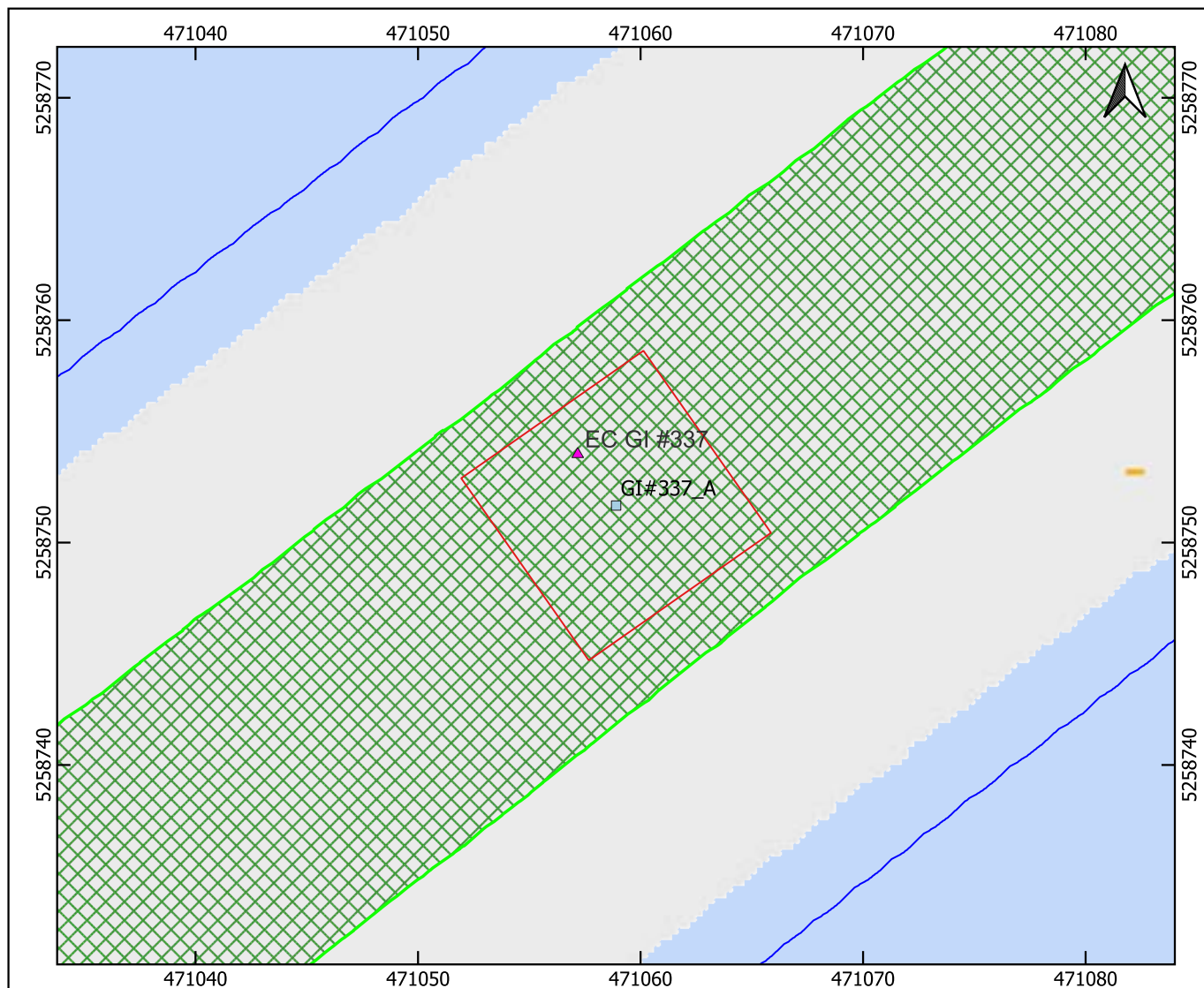


ANNEXE A: AO5 - EC GI #336 ALARP CERTIFICATE GIS

Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1

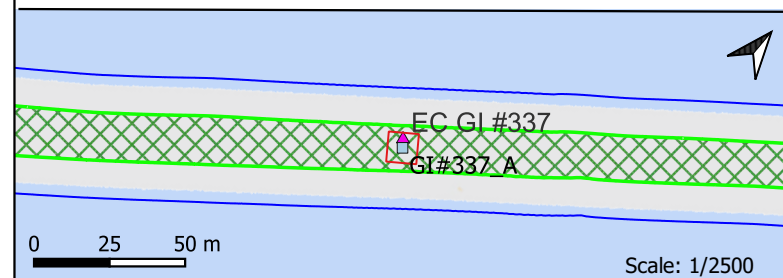


Scale: 1/475000



ANNEXE A: AO5 - EC GI#337_A ALARP CERTIFICATE GIS

Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1



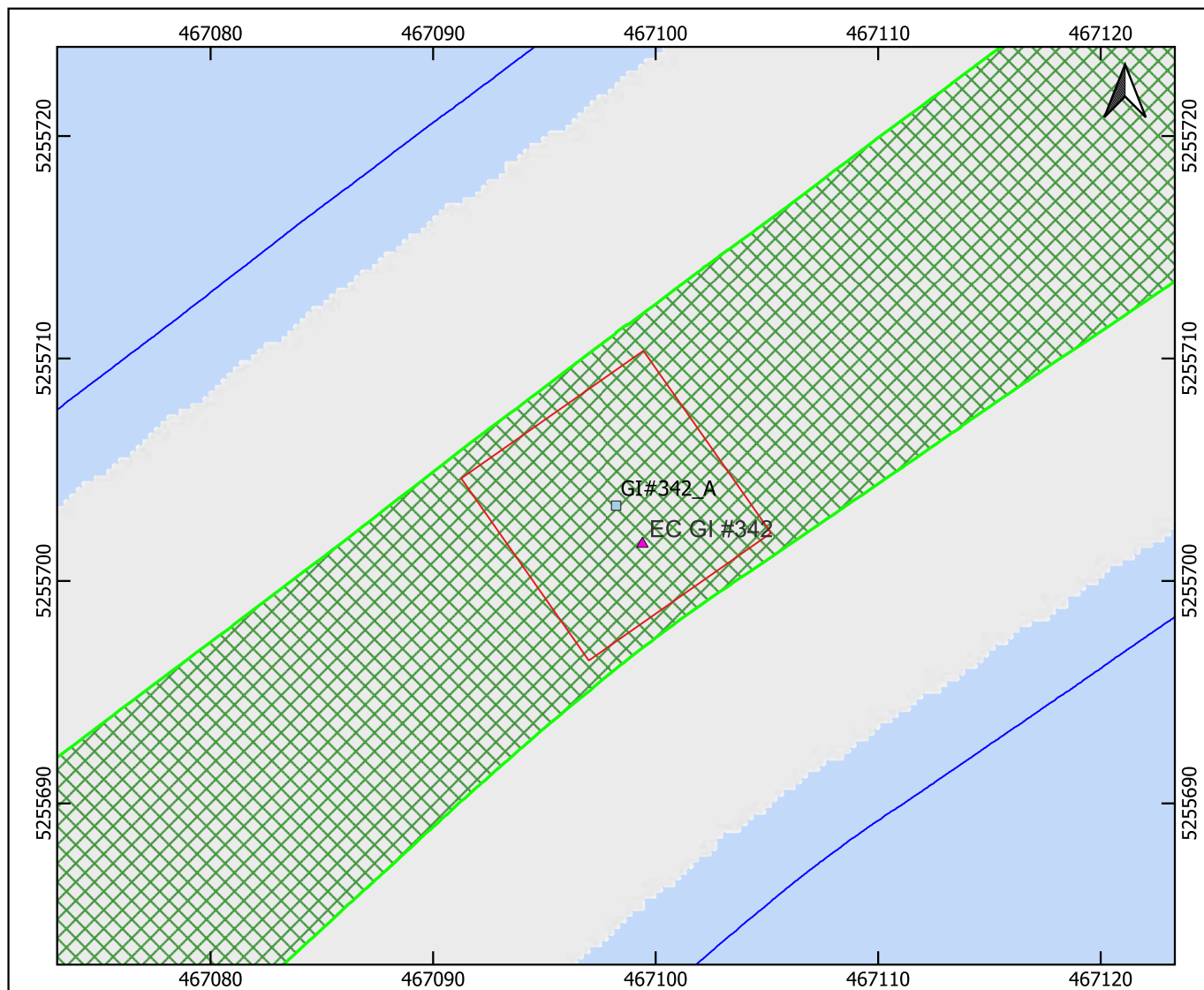
- | | |
|-------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| ■ AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:
Easting: 471058.9 , Northing: 5258751.66



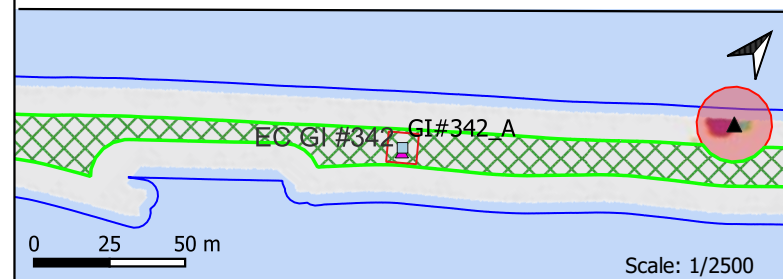
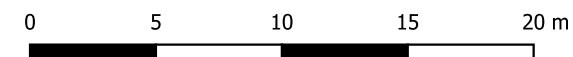
Residual total magnetic field
(nT)





ANNEXE A: AO5 - EC GI#342_A ALARP CERTIFICATE GIS

Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1



- | | |
|-------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| ■ AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:

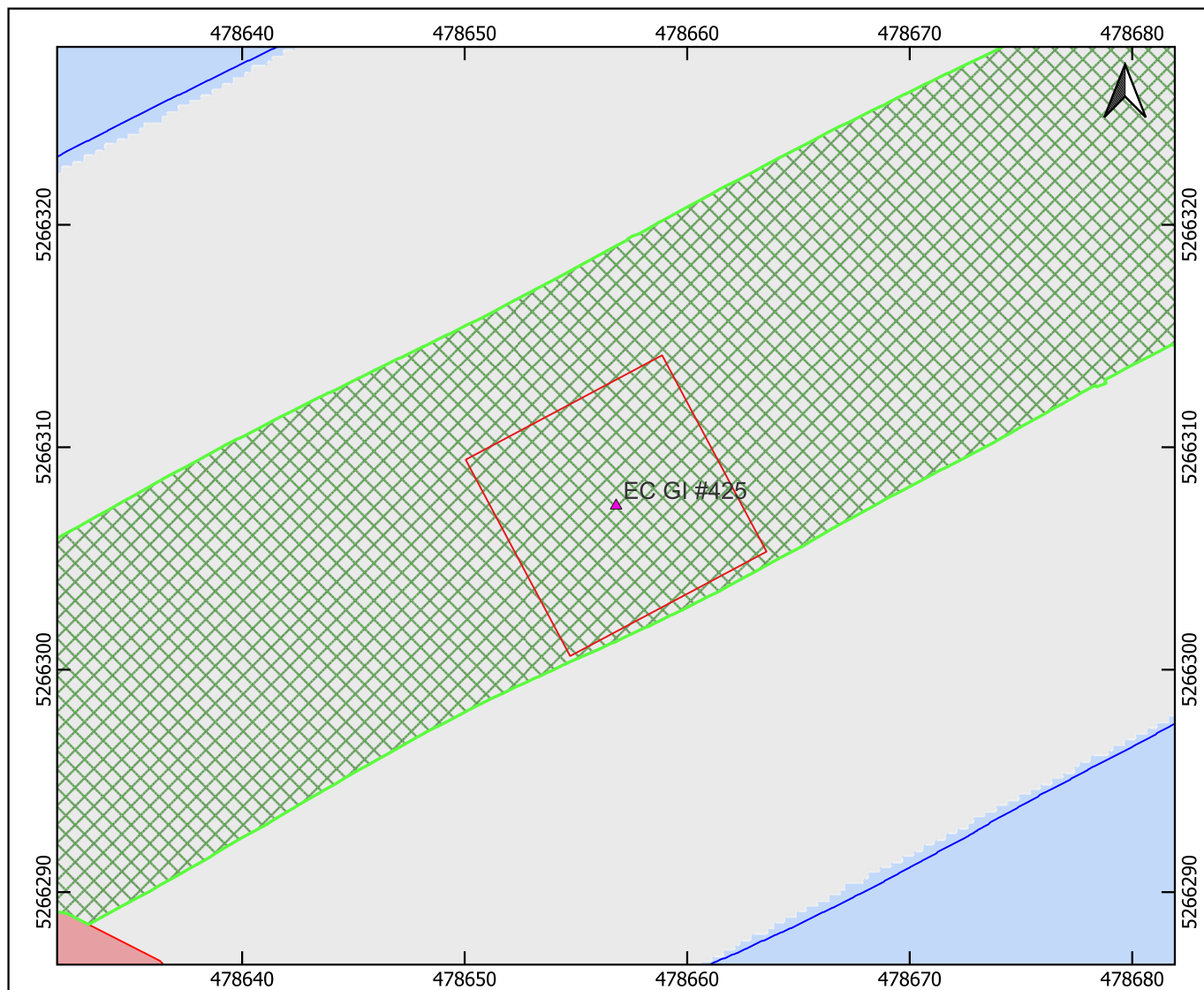
Easting: 467098.22 , Northing: 5255703.38



Residual total magnetic field
(nT)



Scale: 1/475000



- | | |
|------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:
Easting: 478656.8 , Northing: 5266307.37

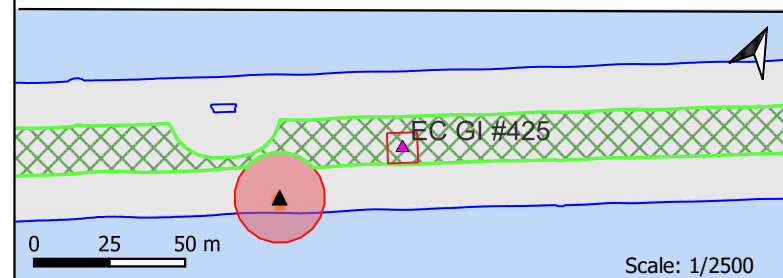
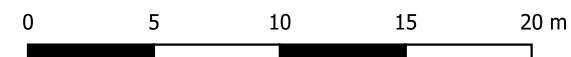


**Residual total magnetic field
(nT)**

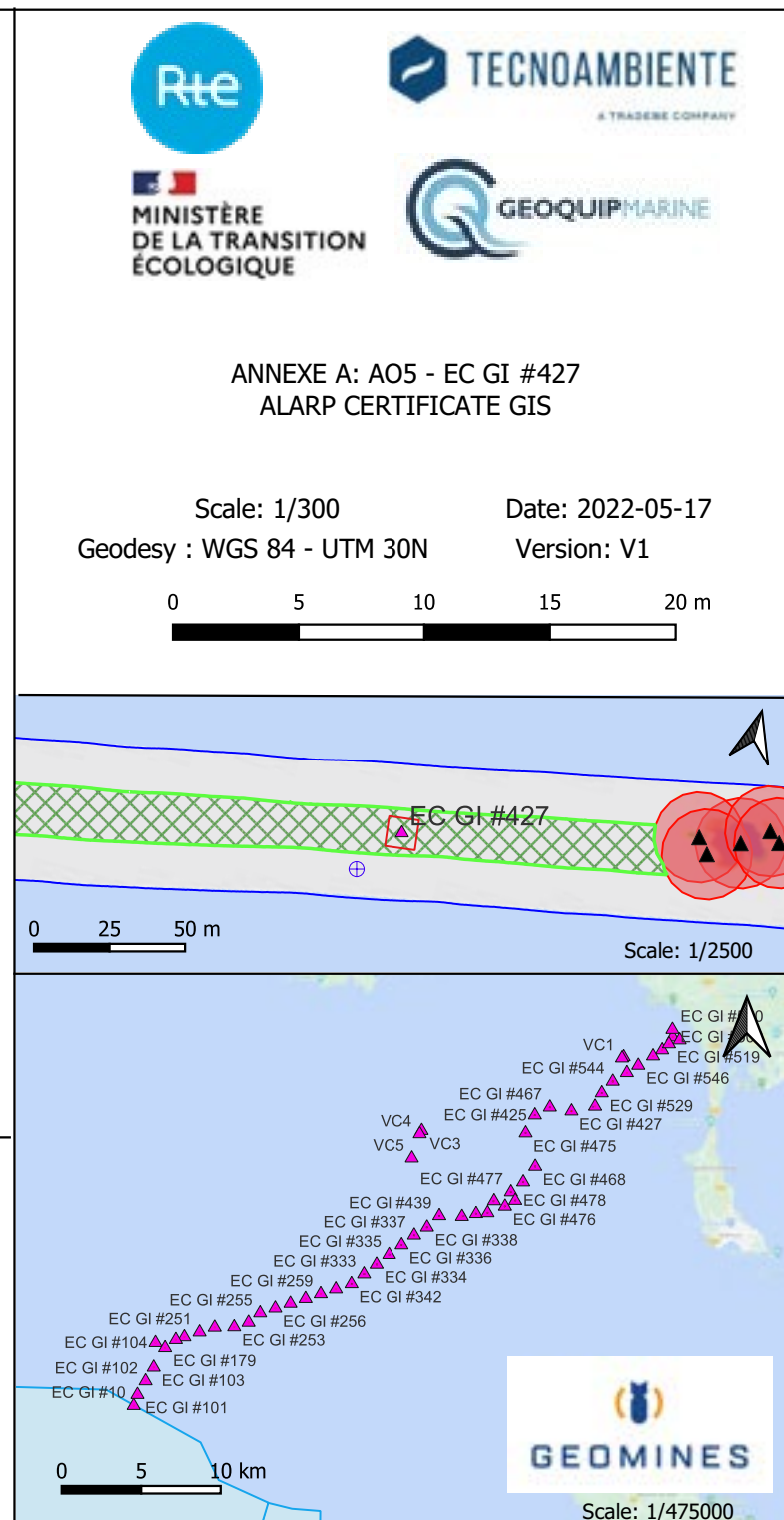
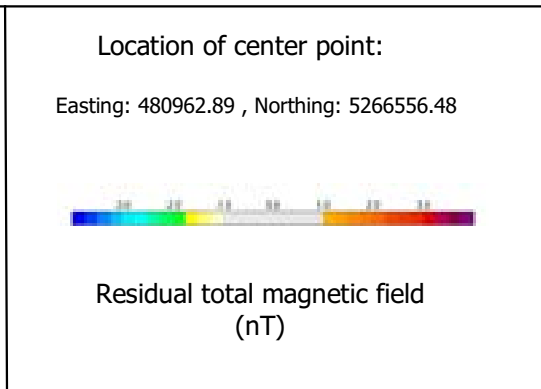
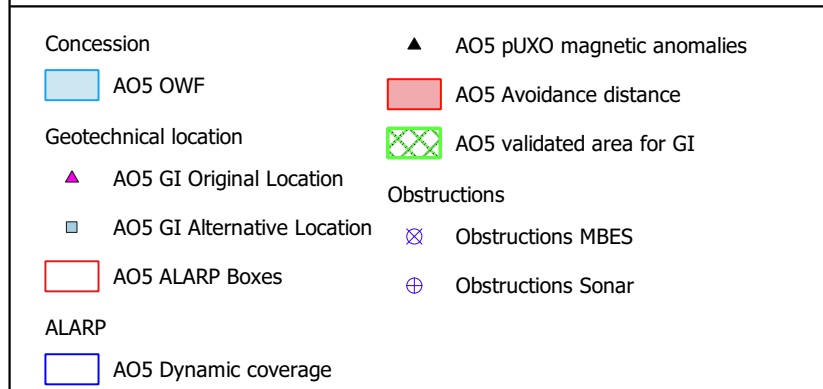
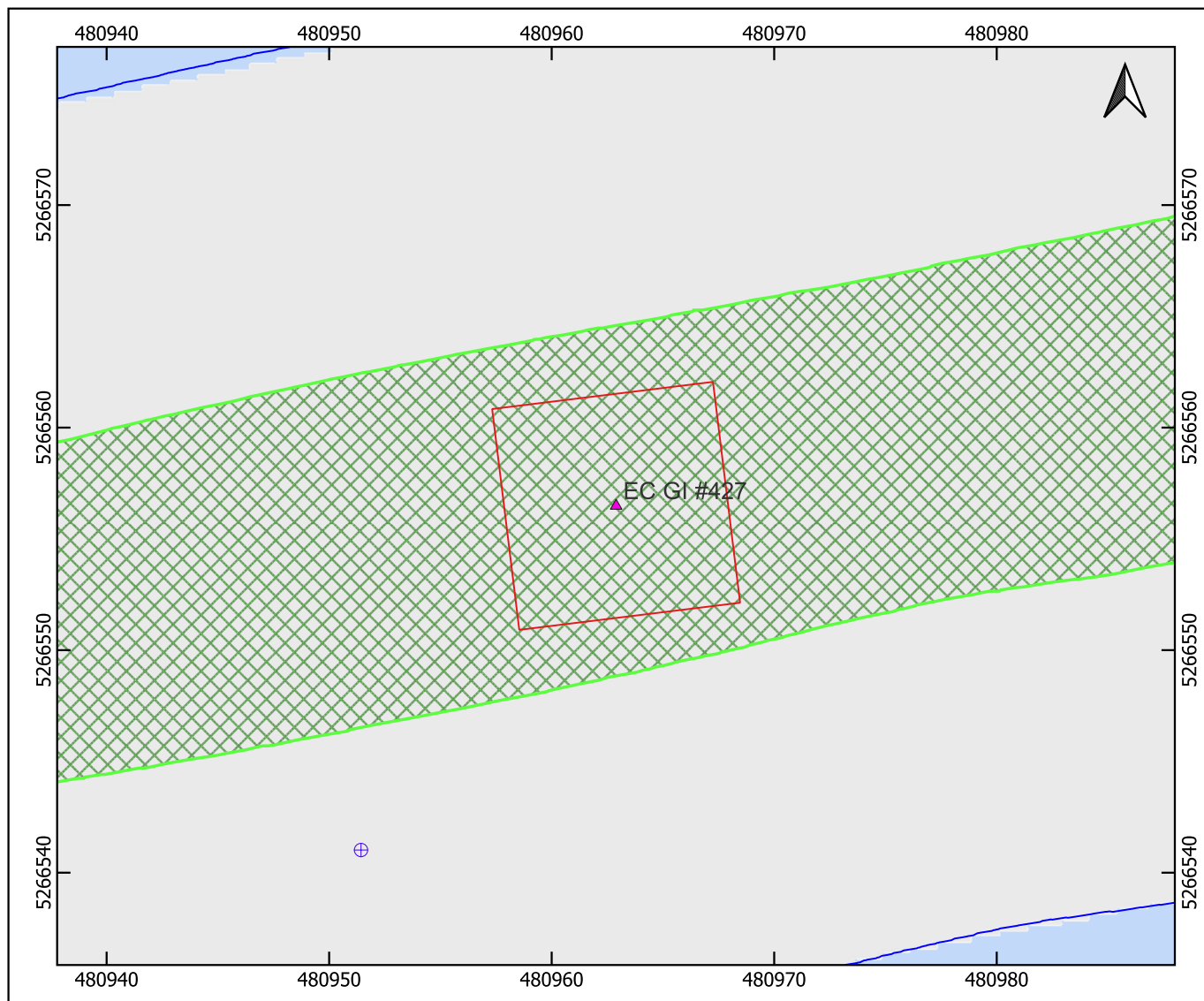


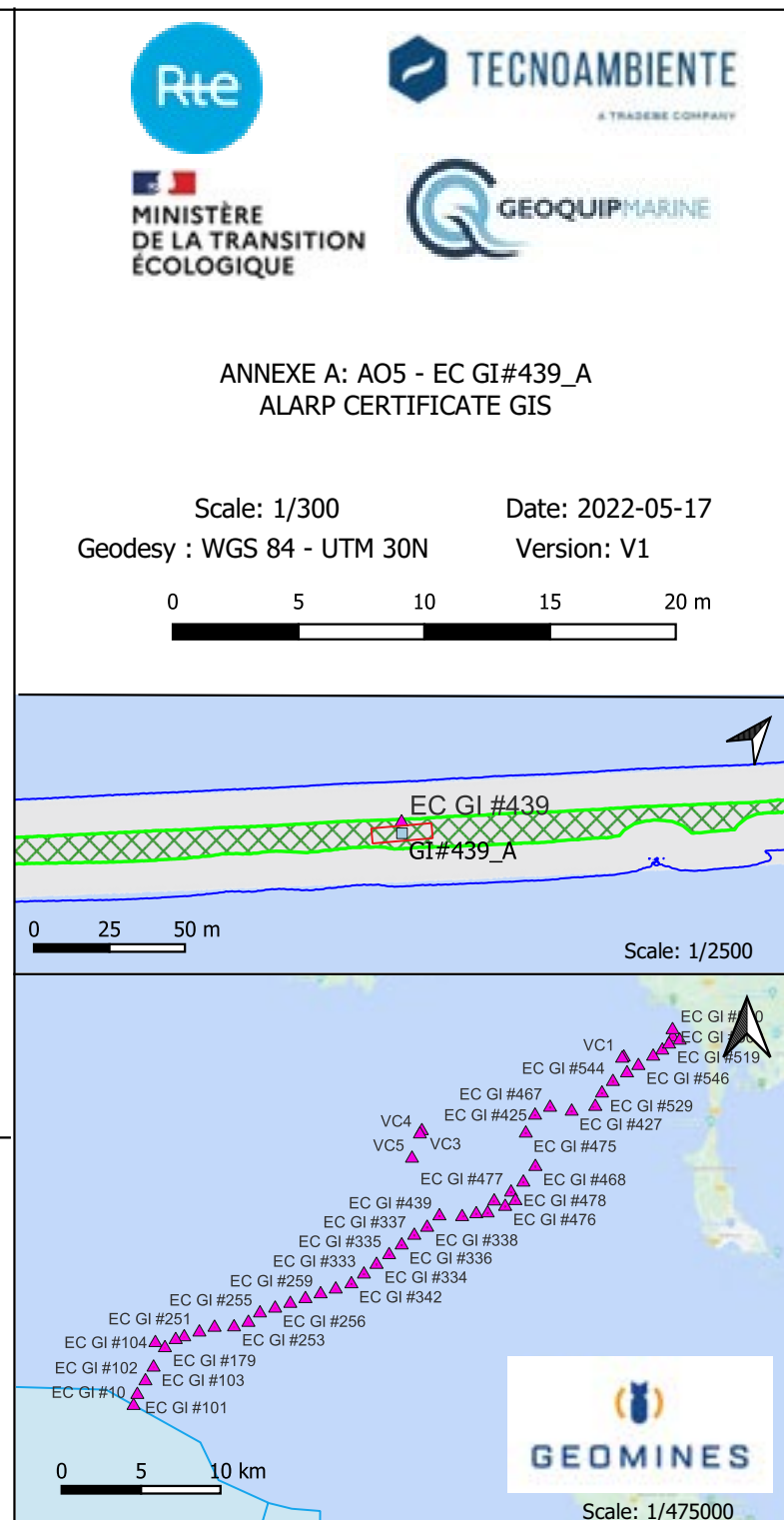
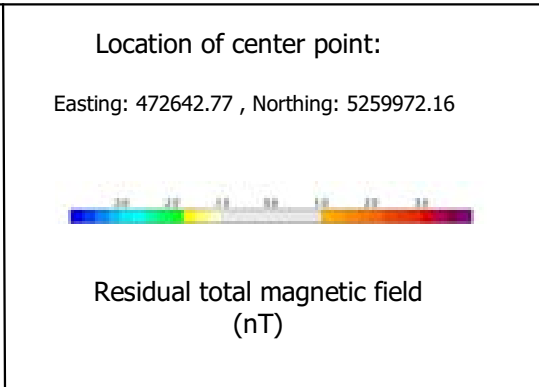
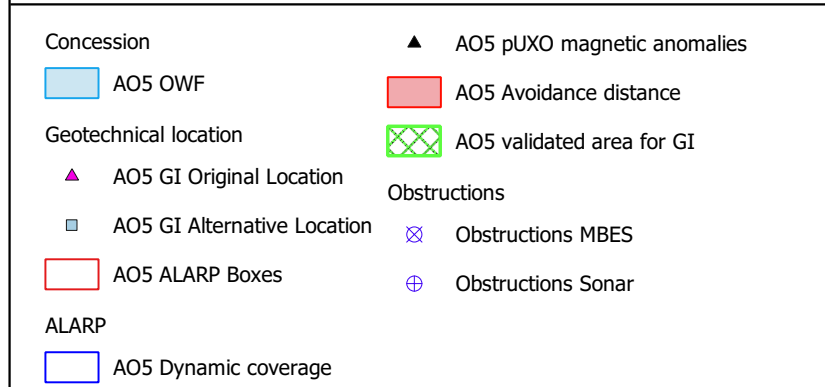
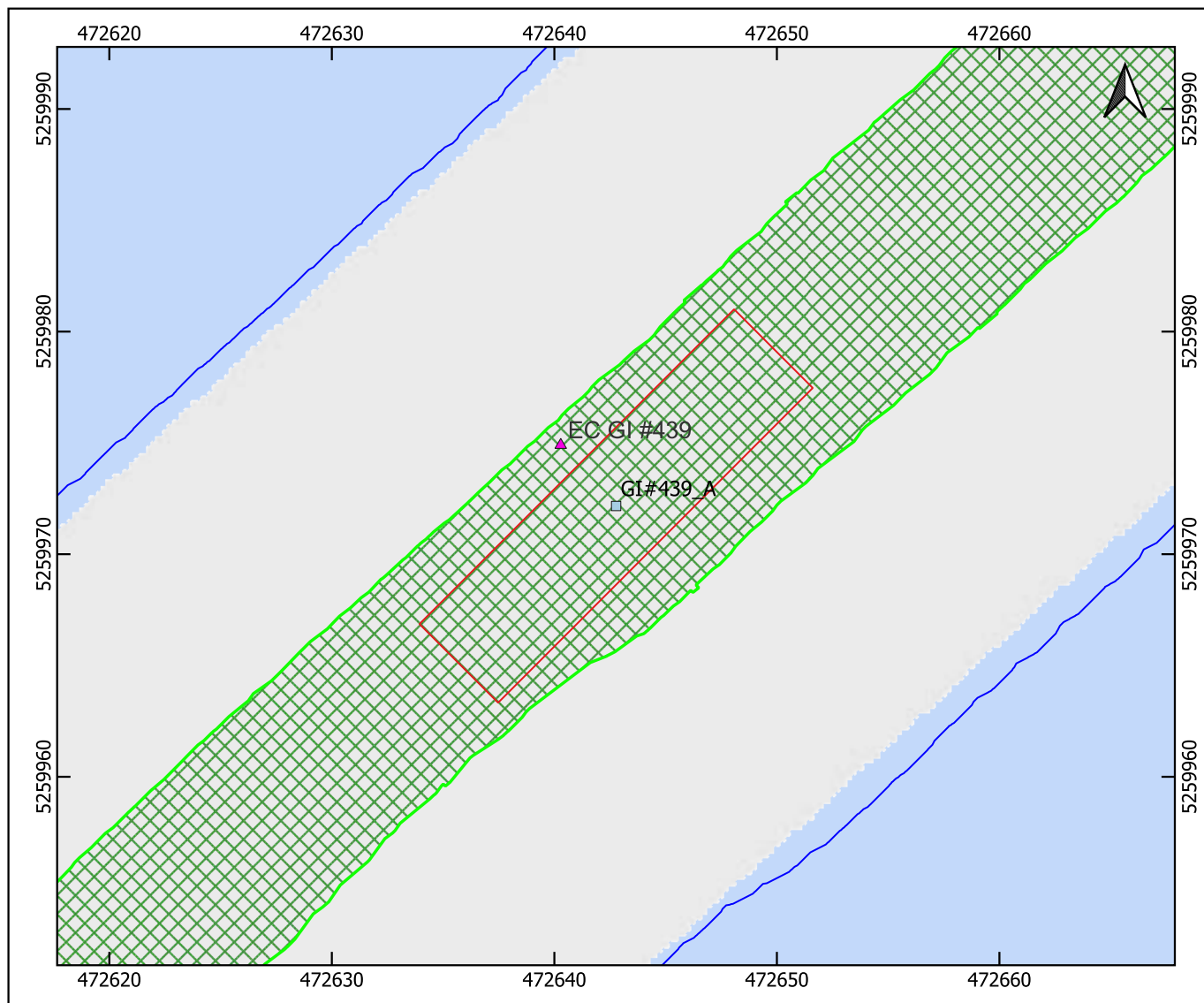
ANNEXE A: AO5 - EC GI #425 ALARP CERTIFICATE GIS

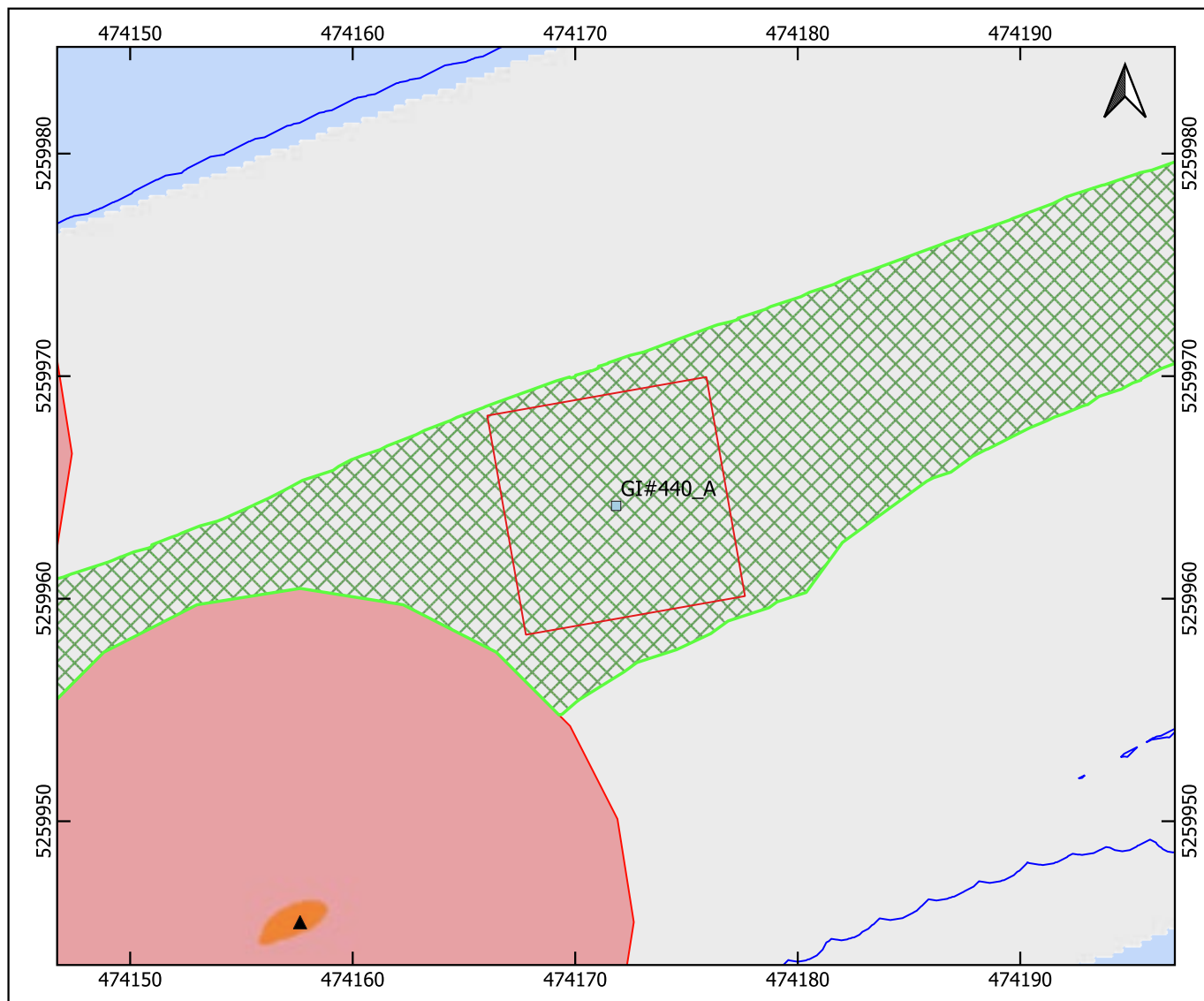
Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1



Scale: 1/475000







- Concession
- AO5 OWF
- Geotechnical location
- AO5 GI Original Location
 - AO5 GI Alternative Location
 - AO5 ALARP Boxes
 - AO5 Dynamic coverage
- AO5 pUXO magnetic anomalies
- AO5 Avoidance distance
 - AO5 validated area for GI
- Obstructions
- Obstructions MBES
 - Obstructions Sonar

Location of center point:
Easting: 474171.83 , Northing: 5259964.17

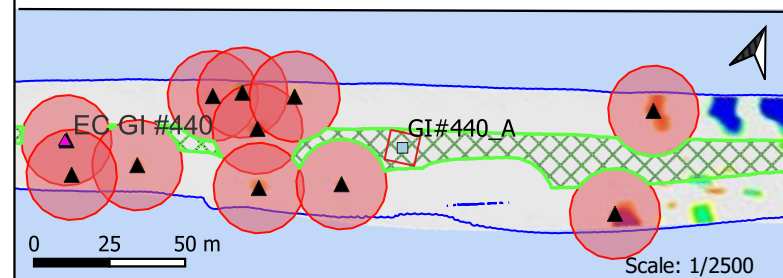
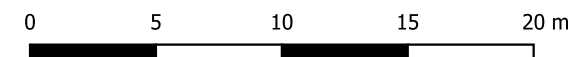


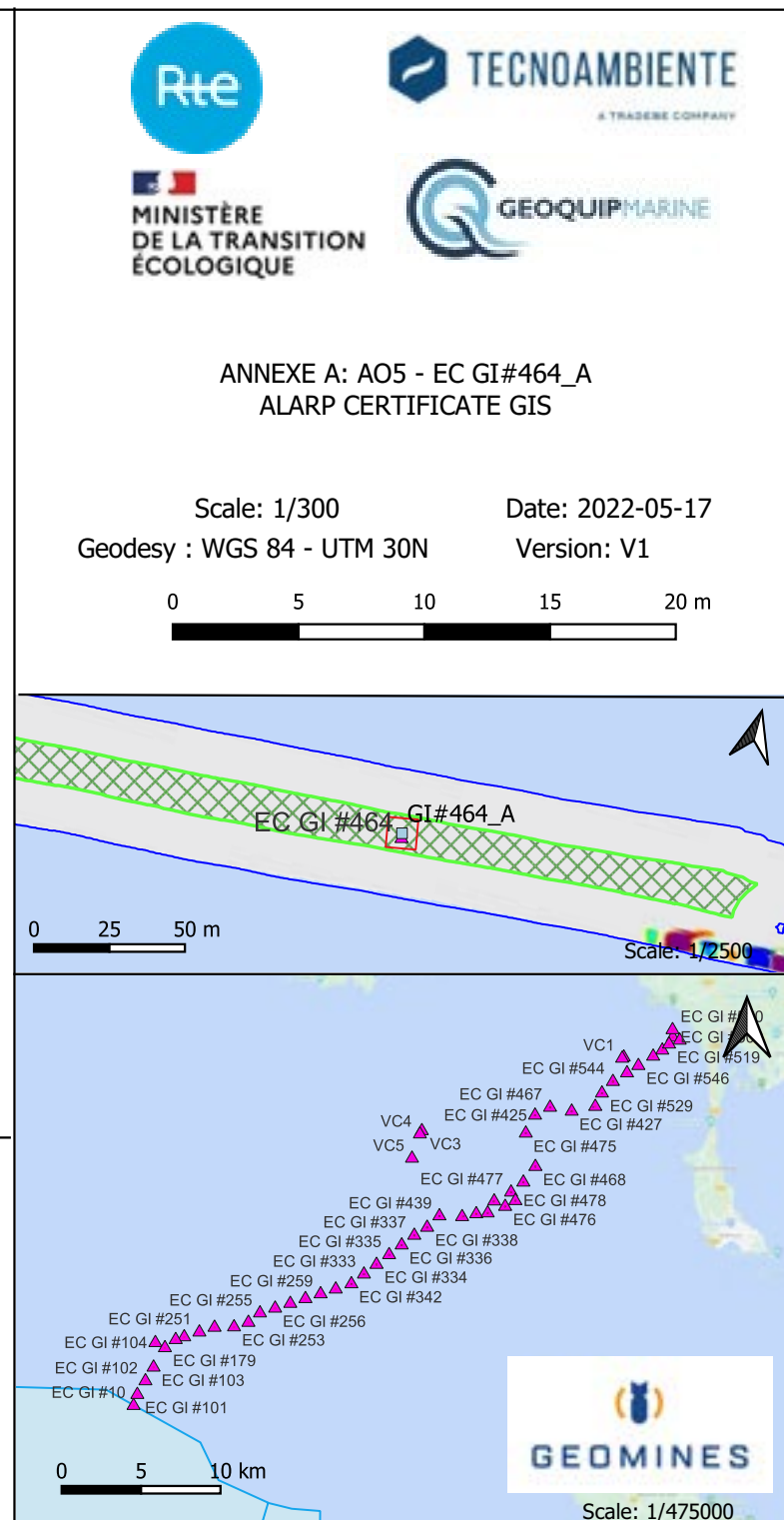
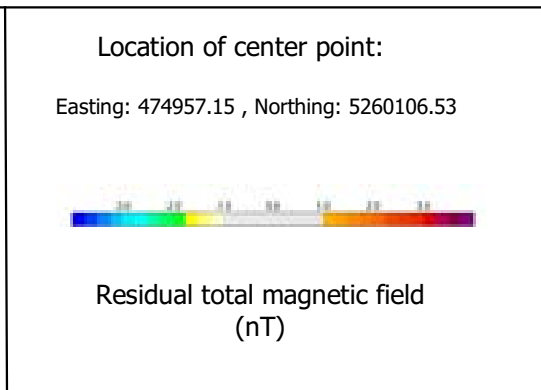
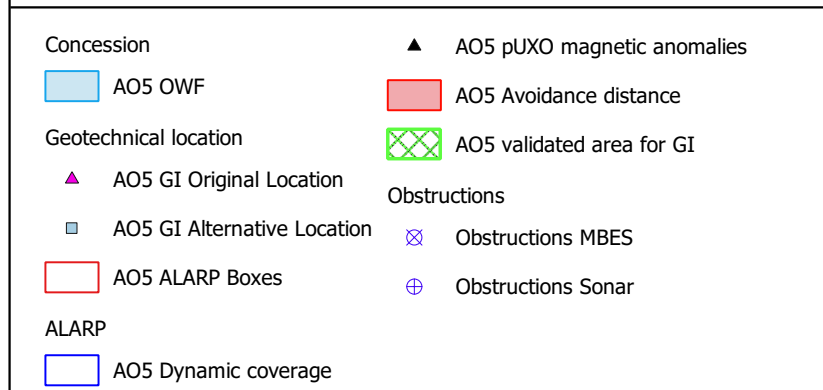
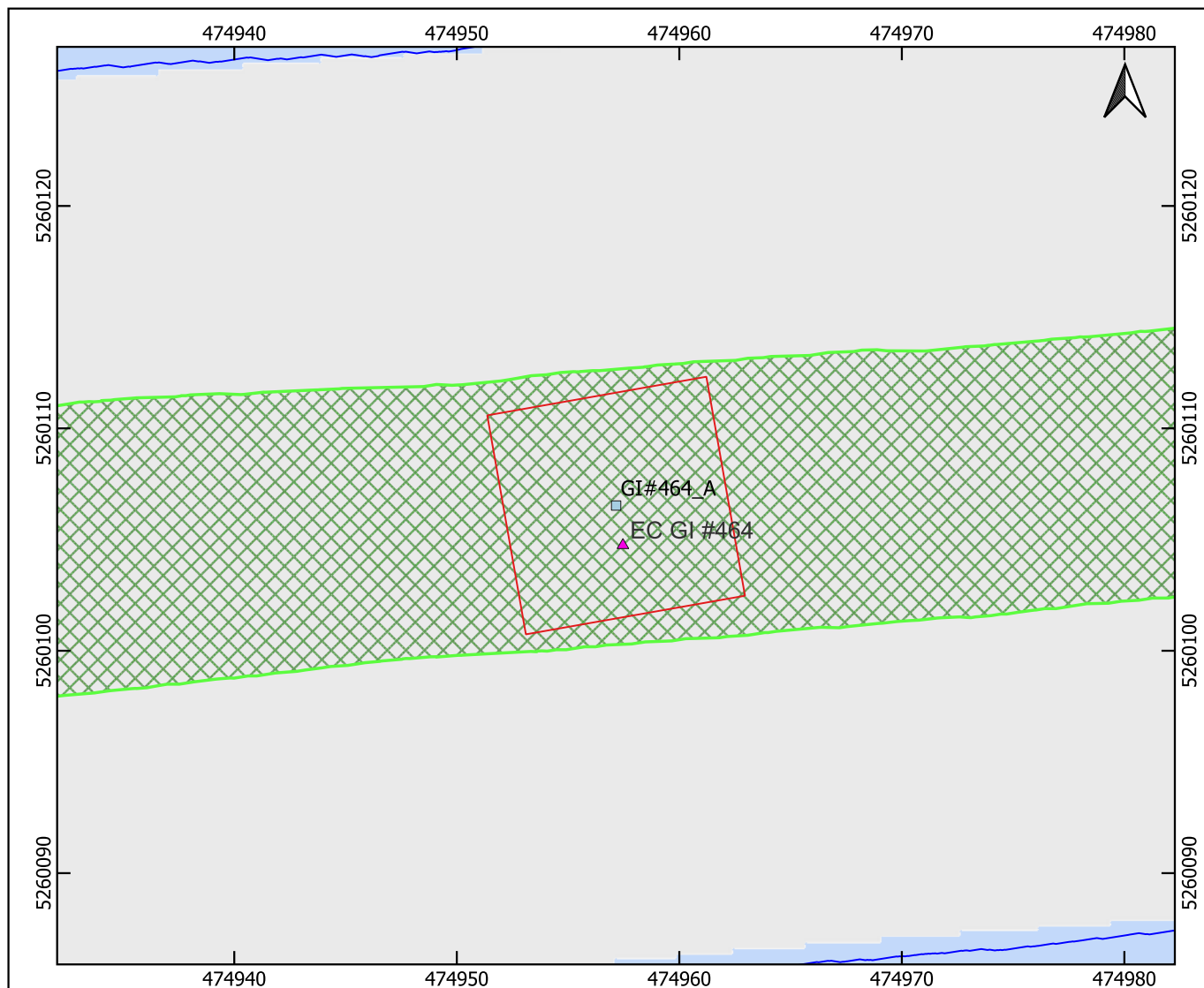
Residual total magnetic field
(nT)

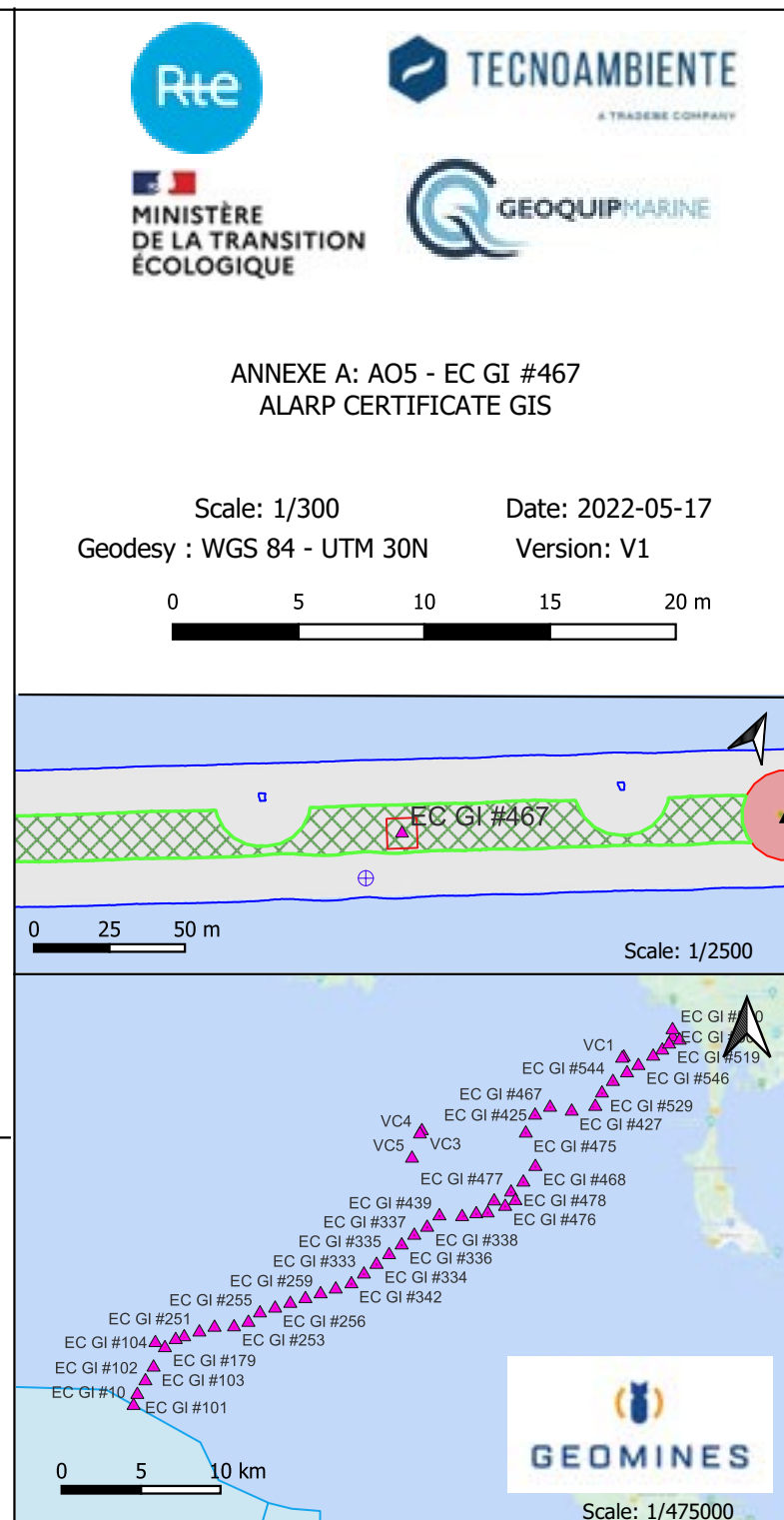
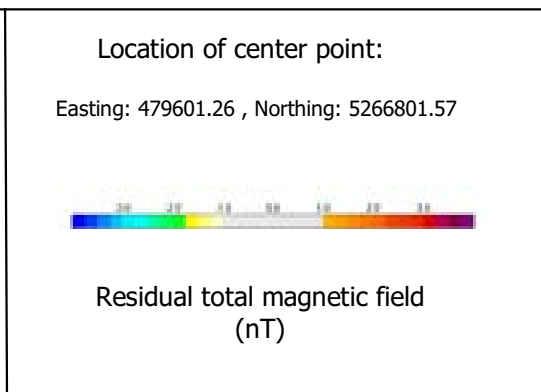
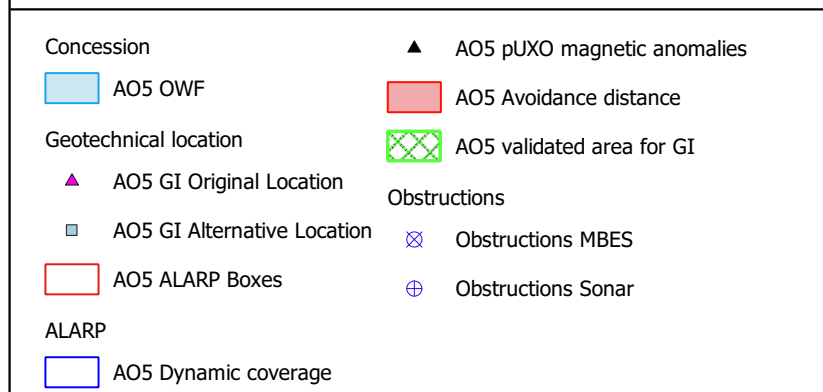
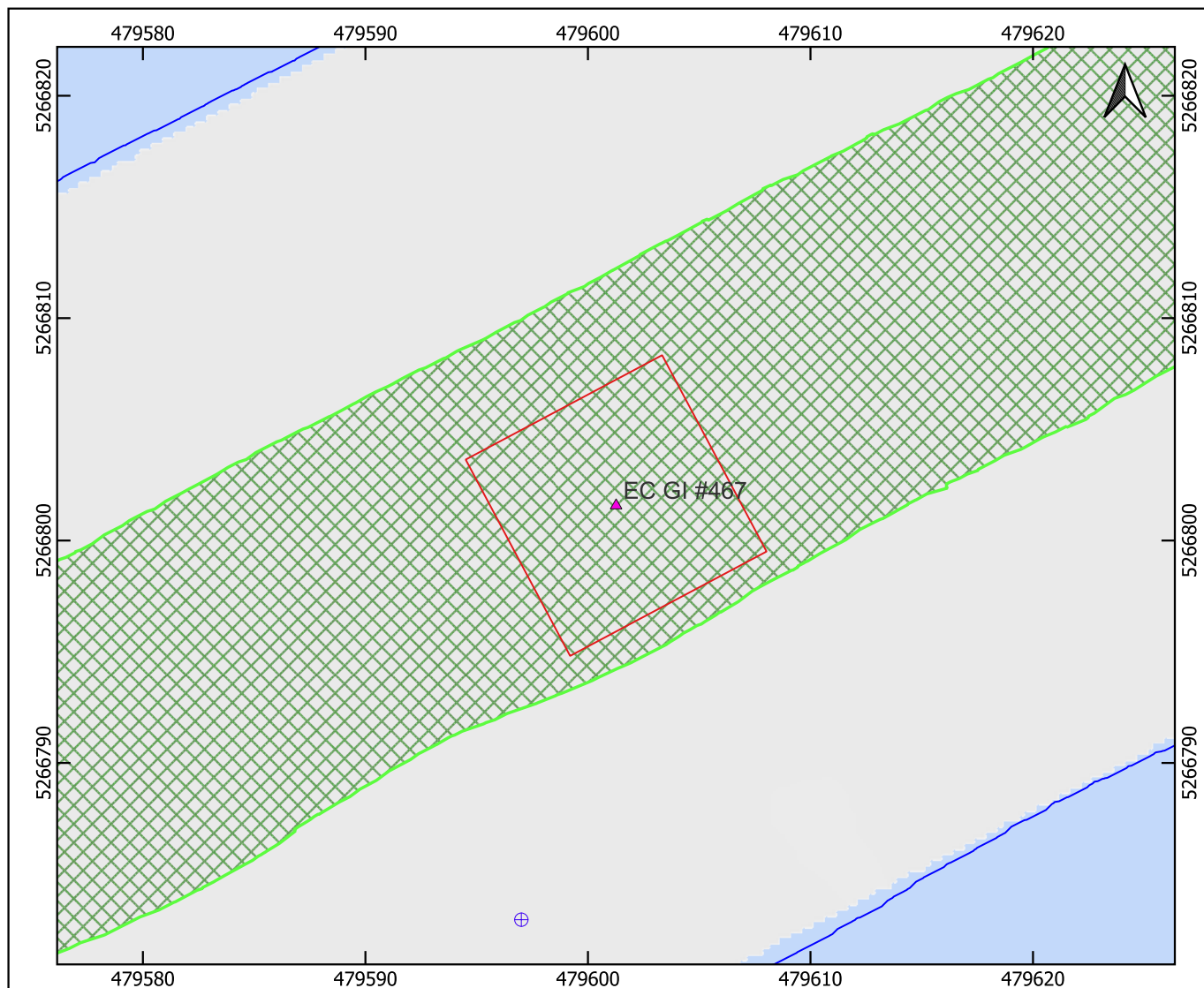


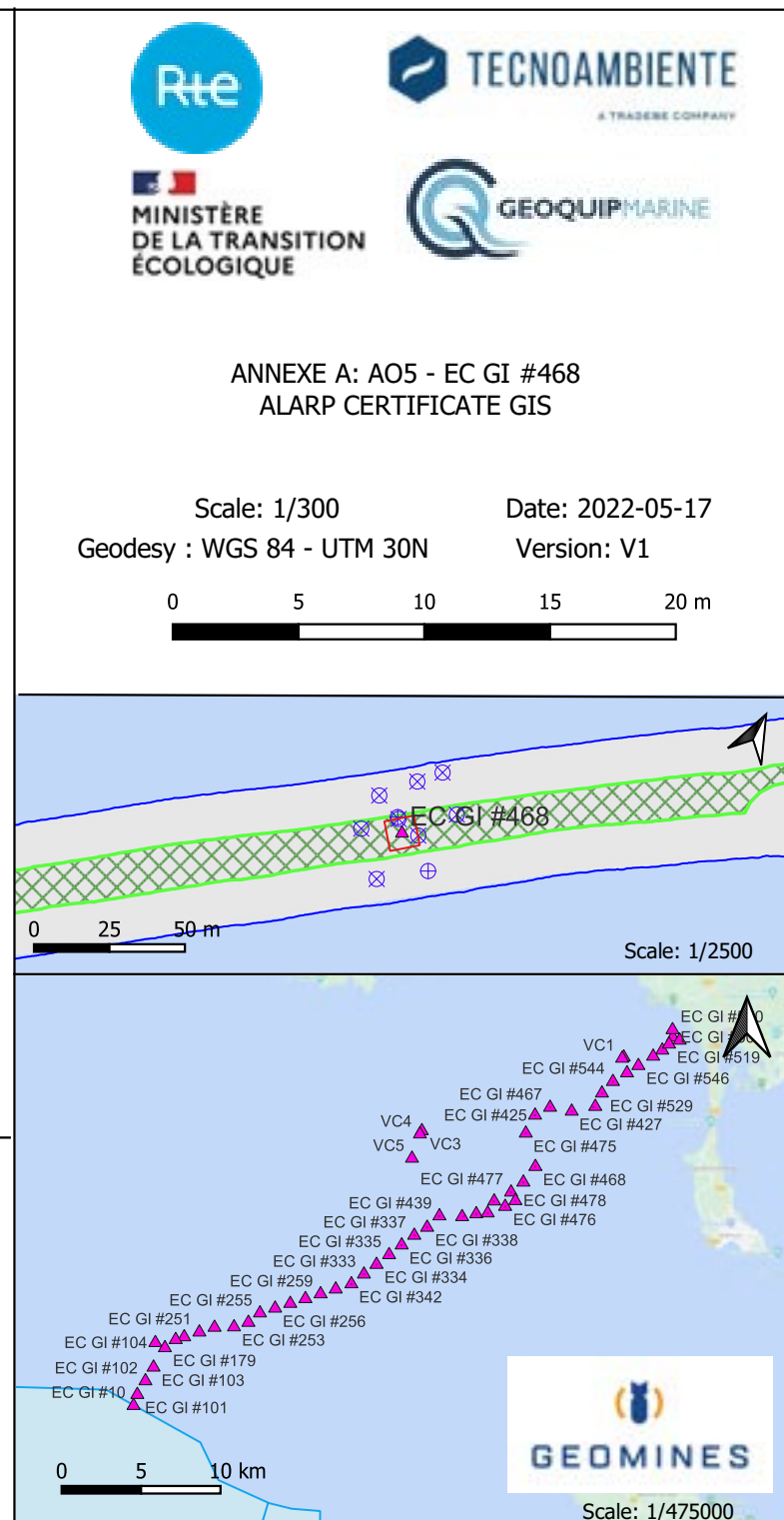
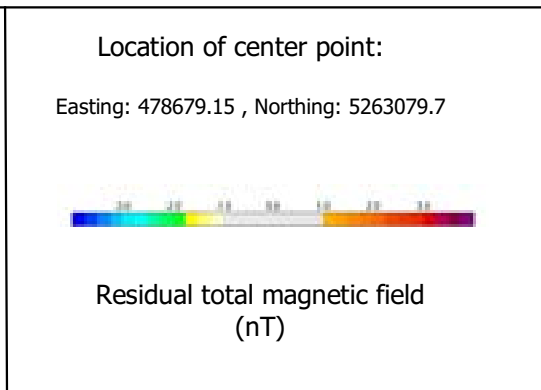
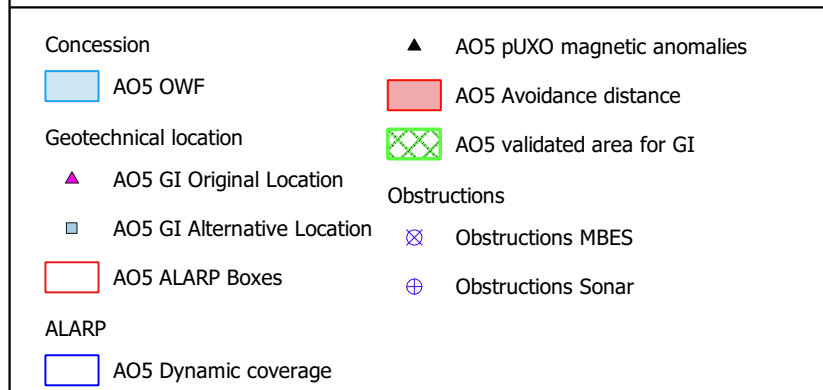
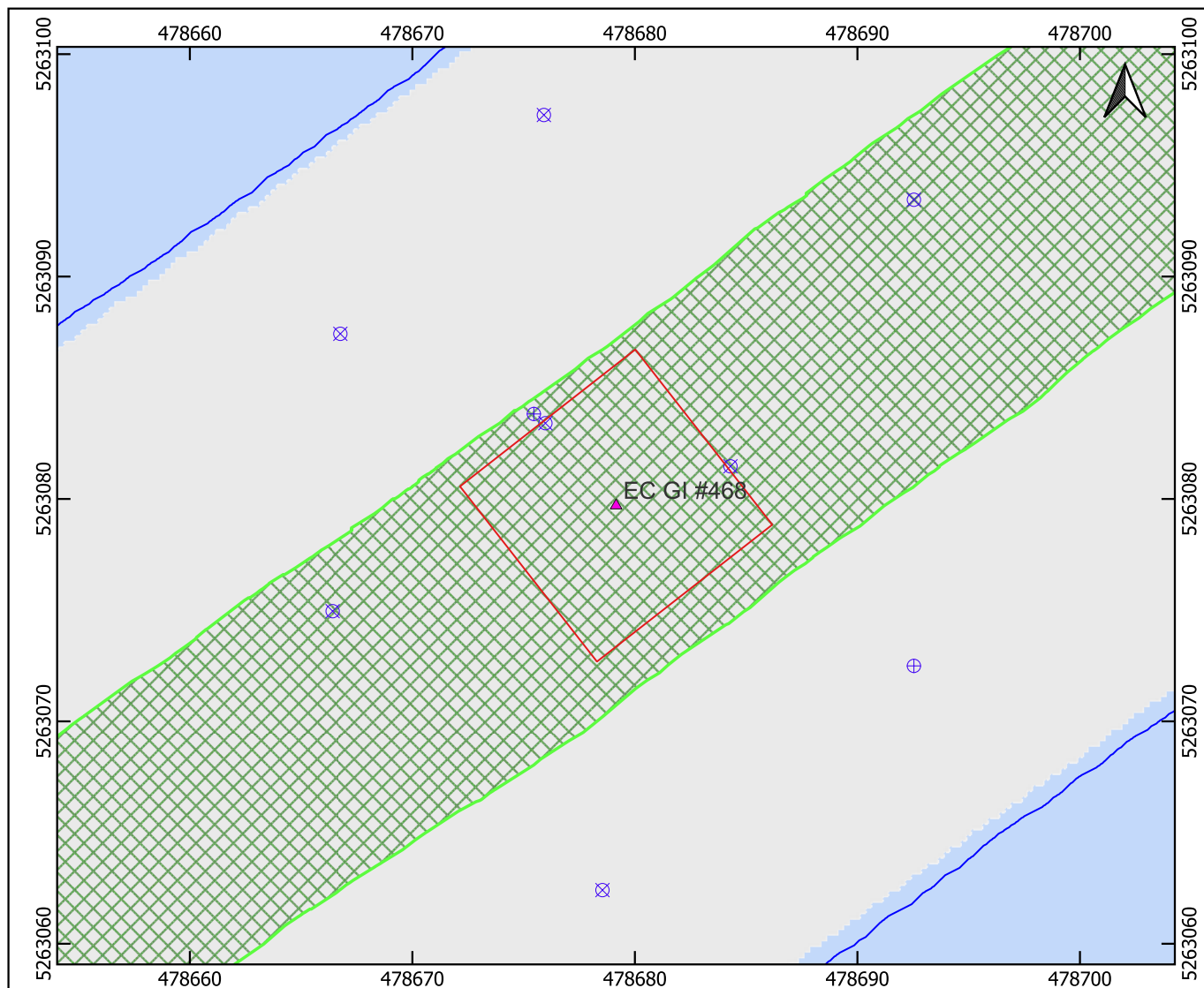
ANNEXE A: AO5 - EC GI#440_A ALARP CERTIFICATE GIS

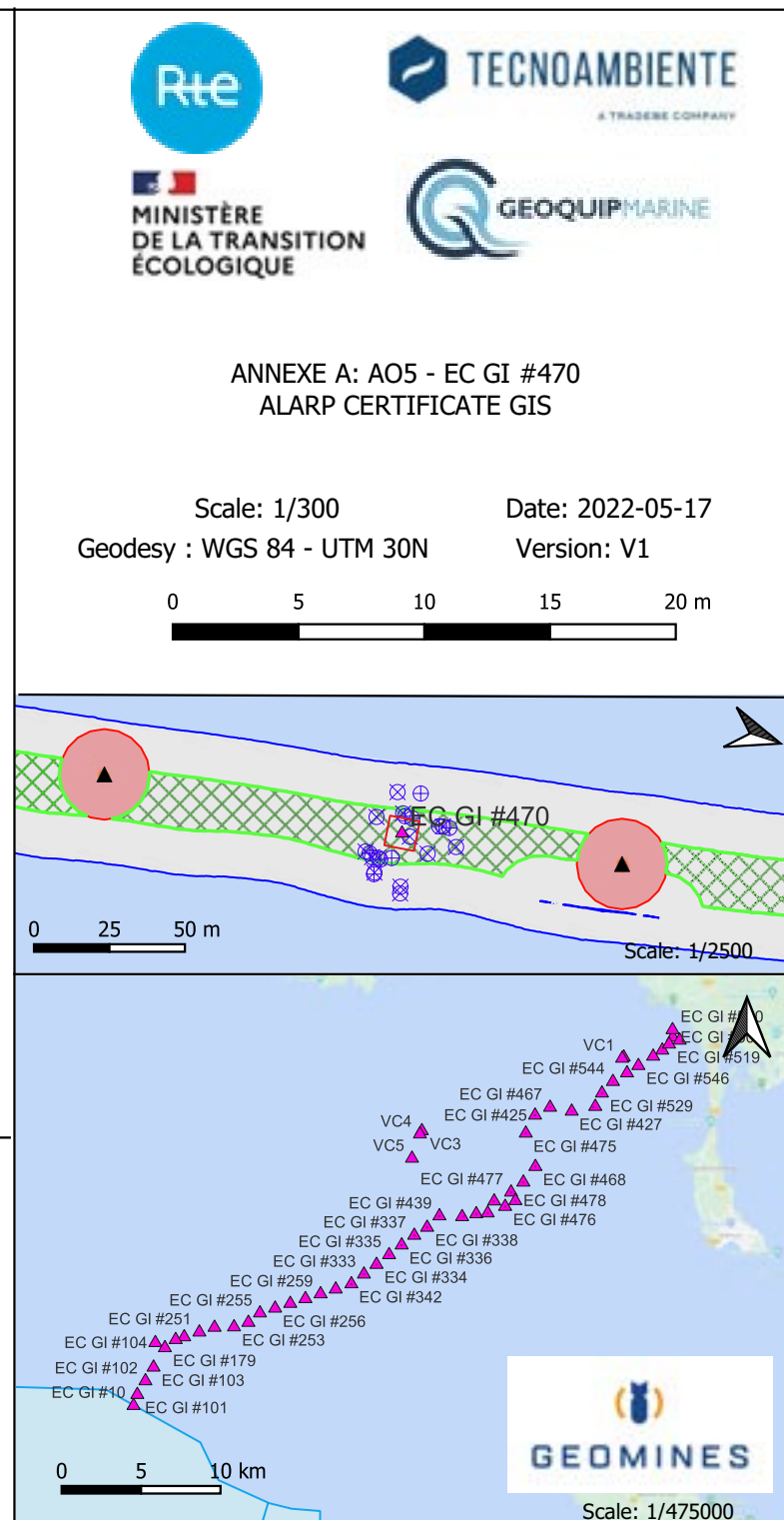
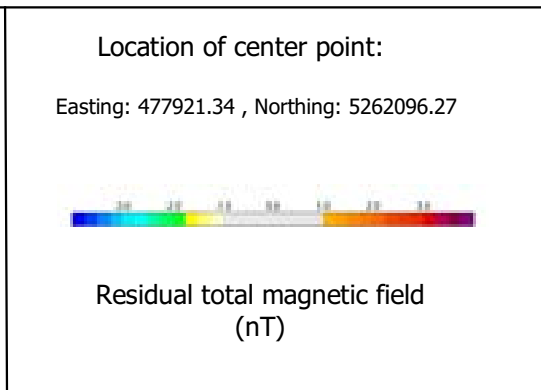
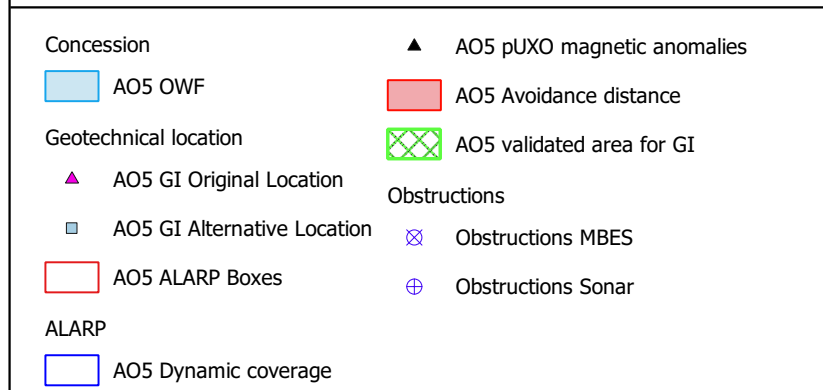
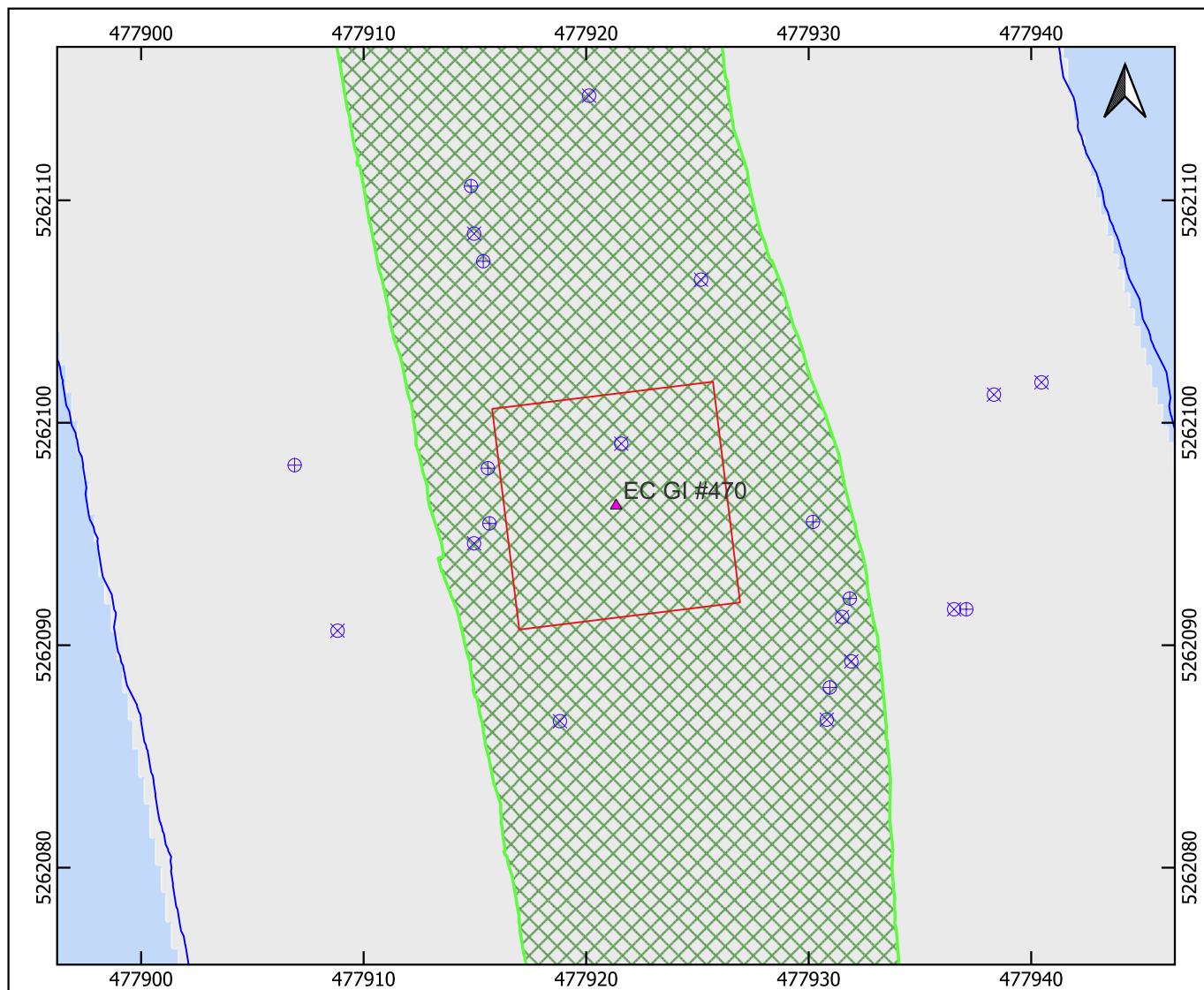
Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1

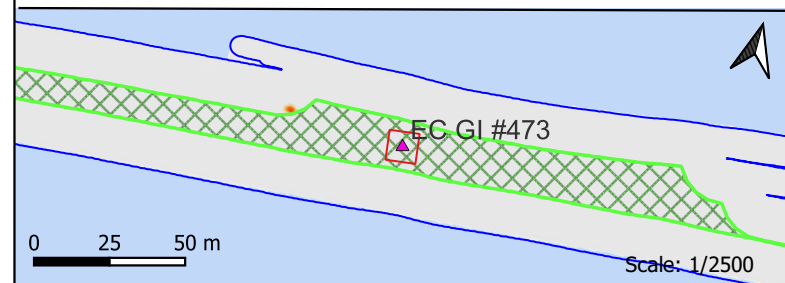
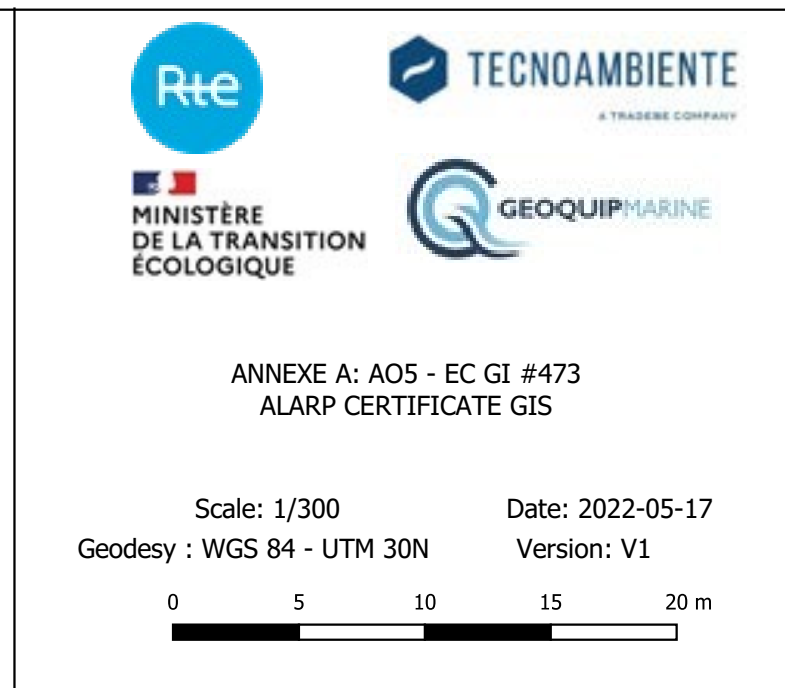
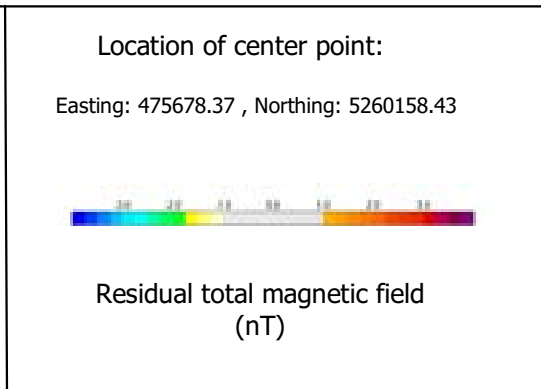
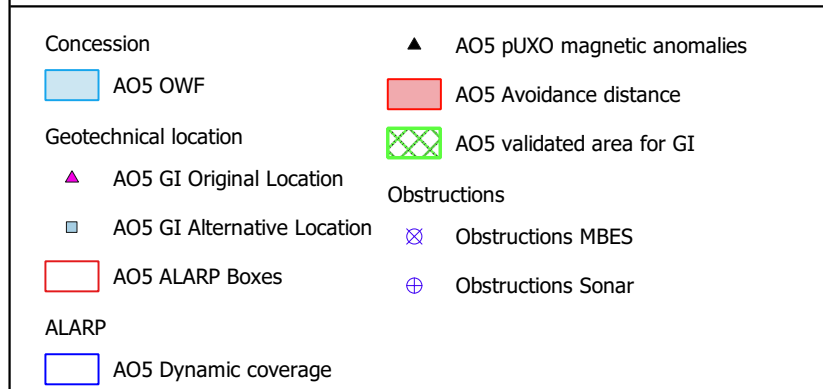
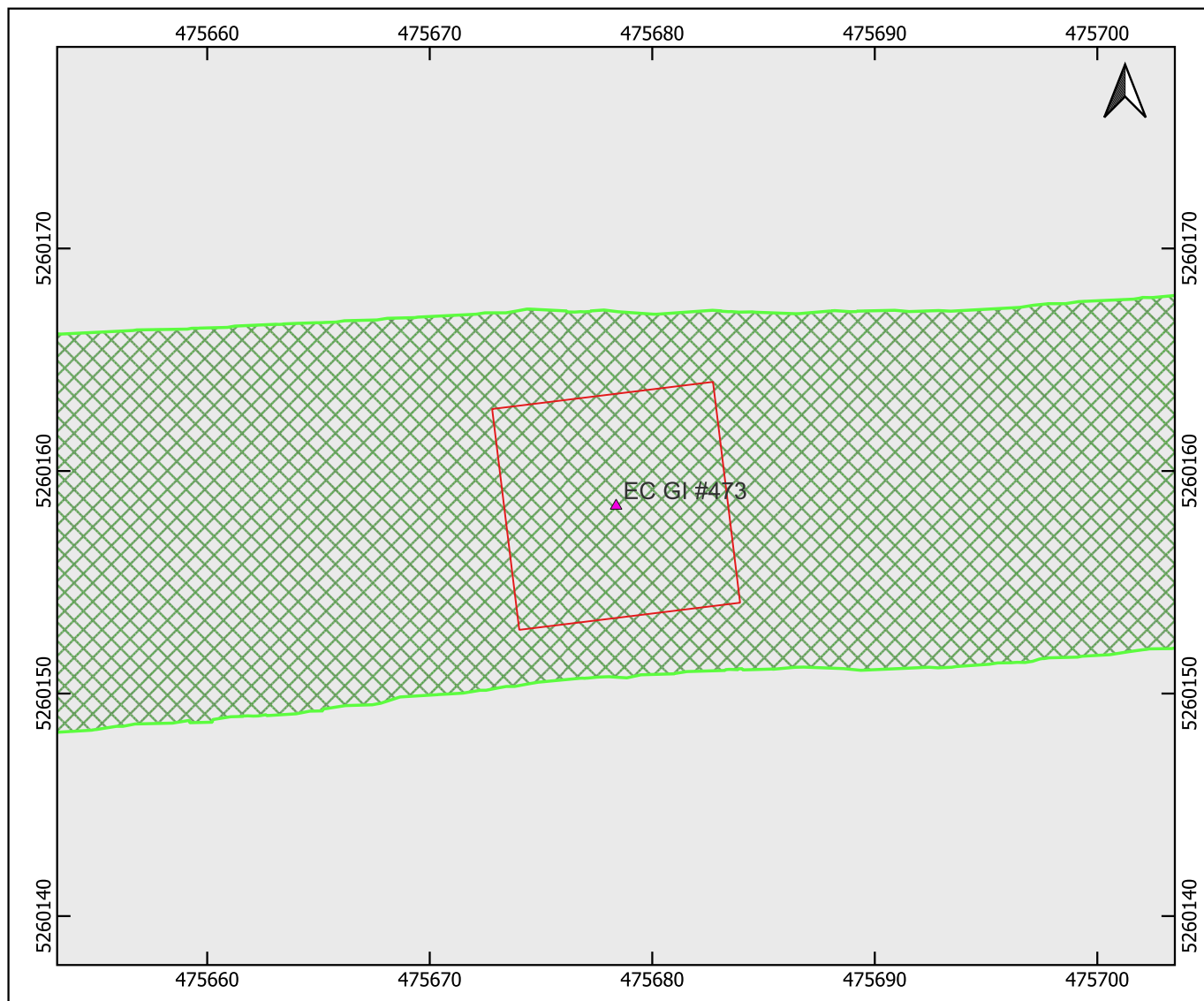


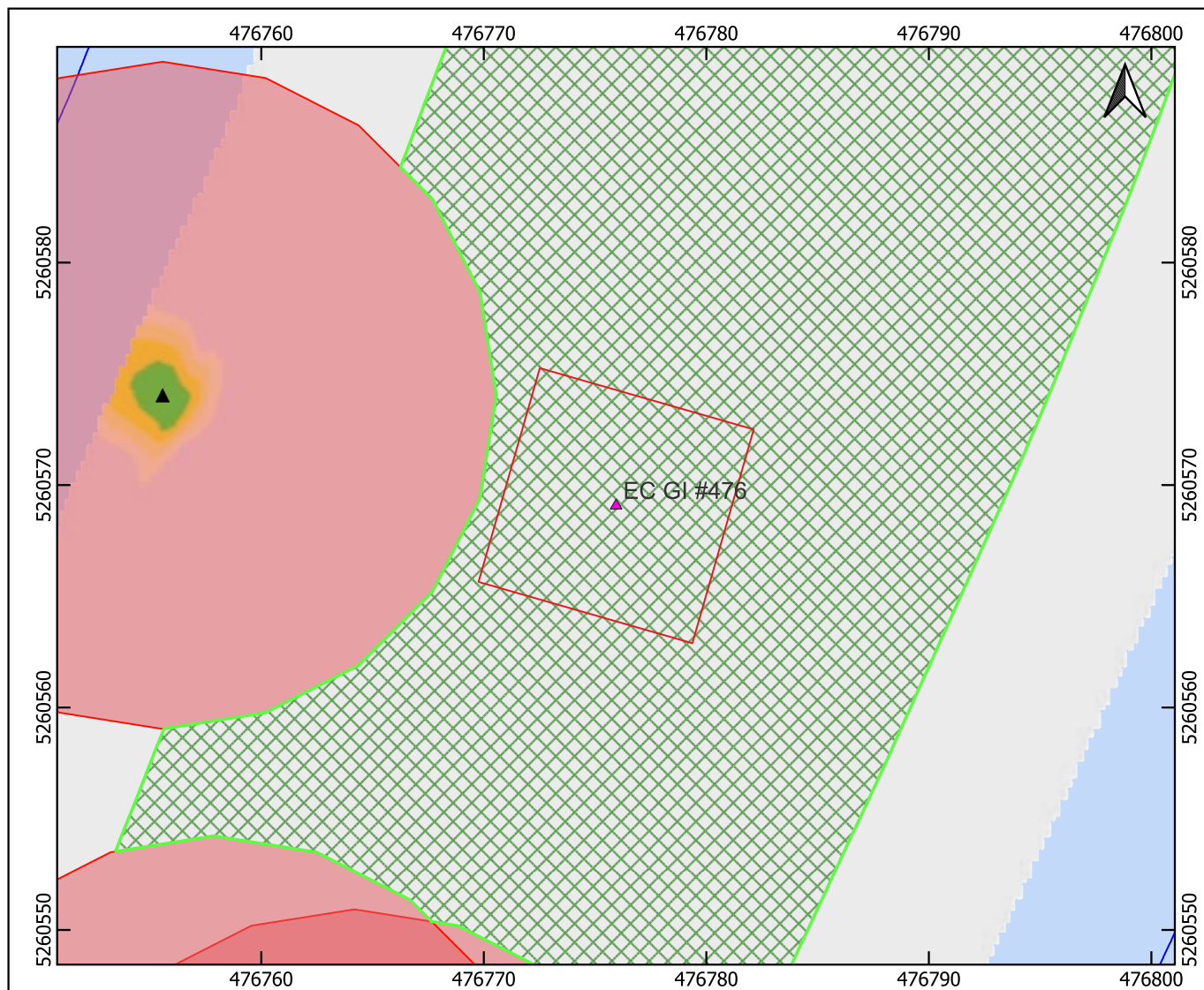












- Concession
- AO5 OWF
- Geotechnical location
- AO5 GI Original Location
 - AO5 GI Alternative Location
 - AO5 ALARP Boxes
 - AO5 Dynamic coverage
- Obstructions
- Obstructions MBES
 - Obstructions Sonar
- ALARP
- AO5 Dynamic coverage
- AO5 pUXO magnetic anomalies
- AO5 Avoidance distance
 - AO5 validated area for GI

Location of center point:
Easting: 476775.94 , Northing: 5260569.07

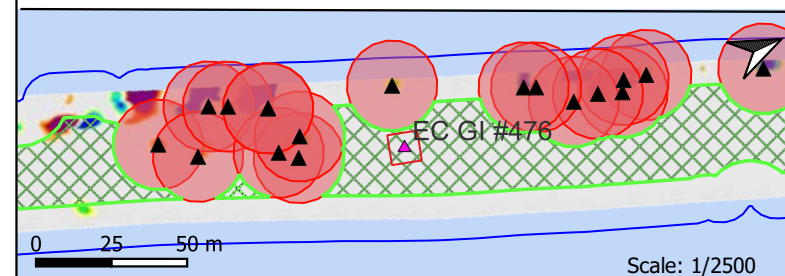
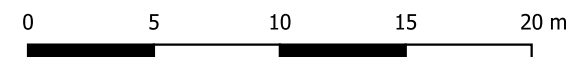


Residual total magnetic field
(nT)

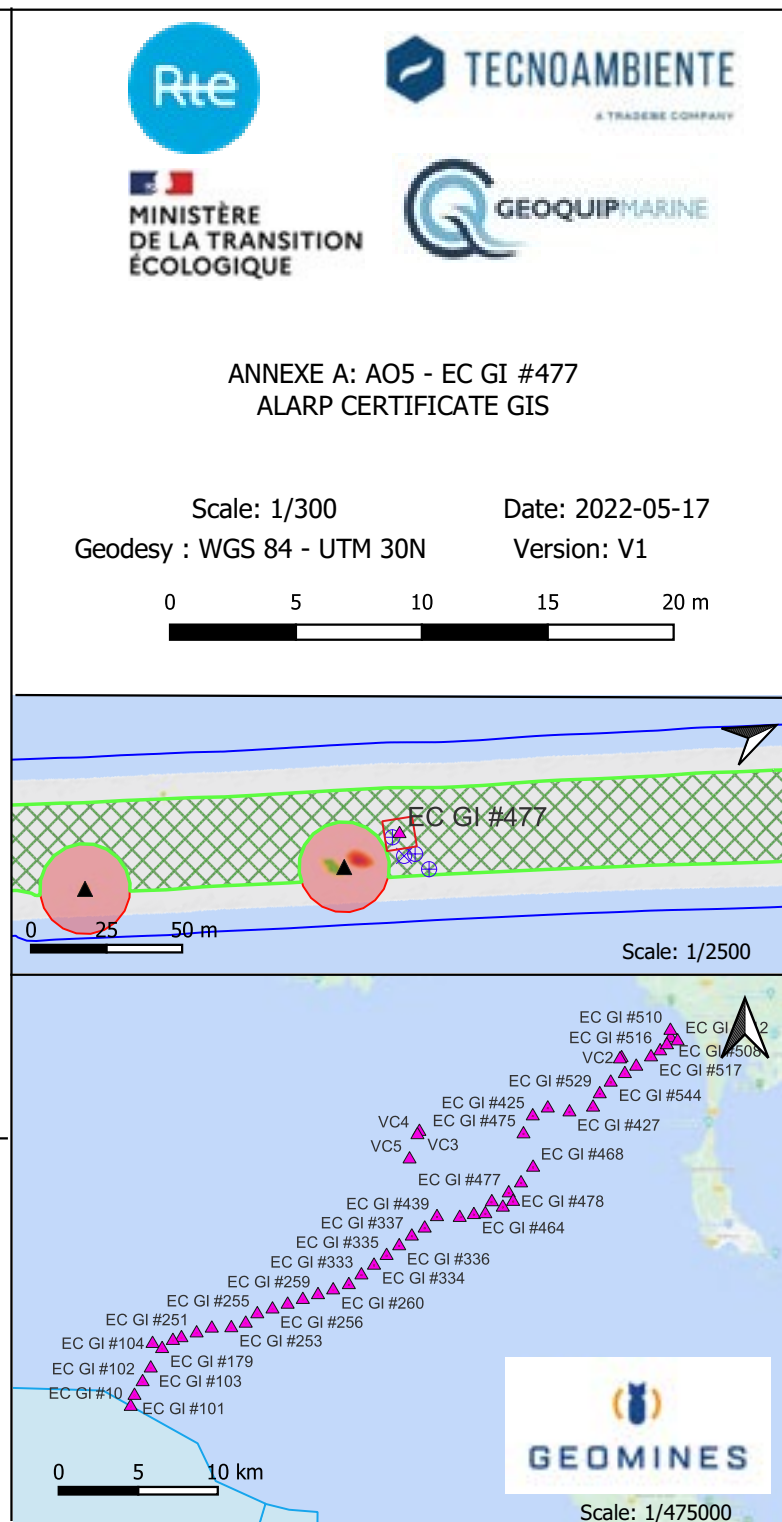
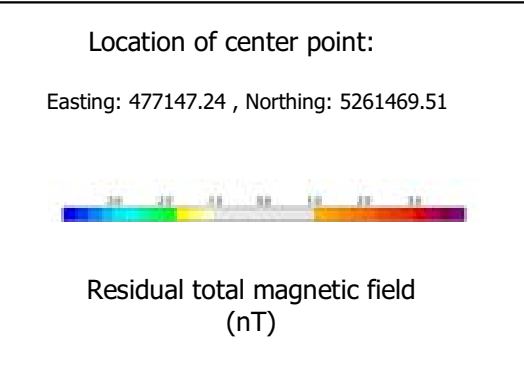
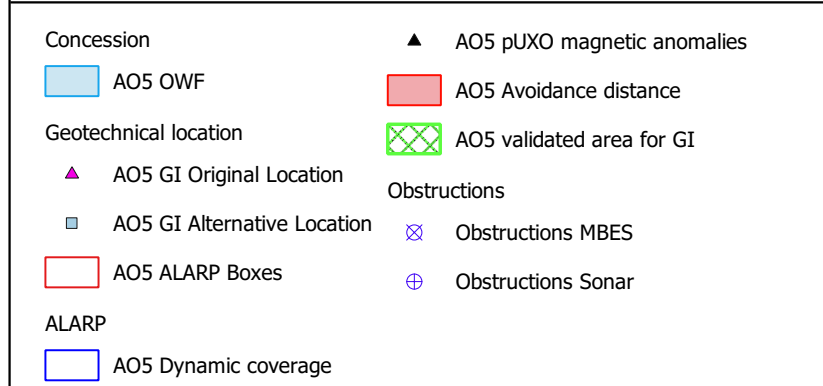
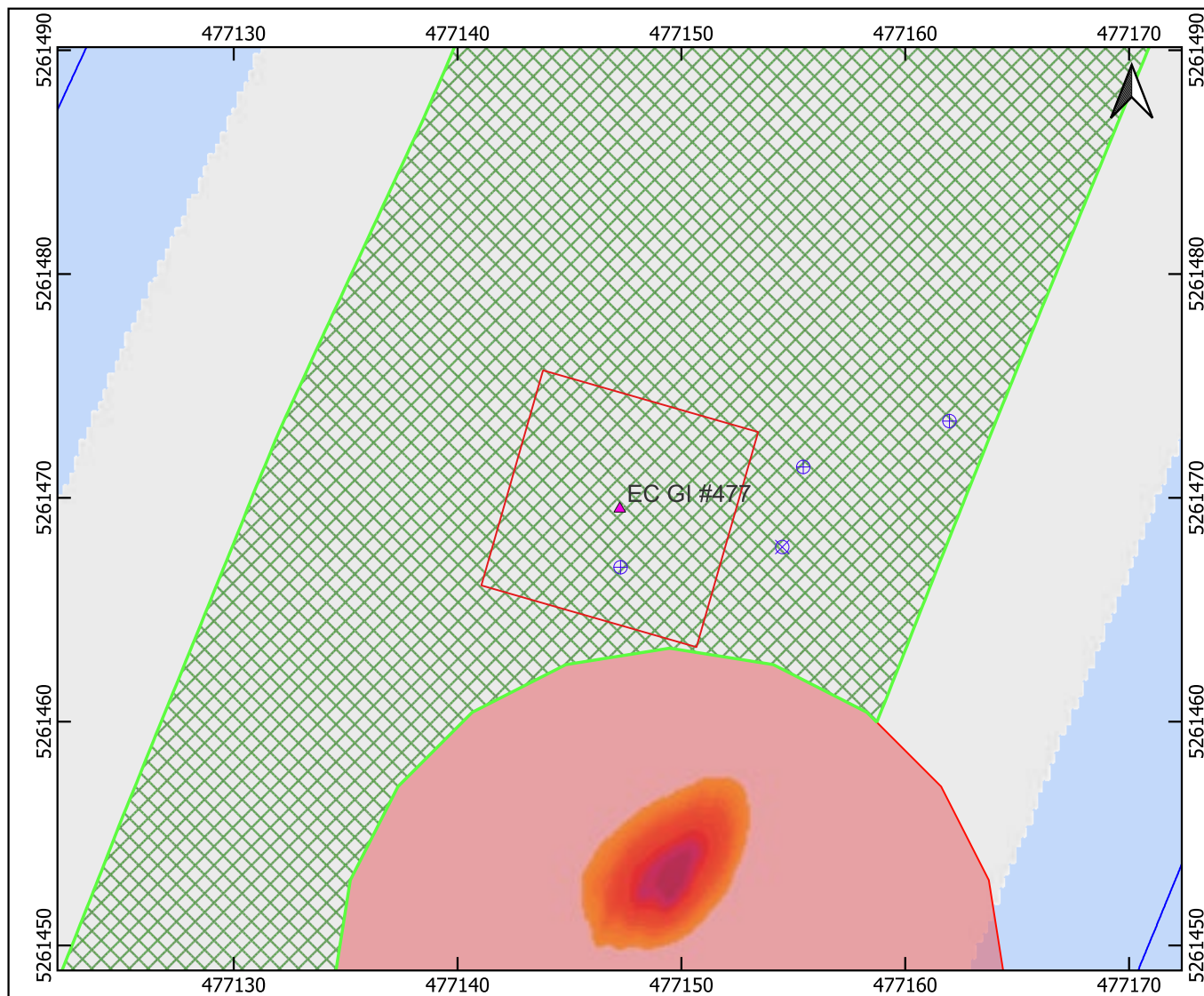


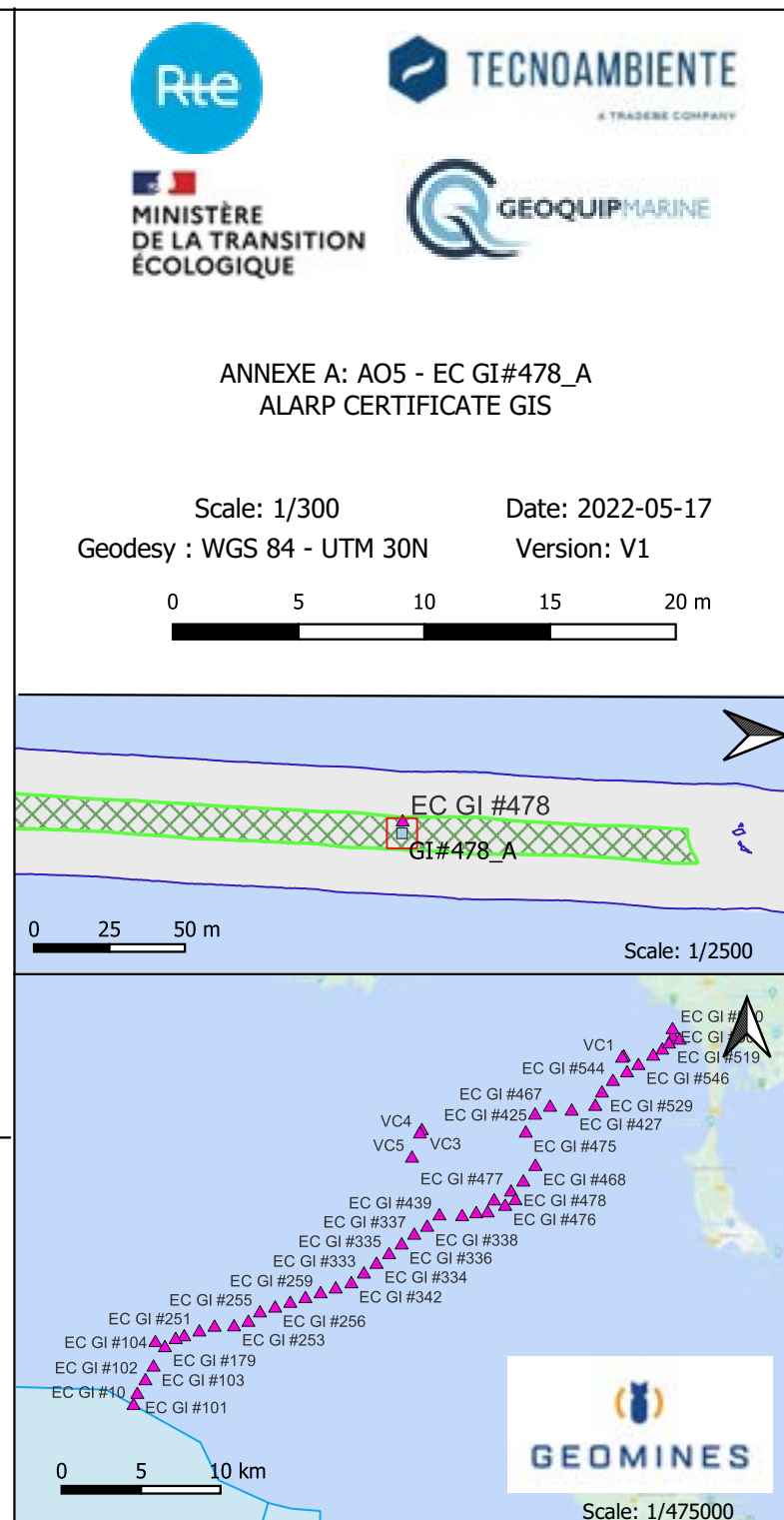
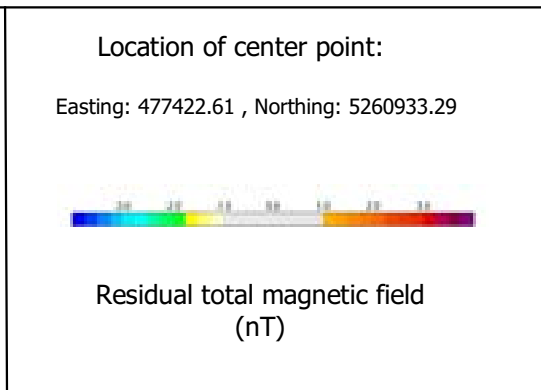
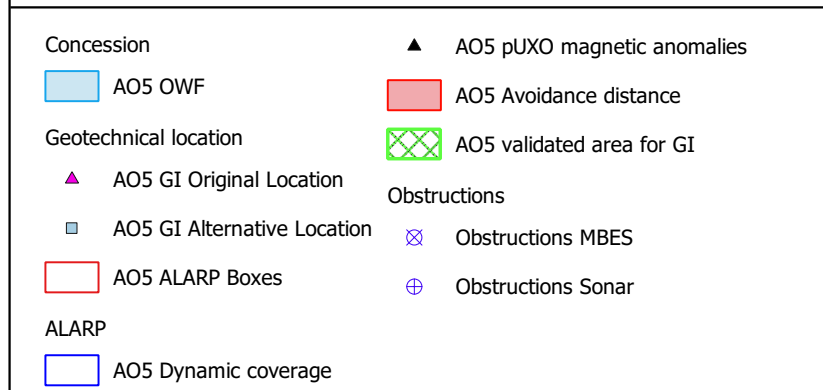
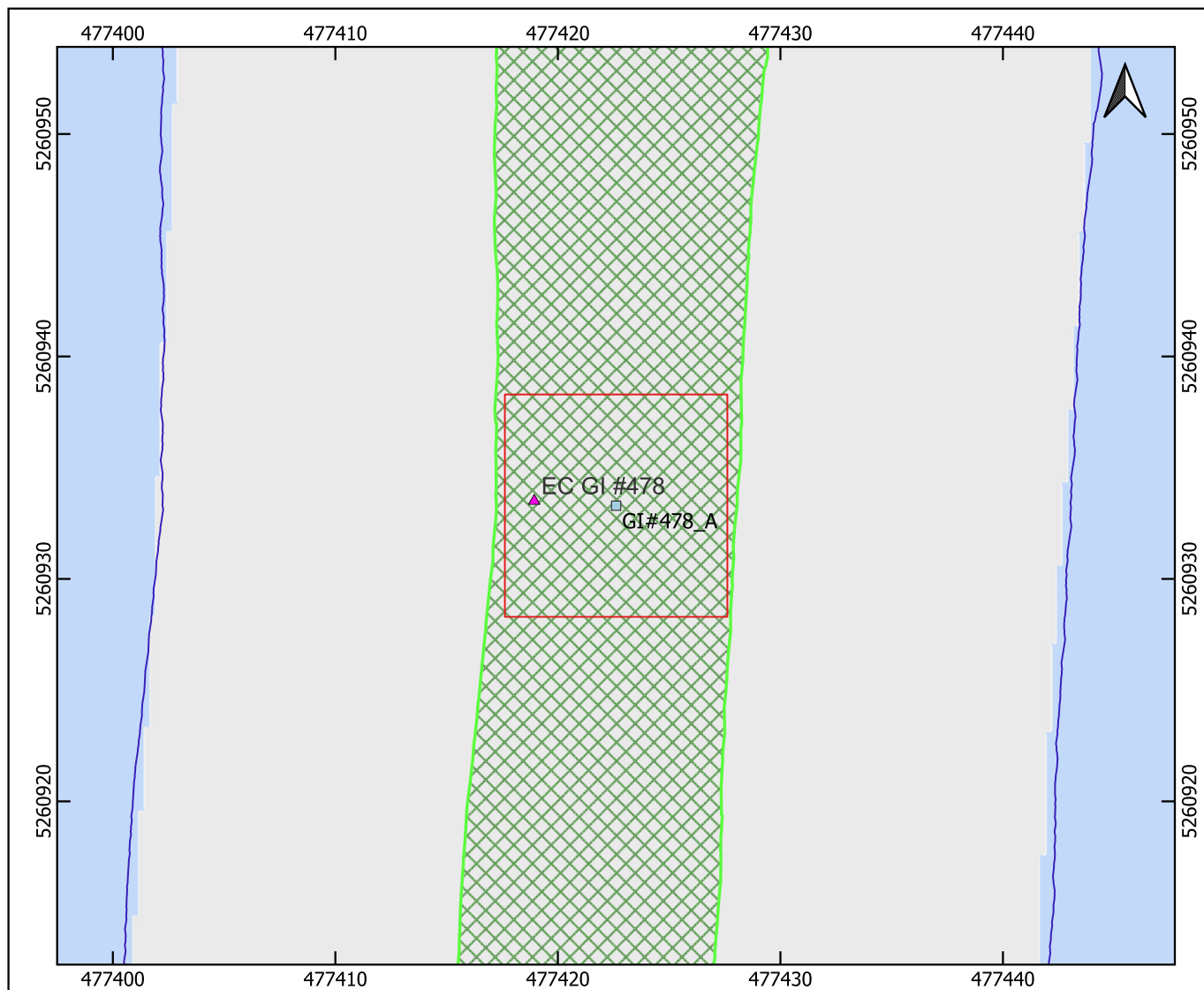
ANNEXE A: AO5 - EC GI #476 ALARP CERTIFICATE GIS

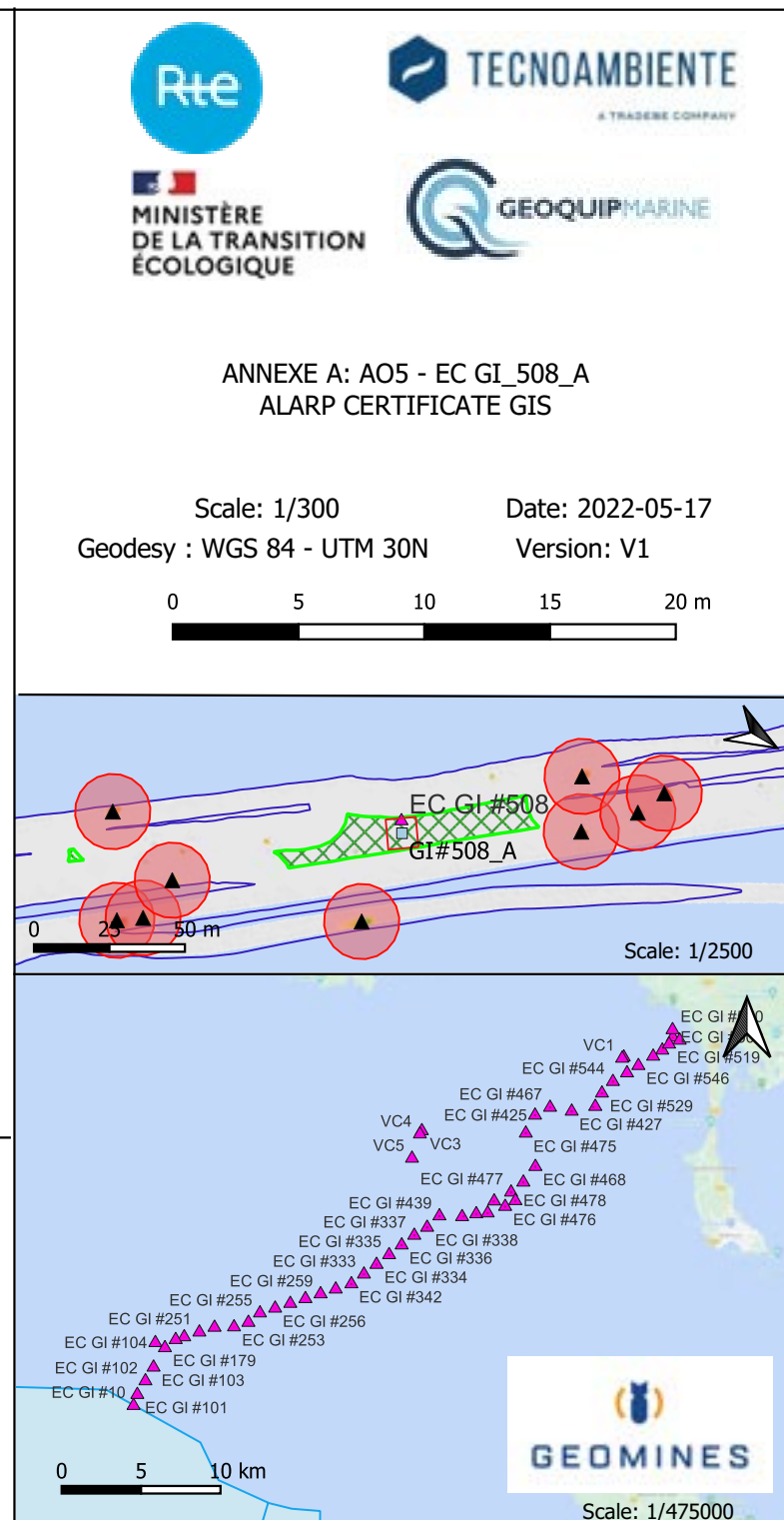
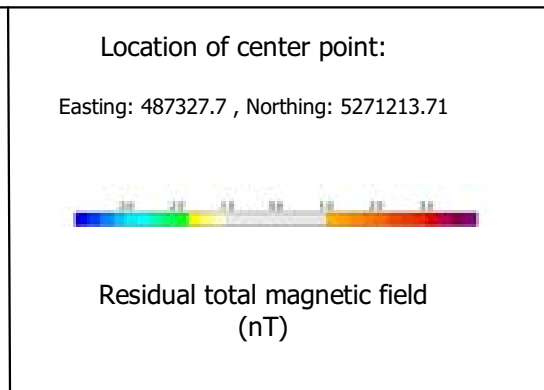
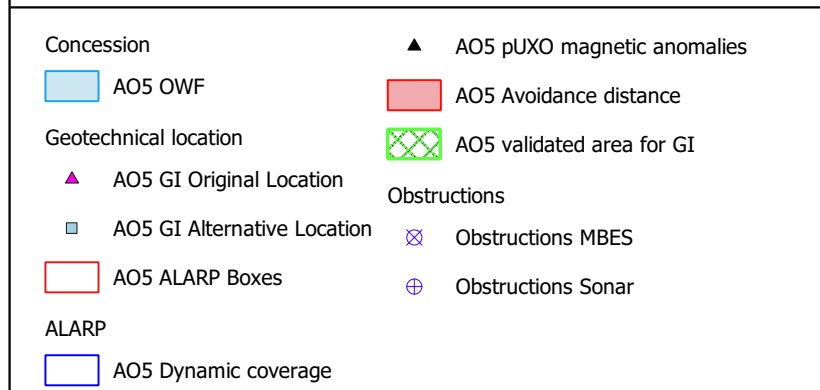
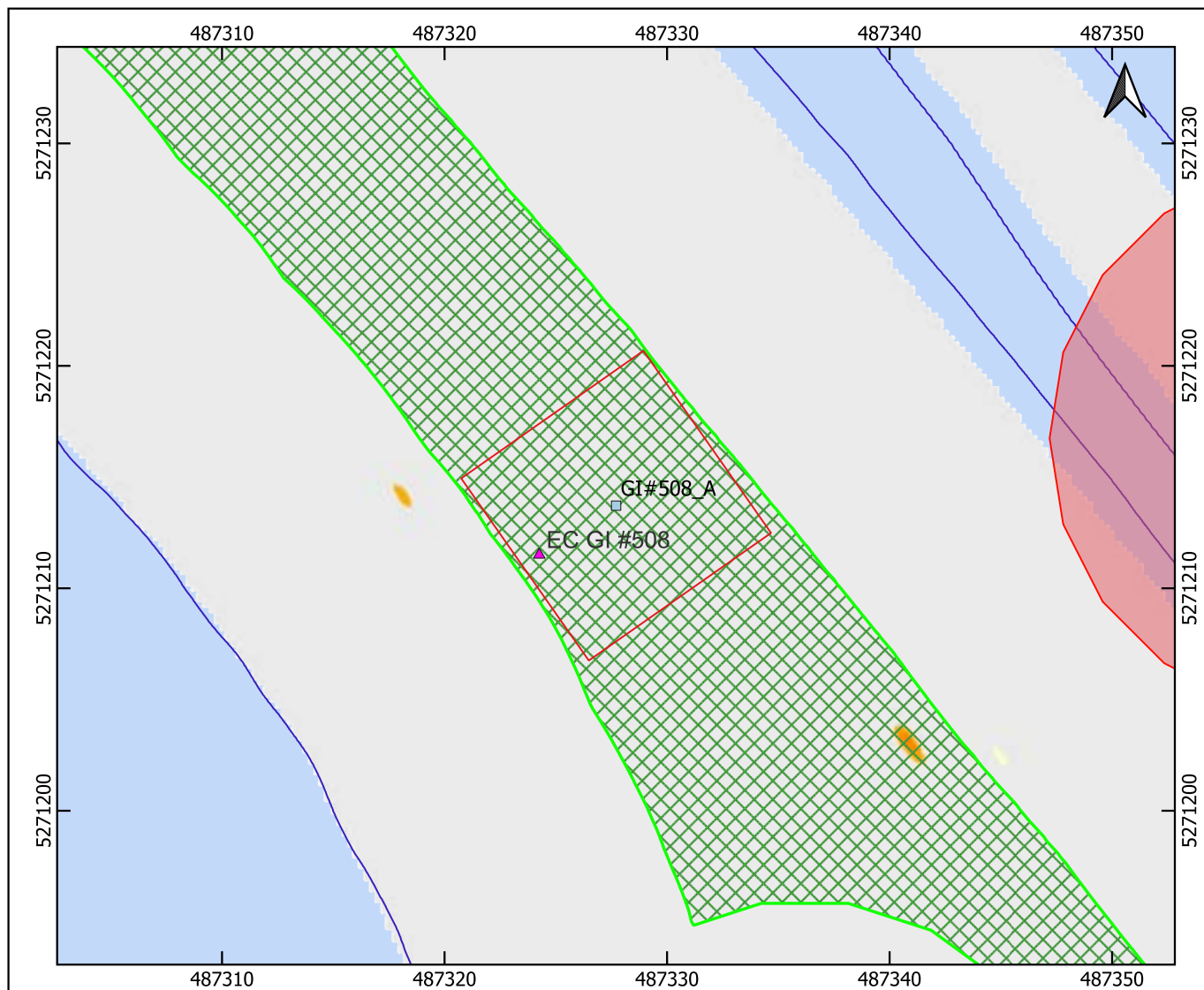
Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1

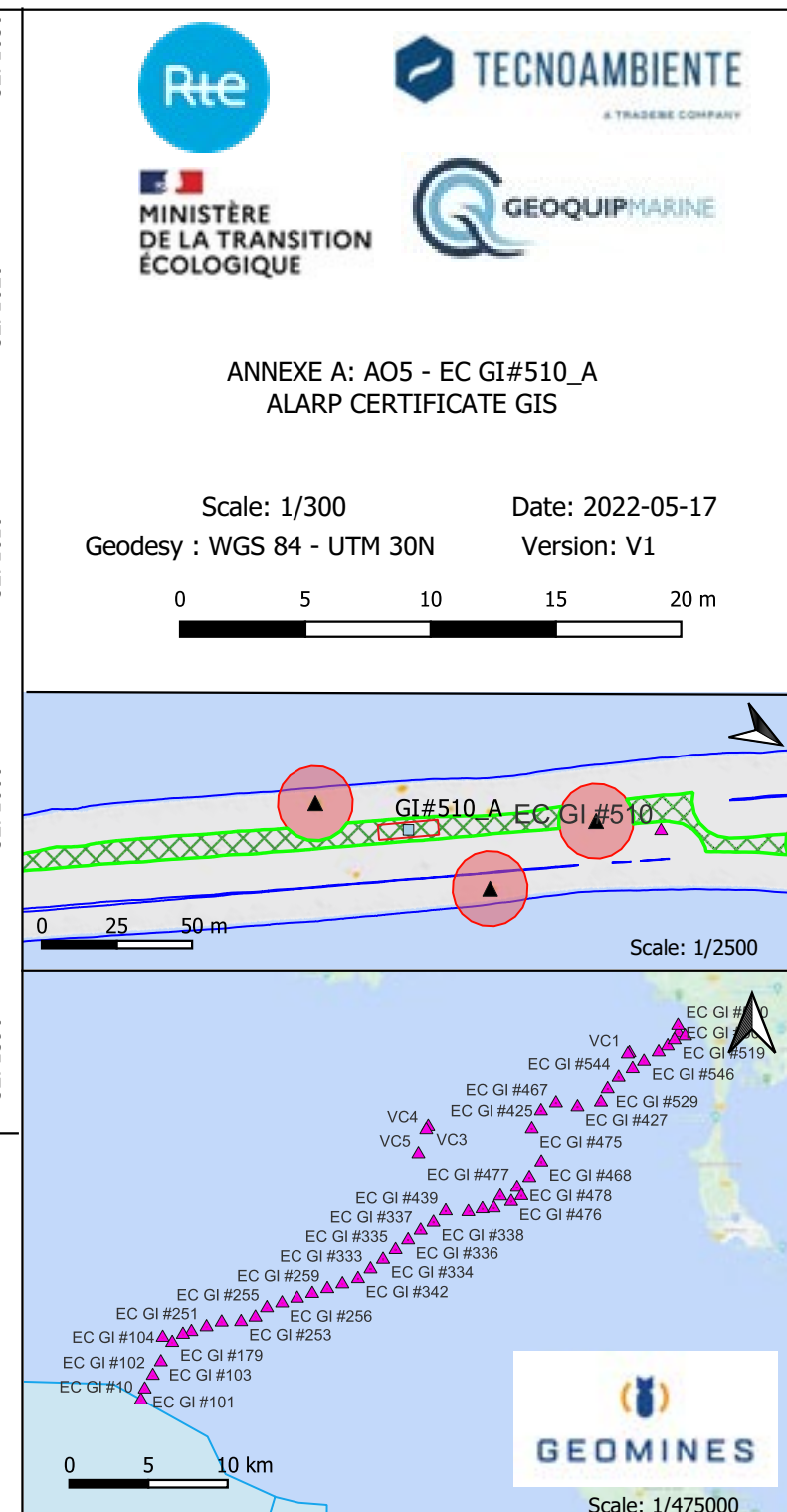
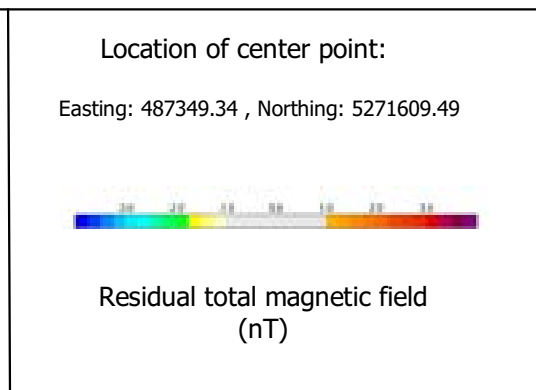
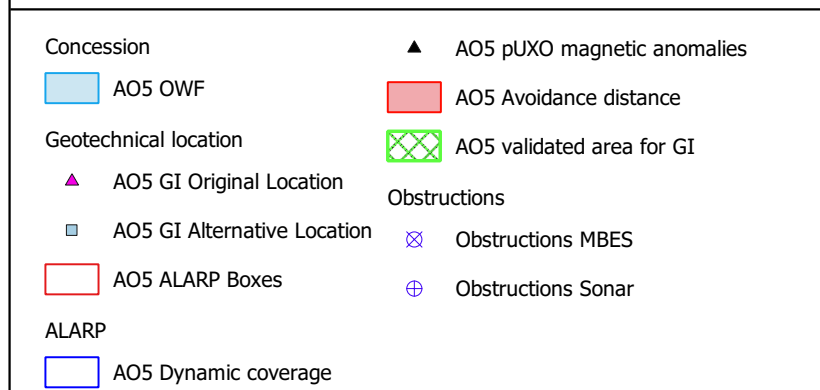
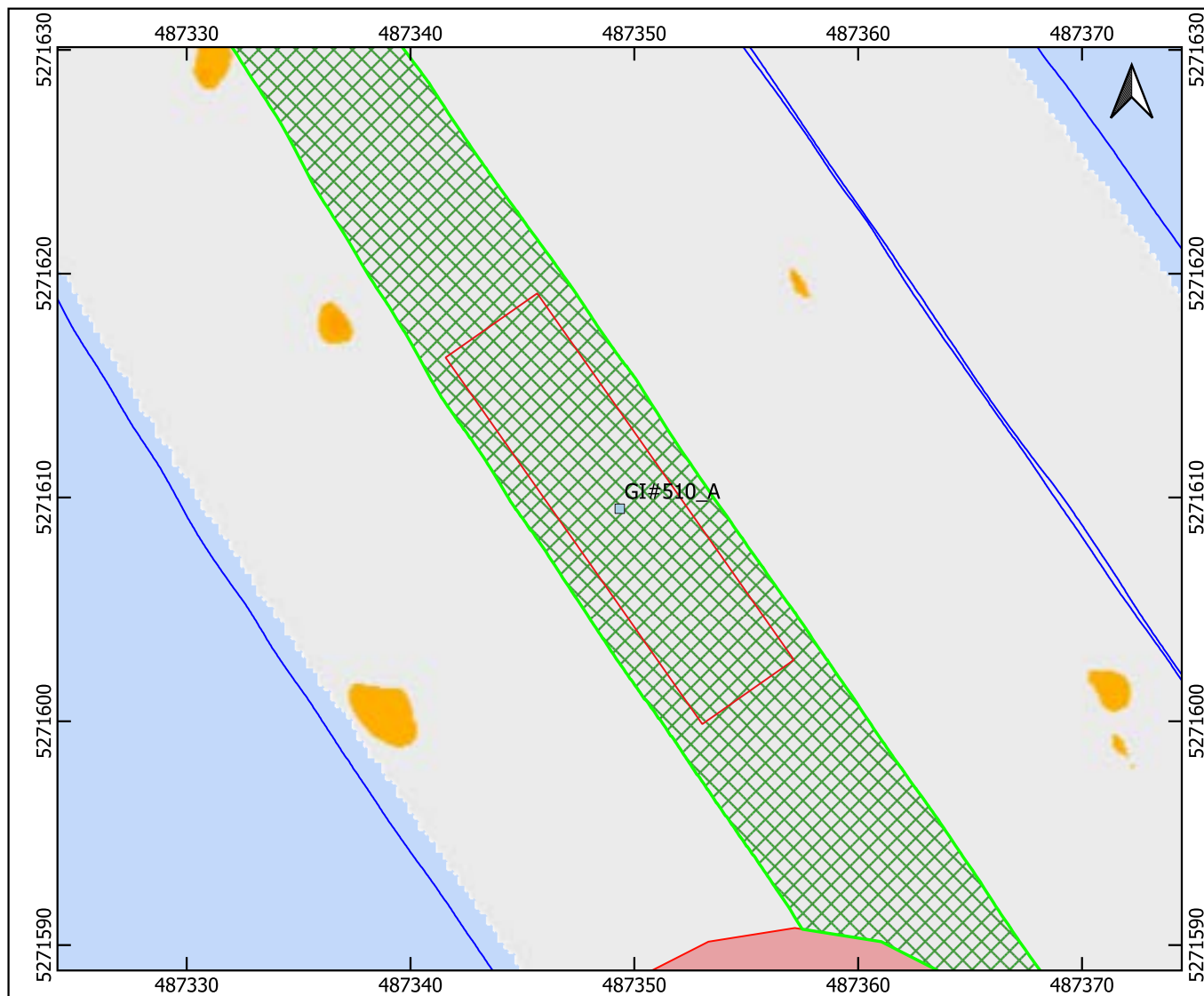


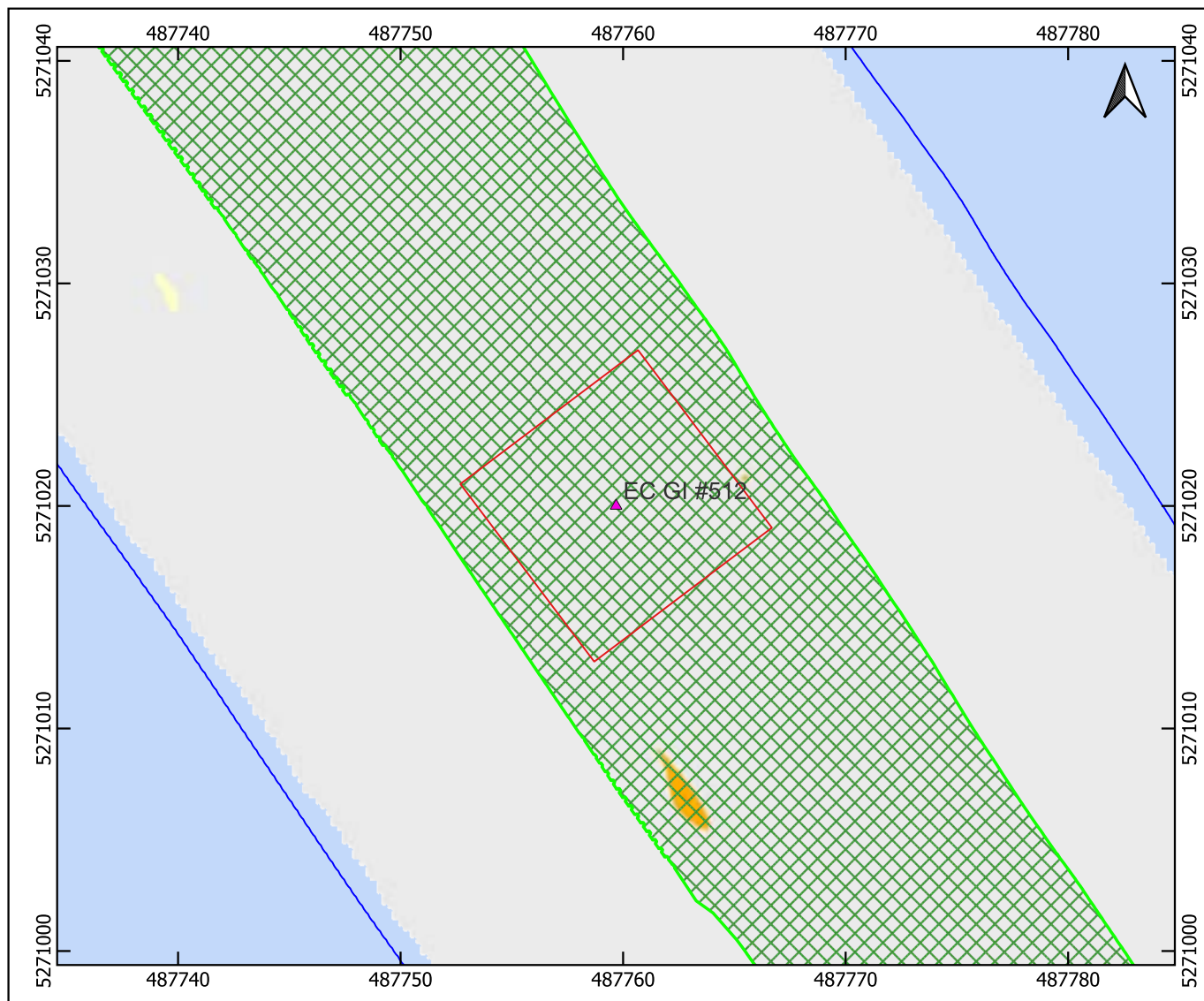
Scale: 1/475000











- Concession
- AO5 OWF
- Geotechnical location
- AO5 GI Original Location
 - AO5 GI Alternative Location
 - AO5 ALARP Boxes
 - AO5 Dynamic coverage
- AO5 pUXO magnetic anomalies
- AO5 Avoidance distance
 - AO5 validated area for GI
- Obstructions
- Obstructions MBES
 - Obstructions Sonar

Location of center point:
Easting: 487759.68 , Northing: 5271020

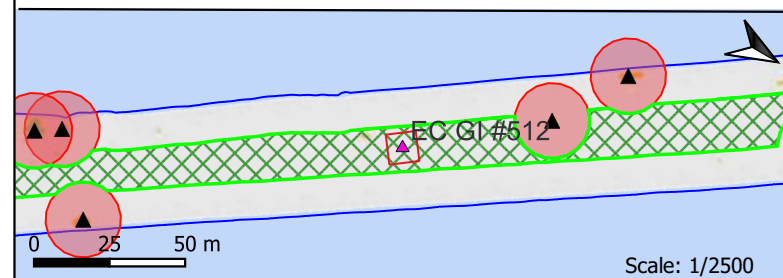
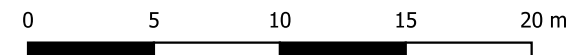


Residual total magnetic field
(nT)

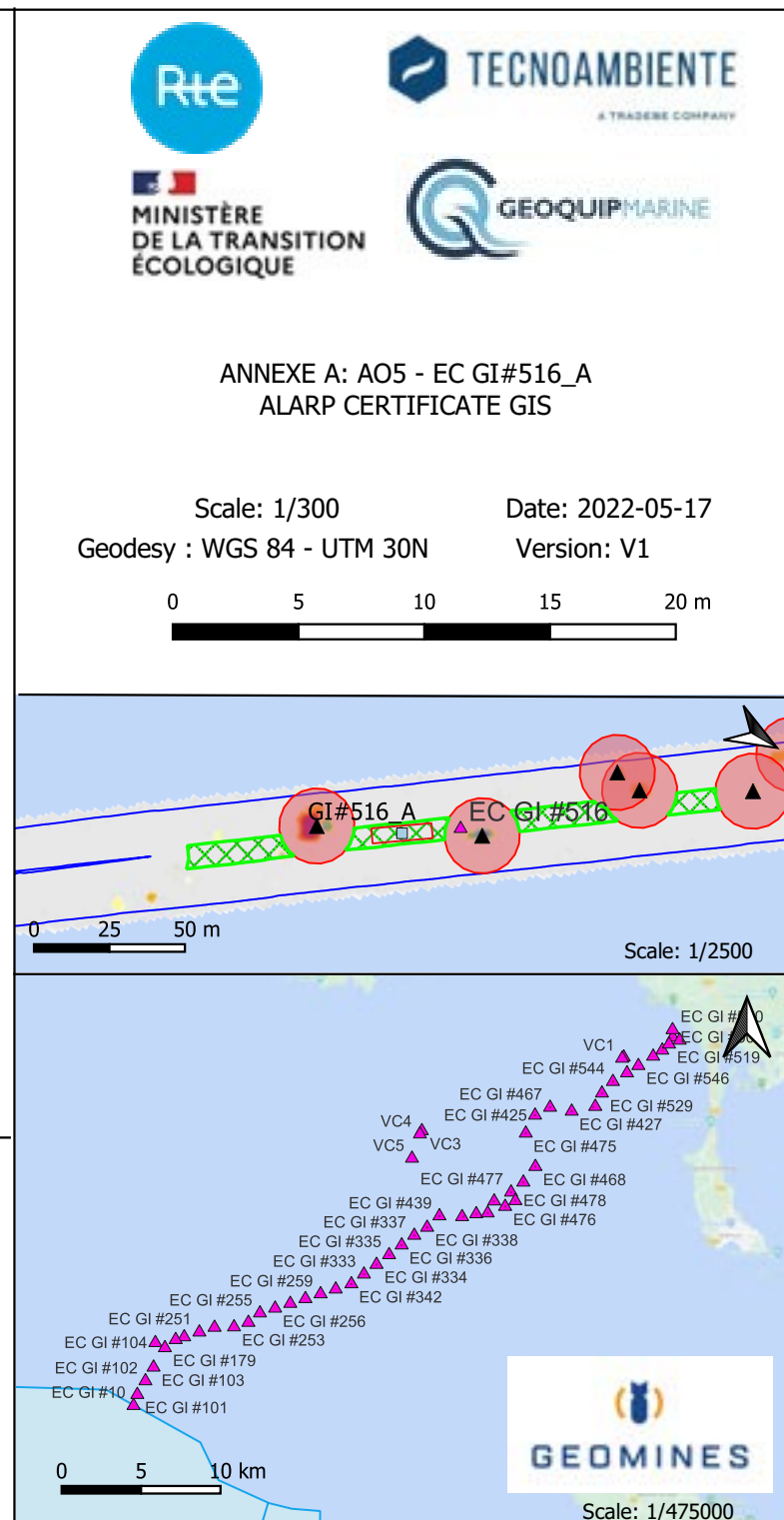
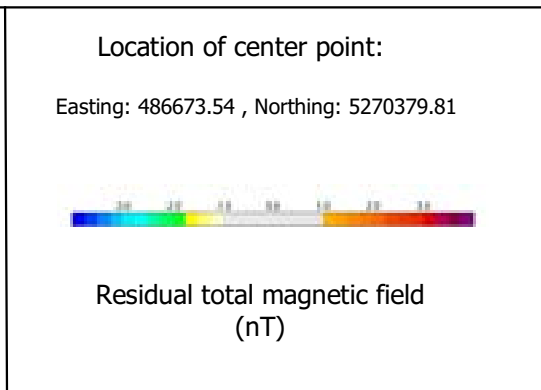
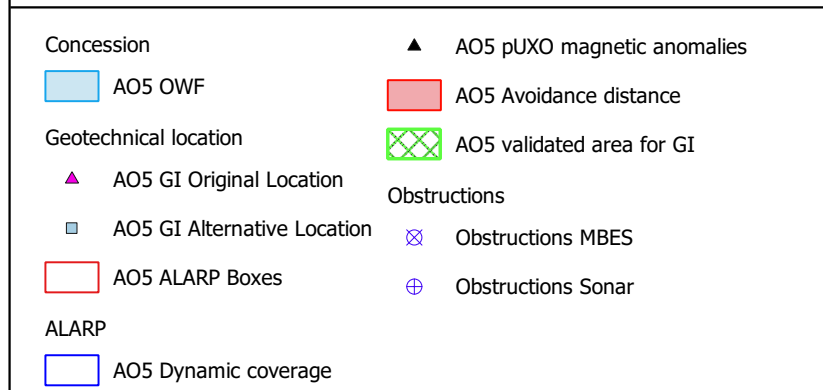
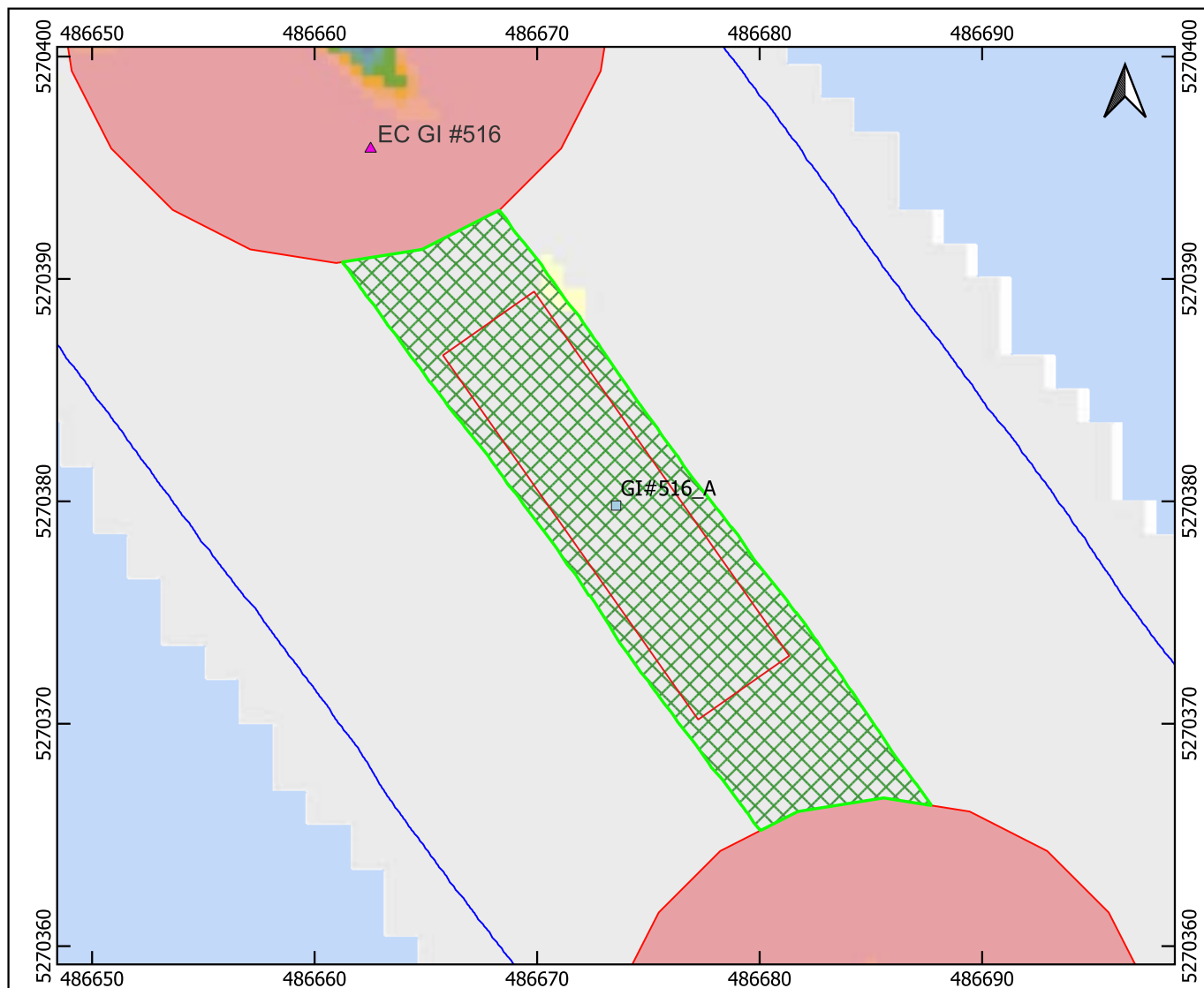


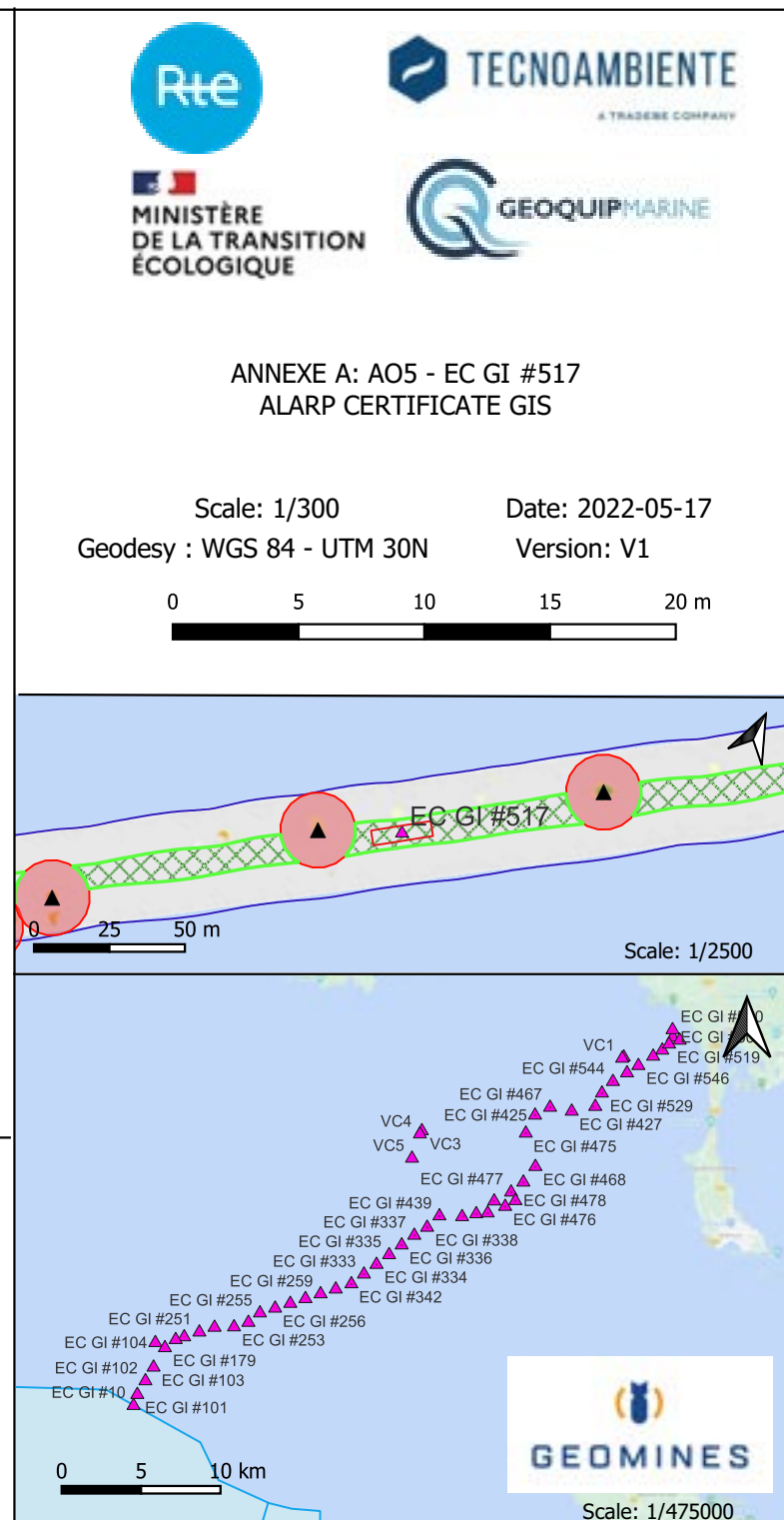
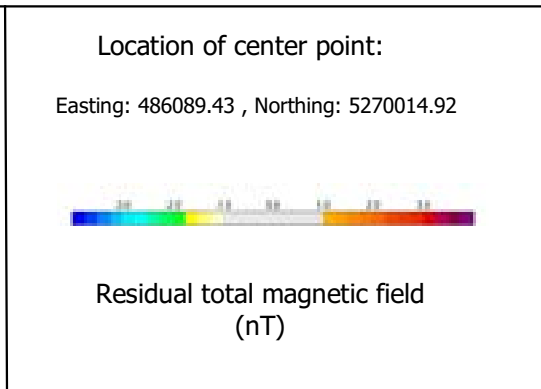
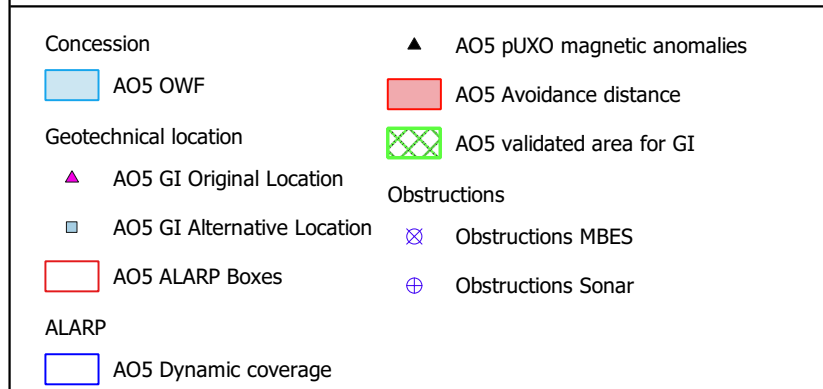
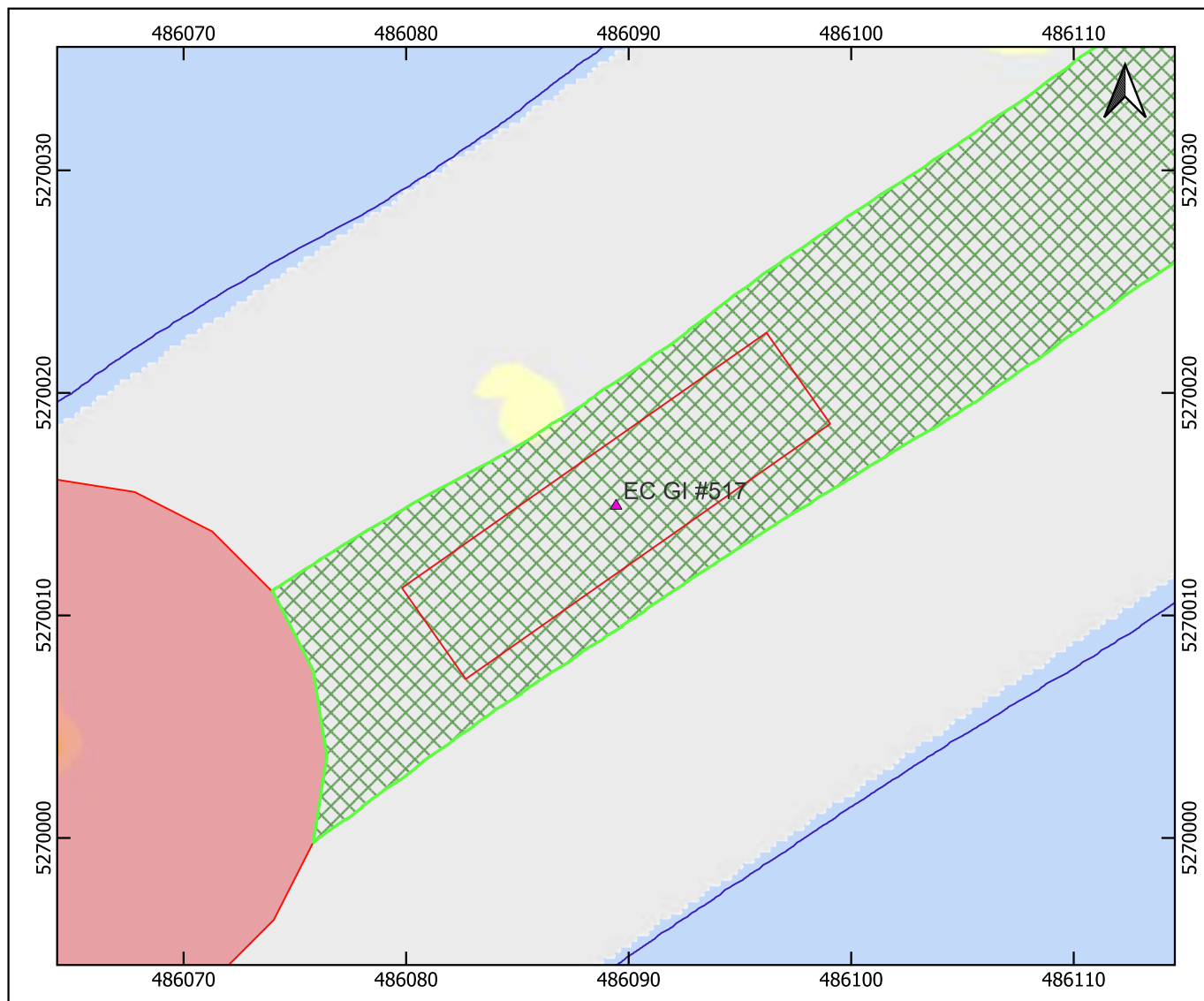
ANNEXE A: AO5 - EC GI #512 ALARP CERTIFICATE GIS

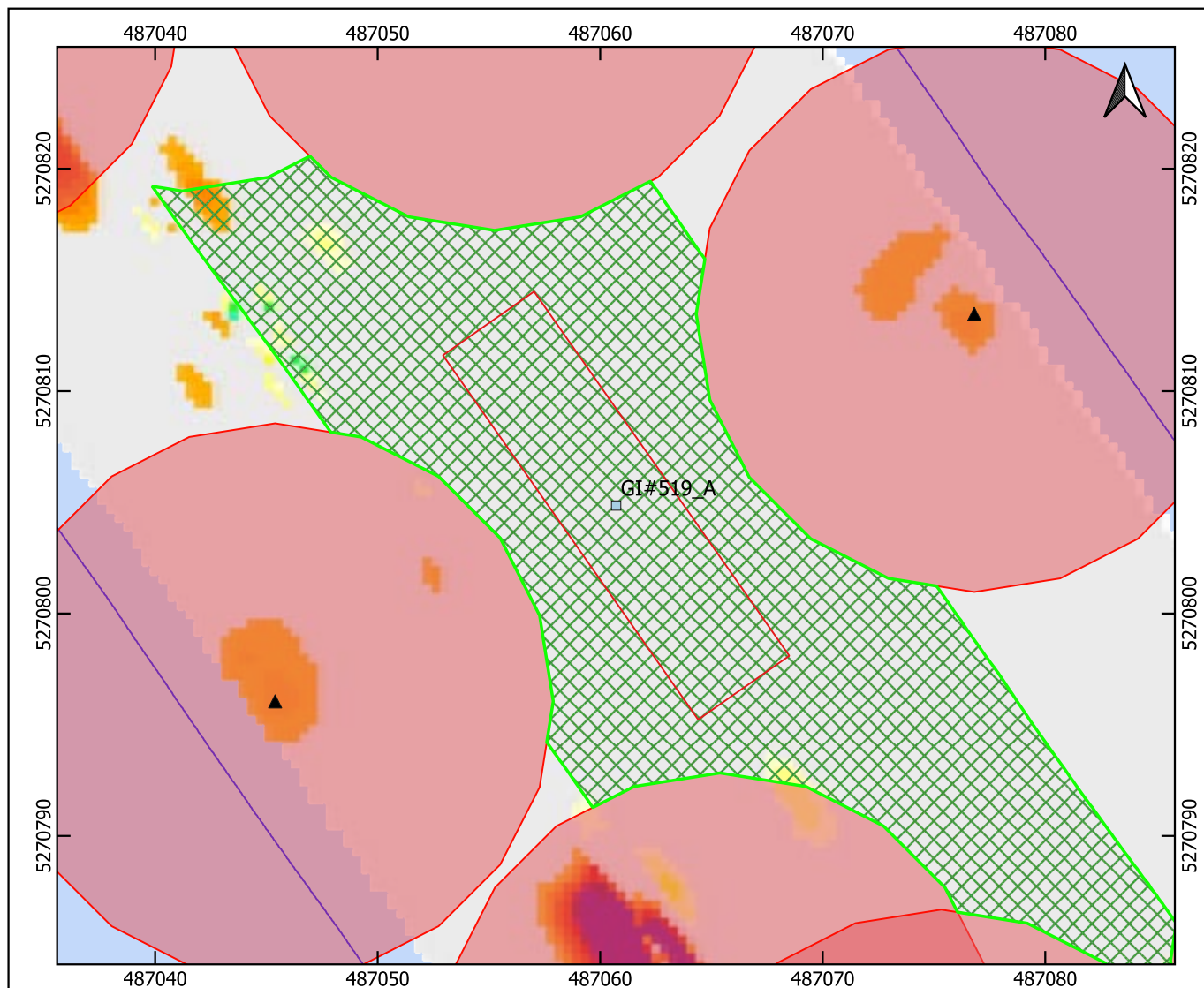
Scale: 1/300
Geodesy : WGS 84 - UTM 30N
Date: 2022-05-17
Version: V1



Scale: 1/475000







Concession

AO5 OWF

Geotechnical location

AO5 GI Original Location

AO5 GI Alternative Location

AO5 ALARP Boxes

ALARP

AO5 Dynamic coverage

AO5 pUXO magnetic anomalies

AO5 Avoidance distance

AO5 validated area for GI

Obstructions

Obstructions MBES

Obstructions Sonar

Location of center point:

Easting: 487060.71 , Northing: 5270804.85



Residual total magnetic field
(nT)



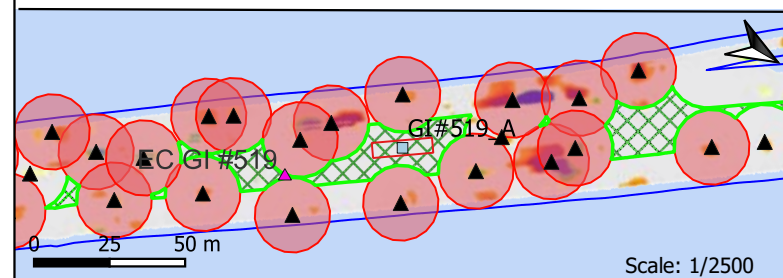
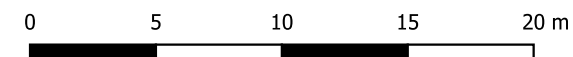
ANNEXE A: AO5 - EC GI#519_A ALARP CERTIFICATE GIS

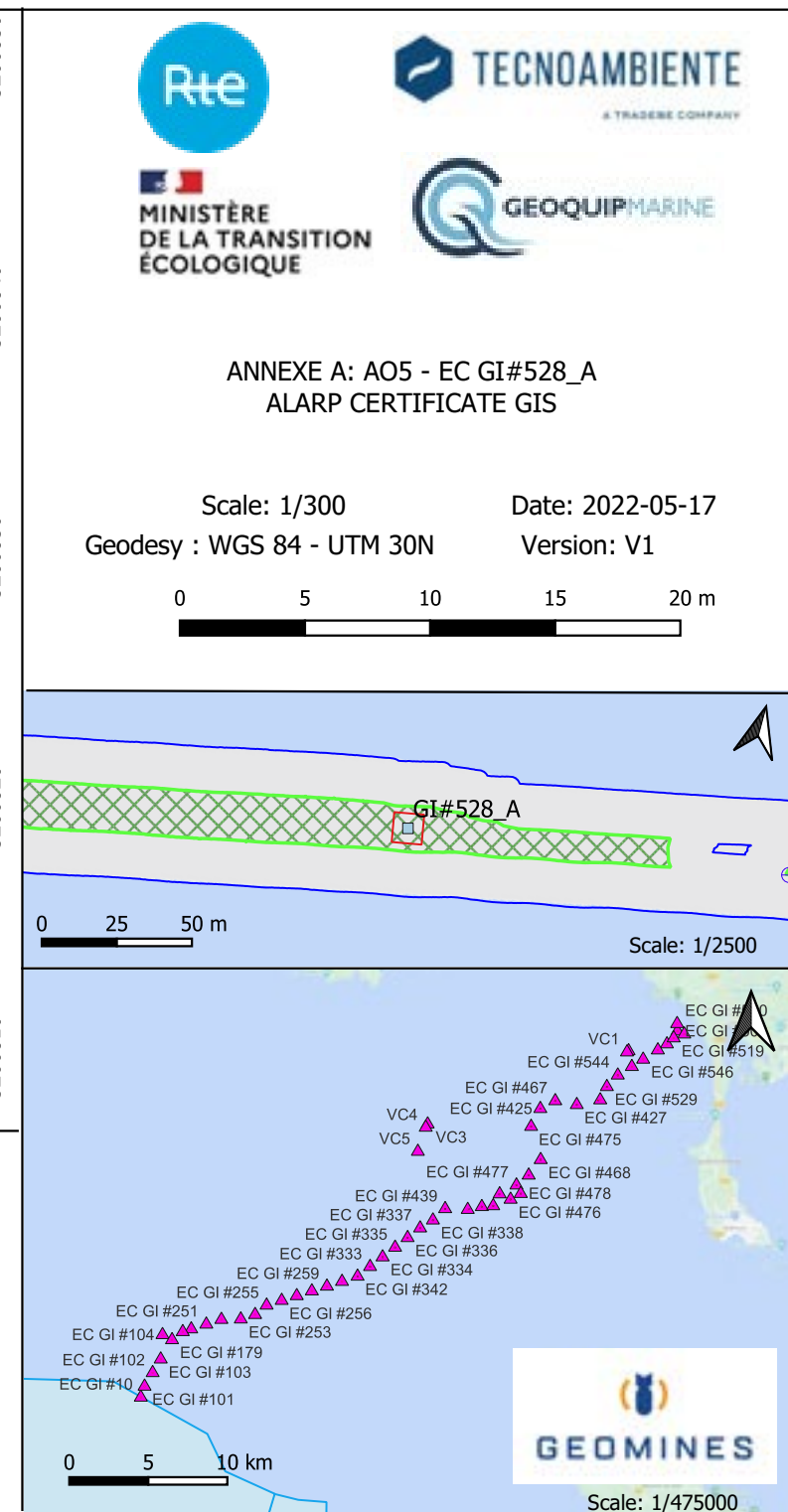
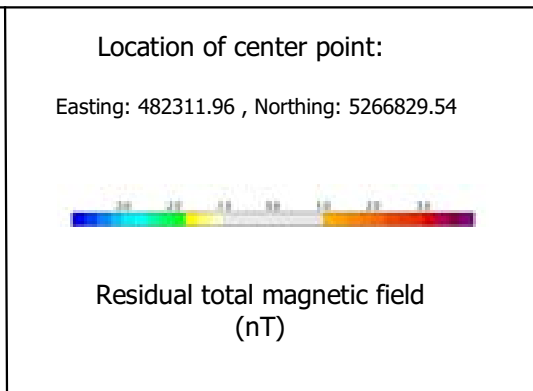
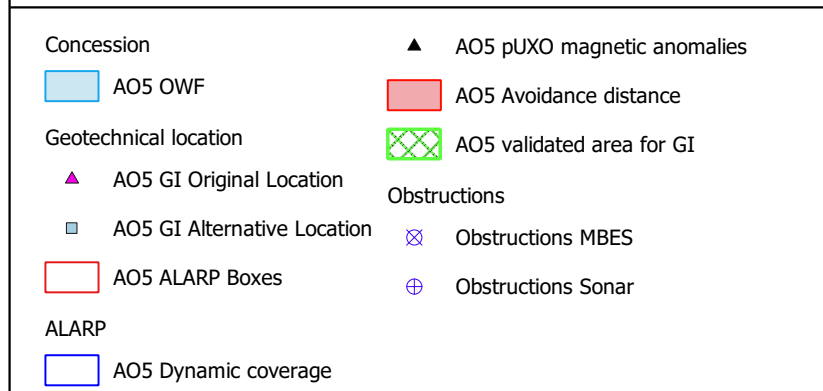
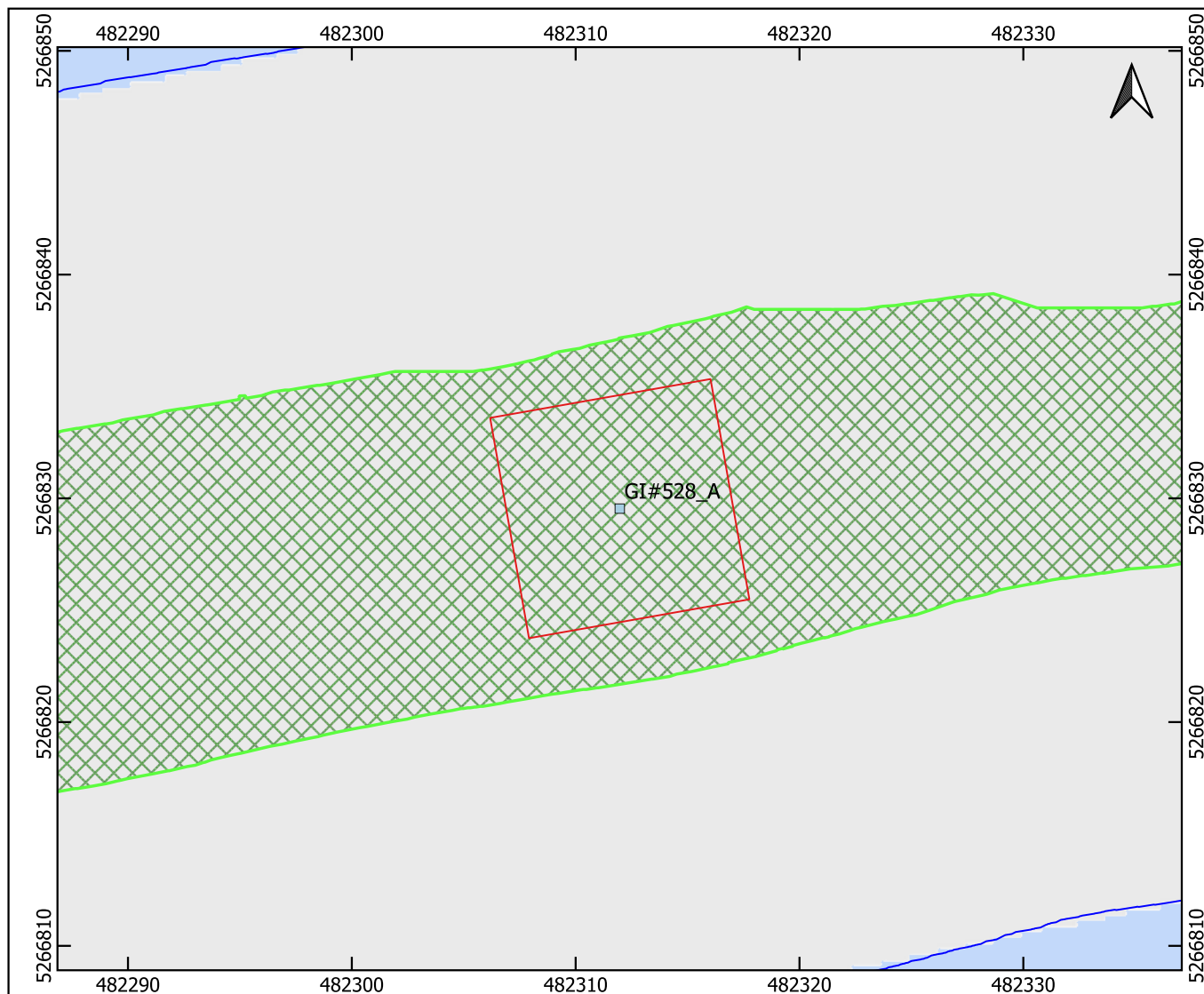
Scale: 1/300

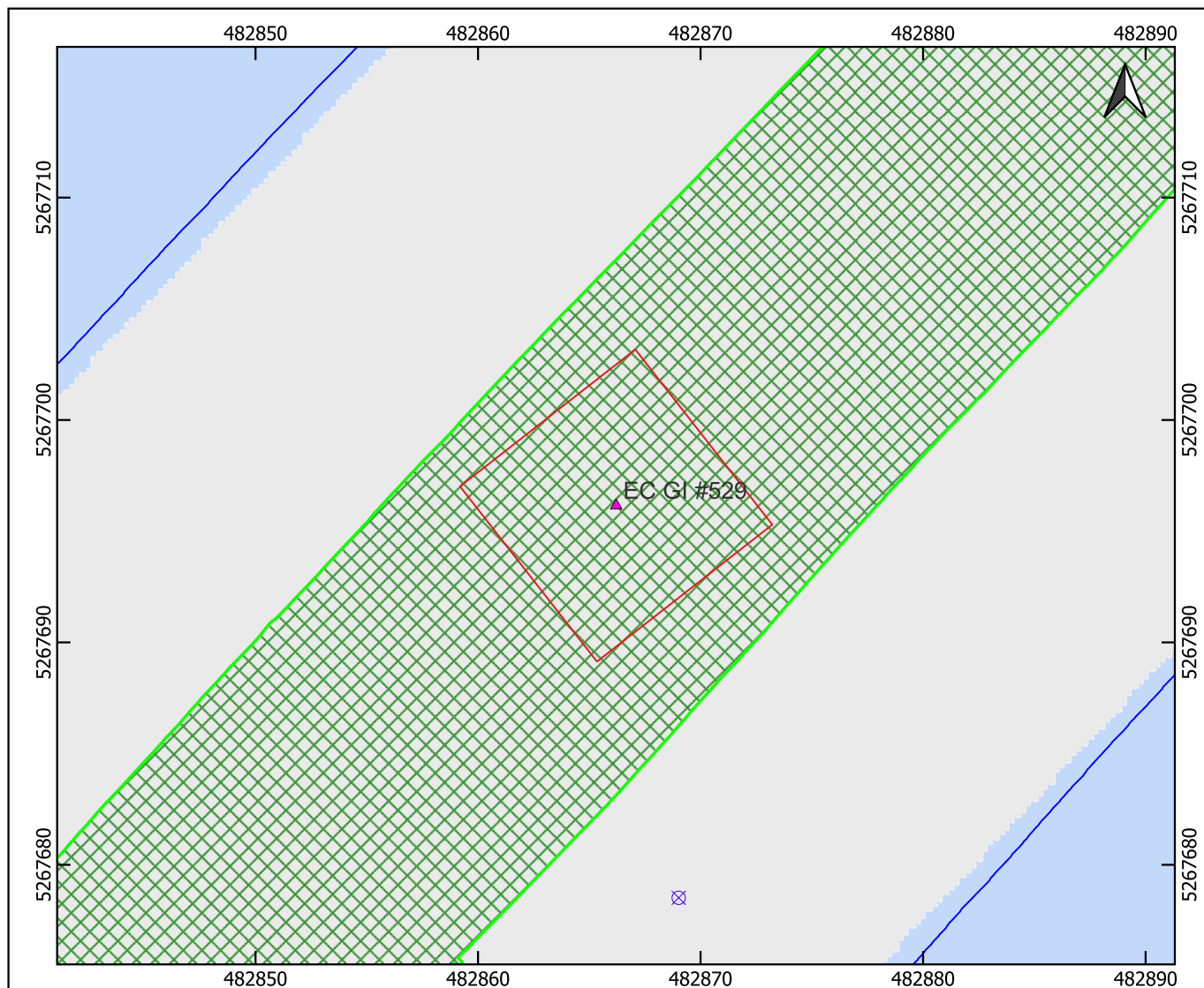
Date: 2022-05-17

Geodesy : WGS 84 - UTM 30N

Version: V1







- | | |
|-------------------------------|-------------------------------|
| Concession | ▲ AO5 pUXO magnetic anomalies |
| AO5 OWF | AO5 Avoidance distance |
| Geotechnical location | AO5 validated area for GI |
| ▲ AO5 GI Original Location | Obstructions |
| ■ AO5 GI Alternative Location | Obstructions MBES |
| AO5 ALARP Boxes | Obstructions Sonar |
| ALARP | |
| AO5 Dynamic coverage | |

Location of center point:

Easting: 482866.2 , Northing: 5267696.15

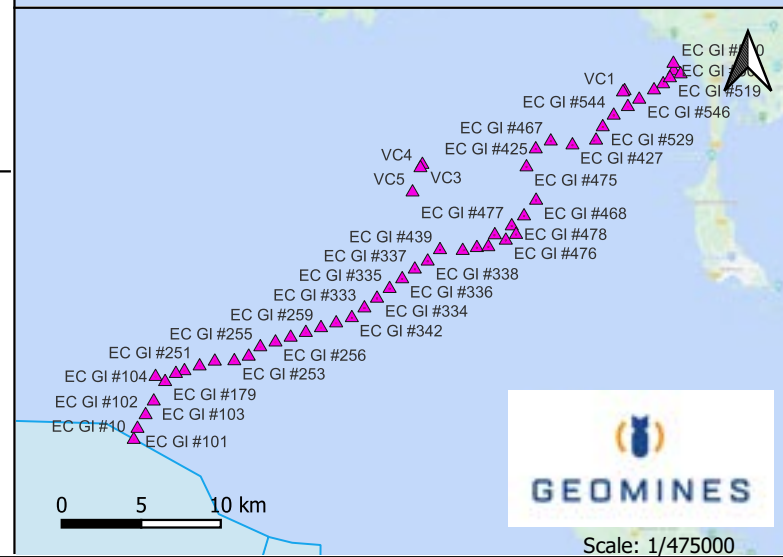
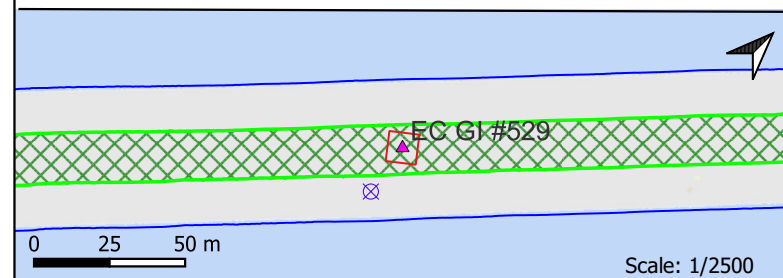
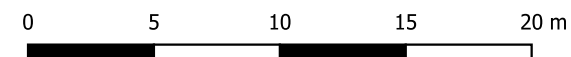


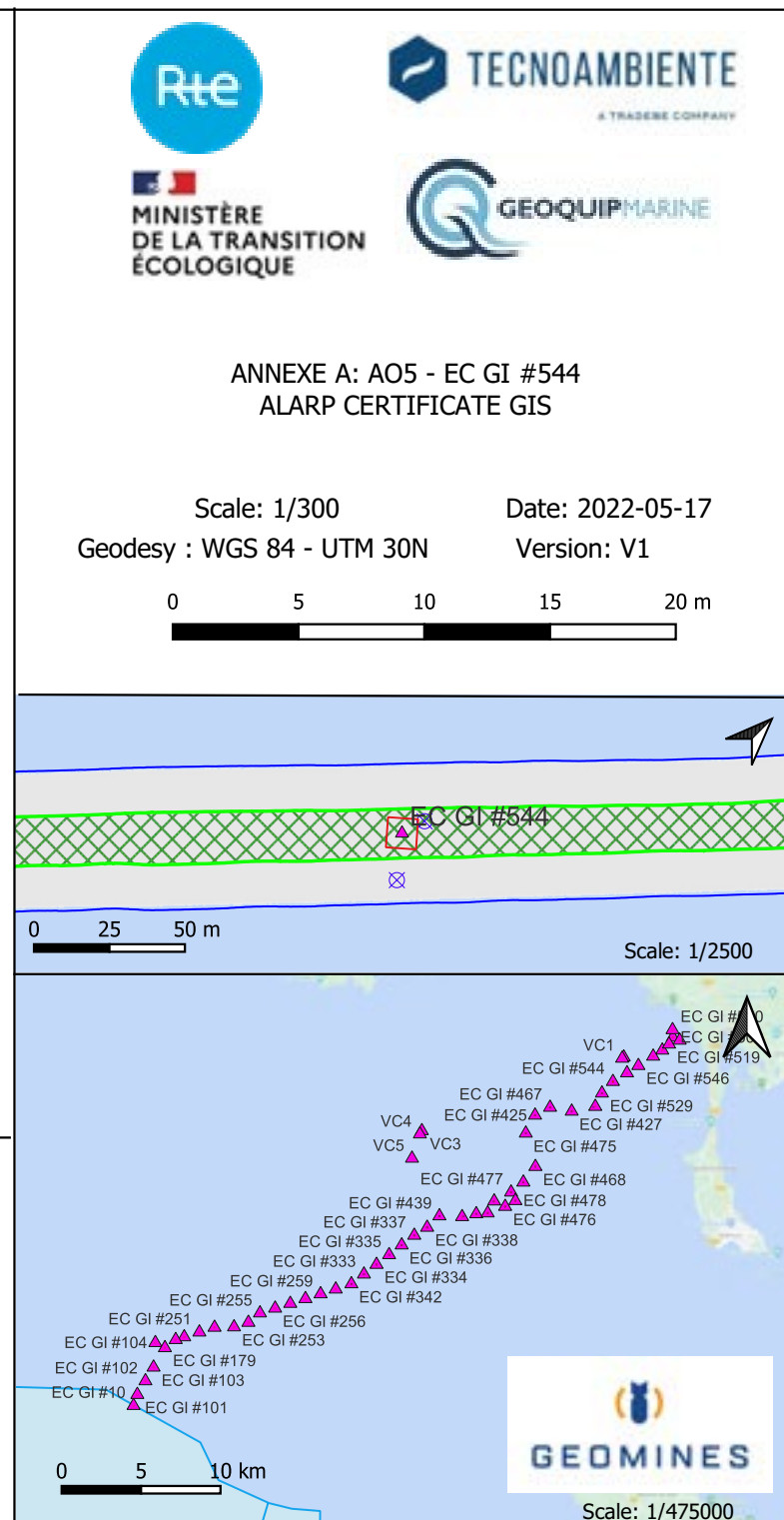
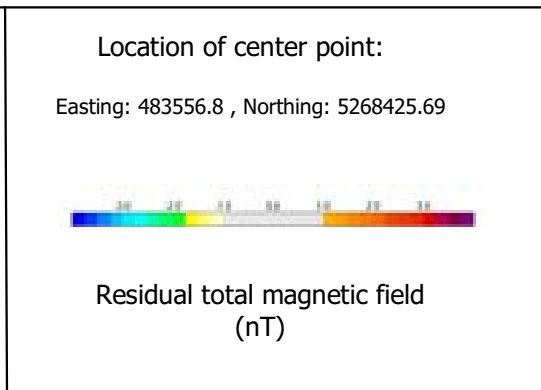
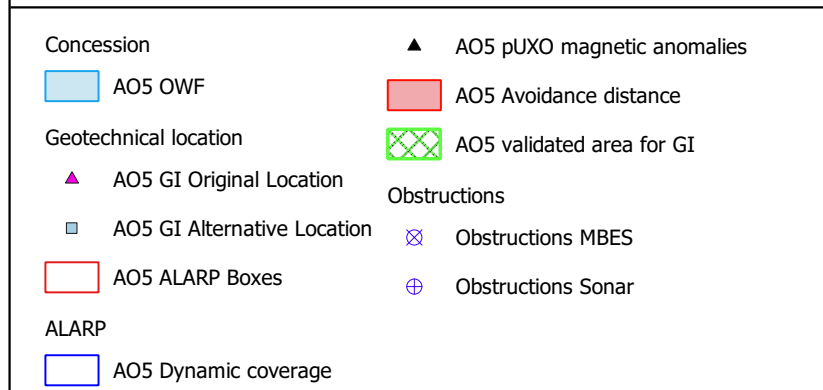
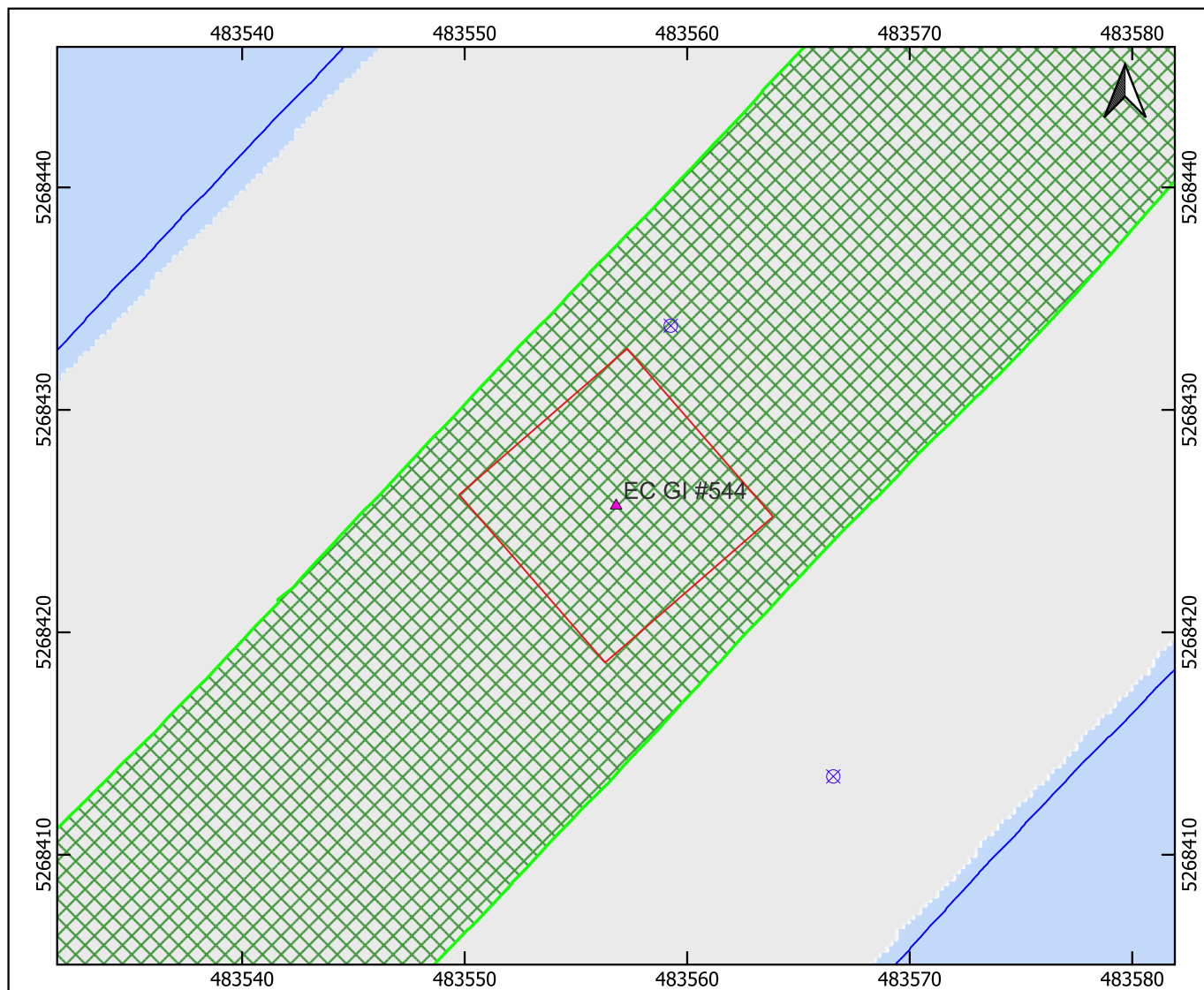
Residual total magnetic field
(nT)

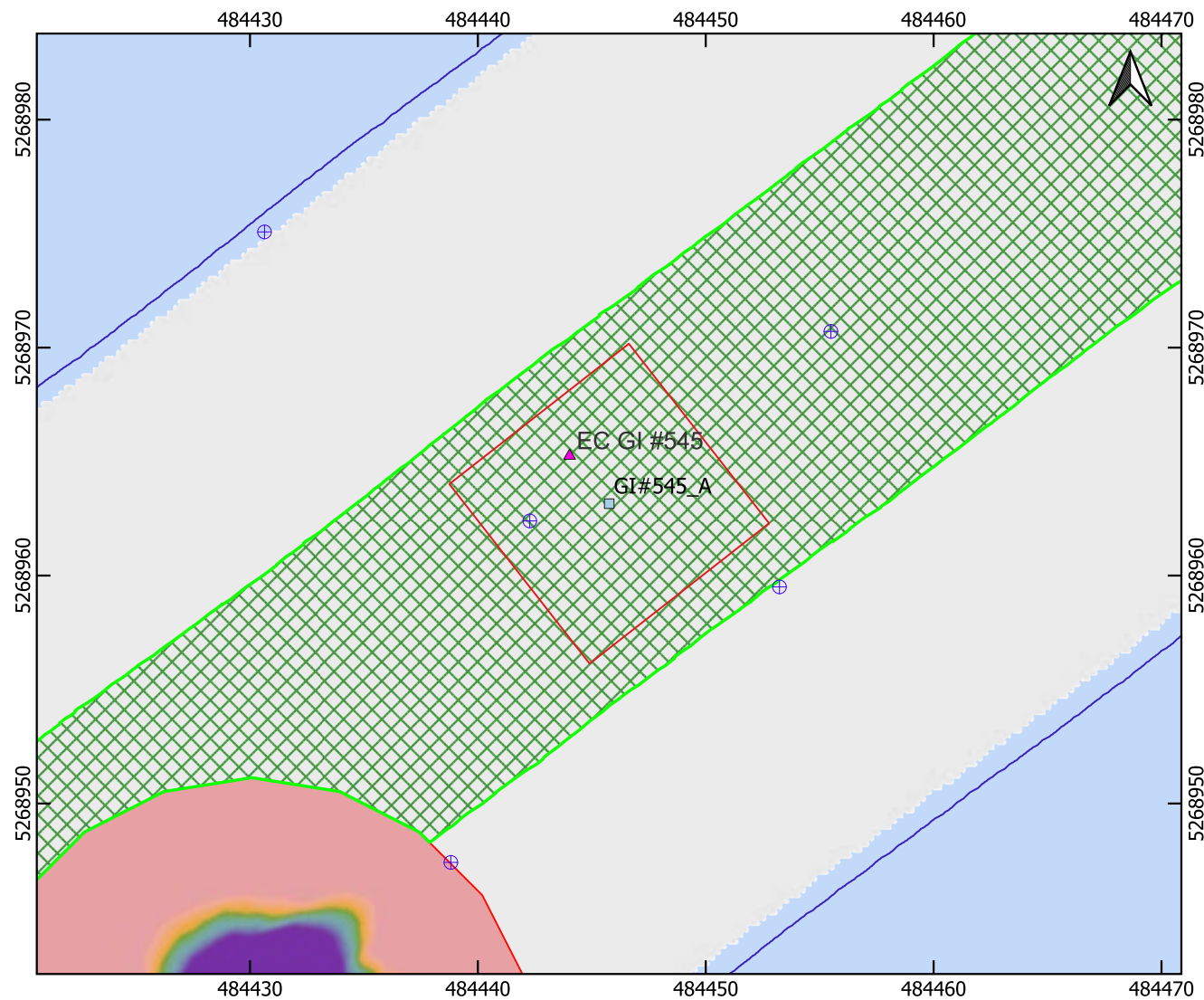


ANNEXE A: AO5 - EC GI #529 ALARP CERTIFICATE GIS

Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1







ANNEXE A: AO5 - EC GI#545_A
ALARP CERTIFICATE GIS

Scale: 1/300 Date: 2022-05-17
Geodesy : WGS 84 - UTM 30N Version: V1

