Invitation To Tender

Airborne Electromagnetic Test Survey

Cornwall, United Kingdom

Client: Deep Digital Cornwall

Issued: 5 September 2022

European Union
European Regional Development Fund

DEEP DIGITAL CORNWALL

HM Government

Contents

1 Introduction

Deep Digital Cornwall ("the Client") requires airborne electromagnetic (AEM) and associated data over two test survey polygons in Cornwall to be provided by a suitable contractor ("the Contractor"). The services (cumulatively, "the Services") shall comprise:

- Acquisition of AEM, magnetic and ancillary datasets
- Data processing
- Data delivery.

The scope of work requires approximately 100 km^2 of airborne survey to be flown, ideally in Autumn 2022. Initial modelling suggests that 200m flight lines flown north-south with 2,000m tie lines flown east-west will adequately delineate the geological features of interest.

2 Acquisition block boundaries

The blocks selected for survey are depicted in Figure 1.

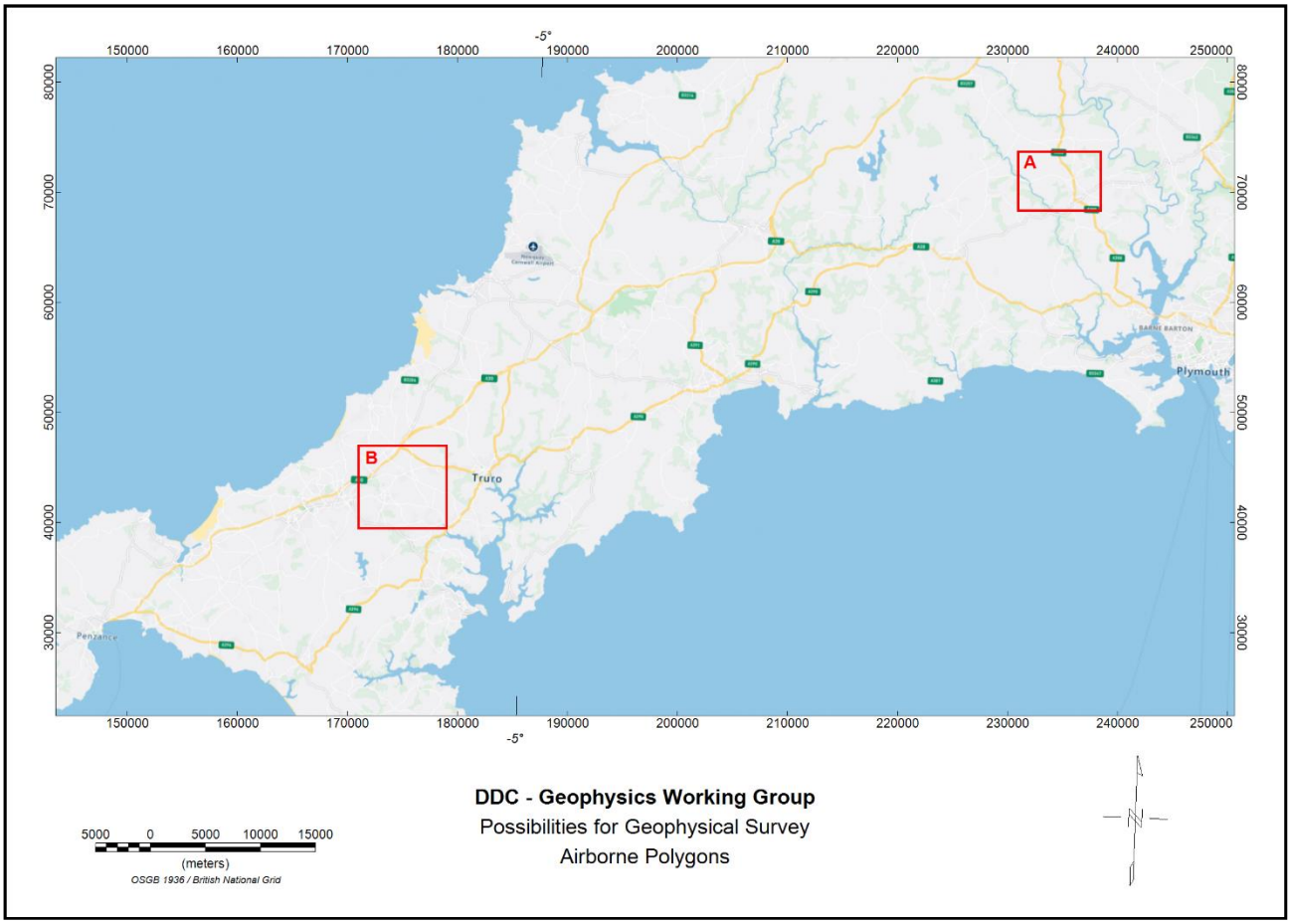

Figure 1: Blocks selected for survey (A) Redmoor (B) United Downs

The corner coordinates of each survey block are specified in Table 1. Run-ins should be of sufficient length that all instrumentation has stabilised before crossing into the specified acquisition survey block.

Block	Corner	Easting (m)	Northing (m)
Redmoor	SW	230940.00	68377.26
	NW	230940.00	73710.59
	NE	238440.00	73710.59
	SE	238440.00	68377.26
United Downs	SW	170980.00	39518.55
	NW	170980.00	46990.53
	NE	179010.00	46990.53
	SE	179010.00	39518.55

Table 1. Corner coordinates of survey blocks (OSGB 1936 / British National Grid (EPSG 27700))

All survey data shall be delivered in OSGB 1936 / British National Grid (EPSG 27700). The vertical datum shall be Ordnance Datum Newlyn (ODN).

3 Geological overview and survey objectives

The local geological setting of the survey area is shown in Figure 2.

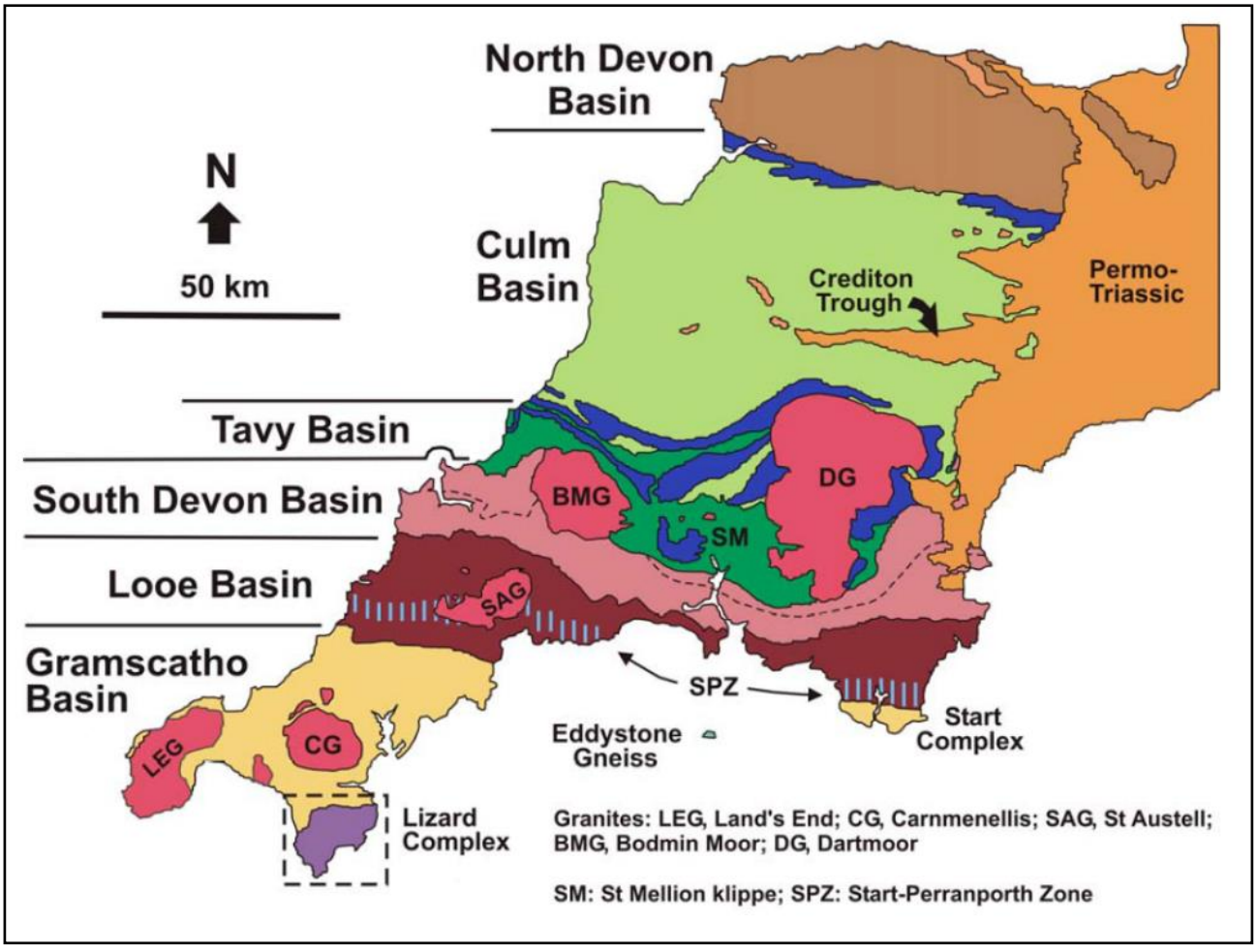

Figure 2: Local geological setting (after Shail & Leveridge, 2009)

This region of Cornwall is highly prospective for lithium, copper, tin, tungsten, etc. Given the UK government's current focus on critical minerals[1], it is hoped that this test survey will provide the necessary motivation for a much larger AEM and/or AGG survey, as part of creating a credible geoscientific baseline to facilitate world-class mineral exploration by the private sector.

The intended targets/goals for this AEM survey are as follows:

- Understand the regional fault system and its associated mineralisation;
- Map the top surface of the deep granite (located 0 to 2500m below surface);
- Investigate the hydrothermal and structural interaction of the granite with the overlying killas;
- Give confidence in lithological variations and possible structural trends with depth.

Tender submissions should demonstrate specific attention to the above survey objectives, possibly including the recommendation of particular acquisition and/or processing strategies, and fully addressing the general issue of spatial resolution vs penetration depth.

4 Technical requirements

4.1 Survey standards

The operations shall be provided to International best practice and in compliance with all local and international regulations and all relevant HSSE standards. Proof of such compliance shall be provided at tender stage and at project completion.

4.2 Quality control

The Client will appoint a Client Representative who will be responsible for approving all technical aspects of the Services throughout the data planning, acquisition, processing and delivery phases.

4.3 Data acquisition

4.3.1. Positional control

(a) Fill-in or repeated flight lines will be required where flight lines are more than 20 metres off course over a continuous distance of 500 metres or more unless the deviation is required by safety or civil aviation requirements.

(b) Nominal transmitter and/or towed bird/assembly terrain clearance will be specified in the Request for Quotation.

(c) Every effort within the bounds of safety considerations shall be made to conduct the survey at the nominal transmitter and/or towed bird/assembly terrain clearance.

(d) The average transmitter and/or towed bird/assembly terrain clearance for any one flight line shall be within ±5 metres of the nominal transmitter and/or towed bird assembly terrain clearance.

(e) Where the transmitter and/or towed bird assembly terrain clearance varies from that nominated by more than 20 metres over a continuous distance of 500 metres or more, a fill-in line will be flown at the Contractor's expense unless it can be reasonably demonstrated that such flying would not be safe.

[1] See for example "Resilience for the Future: The UK's critical minerals strategy", published on 22 July 2022 by the Department for Business, Energy & Industrial Strategy, and available for download at: https://www.gov.uk/government/publications/uk-critical-mineral-strategy/resilience-for-the-future-the-uks-critical-minerals-strategy.

4.3.2. Altimetry and attitude sensors

Radar altimeter

(a) A suitable radar altimeter (details to be supplied by the Contractor) will be used to measure the height of the aircraft above ground level.

(b) Radar altimeter data must be recorded at intervals of 0.2 seconds or less.

(c) The radar altimeter data shall have an absolute accuracy of ±0.5 m or better.

(d) The vertical offset between the radar altimeter antenna and the aircraft's or towed bird/assembly's GPS antenna will be measured.

Laser altimeter

(a) A suitable laser altimeter (details to be supplied by the Contractor) will be used to measure the height of the aircraft or towed bird/assembly above ground level.

(b) Laser altimeter data must be recorded at intervals of 0.2 seconds or less.

(c) Laser altimeter data shall have an absolute accuracy of ± 0.1 m or better.

Altimeter linearity checks

(a) Radar and laser altimeter linearity will be verified before commencement of survey operations by flying over a level airstrip, or similar flat surface, at aircraft or towed bird/assembly terrain clearances of 30, 60, 90, 120, 150 and 180 m.

(b) Measured averages for each height-pass from the laser altimeter, radar altimeter, and all GPS instruments will be compared in regression cross-plot form to determine consistency between the instruments. Any non-linearity or offsets between the instruments shall be corrected for in the data processing.

Attitude sensors

(a) A suitable attitude sensor (details to be supplied by the Contractor) will be used to measure the attitude of the transmitter loop with respect to the horizontal.

(b) A suitable attitude sensor (details to be supplied by the Contractor) will be used to measure the attitude of the receiver coils with respect to the horizontal.

(c) Prior to the commencement of the survey, calibration measurements will be made to determine any difference between the true angle that the transmitter loop and receiver coils exhibit with respect to the horizontal and the angle measured by the attitude sensor(s).

(d) All results of the attitude sensor calibrations are to be compiled for inspection by the Client Representative before commencement of the survey. The results will also be included in the Acquisition Report.

4.3.3. Electromagnetic data acquisition

Electromagnetic system

(a) The system's transmitter current waveform(s), and if applicable the receiver voltage waveform, must be recorded at least daily.

High altitude zero-lines

(a) At the start of the first flight of every flying day, and at the end of the last flight on every flying day, a 60-90 second high altitude reference line will be flown at 1000 metres above ground level or higher.

(b) These high altitude zero lines will be used as a check on system noise levels in the absence of ground effect.

(c) For any flight, if the standard deviation of the high altitude zero-line data for a zero-line and window combination exceeds the corresponding values in the Noise Characteristics table supplied by the Contractor then that window will be deemed to be "noisy". If more than 25% of the windows are deemed to be noisy in either component, then that flight must be reflown at the Contractor's expense.

(d) If high altitude data are not able to be acquired at the end of the flight due to low cloud or other circumstances beyond the control of the Contractor, the Contractor will not be obliged to re-fly the flight. Although the reasons for this omission shall be fully documented and communicated to the Client Representative within 24 hours of occurrence.

(e) On a daily basis, the Contractor shall verify that the high altitude zero-line data are meeting the requirements of this clause.

Noise levels shall be used when making an assessment of the technical suitability of the system for a specific survey and as a quality control check on data during the survey. Noise levels form part of the allowable noise levels as specified above. The Noise Characteristics for the system shall be specified by the Contractor in their bid document.

Parallax checks

Electromagnetic data do not typically require a cable-length parallax correction as the GPS is mounted on the bird frame. An electronic timing-lag is determined for each survey and applied to data. The timing-lag will be determined by flying over a suitable short-wavelength anomaly in opposite directions and the lag will be adjusted such that the anomaly shapes align when plotted with respect to position. This will be carried out for electromagnetic, altimeter and magnetic sensors.

4.3.4. Magnetic data acquisition

a) No line data will be accepted where point to point instrument noise (defined as normalised fourth difference) exceeds 0.1 nT peak-to-peak for more than 500m.
b) Temporal variations of magnetic field will be monitored during the course of the survey.
c) No line data will be accepted where the change in the diurnal field exceeds 3 nT from any 60 second chord or 0.5 nT from any 15 second chord.
d) No line data will be accepted where the base station recorded magnetometer instrument noise levels are in excess of 2 nT for periods longer than 10 minutes or more, or where the base station has ceased to function for periods of 10 minutes or more.
e) Survey data acquisition will be stopped during severe magnetic activity based on the magnetic weather forecast.

4.4 Data Processing requirements

Sufficient processing shall be carried out in the field by the Contractor to verify that data conform to the specifications. Such data shall be made available to the Client Representative for verification on an agreed schedule and to the Client via secure FTP or similar. It is a requirement for all draft data to be accepted by the Client before the Contractor is permitted to demobilise.

Final data products (see below) and a data processing report shall be delivered within 30 days of survey demobilisation.

4.5 Reporting requirements

4.5.1 Data acquisition report

A data acquisition report combining operational and navigational aspects of the project will be issued by the Contractor on aircraft demobilisation. The final version of this report is required within 30 days from demobilisation. This report will contain a précis of all the daily information and statistics along with Mobilisation/Demobilisation reports, brief descriptions of all survey instrumentation, data QC measures and a comments/recommendations section.

4.5.2 Data processing report

A data processing report is required with the final survey deliverables. This will include a discussion of the processing steps applied, any problems encountered, and a summary of the supplied data formats.

4.6 Data Delivery requirements

4.6.1 Databases

Profile database(s) shall include raw, intermediate and processed channels of electromagnetic, conductivity, magnetic and ancillary data.

4.6.2 Grids and voxets

Gridded electromagnetic data shall include:

- Representative early, middle and late time windows for each data channel
- Ternary image of the above
- Interpretive grid/voxet products to be agreed between the Client and the Contractor

Gridded conductivity data shall include:

- Conductivity slices
- Conductivity sections
- Interpretive grid/voxet products to be agreed between the Client and the Contractor

Gridded magnetic data shall include:

- Residual Magnetic Intensity - compensated, diurnal and IGRF corrected, levelled total magnetic anomaly
- Reduced-to-pole RMI
- First vertical derivative of RTP
- Total horizontal derivative of RTP
- Total gradient (aka analytic signal) of RTP
- Interpretive grid/voxet products to be agreed between the Client and the Contractor

Gridded ancillary data shall include:

- Digital terrain model derived from altimeter and GPS measurements, and supplemented if necessary with SRTM or similar.

4.6.3 Digital archive

A digital archive shall be delivered on HDD (two copies) to the Client Representative. It shall include:

- Acquisition report (see above) in Adobe Portable Document Format (PDF)
- Processing report (see above) in Adobe Portable Document Format (PDF)
- Profile database(s) (see above) in ASCII XYZ and Geosoft GDB formats
- Gridded data (see above) in ASCII XYZ and Geosoft GRD formats.

5 Commercial requirements

The Contractor is to submit costs for completing the Services in GBP exclusive of UK VAT, using the Bill of Quantities shown in Table 2.

Cost item	Number	Unit	Rate (GBP)	Total (GBP)
Survey mobilisation		Quantum		
Data acquisition		Line km		
Survey demobilisation		Quantum		
Data processing		Quantum		
Report generation		Quantum		
Total cost (GBP)				

Table 2: Bill of Quantities for Cornwall AEM Test Survey (exclusive of UK VAT)

A Gantt Chart summarising key project milestones should also be provided, along with the Contractor's provisional availability for commencement of survey operations.

6 Alternative Proposal

Detailed specifications and parameters for the Services are set out in the preceding paragraphs and the Contractor must comply with these in its tender submission. However, if the Contractor wishes to propose alternative specifications, parameters or services, it should do so in a separate section of the technical submission. Information regarding capability and procedures for any alternative services plus any other optional and special processing routines which the Contractor feels may be relevant should be provided.

The Contractor should at its own expense undertake any necessary modelling exercises or make use of analogous previous experience in this geological setting in order to demonstrate the benefits of alternative services, including any changes to the specified technical parameters such as line spacing, terrain clearance etc.

Such alternative proposal should be costed separately from the main commercial submission.

7 Evaluation criteria

This section sets out the Evaluation Criteria and approach to evaluation. Evasive, unclear or hedged responses may be discounted in evaluation and may, at the Client's discretion, be treated as non-compliant.

Scoring will be applied using the Evaluation Criteria in Table 3 below, which will be applied against the following categories:

1. **Technical – 60% - Section 3. Compliance with the goals of the survey.**
2. **Commercial – 40% - Section 5. Best value pricing in Table 2 above (when compared with other bids).**

Note that non-integer scores may be awarded to individual bids.

Score	Definition
5	The response by the Bidder provides a very high degree of confidence of being able to support the achievement of the intended outcomes of the Project. The response is fully detailed with appropriate explanations and supporting evidence, there are a limited number of minor issues and no major issues. The response demonstrates many more strengths than weaknesses, desired standards will be met in all respects
4	The response by the Bidder provides a high degree of confidence of being able to support the achievement of the intended outcomes of the Project. The response is detailed with appropriate explanations and supporting evidence, there are a number of minor issues and a limited number of major issues. The response demonstrates more strengths than weaknesses, desired standards will be met in most respects
3	The response by the Bidder provides an acceptable degree of confidence of being able to support the achievement of the intended outcomes of the Project. The response is sufficiently detailed with some appropriate explanations and supporting evidence, there are a number of minor issues and a limited number of major issues The response demonstrates more strengths than weaknesses, desired standards will be mostly met
2	The response by the Bidder gives rise to some concerns about being able to support the achievement of the intended outcomes of the Project. The response has limited detail with limited appropriate explanations and supporting evidence, there are a number of minor issues and a number of major issues. The response demonstrates fewer strengths than weaknesses, desired standards may not be met.
1	The response by the Bidder gives rise to many concerns about being able to support the achievement of the intended outcomes of the Project. The response has limited detail with limited appropriate explanations and supporting evidence, there are many minor issues and a high number of major issues. The response demonstrates fewer strengths than weaknesses, desired standards are unlikely to be met.
0	The response by the Bidder is non-compliant; the response gives rise to many concerns about being able to support the achievement of the intended outcomes of the Project. The response has insufficient detail with virtually no appropriate explanations and supporting evidence, there are many minor issues and a high number of major issues. The response demonstrates fewer strengths than weaknesses, desired standards are highly unlikely to be met.

Table 3: Evaluation Criteria

8 Other considerations

This procurement is being managed in keeping with ESIF Procurement law, in the sub-OJEU threshold.

The Contractor is assumed to have given due consideration to environmental, weather, population and infrastructure constraints on the proposed airborne survey and its associated ground support.

The Contractor should be able to demonstrate its technical capabilities and how all aspects of the survey operation (including but not limited to HSSE, Emergency Response, social performance and reputational risks) will be managed.

The Contractor should offer a clear demonstration of how the work programme will be conducted, as well as evidence of capability in performing the work and operating in similar areas/conditions.

Particular importance is placed by the Client on thorough forward planning, which is key to the success of this project.

The Contractor is required to request all permits necessary to complete the survey in line with the Client requirements (save where is it proved mandatory that the Client must apply for the permits directly).

The information given above is provided by the Client, but the Client cannot guarantee its accuracy or be held responsible for any lack of information, errors or inconsistencies.

All technical and commercial queries in regard to this tender should be directed to Deep Digital Cornwall c/o Mr Fred Jackson (f.jackson@cornishlithium.com) by no later than 16h00 on Friday 23 September.

All bid submissions should be fully compliant with the technical and commercial requirements of this invitation to tender, and should be submitted to Deep Digital Cornwall c/o Mr Fred Jackson (f.jackson@cornishlithium.com) by no later than 16h00 on Friday 30 September.