Lough Feeagh, Mayo, Geophysical Survey Report

Project	**Lough Feeagh Geophysical Survey**
Survey date	28/01/2023 and 27/03/2023
Survey location	Lough Feeagh, Mayo
Survey type	Sub-Bottom-Profiler
Report date	30/03/2023
Location	Lough Feeagh, Mayo
Coordinate system	ITM

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1. INTRODUCTION

Hydromaster were contracted by Mary Immaculate College to carry out a geophysical survey in Lough Feeagh, County Mayo. The following report details operations completed and results from the survey. The survey vessel was mobilised on 28/01/2023 and the 27/03/2023 in Lough Feeagh, with survey work commencing on 28/01/2023 and being completed on the 27/03/2023.

The purpose of the survey was to investigate the nature of the lake floor and the sediment below, using the Innomar SES-2000 Sub-bottom Profiler.

2. EXECUTIVE SUMMARY

Data quality was very good in general, with what has been interpreted as rockhead visible in the south of the survey area, overlain by clear layers of sediment. Penetration was poor in some areas due to blanking from gas from organic matter in the silt. We can clearly see areas of high and low concentration gas and these areas could me mapped if required. We see predominantly exposed and shallow rock on the south end of the lake and gas blanking from the centre to the north end. It would be interesting to plot available cores onto the seismic profiles.

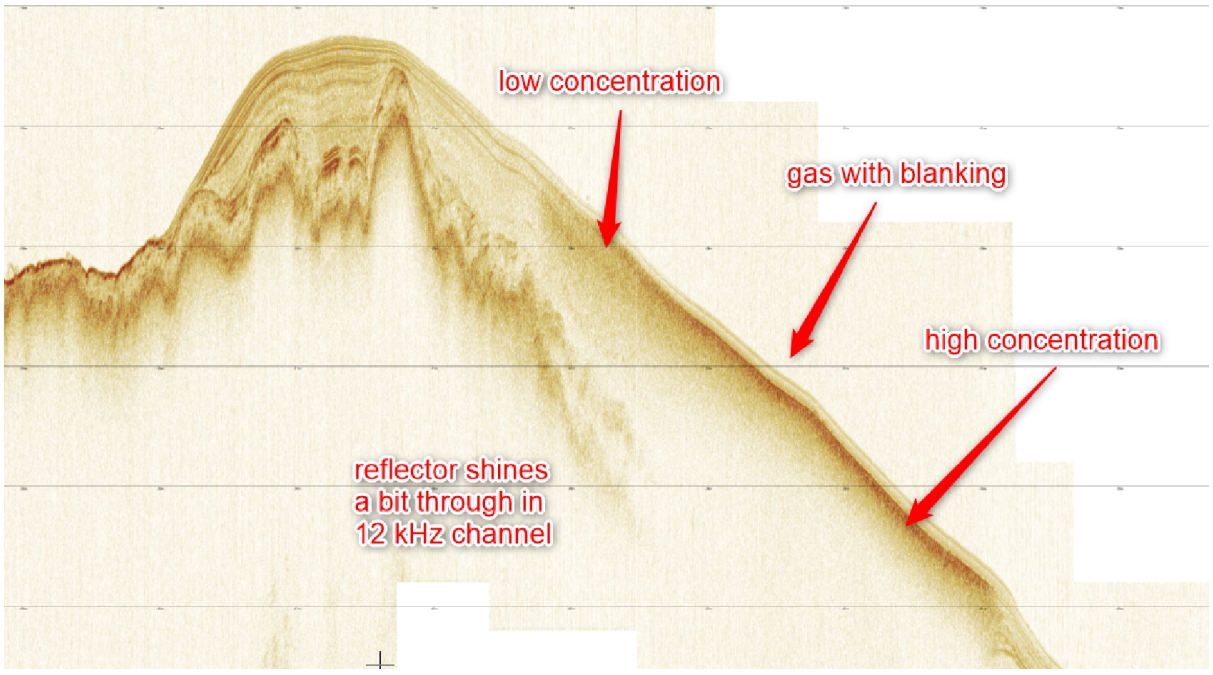

Figure 1. A good example of a profile showing rock head, silt layers and gas blanking.

3. Survey methodology

The survey was carried out at 60 m interval line spacing to ensure a full area coverage.
A sub-bottom profiler (SBP) survey was conducted at slow speed to ensure optimum quality data. And dual frequencies (6 - 12 kHz) were chosen which have proved to give a good mix of penetration in the past. Profiles were run north-south and the main body of the lake was surveyed rather than the bays.

3.1 Survey areas

Survey operations were conducted in Lough Feeagh, in the required survey area, shown in Figure 1. The survey vessel tracklines are shown in figure 1 below.

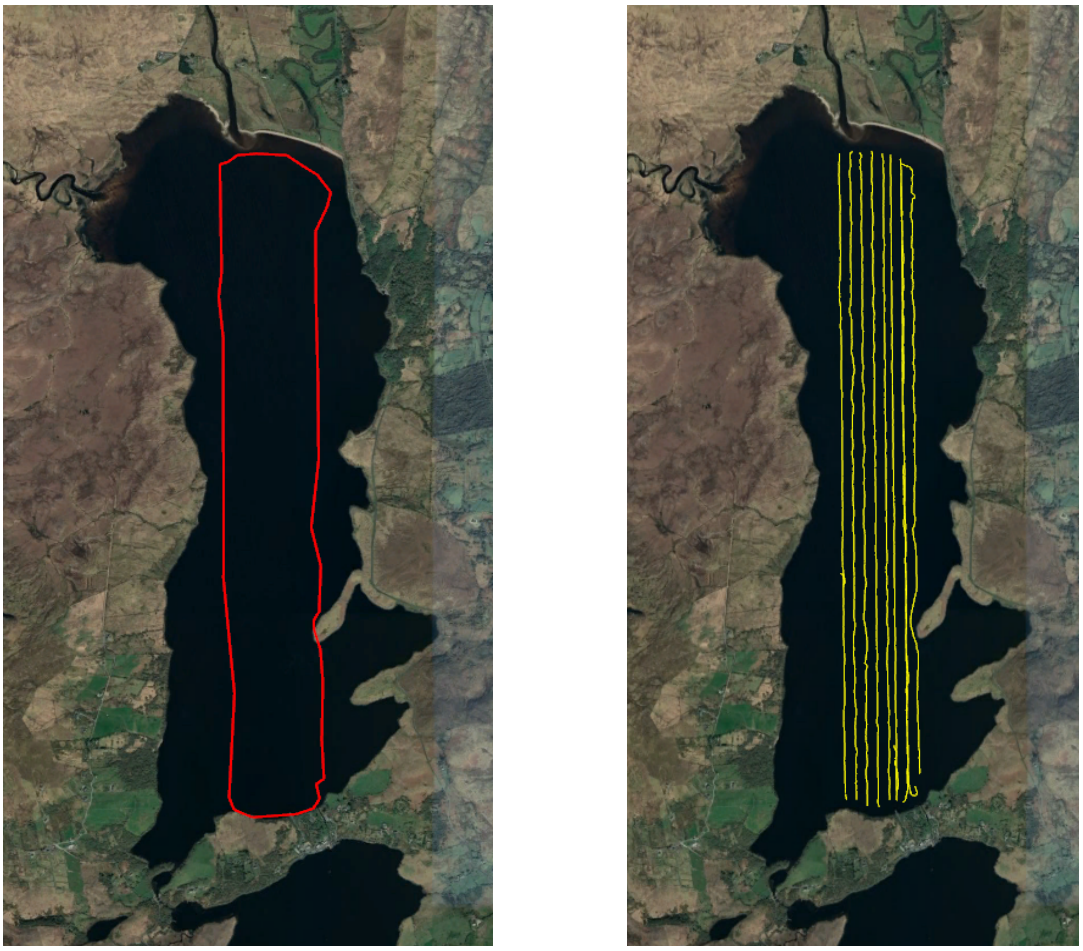

Figure 2: Survey area (left) and survey tracklines (right)

3.2 Survey equipment

- **Sub-bottom profiler**

The seismic data were collected with INNOMAR SES-2000 parametric sub-bottom profiler (Figure 2). It was operated at high (12kHz) and low (6kHz) secondary and 100kHz primary frequencies and is suitable for shallow water depths, as in the survey area.

Figure 3: SES Innomar 2000

Table 1: Innomar SES parametric SBP specifications

Water depth range	0.5-500m
Sediment Penetration	Up to 50m
Range/Layer resolution	<1cm / up to 5cm
Transit beam width(-3dB)	Approx. ±2°/footprint <7% of water depth
Primary Frequencies	Approx. 100kHz (frequency band 85-115 kHz)
Primary source level	>240dB//µPa re 1m

- **Position and heading**

Vector VS330 GNSS compass was used to give RTK position and heading to the survey vessel and as a sensor for the Innomar system (Figure 3).

Figure 4. VS330 GNSS compass.

3.3 Horizontal Control

All data was collected in the specified project coordinate reference system: Irish Transverse Mercator. Details are shown in table 1.

Table 2: ITM parameters

Geodetic and projection parameters	
Datum	IRENET95
Reference Ellipsoid	GRS80
Projection type	Irish Transverse Mercator
Central Meridian	8° West
Scale factor on central Meridian	0.99982
Latitude of origin	53.5° North
False Easting (m)	600000
False Northing (m)	750000
EPSG Code	2157

4. SURVEY RESULTS

A total of 12 survey lines were acquired – 8 Mainlines and 4 crosslines data quality was very good. Penetration achieved was according to requirements, with reflectors resolved 15 m below lakebed. The SBP data were acquired as .raw files and processed using ISE software. Data were bottom tracked using ISE software. The lakebed was picked allowing for accurate application of gain filters and removal of the water column.

The lower frequency of 6 kHz typically penetrates deeper than the higher channels albeit with a loss of resolution but in this case we found that the higher frequency had better penetration of the gas areas. This is possibly related to the size of the gas bubbles and it's effect on the attenuation of sound.

4.1 Sub-bottom Profiler profile location

Profile locations are shown in figure 4:

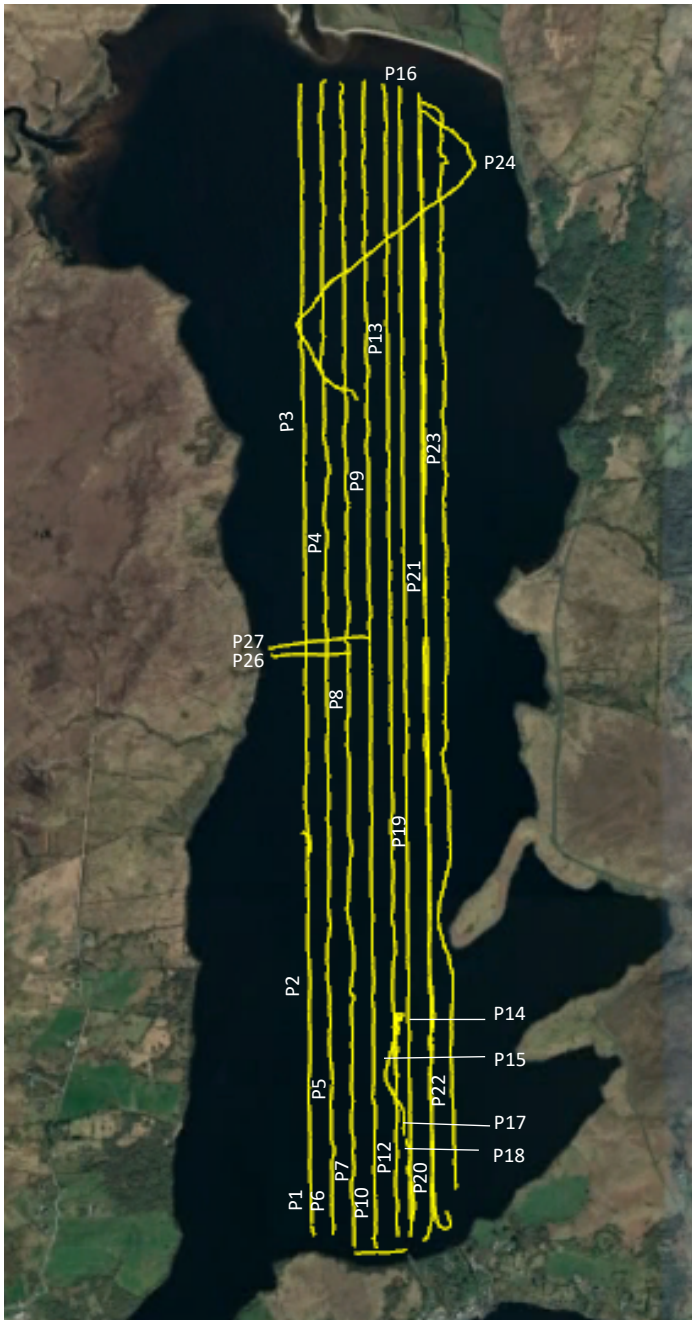

Figure 5. Survey lines and corresponding profile numbers

4.2 Sub-bottom Profiler profile Results

The lakebed in the survey area ranges from -2.5 m to -52 m. It deepens from the south, towards the north of the survey area, with maximum depths of approximately - 51.66 m located in the centre. This is shown in figure 5.

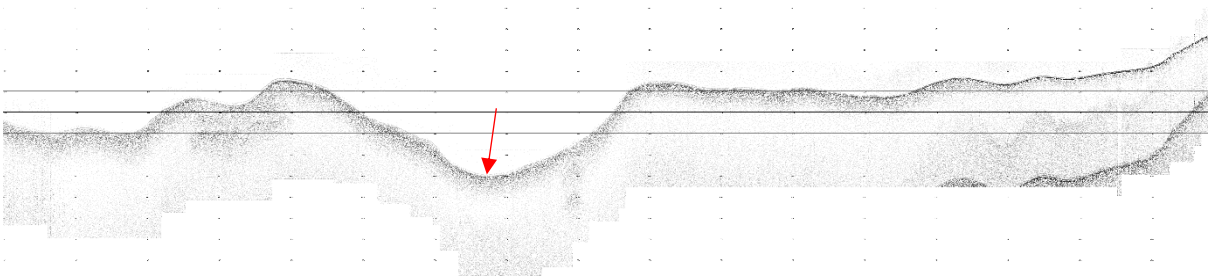

Figure 5: Seismic profile P3 showing the maximum depth of the lake floor at - 50.05 m (red arrow).

Acoustic penetration is not consistent across the survey area, with acoustic blanking occurring at times. This acoustic blanking has been interpreted as being the result of a layer of sediment such as peat, which has a high organic matter content, at, or just below the surface. Organic matter causes air bubbles to be present in the sediment and these bubbles are impenetrable to sound. This results in acoustic blanking rendering any seismic units below such a layer invisible (Figure 6). Interestingly, there is penetration in the area between the two areas of blanking as shown in figure 6.

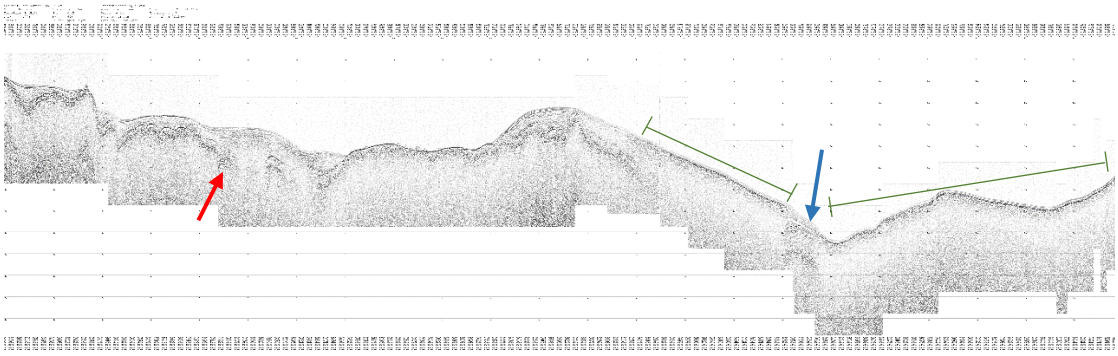

Figure 6: Seismic profile P19 showing acoustic penetration to depths of approximately 7 m (red arrow), acoustic blanking (green sections) and penetration between areas of blanking (blue arrow).

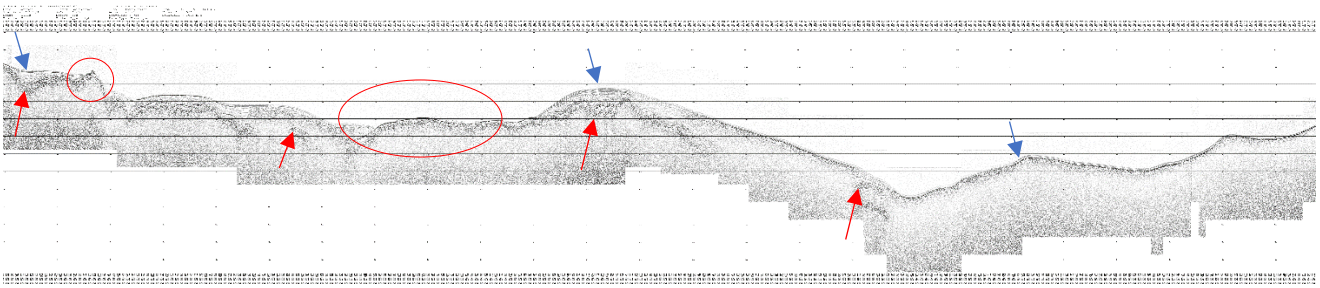

Figure 7: Seismic profile P19 showing rockhead (red arrows) beneath the lakebed (blue arrows). The rockhead can be seen outcropping in the areas marked by red circles.

Where there was no acoustic blanking, penetration was sufficient to see what is believed to be a layer of rock at depths of between 0 m and 7.7 m below the lakebed, particularly in the southern part of the survey area. It is likely that this rock head is visible at the lakebed in areas, however it is predominantly covered by a layer of sediment. Figure 7 shows an example of an area where the rockhead is outcropping.

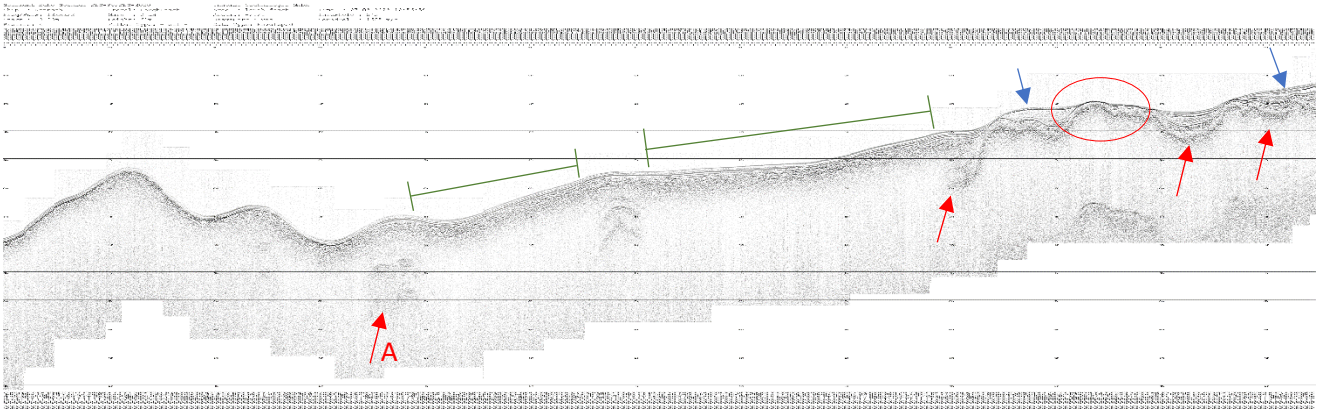

Figure 8: Seismic profile P4 showing rockhead (red arrows) beneath the lakebed (blue arrows). The red arrow marked 'A' marks a layer thickness of 15.5 m. The rockhead can be seen outcropping in the areas marked by red circles. The sections in green indicate examples of acoustic blanking.

Again, figure 8, acoustic blanking occurs in the areas marked above however, where no blanking occurs, what is interpreted as being rockhead can be seen as depths from 0 – 15.5 m. It is likely that this rock head is visible at the lakebed in areas, however it is predominantly covered by a layer of sediment.

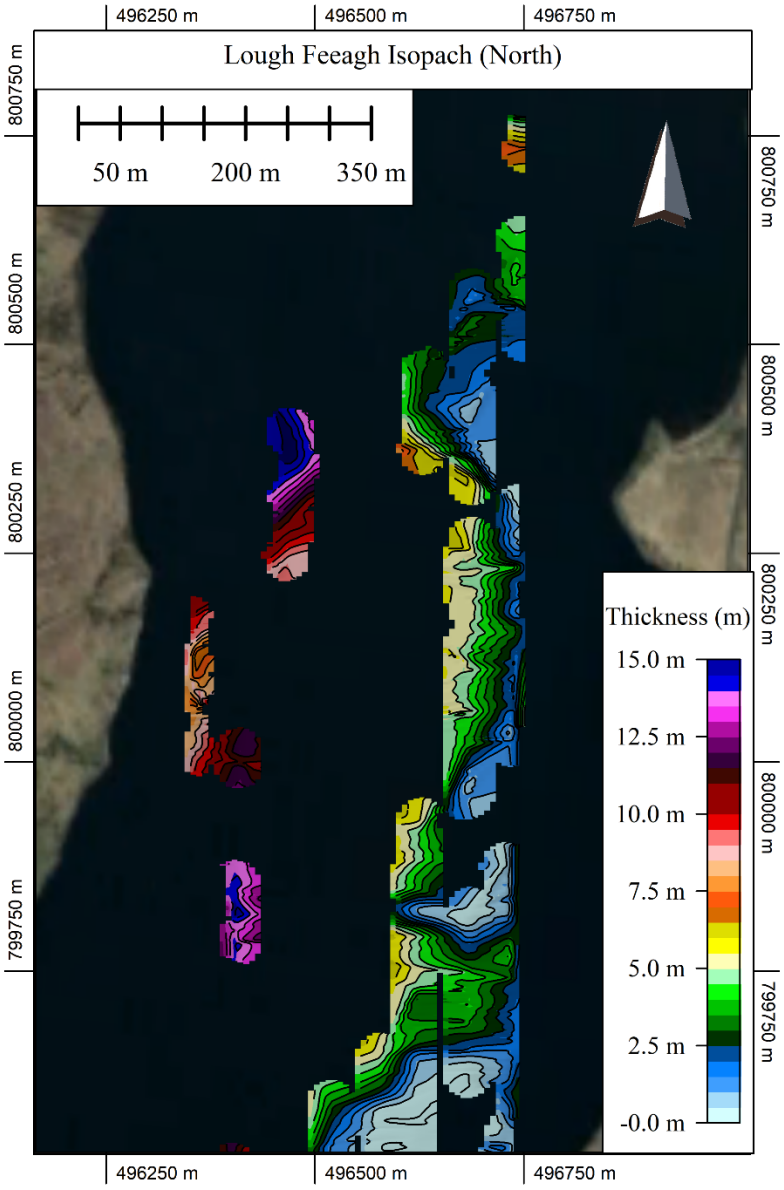

Figure 9: Isopach showing the thickness of the sediment between the lakebed and rockhead in the northern half of the survey area.

Figure 9 is an isopach showing the thickness of sediment between the lakebed and the rock layer in the northern half of the survey area. Sediment thickness is predominantly between in the range of 0 – 5 m. There appears to be a layer of sediment approximately 15.5 m in thickness to the north of the survey area however it is possible that this is an artefact of the data and in order to confirm a core would be necessary.

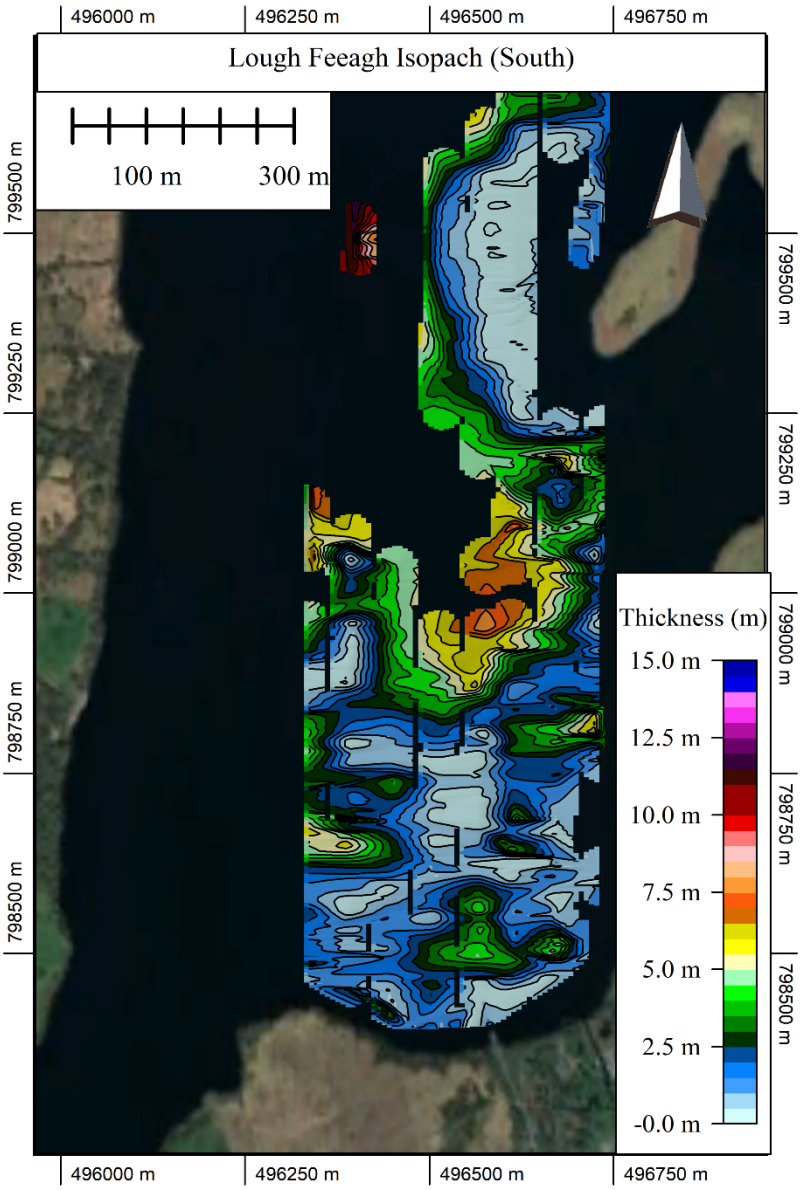

Figure 10: Isopach showing the thickness of the sediment between the lakebed and the rockhead in the southern half of the survey area.

Figure 10 is an isopach showing the thickness of sediment between the lakebed and the rock layer in the northern half of the survey area. Sediment thickness is predominantly between in the range of 0 – 5 m, increasing in thickness in a northerly direction.