

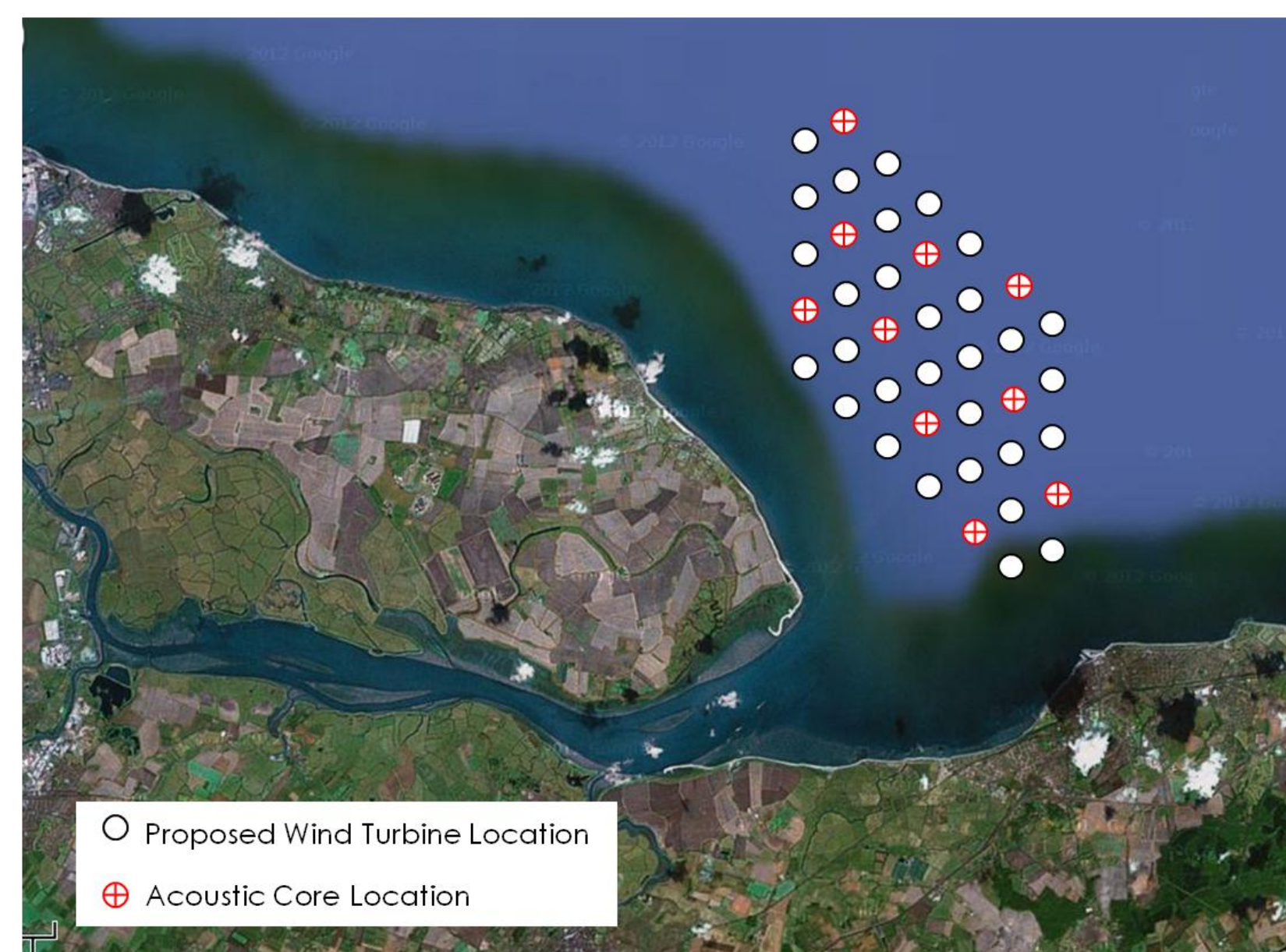
Acoustic Corer™

Statistical Analysis Methodology

1. The Scope of Works

PanGeo Subsea employs a statistical approach to determine the risk associated with piling operations for installation of wind turbines and other offshore structures.

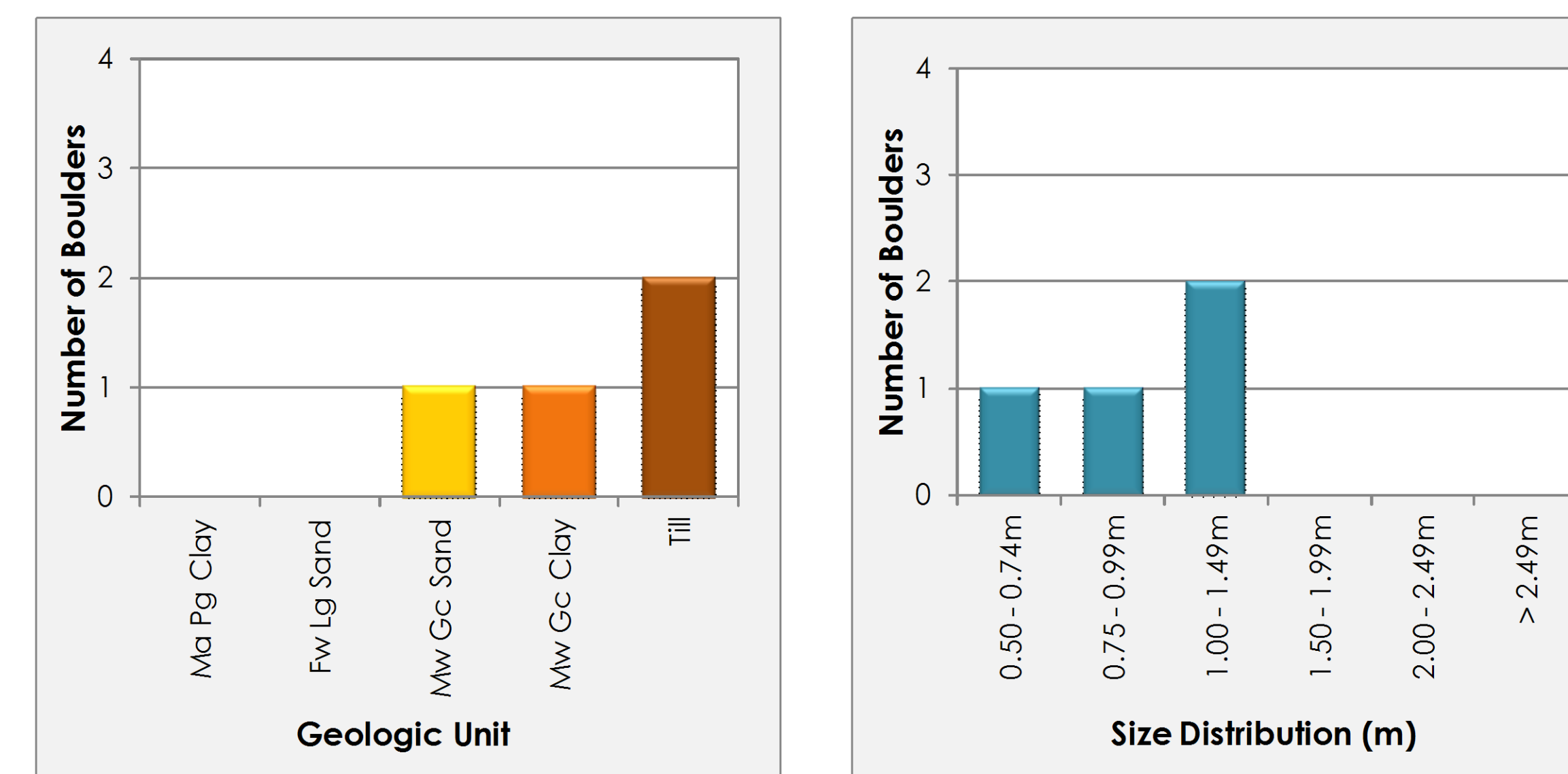
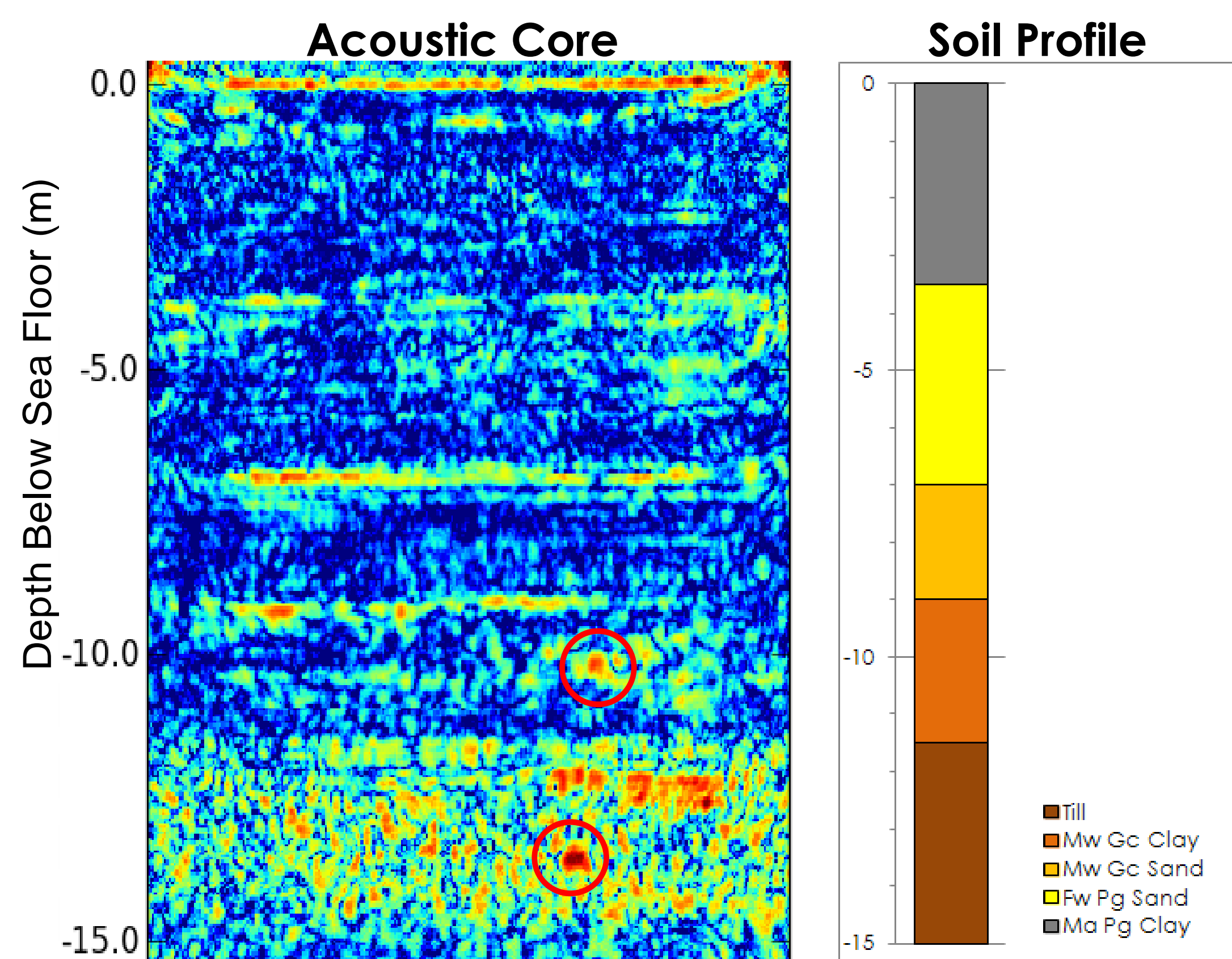
Right: A map of proposed piling locations for an offshore wind farm consisting of 40 turbines. The turbines are to be installed on 6m diameter x 30m long monopiles. PanGeo Subsea's Acoustic Corer™ is used to survey a subset of the installation sites. 10 acoustic cores are collected, covering 25% of the area of interest.



2. Individual Site Analysis

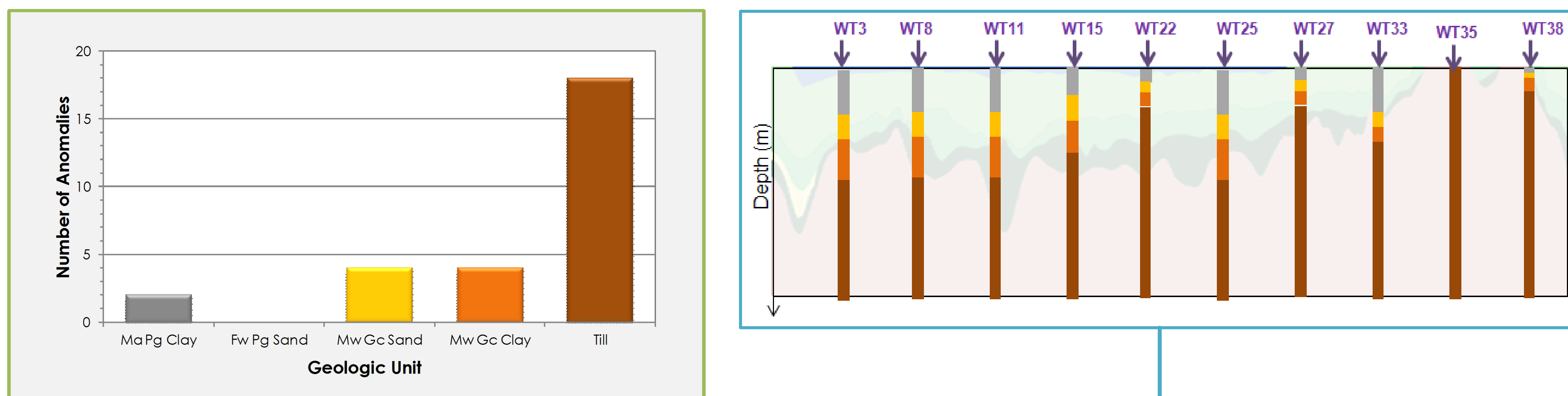
2. Individual Site Analysis

Available data are compiled to generate a soil profile of the site (left). The acoustic core is examined and the details of any anomalies are noted including size, location, and the surrounding geological unit.



3. Assembling The Results

Once the individual site interpretations are complete the interpreting geoscientist then takes a more holistic view of the results and analyzes the soil profiles from all the sites to establish geological trends. The number of boulders identified is divided by the total volume scanned for each geologic unit to determine the average boulder density.



Geological Unit	Number of Boulders in Geological Unit	Volume Scanned of Geological Unit (m³)	Number of Boulders per m³
Ma Pg Clay	2	5089	0.0004
Fw Pg Sand	0	1696	0.0000
Mw Gc Sand	4	6786	0.0006
Mw Gc Clay	4	6786	0.0006
Till	18	13572	0.0013
Total	28	33929	0.0008

This table indicates that the Till unit has the highest number of boulders per cubic metre. It follows that more boulders are likely to be found at foundation locations where the Till unit dominates stratigraphy. This information can be extrapolated to estimate the risk of geohazards present at unscanned pile installation sites where the stratigraphy is known.

4. Predicting Boulder Encounters

Based on the subset of scanned pile installation sites, we can predict the likelihood of a boulder encounter at unscanned sites where the stratigraphy is known from either sub-bottom profiles or cone penetration tests (CPT). The results below show that there is a high risk (59% chance) of encountering a boulder in the Till, whereas there is a negligible risk in the units above.

Geological Unit	Unit Thickness	Geological Unit Volume	Boulder/ m³/unit	Number of Boulders
Ma Pg Clay	6.00	169.6460	0.0004	0.0667
Fw Pg Sand	0.00	0.0000	0.0000	0.0000
Mw Gc Sand	2.50	70.6858	0.0006	0.0417
Mw Gc Clay	5.70	161.1637	0.0006	0.0950
Till	15.80	446.7345	0.0013	0.5925
Total	30.00	848.2300		

Additional predictions can be made about the size of the boulders to be encountered. The boulder size distribution plot below shows that there is an almost 40% chance of encountering a boulder 1m in diameter or greater.

