Using a High Resolution CEESCOPE™ Echo Sounder and HYPACK® Software for Emergency Object Detection.

How careful scrutiny of precise CEESCOPE™ single beam echo sounder client data by a CEE HydroSystems hydrographic surveyor allowed location of a missing structure and provided a good illustration of the concept of transducer beamwidth.

This survey challenge emphasises the value of knowing the capability of your equipment - hardware and software. A 30m (98 ft) structure with a diameter of about 1m (3.3ft) was installed standing some 10m above the water line in 20m of water. One day it was there, with instruments working normally and the next day it had vanished. It is not unusual for items located on offshore structures to be stolen or damaged by illegal mooring but it is unusual for a whole structure to be stolen. The most likely cause of disappearance was vessel collision or a misguided choice of mooring location. But it was necessary to locate and remove this marine hazard.

Co-ordinates of the original location were available but were without great accuracy. The preferred search tools - sidescan sonar or a magnetometer - were not readily available to the search crew. They did have access to a CEESCOPE™ 200 hydrographic survey system. The CEESCOPE provides an integrated package of high accuracy GNSS positioning, dual channel hydrographic echo sounder, a data logger and a rechargeable battery.

A search of the area around the given co-ordinates failed to show any signs of the structure. Figure 1 (left) shows the track lines of this first search. The given co-ordinates were then adjusted to allow for a possible offset between charted and WGS84 positions. A second survey was then carried out using the CEESCOPE with a dual frequency transducer, shown on Figure 1 (right).

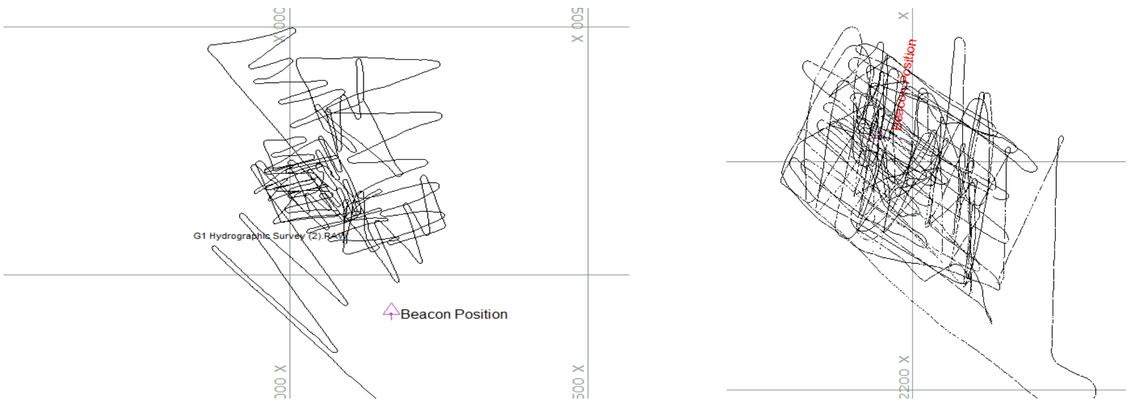

Figure 1. Search pattern used to locate missing 30m-long structure.

The echo sounder records from the second search were then examined in HYPACK™ single beam editor to see what might be visible. Data were logged continuously over the search area at nearly 20 Hz on both 33 kHz and 200 kHz sonar channels. At first sight there was not much to indicate anything of interest on the bottom, shown on the upper traces on Figure 2. Now if the scale is expanded in the vertical and the horizontal directions, relatively very small echoes can be seen in greater detail. Now if the full power of HYPACK®'s display capability is used, individual echoes may be quite clearly delineated. This close-up view allows an appreciation of the advantage in this case of using a dual frequency echo sounder system (Figure 2, bottom trace).

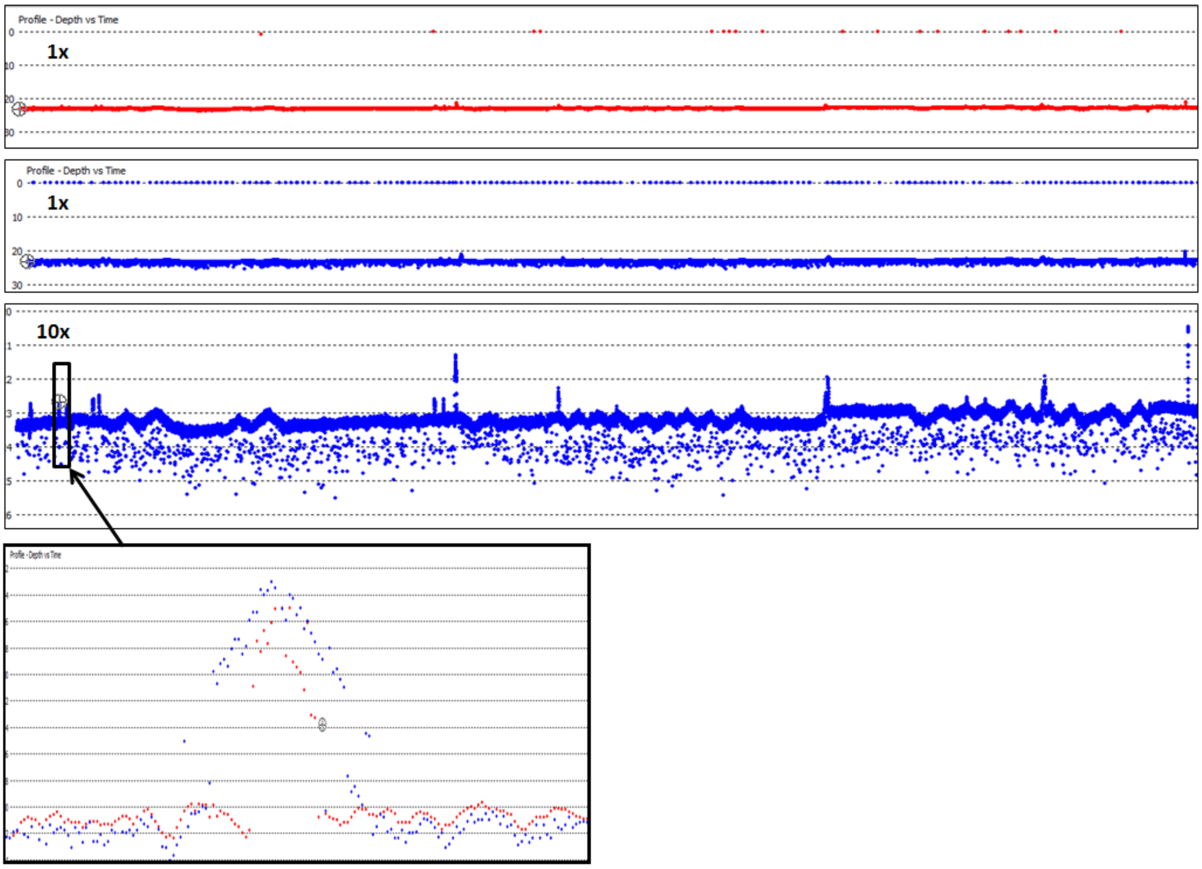

Figure 2. 200 kHz (red) and 33 kHz (blue) sounding traces in HYPACK® SBMAX editor at 1x, 10x and 100x scale factor.

At this expanded scale, it is possible to count the echoes received from one survey pass over an object. A total of about 18 echoes were received on the 200 kHz HF channel. A total of around 44 echoes were received on the 33 kHz LF channel. The width of the HF echo spread at 20m range is around 5m (a 9° transducer beamwidth), and the LF is around 12m (a 19° transducer beamwidth. In 20m water depth we would expect the echo sounder to operate with a ping rate of about 18 Hz. So the HF channel gave echoes over roughly one second, and the LF channel gave echoes over roughly two seconds (as a result of the wider beamwidth). At a mean boat speed of 3.5 knots one second = 1.8m.

So now the survey data show a number of small echoes none of which mean much on their own. But using a common sense approach, the next logical step is to determine the co-ordinate values of each of these small echoes and plot them to see the resultant spread and relationship of any one to the others. This is made quite easy by the HYPACK™ survey display available in SBMAX data processing, allowing the echo sounder possible 'hits' to be converted to 'Target' grid values.

A plan view of the echoes (marked targets) from the complete dataset is given in Fig 3, below. With the span of the targets about 30m, it is clear that the structure is lying on the bottom close to its original location.

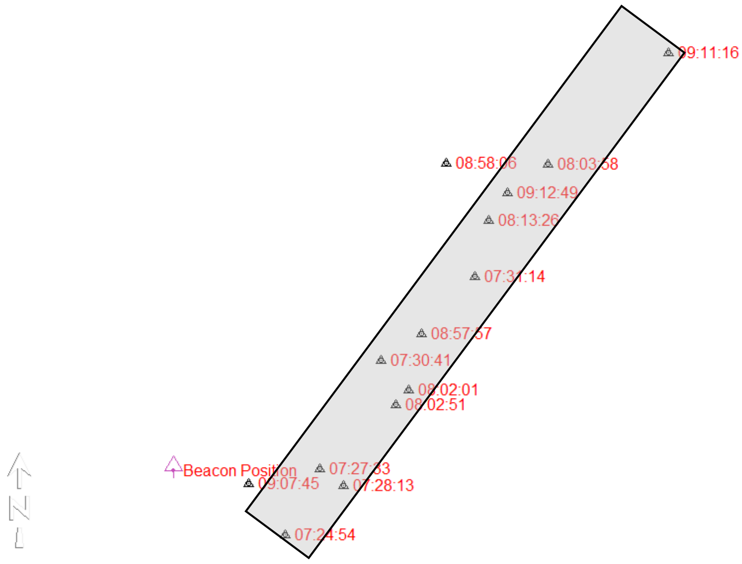

Figure 3. Plan view of echoes considered likely to be significant. The spread of these echoes is 30m - the height of the structure, marked by the grey shaded overlay.

The use of a low ping rate echo sounder (say 5 Hz or less) could not have found the structure. Use of a narrow beam transducer would have further downgraded the chances of finding anything at all – except perhaps the bottom. In addition to having plenty of pings to hit the object, having the wider beamwidth LF data available was extremely useful to increase the number of echoes received from the missing structure.

According to Dave Garforth, who was asked by the client to find the structure from the data: "When faced with an unexpected task just take your time and consider what information and tools you have? Consider just how valid is the need for a ‘quick’ answer. If it looks like you are going to have to wait before getting the usual tools to do the job why not give things a go with what you do have. It is better than doing nothing and you might just surprise yourself!"