Curtin

UNIVERSITY OF TECHNOLOGY

Centre for Marine Science and Technology

Non-Commercial Report

SIDESCAN SONAR MAPPING OF FREMANTLE SAILING CLUB HARBOUR

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Fremantle Sailing Club

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Project: CMST 1077

Report: CMST 2012 v1.0

Date: 23rd March 2012

CONTENTS

1 INTRODUCTION

The aim of this project was to generate a map of the seabed at FSC harbour. It was an unsolicited and unfunded project conducted for the benefit of FSC, displayed at the CMST "Show and Tell" evening held at FSC on 15th March for Club members.

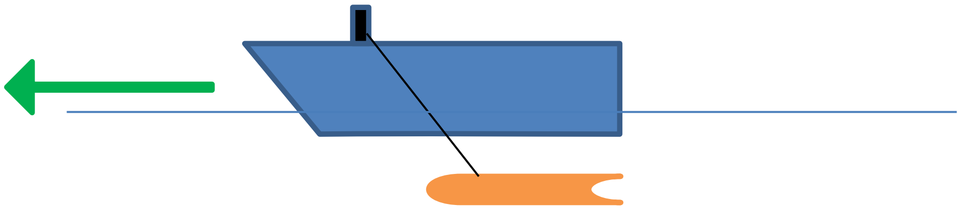
2 EQUIPMENT AND SETUP

The survey was conducted using the CMST Humminbird 898 sidescan sonar mounted on a towfish (Figure 1) which was attached to an arm off the CMST 4m dinghy. Power was from a pre-used 12V dry cell CMST USR battery pack of unknown capacity (the dedicated wet cell car battery was not holding its charge).

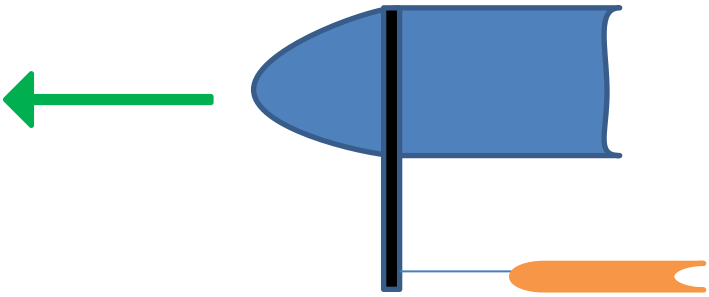
The sonar was towed from an arm off the port side at the aft end of the foredeck (about 3m forward of the motor) and about 1.5m off the centreline and 0.5m above the waterline. Approximately 3m of cable was deployed, running at an angle of about 30º off the horizontal. This resulted in a towfish depth of about 1m, varying slightly with boat speed. The geometry is shown in Figure 2

The sonar looks sideways on both sides of the vessel out to an angle of about 10º below horizontal. The sonar settings were all at default values.

Figure 1 transducer (black) attached to towfish (orange)



Side view (profile)



Plan view

Figure 2 Sidescan deployment geometry (not to scale)

3 FIELD WORK

The survey was conducted on the morning of Wednesday 22nd February2012, starting at about 0900 and ending about 1015. There was one person on board the boat, Kim Klaka.

3.1 Environmental conditions

Wind was consistently SSW at 10kn, as measured at Fish Rock and RPYC Annexe (www.seabreeze.com.au). Waves were negligible (<0.05m) in the survey area. Tidal heights at Fremantle were 0.68m at 0900 and 0.75m at 1030. There was +0.35m tidal residual (http://www.transport.wa.gov.au/imarine/19273.asp).

3.2 Survey execution

The survey was started in the “big pond” area of the harbour and the sequence is shown in Figure 3. In essence, the big pond was surveyed first, out as far as the end of the southern groyne. Then the gaps between jetties A-B, B-C, C-D and D-southern groyne; then the small dinghy pond; then between jetties G-A and finally between G and the shoreline.

The survey was conducted at a nominal 4kn boat speed, decreasing to about 3kn at the turns.

As the boat approached the small dinghy pond, the low voltage warning came up on display. The remainder of the survey was conducted with this warning displayed, with no apparent effect.

Figure 3 Survey track

4 RESULTS

4.1 Overview

Coverage of the area and large scale features are shown in Figure 4, which is a mosaic of the data. The dark stripes are where there was no coverage. The results show the seabed to consist of mud and sand, with some artificial features such as jetty piles and debris also showing up.

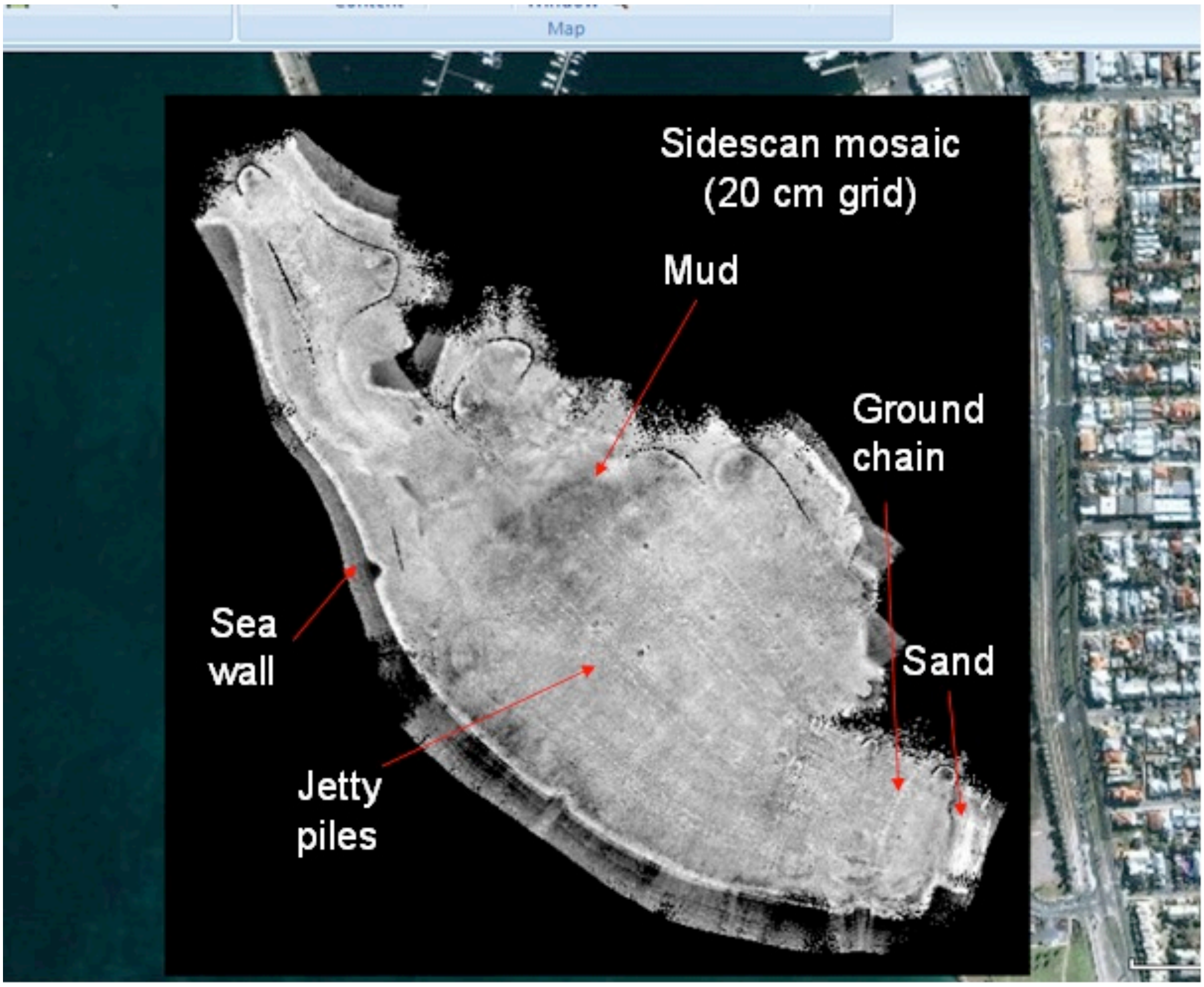


Figure 4 Summary of results

4.2 Depths

Uncorrected depths of the surveyed area are shown in Figure 5. The survey was not intended to generate an accurate bathymetric plot but the instrument produces readings of depths directly below the transducer. The transducer was towed at an unmeasured depth below the sea surface so it is not possible to determine absolute depths. However, the tow angle of the towfish cable did not appear to change much with change of boat speed, and the boat speed was generally consistent to within +-5% except during some of the tight turns. It is concluded that relative depths are probably accurate to within +-0.1m. Furthermore, the combined tide height and residual was 1.1m and the towfish depth was estimated at 1m, so it is inferred that the measured depths were generally about 0.1m greater than chart datum.

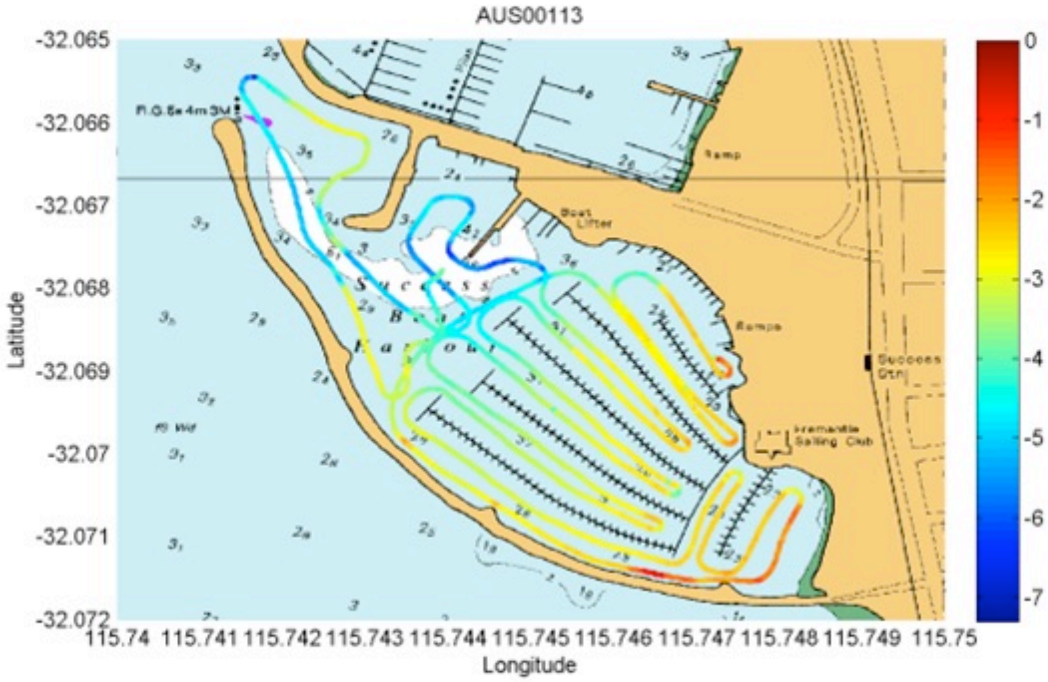


Figure 5 Water depths (m) – uncorrected

The depths in the large pond are 4-5m, around the jetties they are generally 3m and in the dinghy pond they reduce to about 2m. There are some shallow areas near the base of the south-western sea wall where depths are less than 1m. These could be monitored for change by repeating the survey at suitable time intervals.

The full depth data set shows some small but very deep holes in the seabed in several places, the reason for which is not known. The largest of these is on the north-eastern side of C jetty, about half way along. It is 1m deeper than the surrounding area.

4.3 Seabed features

The figures referred to in this section are screen grabs from the Humviewer software. They show a plan view, with the thick vertical stripe indicating the path of the boat. (Strictly speaking, it shows the path of the transducer, which is offset about 1.5m to port of the vessel centreline.) Orientation is bow-up i.e. the image to the left of the strip is looking to port. The thick strip is a narrow “blank zone” directly under the transducer where there is no sidescan data available.

The underwater structure of the groynes and sea walls is clearly shown (Figure 6), with boulders protruding slightly into the channel at some points. Repeating the survey at regular (e.g. annual) intervals could be useful in monitoring degradation of the structure.

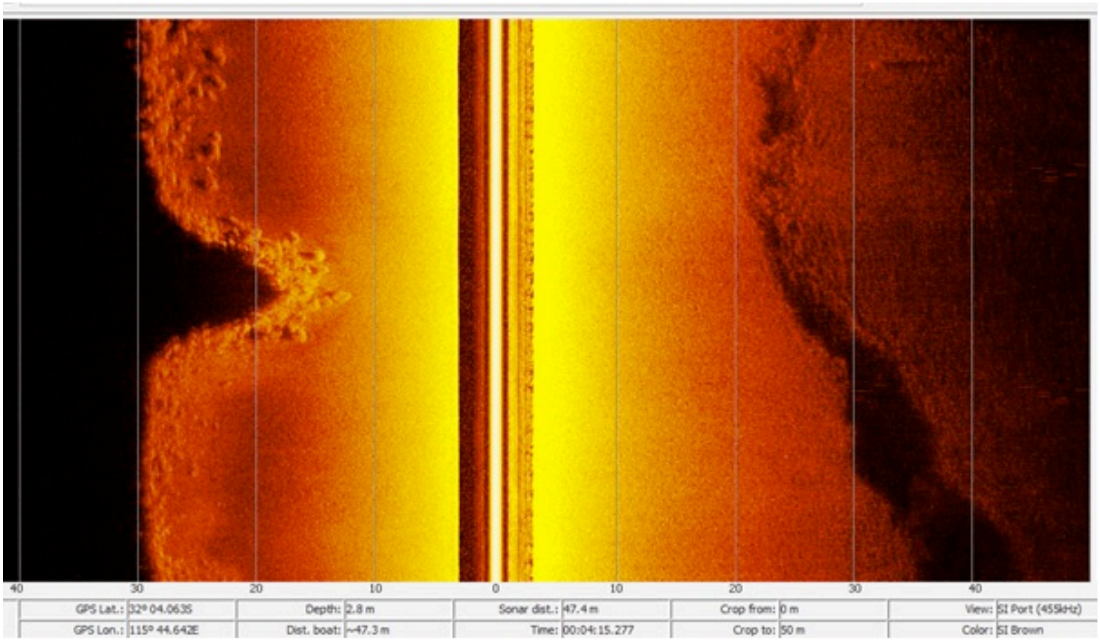


Figure 6 Sea wall

The jetty piles were visible, as shown in Figure 7. The elongation of their shape and their “wake” is a result of acoustic shadowing. This serves as a reminder that these are acoustic images, which are not the same as a conventional photograph.

In some of the pens there are features which could be the underwater parts of a boat hull. Bear in mind that objects smaller than about 1m across (e.g. a yacht keel end-on) will not show up, nor will objects close to the surface that are above the line of view of the sonar.

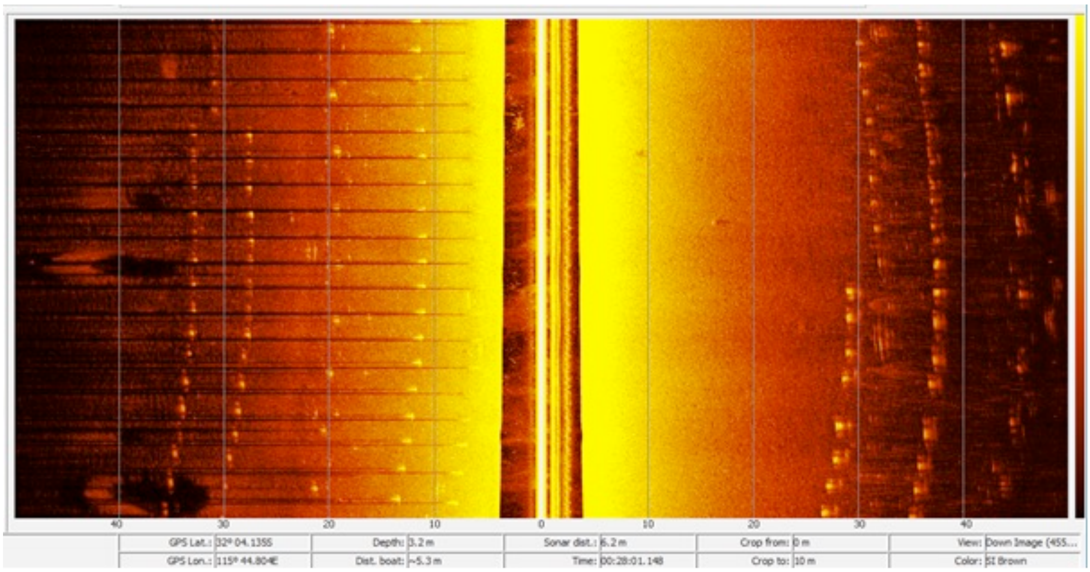


Figure 7 Jetty piles

One feature that is very clear is the ground chain running along the collector jetty (Figure 8). Repeating the survey at regular (e.g. annual) intervals could be useful in monitoring the position and alignment of the chain, though there may be simpler ways of doing this.

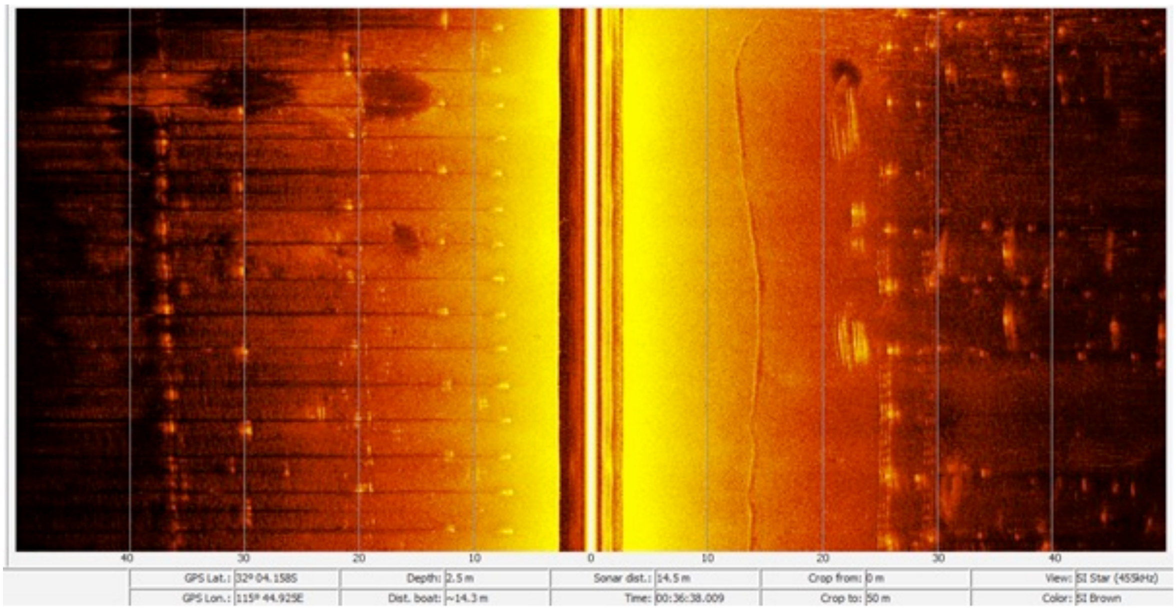


Figure 8 Ground chain at Collector jetty

There are several objects which appear to be debris. Figure 9 shows one such object. The left side of the image is a vertical slice through the water of a short section of the track of the boat (bow to the right), directly under the transducer. It is not possible to see anything directly under the transducer in the plan view (the right hand image in the figure) but there are several objects visible to port, which may extend into the blank zone.

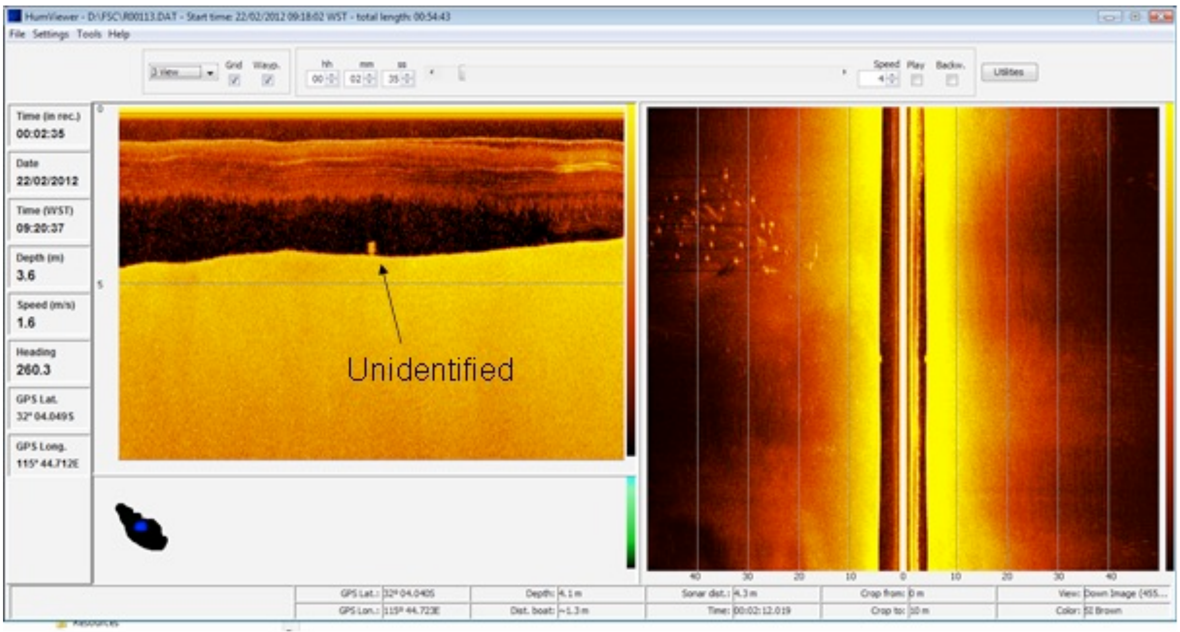


Figure 9 Example of object on sea bed

One of the more puzzling features is a series of dark, lozenge shapes in and around the jetties e.g. Figure 9. There are about half a dozen of them, particularly around B and C jetties. Sometimes they are accompanied by a large increase in depth (>0.5m) but this is not always the case. They are probably not all the same type of feature; the sonar will pick up most of them on both the “out” and “return” trip of the vessel i.e. once to port and then again onto starboard. Some of the shapes are replicated on both sweeps, suggested a physical hole in the sea bed or a drastic change in the seabed type. However, others do not show up to nearly the same extent in both sweeps, suggesting the shape is an acoustic shadow formed by a ridge between the transducer and the shape (the ridge would not be in the way on the return sweep, so no shadow would be generated. More detailed analysis of the results or inspection by divers, may improve our understanding of these phenomena.

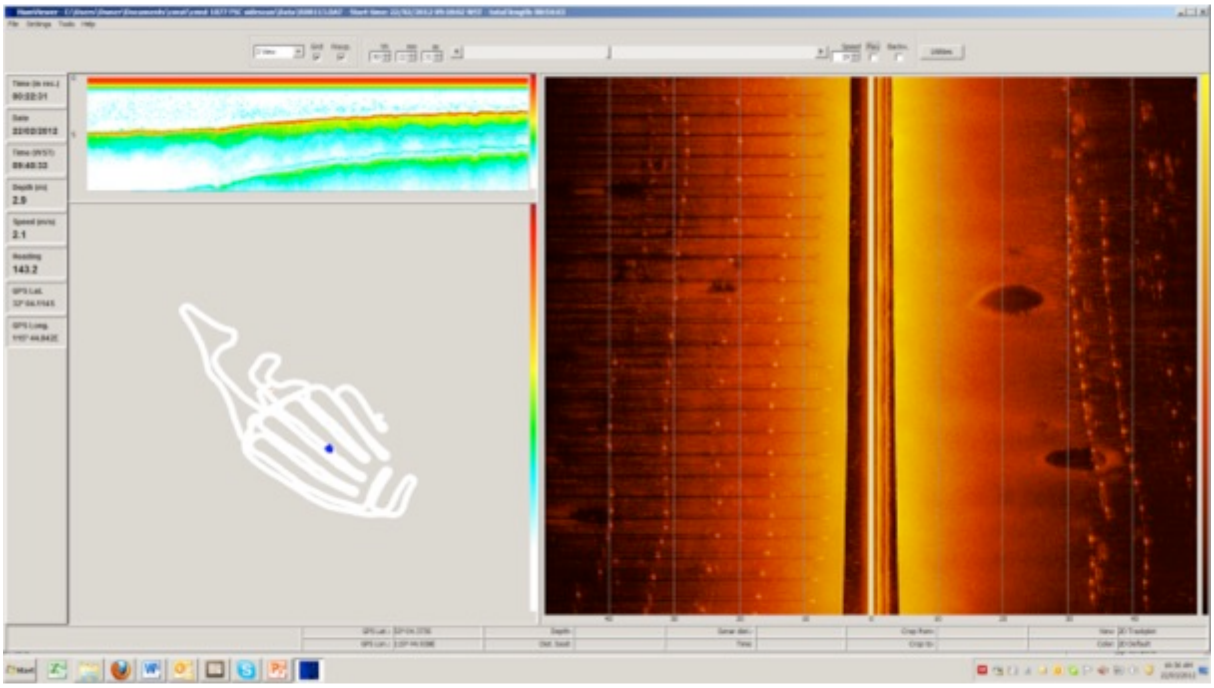


Figure 10 "Black holes" between jetties

5 CONCLUSIONS AND RECOMMENDATIONS

The sidescan sonar survey of the seabed has shown a number of features.

- The seabed is mainly mud and sand.
- Manmade features which are positively identified from the survey could be monitored for change by repeating the survey at suitable time intervals.
- The depths are indicative only, but show some shallow areas near the base of the western sea wall. Again, these could be monitored for change by repeating the survey at suitable time intervals.
- The depth information shows some very deep holes in the seabed, the reason for which is not known
- There appear to be some items of debris on the seabed. The survey results could be used to guide divers to them at the next Harbour Clean-up Day.
- There are some puzzling features amongst the pens which warrant further investigation. Inspection by divers would be helpful.