Albany Foreshore Project Stage Two Interim Maritime Archaeological Survey Report for Landcorp

Edited by Jeremy Green
with contributions by
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Recommendations

Ross Anderson and Corioli Souter

The potential for maritime archaeological material to occur in the project area, notably the remains of the Albany Floating Dock should be considered. As such, archaeological monitoring during the course of any approved works as well as a detailed archaeological assessment undertaken prior to the works commencing, of the specific land and submerged areas affected by the development's construction should be conducted.

A suitably qualified and experienced archaeologist should be engaged to conduct a formal archaeological watching brief for:

1. The monitoring and archaeological management of the landfill area inshore of the harbour during all further terrestrial ground disturbing work
2. Monitoring of the harbour dredging/ bund excavation carried out in areas of magnetic anomalies, in case of finds of significant concentrations of artifacts or remains of the historic floating dock being found. Monitoring and sampling of the content of dredge spoil should be conducted as part of this process.
3. An Archaeological Management Plan should be prepared by a qualified and experienced archaeologist to outline policies and procedures to be followed by Landcorp and its contractors during the course of development works, and in the event of there being any archaeological finds.
4. Targeted test excavation and monitoring should be carried out in the area of the winch shed where the remains of the P&O floating dry dock are most likely to be found (see Fig. 26), prior to any development in this area.
5. Test excavation and monitoring should be carried out in any area where development is likely to impact on the original seabed level.
6. Historic piles beneath and near the Albany Town Jetty to be left in situ.

An archaeological watching brief is a formal programme of observation and investigation conducted during any ground disturbing operation carried out for non-archaeological reasons. It is usually employed within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed.

The purpose of an archaeological watching brief is:

1. to allow, within the resources available, the preservation by record of archaeological deposits, the presence and nature of which could not be established (or established with sufficient accuracy) in advance of development or other potentially disruptive works, and
2. to provide an opportunity, if needed, for the watching archaeologist to signal to all interested parties that an archaeological find has been made for which the resources allocated to the watching brief itself are not sufficient to support treatment to a satisfactory and proper standard.

An archaeological watching brief is not intended to reduce the requirement for excavation or preservation of known or inferred deposits, and it is intended to guide, not replace, any requirement for contingent excavation or preservation of possible deposits. The objective of an archaeological watching brief is intended to establish and make available information about the archaeological resource existing on a site. The programme results in the preparation of a report and ordered archive. In the event of discovery of any archaeological cultural material, a watching brief should lead to an appropriate archaeological project being designed and implemented. A watching brief does not include monitoring for preservation of remains in situ.

A series of test excavations in the landward side of the Stage 2 development where excavation is scheduled, as discussed with Landcorp and Eureka archaeologists (13/02/08), is also recommended. Test excavation is a form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development. This will also assist in determining whether the remains of the floating dock are in the development area.

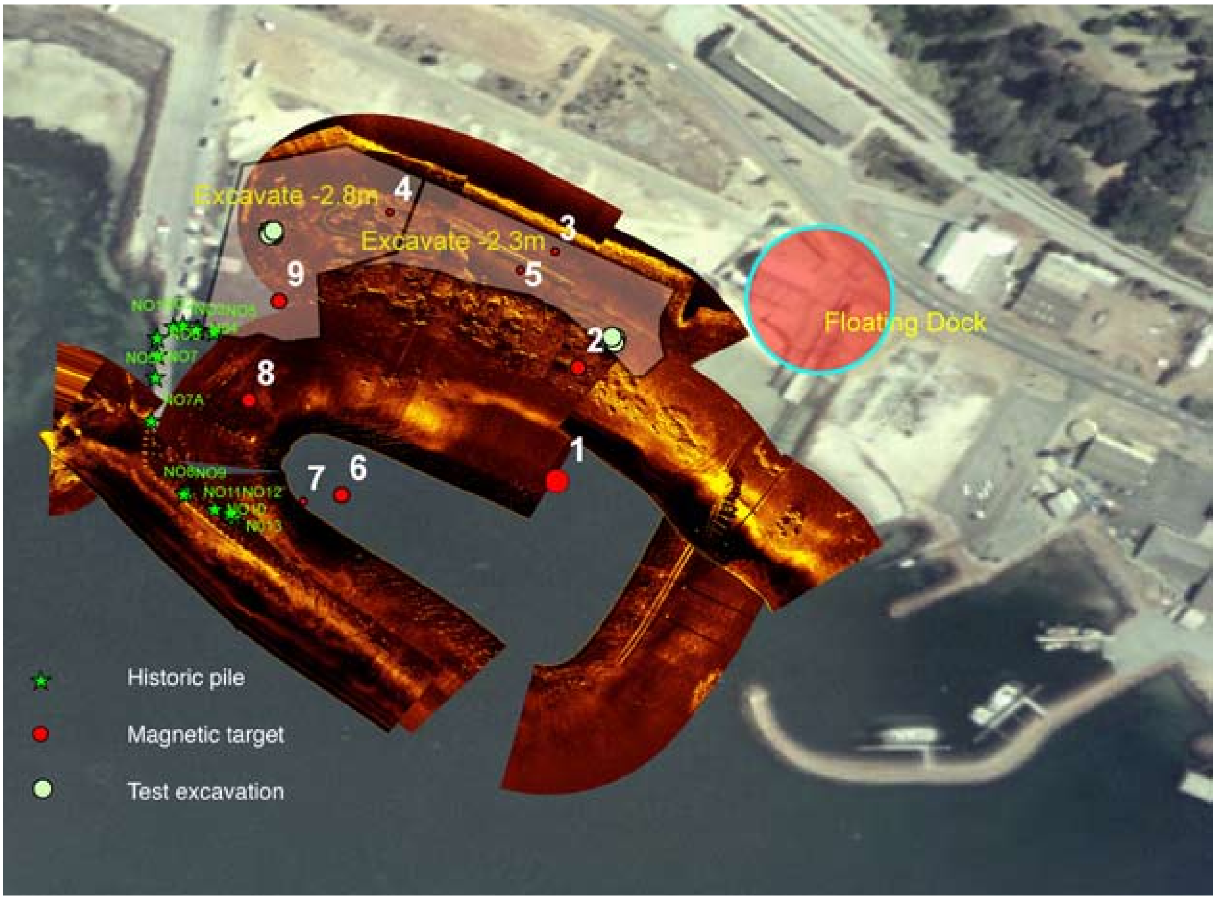

Figure 1. Overall view of the major findings of survey.

Background

Ross Anderson

Maritime archaeological survey work was undertaken on the Albany foreshore for Landcorp by the Western Australian (WA) Museum in 1994. This included extensive underwater archaeological surveys, test-pits and excavations underneath and to the east of the Town Jetty. This work is summarised in the WA Museum's 1995 Albany Town Jetty report (Garrett, *et al.*, 1995).

In 2007, the Environmental Protection Authority required a further Environmental Impact Assessment for a modified foreshore development plan that was divided into two development phases.

Stage 1 includes the main foreshore area with Anzac Peace Park, railway footbridge and Entertainment Centre, earthworks, construction of revetment walls, disposal of material, installation of underground services (water, power, gas, sewerage, drainage) and landscaping. Stage 2, a marina construction, involves dredging of the harbour (construction of bunds, drainage of enclosed area and then removal by excavator) together with placement of breakwaters and widening of Princess Royal Drive. As the focus of much of the activity centres around the reclaimed land overfilling the historic foreshore area including the old Toll Place and Town Jetty area, an archaeological management plan (Wolfe, 2007) and archaeological monitoring programme was required.

In October 2007 Eureka Archaeological Consultants excavated remnants of the Old Town Jetty dating to 1864–70s, buried by dredge spoil fill in the 1940s, in the Stage 1 works area (Souter, 2007).

As Part of the Stage 2, a maritime archaeological survey using remote sensing and excavation was required for the dredging and land reclamation of the marina area. The WA Museum Department of Maritime Archaeology (DMA) undertook this work.

Further terrestrial archaeological monitoring work on the reclaimed foreshore area in the vicinity of Stage 2 is required as the significant remains of the 19th century P&O floating dock for repair and maintenance of their coal lighters is believed to be in this area.

Aims

The aims of the February 2008 survey were to:

1. Record the existing piles of the jetty by total station
2. Record any early wooden piles beneath the modern structure
3. Conduct a remote sensing survey (side scan sonar and magnetometer) of the harbour area
4. Conduct underwater archaeological excavations of the areas subject to dredging/ bunded dry excavation
5. Conduct a conservation assessment of the condition and integrity of early wooden piles.

Survey of Town Jetty Piles

Jeremy Green & Tracey Miller

Survey control points provided by Mark Anderson from 35 Degrees South surveyors were used to set up the total station survey.

In order to carry out a survey of both the modern jetty piles and historic underwater pile locations, staff first numbered each of the existing modern piles by marking gaffer tape over the location of each one on the timber jetty deck, over the total length of the jetty.

Each of the jetty pile points was then mapped using the Leica total station and the data subsequently entered into an Arcview GIS programme. Note all the coordinates recorded during this survey were geographical latitude and longitude GDA94 datum. The resulting GIS overlay is a permanent record of the location of the modern jetty piles that can be viewed in relation to rest of the modern and historic Albany foreshore, based on aerial photographs and historic map overlays Figures 19 & 20.

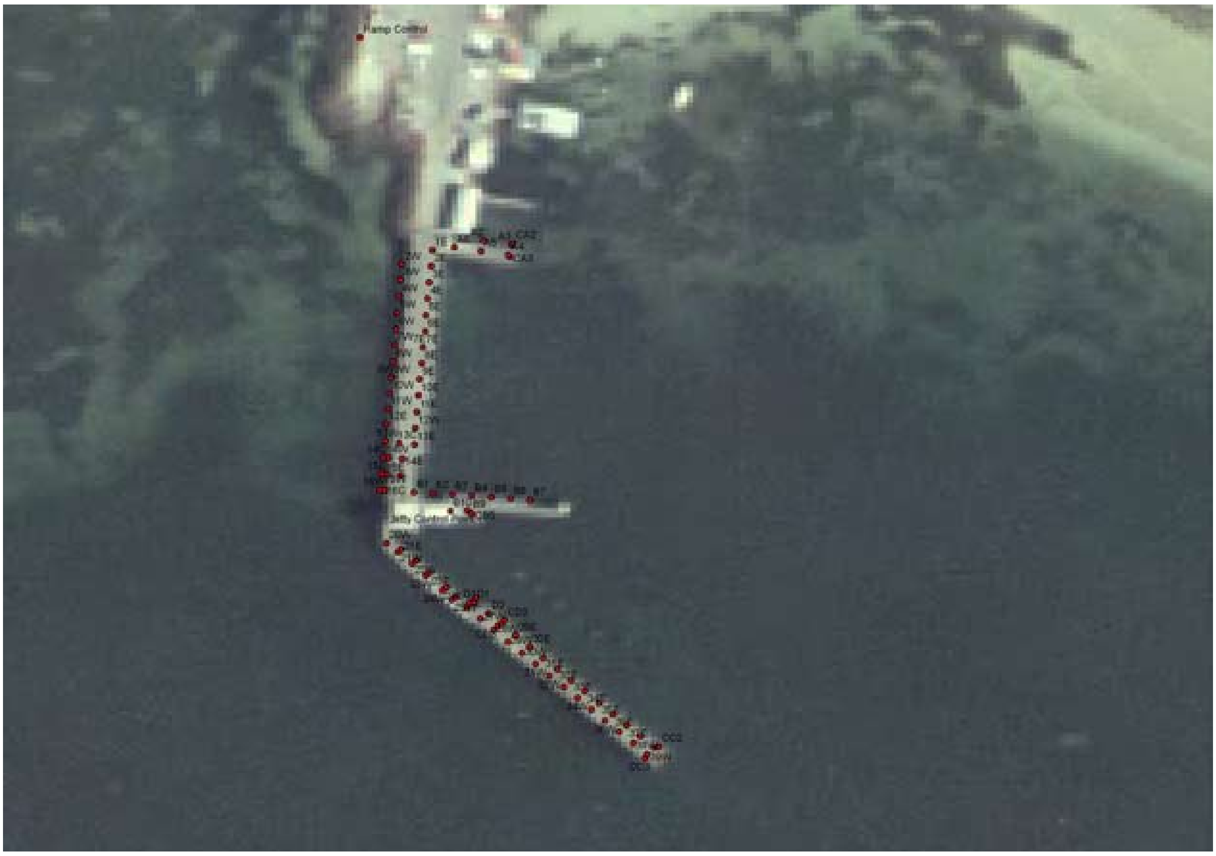

Figure 2. Total station survey of the existing Town Jetty piles.

Underwater survey of historic jetty piles

Jessica Berry & Tracey Miller

The modern jetty piles were used as control points to reference the location of historic underwater jetty piles.

Over a number of dives three staff undertook a reconnaissance on scuba to ascertain the number of old piles below the jetty. These dives were followed by a systematic search around each modern pile by two staff members whilst a third remained above on the jetty and another assisting in a small boat. A total of thirteen old piles were found underwater. Each time a pile was found one diver would return to the surface to ascertain from the third staff member its precise location according to the numbering system of the modern piles. Using fibreglass tape-measures divers then measured in each old pile to four of the closest modern piles whose precise location is known from the Total Station survey. This information was then fed into Site Recorder® archaeological mapping program to generate a plan of the old piles, which was subsequently added in as a layer in the Arcview GIS program.

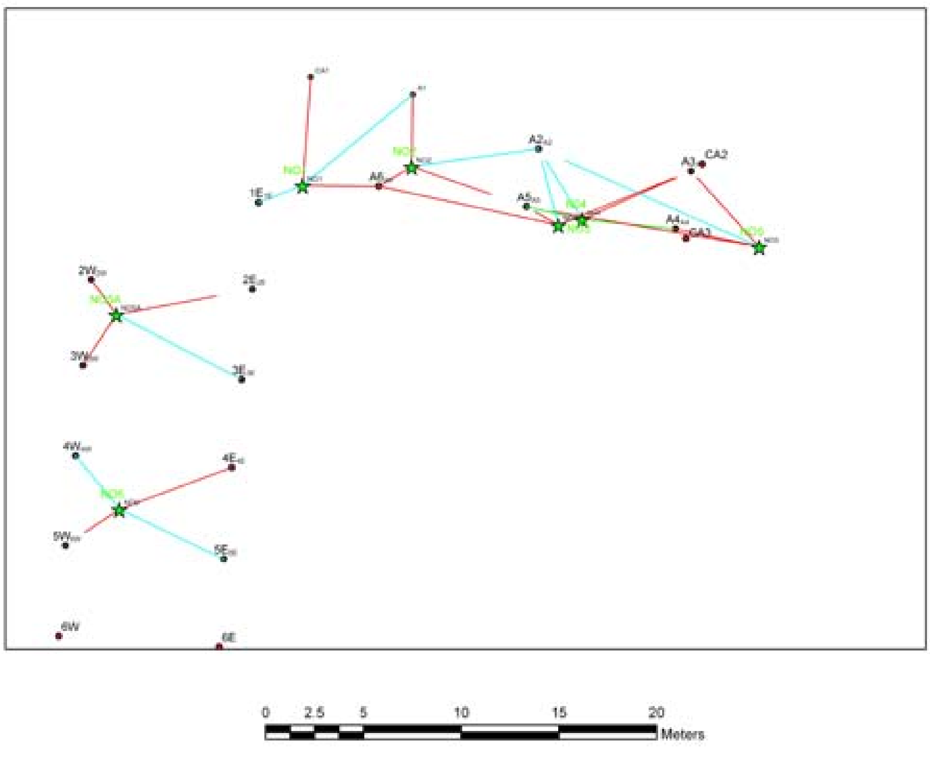

Figure 3. Site Recorder plan showing the positions of six historical piles on the shore end of the Town Jetty.

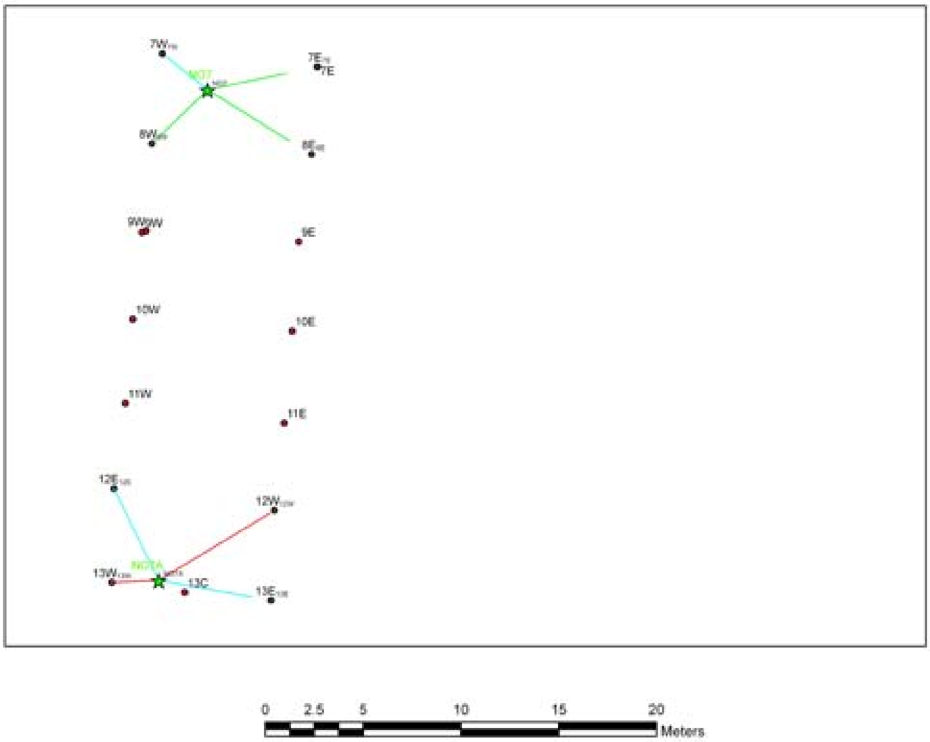

Figure 4. Site Recorder plan showing the positions of one historical pile in the mid-part of the Town Jetty.

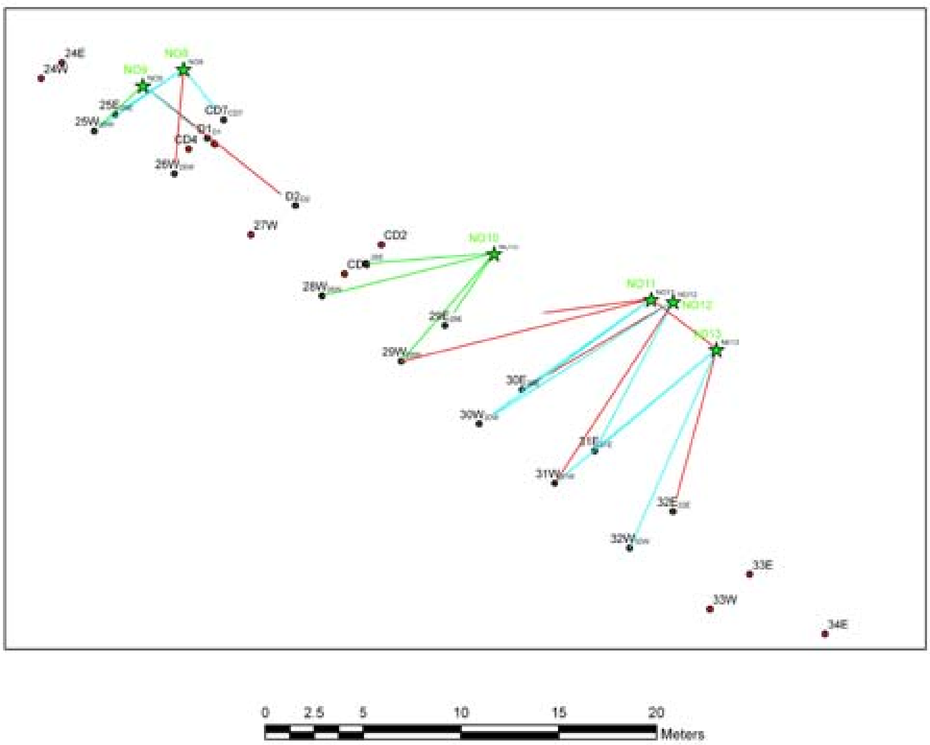

Figure 5. Site Recorder plan showing the positions of two historical piles towards the end of the Town Jetty.

Figure 6. Survey positions of historic piles.

Table 1. Positions and diameters of the historical piles.

Pile Number	Latitude	Longitude	Diameter in m
1	-35.03108600	117.88641000	0.28
2	-35.03107900	117.88647700	0.30
3	-35.03110500	117.88654800	0.36
4	-35.03113900	117.88657800	0.30
5	-35.03112500	117.88647300	0.36
5A	-35.03116200	117.88629000	0.36
6	-35.03125900	117.88629000	0.28
7	-35.03137600	117.88627600	0.33
7A	-35.03159800	117.88623600	0.34
8	-35.03197500	117.88644200	0 .24
9	-35.03197862	117.88642369	0.25
10	-35.03205800	117.88658100	0.30
11	-35.03206784	117.88664417	0.30
12	-35.03208237	117.88666386	(not measured)
13	-35.03211519	117.88670090	0.38

Table 2. Latitude and longitude of the existing jetty piles on the Town Jetty determined by total station survey

Name	Latitude	Longitude
0E	-35.03108133	117.88634920
1E	-35.03111983	117.88634800
2E	-35.03116033	117.88634450
3E	-35.03120200	117.88634030
4E	-35.03124267	117.88633570
5E	-35.03128633	117.88633350
6E	-35.03132733	117.88633070
7E	-35.03136800	117.88632670
8E	-35.03140717	117.88632150
9E	-35.03144883	117.88631620
10E	-35.03148717	117.88631630
11E	-35.03152950	117.88631200
12E	-35.03157317	117.88630730
13E	-35.03161400	117.88630530
13C	-35.03160667	117.88626770
13W	-35.03160350	117.88623470
12W	-35.03156583	117.88623430
11W	-35.03152267	117.88623900
10W	-35.03148383	117.88624350
9W	-35.03144083	117.88624780
8W	-35.03140167	117.88625070
7W	-35.03136083	117.88625470
6W	-35.03132017	117.88625900
5W	-35.03128000	117.88626230
4W	-35.03123833	117.88626700
3W	-35.03119567	117.88627030
2W	-35.03115700	117.88627380
1W	-35.03111533	117.88627880
0W	-35.03107383	117.88627820
A1	-35.03108717	117.88640980
A2	-35.03109700	117.88647670
A3	-35.03110567	117.88654820
A4	-35.03113433	117.88654000
CA3	-35.03113933	117.88654350
CA2	-35.03110250	117.88655300
A5	-35.03112467	117.88647300
A6	-35.03111417	117.88640780
CA4	-35.03111283	117.88635800
CA1	-35.03107900	117.88636250
14E	-35.03164883	117.88628100
14C	-35.03164833	117.88627650
14W	-35.03164550	117.88622680
15E	-35.03164467	117.88622950
15C	-35.03169050	117.88627230
15W	-35.03168850	117.88623820
16E	-35.03168367	117.88622400
16C	-35.03172567	117.88626600
16W	-35.03172917	117.88622950
17E	-35.03172600	117.88621830
17W	-35.03177117	117.88622430
18E	-35.03181333	117.88622570
18W	-35.03180700	117.88620870
19W	-35.03183733	117.88620380
20E	-35.03185150	117.88624180
20W	-35.03185600	117.88623220
21E	-35.03187617	117.88627250
21W	-35.03188050	117.88626300
22E	-35.03190850	117.88631070
22W	-35.03191500	117.88629720
23E	-35.03193933	117.88634420
23W	-35.03194733	117.88633500
24E	-35.03197000	117.88637830
24W	-35.03197583	117.88636820
25W	-35.03200083	117.88640070
25E	-35.03199367	117.88641130
26W	-35.03202450	117.88644250
27W	-35.03205117	117.88647670
28W	-35.03208067	117.88650370
28E	-35.03206383	117.88652530
CD4	-35.03201283	117.88644200
CD1	-35.03199800	117.88645920
D1	-35.03200850	117.88645170
D2	-35.03203217	117.88649070
CD3	-35.03207000	117.88651380
CD2	-35.03205650	117.88653030
29E	-35.03209283	117.88655970
29W	-35.03210883	117.88654030
30W	-35.03213950	117.88657600
30E	-35.03212300	117.88659350
31E	-35.03215183	117.88662780
31W	-35.03216600	117.88660950
32W	-35.03219583	117.88664580
32E	-35.03218000	117.88666380
33E	-35.03220767	117.88670150
33W	-35.03222383	117.88668300
34W	-35.03225100	117.88671830
34E	-35.03223567	117.88673670
35E	-35.03226417	117.88677480
35W	-35.03228150	117.88675280
36W	-35.03230917	117.88678870
36E	-35.03229333	117.88680800
37E	-35.03232067	117.88684250
37W	-35.03233567	117.88682350
38W	-35.03236467	117.88685850
38E	-35.03235217	117.88687520
39E	-35.03237667	117.88691280
39W	-35.03238733	117.88689250
CC2	-35.03237400	117.88692600
CC3	-35.03240167	117.88689070
CC4	-35.03208550	117.88648570
B13	-35.03176183	117.88625820
B12	-35.03177000	117.88630130
B11	-35.03176617	117.88634120
B10	-35.03178250	117.88639620
B9	-35.03178183	117.88644730
CB5	-35.03178800	117.88644800
CB4	-35.03174567	117.88645830
B4	-35.03174300	117.88644880
B5	-35.03174217	117.88650480
B6	-35.03174550	117.88654870
B7	-35.03175267	117.88659800
B8	-35.03175617	117.88664480
BB3	-35.03176067	117.88664970
CB2	-35.03175350	117.88664780
B3	-35.03173783	117.88639980
B2	-35.03174050	117.88634830
B1	-35.03172700	117.88629920
X1	-35.03106900	117.88637030
X2	-35.03171517	117.88627400
X3	-35.03171367	117.88629080
X4	-35.03172250	117.88628670
X5	-35.03172550	117.88639570
X6	-35.03172850	117.88643550
X7	-35.03173483	117.88647920
X8	-35.03173433	117.88652000
X9	-35.03173967	117.88656480
X10	-35.03174583	117.88665430
X11	-35.03174483	117.88666030
X12	-35.03175717	117.88666220

Note the jetty piles were numbered from the shore outwards, W=west, C=central and E=east. The X series belong to the finger wharves.

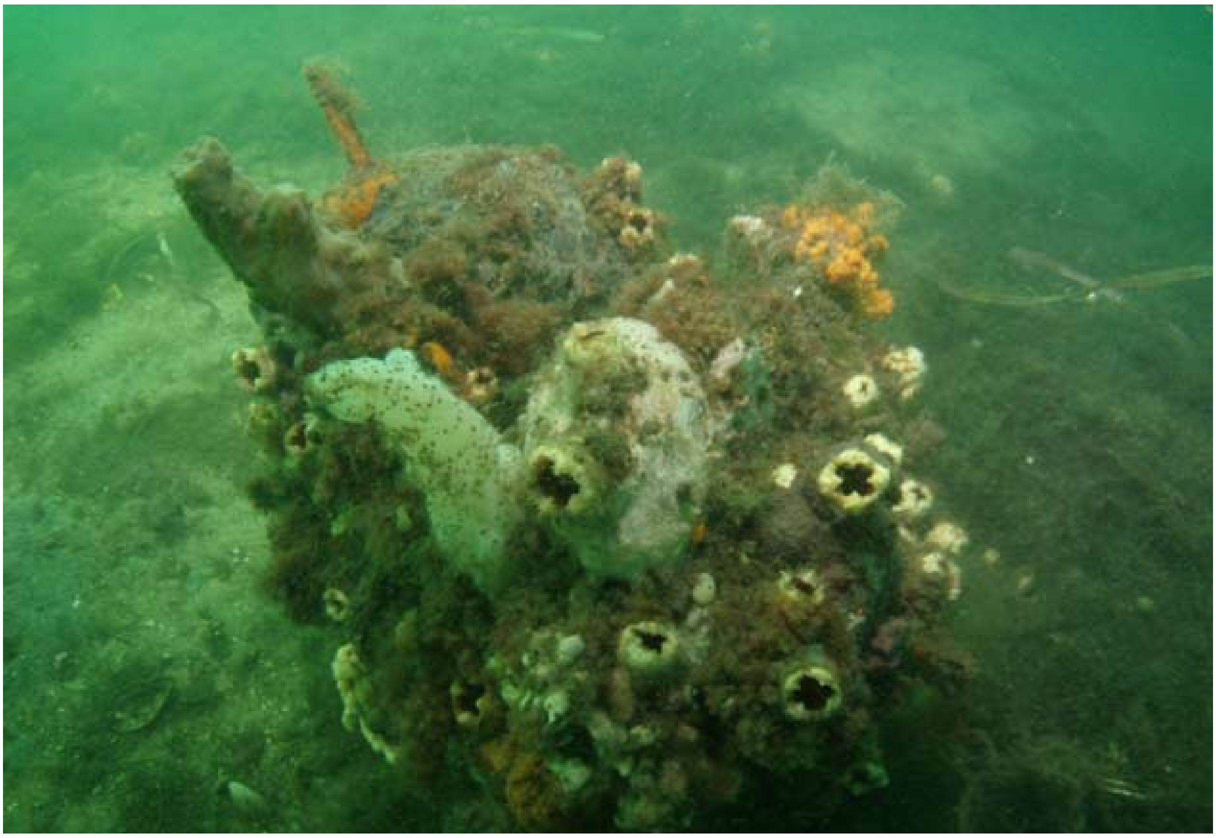

Figure 7. An historic pile.

Figure 8. Modern jetty pile.

Remote sensing survey harbour area

Jeremy Green

Equipment Overview

Equipment used for the remote sensing and position-fixing components of the survey were:

a) Marine Sonics side scan sonar and PC processing software

The Marine Sonics side scan sonar uses a dual frequency tow fish (150/600 KHz) and the software, Sea Scan PC, uses an Intel-based computer with the Windows operating system for data display and system control. The Sea Scan PC program allows the operator to control the sonar data collection process, view, analyse, and save the sonar image with the related navigational information. The program also features a sophisticated integrated plotter to plot location and estimated swath coverage. The Sea Scan PC enables the operator to view wide tracts of the seafloor by insonifying along the swath width and recording the strength of the echoes from the sea bottom. The tow fish is towed just above the bottom of the seafloor. The tow fish continuously emits narrowly focused beams of sound perpendicular to the path of motion. The sound pulses pass through the water but are reflected from the seafloor and objects, such as wreck sites, on the seafloor. The control computer records the echo signal strengths as they return and then draws the entire sonar record line on the screen. An image of the seafloor is built, line by line, as the sonar record line from each pulse of the sonar is returned and drawn on the screen. (Marine Sonics, 2006: 7).

b) Elsec Type 7706 magnetometer

This magnetometer has a field strength range of 20,000–90,000 nT in 24-switched ranges. The data is also shown in real time with along with the side scan trace and navigational information using the Sea Scan PC software. This enables the operator to analyse and correlate magnetic anomalies with sonar imagery of the seabed. The magnetometer operates using proton precession and measures magnetic field intensity variations causes by ferrous deposits.

c) Garmin GPS and Fugro Omnistar Differential GPS 8400

The handheld Garmin GPS has a position accuracy of within 5m while the Fugro DGPS has an accuracy of within 20cm. The Garmin GPS was used to plot and record tracks of the survey vessel and position-fix targets. The DGPS was used to record land-based survey control points in order to geo-reference sites onto maps and charts.

Figure 9. Plan of the track of the survey vessel during course of the three-day survey.

The 2008 Museum Remote Sensing Survey

Three days of marine survey work were completed (15, 17 and 18 February), during this time about 8.5 km of track was covered within the confine of the Town Jetty and the Port Authority moles. Figure 5 shows the tracks of the vessel during the various stages of the operation. Tracks were run east–west because of the nature of the seabed; it was easier to maintain a constant depth in this direction as the seabed generally sloped down to the south. Some inconsistencies were noticed in the side scan traces (particularly with the slipway track) because the position of the side scan fish lay slightly behind the position of the GPS antenna thus causing discrepancies depending on which direction the vessel was travelling. Both side scan and magnetometer were deployed at the same time and data was recovered in separate channels in the Marine Sonic software, track in one channel, magnetic data in a second and a series of MST files representing the sonar image. The sonar software enabled height and measurement of objects as well GeoTIFFs that could be imported into a GIS to create a sonar mosaic. The GIS system used was ArcMap and is part of a series of regional GIS that have been created for Western Australia dealing with underwater cultural heritage.

Results

Side Scan Sonar

The objective of the side scan sonar survey was to identify any objects, cultural or otherwise that lay on the surface of the seabed. The side scan sonar was run on a single channel to simplify the recording and at the high frequency setting. Swath widths were generally 50 or 75 m and the resolution was either about 5.0 mm or 7.5 mm per pixel; in other words the system could resolve objects about 10 mm in size. The initial survey concentrated on the shallow water area where the dredging was to take place See Figure 6. Figure 8 shows the proposed area to be dredged superimposed over a sonar mosaic; the sea wall and the small groin to the east of the wall can be clearly seen. The overall sonar survey is shown in Figure 9.

The area with the sea grass is shown in Figure 10 where the beds of grass are clearly delineated. In the lower mid-left of this image structure and large objects can be seen. These are enlarged in Figure 11 which is a waterfall image of sonar trace, chains and scour can be seen in lower left and a small car tyre can be see in upper left. The slipway can be clearly seen in the bottom right of Figure 10. Some alignment problems can be seen in this mosaic caused by the layback issues discussed above. Detail of slipway can be seen in waterfall image Figure 12. Bright objects on either side of slipway with dark acoustic shadows to left are the spit posts.

In Figure 9 a number of small targets can be seen in the centre of the image, using SeaScanPC software it is possible to measure the height of these objects. Figure 7 shows two small objects with acoustic shadows to left, by measuring length of shadow against the height of tow-fish above sea bed it is possible to determine the approximate height of the object, in this case the object is 2.19m high.

Figure 10. Plan showing the proposed development and the proposed dredged area in white (upper left).

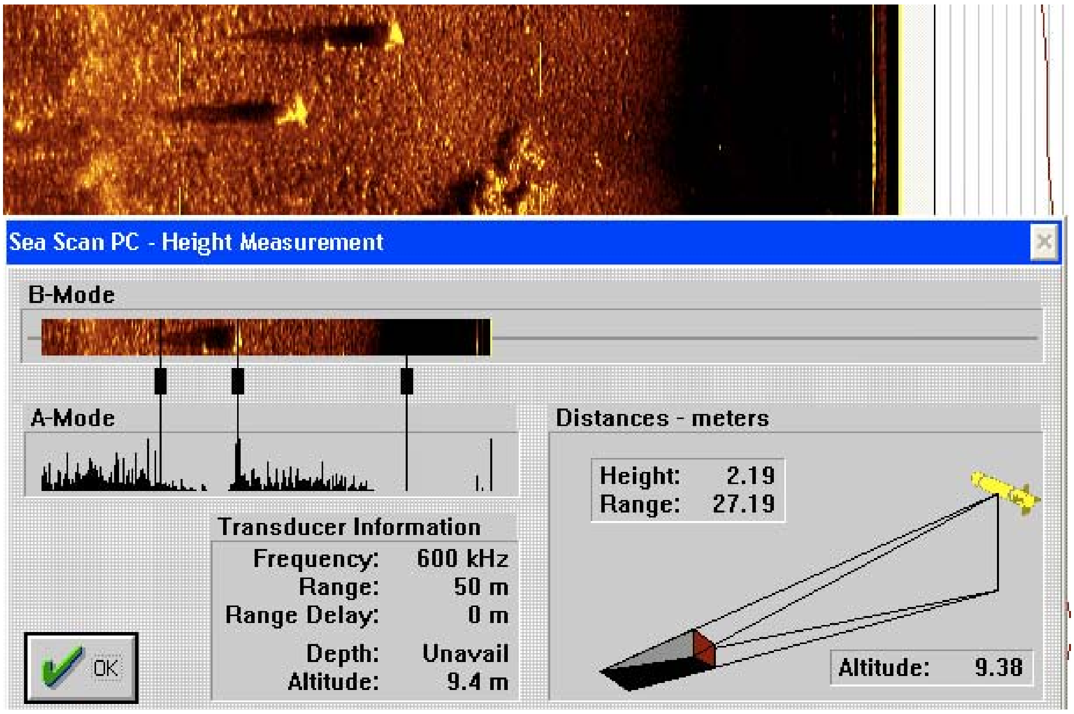

Figure 11. Screen grab of Sea Scan PC software showing the height measuring feature. In the sonar trace two small targets with acoustic shadows can be seen. The analog height measuring software places one of the three markers on the top of the object, one on the end of shadow and on the seabed (mid left). The analog shows how this operates in relation to the towfish (lower right). Target height estimated to be2.19 m although the precise location of sea bed is not clear in this case, making measurement uncertain. Note magnetometer trace on upper right.

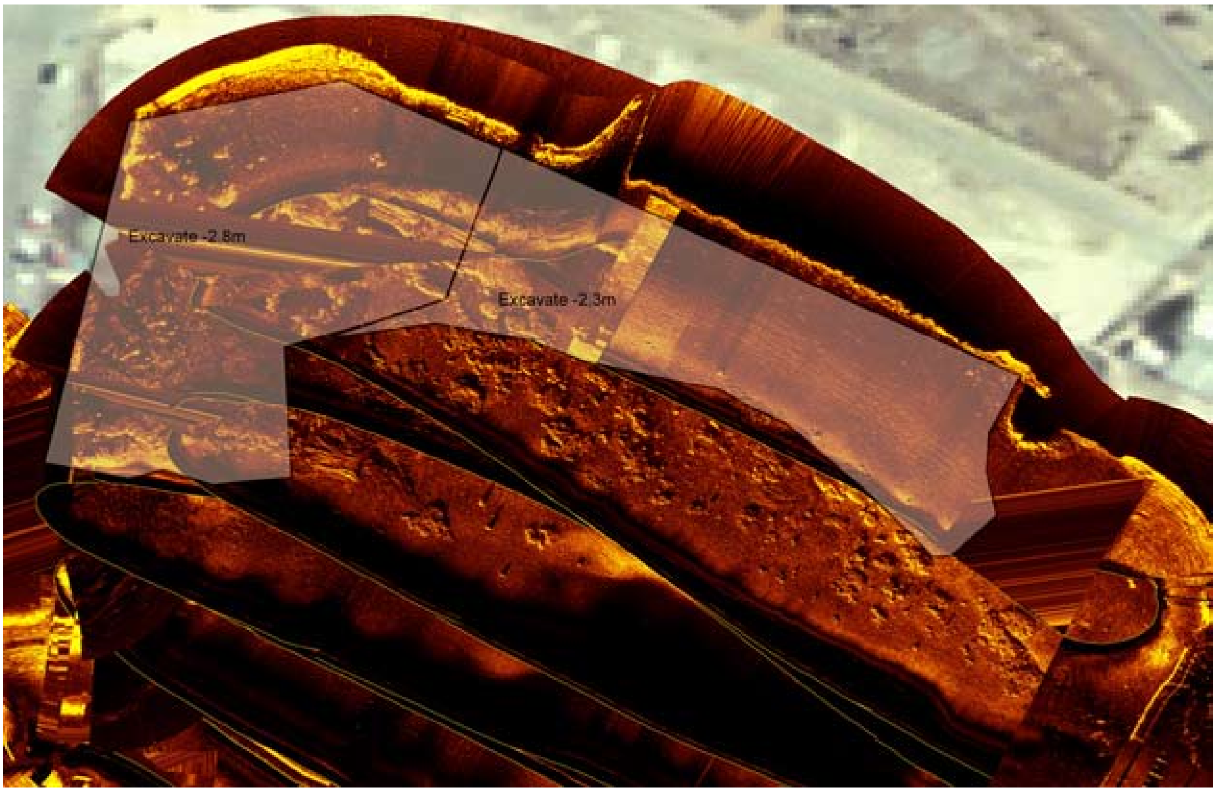

Figure 12. Area to be dredged shown superimposed on side scan sonar trace mosaic.

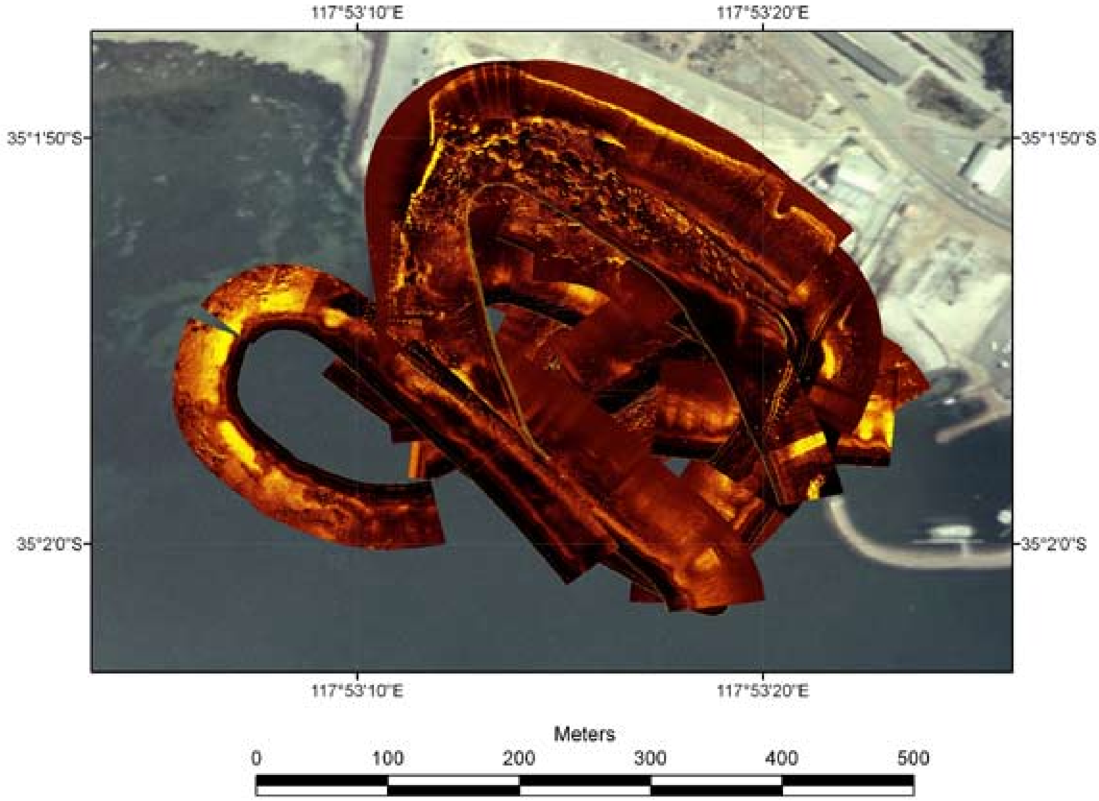

Figure 13. Total area covered by side scan sonar mosaic.

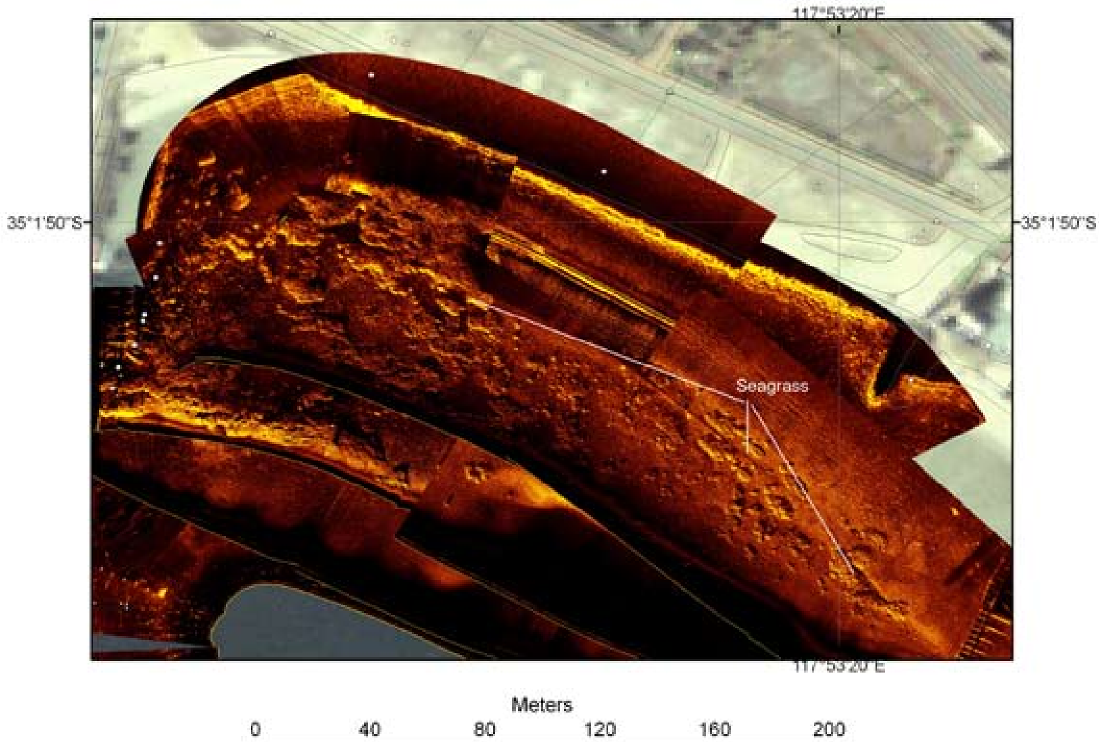

Figure 14. Detail of soanr mosaic showing beds of sea grass and the outline of the sea wall and groin, with part of slipway showing in bottom right.

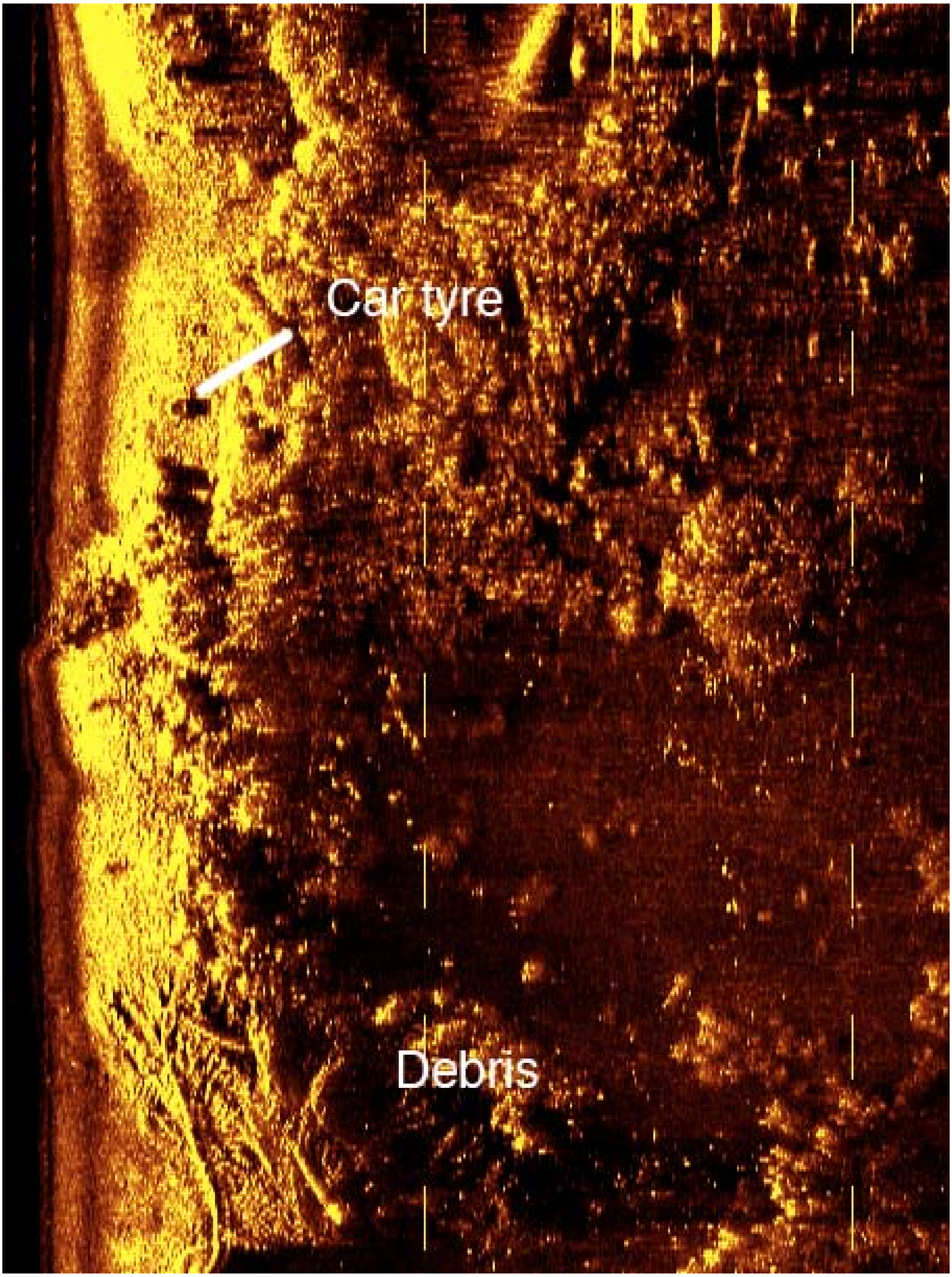

Figure 15. 'Waterfall' sonar trace showing debris and a car tyre. Note the left-hand side of image represents the towfish, the irregular line slightly to the right is the sea bed bottom directly below the towfish and trace to right is an image of the seabed. Yellow markers represent 50 m intervals.

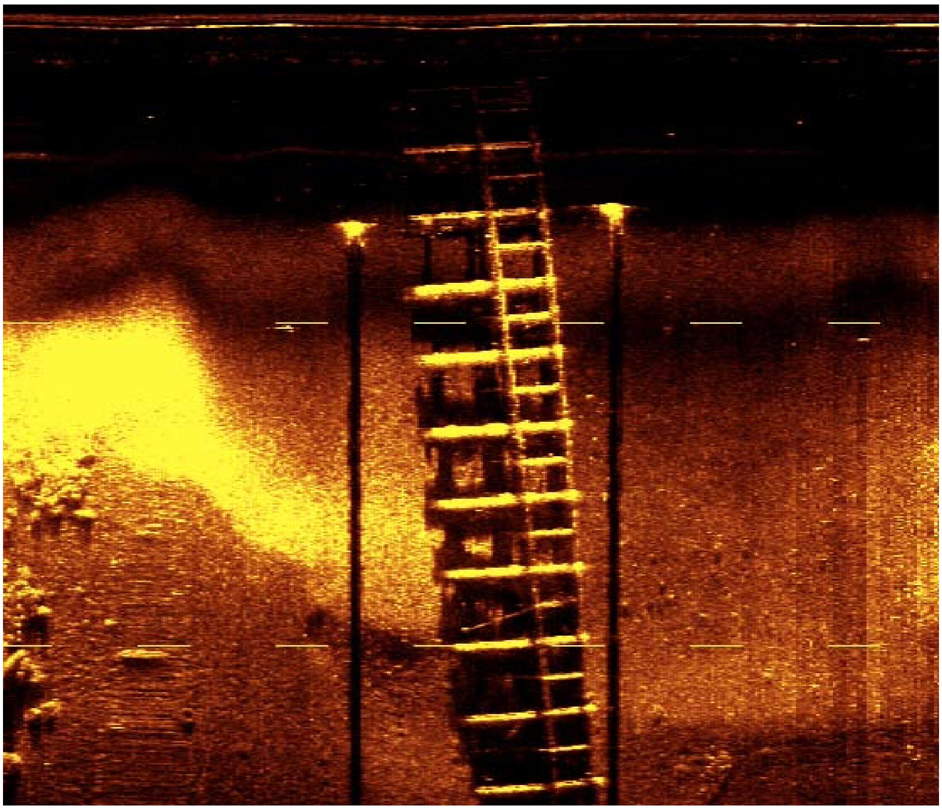

Figure 16. Detail of slipway track structure. Note two bright spots with shadows extending downwards are the slipway guide dolfins for the slipway with their associated acoustic shadows.

The Old Whalers Jetty

The Old Whalers Jetty was studied to determine its extent and the debris field associated with it. Figure 13 shows the extent of the mound representing the location of the demolished jetty. To the left the piles of the existing jetty can be seen, together with the propeller wash of the vessel from the previous run (the small bubbles formed in the wash create marked trail that lasts for several minutes). In the centre of the image, to the right of the existing jetty, debris can be seen. This is enlarged in Figures 15 and 16 showing what appears to be piles and jetty structural elements lying on the jetty mound and off to the northern side. Software shows that the large piles lying on the seabed are about 6 m long, Figure 17.

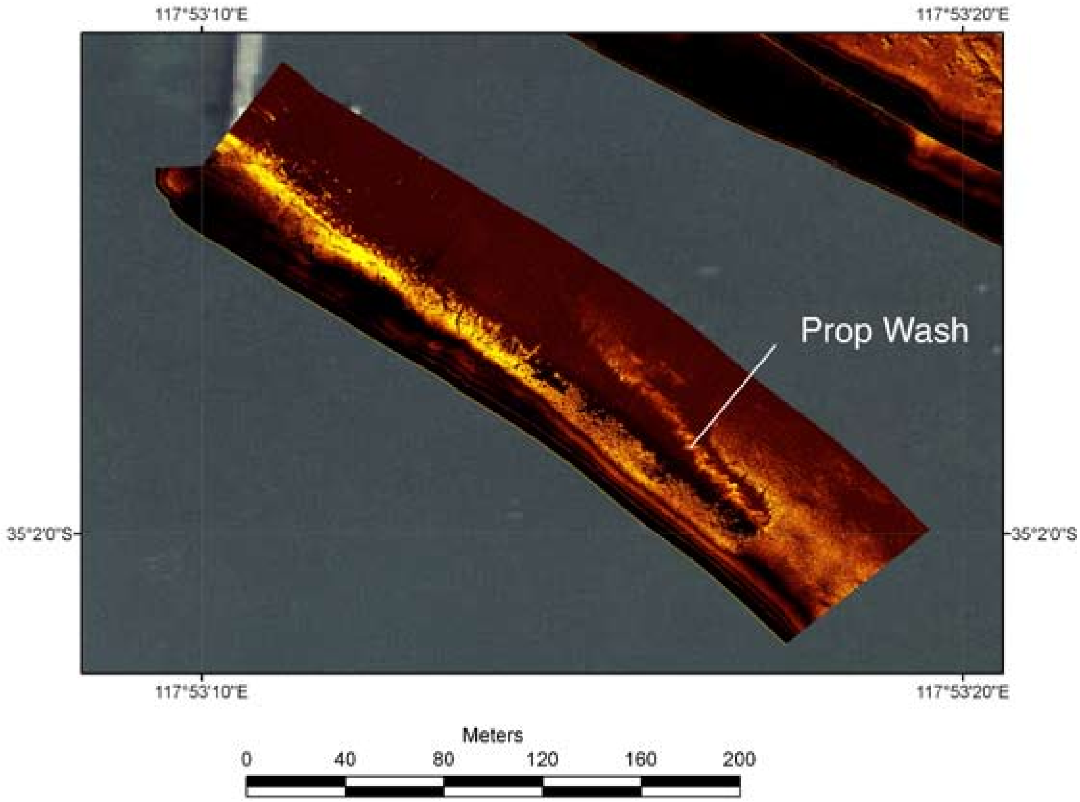

Figure 17. Side scan trace of end of Town Jetty showing mound associated with the demolished Whalers Jerry and some of the debris. Note the small bright spots and lines (upper left) are the piles of the existing jetty.

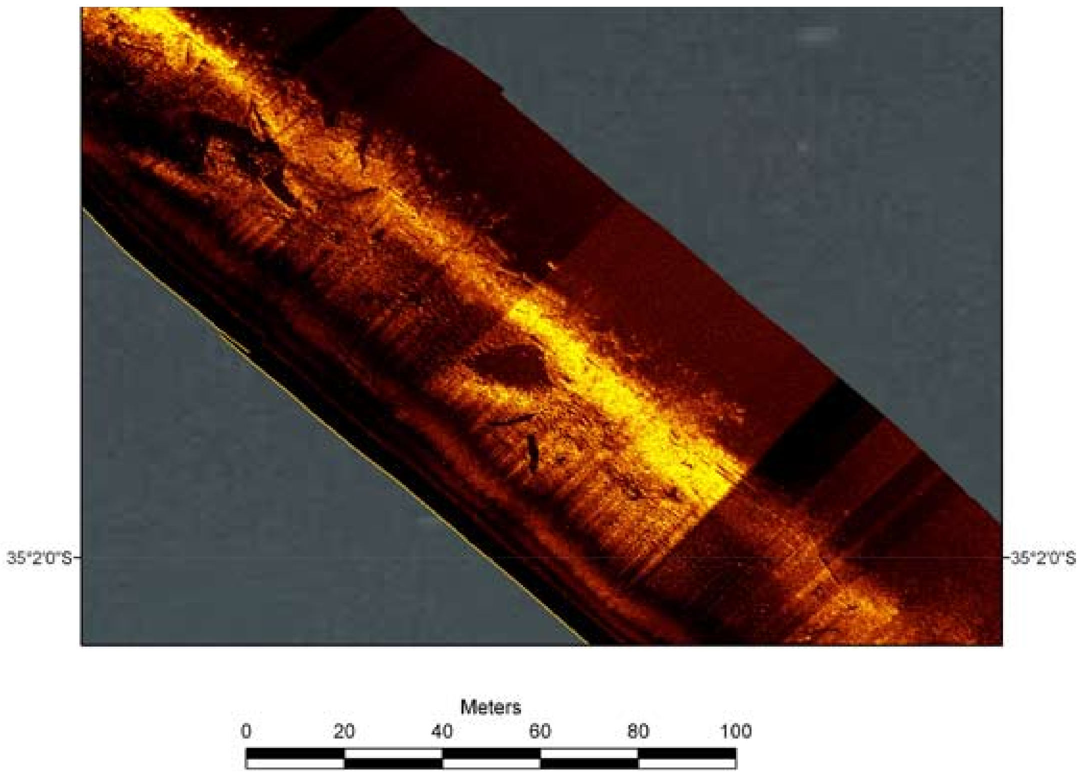

Figure 18. Enlargement of debris field

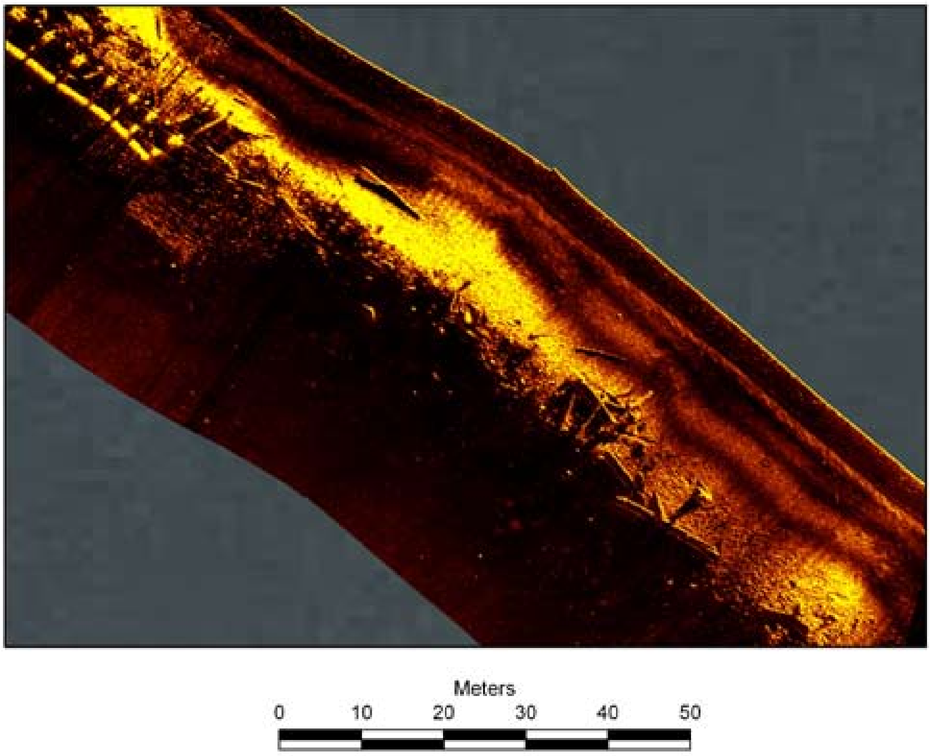

Figure 19. Further enlargement of debris. Note piles of existing jetty (upper right).

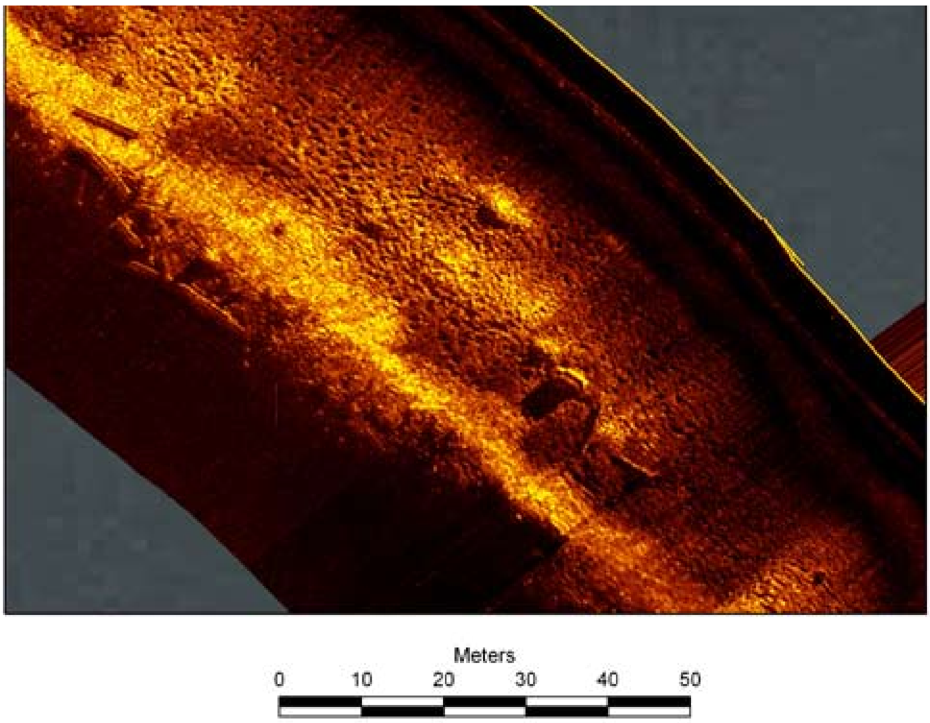

Figure 20. Side scan image of the Whalers Jetty mound on north side.

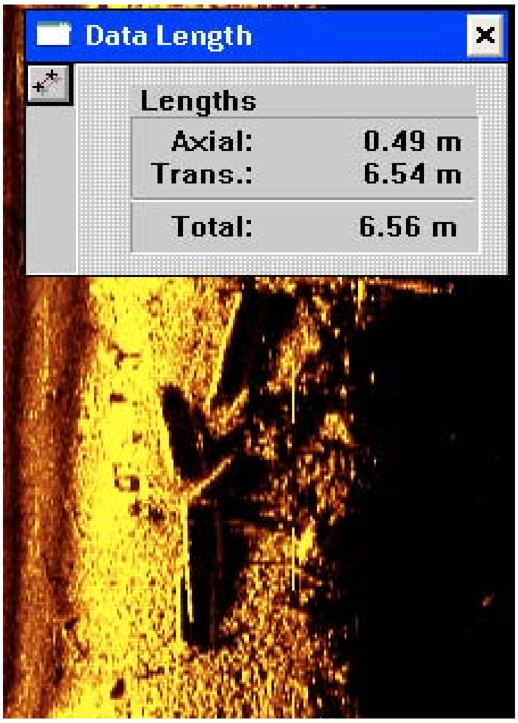

Figure 21. Sea Scan PC software distance measuring feature. The length of the linear feature in lower centre is 6.56 m.

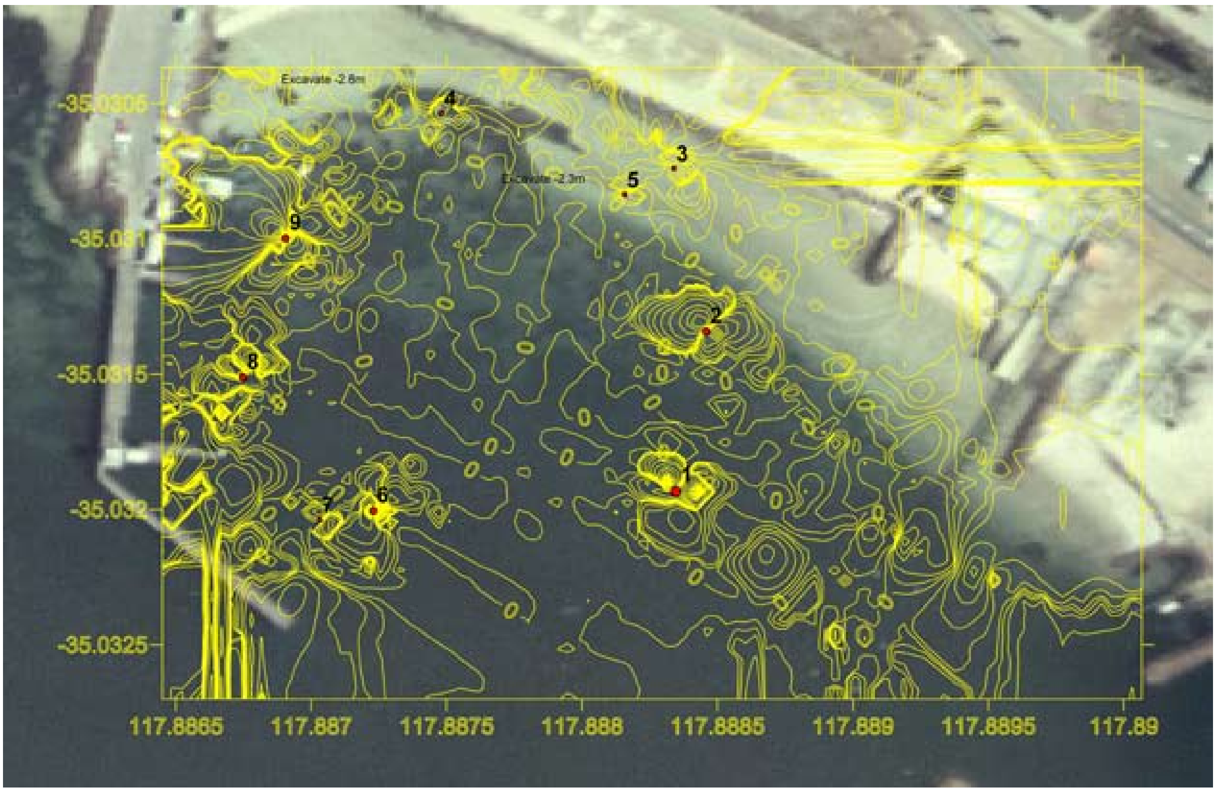

Figure 22. Magnetic contour plot of differential signal. Magnetic targets numbered 1 to 6.

Magnetic Recording

Figure 18 shows a plot of the magnetic differential field intensity over the Town Jetty harbour area. Because the magnetic survey was carried out over a number of hours on the three days, the diurnal field intensity that gradually changes over time creates problems in reducing the absolute background field intensity to a common value. Therefore, as the signal was recorded digitally and integrated with position and time, it was possible to calculate the differential signal. Since the magnetometer records the field intensity once every second, the difference between each successive signal produces a differential reading, which is independent of the absolute value. By downloading the data recovered in software by the Marine Sonic PC program, it was possible, using an Excel spreadsheet, to calculate the differential value between successive records.

The magnetometer signal and the GPS location of the signal was then used to create a contour plot. Surfer was the program used, which creates a map showing the differential field intensity contours. Unfortunately, Surfer does not have the ability to blank areas where no readings were made. As a result the program attempts to interpolate in these areas. In the Town Jetty survey, the magnetic effect of the slipway caused very large magnetic disturbances so the survey did not proceed into that area, although the effects were noted a considerable distance away. In addition no recording were made in the northeast corner of the magnetometer plot because this was dry land. Therefore, when examining this plot, it is important to remember that everything on land should be ignored, everything in the region of the slipway should be ignored and the southwest corner near the jetty should also be ignored.

The survey shows 5 main areas of magnetic disturbance: 1. Large magnetic target in deep water; 2. Medium sized magnetic target on the slope leading to the shallows; 3, 4 & 5. Large area in the shallows with numerous small magnetic targets; 8. A series of magnetic targets to east of Town Jetty; 9. A complex magnetic target in deep water at shoreward end of jetty; 10. A complex of magnetic targets near old tug berth.

It is likely that 3 represents small boat moorings or possibly small buried iron material, 4 is likely to be moorings relating a medium sized fishing boat, or moorings for vessels docked on Town Jetty to the west. The anomalies 5 and 6 are unknown and will require investigation. Large anomalies 1 and 2 are also unknown, but possibly substantial iron objects such as large mooring anchors. Because of the very complex nature of the magnetic signals, it is very difficult to interpret. Anecdotal information suggests that the whole of the area is covered in mooring chains and anchors and these are likely to mask anything that is smaller such as a wooden vessel.

Table 3. Magnetic targets (L = Large; M = Medium; S= Small

TARGET	LAT	LONG	TYPE
1	-35.032	117.888	L
2	-35.031	117.888	M
3	-35.031	117.888	S
4	-35.031	117.887	S
5	-35.031	117.888	S
6	-35.032	117.887	M
7	-35.032	117.887	S
8	-35.032	117.887	M
9	-35.031	117.887	M

Historical Shoreline

A number of charts of Princess Royal Harbour have been located, these include charts dated 1873 (Figure 19), 1890, 1894, 1919 (Figure 20) and 1959 (Figure 21). These charts have been georeferenced against the modern aerial photographs so that it is possible to see the changes that occurred in the shoreline and the jetties. Not all the charts are of good quality, but there is enough topographical information to create a reasonable fit to the old and modern features (hilltops, road intersections, etc). The figures have been created so that the historical charts are semi-transparent, and the modern features can be seen underneath. The Figure 19, the 1873 chart shows the town jetty and two other jetties to the east. The shoreline is clearly indicated with the shallows, probably less than 2 feet shown dotted. The Figure 20, the 1919 chart shows the Town Jetty with the baths and the small jetty still on the shore. The Figure 21, the 1959 chart shows the extension to the jetty, with an additional new jetty with platform of some sort. The Figure 21 shows the extended jetty and extended baths with reclaimed land.

Figure 23. Trace of the original shore line taken from a semi-transparent georeferenced 1873 chart and superimposed over a contemporary aerial photograph.

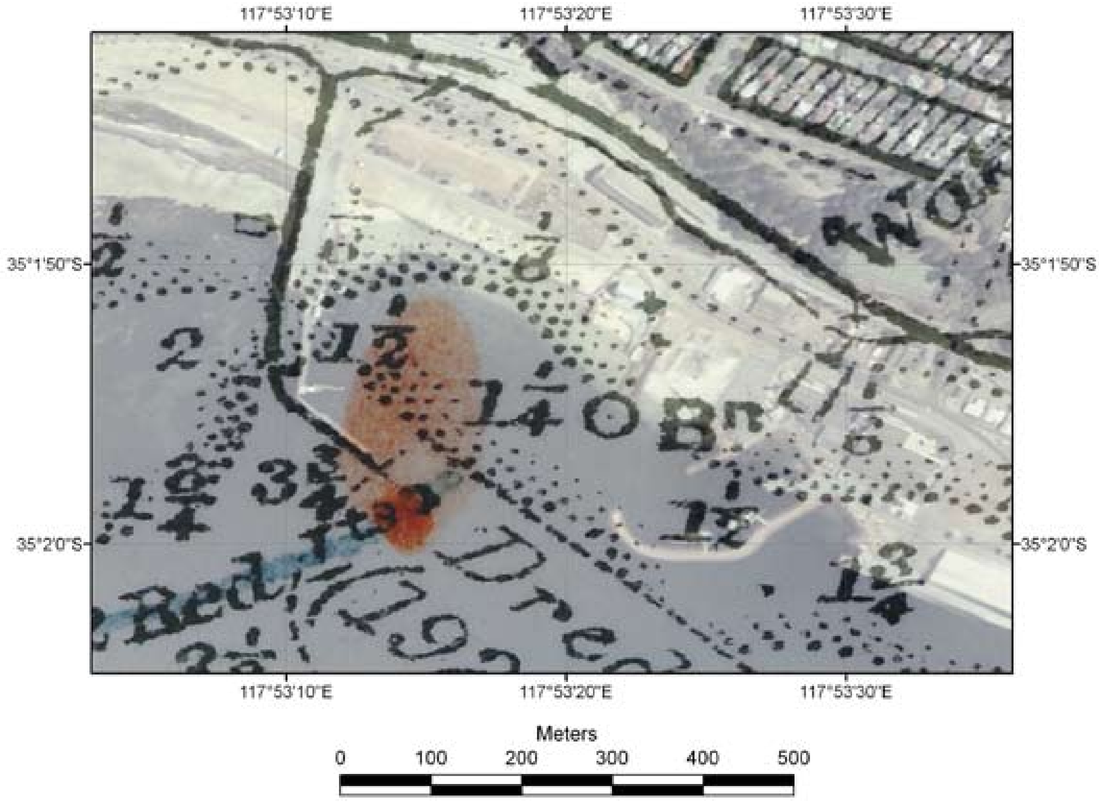

Figure 24. Detail of the 1919 chart showing the Town jetty before the construction of the Whalers Jetty , overlaid on a modern aerial photograph.

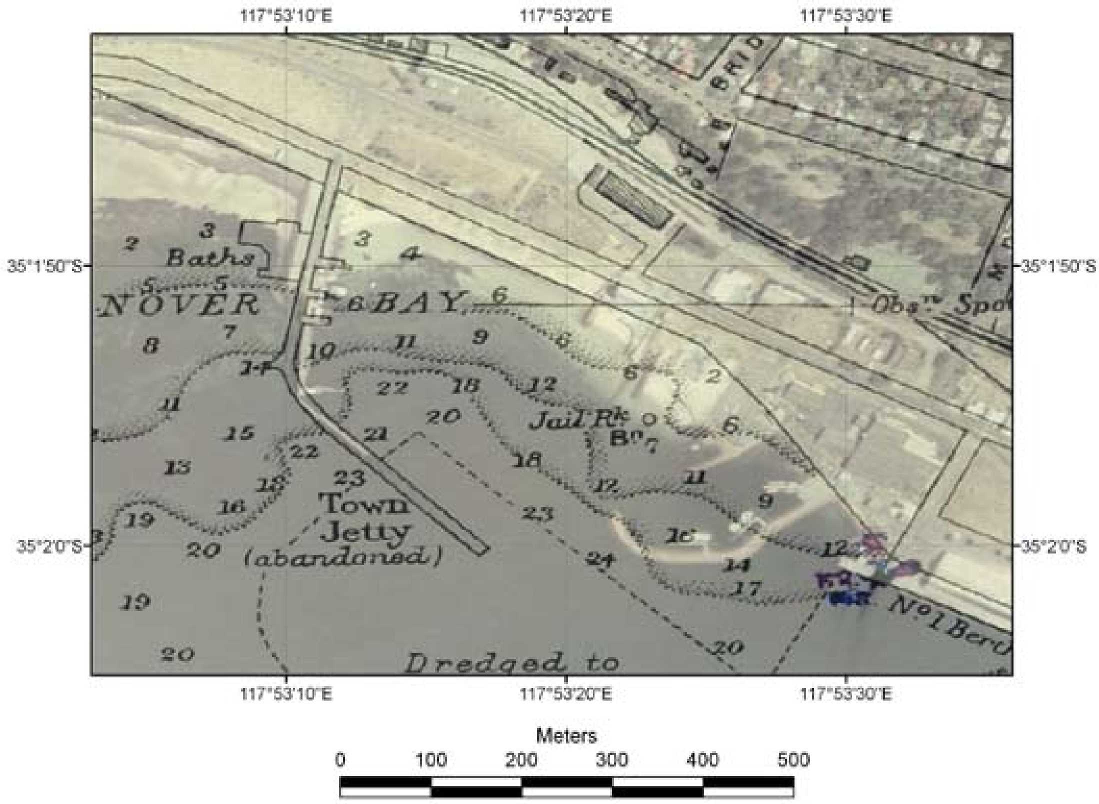

Figure 25. Detail of the 1959 chart showing Town jetty with Whalers Jetty extension, overlaid on a modern aerial photograph.

Figure 26. Trace with the semi-transparent chart removed.

The Floating Dock

One substantial structure, the P&O floating dock, is believed to lie under the seabed in this area or beneath landfill in the reclaimed land area (Garratt, *et al.*, 1995; Wolfe, 2007: 19). As part of this project an attempt was made to determine the approximate location of the Floating Dock that was abandoned sometime after the end of the First World War. A number of historical photographs were obtained from Adam Wolfe and from Malcom Traill, Albany Library. A total of eleven historical photographs of Princess Royal Harbour were found showing the Floating Dock. In some cases these photographs can be dated, for example, the American Fleet visited Albany in 1908 and the Floating Dock can be seen in the foreground (Figure 23). In many cases the Floating Dock can be seen against coastal features that allows a position line to be drawn. A position line is basically a photo-transit; this is where two features in a photograph are aligned then a line can be extended from these two features (the position line) and this line can now be drawn on a map or chart. If other features, such as the Floating Dock, lie on an extension of the position line then they will lie somewhere on the position line on the chart. If two or more different position line can be constructed, then the intersection of these lines on the chart gives the position of the object. These position lines (Figures 23–25) have been drawn in on the GIS of Albany to show the approximate position of the Floating Dock (Figure 26). Two clear position lines, one coinciding with end of the Whalers Jetty with a point slightly east of Bridge Street (Figure 24) and a second aligned with Seal Island and Mistaken Island (Figure 23) give an approximate position of the mooring for the Floating Dock. A third line which is the projection eastwards of the southern side of the old Jetty Baths (Figure 25) give additional support to the location of the Floating Dock mooring, Other photographs confirm that the general area where the Floating Dock was usually anchored was in the approximate area of the winching shed of the present slipway.

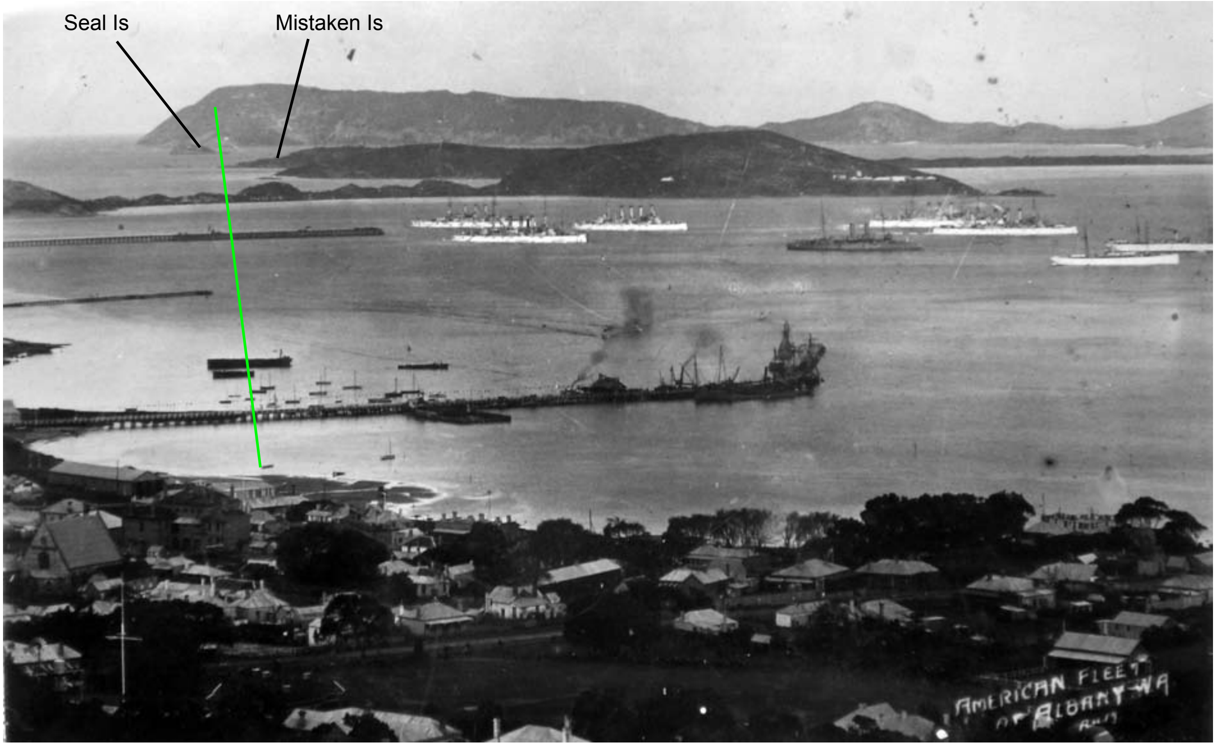

Figure 27. A 1908 view of Albany showing visiting American Fleet. Note alignment of the righthand side of Seal with the lefthand side of Mistaken Islands

Figure 28. Undated view of harbour showing position line from end of the Whalers Jetty to slightly east of Bridge Street. Note the Whalers Jetty was demolished and the extent demolished can be seen by comparison with the modern situation in Figure 24.

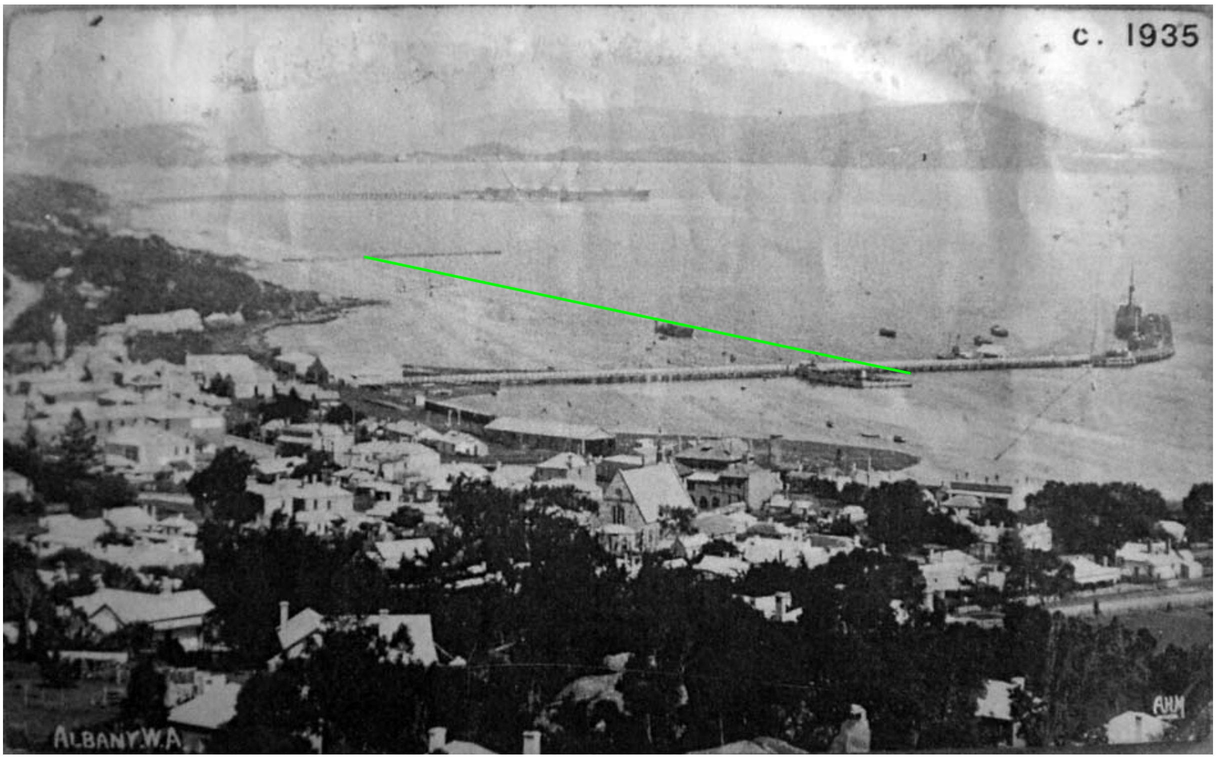

Figure 29. Position line from Old Town Baths.

Figure 30. Position lines taken from following three historical photographs.

Underwater archaeological excavations harbour area

Ross Anderson

Wolfe and the 1995 Museum excavation team have identified the harbour area as having maritime archaeological potential. Although the area has been previously dredged from 1893 the area includes the earlier 1900 jetty alignment and has low concentrations of 19th and 20th century artefacts. (Garratt, *et al.*, 1995; Wolfe, 2007:20)

In addition to referencing those test pits and test trenches dug in 1994, in 2008 two two-metre-square areas were selected for excavation. These were in shallow water (<2m depth) on a sand and weed bottom, close in to the sandbank fronting the existing stone harbour revetment wall east of the Town Jetty. The shallow sandbank itself was not selected for excavation as horses were being exercised in this area on a daily basis, and the possibility of accidental injury caused by a horse walking into an unattended deep excavation hole was considered an unacceptable risk.

Excavation was undertaken using a water dredge within a two-metre grid held in place by plastic star pickets.

The grid corners and depth of base of trench were surveyed in using shore-based total station to reference the grids and depth to Australian Height Datum (AHD)

The aim of the excavations was to determine the extent and density of any cultural layers. Previous Albany Town Jetty excavations in 1994 revealed extensive artefact deposits close to the jetty (Garratt, *et al.*, 1995). Additionally there was the possibility of locating some or part of the hull of the P&O floating dock that was last seen close to, or underneath, the revetment wall and possibly within the dredging footprint area.

Grid Square 1

This grid was laid on the seafloor in 1.8m depth measured with plumb bob and tape measurement and excavated on Tuesday 19 February 2008 between 10am and 3pm.

The seabed consisted of a thin surface layer of contemporary sea grass, sand, silt and shell overlying a compacted silt layer, in turn overlying an earlier seafloor/ sea grass layer 70cm below the seabed. Modern rubbish including 1970s brown glass beer stubbies, a plastic lid, eroded timber (no signs of working – undiagnostic) , a green glass fragment and small pieces of coal were found to the base of this earlier sea grass layer, indicating a 1970s-modern seafloor layer. Below this layer was a layer of soft silt and shell that continued to 3.0 metres below sea level. As dredging in this area was to be to 2.3 metres below AHD the excavation was discontinued with no further evidence of any older cultural layers or artefact deposits within the proposed dredged depth.

The excavation began to fill naturally by sand movement the next day and was not backfilled

Grid Square 2

This grid was laid on the seafloor in a depth of 1.7m close to the Albany Dive charter boat pen and Town Jetty. Dredging in this area is planned to be 2.8m below AHD. Being closer to the jetty structure it was thought any older layers or a greater density of artefacts (if any) would be more likely to be discovered.

A thick 40cm surface layer of dead tangled sea grass was encountered immediately below the bare sand seafloor surface. Mixed into this sea grass layer were similar artefacts as found to the base of the seafloor sea grass layer of Grid square 1, namely undiagnostic (i.e. providing no relevant archaeological information) eroded timber fragments, modern bottles, a piece of slate, rocks, silt and shells. Both layers are therefore probably related. Below this layer a distinctive undisturbed, thick, tightly packed shell matrix mixed with clean white sand was encountered, and this was sounded down to 3.0m. Some of the shells were extremely large oyster shells causing dredge blockages. This may be related to the deeper layers encountered in the 1994 excavation that were dated to 5000 years BP. This depth was the maximum working extent of the water dredge without enlarging the grid square (due to the coning effect of trench walls in a sandy marine environment), and with no sign of any further layering or signs of cultural material other than the thick shell bed the excavation was discontinued.

Interpretation

It is apparent that any cultural material lies above the sea grass bed layers in both Grid 1 and Grid 2, and this is mainly modern.

Interestingly and somewhat surprisingly there were few artefacts in Grid 2, even though it was towards the earlier 1880-88 (shore) end of the Town Jetty.

A photograph taken from the Residency Point in January 1927 looking across the shallow flats fronting Albany shows the shallow seabed prior to its reclamation. The sea grass and shell layers encountered in both of the excavation grids were at the deeper end of the shallows as the seabed sloped into deeper water.

Figure 31. View from Residency Point 1927 (Albany Foreshore Development Project 1994)

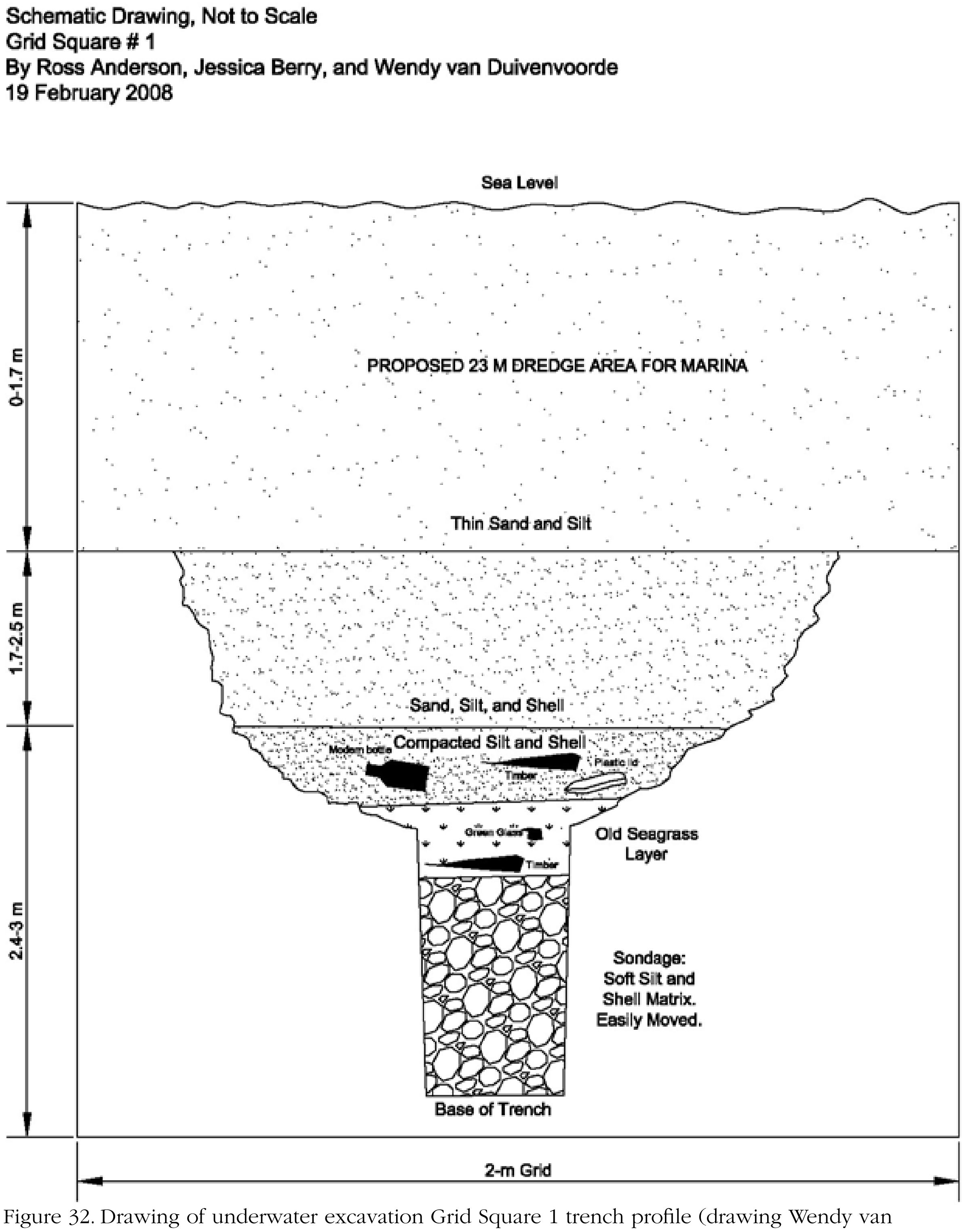

Figure 32. Drawing of underwater excavation Grid Square 1 trench profile (drawing Wendy van Duivenvoorde).

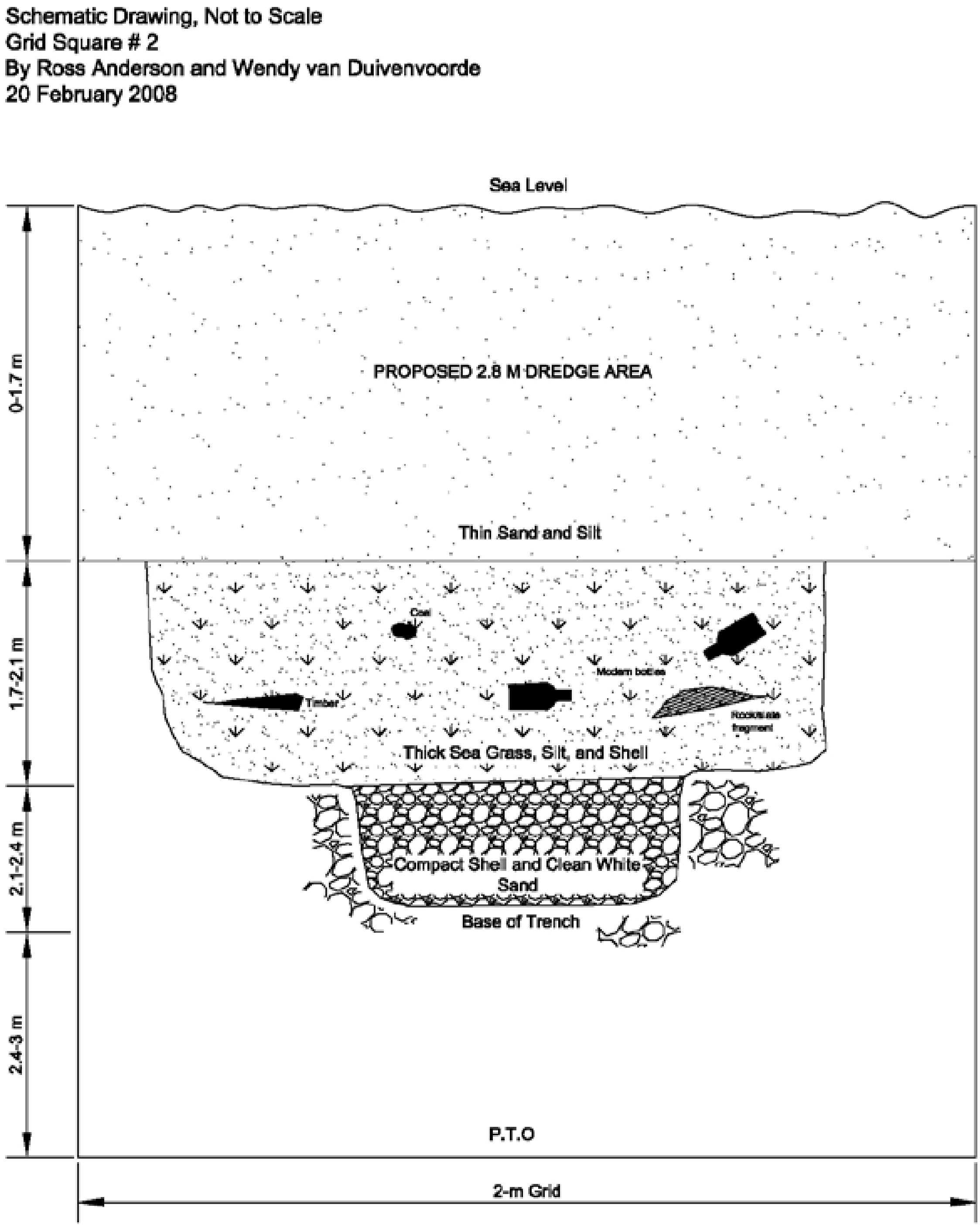

Figure 33. Drawing of underwater excavation Grid Square 2 trench profile (drawing Wendy van Duivenvoorde).

Figure 34. Archaeologists excavating test square.

Figure 35. Seagrass matte.

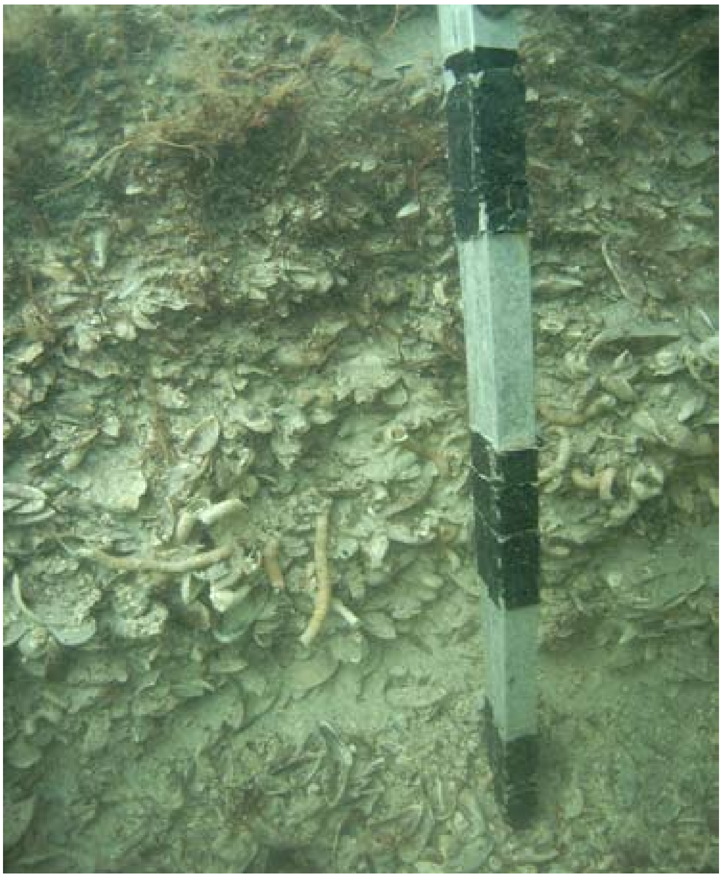

Figure 36. section through side of trench, showing differences in shell concentration.

Figure 37. Modern artefaccts on the sea bed.

Conservation Assessment of the Albany Town Jetty Development Site February 2008

Jon Carpenter & Vicki Richards

Background

During November–December 1994, a combined maritime archaeological investigation and on-site conservation assessment was conducted on submerged sections of the Albany Town Jetty and in the seabed sediments that surrounded the structure. The conservation survey undertaken in 1994 was comprehensive and a range of data recording methods were used to assess both the seawater and seabed environment and to determine the condition of a selection of submerged materials both organic and inorganic. The full Conservation Management Report is presented as Appendix H in Garratt, *et al.* (1995) and discusses a broader and more encompassing interpretation of the environment on and around the jetty structure.

Scope of work

This most recent on-site conservation assessment (13–21 February 2008) was mainly concerned with the area proposed for reclamation and building development near the Albany foreshore. The temperature, pH, redox potential, dissolved oxygen content and salinity of the local water column and the pH and redox potential of the sediment in the test excavation squares were measured. The condition of the wooden jetty pile remains was also assessed. This report is an adjunct to the more comprehensive 1994 conservation survey and briefly discusses the local underwater environment and the integrity of the submerged jetty piles.

Methodology

The redox potentials (E_{redox}) were measured on a high impedance digital multimeter, sealed in a custom-built plexiglass waterproof housing, set to read at 2V direct current. The measured voltage refers to the difference in electrical potential between a working electrode, in this case a platinum electrode and a reference electrode, a silver/silver chloride/seawater electrode. Measurements of pH were effected by a BDH GelPlas flat surface pH electrode connected to a Cyberscan 200 pH meter sealed inside the custom-built plexiglass waterproof housing. The water depth was measured with a digital dive computer. The temperature, salinity and dissolved oxygen concentration of the seawater column was measured on-site at 0.5m intervals to a maximum depth of 3m with the appropriate sensors connected to a TPS 90DC Microprocessor Dissolved Oxygen and Conductivity meter. The condition of the wooden jetty piles was assessed by the simple probe penetration test, where a stainless steel probe is physically pushed into the surface of the wood as far as possible and then the depth of penetration (mm) recorded.

General Environment

Seawater

The temperature, salinity and dissolved oxygen content of the water column on the Albany Town Jetty site were measured on three separate occasions (13/2/08, 14/2/08, 20/2/08) at two different positions (directly from the jetty adjacent to the 1994 datum pile and at excavation pit 2 area). The results are presented in Table 1.

Table 4. Temperature, salinity and dissolved oxygen content of the water column on the Albany Town Jetty site.

Water Depth (m)	Dissolved Oxygen Content [ppm(S)][1]	Salinity (ppt)	Temperature (°C)
1994 Datum Pile (A) – 13/2/08			
0.0	7.14	37.8	21.8
0.5	7.04	37.8	21.8
1.0	6.92	37.8	21.7
1.5	6.85	37.8	21.7
2.0	6.82	37.8	21.6
2.5	6.78	37.9	21.4
Average	6.93 ± 0.14	37.8 ± 0.0	21.7 ± 0.2
1994 Datum Pile (B) – 14/2/08			
0.0	7.03	37.8	21.8
0.5	6.96	37.8	21.7
1.0	6.86	37.9	21.7
1.5	6.81	37.9	21.5
2.0	6.87	37.9	21.4
2.5	6.30	37.5	20.6
3.0	6.17	37.6	20.6
Average	6.71 ± 0.34	37.8 ± 0.2	21.3 ± 0.5
Excavation Pit 2 – 20/2/08			
0.0	7.45	38.3	18.6
0.5	7.23	37.9	18.8
1.0	7.08	37.8	19.0
1.5	6.92	37.6	19.0
Average	7.17 ± 0.23	37.9 ± 0.3	18.9 ± 0.2
Temperature Compensated DO Data Excavation Pit 2 – 20/2/08			
0.0	7.18		
0.5	6.96		
1.0	6.81		
1.5	6.65		
Average	6.90 ± 0.23		

1 The dissolved oxygen concentrations have been salinity compensated.

Over the seven day site investigation period, the average water temperature was 20.9 ± 1.2°C, varying between 21.8°C and 18.6°C, the average salinity was 37.8 ± 0.2 ppt, the average pH was 8.00 ± 0.17 at a depth of 1m and the average redox potential was -0.038 ± 0.029V relative to the normal hydrogen electrode (NHE). The average dissolved oxygen content (salinity compensated) at the seawater surface was 7.12 ± 0.08 ppm and at a depth of 1.5m was 6.77 ± 0.11 ppm. These results indicate that the Albany Town Jetty site is a typical aerobic marine environment and are in general agreement with Atkins *et al*. (1980) who states that Princess Royal Harbour has a salinity and temperature range of 31-37 ppt and 13-21°C, respectively.

There was no significant change in salinity with depth but the general decreasing trend of dissolved oxygen concentration with increasing water depth is typical for an open circulation ocean environment (Figure 30). However, the solubility of oxygen in seawater increases with decreases in temperature and salinity. Since any differences in salinity were directly compensated for by the 90DC instrument, the dissolved oxygen contents measured on 20/2/08 were mathematically corrected for the 2°C temperature difference using Grasshoff's (1976) oxygen solubility in seawater table [Pearson, 1987: 5]. Hence, the average corrected dissolved oxygen concentration of the water column measured on 20/2/08 was 6.90 ± 0.23, which is in closer agreement with the average readings obtained on the 13/2/08 and 14/2/08 (Table 1).

In addition, the significant decreases in both the dissolved oxygen content and temperature measured at 2.5 and 3.0m on 14/2/08 from the 1994 datum pile would be attributed to the electrodes resting on the seabed surface and not suspended in the water column. The dissolved oxygen electrode is basically a Clarke electrode and as such requires the free movement of oxygen to the electrode surface to gain accurate readings. If the free flow of oxygen to the electrode surface is suppressed, such as when the electrode is in intimate contact with sediment, then the amount of dissolved oxygen reaching the electrode surface will decrease and the readings will consequently decrease. Hence, these two readings were removed prior to graphing the dissolved oxygen values versus water depth (Figure 30).

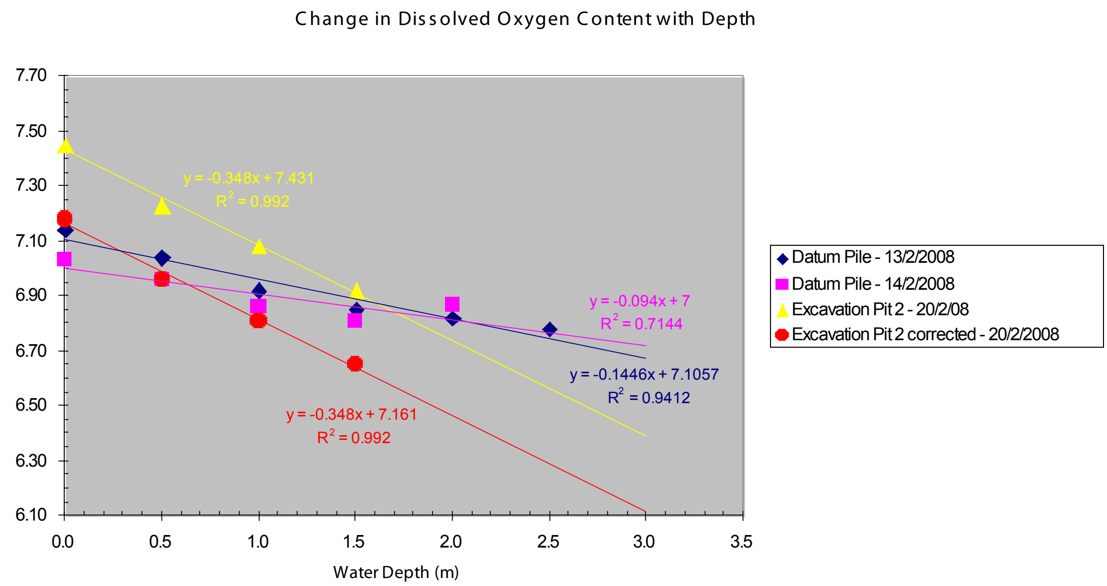

Figure 38. Change in dissolved oxygen concentration with increasing water depth on the Albany Town Jetty site.

It can be clearly seen from Figure 30 that when the dissolved oxygen contents are corrected for the temperature difference there is very little variability between the dissolved oxygen concentrations of the water column measured at different times and positions during the investigation period. Changes in these physical parameters can affect the corrosion and degradation rates of inorganic and organic materials in the marine environment, however the Albany Town Jetty site was relatively stable with respect to these parameters.

Sediment

Two excavation pits (Excavation Pit 1 & 2) were dredged within the confines of a $2m^2$ grid square. Redox potential and pH readings were acquired (~15 mins after excavation completed) extending from the sediment surface, progressing every 0.1m down the slope of one wall of the exposed cross-section of the seabed to the base of the pit.

Table 5. Chemical measurements in the excavation pits on the Albany Town Jetty site.

Depth from Water Surface (m)	Depth of pit from sediment surface (m)	pH sediment	Redox potential (E_{redox} vs NHE) (V)	Description
Excavation Pit 1 (19/2/08)				
1.0	na[1]	7.80	-0.017	open water column
1.8	0.0	7.27	-0.089	sediment surface – seagrass, sand, silt, shell
1.9	0.1	7.39	-0.222	sand, silt, shell
2.0	0.2	7.29	-0.268	sand, silt, shell
2.1	0.3	7.16	-0.237	sand, silt, shell
2.2	0.4	7.15	-0.222	compacted silt, shell
2.3	0.5	7.14	-0.228	compacted silt, shell
2.5	0.7	7.09	-0.248	base of pit – seagrass mat
Excavation Pit 2 (20/2/08)				
1.0	na	8.10	-0.026	open water column
1.7	0.0	6.53	-0.178	sediment surface – sand
1.8	0.1	6.46	-0.173	seagrass, silt, shell
1.9	0.2	6.57	-0.204	seagrass, silt, shell
2.0	0.3	6.78	-0.198	seagrass, silt, shell
2.1	0.4	6.64	-0.109	seagrass, silt, shell
2.2	0.5	6.75	-0.056	large and compact shell, sand (white)
2.3	0.6	6.73	-0.032	large and compact shell, sand (white)
2.4	0.7	6.70	-0.030	base of pit – large and compact shell, sand (white)

1 not applicable

The pH and redox potentials versus sediment depth intervals for both excavation pits are plotted on the graphs in Figures 31 and 32, respectively.

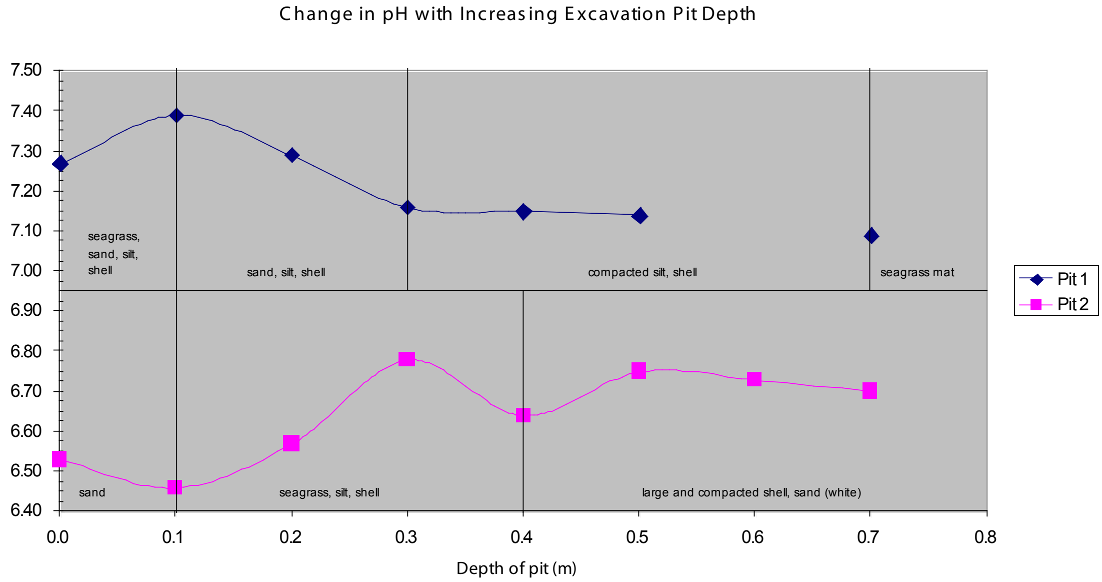

Figure 39. The pH of different sedimentary layers in the excavation pits as a function of increasing sediment depth.

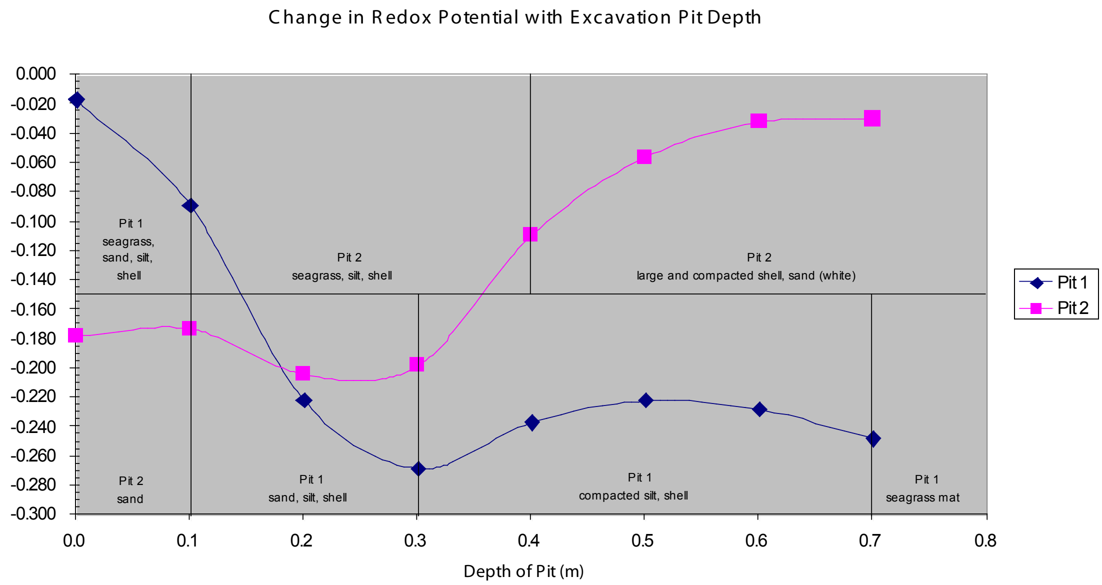

Figure 40. The redox potential of different sedimentary layers in the excavation pits as a function of increasing sediment depth.

Excavation Pit 1

The sedimentary profile of pit 1 consisted of a thin surface layer of contemporary seagrass, sand, silt and shell overlying a layer of sand, silt and shell to a depth of 0.3m. After this depth the sediment layer became more compacted until a dead seagrass layer was reached at the base of the pit at a depth of 0.7m. No measurements were recorded in the sondage.

The lower pH of the surface sediments (~7.27) compared to the pH of the aerobic seawater at 7.80 was to be expected due to the aerobic degradation of organic detritus concentrated in the surface fractions (Figure 31). The pH then decreased until it stabilised at approximately 7.15 in the compacted sediment layer at a depth of 0.3m. The pH then decreased slightly again when the dead seagrass layer was reached at the base of the pit due to the anaerobic decomposition of the plant matter by facultative and near-anaerobic bacteria producing weak acids and polysulphides.

The redox potential of the surface sediment was -0.017V indicating that the sediment was neither oxidising nor reducing in nature, which is typical for surface sediments where dissolved oxygen exchange at the sediment/seawater interface is greatest (Figure 32). The voltage then decreased dramatically over the next 0.2m until an average redox potential of -0.240V was reached at a depth of 0.3m indicating that the compacted sedimentary layers were reducing in nature. This is not unusual as sediments tend to become more reducing in nature as the dissolved oxygen content decreases with increasing sediment depth. Hence, the significant decrease in redox potential after 0.3m indicated that this compact silt and shell layer was essentially stable and had not been subjected to excessive sand and water movement for an extended period of time.

Excavation Pit 2

The sedimentary profile of pit 2, which was excavated closer to the jetty, differed markedly from pit 1. The seabed surface consisted of sterile sand overlying a thick dead seagrass layer, which extended to a depth of 0.4m. After this depth, compacted shell and worm casts, including some very large oyster shells, mixed with clean white sand extended to the base of the pit (0.7m).

The average pH of the surface sediments (0.2m) was approximately 6.50, which increased to an average pH of 6.70 in the compacted sediment (Figure 31). This sharp increase in pH would be due to significantly less quantities of deteriorating seagrass and increasing amounts of calcareous material present in this compacted layer. In addition, the pHs of the sediment measured in pit 2 were significantly lower than the those recorded in pit 1. This general increase in the acidity is simply due to the larger concentrations of degrading plant material in pit 2 as compared to the relatively sterile nature of the sedimentary layers in pit 1.

The average redox potential of the seagrass layer in pit 2, which extended to a depth of 0.4m, was about -0.188V, indicating that this area was reducing in nature (Figure 32). Increased biological deterioration of the detrital plant matter would deplete dissolved oxygen concentrations in this layer, thereby producing a more reducing environment in this relatively shallow depth range. Below this depth, where the compacted shell and sand layer was observed, the voltage increased quite rapidly to a maximum potential of -0.030V, indicating that this layer was significantly more oxidizing in nature. The white appearance of the sand in this layer also supported a more oxidizing microenvironment as sediments in more reducing environments tend to become grey in colour. This can be explained by the absence of large quantities of organic matter in this sedimentary layer. Microbial activity decreases significantly with a decrease in the quantity of organic matter present in a sediment and therefore less dissolved oxygen is utilised in metabolic processes and a concomitant increase in redox potential ensues.

Conservation conclusions

The physico-chemical results of the seawater indicate that the Albany Town Jetty site is a typical, open circulation, aerobic marine environment and therefore, aerobic degradation mechanisms would be expected to occur on exposed inorganic and organic materials. In addition, the results obtained from the chemical measurements of the sedimentary layers in excavation pits 1 and 2 are in general agreement with the 1994 data acquired from the N-S transect excavation pit (1) and the mail steamer jetty test pit (#2), respectively (Garratt *et al*. 1995; Appendix H, pp. 9-11). In brief, the results indicate that there are significantly greater quantities of detrital plant matter present in the sediments closer to the jetty. Therefore, microbial and chemical activity and hence, the rate of degradation of organic and inorganic materials, would be greater in sediment near the jetty than in the more sterile sediment east of the jetty.

Figure 41. Conservator recording data in test pit.

Conservation Assessment of Artefacts

Wooden Jetty Piles

The 1994 condition assessment of the historic jetty pile identified as the datum pile, involved progressively drilling into the pile then the pH and redox potential of the wood measured at increasing penetration depths. This recent degradation assessment was conducted by a simple probe penetration test, which can be used to qualitatively determine the extent of wood deterioration. The results of the probe penetration test and the diameter measurements of the jetty piles on the Albany Town Jetty piles are presented in Table 3.

Table 6. Probe depths and diameter measurements of the Albany Town Jetty piles.

Pile Number	Probe Depth (mm)	Diameter (mm)
1	30	280
2	15	300
3	30	360
4	15	300
5	15	360
6	40	280
7	10	330
8	5	240
9	40	250
10	10	300
11	5	300
12	40	nd[1]

1 not determined

The twelve historic wooden jetty piles from the Albany Town Jetty recently examined to determine the extent of degradation, had been severed off at an average height of <0.5m above the seabed. The diameter of the piles ranged from 240mm to 360mm either reflecting the original tree-growth diameter, or where the diameter is reduced, indicating wood loss due to more than average degradation, however, the former would appear the more likely option as there was no apparent relationship between the diameter of the pile and the probe depth. The average diameter was 300 ± 39mm indicating most piles were closer to original tree diameter despite some surface degradation. The extent of degradation ranged from 5mm to 40mm. The average depth of the degraded surface was 21 ± 14mm. This average probe depth is typical for wood that has a relatively thin, degraded outer layer overlying an essentially extensive undegraded core.

The eucalypt jetty piles used in Western Australia appear to survive well despite extensive periods of submergence in the marine environment, particularly those located in the cooler waters of the South West coastal region. Piles recovered during removal of the Albany Deep Water Jetty exhibited limited surface degradation, the extent of which was comparable to the range of degradation in the remains of the old piles of the Albany Town Jetty. The sections of the Deep Water Jetty piles formerly buried in the seabed exhibited very little degradation. The buried sections of the historic piles from the Albany Town jetty are expected to be in a similarly good state of preservation.

The results of these probe tests are comparable to the results obtained during the 1994 survey (Garratt *et al.* 1995; Appendix H, pp. 4, 7-8).

ARTEFACT MATERIALS

The artefacts recovered from the two excavation pits comprised of two modern beer bottles, a fragment of potentially older green glass and small pieces of wood that could possibly be small fragments or off-cuts from jetty construction work. In conservation terms the condition of all of the glass was very good. The waterlogged wood was not affected by marine borers and appeared to retain its original form and dimensions. The well-preserved condition of the wood supports the original conclusions drawn and consequent predictions made about the preservation of organic materials that are likely to be found in the sediment environment surrounding the Albany Town Jetty and potential examples that may be found during excavations of the development site.

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