Koombana Bay foreshore maritime archaeological survey and excavations 21-28 November 2011

Ross Anderson and Madeleine McAllister

Report – Department of Maritime Archaeology, Western Australian Museum – No. 286

Prepared for the City of Bunbury

May 2012

Abbreviations

AHD	Australian Height Datum
AMG	Australian Map Grid
BUEE	Bunbury Excavation East (Lot 882)
BUEW	Bunbury Excavation West (Lot 881)
CoB	City of Bunbury
cm	centimetre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
GDA 94	Geocentric Datum of Australia 1994
GIS	Geographic Information System
GPR	Ground Penetrating Radar
km	kilometre
m	metre
mm	millimetre
MAAWA	Maritime Archaeology Association of Western Australia
PCG	Perth Coastal Grid
SEM	Scanning Electron Microscope
SWIT	South West Institute of Technology
UTM	Universal Transverse Mercator
UWA	University of Western Australia
WAM	Western Australian Museum
www	world wide web

Executive Summary

This report provides the historical background, methodology and results of archaeological surveys and excavations carried out at Lots 881 and 882, Koombana Bay foreshore between 21—28 November 2011. Three sites relating to shipwrecks were located, with descriptions and interpretation provided.

Post-excavation analyses of the sites included historical research, timber sample identifications, fastenings analyses, structural analyses, photographic analysis of perspective and aerial photography and reporting on the *in situ* materials conservation and environmental parameters for the long-term preservation of the sites. Survey results are presented in the form of site plans and GIS (Geographic Information System) mapping.

The main findings are that one shipwreck site on Lot 882is identified as being protected by the *Maritime Archaeology Act 1973,* and two sites on Lot 881 are identified as being parts of shipwrecks that may be protected by the *Maritime Archaeology Act 1973*. Recommendations are made for further work in the study area.

It is **recommended** that:

1. A close-plot water probe survey should be conducted on Lots 881 and 882 to determine the presence of potential maritime archaeological sites that may be protected by the *Maritime Archaeology Act 1973*.

2. The City of Bunbury continue to work with the WA Museum to investigate Lot 881 and 882 to locate maritime archaeological sites, and establish processes for their long-term protection and management under the *Maritime Archaeology Act 1973* and local planning regime. Mapping of the sites and making provision for buffer zones will avoid unnecessary impacts to shipwreck sites by any future development of this area.

3. The City of Bunbury should add all of the shipwreck and archaeological sites located so far to their Municipal Heritage Inventory to protect the sites, and inform future planning and management decisions.

4. Copies of this report should be provided to the Bunbury Historical Society, City of Bunbury library and the State Heritage Office.

Table of Contents

List of Figures

List of Tables

Acknowledgements

The authors, the WA Museum and the City of Bunbury thank the following people and organisations for their valuable support in undertaking the Koombana Bay foreshore archaeology project, and in completing the historical research and analyses for this report.

City of Bunbury
Michael Stewart, Leigh Barrett, Del Ambrose, Trevor Ayres, Rachel Slattery

WA Museum, Department of Maritime Archaeology
Ross Anderson, Field Director
Patrick Baker, photographic services
Mack McCarthy, logistics, volunteer coordinator

WA Museum, Department of Materials Conservation
Jon Carpenter, conservator
Isa Loo, conservator and archaeology volunteer
Vicki Richards, research chemist

Archaeology supervisors
Alice Beale, Department of Anthropology, WA Museum
Reneé Gardiner, Earth Imprints Consulting
Jason Raupp, PhD candidate, Flinders University of South Australia
Jennifer Rodrigues, Department of Maritime Archaeology, WA Museum
Debra Shefi, PhD candidate, Flinders University of South Australia
David Steinberg, maritime archaeologist, Northern Territory Department of Natural Resources, Environment, the Arts and Sport, Heritage Branch

Flinders University of South Australia and University of Western Australia student volunteers
Kurt Bennett, Maddy Fowler, Zidian James, Alex Kilpa, Madeleine McAllister, Melanie Robinson, Zoe Robinson, Kate Saxon, Danielle Wilkinson

Archaeology volunteers
Csilla Ariese, archaeologist, WA Museum intern
James Redmond, consultant archaeologist
Michael Gregg, Department of Maritime History, WA Museum

Precision Drainage
Dave Pride, Peter Langridge, Dan Armstrong, Lester Hodge, Chris Lucas, Chay MacDonald, Aaron Mills, Allen Pearson, Harley Tito, John Weatherly

South West Institute of Technology, School of Surveying
Bill Chernabaeff, Ian Fewster, Jake Friend, Mike Horton, Sam Klein, David MacInnes, Karl O'Toole, Sam Prater, Steve Radbone, Michael Rayner, Yosep Shon

Geophysical surveys
Richard Yelf, Georadar Research Pty Ltd
Phil McClelland, Ultramag Geophysics
Darren Wilkinson, Cardno Spectrum Survey

Survey support
Thompson Surveying Consultants
Harley Global – Bunbury office
Ray Parks, surveyor (ret.)

Mechanical excavation
Kelvin Roberts, Supervisor, J.W. Cross & Sons Earthmovers
John Cross, Excavator operator, J.W. Cross & Sons Earthmovers

Metal detection
Bob Sheppard, Heritage Detection Australia

Samples analysis
Dr Ian Godfrey, Head, Department of Materials Conservation, WA Museum
Wendy van Duivenvoorde, Flinders University of South Australia
Michael Verrall, CSIRO Exploration and Mining

Historical research
Phyllis Barnes, Bunbury Historical Society
Grahame Coves, Bunbury Port Authority (ret.)
Philip L. Hartling, Nova Scotia Archives
Judith Lund, Author
Jason Raupp, Flinders University of South Australia
Leonie Samuelsson, WA Museum Library
Adam Wolfe, Consultant maritime historian and archaeologist

Historic photographs
Rod Dixon, Richard Rennie, Ray Repacholi, George Rose, Julian Saunders

GIS and photographic analysis
Jeremy Green, Patrick Baker and Madeleine McAllister, Department of Maritime Archaeology, WA Museum

Videography
Ian McCann, Maritime Archaeology Association of Western Australia

Vue Group
Alan Lindsay, Helen Clucas, David Rutherford
Website: **carparkwhalers.com**

Carissa Howard, Birdhouse Design
Rodney Hoath, Department of Planning and Infrastructure
Sophie Teede, Marine biologist

1. INTRODUCTION

1.1. Background

Reclaimed land along the Koombana Bay foreshore at Bunbury contains the remains of at least twelve shipwrecks protected as maritime archaeological sites under the Western Australian *Maritime Archaeology Act 1973*. Maritime archaeological sites are vested in the Western Australian Museum (WAM).

In May 2009 the City of Bunbury (CoB) commissioned magnetometer and ground penetrating radar (GPR) surveys to be carried out on Lots 881 and 882 on Koombana Drive. The results of the surveys showed magnetic and radar anomalies interpreted as cultural features, likely to be the remains of the shipwrecks (Cardo Spectrum Survey 2009). The sites lie on the old 1896 shoreline, which has since prograded northwards due to harbour improvement works that commenced in 1896 causing sedimentation of Koombana Bay.

Since March 2009 CoB and WAM staff have been in discussion regarding the future development of Lots 881 and 882; the protection of all pre-1900 shipwreck sites buried in reclaimed land at Koombana Bay as being vested in the WA Museum under the *Maritime Archaeology Act 1973*; and long-term site management and conservation issues.

In a meeting held on 20 May 2010 the CoB Mayor, Councillors and staff and WAM staff discussed the future development of Lots 881 and 882 and the CoB's intention to develop Lot 882 as a site for the Three Waters Visitor Centre. The CoB is in negotiations with the State Government over the transfer of Lot 881 to freehold status to fund this development.

The meeting resolved that archaeological test excavations of the anomalies on Lots 881 and 882 were required to identify the nature of the features, and the CoB requested WAM assistance to prepare a project brief and methodology for this work.

A Memorandum of Understanding between the CoB and WAM (Appendix A) defined the scope and nature of the archaeological test excavations to be undertaken.

1.2. Objectives

The objectives of the archaeological test excavations were to:

1. Excavate selected areas on Lots 881 and 882 to determine if the geophysical anomalies detected by the magnetometer and GPR surveys are cultural features;
2. Identify any cultural features to determine if they are shipwreck-related, and therefore maritime archaeological sites;
3. Determine the extent and alignment of the cultural features;
4. Define an adequate buffer zone to protect the cultural heritage values of any protected maritime archaeological sites; and
5. Backfill sites following test excavations.

The archaeological investigations included:

1. Mechanical and manual excavation, and recording of cultural features located in Lot 881 and Lot 882; and

2. Water probe surveys to further identify and delineate anomalies, and locate any other potential cultural heritage sites not able to be detected using magnetometer or GPR.

1.3. Study area

The study area lies within the cadastral limits of Lots 881 and 882 along Koombana Drive, on the foreshore of Koombana Bay, Bunbury, located approximately 170 km south of Perth (refer Figure 1 and Figure 2).

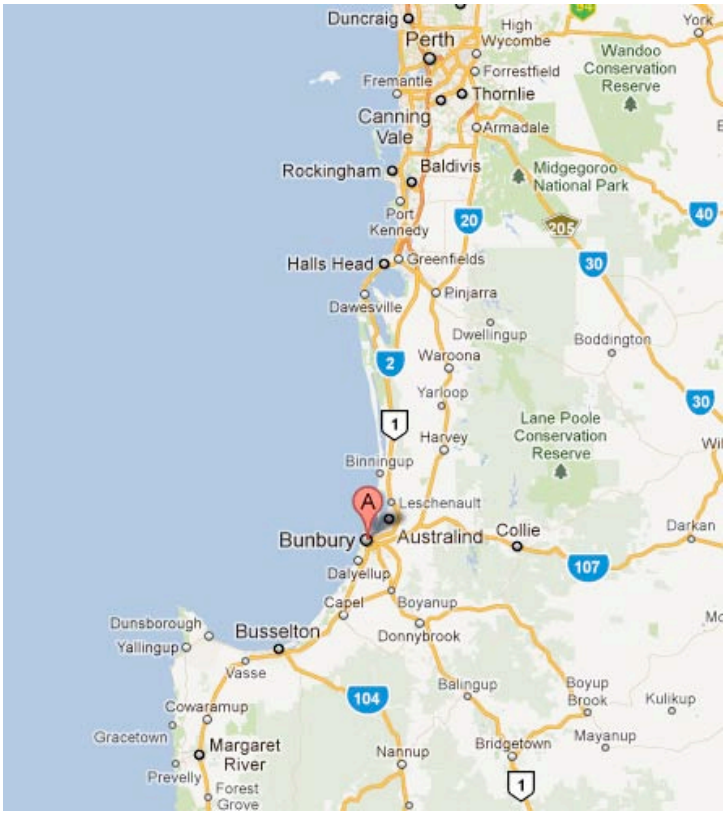


Figure 1. Location of Bunbury, 170 km south of Perth.

Source: WhereIs (online), 2012.

Figure 2. Study area location south of Koombana Drive, Bunbury.
Source: Landgate/ WA Museum.

1.4. Legislative requirements and practice guidelines

All work was completed observing legal requirements under the *Maritime Archaeology Act 1973* and in accordance with the Australasian Institute of Maritime Archaeology (AIMA) Code of Ethics, the principles outlined in the Australia ICOMOS *Charter for the Conservation of Places of Cultural Significance* (*Burra Charter*) guidelines (1999) and Annex to the *2001 UNESCO Convention on the Underwater Cultural Heritage*.

1.5. Project team

The details of the project team are presented in Table 1.

Table 1. Project Team.

Role	Company	Contact Person
Project Manager	City of Bunbury	Michael Stewart, Leigh Barrett
Field Director	WA Museum, Department of Maritime Archaeology	Ross Anderson
Dewatering	Precision Drainage	Dave Pride

Role	Company	Contact Person
Mechanical excavation	J.W. Cross & Sons Earthmoving	Kelvin Roberts, John Cross
Surveyors	South West Institute of TAFE, School of Surveying	Bill Chernabaeff
Materials conservation	WA Museum, Department of Materials Conservation	Vicki Richards, Jon Carpenter
Archaeological field team	Flinders University University of Western Australia	Volunteers

2. LAND USE HISTORY

2.1. Introduction

A brief chronological summary of the maritime and land use history of the study area is provided below to assist in understanding the events and the processes that have resulted in shipwrecks, potential archaeological deposits and left material traces of past development, impacts and use.

2.2. Chronology

The historical use of the study area between 1830 and 1896 relates to the littoral zone with the pre-1896 shoreline running through the area. Shipping in Koombana Bay was exposed to north and north-west gales. Ships that were blown ashore and unable to be refloated became shipwrecks lying in the littoral zone of Koombana Bay. The earliest recorded ships wrecked within the study area are the American whalers *Samuel Wright* and *North America,* lost in the same northwest gale on 8 July 1840. Subsequently other shipwrecks and disassociated wreckage were washed up along the beach between the Leschenault Estuary entrance bar ('Stingray Surf') and North Beach, east of the estuary entrance. Exposed wrecks were salvaged and reused for vessel construction, firewood, building timbers, fastenings and cargo, though buried parts of shipwrecks that were not salvaged have remained well preserved.

At least nine shipwrecks have been recorded as having blown ashore in the area from the mouth of the Leschenault Estuary to the North Beach—approximately between the present day Estuary Entrance Cut and the Inner Harbour. Additionally there may be 'rafts' of disassociated wreckage from other wooden shipwrecks such as the *Midas* (1876), *Solglyt* (1901) and *Laughing Wave* (1903) washed up in the study area. Detailed historical descriptions of the wrecking events are found in Henderson (1977), Cairns & Henderson (1982) and McCarthy (1982), with a précis of the wrecks provided in Table 2 below.

Table 2. Chronology of shipwrecks in North Beach area, Koombana Bay.

Shipwreck	Description	Sources
Samuel Wright (8/7/1840)	American whaler, 372 ton wooden ship b.1824Portsmouth, New Hampshire. Whaler registered Salem, Massachusetts. Blown ashore 'high on the beach'.	McCarthy 1982, Henderson 1977.
North America (7/8/1840)	American whaler. 260 ton wooden ship registered Wilmington, Delaware. Blown ashore in same gale as the *Samuel Wright*.	McCarthy 1982, Henderson 1977, *Perth Gazette* 1/8/1840
North America (11/4/1843)	American whaler, 285 ton wooden ship b. Warren, New York in 1804. Dimensions 29.1 x 7.9 x 4.0m. Blown ashore in a violent storm.	McCarthy 1982, Henderson 1977, Barnes 2010.
Elizabeth (17/11/1843)	100 ton wooden schooner b. 1831 Calcutta, India. Dimensions 18.9 x 5.5. x 2.7m. Owned by L. and W. Samson of Fremantle and used in coastal and international trade, last voyage Kepulauan Riau to Fremantle.	McCarthy 1982, Henderson 1977.

Whalers cutting in flat (1847)	Blown ashore in same gale as *Antelope* (the *Antelope* was later refloated).	*Inquirer* 11/8/1847 p.2.
Midas (1872)	555 ton wooden barque b. 1865 Farmingdale, USA. Heavily salvaged including new karri pine deck used to build a wooden lighter.	Minutes of Court of Inquiry regarding the Stranding of the Barque *Midas* on 10 March 1872, C.S.R. 727, fol. 30 Herald, 28 March 1874 *Western Australian Times*, 11 August 1876; McCarthy 1982; E.H. Withers diary.
Annie M. Young (4/11/1876)	Wooden 335 ton brig, b. 1863 in Yarmouth, Nova Scotia. Dimensions 33.2 x 8.1 x 5.3m. Iron knees and copper sheathed. Owner W. McCormick, Dublin. Cargo of jarrah piles for New Zealand.	McCarthy 1982, W. P. Clifton to Col. Sec., 4 November 18 76, C.S.R. 844, fol. 190 SRO 129 File 23/911 Police Records *Inquirer*, 29 November 1876 E.H. Withers diary *Novascotian,* 14 Dec 1863 p.3
Citizen of London (20/8/1880)	53 ton wooden schooner, single deck, dimensions 17.4 x 5.7 x 2.6m, b. Vasse, WA, 1878 by George Payne. Struck jetty and blown ashore with cargo of sandalwood from Bunbury to Fremantle. Owners George and Arthur Payne of Capel.	*The Countryman*, 27 June 1961 Inquiry respecting *Citizen of London*, 3 September 1880, C.S.O. 1309/1880, fol. 44 *West Australian*, 5 May 1880; NAA: A7499, CA808.
Star of the South (25/6/1888)	12 ton wooden lighter b. Bunbury 1875 by James Dagley Gibbs, dimensions 14.2 x 3.8 x 1.6m, cutter rigged. Blown ashore with cargo of guano from Shark's Bay in mouth of estuary in same gale as *Citizen of London*.	*Inquirer*, 25 January 1888, 27 June 1888. *West Australian*, 27 June 1888, p. 3d. E.H. Withers diary McCarthy 1982; NAA: A7499, CA808.
Cingalee (1887)	337 ton wooden barque b. 1872 Dundee, Scotland, dimensions 40.1 x 7.9 x 4.5 m, one deck. Wrecked Lacepede Islands 1886,refloated and repaired in Fremantle. Blown ashore at Bunbury nearly in same spot as *Annie M. Young*, heavily salvaged for firewood.	*West Australian*, 21 June 1887, p. 2g Inquiry Evidence, 28 July 1887, CSO 2009/1888 *Inquirer*, 25 January 1888. McCarthy 1982; NAA: A7499, CA808.
Solglyt (1901)	875 ton wooden barque b.1888 Grimstead, Norway, dimensions 53 x 10.5 x 6.1 m.	Harbour & Light AN 16/5/ACC1066/4196/1907 (BATT) McCarthy 1982.
Laughing Wave (1903)	161 ton wooden schooner b. Fremantle 1868, dimensions 34.55 x 7.14 x 3.6 m	*West Australian*31/8/1903 p.4i and 5/9/1903 p.6a; McCarthy 1982.

From 1896, development of the Port of Bunbury and construction of a rock breakwater to reduce wave action in Koombana Bay created an obstacle to the natural northerly longshore drift of sediment. However it also trapped sand travelling in a southerly direction as a result of north-westerly storms causing sedimentation of Koombana Bay. Sediments were also deposited in Koombana Bay during flooding of the Leschenault Estuary. The Power Station groyne was built in 1934-36 to halt the north-south drift of sand into the harbour, and the original Estuary mouth was plugged with a new opening 'The Cut' and northern groyne constructed to reduce sedimentation (Riedel & Byrne 1980: 2-5). However between 1896 and 1936, the coastline in Koombana Bay has prograded out to its current location, approximately 200 m north of the pre-1896 coastline. A railway (since removed) was constructed through the study area in the 1930s to transport quarried rock from Roelands quarry for further breakwater improvements. Due to this sedimentation and coastal prograding Lots 881 and 882 now overlie the pre-1896 beach and northern shoreline of Koombana Bay.

Figure 3. Geo-referenced Wollaston map showing pre-1896 shoreline in North Beach area with 2012 shoreline (Landgate/ WA Museum).

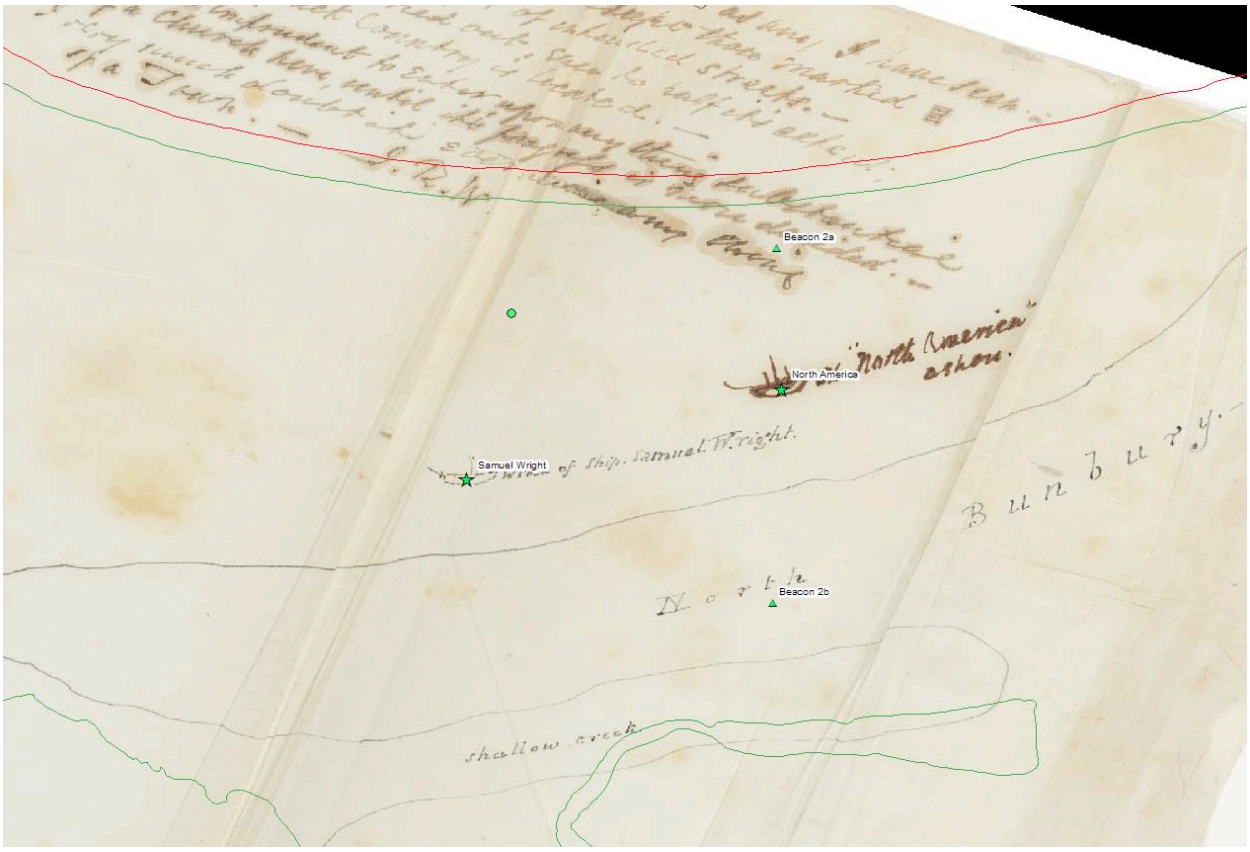


Figure 4. Detail of geo-referenced Wollaston map showing 2012 shoreline (red and green lines indicate tidal zone), and pre-1896 North Bunbury shoreline with positions of the American whalers *Samuel Wright* (1840) and *North America* (1840) ashore (Landgate/ WA Museum/ Mitchell Library).

From 1956 mining of rich mineral sands including zircon, monozite and ilmenite by the Cable Sands Company saw large-scale industrial disturbance of the area. Between 1962 and 1963 Cable Sands Company bulldozer operators uncovered the remains of four wooden shipwreck sites including an American whaler and three unidentified sites. Three of the wrecks had copper alloy fastenings and timber frames, and one of the wrecks had a wooden hull with iron knees (McCarthy 1982).

Site M was discovered during preparation of the launching site for the Cable Sands Company floating dredge, and was partially covered by Cable Sands Company drying shed. This site was left unexcavated, and no further research or identification has been carried out (McCarthy 1982). It lies outside of the present study area.

Site K lay 800 m south from Site M and, after being uncovered by the Cable Sands Company, was further excavated by members of the Bunbury Historical Society and other locals (McCarthy 1982). Dr Ian Crawford of the WA Museum's Anthropology Department visited the site in 1962 and took photographs, measurements, timber samples and a sample of artefacts. The wreck was described as a well-preserved wooden hull 95.5 feet (29.1 m) lying upright, on an even keel, on an approximate north-south axis. The length matched the recorded dimensions of the American-built, two-decked ship *North America* (1843) of 95.5 x 26 x 13 ft (29.1 x 7.9 x 3.9 m) and timber samples were identified as the native American timber Pencil Cedar (*Juniperus Virginiana*) and White Oak (*Quercus sp.* – Europe and northern America). Associated artefacts

included a windlass, rudder, ceramics, bricks, glass and a cask lid inscribed 'Prime Pork Baltimore 18-1'. Based on the artefacts, timber samples and length measurement, the site was identified as the American whaler *North America* (1843) (McCarthy 1982).

Figure 5. Bunbury shipwreck Site K/ *North America* (1843) being exposed by Cable Sands Company bulldozer operator Mr Leo Sophilis (WA Museum).

Figure 6. Site K/ *North America* (1843) (Courtesy Julian Sanders).

Site L lay on an east-west axis 30 m from Site K. It has been described as lying 'a few yards north and slightly east' and 'partly on its side' (Deman, R. to WA Museum, pers. comm., 25/2/1991). Due to theft of the windlass, rudder and other artefacts from Site K, the Bunbury Historical Society recommended that Site L be left unexcavated. Based on historical information that Site K/*North America* (1843) went ashore lying close to the *Samuel Wright*, McCarthy tentatively identified this wreck as the *Samuel Wright* (McCarthy 1982). Alternatively it could be one of the other seven shipwrecks recorded as having gone ashore in the North Beach area.

Site J was uncovered by Cable Sands Company bulldozer operator Mr Leo Sophilis and was subsequently relocated visually and by magnetometer survey during the WA Museum's 1982 survey. This wreckage was described as section of mid to late 19th century ship's hull in the range of 200-400 tons with iron knees, and was lying under the Number 2 tee of the Koombana Park golf course (McCarthy 1982).

At the cessation of sand mining activities in this area the sites were reburied in mine tailings, though unfortunately their exact positions were not recorded (McCarthy 1982). Since the passing of over half a century the wrecks have again literally become 'buried in the sands of time'.

From the cessation of sand mining to the present day the area has been used as a caravan park, mini golf course, car park, main road, suburban and foreshore development zone and vacant land.

Table 2 presents a chronology of the relevant land use history and historical events relating to the study area.

Table 2.Chronology of land use relating to Koombana Bay foreshore.

Date	Description
1830	Military station set up under Ensign MacLeod 'on the north shore of the inlet at a place the natives called Didinup'. Soldiers constructed a dugout canoe to cross the estuary (Barker 1992: 8).
1840	American whaling ships *Samuel Wright* and *North America* blown ashore and wrecked on the North Beach. Carcasses of whales were washed up on the beach in the course of whaling operations during the 1840-50s, and Aboriginal groups are recorded to have visited the area to feast on whales. Robert Scott employed Aboriginal people in a bay whaling venture.
1842	Survey of Bunbury undertaken by Henry Mortlock Ommaney using *Samuel Wright* mast as a conspicuous landmark. Ommaney also records the position of a whaler's grave in the area, and location of Western Australian Company store house.
1843	American whaler *North America* and schooner *Elizabeth* both blown ashore and wrecked on North Beach. Reverend Wollaston traces Ommaney's map showing locations of *Samuel Wright* and *North America* (1840).
1847	Whalers' cutting-in flat (working platform used in processing of whales) blown ashore.
1872	Barque *Midas* wrecked in Koombana Bay and broken up/ salvaged.

Date	Description
1876	Brig *Annie M. Young* blown ashore and wrecked on North Beach.
1880	Schooner *City of London* smashed against jetty and was run aground on the North Beach (Barker 1992: 122).
1887	Barque *Cingalee* blown ashore and wrecked on North Beach.
1895	Barque *Agra* blown ashore on northern side of entrance to the estuary, but later refloated.
27 April 1896	Commencement of construction of Bunbury breakwater at Casuarina Point. Railway line built and stone obtained from Collie quarries.
1899	Breakwater construction completed.
1900	Area used as a Quarantine Ground.
1918	Breakwater extended. Increased siltation of jetty berths and accretion of sand at the river mouth becomes evident. Continual dredging of harbour required.
1933	Breakwater improvement scheme commenced. Stone obtained from Roelands quarries. Construction of railway through study area to transport stone.
1950s	Area reported to have been used by individuals from low socio-economic groups living in shacks and makeshift housing e.g. pensioners.
1956	Cable Sands Company sand mining operations commence.
1960-63	Discovery of at least two large intact shipwrecks in study area by bulldozer operators, including one identified as the *North America* (1843). Removal, relocation and burning of wreck material reported to have occurred during sand mining operations. Use of water pumps and fire hoses by the general public to wash sand from wrecks and recover artefacts. Some large artefacts illicitly removed from the sites e.g. windlass, rudder.
1970-80s	Use as a caravan park and mini-golf course.
1980s	Bitumen car park laid on Lot 882. Construction of 'The Cut' into Leschenault Estuary results in discovery of hull remains identified as part of the wrecked Norwegian barque *Solglyt* (1901). The wreckage was broken up, removed and reburied.
1982	State Electricity Commission and WA Museum conduct Koombana Bay shipwreck survey (McCarthy 1982).
1988	Koombana Bay shipwreck trail established. A plinth commemorating the three American whaling shipwrecks placed based on surveyor Ray Parks' recalculation of Ommaney's position of *Samuel Wright*.

In 1982 the WA Museum was commissioned to carry out a survey of Koombana Bay wrecks for the State Energy Commission (McCarthy 1982). Maritime archaeologist Mike McCarthy incorporated historical, archaeological and oral sources to identify the approximate locations of shipwrecks, including within the current study area (Figure 7).

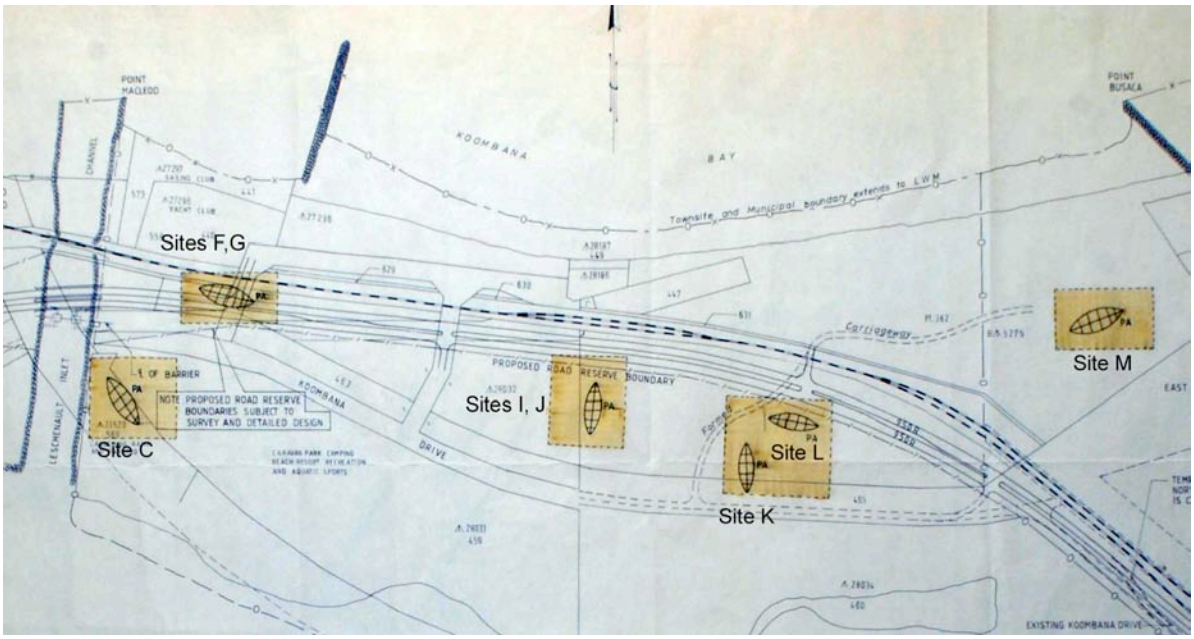


Figure 7. Approximate positions of wooden shipwreck sites located on Koombana Bay foreshore documented in McCarthy (1982). Sites I, J, K and L are in the current study area (WA Museum).

Historical research using maps and charts, and documentary sources has provided information that assists in determining the approximate location of wrecks, and their relationship to each other. In 1840 Reverend Wollaston traced surveyor Henry Ommaney's map of Bunbury that provided a location for the *Samuel Wright* and *North America* (1840). Commander John Lort Stokes R.N. charted Koombana Bay in 1841 and also provided an approximate location for a wreck, probably the *Samuel Wright* which was still visible in 1843.

Marshall Waller Clifton wrote on 17 April 1841 that the *Samuel Wright* 'lies near the shore on the land outside the Bar of the Inlet to the present time' (Barnes and Cameron 2010). When the *North America* (1843) was later blown ashore in a violent storm on 11 April 1843, Clifton described it as having 'drifted stern foremost over that (the eastern) end of the bar and settled on the beach near the wreck of the *SamlWright'* [sic] (Barnes and Cameron 2010).

E.H. Withers recalled that: 'Some time in the [18] 80s a vessel called the *Annie M. Young* went on the north beach, she was partly loaded with timber, a man named Sam Ward had a bullock team, he took the job of getting the piles and other sawn timber out of her, she was too far gone to refloat so they took what they could and then left the rest. A lot of people got firewood from her and wire rigging. She was a wooden ship, as nearly all were at that time. Another ship, the *Cingaluse* [*Cingalee*] or something like that also went ashore in nearly the same spot and was broken up' (E.H. Withers diary: 3).

Members of the public attended public tours of the November 2011 archaeological excavations, including ex-Cable Sands Company workers, who provided information of their experiences and discoveries of wrecks in the 1960s.

Mr Ray Repacholi advised that there were a total of four wrecks exposed in the area. Bunbury Apex club members used fire hoses to 'clean out' the interior of one wreck and exposed barrel lids with the words 'Nantucket' burnt into them, and numerous clay pipes.

Mr Amando Spinello worked as a lathe operator in the Cable Sands workshop, and advised that a larger ship with copper alloy sheathing and four inch long copper alloy 'nails' was found on the 'left hand side of the silos', and that two wrecks were found in the vicinity of the drying shed. He also advised that the current boat-shaped fence and wreck plinth marked the location of one shipwreck site found 'close to the dunes'.

Mr Colin Coote's father Kevin Coote was a bulldozer driver for Cable Sands, and Colin advised there are 'two wrecks further south of the sand dune'. In the early 1960s as a kid, he salvaged 'buckets' of copper bolts off the wrecks and sold them for scrap metal value. He also advised there were wrecks within the Cable Sands Company grounds.

Mr Frank Spineri worked as a welder/ boilermaker at Cable Sands in the 1960s, and recalled building the floating dredge. When they excavated next to the shed in order to launch the dredge they discovered a wreck under about three metres of sand. He described the location as about 10-15m from the south wall of the drying shed (this building is still standing). This correlates with information about 'Site M' found in proximity to the drying shed (McCarthy 1982).

Mr Dave Scott provided information that ship wreckage was found close to the current Koombana Drive during sand mining operations, and that this wreckage was dragged out of the way to higher ground.

Mr George Webber was a bulldozer driver and recalled getting bogged with his D4 Caterpillar, requiring cranes to get it out. During the discovery of one wreck the Museum fenced it off to protect the site, but another was apparently described as not being significant as 'it was not a whaler'. He recalled 'burning a lot of timbers' during his work on nightshift and noticed that the timbers produced a curious 'bright red ash'.

Mr John Cross worked as a bulldozer driver in the 1960s and was the excavator operator on the November 2011 archaeological project. John's recollection of the location of the large wreck lying north-south ('Site K' *North America* (1843)) was that it lay approximately between the areas of the excavated trenches on Lots 881 and 882.

Figure 8. Excavator operator John Cross working at Cable Sands Company in the 1960s (courtesy John Cross).

3. PHOTOGRAPHIC AND GIS ANALYSIS

3.1. Shipwrecks

Since the November 2011 excavations members of the public have provided previously unseen photographs of the Koombana Bay shipwrecks taken when they were lying exposed in the 1960s. The photographs contain background landmarks that assist in identifying shipwrecks and their possible locations. Recognisable landmarks include navigation beacons, power poles, power station chimneys, the Bunbury jetty, vegetation, the Cable Sands Company drying sheds and silos. Although no single photograph contained sufficient information to relocate the exact position of a shipwreck, when analysed in combination with other photographs with landmarks, historic maps and charts and aerial photography, approximate locations may be ascertained. A post-excavation project to maximise available information combined information from perspective photography in WA Museum and private collections, historic aerial photography, historic charts and survey information into the Department of Maritime Archaeology's Geographic Information System (GIS).

3.1.1. Site 'K'/ *North America* (1843)

Figure 9. Site K/ *North America* (1843) soon after being discovered in 1962, view south. Note the power pole and navigation beacon in the background. (Ian Crawford/ WA Museum).

Figure 9 shows the wreck designated Site 'K' subsequently tentatively identified as the American whaler *North America* (1843) (McCarthy 1982). The navigation beacon and power

pole in the background provide points of reference for comparison with historical aerial photographs and charts.

Figure 10. Site 'K'/ *North America* (1843), view facing north. Note the navigation beacon in the background (Courtesy Mr Richard Rennie).

The photograph in Figure 10 was provided to the WA Museum by Mr Richard Rennie following the site's discovery. Significantly, it shows the corresponding navigation beacon to that in Figure 9 and assists in pinpointing the location of the wreck in this image. Although the navigation beacons no longer exist, in 1982 surveyor Ross White undertook a similar exercise to relocate shipwrecks in relation to historic photographs, which included ascertaining the function and geographic co-ordinates of these beacons. White determined that the beacons were dredging beacons for the approaches to the Bunbury jetty. The UTM geographic coordinates provided by White for these beacons were incorporated into the GIS.

The Department of Maritime Archaeology also conducted a search of Landgate historic aerial photography and acquired relevant frames. Aerial photographs were geo-referenced to overlay historic maps and satellite imagery in the GIS. Figure 11 and Figure 12show how the original point of perspective in historic photographs may be relocated by matching background landmarks with known features on charts and aerial photography.

Figure 11. Image of 'Site K'/ *North America* (1843) looking approximately east-north-east. Cable Sands Company drying shed, silos and Bunbury power station chimneys at top right. (Rod Dixon Collection/ WA Museum).

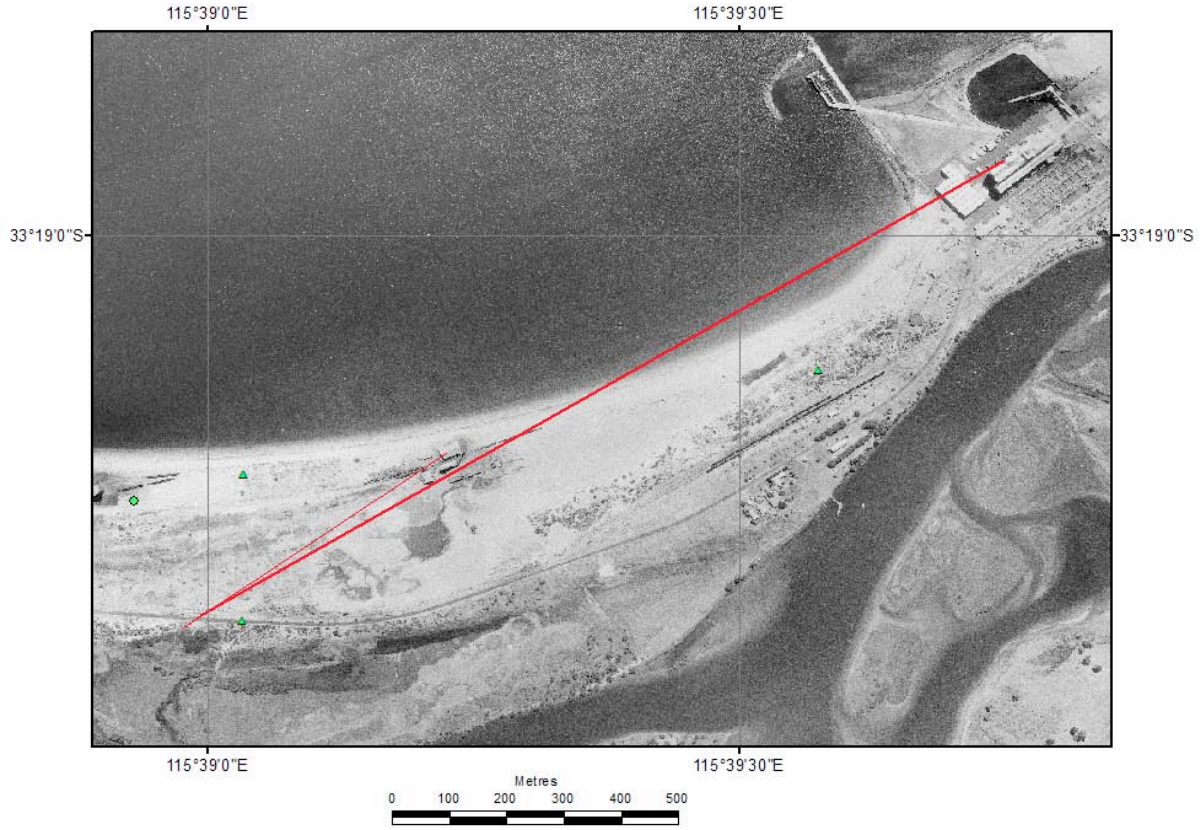


Figure 12. 1960 aerial photograph of the Koombana Bay foreshore showing Cable Sands sheds (just left of centre of image) and Bunbury power station (at top right of image), with transit lines in red. Green triangles represent dredging beacons (Landgate/ WA Museum).

Figure 12 shows the two transit lines converging from the power station chimneys and Cable Sands drying shed, obtained from the point of perspective in Figure 11. The green triangles in Figure 12 and Figure 13 mark the points for the dredging beacons seen in Figure 9 and Figure 10 (the green circle marks another unrelated beacon point). The point of convergence of the transit lines marks the approximate location of the original point of perspective in Figure 11, and as the wreck lies along a line between the navigation beacons gives an approximate location for the wreck.

In order to understand where this location lies in the present day, the transit lines were overlaid onto a modern aerial photograph (Figure 14). The results indicate that the location of Site 'K' *North America* (1843) lies in the vicinity of the south-east end of the car park.

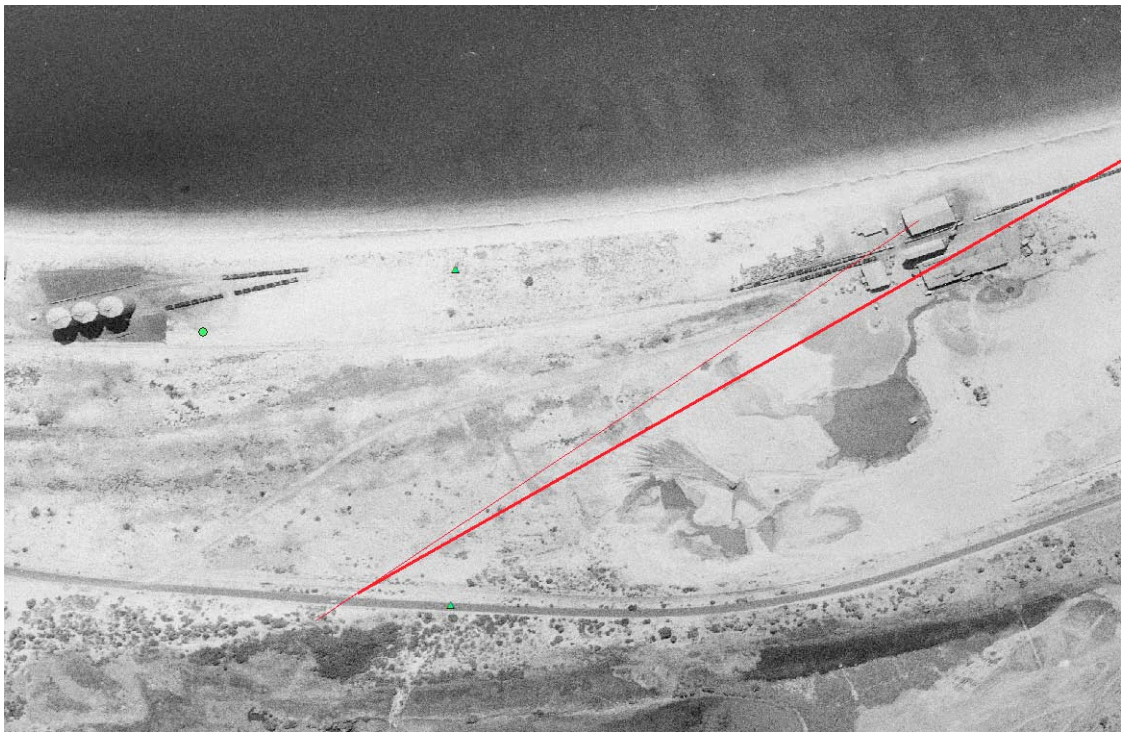


Figure 13. Detail of 1960 aerial image showing beacon points and transits. (Landgate/ WA Museum).

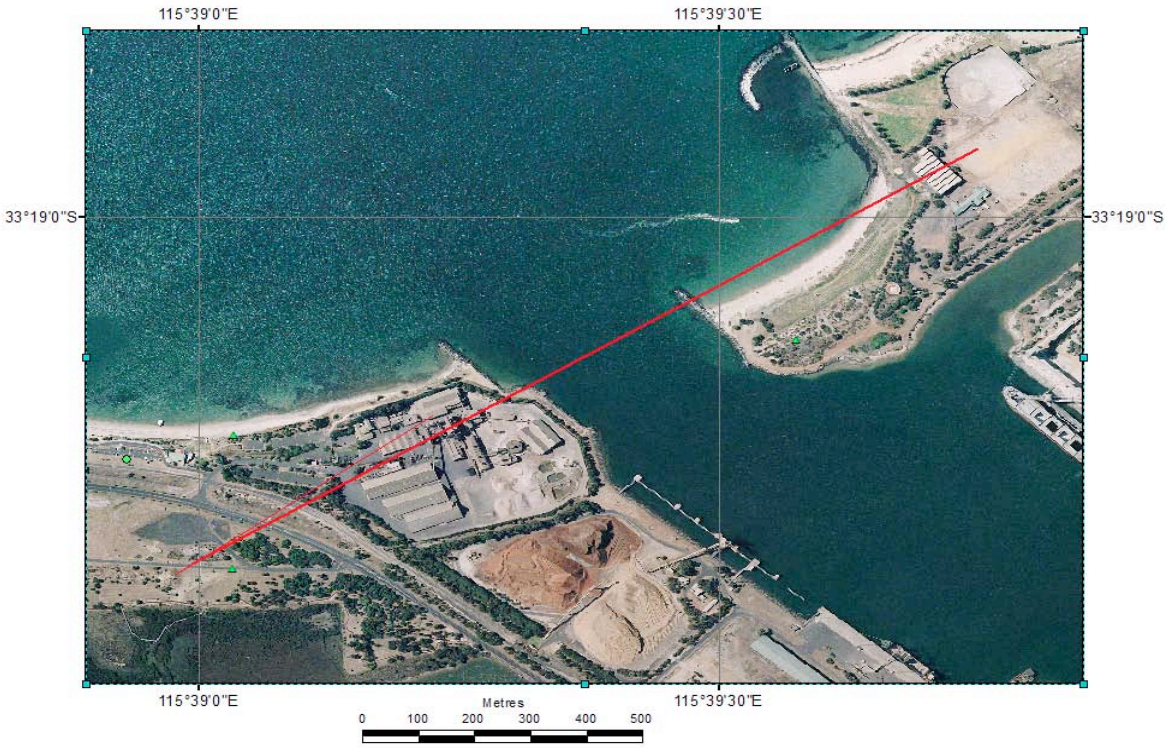


Figure 14. Modern aerial image with historic transits for Site K/ North America (1843) (Landgate/ WA Museum).

3.1.2. Samuel Wright (1840)

In his position as Government Resident Surveyor in the Vasse and Leschenault Districts, Henry Mortlock Ommaney undertook a survey of Bunbury in 1841-42 (Parks 1990: 157). Ommaney included the position of 'Coffin's wreck' on his map, and used the mast from the wreck of *Samuel Wright* as a conspicuous landmark from which to take angles. There is no surviving map of Ommaney's survey, however a tracing of Ommaney's map by Reverend Wollaston has been dated to around 1843 (Parks 1990:157-158). In 1988 surveyor Ray Parks' recalculated a position for the *Samuel Wright* from Ommaney's Field Notebooks in the Battye Library (Parks 1990: 162, 166).Parks' position for the *Samuel Wright* was calculated in UTM as 6312028.456, 374141.431 (AGD84) (S 33.32222°, E 115.64932° (GDA94)).As part of 1988 Australian Bicentennial activities, a commemorative plinth was placed on the location of the *Samuel Wright*'s mast (Parks 1990: 1966).

The Department of Maritime Archaeology obtained a copy of Wollaston's map from the Mitchell Library, NSW. The Wollaston map was geo-referenced and added to the GIS, with the finding that the position of the *Samuel Wright* lay within the Lot 882 archaeological grid, some 70 m from Parks' position (Figure 15). It is noted that the Wollaston map has paper fold creases that affect its accuracy, which in turn affect the accuracy of the projected location for the *Samuel Wright*.

It is significant that both Parks' and the WA Museum's attempts to relocate *Samuel Wright*'s position from two separate sources of information place the *Samuel Wright* within the study area.

Figure 15. Two projected locations of *Samuel Wright* derived from 1) geo-referencing Wollaston's map of Bunbury and 2) Parks' recalculation from Ommaney's field notes. Note also Parks' calculated position for the whaler's grave, and Wollaston's position for the *North America* (1840) (WA Museum/ Landgate).

3.2. Other sites

3.2.1. Western Australian Company store house (1841)

In an attempt to provide better control for the geo-referencing of the Wollaston map, a related project was undertaken to relocate the site of the WA Company Store on the northern side of the Leschenault Estuary, that is marked on Wollaston's map.

The Western Australian Company founded the settlement of Australind north of Bunbury in 1841. In April 1841 Mr Moore established a store on the northern side of the Leschenault Estuary for Australind settlers to unload from ships, and then transport their supplies to Australind by boat. The store was described by Marshall Waller Clifton as being 'badly constructed' of 'American shipwreck timbers', and was not ideally situated as it flooded in up to three feet of water during one storm (Barnes and Cameron 2010; Barnes, P., pers. comm., October 2011). The Western Australian Company is also recorded as having used the wreck of the *Samuel Wright* itself as a storehouse (*Perth Gazette and Western Australian Journal* 11/12/1841, p.2).

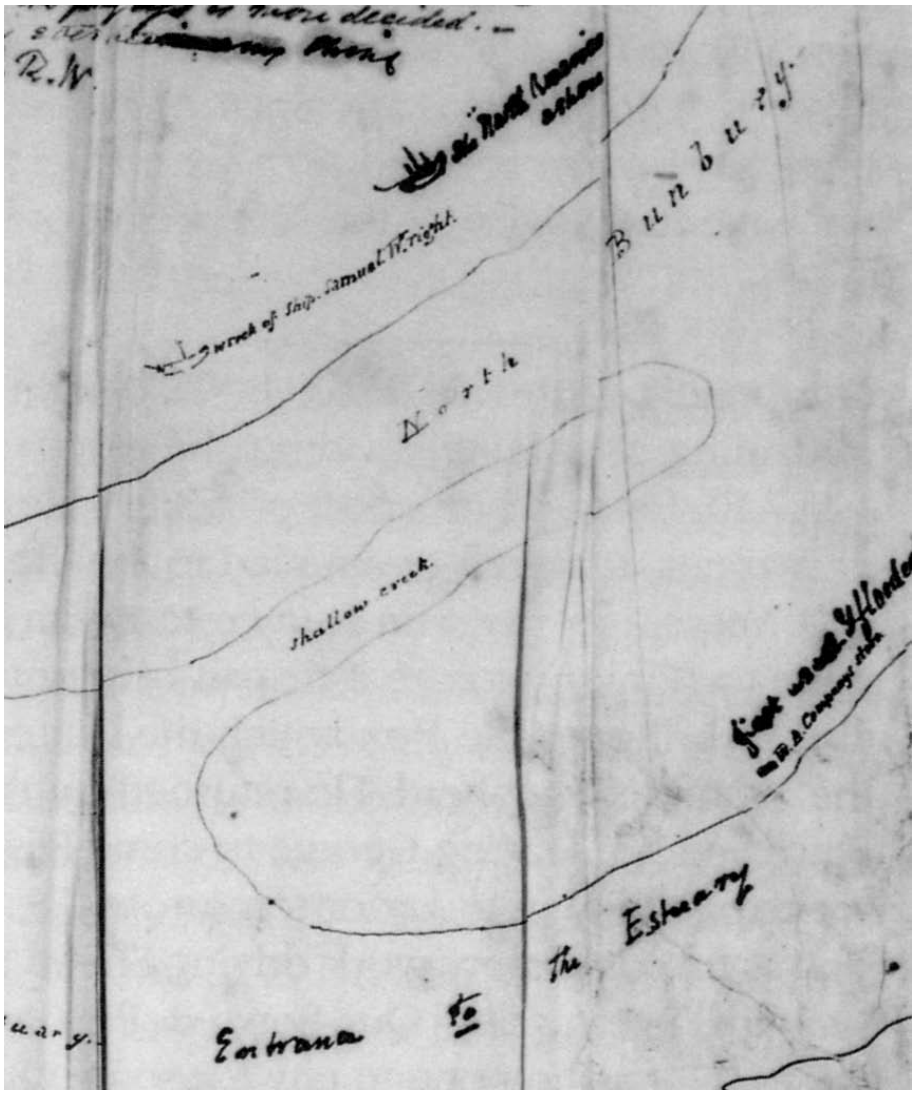


Figure 16. Wollaston's map showing location of WA Company store (bottom right of image) on northern shore of Leschenault Estuary in relation to *Samuel Wright* (1840) and *North America* (1840) shipwrecks (Mitchell Library).

Reverend Wollaston marked the location of the store on his plan of Bunbury (Figure 16), and this plan was scanned and geo-referenced to provide a search location. On 23 November 2011 a visual and metal detector search was made for the site of the Western Australian Company store house. Three squared timber posts embedded in swampy ground (Figure 17 and Figure 18), some broken green glass and an area of compacted ground that is possibly a built-up floor, were located in a marshy area on the northern side of the inlet that correlated with the coordinates obtained from Wollaston's map. No metal targets were detected.

The site appears to be the remains of the 1841 Western Australian Company store, and has historical and archaeological significance as an early colonial site associated with the settlement of Bunbury and Australind.

Figure 17. Timber post in situ identified as remains of the Western Australian Company store (Ross Anderson/ WA Museum).

Figure 18. Two timber posts one metre apart associated with an area of compacted earth floor (Ross Anderson/ WA Museum).

3.2.2. Whaler's grave

During his 1841-42 survey Ommaney recorded the positions of other whaling-related sites in Koombana Bay including hilltop lookouts, wells and a whaler's grave (Parks 1990: 162). These positions were recalculated from Ommaney's Field Notebooks by surveyor Ray Parks in 1988, and provided as UTM coordinates (AGD84). These coordinates were converted to decimal degrees using GDA94 datum to put in the WA Museum's GIS, and the resulting position of the grave is plotted to lie underneath, or nearby the old Koombana Drive easement within Lot 882 (Figure 15). The grave has possibly been disturbed by surface earth-works; however as a buried feature it is recorded as a potential heritage site within the study area.

The coordinates are 6311975.707, 374363.701 (UTM AGD84), S 33.32272°, E 115.65171° (GDA94).

4. METHODOLOGY

4.1. Introduction

This section outlines the WA Museum's approach to the archaeological test excavations undertaken on the Koombana Bay foreshore, based on the project brief and Memorandum of Understanding (Appendix A). The archaeological test excavations were carried out over eight days between 21 and 28 November 2011.

4.2. Magnetometer and ground penetrating radar (GPR) surveys

The City of Bunbury commissioned Cardno Spectrum Survey and Georadar Research to carry out magnetometer and GPR surveys in 2009 (Cardno Spectrum Survey 2009). The magnetometer survey covered the entire study area, while the GPR surveys were carried out within smaller grids at each lot, based on the results of the magnetic survey.

A magnetometer detects anomalies in the earth's magnetic field. Therefore, they may not necessarily locate wooden shipwrecks with copper alloy and treenail (wood) fastenings. Such sites are not likely to be discovered using this technique unless they contain significant amounts of iron or igneous rock ballast. The magnetic survey did locate a number of targets including one major feature thought to possibly be a shipwreck.

The GPR surveys were carried out over an area measuring 40 m (N-S) by 50 m (E-W) on Lot 881, and 20 m (NE-SW) by 30 m (NW-SE) on Lot 882. The survey found positive anomalies that 'may be related to shipwrecks' (Figure 19). Further GPR surveys were recommended to be conducted across a broader area, though this did not occur (Cardno Spectrum Survey 2009).

In accordance with the Memorandum of Understanding (Appendix A) the WA Museum and City of Bunbury focused attention on magnetic and GPR targets in the areas of the GPR grids in Lots 881 and 882.Some of the magnetic anomalies were located outside of the fenced work area e.g. Targets 11 and 12, with other features evident north of Koombana Drive. As they fell outside of the brief, these anomalies were not investigated by water probing or archaeological excavation.

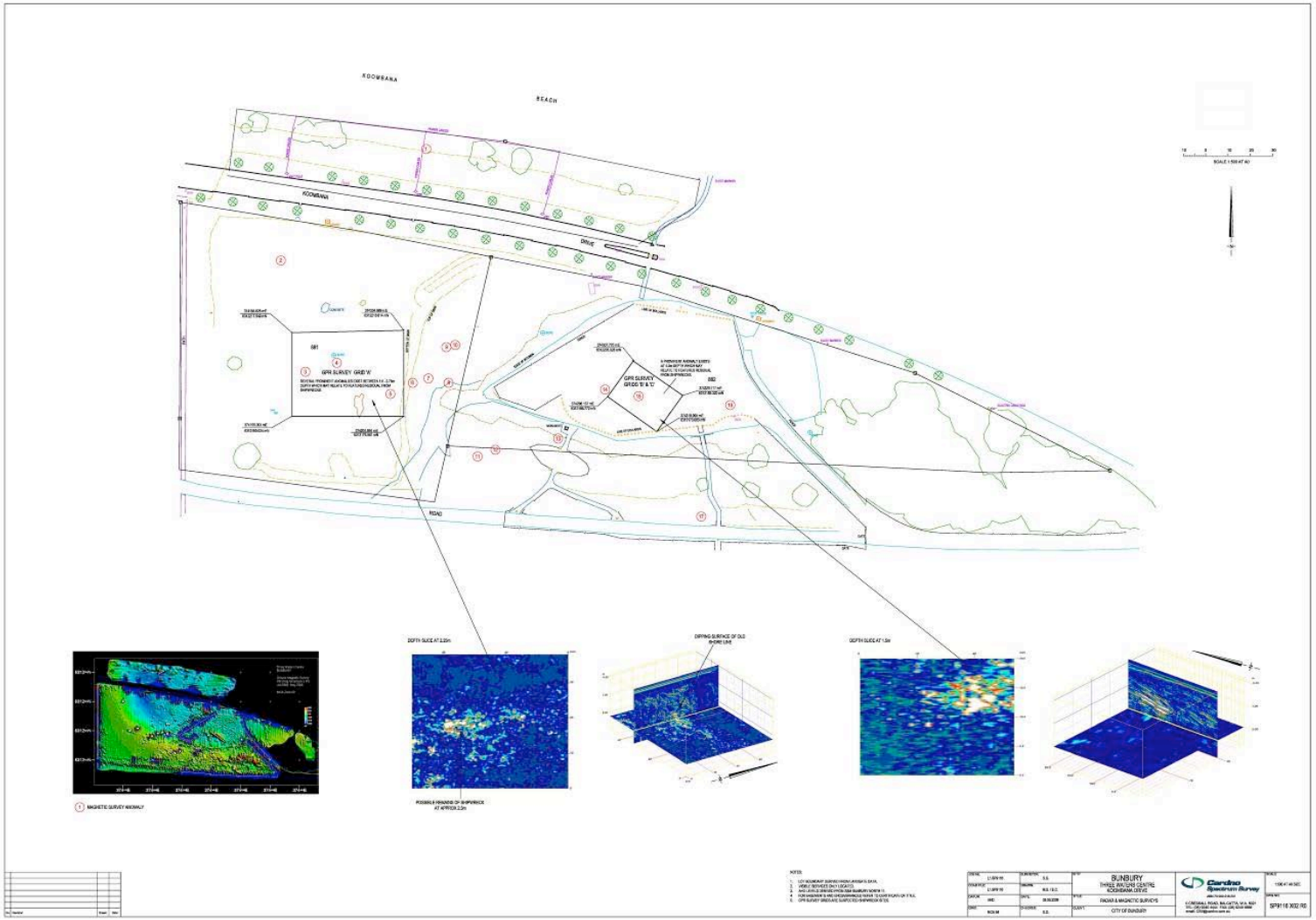


Figure 19 Map showing magnetic (red circles) anomalies, location of Ground Penetrating Radar (GPR) survey grids and GPR anomalies (Cardno

4.3. Survey

An archaeological grid comprising 5 m x 5 m squares was established up over Lots 881 and 882 (Figure 20) in order to provide precise control for surveys and excavations. Lecturer Bill Chernabaeff and ten students from the South West Institute of Technology (SWIT) Bunbury campus, School of Surveying provided survey support to the project. The grid was based on the Perth Coastal Grid datum and tied to the Australian Height Datum (AHD). Datums were obtained from Thompson Surveyors and Bunbury Port Authority. The grid was mapped in the Civil CAD computer program.

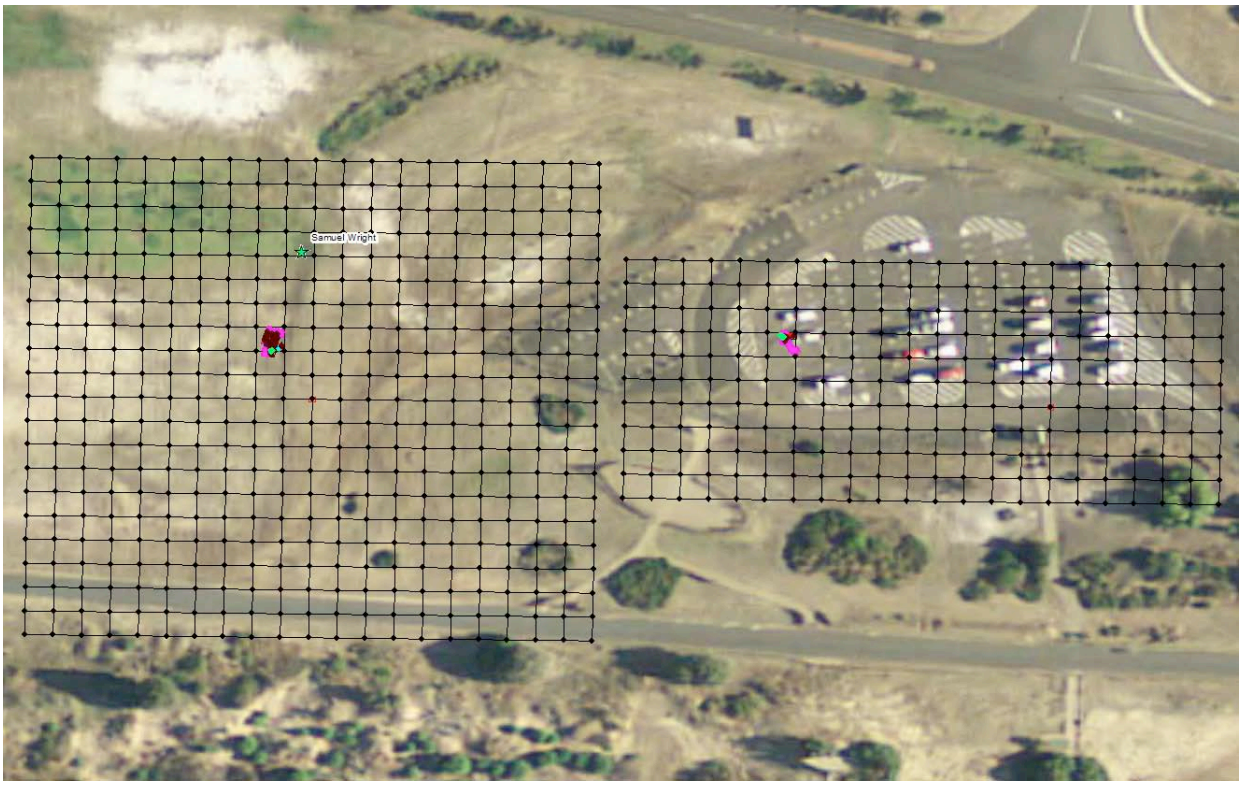


Figure 20. GIS image showing archaeological grids superimposed over Lot 881 (left) and Lot 882 (SWIT/ WA Museum).

Survey equipment included two Trimble 600 Geodimeter total stations with Top Con FC120 handheld controllers, and three Leica 1200 GPS units with base stations, providing an accuracy of within 5 mm. Accuracy using total station on Lot 881 was within 5mm, while in Lot 882 excavation GPS and base stations were used to provide accuracy within 20mm. Additional equipment was provided by Harley Global's Bunbury office.

The survey team physically laid out the archaeological grid markings, recorded all water probe survey locations, excavation trench corners, archaeological features, took levels and provided mapping support.

Figure 21. Bill Chernabaeff and SWIT School of Surveying students with mobile GPS units (Ross Anderson/ WA Museum).

4.4. Dewatering and water probe survey

Dewatering and water probe surveys were conducted by Precision Drainage contractors. Water probing was undertaken to confirm and delineate sites identified by magnetometer and GPR surveys, and also to begin methodically sampling the survey area in 5m square grids. This size grid was chosen as the minimum by which to detect the beam of a 300-500 ton wooden ship (generally about 8m beam width) or significant sections of wreckage greater than 5m square.

Water probe surveys utilised a team of three staff. A holding tank of recycled groundwater and water pump was used to force a jet of water at pressure through lengths of aluminium pipe, measuring 3.5 m and 5.5 m long, to liquefy subsurface sediments and allow the pipe (the 'probe') to easily pass through the deposits. The water probe operators could detect changes in sediment composition and determine the depths of deposits up to 5.5 m depth through encountering resistance and/or obstacles e.g. wood, metal, beds of seagrass, shell or rock.

An assistant scribe recorded the number, location, depth and the operator's interpretation of the sediment composition and any obstacles on a water probe survey form, and the probe location was surveyed in by the survey team.

A map of the subsurface deposits was created to show the composition of the sediment encountered during the probing including seaweed, wood, metal, rock, or sand.

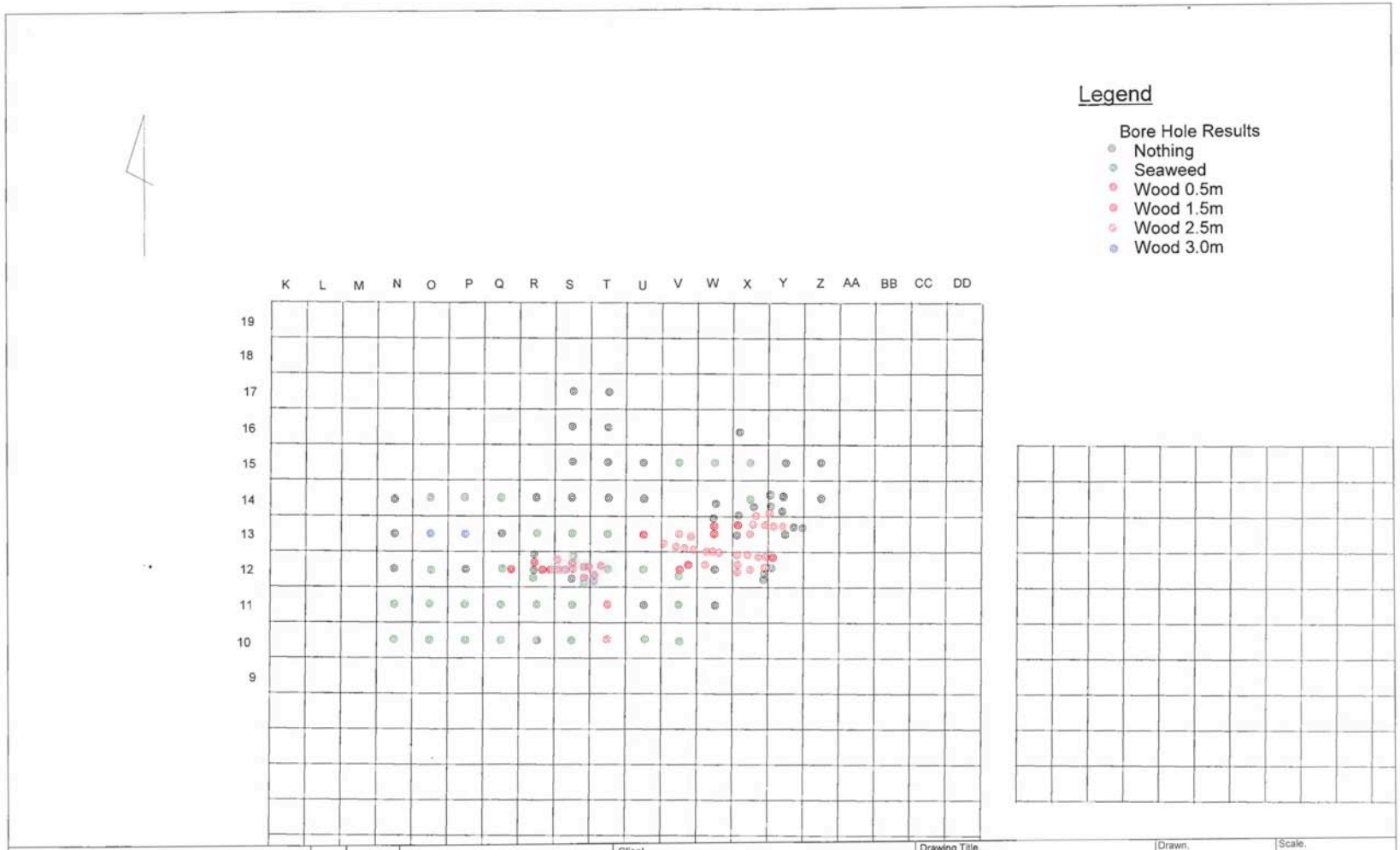
If wood or metal were encountered, further probes were undertaken radiating outwards in different directions to delineate the extent of the feature. The water pressure could wash loose timber fragments back up the probe hole to the surface, allowing timber samples to be collected for later analysis.

The water probe survey was essential to define the extent of potential cultural features. As the depth of the excavation in Lot 882 would only permit a 5m square excavation at 5 m depth within the time constraints, water probing allowed the precise targeting of an edge of a structure in order to allow maximum information about the interior and exterior of the hull to be recorded.

Dewatering of archaeological excavation trenches involved lowering the ground water table by installing arrays of PVC pipe 'spears' around the site. The spears were connected to water pumps operating 24 hours a day to create a 'cone of depression' in the water table in the targeted area. The water table was lowered to 2.5 m (previously 600m m) in the areas of Trench 1 and Trench 2 in Lot 881, and to 5 m (previously 1600mm) in the area of Trench 1 in Lot 882. Dewatering the site allowed 'dry' terrestrial excavation techniques to be used.

Figure 22. Precision Drainage dewatering team on site (Ross Anderson/ WA Museum).

Figure 23. Water probing grid square H8 in plinth area, view southwest (Ross Anderson/ WA Museum).



South West Institute of Technology
Your Regional TAFE

Rev	Date	Issue / Ammendment
A	22 Nov	Initial Issue

Client.
WA Maritime Museum

Drawing Title.
Water Boring Results in Local Grid

Drawn. M.A.Rayner
Date. 22 Nov 2011
Approved.

Scale. 1:500
Drawing No. KOOMX_1
Revision. A

A3

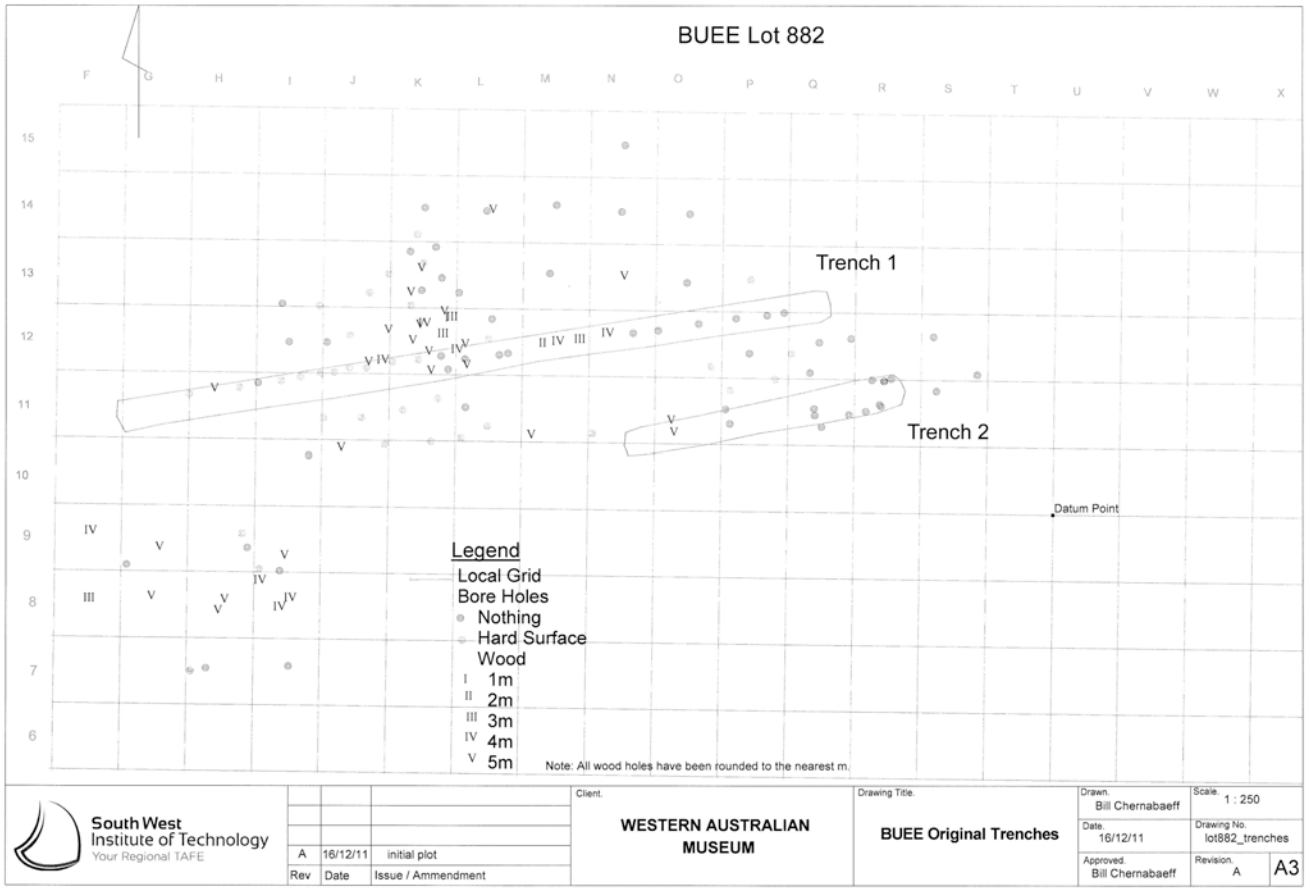


Figure 25Map of water probe locations overlaid on Lot 882 archaeological grid. Bow located in square K12, plinth location is in square H8 (SWIT).

Figure 26. Dewatering system being installed on Lot 882, view north (Ross Anderson/ WA Museum).

4.5. Excavation

The project brief was limited to excavation of magnetic and GPR anomalies, to confirm the presence or absence of shipwrecks within the defined areas within an eight day timeframe. The knowledge that this area had been extensively disturbed by industrial activities informed the excavation strategy (Anderson 2010) allowing for mechanical removal of overburden until any cultural layer was reached. Mechanical excavation was undertaken by experienced plant operator John Cross with archaeological supervision and monitoring.

4.5.1. Mechanical excavation

J.W. Cross and Sons provided plant for the mechanical excavations including a Caterpillar 20 ton long-arm excavator, Caterpillar short-arm excavator (Figure 27) and Caterpillar front-end loader. Komatsu also donated a hybrid diesel-electric excavator for use in the project.

The short-arm excavator was used to remove small sections of car park asphalt and road base to allow water probing and excavation. The long-arm excavator was used with a mud bucket to remove sediments in shallow spits of approximately 10 cm until any cultural features were located. Once cultural features were located manual excavation was commenced. Plant operator, John Cross previously worked as a machinery operator for Cable Sands Company in

the 1960s and provided valuable information on the discovery of the wrecks, and land use history.

Figure 27. Long and short arm excavators on site (Ross Anderson/ WA Museum).

4.5.2. Manual excavation

Qualified archaeologists supervised the excavations and directed students and volunteers. Professional archaeologists from Flinders University of South Australia, Earth Imprints Consulting and Northern Territory Department of Natural Resources, Environment, the Arts and Sport–Heritage Branch assisted WA Museum archaeologists to provide supervision in a voluntary capacity. Volunteer students participated from the Flinders University Maritime Archaeology program and University of Western Australia Archaeology program. Avocational volunteers from the Maritime Archaeology Association of Western Australia also participated.

4.6. Conservation

Vicki Richards, research chemist and Jon Carpenter, conservator from the WA Museum's Department of Materials Conservation were present during all stages of excavation. Conservation work included measuring site environmental parameters, providing 'first aid' treatment for artefacts, packaging artefacts and samples for transport and obtaining timber,

metal and other samples for analysis. Dr Ian Godfrey, Head of Materials Conservation undertook the wood identifications.

4.7. Metal detecting surveys

Bob Sheppard from Heritage Detection Australia provided professional metal detecting services following archaeological standards, using a Minelab SD2000 metal detector with 18 inch and 6 inch coils.

Metal detecting provided an extra measure of sensitivity and predictability for locating any potential features during both the mechanical and manual excavation processes. Spoil heaps were checked for any metal artefacts, allowing any necessary modifications to the excavation methodology at an early stage. A full metal detection report was provided separately (Sheppard 2011).

4.8. Community engagement

Community engagement was an important part of the Koombana Bay archaeological project as the process of research, discovery and identification of archaeological sites has important educational value and community benefits. Increased public understanding of the value of normally 'invisible' archaeological heritage sites and the dissemination of knowledge about the location and significance of sites assists in their long-term protection.

Media interest in the project was substantial with coverage from the South West Times, Bunbury Herald, West Australian, GWN 9, WIN News, ABC 7.30 Report, ABC Southwest Morning Show and Curtin Radio. As a result there was significant public interest and visitor numbers, and members of the community came forward providing historical information and photographs of the site and shipwrecks within the study area. Artefacts were also donated to the museum including a piece of teapot recovered from the continental shelf by a shark fisherman and 230,000 year old fossils from the Geographe Bay hinterland.

4.8.1. Public lectures

Public lectures were held in the evenings between 24 and 26 November 2011 at the City of Bunbury offices. Over 100 people attended the public lecture series. Presentations were provided by:

- Dr Mike McCarthy, Curator, WA Museum – 'Koombana Bay - a rich maritime history';
- Ross Anderson, Curator, WA Museum – 'Bunbury foreshore archaeology project';
- Jason Raupp, PhD Candidate, Flinders University of South Australia – 'Archaeological investigations of whaleships wrecked in the Northwestern Hawaiian Islands';
- Vicki Richards, Research Chemist, WA Museum – 'To raise or not to raise'; and
- Patrick Baker, Photographer, WA Museum – 'Fish and Ships—the life of an underwater photographer'.

4.8.2. Public site tours

Public tours of the excavation sites were advertised in the local newspapers and City of Bunbury website. Tours were conducted at 1pm, 2pm, 3pm and 4pm daily from 23 to 27

November 2011. Over 250 visitors were recorded. Tours were conducted by archaeologists, students and City of Bunbury staff.

4.8.3. Carpark Whalers website

Alan Lindsay and Helen Clucas of Vue Group made a series of eight short 3-5 minute film documentaries following the excavation funded by Screen West, Lotterywest and the South West Development Commission, that were uploaded onto a website daily (www.carparkwhalers.com). The website generated worldwide interest registering between 5th and 8th for number of hits worldwide on MySpace during the period of the excavation.

5. RESULTS

5.1. Introduction

The following section presents the results of the preliminary archaeological investigations. A catalogue of the artefacts collected during the investigations is provided in Appendix D.

5.2. Lot 881 excavations

5.2.1. Trench 1

Wooden and metal targets were located during water probe testing of magnetometer Targets 6 and 7 in survey grid squares Y12, Y13, Y14, X12 and X13. The trench was located to identify the wood and metal targets identified during the water probing. The dimensions of the trench were 5m N-S x 6.5m W-E.

The tidally affected ground water table level in this area was between 600mm (@ 0.75 m tide) and 1100mm (@ 0.25 m tide) below ground surface level. Dewatering spear pumps were installed in a single line along the northern edge of the trench to a depth of 3.5 m to allow excavation to a maximum of 2.5 m.

A PVC water pipe and electrical wiring associated with the caravan park's water reticulation system was uncovered during mechanical excavation of the eastern side of Trench 1, and excavation was halted at this extent of the site.

5.2.1.1. Description

This site is a section of wooden ship's side hull structure with an extent of approximately 15 m (E-W) by 10 m (N-S), constructed with iron hanging knees and copper alloy fastenings. All of the iron knees were broken except for one, which protruded to just 5 cm below the current ground surface level. The majority of the remains were broken and lying flat approximately 1.0-1.5 m below ground surface level. Marine biologist Sophie Teede identified purple barnacles (*balunistigonus*) and burrowing worm casings on the iron knees and fastenings. A corroded modern steel wire cable was associated with the remains.

Figure 28. Timber hull planking and frames found underlying iron knees on Lot 881 Trench 1. Research chemist Vicki Richards is collecting wood core samples (Jon Carpenter/ WA Museum).

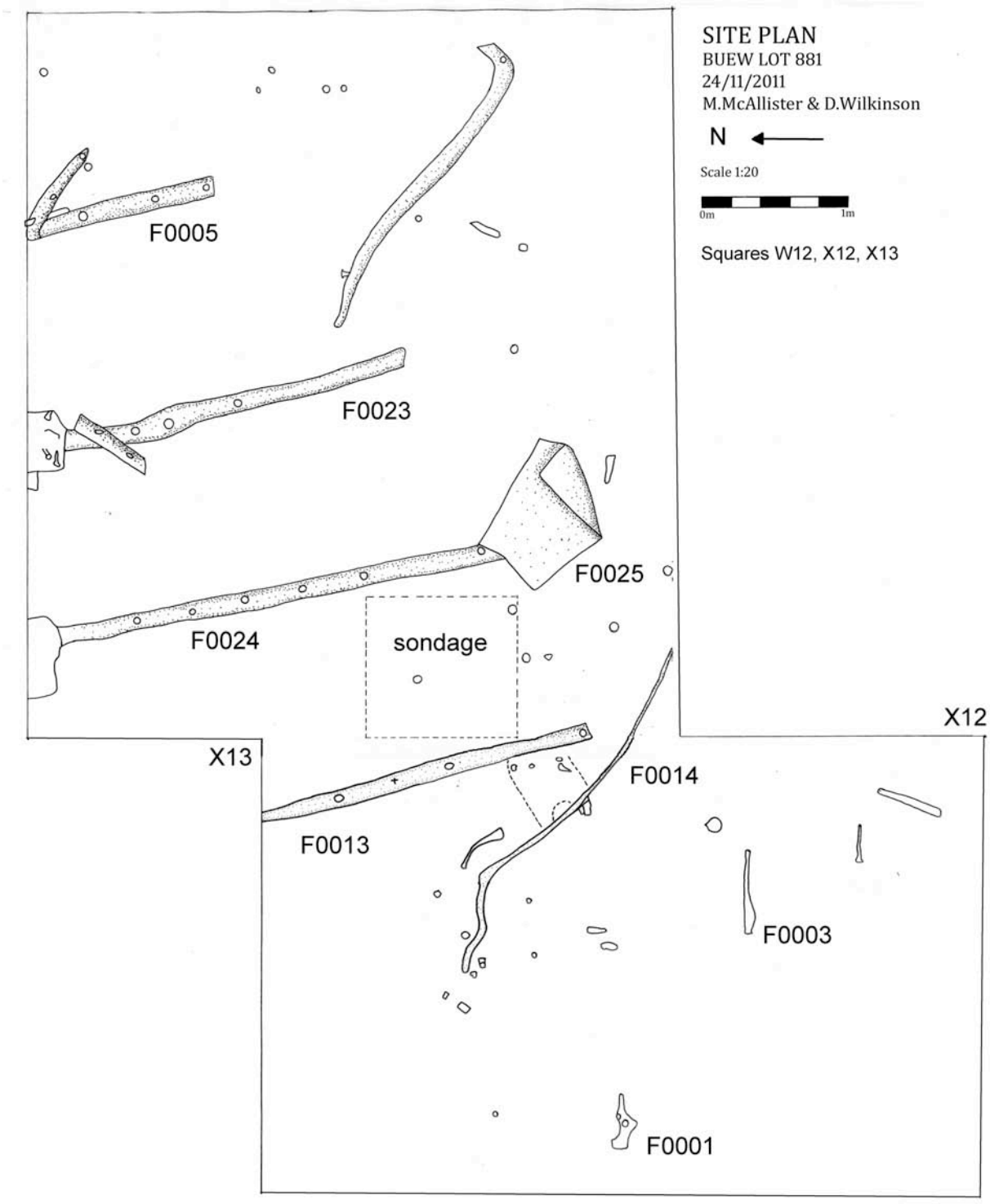


Figure 29. Site plan of BUEW Lot 881Trench 1 (WA Museum).

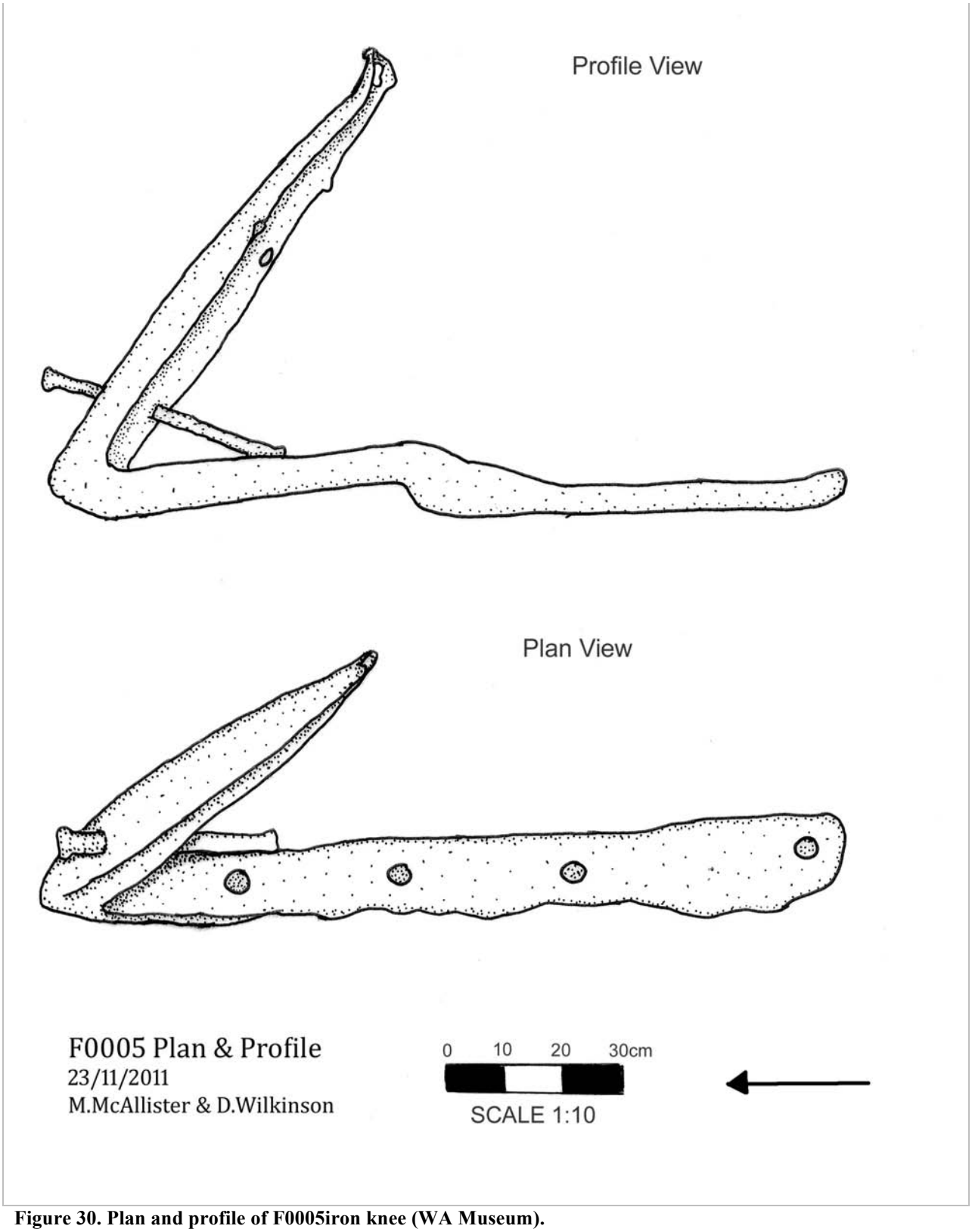


Figure 30. Plan and profile of F0005iron knee (WA Museum).

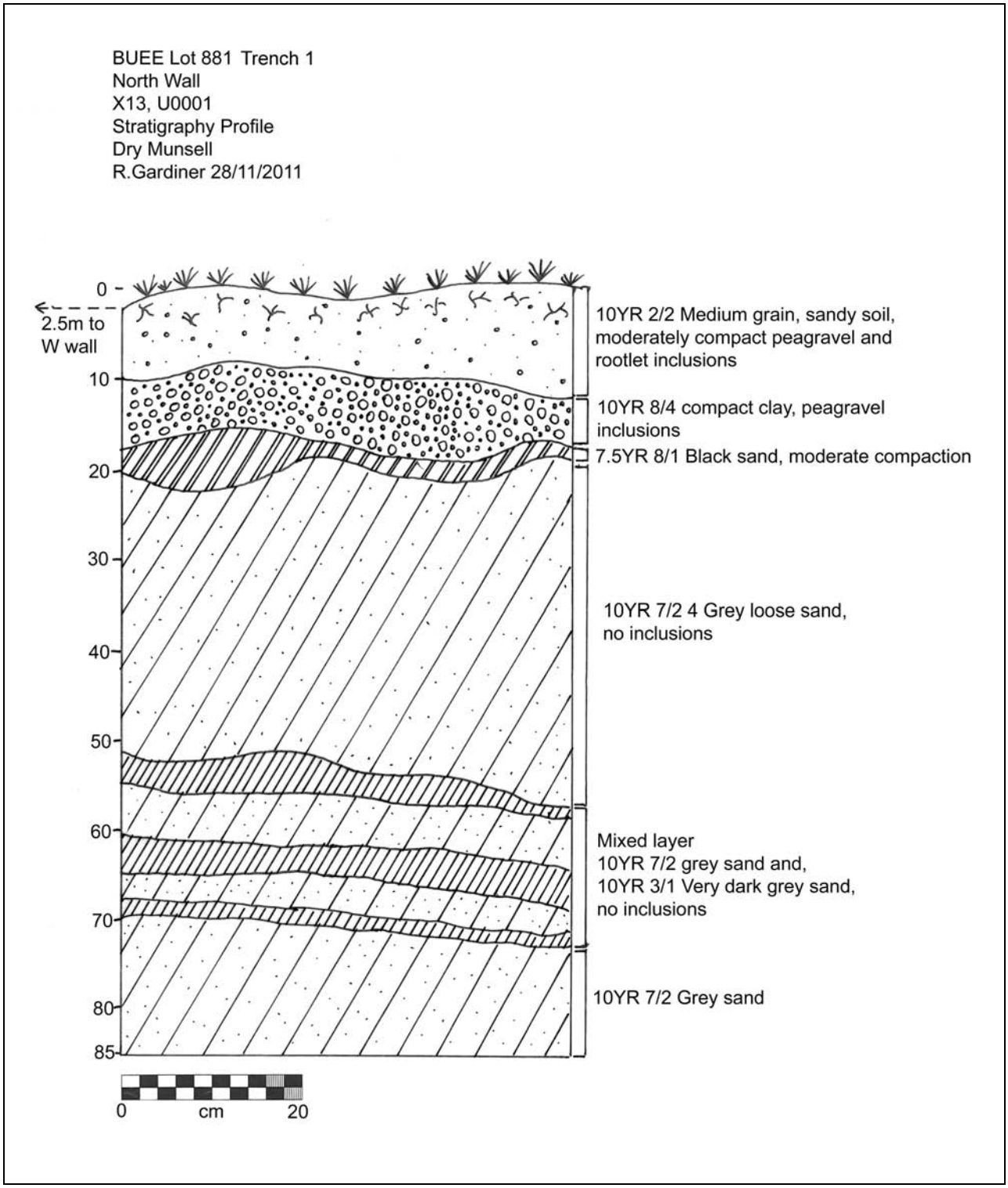


Figure 31 BUEW Lot881 Trench 1 north wall stratigraphy profile (WA Museum)

5.2.1.2. Structural analysis

5.2.1.2.1. Iron knees

The structure featured four iron knees *in situ* overlying preserved timber hull structure. The dimensions of the knees are recorded in Table 3. This site is comparable to a site located in

1973 during excavation of the channel from Koombana Bay into the estuary (Figure 32). This wreckage was identified as a portion of the hull of the *Solglyt* (1901).

Table 3.Knee Dimensions (metric and imperial).

Feature No.	Siding	Moulding	Length	Spacing	Angle of knee
F0005	140 mm 5.5"	50 mm 2"	1300 mm 51" (4'3")	1400-1360 mm 55" - 53.5" (4'6")	50º
F0023	140 mm 5.5"	50-75 mm 2" - 3"	2380 mm 94" (7'10")	1200-1300 mm 51" - 51.2" (4'3")	NA (broken)
F0024	140 mm 5.5"	NA	3100 mm 122" (10'2")	1240-1380 mm 49" - 54" (4'4")	NA (broken)
F0013	100-140 mm 3.9" - 5.5"	NA	2300 mm 90" (7'6")	NA	NA (broken)

Figure 32.Section of wreckage found in 1973 identified as the upper port hull section of the *Solglyt* (1901) before being removed. Note the iron knee riders (Patrick Baker/ WA Museum).

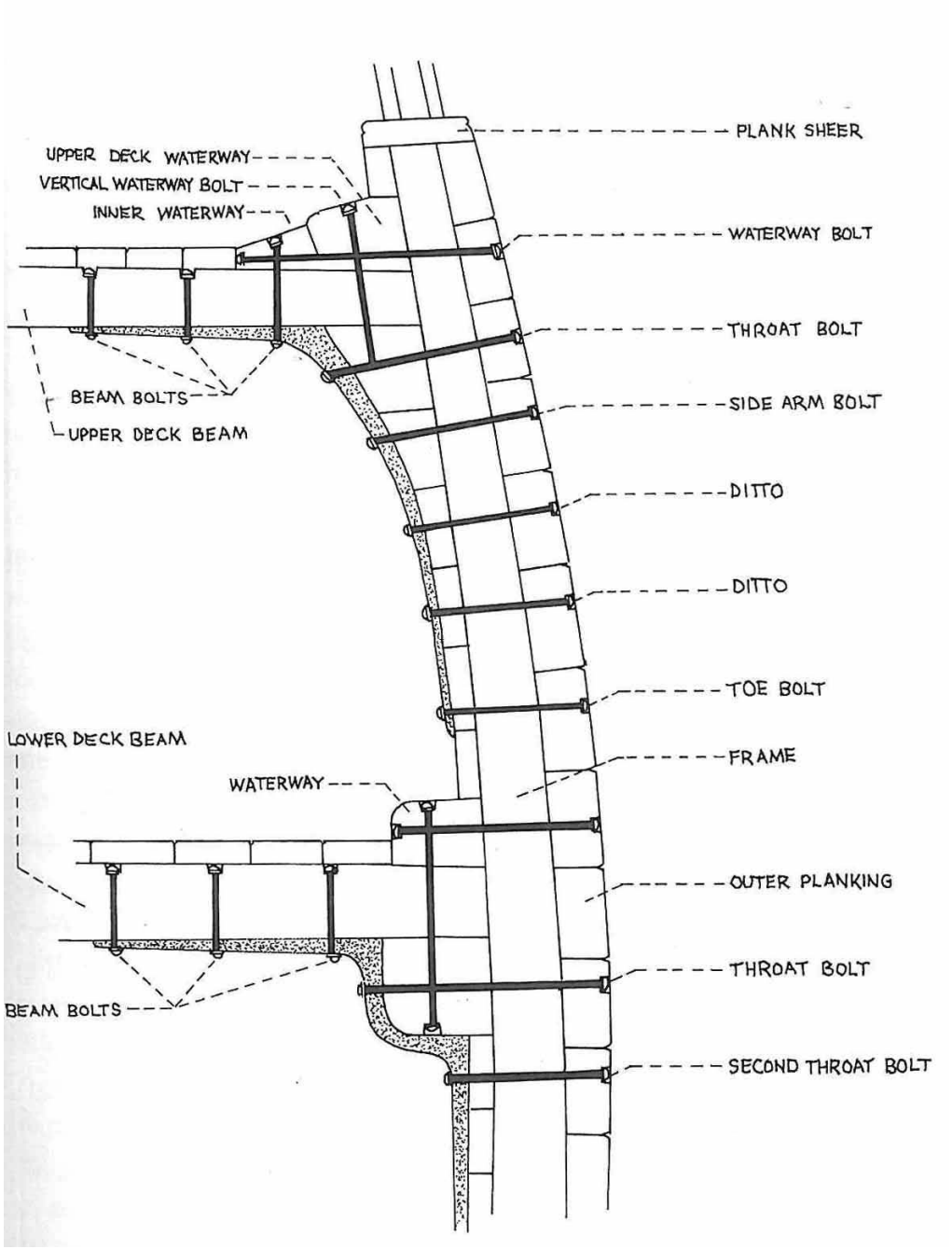


Figure 33.Cross-section of a two-decked wooden ship constructed with iron knees (Illustration: Chris Buhagiar in McCarthy 2005: 47).

5.2.1.2.2. Frame Dimensions

A single frame recorded in the 1 x 1 m sondage had measurements of 220 mm (8.7”) siding and 160 mm (6.3”) moulding, and is interpreted as either a second or third futtock, or top timbers. If it is a second or third futtock then it falls into the approximate vessel size of 300-400 tons (McAllister 2012:16). However, if the frame timbers represent top timbers this could extend the possible size range up to 600-700 tons.

5.2.1.2.3. Planking

Comparison of the inner planking dimensions 150 mm (6") siding and 100 mm (3.9") moulding with Lloyd's Planking Table (Desmond 1919:21) provides a size range between 500 and 700 tons.

5.2.1.2.4. Wood identification

All of the samples from Trench 1 Lot 881 were identified by Dr Ian Godfrey (see Appendix D.) as soft wood pine of the red deal type. These pines are native to Europe (Scot's Pine (*Pinussylvestris L.*) and Austrian/Corsican pine (*P. nigra Arnold*), North America (red pine (*P. resinosa Ait.*)) and Asia. Therefore the ship was constructed in the northern hemisphere, most likely in northern Europe or northern America.

5.2.1.2.5. Fastenings analysis

Diameters of the fastenings in the iron knees were measured *in situ*, and give the best indication of the size range of the vessel. Comparison of the fastenings with Lloyd's Fastening Dimensions (Desmond 1919: 21) gives a tonnage range between 250 – 700 tonnes (McAllister 2012:17).

5.2.1.3. Interpretation

This site is the upper part of the hull of a wooden ship constructed with iron knees, treenail and copper alloy fastenings. The fastenings provide a size range for a wooden ship of between 250-700 tonnes, although it would be towards the upper end of this range as larger ships have small, as well as large fastenings. Therefore a vessel of between 500-700 tons is more likely (McAllister 2012:18). Wooden shipwrecks recorded to have gone ashore in the North Beach area within this tonnage range are the *Midas* (555 tons wrecked 1872) and *Solglyt* (875 tons wrecked 1901).

The wooden hull planking, iron knees and copper alloy fastenings are consistent with documented post-1840 ship construction methods, and are typical of mid to late 19th century wooden sailing ships.

It appears that this structure is from a shipwreck that broke up into floating sections or 'rafts' of wreckage, and was washed ashore onto North Beach. Evidence of purple barnacles (*balunistigonus*) and burrowing worm casings on the internal structure of the hull/ knees indicates that it was at some time previously located in the inter-tidal zone.

Information was provided by Dave Scott that shipwreck material located during the course of sand mining operations was dragged to higher ground away from the mining activity area. On the basis of evidence of the structure's location, barnacles and steel cable, this structure is interpreted as a piece of disassociated 19th century wreck structure from the *Midas* (1872) or *Solglyt* (1901) previously washed ashore that was at some time in the inter-tidal zone, and removed to its current location during sand mining operations in the 1960s.

Figure 34. Archaeologists recording features in BUEW Trench 1 on Lot 881, Squares X12 and X13, view northeast (Ross Anderson/ WA Museum).

5.2.2. Trench 2

The water probe survey located wood at a depth of between 1.0—1.5 m below ground surface level in survey grid squares S11 and S12. Trench 2 was opened to test the finds from the water probe survey and magnetometer and GPR surveys. The total dimensions of Trench 2 were 6.5mN-S x 5 m E-W.

As with Trench 1 the tidally affected ground water table level in this area of Lot 881 was between 0.6 m (@ 0.75 m tide) and 1.1m (@ 0.25 m tide) below ground surface level. Dewatering spear pumps were installed in a line along the northern edge of the trench to 3.5 m, to allow excavation to a maximum of 2.5 m.

Figure 35. Archaeologists and SWIT surveyors recording deck structure in BUEW Lot 881 Trench 2, Squares S11 and S12, view south (Patrick Baker/ WA Museum).

5.2.2.1. Description

This site is a portion of wreckage from a ship's deck measuring over 10 m (N-S) by 10 m (E-W). It comprises partially degraded timber deck planking with white lead caulking, rows of iron deck spike fastenings with evidence of deck beam spacing, waterway and beam shelf. The deck is on a slight incline, and the timber planking is degraded and missing where it protrudes from the protective environment of the water table, leaving just the remains of the corroded iron deck spike fastenings. A glass prismatic deck-light was found just south of this wreckage during mechanical stripping of the overburden (Figure 38). The deck-light was lying loose with its flat (top) side up.

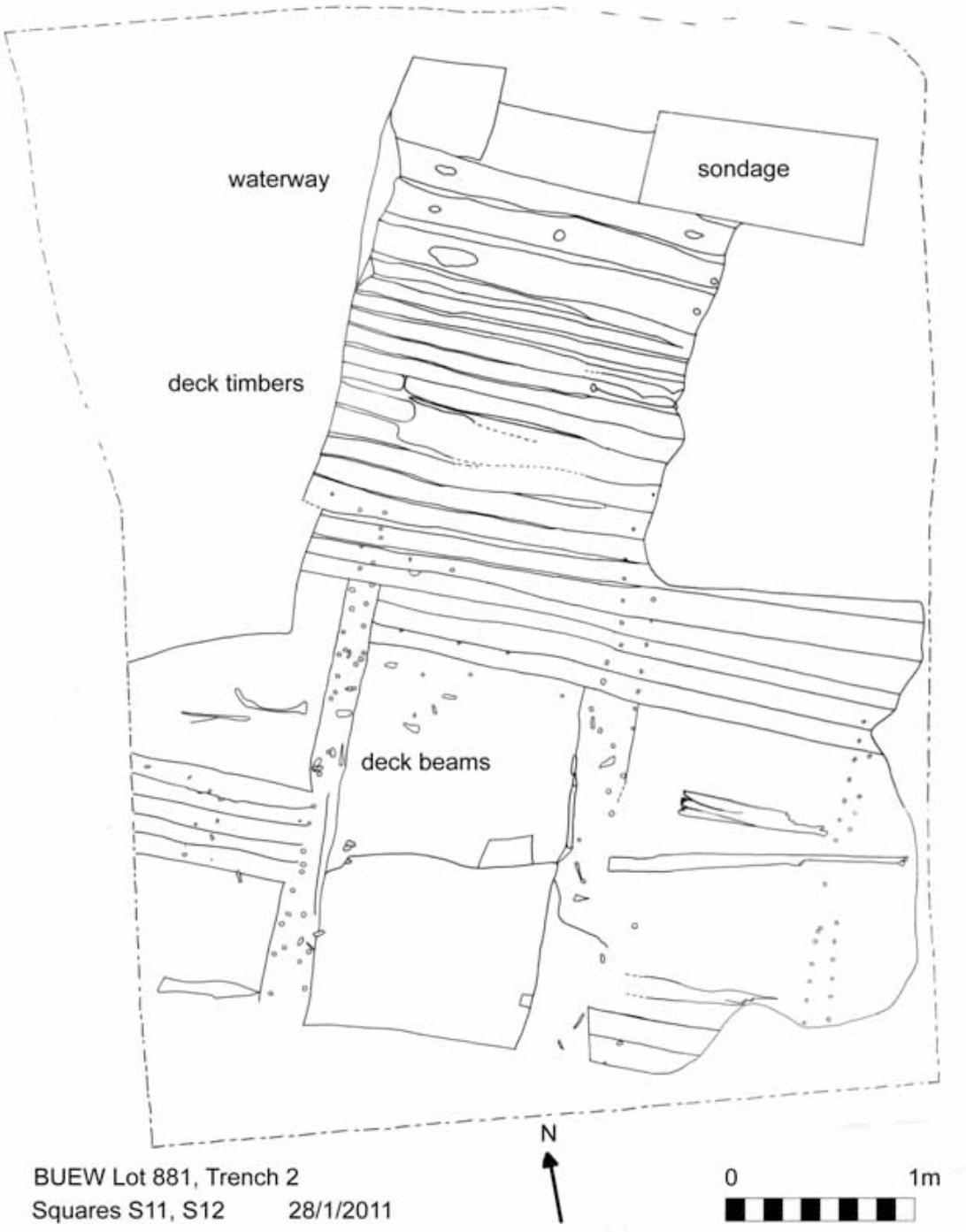


Figure 36.Lot 881 Trench 2 site plan.

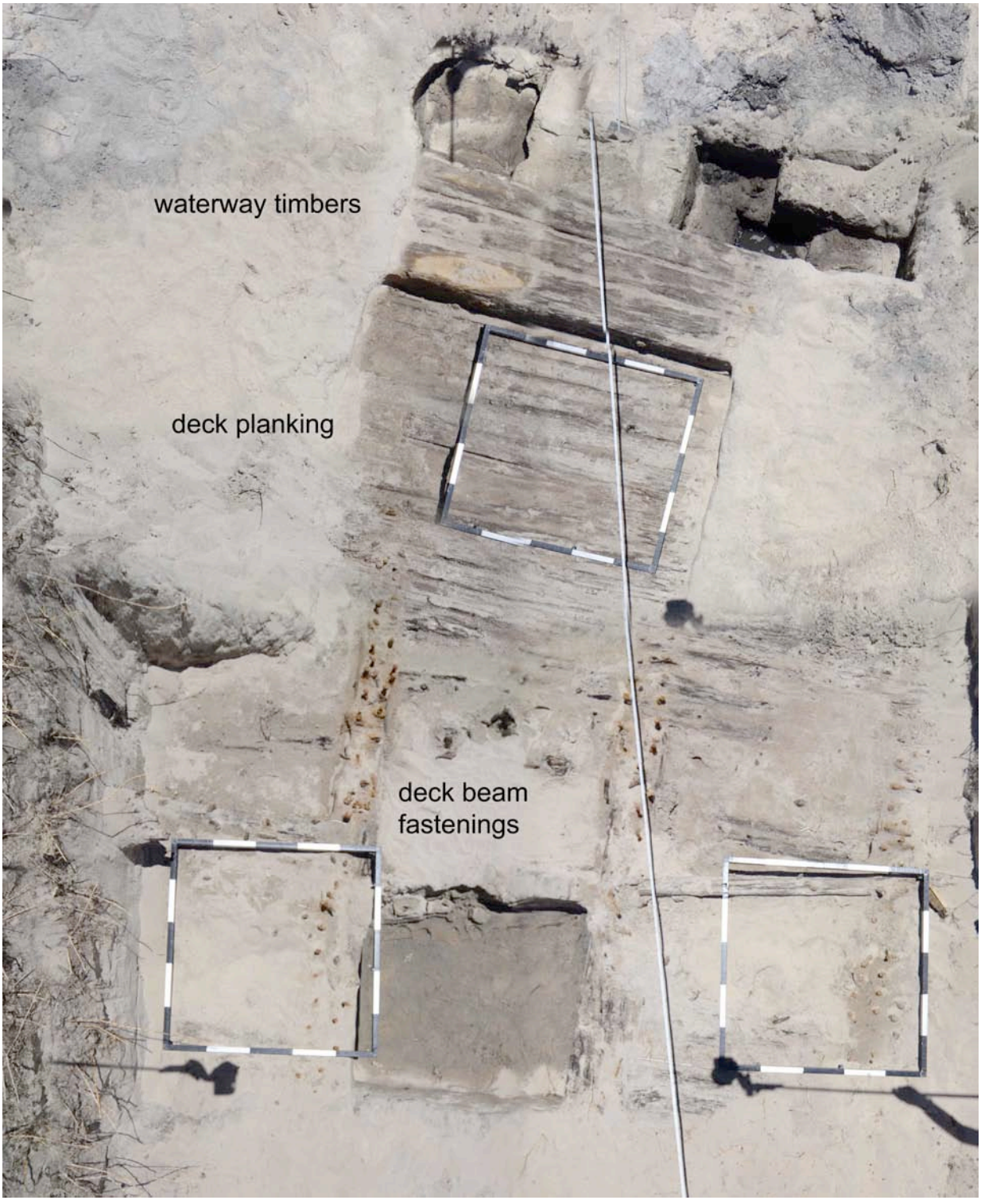


Figure 37 Photo-mosaic of BUEW Lot 881 Trench 2. One metre squares for scale (Patrick Baker/ WA Museum)

BUEW Lot 881 Trench 2
East Wall
Stratigraphy Profile
Dry Munsell
R.Gardiner 28/11/2011

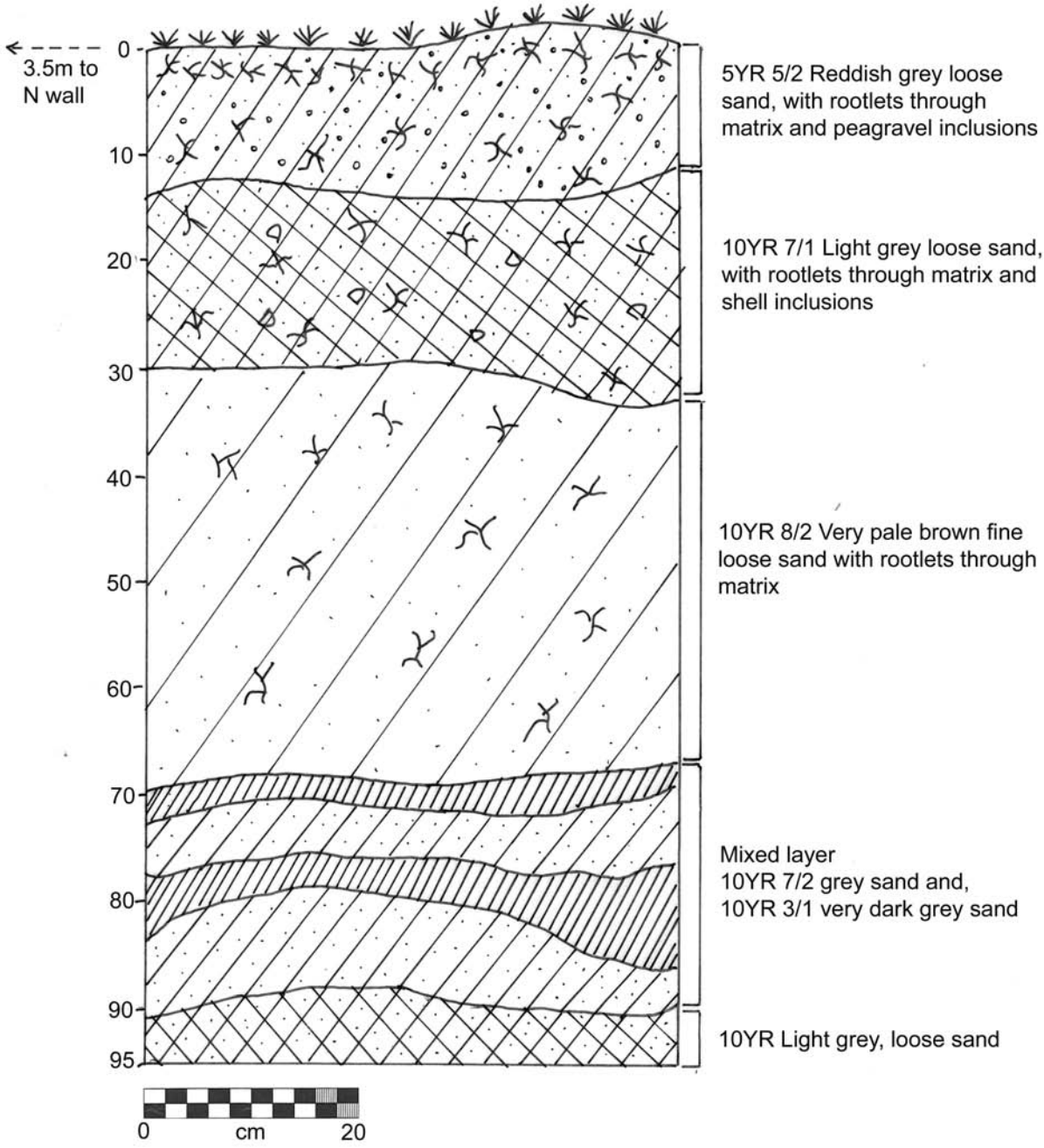


Figure 38.Glass prismatic decklight used to provide light to the interior of a ship (Ross Anderson/ WA Museum).

5.2.2.2. Structural analysis

5.2.2.2.1. Fastenings analysis

Fastenings on this site included iron bolts, copper alloy bolts, treenails and iron deck spikes. Lloyd's Fastening Dimensions' table (Desmond 1919:21) state that a vessel with deck bolts for upper deck hanging knees measuring between 1"-1.6" diameter would give a tonnage of anywhere between 500-1350 tonnes (McAllister 2012:21).

For the various sizes of treenails recorded (1"-1.8") Lloyd's Fastening Dimensions (Desmond 1919:21) gives a vessel size range of between 100-1350 tons.

5.2.2.2.2. Timber samples identification

All of the timber samples collected from Trench 2 were identified by Dr Ian Godfrey (see Appendix D.) as a red deal pine native to northern hemisphere countries in Europe (Scot's Pine (*Pinussylvestris L.*), Austrian/Corsican pine (*P. nigra Arnold*)), North America (red pine (*P.*

resinosa Ait.)) and Asia. Therefore this vessel is most likely to have been constructed in northern America or northern Europe.

5.2.2.2.3. Deck planking

Deck planking thickness can provide an indication of vessel size (Lloyd's Scantling Table 'Flat of upper deck' (Desmond 1921: 20)). However due to the degraded nature of the exposed planking and the inability to measure the thickness of the buried planking, this measurement was not obtained.

5.2.2.3. Interpretation

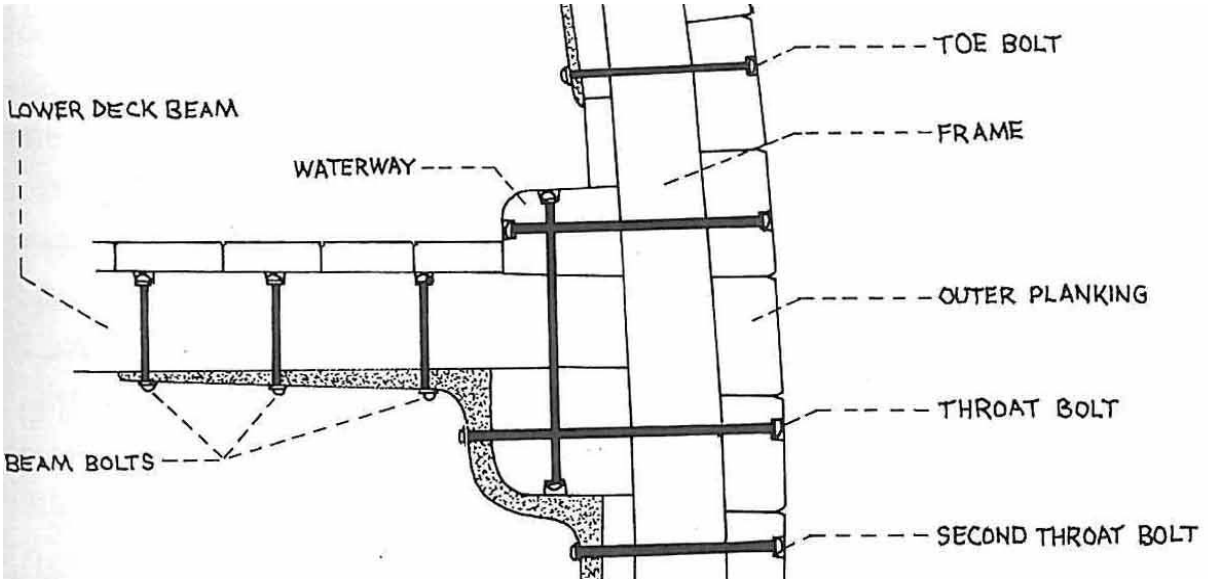


Figure 39.Diagram of wooden ship lower deck structure. Note raised waterway timber bolted through deck beam to lower shelf (Illustration: Chris Buhagiar in McCarthy 2005: 47).

This structure is a section of ship's deck planking with associated deck beams and fastenings, with a waterway composed of three longitudinal timbers (Figure 39). White lead caulking found between the planks was commonly used from the 1870s for waterproofing. A glass prismatic deck light was located at the southern end of the trench, although is not definitely associated with the wooden deck structure as it was an isolated find.

Structural analysis of the iron and treenail fastenings indicates a vessel within the range of 500-1350 tons. The largest wooden ships to be wrecked in Koombana Bay were the *Midas* (555 tons, wrecked 1872) and the *Solglyt* (875 tons, wrecked 1901), and it is possible that the deck structure originated from one of these vessels. There is a reference to the recently installed karri pine deck from the wreck of the wooden sailing ship *Midas* (1872) being salvaged and used to build a flat-bottomed cargo lighter:

> The decking of the *Midas* was put on while she was being loaded. It was Karri pine, a Mr Gibbs and sons and Jas. Wenn built a Flat Bottom boat out of it about 30 tons displacement...Afterwards I [E.H.Withers] used to help take cargo to and from ships in the Bay (E.H.Withers n.d.).

This information when correlated with the wood identification results suggests that the deck structure is possibly from the *Solglyt*, though a firm identification is not possible given that the *Midas* may not have had all of its decks replaced.

As with Trench 1, steel cable was found associated with the site indicating that the structure may have been removed from the inter-tidal zone and transported to its current location, to make way for sand mining operations in the 1960s.

5.3. Lot 882 excavations

5.3.1. Trench 1

Trench 1 was mechanically excavated across the GPR grid C in an attempt to locate the cause of a large magnetic anomaly, and GPR anomalies reported between 1.5 and 4 m deep (Cardno Spectrum Survey/ Georadar Research 2009). Trench 1 was 1.8 m wide and extended 55 m in a WSW–ENE direction to a maximum depth of 2.2 m, cutting across grid squares H11 to Q12. Trench 2 was excavated to the south and extended 20 m in a WSW–ENE direction to a maximum depth of 2.2 m, cutting across grid squares O11 to R11. Water probe testing was conducted in the base of Trench 1 and Trench 2 to a maximum depth of 5.5 m, with numerous solid hits of wood and rock detected between 4 and 5 m in the area of grid squares K11 and L11 in Trench 1, and O11 in Trench 2.Dewatering gear was installed to allow the archaeological excavation to focus on Trench 1, and Trench 2 was closed.

Figure 40. Commencement of Trench 1, Lot 882 on 21 November 2012. Base of trench is at water table level (Ross Anderson/ WA Museum).

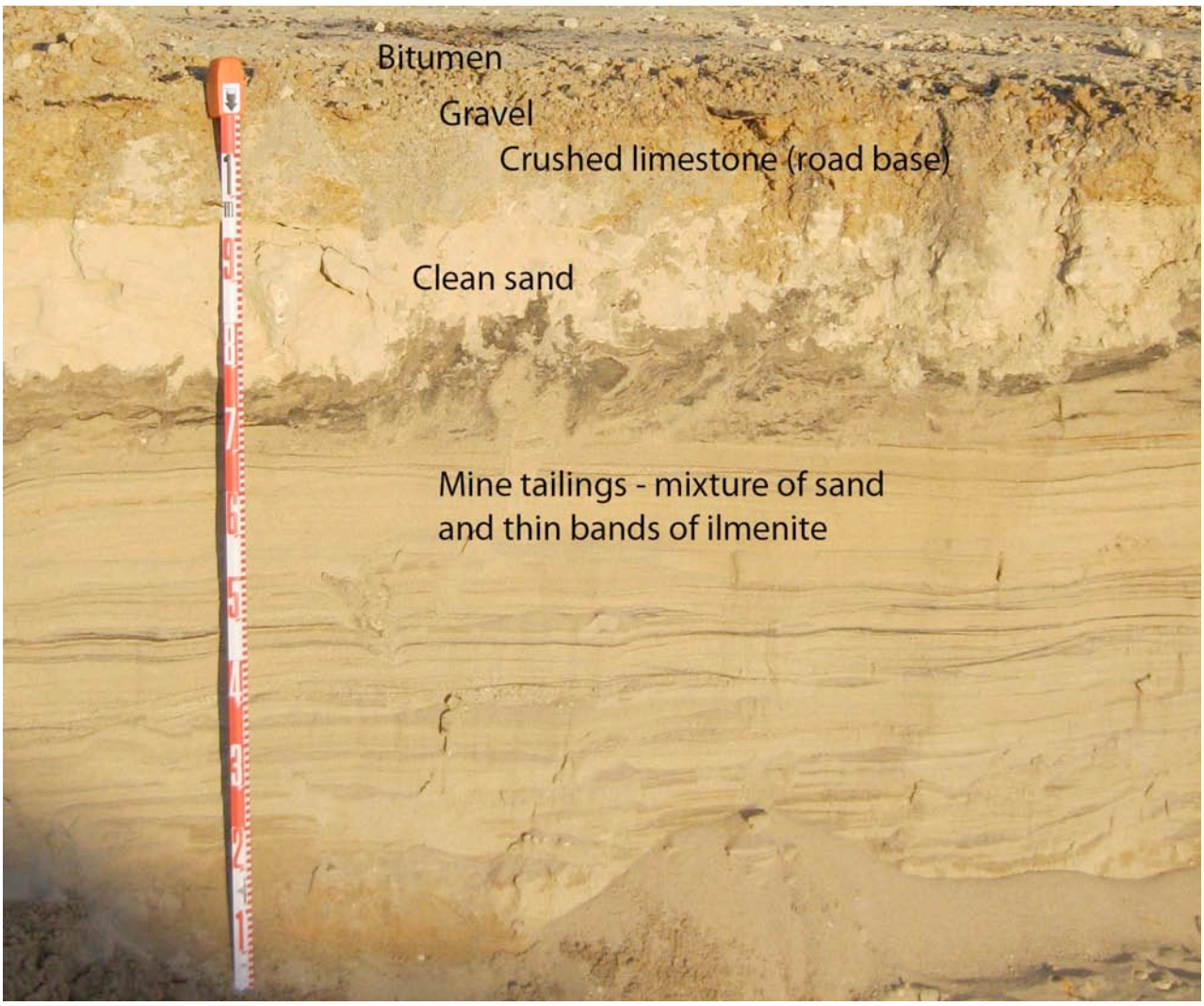


Figure 41. Stratigraphy in upper metre of east wall of Lot 882 Trench 1 (Ross Anderson/ WA Museum).

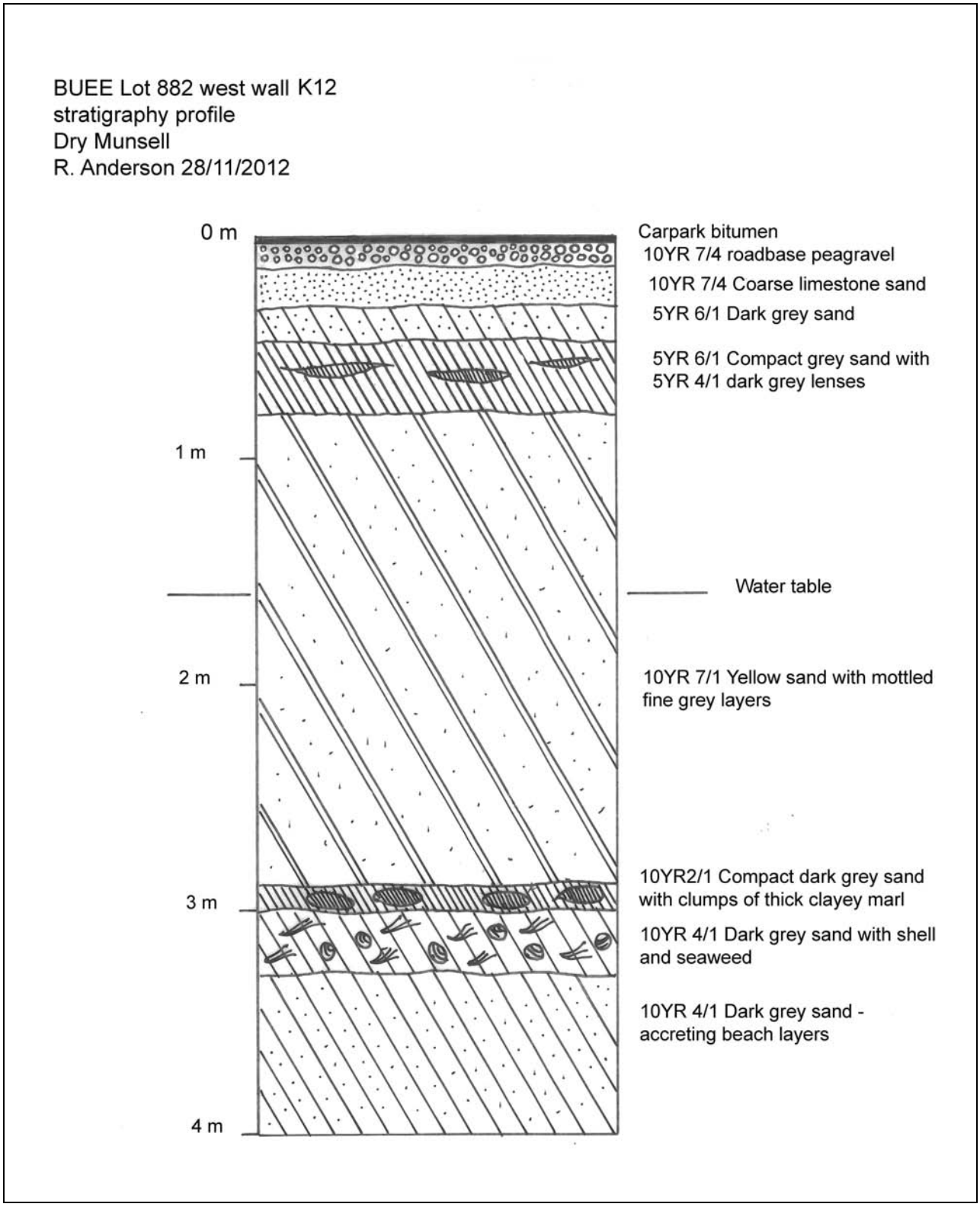


Figure 42 BUEE Lot 882 Trench 1, Square K12, west wall stratigraphic profile (WA Museum).

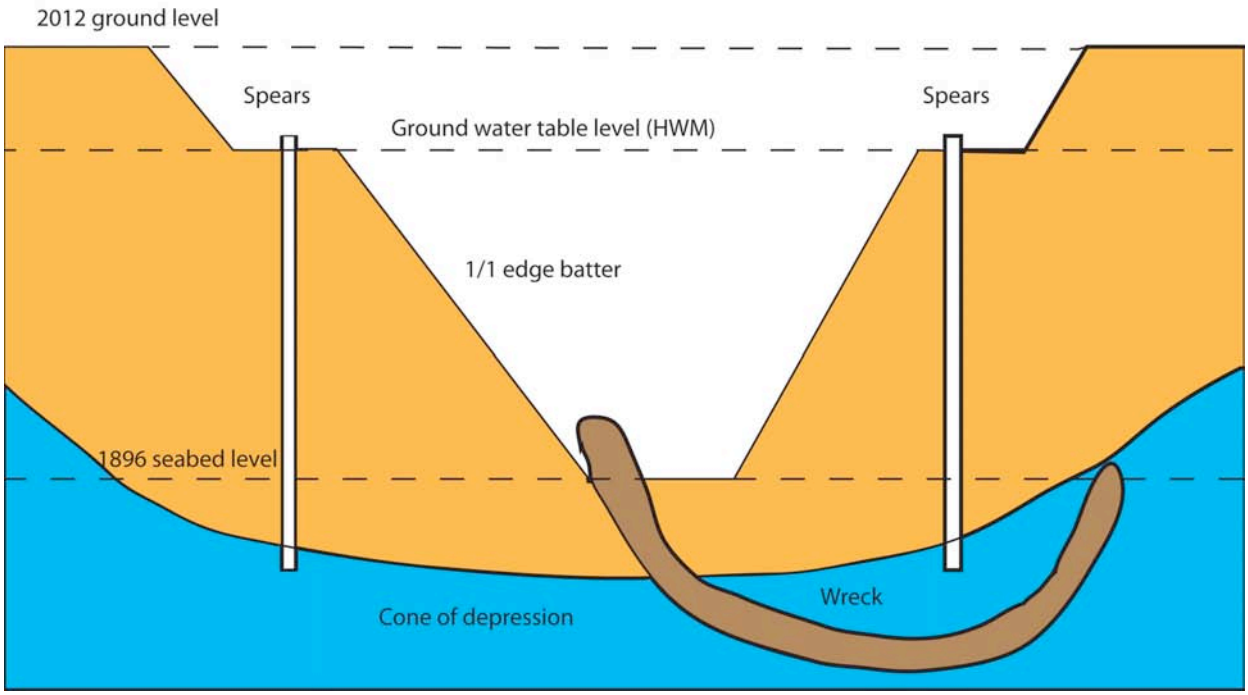


Figure 43. Schematic diagram of dewatered, excavated section through Trench 1, Lot 882 (WA Museum).

The tidally affected ground water table level in this area of Lot 882 was between 1600mm (@ 0.75 m tide) and 2100mm (@ 0.25 m tide) below ground surface level.Spears were installed to a depth of 5.5 m to allow the trench to be dewatered and excavated to a depth of 4.5 m. Due to the depth of Trench 1 the trench walls were battered at a 1:1 ratio. This resulted in the focus area at the base of Trench 1 being approximately 5 x 5 m, located within grid square K12. As the excavation progressed some flooding was experienced at the base of the trench, and the dewatering team used a portable water pump in combination with blue road metal placed in the base of the trench to assist with dewatering (Figure 45).

Figure 44. Archaeologists excavating inside bow hull remains in Lot 882 Trench 1. Note shattered stempostand flare of bow (Ross Anderson/ WA Museum).

Figure 45. View into Lot 882 Trench 1 facing north. Note road metal (gravel) added in SW corner of trench to assist dewatering and sandbagsfor hull support (Ross Anderson/ WA Museum).

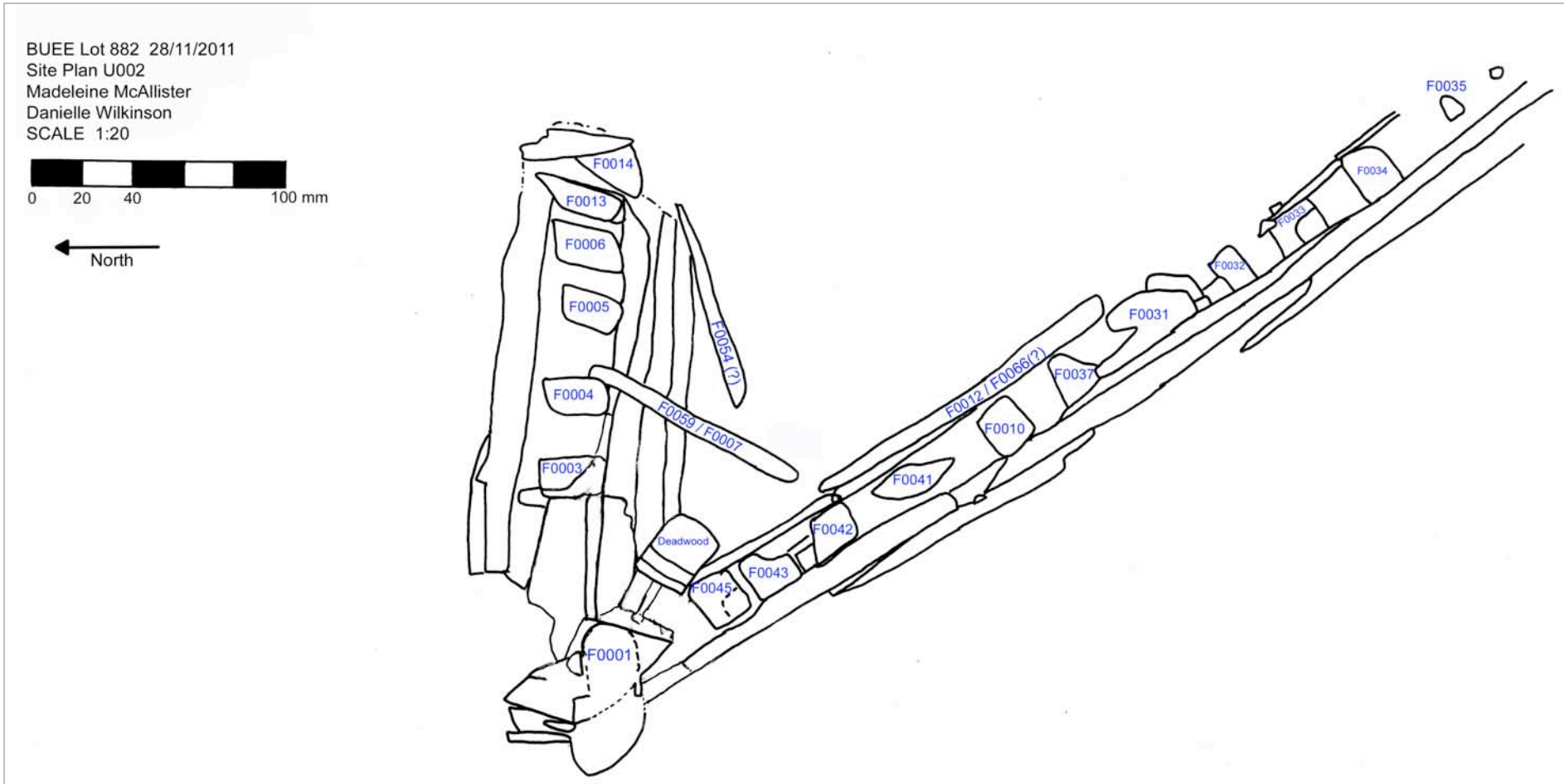


Figure 46. Lot 882 Trench 1 site plan of bow structure (WA Museum).

5.3.1.1. Description

Survey grid squares K12, K13, L12 and L13 were mechanically excavated. Brc collapsed wooden ship frames were found lying loose at a depth of 3.7-3.8 r surface level, and a coherent bow structure with stem-post, deadwood, apron, planking, frames and iron reinforcing knees located in square K12. The top c was found at 3.9m below ground surface level. The dimensions of the exposed x 4 x 2.5 m. The hull was fastened with treenails and copper alloy bolts, w sheathing. A section of exposed copper alloy stem-post sheathing with waterl and '9' representing the draft in feet was recovered. The stem-post was heavil split, apparently through previous mechanical damage/ impact.

The keel was oriented 114° southeast. The angle of heel was measured at 19° and towards the starboard side (north), and angle of rake at 23° from the verti angle of rake could not be determined due to the probability that the wreck is even keel.

5.3.1.2. Structural analysis

5.3.1.2.1. Frame dimensions

Lloyd's Scantling Table (Desmond 1919:21) indicates that frame dimensions between 5.5" (140 mm) and 8" (203 mm) would match the dimensions of a range of 300-600 tonnes (McAllister 2012:5).

It is most likely that F0006 and F0043 represent filling frames. A filling frame i that sits between two frames and reaches from the keel to the turn of the 1919:53). This indicates that the frames that were measured were second or thir

5.3.1.2.2. Stem-post dimensions

The stem-post dimensions measured 11" (285 mm) siding by 10.5" (260mm) m the heavily damaged and split condition of the stem, the measurements tak accurate and as a result the indicated tonnage of the vessel from the stem-pos (McAllister 2012:5).

Lloyd's scantling dimensions for 'Keel, Stem, Apron, and Stern post Sidi (Desmond 1919:21) indicates a vessel of between 200-300 tonnes.

5.3.1.2.3. Outer Hull Planking

The vessel is constructed with a single layer of outer planking. The outer hull pla of 3.2 in. (80mm) indicate a vessel of between 200-300 tonnes (Desmond 1919:

5.3.1.2.4. Ceiling planking

The ceiling or inner planking is usually of the same dimensions from the keel the first deck beam, and this area falls in Lloyd's category of 'Ceiling below ho The dimensions of 1.6 in. (20mm) thickness give a range of between100-200 to 1919:21).

5.3.1.2.5. Iron crutch knees

The stem-post structure exhibited two iron crutch knees, the lower one *in situ* and the upper one collapsed into the hull. Another collapsed iron knee was partially exposed outside the hull in the northern wall of the trench. The strong magnetic anomaly over the length of this wooden shipwreck site indicates the presence of a large amount of iron, which is likely to be an indication of other iron hanging and/ or lodging knees present on the buried structure.

Iron knees have been used in wooden ship construction since the mid 17th century (Goodwin 1997), with one reference to the use of 'cast iron for hanging and standing knees between decks to every other beam' in the construction of the American whaling ship *George Canning* in1827(Records of the Hillman Shipyard 1827-1839; J. Raupp, pers. comm. 12/2012).Iron knees were used in the construction of the main and/ or 'tween (between) decks of whalers to increase hold space for barrels of whale oil on long voyages. The presence of iron crutch knees reinforcing the bow is more typically seen in mid to late 19th century wooden sailing ship construction.

Figure 47. View of wreck interior in Trench 1, Lot 882. Note ceiling planking and iron crutches(upper crutch has collapsed, lower crutch isstill fastened in place). Stem post at upper left of image. (Ross Anderson/ WA Museum)

5.3.1.2.6. Hull sheathing

Metal hull sheathing is a useful indicator for dating wrecks. From the late 18th century ocean-going ships were sheathed in copper to stop the destructive wood boring shipworm (*teredo navalis*) and biological fouling occurring so quickly on the submerged hulls of wooden vessels (Bingeman *et al* 2000:218). Later on, various copper alloys were patented to try and alleviate the galvanic action created when copper and iron came into contact underwater, to make manufacturing costs cheaper and increase malleability and durability (McCarthy 2005;103). Analysis of the metallurgical/ elemental composition of metal hull sheathing can thus provide a date for a ship's construction.

Scanning Electron Microscope (SEM) analysis of sheathing sample BUEE 5635 provided an elemental composition of 61.62% copper, 37.25% zinc and 1.13% lead (McAllister 2012) (Appendix C).

In 1832, George Frederick Muntz took out a patent for a copper-zinc alloy with a composition of between 60-62 parts copper to 38-40 parts zinc (Bingeman *et al.* 2000:224; Vickers 1923:425), that is known as 'Muntz metal'. In 1846 Muntz took out another patent to include a small percentage of lead to improve malleability, and decrease loss of copper through oxidisation. Muntz metal samples from other Western Australian historic shipwreck sites have shown variations of between 59-64% Cu, 34.5-40% Zn, 0.8-1.4%Pb and 1% Fe (Carpenter, J., pers. comm. 16/6/2010; Anderson 2010:9). The ratios in BUEE 5635 fall within the range of Muntz metal, and the presence of 1.13% lead is a positive indication that the alloy dates from sometime after Muntz's patent of 1846. Allowing for some variation due to metal loss through aerobic and/or anaerobic corrosion, the concentrations of metal in the alloy are consistent with a post-1846 date for Muntz metal (McAllister 2012:8).

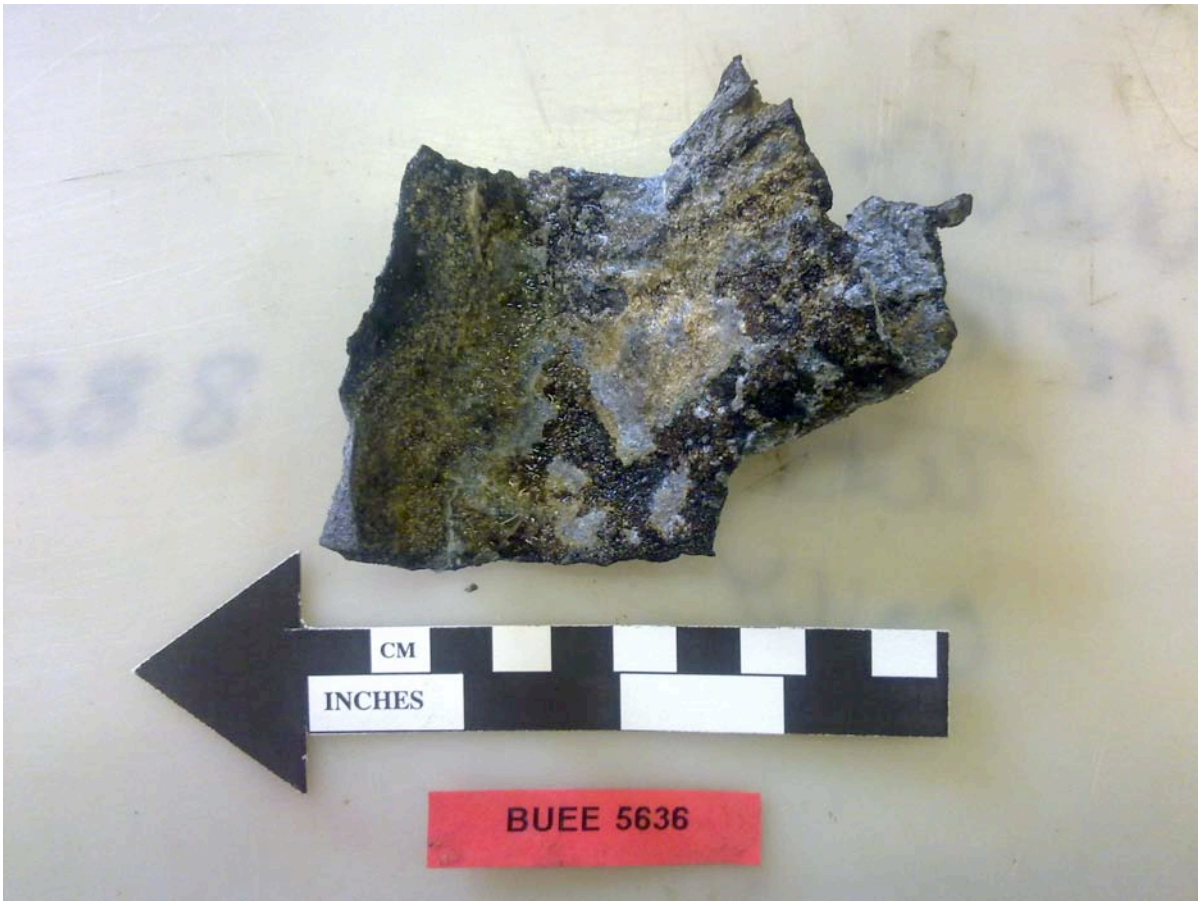


Figure 48. Copper alloy sheathing sample BUEE 5636 (Maddy McAllister/ WA Museum).

5.3.1.3. Fastenings analysis

5.3.1.3.1. Copper alloy fastenings

A copper alloy bolt BUEE 5653 with a 1 inch (25 mm) diameter, was found wedged in the stem-post structure giving a range of 400-500 tonnes (Desmond 1919:21). If it is associated with the deadwood or stemson then it gives a much smaller range of 100-200 tonnes (McAllister 2012:7). Analysis of the composition of the bolt using a SEM revealed it had a copper to zinc ratio of about 70:30 (see Appendix C).

Artefact BUEE 5657, a broken copper alloy bolt, has a diameter of 24 mm, placing the vessel in the range of 250-450 tonnes (Desmond 1919:21). The SEM analysis showed the bolt had a copper to zinc ratio of 60:37, with a small percentage of lead (approximately 2%) (see Appendix C).

Sheathing tacks measured from BUEE ranged from 1 inch to nearly 2 inches long. The composition of one sheathing tack BUEE 5634 was analysed with the SEM and revealed a copper to zinc ratio of 80:20 (see Appendix C).

5.3.1.3.2. Iron bolts

Due to the corroded and concreted condition of the iron bolts, dimensional analysis was not undertaken. The iron bolts found on the site are likely to be associated with the construction of the hull of the vessel above the waterline.

5.3.1.3.3. Treenails

Treenails BUEE 5642, 5643, 5644, 5660 and 5664 were measured as having diameters between 30 and 38mm, with an average size of 1 1/3" (33mm). Comparison with 'Lloyd's Fastening Dimensions: Sizes of Bolts, Pintles of Rudder, and Treenails' (Desmond 1919: 21) indicates a vessel within a range of 350 – 450 tonnes (McAllister 2012:11).

5.3.1.4. Interpretation

This site is an intact lower hull of a wooden shipwreck sheathed with Muntz metal, constructed with iron knees, copper alloy bolts, iron bolts and treenails.

The structural and fastenings analyses provide a size range for the vessel between 200-450 tonnes. Analysis of wood samples indicates that the vessel was constructed in northern Europe or North America.

The magnetometer data indicated a strong magnetic anomaly in the area, which is consistent with the magnetic signature of a wooden shipwreck constructed with iron knees. The degree of integrity of the bow structure and state of preservation strongly suggests that the hull structure is preserved intact for its entire length, estimated to be between 33-40m (see below). The stem-post has been extensively damaged, probably as a result of impact with earthmoving machinery relating to the Cable Sands Company operations in the 1960s when the shipwreck was originally discovered. The draft markings '8' and '9' visible on the stem-post (Figure 49) provide firm evidence that 8-9 feet (2.4 - 2.7 m) of intact hull remains buried between 3.9 and 6.6 m below the current ground surface level.

Intact stratigraphy in the western wall of Trench 1 provided evidence of unexcavated mineral sand beds and the original pre-1896 seabed/ shoreline (Figure 42), probably as the wreck was avoided by machine operators soon after its discovery.

Figure 49.Stem post sheathing with waterline markings '8' and '9' feet (Jon Carpenter/ WA Museum).

During the excavation Mr Ray Repacholi provided a copy of an historic photograph to the WA Museum that shows a large wooden wreck in the study area (Figure 50). The Bunbury jetty, railway line and Koombana Bay are visible in the background indicating that the wreck is oriented in an approximately east-west direction, and it is clearly not Site K/ *North America* (1843). Based on the wreck's location and orientation it appears it is the same site excavated in Lot 882 Trench 1. The photograph also shows the southern part of the site left apparently unexcavated. The site orientation and location accords with the wreck previously uncovered and identified as Site L (McCarthy 1982).

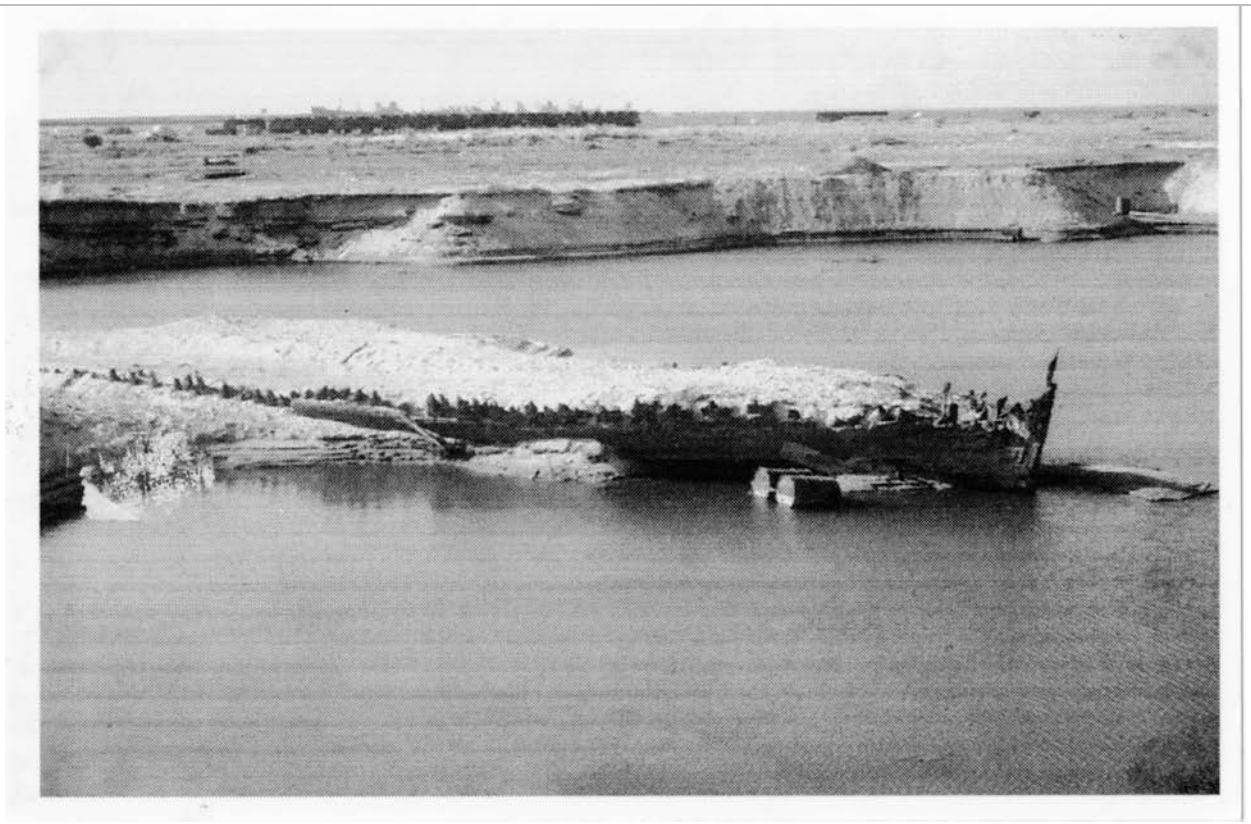


Figure 50. 1960s photograph of a wooden shipwreck lying in a west-east orientation, believed to be the same site excavated in Lot 882 Trench 1 Square K12 (Courtesy Mr Ray Repacholi).

The post-1846 construction date and tonnage range of 200-400 tons provides two possible candidates for identification, namely the 303 ton wooden brig *Annie M. Young* built at Yarmouth, Nova Scotia in 1863, wrecked on North Beach, Bunbury in 1876; and the 337 ton wooden barque *Cingalee* built in Dundee, Scotland in 1872, wrecked on North Beach, Bunbury in 1887. Of these wrecks the *Annie M. Young* is known to have been constructed with iron knees (*Novascotian*14/11/1863 p.3). The registration certificate for the *Cingalee* (NAA: A7499, CA808) describes it as being constructed with one deck and wooden frames, although this does not confirm whether it was constructed with iron knees or not. As the *Annie M. Young* is recorded as having an overall length of 33.2 m, and the *Cingalee* 40.1 m, a length measurement would provide a conclusive identity for the wreck.

5.3.2. Trench 2

Lot 882 Trench 2 was mechanically excavated to the south of Trench 1 and extended 20 m in a WSW–ENE direction to a maximum depth of 2.2 m, cutting across grid squares O11 to R11. Water probe testing was conducted in the base of Trench 2 to a maximum depth of 5.5 m, with solid hits of wood detected at 5 m in the area of grid square O11.These hits are considered to be the amidships part of the wreck discovered in Trench 1. Dewatering gear was installed to allow the archaeological excavation to focus on Trench 1, and Trench 2 was closed without further excavation.

5.4. Backfilling

At conclusion of the excavation, non-diagnostic artefacts such as loose timber fragments and iron concretions were wrapped in geo-textile and replaced in the bases of their respective trenches before being backfilled, retaining their field numbers where applicable. All sites were then covered with a layer of geo-textile and backfilled with overburden from the spoil heaps.

Figure 51. Backfilling Lot 882 Trench 1 over layer of geo-textile (Ross Anderson/ WA Museum).

6. CONCLUSION

6.1. Introduction

The following section summarises the findings of the archaeological investigations (Section 6.2) followed by recommendations for the future work and the long-term management of the sites (Section 6.3).

6.2. Findings

1. Magnetic and GPR anomalies on Lot 881 and Lot 882 were investigated and confirmed to be cultural features related to shipwrecks.

2. The shipwreck site in Lot 882 is buried on the pre-1896 shoreline, and is therefore a pre-1900 shipwreck protected as a maritime archaeological site under the *Maritime Archaeology Act 1973*. It is identified as either the *Annie M. Young* (1876) or *Cingalee* (1887).

3. Two sites consisting of detached sections of wooden hull structures from shipwrecks were located in Lot 881, and both appear to have been removed to their current position from the inter-tidal zone sometime during sand mining operations in the 1960s.

4. The site located in Lot 881 Trench 1 is identified as detached hull side wreckage from either the 555 ton wooden sailing barque *Midas* (1872) or 875 ton barque *Solglyt* (1901). Due to the uncertainty of identification it is not confirmed whether this site may be protected as a maritime archaeological site under the *Maritime Archaeology Act 1973*.

5. The section of shipwreck found in Lot 881 Trench 2 is part of a ship's deck, and is possibly detached wreckage from either the *Midas* (1872) or *Solglyt* (1901). It is therefore uncertain at this stage whether the site is protected as a maritime archaeological site under the *Maritime Archaeology Act 1973*.

6. Not all magnetic anomalies on Lots 881 and 882 were able to be archaeologically tested within the eight day timeframe.

7. A water probe survey conducted on the last day on Lot 882 located a cluster of solid wood targets at a depth of 5 metres in the area of the pre-1896 shoreline and concrete interpretation plinth. This plinth was placed in the position of the wreck of the *Samuel Wright* (1840) (Parks 1990: 166) and is likely to be the remains of a shipwreck.

8. A GIS analysis using Reverend Wollaston's tracing of surveyor Henry Ommaney's map of Bunbury has provided an alternative possible location for the wreck of the *Samuel Wright* in Lot 881.

9. At least two other shipwreck sites discovered during sand mining operations are recorded to lie within or nearby the study area, and remain to be positively relocated.

10. Following the discovery of shipwreck sites in the 1960s during sand mining activities, they were reburied in tailings, which is evident in the sites' stratigraphy as thin layers of clean sand and remnant mineral sands.

11. Not all wooden shipwrecks will have a magnetic anomaly if they are wholly timber and copper-fastened, therefore future survey methodologies should incorporate a strategy to detect these wrecks.

12. A photographic and GIS analysis to identify locations of shipwrecks in the study area used 1960s perspective and aerial photography to provide a possible location for the American whaling shipwreck Site K/ *North America* (1843) in Lot 882.

13. The shipwrecks in the location of the pre-1896 shoreline on Lots 881 and 882, and in the North Beach reclaimed foreshore area generally, are a significant maritime heritage resource with regional, national and international significance. The wrecks have been buried as a result of coastal changes resulting from port development, and remain well preserved.

14. An historical archaeological site was located outside the study area that is considered to be the remains of the 1841 Western Australia Company store.

15. A whaler's grave is recorded to lie within Lot 882, and as a buried feature is considered to be a potential heritage site.

6.3. Recommendations

It is **recommended** that:

5. A close-plot water probe survey should be conducted on Lots 881 and 882 to determine the presence or absence of potential maritime archaeological sites that may be protected by the *Maritime Archaeology Act 1973*.

6. The City of Bunbury continue to work with the WA Museum to investigate Lot 881 and 882 to locate maritime archaeological sites, and establish processes for their long-term protection and management under the *Maritime Archaeology Act 1973* and local planning regime. Mapping of the sites and making provision for buffer zones will avoid impacts to shipwreck sites by any future development of this area.

7. The City of Bunbury should add all of the shipwreck and archaeological sites located so far to their Municipal Heritage Inventory to protect the sites, and inform future planning and management decisions.

8. Copies of this report should be provided to the Bunbury Historical Society, City of Bunbury library and State Heritage Office.

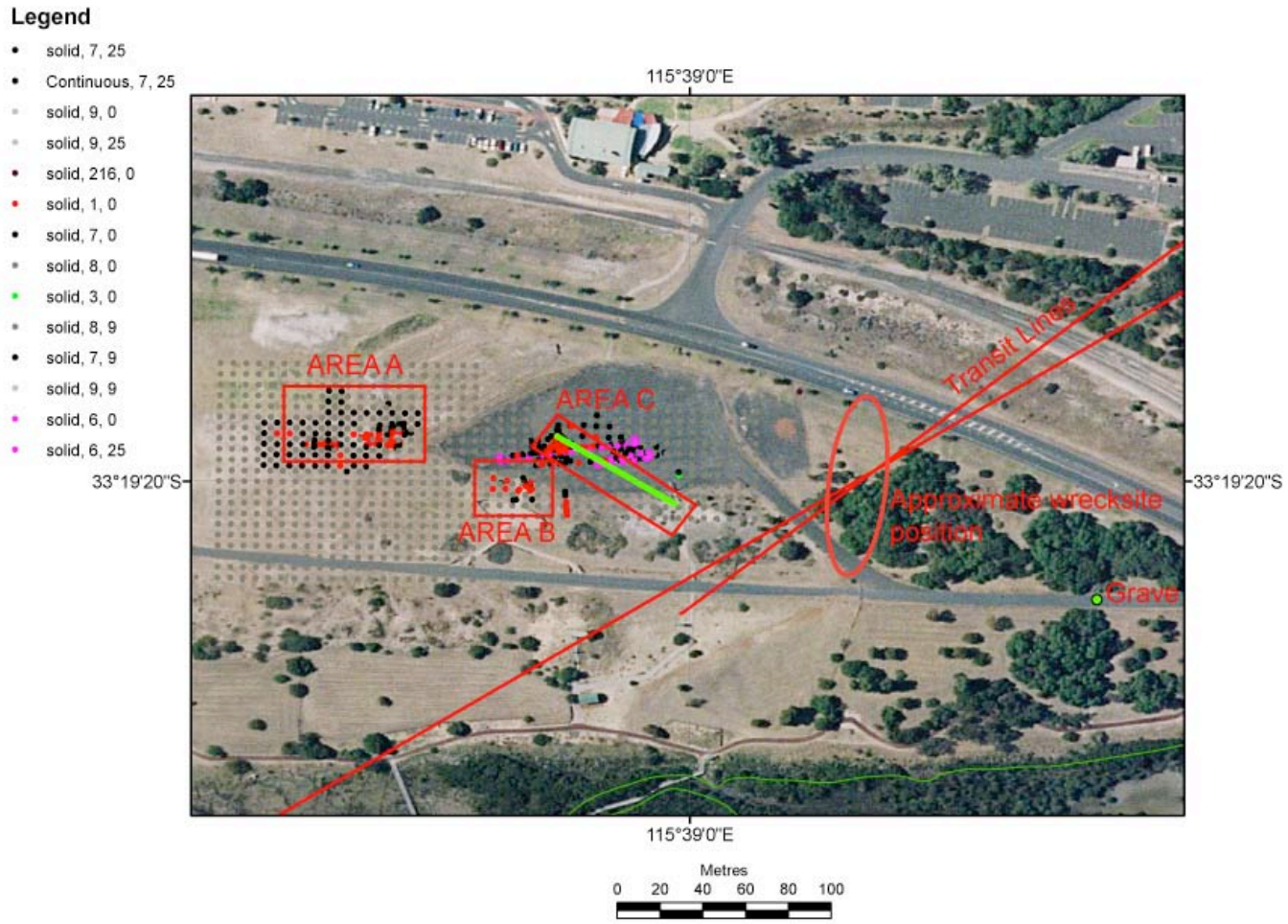


Figure 52: Map showing locations and recommended buffer zones for located maritime heritage sites (Areas A, B and C), approximate location for site identified as Site K/ *North America* (1843) and whalers grave (WA Museum)

Table 4 below provides positions for recommended buffer zoned for located shipwreck sites, and potential locations for shipwreck/ heritage sites as shown in Figure 52.

Table 4: Recommended buffer zone locations for known maritime heritage sites and potential maritime heritage sites.

POSITION (UTM ZONE 50 (WGS84)	EASTING	NORTHING
AREA A NW	374184.35	6312220.38
AREA A SE	374258.66	6312174.67
AREA B NW	374259.85	6312185.49
AREA B SE	374290.58	6312160.88
AREA C N	374292.13	6312166.25
AREA C E	374346.55	6312149.52
AREA C S	374337.53	6312152.47
AREA C W	374282.16	6312192.60
Grave	374504.27	6312124.10

References

Anderson, R., 2010.*Glenfields beach timber inspection and identification*, unpublished report, Department of Maritime Archaeology report No. 264, p. 8

Anderson, R., 2010. Test excavation of magnetic and radar anomalies Bunbury: Archaeological brief and research design, Report—Department of Maritime Archaeology, Western Australian Museum—No. 265, Fremantle.

Barker, A.J. & Laurie, M., 1992.*Excellent connections: a history of Bunbury*, Western Australia 1836-1990, City of Bunbury, Bunbury.

Barnes, P and Cameron, Prof. J., 2010. *The Australind Journal of Marshall Waller Clifton*, Hesperian Press, Perth.

Barnes, P., 2000.*Marlston Hill and all that*, Landcorp, Bunbury.

Bemax Cable Sands, 2006. 50 years on: celebrating 50 years of mining, Bunbury

Bingeman J.M., Bethel J.P., Goodwin P. & Mack A.T., 2000.Copper and other sheathing in the Royal Navy, *The International Journal of Nautical Archaeology,* **29**.2: 218-224.

Cardno Spectrum Survey, June 2009.Three Waters Centre shipwreck investigation. Unpublished report for City of Bunbury, Balcatta.

Desmond, C.,1919. *Wooden Ship-Building,* Vestal Press Ltd, New York.

File 2009/0068/SG Collection Management–Maritime Archaeology–Shipwrecks–American whalers, Bunbury (formerly MA 22/87), WA Museum.

File2010/0037/SG Collection Management–Maritime Archaeology–Area–Bunbury (formerly MA 405/71), WA Museum.

Goodwin, P. 1997. The influence of iron in ship construction 1660 to 1830, http://www.maritime.org/conf/conf-goodwin.htm, accessed 17 May 2011.

Halls, C.E., 1970, Bunbury's buried shipwrecks, *Port of Fremantle Quarterly*, Summer 1970, Fremantle.

Hunt, G.F., 196?. A study of the development of the Bunbury Harbour from the inception of the scheme until the present day, Thesis (Teachers' Higher Certificate) Western Australia.

McAllister, M., 2012, Koombana Bay Foreshore Excavation – Structural analysis, Report—Department of Maritime Archaeology, Western Australian Museum, No. 293.

McCarthy, M., 1982, Koombana Bay wrecks: an investigation of wrecks in the Bay for the State Energy Commission of Western Australia, Report—Western Australian Museum, Department of Maritime Archaeology, No. 19, Fremantle.

McCarthy, M., 2005.*Ship's Fastenings: from Sewn Boat to Steamship*, Texas A&M University Press, College Station.

Miner, D.F. & Seastone, J.B., 1955.*Handbook of Engineering Materials,* Wiley Engineering Handbook Series, John Wiley & Sons, Inc. New York, pp. 316-317

Moss, A., 2007. Analysing iron knees to aid in the identification of historic ship remains, *Bulletin of the Australian Institute for Maritime Archaeology,* Vol.31:85.

National Archives of Australia, Register of British Ships, Port of Fremantle, *Cingalee*, Series A7499, CA808.

National Archives of Australia, Register of British Ships, Port of Fremantle, *City of London*, Series A7499, CA808.

National Archives of Australia, Register of British Ships, Port of Fremantle, *Star of the South*, Series A7499, CA808.

O'Brien, T.N., 1996. Some abridged history of Bunbury, 1658-1995, Leslie O'Brien Publishing, Canberra.

Ommaney, H.M., 1840. Survey Field Book No. 11, Latour's 100,000 and Bunbury, Department of Lands and Surveys Western Australia, State Records Office, Perth.

Parks, R.G., 1990. The Bunbury town survey—a surveyor's view, *Early Days Journal and Proceedings of the Royal Historical Society of Western Australia (Inc.),* Vol. 10 Part 2.

Records of the Hillman shipyard, Copy of contract for building a ship, 30 May 1827, Collection 9, Box 1/1, Mystic Seaport, USA.

Riedel & Byrne Consulting Engineers Pty. Ltd., 1980. Beach movements, Bunbury: new Bunbury power station, Report No. R21, Job No. J019, Perth.

Sanders, T., 1975, *Bunbury: some early history*, Roebuck Book, Canberra.

Stammers, M.K., 2001. Iron knees in wooden vessels—an attempt at a typology, *The International Journal of Nautical Archaeology,* 30.1: 118-119

Tydeman, F.W.E., 1949. Report on Bunbury Harbour, Government Printer, Perth.

Vickers, C.,1923. *Metals and their alloys,* Henry Carey Baird & Co., Inc., New York.

Williams, J.G., 1894. *The adventures of a seventeen year old lad and the fortunes he might have won*, The Collins Press, Boston.

Willinge, J. 1996. *Full Steam Ahead: Bunbury Port Authority 1909-1995*, Bunbury Port Authority, Bunbury.

Withers, E. H., n.d. Excerpts from diary of Edward Withers, transcribed by Phyllis Barnes.

Wollaston, Rev. J.R., 1841-1844. Picton Journal, Mitchell Library, NSW.

Appendix A: Memorandum of Understanding (MOU) between the City of Bunbury and the Western Australian Museum

Background
Land along the Koombana Bay foreshore at Bunbury contains the remains of at least twelve shipwrecks that are protected as maritime archaeological sites under the Western Australian *Maritime Archaeology Act 1973*. Maritime archaeological sites are vested in the WA Museum.

Magnetometer and Ground Penetrating Radar (GPR) surveys were carried out in May 2009 on Lots 881 and 882 on Koombana Drive that show magnetic and radar anomalies. These anomalies have been interpreted as cultural features, likely to be the remains of the shipwrecks known to have been lost in this area (Cardno Spectrum Survey 2009). The sites lie on the old 1896 shoreline, which has since prograded due to man-made factors and harbour works causing sand accumulation in Koombana Bay. Since March 2009 City of Bunbury and WA Museum staff have discussed construction of the proposed Three Waters Visitor Centre, confirmed the protection of shipwreck sites buried in reclaimed land under the *Maritime Archaeology Act 1973*, the vesting of these sites in the WA Museum, and archaeological and conservation issues relating to possible excavation and display of shipwreck material.

On 20 May 2010 a meeting held between the City of Bunbury Mayor, Councillors and staff and WA Museum staff discussed the future development of Lots 881 and 882. The City of Bunbury wishes to develop Lot 882 as a site for the Three Waters Visitor Centre, and is currently negotiating approval of a land swap of Lot 881 with another parcel of land, to allow development to occur on Lot 881.The meeting resolved that it is necessary to undertake test excavations of the anomalies on Lots 881 and 882 to identify the nature of the features. The City of Bunbury requested WA Museum assistance in preparing a project brief and methodology for the excavation.

Purpose
The purpose of this MOU is to establish the respective responsibilities of the City of Bunbury and the Western Australian Museum's Department of Maritime Archaeology to successfully undertake Archaeological Test Excavations (the Project) on lots 881 and 882 Koombana Drive, Bunbury. The test excavations are due to commence on Monday 21 November 2011 and conclude on Monday 28 November 2011.

The aims of the Project are as follows:
1. Excavate selected areas on lots 881 and 882 to determine if geophysical anomalies are cultural features;
2. Identify any features to determine if they are shipwreck-related;
3. Determine the extent and alignment of the features;
4. Define an adequate buffer zone to protect the cultural heritage values of any protected maritime archaeological sites;
5. Backfill and remediate sites following test excavations.

Responsibilities of the City of Bunbury
- Provide and overall coordinating, project management function;
- Obtain and hold all clearances to undertake the test excavations;
- Provide necessary insurance to cover City of Bunbury employees while on-site;
- Provide necessary insurance to cover the General Public while on-site as part of a public tour;
- Manage the project budget and coordinate funding;
- Devise and implement communication and promotional plans in consultation with the WA Museum;
- All site preparation including, surveying, pegging, spraying, fencing, etc;
- Coordinate contractors required for the Project including excavator, excavator operator, dewatering, etc;
- Provide site equipment such as generator, lunch room, port-a-loos, etc for use by WA Museum employees/volunteers;
- Coordinate and provide a location for public information sessions at times agreed with WA Museum;
- Provide accommodation for up to 25 WA Museum employees/volunteers involved in the Project for the duration of the test excavations;

- Provide breakfast, lunch, morning tea and afternoon tea for up to 25 museum employees/volunteers for the duration of the test excavations;
- Reimburse WA Museum for expenses

Responsibilities of the WA Museum

- Provide professional advice to City of Bunbury staff regarding requirements and planning of the Project;
- Coordinate the volunteers, including transport to and from site, evening meals, etc;
- Provide all necessary insurance to cover WA Museum employees/volunteers including workers compensation and all insurances necessary to cover employees/volunteers 24/7 during their stay in Bunbury and during transport to and from Bunbury;
- Provide any archaeology specific equipment required to complete the Project;
- Manage the operations of the site during the test excavations;
- Conduct regular public tours of the site during the test excavations at times agreed with the City of Bunbury;
- Conduct public information sessions during the test excavations at times and locations agreed with the City of Bunbury;
- Identify and record any structure in detail by measurement, scaled photographs, video and scaled drawings;
- Record the excavation process using site recording forms, field notes, photography and videography;
- Survey, position-fix and tie into mapping grid all excavated areas, coherent structure, artefacts and other relevant features;
- If applicable, recover sediment, timber and material culture samples for further research and analysis;
- If applicable, artefact management to involve recovery, transport, conservation and storage of diagnostic artefacts;
- Provide results and recommendations to the City of Bunbury in report format;
- Provide full and unrestricted access to all primary source data of whatever nature compiled by the WA Museum during the course of the project and permit the City of Bunbury to copy same.
-

Duration

This document may be modified with the mutual consent of both the City of Bunbury and the WA Museum.

This MOU commences on the day this MOU is signed by both parties and terminates when the Final Report has been received by the City of Bunbury and when all monies owing to the WA Museum by the City of Bunbury have been paid.

Signed and agreed on behalf of the City of Bunbury
Name: Andrew Brien
Position: Chief Executive Officer

Signed and agreed on behalf of the Western Australian Museum
Name: Alec Coles
Position: Chief Executive Officer

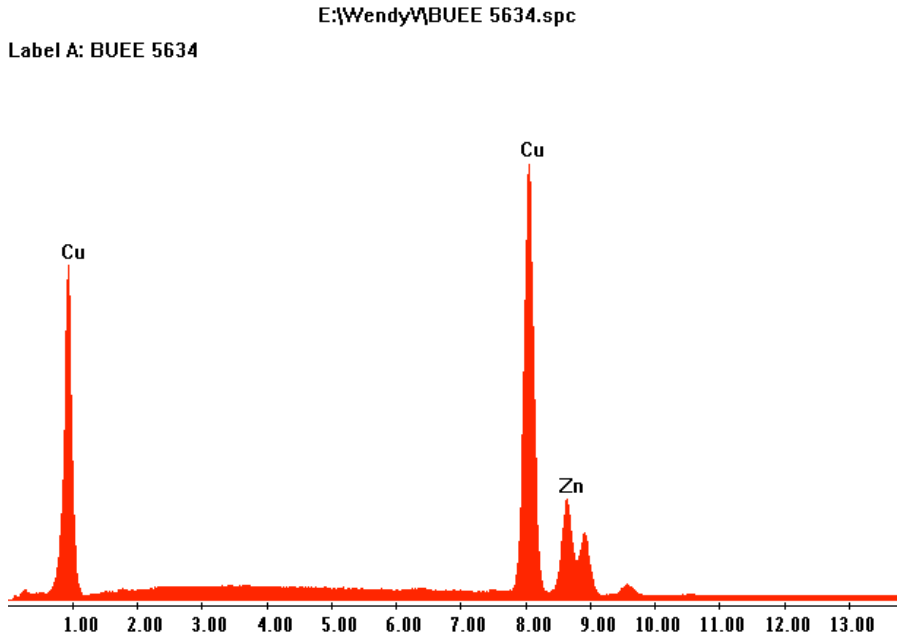
Appendix B: Artefact registrations

Registration Number	No. Items	Description
BUEW5677	1	Fastening, iron bolt, hexagonal head, corroded
BUEW5678	1	Fragment of steel wire cable, corroded
BUEW5679	1	Fastening, iron spike, square section, round head
BUEW5680	2	2x fastenings, iron spikes 1) Heavily concreted 2) Round head, square shank
BUEW5681	3	3x fragments of flat glass, possibly window glass
BUEW5682	11	11x fragments of green bottle glass, neck, body and base fragments, partial embossed marking '102' on base fragment
BUEW5683	1	Fastening, iron spike, with wood attached
BUEW5684	1	Green bottle glass, base fragment
BUEW5685	1	Fastening, iron bolt, round head
BUEW5686	1	Green bottle glass fragment
BUEW5687	1	Green bottle glass fragment
BUEW5688	3	Fastenings x 3 1) 2x Cu alloy threaded slot head grub screws, furniture fittings? 2) 1x sheathing tack
BUEW5689	1	Fragment of steel wire cable, corroded
BUEW5690	2	2x fastenings, Iron spikes, square section, corroded 1) Wood attached 2) Bent
BUEW5691	1	Fastening, iron spike, square section, concreted
BUEW5692	1	Fastening, iron spike, round head, square section
BUEW5693	1	Fastening, iron spike, concreted, bent
BUEW5694	1	Intact glass prismatic deck-light
BUEW5695	1	Fastening, iron drift bolt, corroded, round head
BUEW5696	1	Fastening, iron drift bolt, corroded, round head
BUEW5697	1	Timber sample
BUEW5698	1	Timber sample
BUEW5699	1	Timber sample
BUEW5700	1	Timber sample
BUEW5701	2	Timber sample
BUEW5702	1	Timber sample
BUEW5703	1	Timber sample

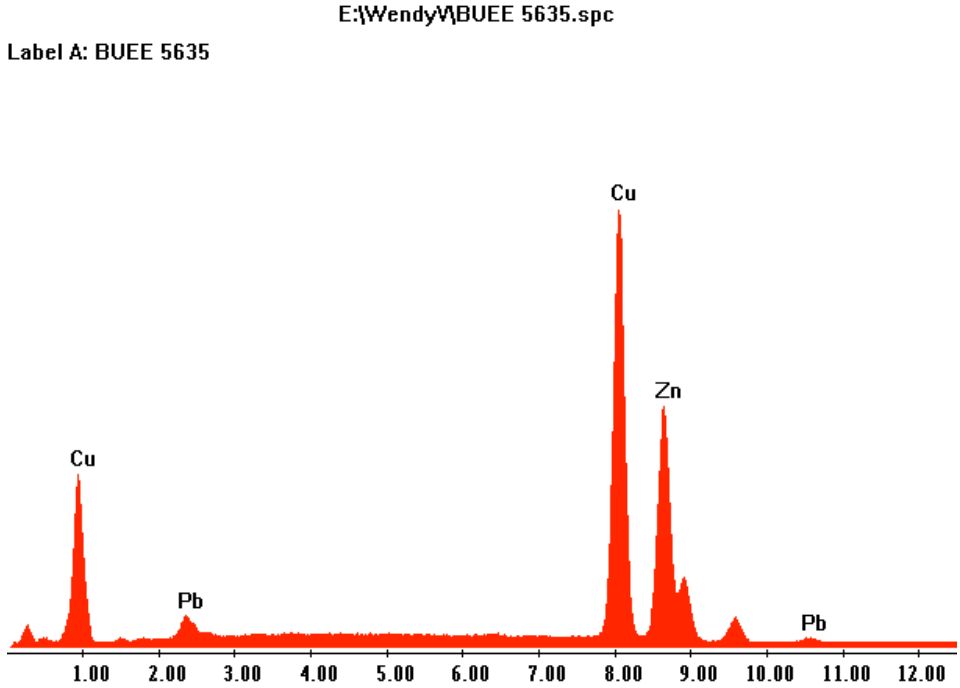
BUEW5704	1	Timber sample
BUEW5705	1	Timber sample
BUEE5632	2	Sheathing fragments, copper
BUEE5633	2	Fastenings, 1x complete copper alloy sheathing tack w/ square shank, and 1x possible head of tack
BUEE5634	1	Fastening, Sheathing tack w/ square shank, slightly bent, copper alloy
BUEE5635	1	Sheathing fragment
BUEE5636	1	Sheathing fragment, bent, copper
BUEE5637	1	Coal
BUEE5638	1	Possible cleat, wood, w/ evidence of nail hole through at an angle
BUEE5639	1	Concretion, possible bolt head
BUEE5640	2	Charcoal sample
BUEE5641	1	Iron fastening
BUEE5642	1	Fastening, tree nail
BUEE5643	1	Fastening, tree nail
BUEE5644	2	Fastening, tree nail + 1 timber fragment
BUEE5645	4	Timber fragments, 1 flat piece is a possible cask stave fragment (has a bevelled edge and a clean break at the weakest point of a stave).
BUEE5646	1	Cask stave fragment, bevelled edge on side
BUEE5647A	8	Bottle fragments, olive green. 1x neck and part shoulder and various body fragments.
BUEE5647B	20	Bottle fragments, olive green. 1x bottle base and various body fragments.
BUEE5647C	1	Cork, from bottle
BUEE5648	2	Fastening, 1x bolt (missing head) and 1x charcoal
BUEE5649	1	Bone
BUEE5650	1	Bone
BUEE5651	1	Bone, worked.
BUEE5652	1	Natural beach rock
BUEE5653	1	Copper fastening with timber attached
BUEE5654	1	Iron piece
BUEE5655	3	Iron bolts, broken.
BUEE5656	1	Iron fastening with wood attached
BUEE5657	1	Fastening, copper alloy, broken bolt, slightly bent near the head and missing end.
BUEE5658	6	Barnacle samples.
BUEE5659	4	Section of stem post timber with copper alloy sheathing attached, including sheathing tacks and draft marks ‘8’ and ‘9’.

BUEE5660	1	Ship's timber w/ evidence of tree nail features, also w/ bolts and tree nails embedded.
BUEE5661	1	Broken timber with tree nail.
BUEE5662	1	Timber
BUEE5663	1	Timber (loose timber 18).
BUEE5664	1	Ship's timber w/ tree nails and tree nail features; and a distinct impression of an iron supporting knee or breasthook.
BUEE5665	1	Flat piece of timber (thought to be cask stave fragment).
BUEE5666	1	Soil sample
BUEE5706	1	Timber sample
BUEE5707	1	Timber samples
BUEE5708	1	Timber and bark samples

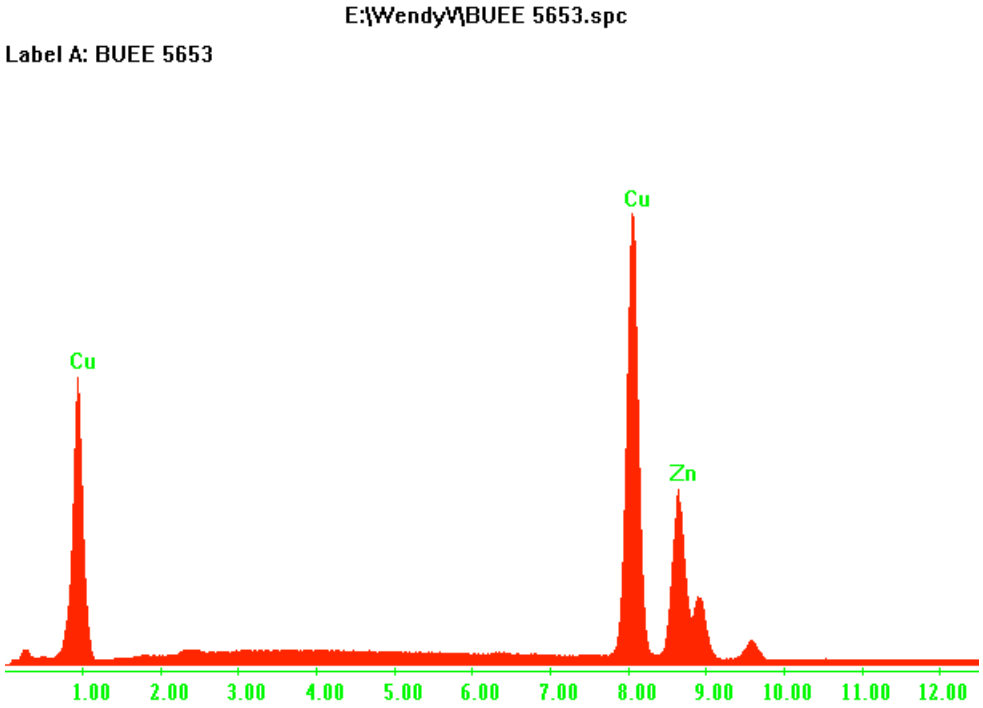
Appendix C: Scanning Electron Microscope Data



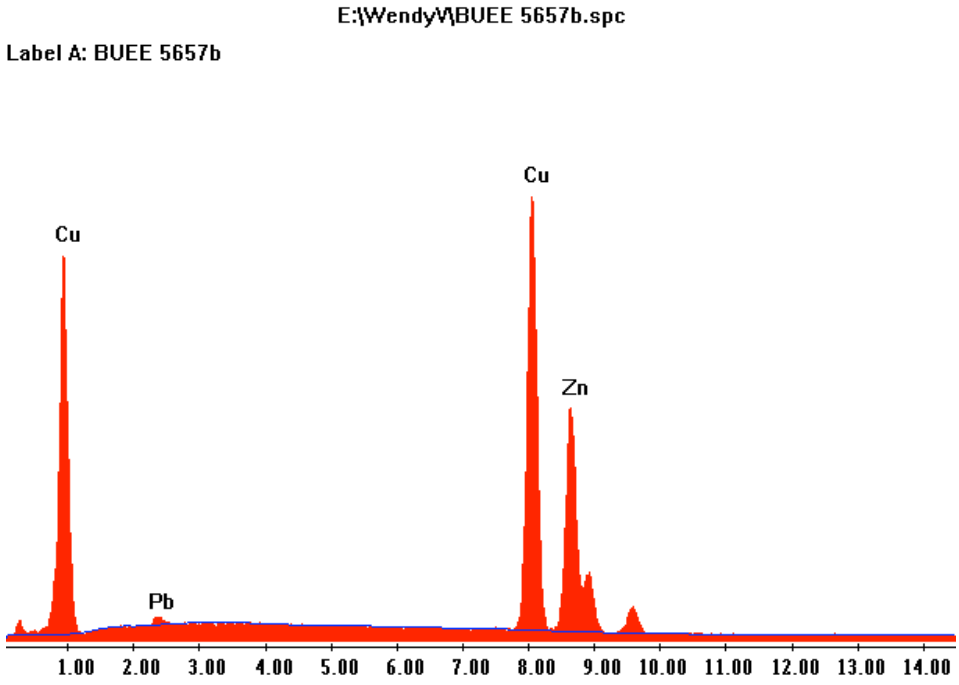
SEM Data for artefact BUEE 5634 – sheathing tack



SEM Data for artefact BUEE 5635 - sheathing



SEM Data for artefact BUEE 5653



SEM Data for artefact BUEE 5657

Appendix D: Results of timber Identification

Job No. - 11/96

Bunbury Excavation East/Lot 882 (Superpit)

BUEE/882

Wood identifications:

All wood samples were polished to a 1200 grit finish before low power microscopic examination of the end grain features. Sections were taken from the radial longitudinal surfaces of any softwood samples for high power microscopic examination. Summaries of all examined timbers are given below.

BUEE/882/WCORE5

Examination of the end grain revealed the following features - rays of 2 distinct widths with the larger rays wider than the pores, distinct growth rings, ring porous arrangement and abundant tyloses present in the pores. The sample is a white oak (Quercus species). White oaks are native to Europe and North America.

BUEE/882/WCORE3, BUEE/882/WCORE6, BUEE/882/WCORE7 and BUEE/882/WCORE8 were also white oak. WCORE3 was quite degraded, the inner parts of WCORE7 were in very good condition and WCORE8 was in very good condition.

BUEE/882/WCORE9 - the sample is a softwood with an abrupt transition between the early and the latewood. Resin canals are present. Highly dentate ray tracheids were clearly visible on the radial longitudinal surfaces but it was difficult to detect the nature of the cross field pits present in the ray parenchyma. Although initial observations were not conclusive, eventually the presence of small pinoid pits (3-4 per crossfield) were detected. The sample is therefore a pine of the pitch pine type, examples of which include longleaf pine (Pinus palustris Mill. - southern North America), slash pine (P. caribaea Morelet - Central America) and loblolly pine (P. taeda L. - southern and south-eastern North America). This sample is therefore of North or Central American origin.

BUEE/882/WCORE10 - sample is a hardwood with the following features: rays are narrower than the pores; soft tissue surrounds the pores; the pores are moderately numerous, are small to intermediate in size, predominantly solitary and in an oblique arrangement; tyloses are abundant. The sample is clearly a Eucalyptus species, native to Australia.

Dr Ian Godfrey, Department of Materials Conservation, WA Museum

29 December 2012

Job No. - 11/95

Bunbury Excavation West/Lot 881/Trench 1

BUEW/881/T1

Wood identifications:

All wood samples were polished to a 1200 grit finish before low power microscopic examination of the end grain features. Sections were taken from the radial longitudinal surfaces of any softwood samples for high power microscopic examination. Summaries of all examined timbers are given below.

BUEW/881/T1/W12/U0002/F0082 - the end grain features were too distorted and no useful diagnostic features could be discerned by microscopic examination. The wood appeared to be a hardwood but that is all that could be concluded.

BUEW/881/T1/SX12/U0002/F0078 - the sample is a softwood with an abrupt transition between the dense latewood and the less dense early wood. Resin canals were present.

Dentate ray tracheids and smooth-walled ray parenchyma with large simple cross field pits were visible on the radial longitudinal surface.

The sample is a pine of the red deal type, examples of which include Scots pine (Pinus sylvestris L. - Europe), red pine (P. resinosa Ait. - eastern North America) and Austrian/Corsican pine (P. nigra Arnold - Europe). Pines of this group are native to Europe, North America and Asia.

BUEW/881/T1/X12/U0002/F0079 - this is also a softwood. The transition between the early and the latewood was more gradual than with sample F0078 but all other features were identical with F0078. This sample is therefore also a pine of the red deal type.

BUEW/881/T1/X13/U0001/F0052 - this sample is as for F0078 and F0079, although the features of the ray tracheids were less clear and only discerned with difficulty. In places there were 2 simple pinoid pits per cross field. A number of sections were taken to confirm the presence of dentate ray tracheids. Sample is a pine of the red deal type.

These wood identifications do not allow a provenance to be given to the wood samples as pines of the red deal type are native to Europe, North America and Asia.

Dr Ian Godfrey, Department of Materials Conservation, WA Museum

29 December 2012

Job No. - 11/97, Bunbury Excavation West/Lot 881/Trench 2

BUEW/881/T2

Wood identifications:

All wood samples were polished to a 1200 grit finish before low power microscopic examination of the end grain features. Sections were taken from the radial longitudinal surfaces of any softwood samples for high power microscopic examination. Summaries of all examined timbers are given below.

BUEW/881/T2/WCORE1 - the sample is a softwood with an abrupt transition between the early and the latewood. Resin canals are present. Dentate ray tracheids and large pinoid simple pits in the ray parenchyma were observed in a radial longitudinal section.

The sample is a pine of the red deal type, examples of which include Scots pine (Pinus sylvestris L. - Europe), red pine (P. resinosa Ait. - eastern North America) and Austrian/Corsican pine (P. nigra Arnold - Europe). Pines of this group are native to Europe, North America and Asia.

BUEW/881/T2/WCORE2, BUEW/881/T2/WCORE3, BUEW/881/T2/WCORE4, BUEW/881/T2/WCORE5 and BUEW/881/T2/WCORE7 had identical microscopic features as BUEW/881/T2/WCORE1 and are therefore also pines of the red deal type. The transition between the earlywood and the latewood was a little more gradual for sample BUEW/881/T2/WCORE3 than for the other samples.

The provenance of these wood samples cannot be conclusively assigned as red deal pines are native to Europe, North America and Asia.

Dr Ian Godfrey, Department of Materials Conservation, WA Museum

29 December 2012

Appendix E: Archaeological features Lot 881 Trench 1

Feature	Description	Square	Unit
F0001	Timber	W12	U0001
F0002	Ilmenite	W12	U0001
F0003	Metal keel bolt	W12	U0001
F0004	Iron bolt	X13	U0001
F0005	Iron knee (upright)	X13	U0001
F0006	Metal keel bolt	W12	U0001
F0007	Metal keel bolt	W12	U0001
F0008	Post hole	W12	U0001
F0009	Copper alloy bolt	W12	U0001
F0010	Iron (?) piece	W12	U0001
F0011	Post hole	W12	U0001
F0012	Post hole	W12	U0001
F0013	Iron knee	W12, X12	U0001
F0014	Iron cable	W12, X12	U0001
F0015	Glass	X13	U0001
F0016	Upright iron bolt	X13	U0001
F0017	Horizontal iron bolt	X13	U0001
F0018	Piece of iron cable	W12	U0001
F0019	Iron (?) fragment	W12	U0001
F0020	(timber) Included in F0029, see for info	W12	U0001
F0021	Iron cable piece (?)	X13	U0001
F0022	2 pieces of glass	X12	U0001
F0023	Iron knee (broken)	X12, X13	U0001
F0024	Iron knee (no short arm)	X12, X13	U0001
F0025	Iron sheeting	X12	U0001
F0026	Iron knee (on its side)	X12	U0001
F0027	Pieces of glass	X13	U0001
F0028	Cluster of bolts (copper alloy), iron fragments, 1m square including part of F0014	W12	U0001
F0029	Planking (timber) + 3 iron bolts	W12	U0001
F0030	Piece of iron cable	W12	U0001

F0031	Iron bolt (?)	W12	U0001
F0032	Iron bolt (?)	W12	U0001
F0033	Copper alloy bolt	X12	U0001
F0034	Iron (?) bolt (in the trench wall)	X12	U0001
F0035	Iron bolt	X12	U0001
F0036	Copper alloy bolt	X12	U0001
F0037	Copper alloy bolt	X12	U0001
F0038	Copper alloy bolt	X12	U0001
F0039	Iron bolt (bent)	X12	U0001
F0040	Iron bolt (?)	X12	U0001
F0041	Iron bolt (?)	X12	U0001
F0042	Iron cable (?)	X12	U0001
F0043	Copper alloy bolt	X12	U0001
F0044	Post hole with wood	X12	U0001
F0045	Iron bolt	X12	U0001
F0046	Iron bolt (?)	X12	U0001
F0047	Iron bolt	X12	U0001
F0048	Iron bolt (?)	X12	U0001
F0049	Metal bolt	X13	U0001
F0050	Copper alloy bolt	X13	U0001
F0051	Horizontal piece of iron in trench wall	X13	U0001
F0052	1m square including broken knee F0023, iron conglomerate (bolts) and wood	X13	U0001
F0053	Sondage 1, 1m square including F0037 and F0038	X12	U0001

Appendix F: Archaeological features Lot 881 Trench 2

Feature	Description	Square	Unit
F0066	Piece of timber	S12	U001
F0069	2 iron bolts	S12	U001
F0083	Deck light	S12	U001
F0091	Ship structure	S11, S12	U001
F0092	BW34, iron bolt	S12	U001
F0093	BE35, iron bolt	S11	U001
F0094	BE36, iron bolt	S12	U001
F0096	Sondage 1	S11, S12	U002

Appendix G: Archaeological features Lot 882 Trench 1

Feature	Description	Square	Unit
F0001	Stem post	K12	
F0002	NE Loose/snapped timber (frame?)	K12	
F0003	NE Frame	K12	
F0004	NE Frame	K12	
F0005	NE Frame	K12	
F0006	NE Frame	K12	
F0007	Iron on NE side	K12	
F0008	Iron (middle)	K12	
F0009	Iron (middle)	K12	
F0010	NW Frame	K12	
F0011	NW Frame	K12	
F0012	NW Iron	K12	
F0013	NE Frame	K12	
F0014	NE Frame	K12	
F0015	Northern exterior timber	K12	
F0016	External northern rock	K12	
F0017	Coal found on NW side	K12	
F0018	Sheathing found outside of the hull on NW side	K12	
F0019	Sheathing found next to F0001	K12	
F0020	Copper fastening found on top of F0001	K12	
F0021	Shell fragment below F0013	K12	
F0022	Wood and iron fastener, NW side, south of F0012	K12	
F0023	Loose timber, NW side, outside of hole, with treenail	K12	

F0024	Bone	K12	
F0025	Broken iron bolt	K12	
F0026	Sheathing (copper)	K12	
F0027	Concretion (possible)	K12	
F0028	Waterworn beach rock	K12	
F0029	Waterworn beach rock	K12	
F0030	Waterworn beach rock	K12	
F0031	Loose timber - broken frame laying across F0037	K12	
F0032	SW Frame - sister frame to F0031	K12	
F0033	SW Frame	K12	
F0034	SW Frame	K12	
F0035	SW Frame	K12	
F0036	SW Frame	K12	
F0037	SW Frame	K12	
F0038	Iron located north of NE hull, in trench wall	K12	
F0039	Iron fastener found under F0001 in association with possible stern knee	K12	
F0040	Concretion/possible bolt head in front of F0001, south of conglomerate	K12	
F0041	NW Frame	K12	
F0042	NW Frame	K12	
F0043	NW Frame (fastened to frame F0042)	K12	
F0044	Glass bottle found north of two iron pieces F0012	K12	
F0045	Sister frame to F0043	K12	
F0046	Possible barrel stave, outside NW hull	K12	
F0047	Possible wooden cleat, outside NW hull	K12	
F0048	Bone located beneath F0003	K12	
F0049	Wooden treenail on F0001	K12	

F0050	Copper fastener between F0001 and crutch knee	K12	
F0051	NW Hull, external, top bar of F0007 on sheathing	K12	
F0052	Copper fastener found outside SW corner	K12	
F0053	Overlap of copper sheathing	K12	
F0054	Iron support – crutch knee	K12	
F0055	Mast step	K12	
F0056	Iron fastening in association/near F0055	K12	
F0057	Iron knee located near F0055 and F0056, not in association with anything-buried	K12	
F0058	Outline of fastener concretion at bow	K12	
F0059	Right angle bent iron at bow with fastener	K12	
F0060	Fastening port side within F0058	K12	
F0061	Fastening head portside within F0058	K12	
F0062	Fastening starboard side within F0058	K12	
F0063	Fastening starboard side within F0058	K12	
F0064	Fastening starboard side within F0058	K12	
F0065	Fastening starboard side within F0058	K12	
F0066	Iron knee aligned with F0037	K12	
F0067	Iron fastening loose against stern knee	K12	