WINWELL
FOUNDATION

Subsurface Acoustic Surveys of Swan and Canning River Shipwrecks

December 2025

Prepared for Heritage Council of Western Australia

Heritage Grant Agreement 40CHG2025

Report prepared and approved by:

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ACKNOWLEDGMENTS

Winwell Foundation acknowledges the Whadjuk Noongar people as custodians, as well as all who have and continue to care for and manage the lands and waters on which this study is based. We pay our respect to all Elders past and present.

Winwell Foundation wishes to thank the volunteer members of the Maritime Archaeological Association of Western Australia (MAAWA) for their long term and enthusiastic interest and support for this project. Volunteer members helped with field survey activities including provision of a backup safety vessel for the Bull Creek site. This help is in addition to their research and field documentation commitment to the historic underwater and buried wreck or vessel abandonment sites in the Derbal Yerrigan/Swan - Djarlgarra/Canning River system.

The Western Australian Museum (WAM), Department of Maritime Heritage staff, are also acknowledged for their support and considered assistance. Thanks especially for the generous supply of their (now former) research vessel *Dirk Hartog* for the surveys in the exposed open water sites on Melville Water. Given the changing weather forecasts that lead up to the planned period of survey, the flexibility and commitment of the WAM skipper and crew is to be commended. In addition, thanks go to the South of Perth Yacht Club who at short notice provided overnight berthing facilities to enable *Dirk Hartog* to be on station at first light for the surveys.

Our appreciation is extended to Dr Doug Bergerson of Acoustic Imaging Pty Ltd who supplied the specialist sub-bottom survey and position fixing equipment, and personally assisted with their field setup and data acquisition and processing tasks. The Environmental, Heritage and Ranger staff from both the Cities of Canning and Melville are also thanked for their interest, support and social media efforts to inform their communities of this project's activities. The project team will be in contact in the new year to offer follow up briefings and/or presentations as committed.

Special thanks are extended to the Heritage Council of Western Australia. The Council awarded the Winwell Foundation (a not-for-profit Charitable Trust) a grant under the 2024-2025 Heritage Grants Program. This grant enabled the project to be undertaken as the funds paid for all third-party expenses, these being matched by volunteer and in-kind support.

Chapter 1 EXECUTIVE SUMMARY

The Derbal Yerrigan/Swan River–Djarlgarra/Canning River system has, from the earliest period of European settlement, been a focus of Western Australian life. Within this system, listed on the State Register of Heritage Places (Place Number P18987), there are historic vessels of significant heritage value located on or under the riverbed sediments.

This project, led by the Winwell Foundation, undertook subsurface acoustic surveys using parametric sub-bottom profiler technology to help characterise and document the buried material remains of four vessels either lost or abandoned in the Swan-Canning River system. The outcomes of the study provided vital information with which preliminary *in-situ* heritage management plans can be prepared by the Western Australian Museum.

Key findings from this study are summarized below. Full interpretations for each site, including recommended actions for further identification and in-situ management purposes, are listed in Chapter 5.

Point Walter Barge – *Dearden's flat* (1882)

Many small and low-density acoustic reflectors formed a mound above the barge and extended beyond the limits of its exposed riverbed outline. This mound of small reflectors interfered with the SBP acoustic waves, resulting in a lack of definition of the barge's buried remains, although it was clear that the acoustic waves had detected the underlying buried material.

Recommendations for in-situ management include:

- Multiple SCUBA dives be undertaken to assess any seasonal, periodic or episodic events such as fish aggregation, benthic macro-invertebrate or detrital accumulations over this site;
- Revisit the site at an opportune time to undertake a follow-up SBP in 'clear' conditions; and
- Assess the hydrodynamic/geochemistry conditions at the site through measurement of current flows, DO profiles under typical tidal flow conditions and following local flood events, and sediment chemistry.

Applecross Barge site (*Jane* 1897?)

The SBP survey revealed two smooth planar, horizontal layers with high reflection amplitudes in the cargo hold extending from gunwale to gunwale,

and from close to the stern to just beyond the forward bulkhead, of the sub-surface sunken barge. The upper layer is located 74–88 cm below the current riverbed surface. The lower layer lies 18–19 cm below the upper layer. The smooth planar layers suggest that the cargo carried by this barge was evenly packed, and not irregular mounds of rock etc.

A small area off the starboard aft quarter of the barge, and at the same depth as the base of the barge, was observed. This area was characterised as having similar high reflection coefficients as the upper cargo layer within the barge, suggesting a similar type of material sitting on a lower and possibly the riverbed level at the time of sinking.

The smooth planar cargo layers, and the similar material found just off the vessel on what is believed to be the former riverbed, align with the contemporaneous newspaper survivor's report of the sinking of the brick carrying barge *Jane* (1897). The SBP data strongly supports, but does not exclusively prove, this identification.

Recommendations for in-situ management include:

- Undertake sediment probing off the starboard aft quarter of the barge to confirm the presence and nature of the material sitting on the lower original bed level;
- Collect several long sediment cores in the surface of the surrounding riverbed to a depth of at least 1m, and analyse for sediment size and DO profiles;
- Undertake a full '3D' SBP survey, using an Innomar Quattro system at 1m line spacing, and analyse to create a 3D visual and VR model to examine finer details of the cargo profile, timbers (possibly the mast or boom) inclined over the cargo and other details in both the bow and aft compartments; and
- If consideration is given to the attempted recovery of bricks from the site to prove identity, then methods for doing such must consider the nature of and the consequential difficulties of working through the finer overlying sediment layer. The SBP reflection profile suggests that the upper surface of the cargo may be slightly less dense than the lower layer, indicating that weathering and some deterioration may have occurred at the top more exposed cargo layer. This might provide a non-open excavation option for recover of cargo fragments.

Bull Creek Unidentified barge (*Dugong*?)

The SBP survey results showed that the barge at this site was flat-bottomed, and that there was no evidence of aft paddle wheel supporting structures.

An historic aerial photograph taken in 1942 shows a double ended barge in the correct location and orientation within Bull Creek. The photo clearly shows the forward deck and the cargo hatch with no indication of a centrally located boiler. The aft section is less clear, but there are no apparent structures nor timbers outside the line of the stern.

A direct comparison of the outline shape of the Dugong, based on the 1896 PWD scaled survey plan, and the in-situ outline of the unidentified barge based on its exposed frame tips, clearly showed that outline shape of the Dugong does not match the in-situ shape of the unidentified barge.

Based on all lines of evidence the unidentified barge in Bull Creek is not the *Dugong* barge.

Oral histories from the now adult children of the earliest settlers on the eastern side of Bull Creek, and separately an earlier interview with a direct Bateman descendent, strongly suggest that the unidentified barge at the head of Bull Creek was once owned and subsequently abandoned by the Bateman family.

Recommendations for in-situ management include:

- The *Dugong's* demise remains a mystery, so further archival research is recommended to try to find additional PWD records pertaining to this vessel; and
- Additional SBP surveys be undertaken on the western bank of Bull creek to try and identify any trace of the other two historic barges.

Melville Water Unidentified wreck

No evidence of buried wreck material was found around the magnetometer GPS co-ordinates extracted from WAM's records.

Recommendations for in-situ management include:

- a more thorough magnetometer survey be undertaken in the area. If significant iron 'hits' are subsequently recorded, then a riverbed surface inspection should be undertaken and a follow-up SBP survey considered.

Chapter 2 PROJECT SETTING

Project Objectives

This project, led by the Winwell Foundation (winwellfoundation.org), undertook subsurface acoustic surveys to help characterise and document the buried material remains of four vessels either lost or abandoned in the Derbal Yerrigan/Swan River–Djarlgarra/Canning River system, herein referred to as the Swan-Canning Rivers, Western Australia. These sites have either been recently discovered and/or are listed on the State's Maritime Archaeological Register.

The study objectives were (i) to try and confirm the identification of two of these historically important buried vessels; (ii) to document the *in-situ* conditions of these and the recently confirmed oldest discovered vessel in the Swan–Canning River system; and (iii) try to locate a fourth vessel which may pre-date them all. The outcomes of the study will provide vital information with which preliminary *in-situ* heritage management plans will be prepared by the Western Australian Museum (WAM), the State's management authority, as these sites fall under the protection of the existing *Maritime Archaeology Act 1973*, or under the forthcoming State legislation currently being drafted.

Background Setting

The Swan and Canning Rivers have, from the earliest period of European settlement, been a focus of Western Australian life. Within the Swan/Canning River system, listed on the State Register of Heritage Places (Place Number P18987), there are historic vessels of significant heritage value located on or under the riverbed sediments. These vessels are associated with early industry and transport of goods and passengers within the colony. They potentially may also record the involvement of local convict labour in ship construction.

During the early settlement period of the Swan River Colony, access through the entrance to the Swan River was blocked by a rock bar, and further upstream, roads consisted of nearly impassable sandy tracks. Consequently, the rivers became the primary means of transportation, and the types of vessels constructed for carriage of goods and people from the 1830s onwards included flats (small boxlike barges), flatbottomed double-ended lighters and sailing barges, as well as cutters, peter boats, punts, whaleboats,

gigs and ferries. Cargo and passenger traffic between inland locations and the port in Fremantle, travelling along the length of these waterways, were subject to local weather conditions and hazards. On days with little wind the sailing barges and punts were poled along until the breeze freshened. However, when caught out in the middle of the river in a strong afternoon seabreeze with their overloaded boats, the "Melville Water became the graveyard of many a traveler and boatman" (Dickson 1998, 2-3).

Convict labour was introduced into the colony in 1850 to help with early construction of roads, buildings and other infrastructure. Within the Swan/Canning system there are only two records of convict labour constructing maritime works—the convict fence within the Canning River listed on the State's Heritage Register (P04609), and the barge *Dugong*, the earliest vessel built on the Canning to service dredging works along the rivers, including the shallow channel alongside the convict fence. The abandonment location of the *Dugong* has yet to been confirmed, but Dickson (1998, 43-44) believed 'that she (the *Dugong*) may be the unidentified wreck in Bull's Creek as the dimensions tally, however that is for others to determine". The unidentified barge lies at the head of Bull Creek, a tributary to the Canning River, immediately adjacent to Bateman Reserve. This heritage listed location (Place Number 25432) incorporates the top of Bull Creek, Bateman Park and the boat landing and jetty remnants associated with Bateman's heritage listed home 'Grasmere'.

Recent technological advances have resulted in the identification of newly discovered wreck or abandonment sites, and sites corresponding to known historical records, as well as a means of mapping and interpretation of their material remains below the seabed without physical disturbance. In 2023, the Maritime Archaeological Association of Western Australia (MAAWA), the volunteer community group associated with WAM, discovered several historic shipwrecks in the Swan River using existing Department of Transport data to search the riverbed (Morrison 2023) (https://www.abc.net.au/news/2023-09-02/shipwreck-found-perth-swan-river-maritime-archaeologists/102798982). Given the historical and social significance of these undisturbed wrecks, alongside the potential *Dugong* site, there is urgent need for maritime heritage management planning and protection, guided by a strong understanding of both what is buried below the riverbed, and their state of preservation. The Winwell team has developed the expertise to use non-invasive subsurface acoustics to survey and interpret these sites for the benefit of the community and preservation of their heritage.

Project sites – historical and heritage context

The four planned historic barge/vessel sites selected for subsurface acoustic surveys are shown on Figure 1. Their historic and heritage context is described in the following sections.

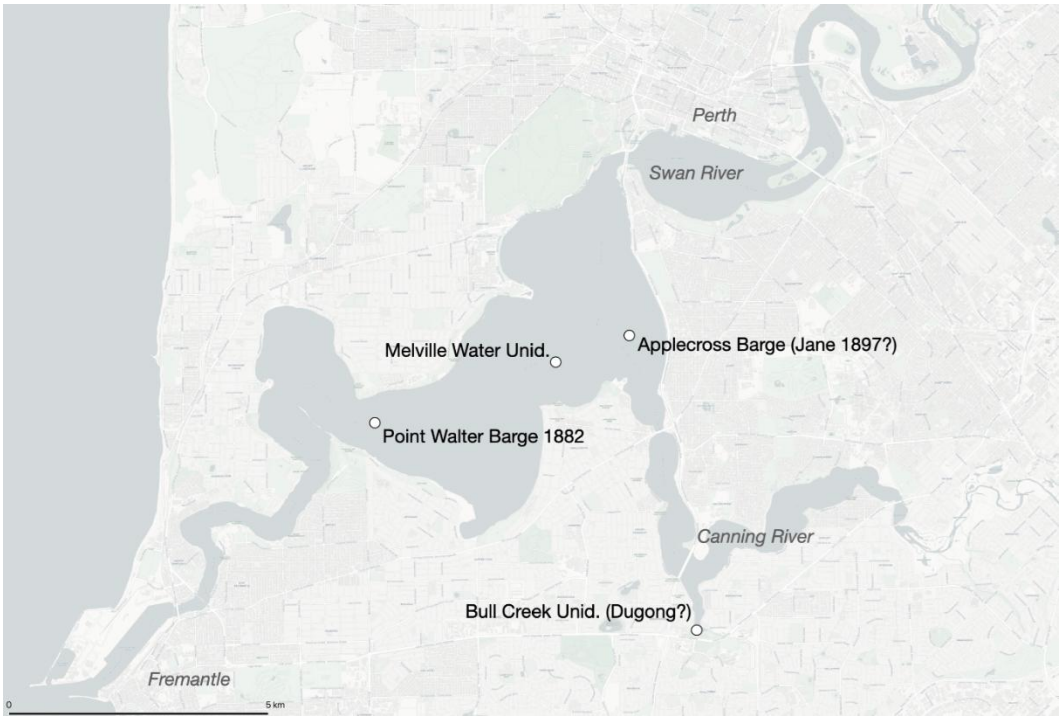

Figure 1. Map of Swan/Canning Rivers showing locations of historic barges and associated subsurface survey sites.

Point Walter Barge – Dearden's flat (1882)

The wreck of a barge sunk with a cargo of limestone at Point Walter, discovered in 2023, was formally identified in July 2024 by the Western Australian Museum (WAM) as *Dearden's flat*. This vessel was lost in 1882 and is now registered as a maritime archaeological site under Section 4.1.(a) of the *Maritime Archaeology Act 1973.* The site is historically significant as the oldest known wreck located in the Swan River. It represents the importance of barges as the primary means for transporting goods in the Perth metropolitan area before the 1920s, after which railways and vehicles became dominant. It also characterises the past trades in bulk stone and timber that built the city of Perth – including major roads, railways and buildings.

The site, as depicted from photogrammetric modelling in Figure 2, and from a contemporary multibeam seabed survey (Figure 3), is uniquely and highly archaeologically significant, with the vessel's construction, cargo and general equipment still mostly intact, in contrast to most similar wrecks which were stripped before abandonment. Surface and subsurface investigations have the potential to reveal details of ship construction, and daily operational details of early river trade. These investigations will also provide information vital to the preparation of heritage management planning activities for this site.

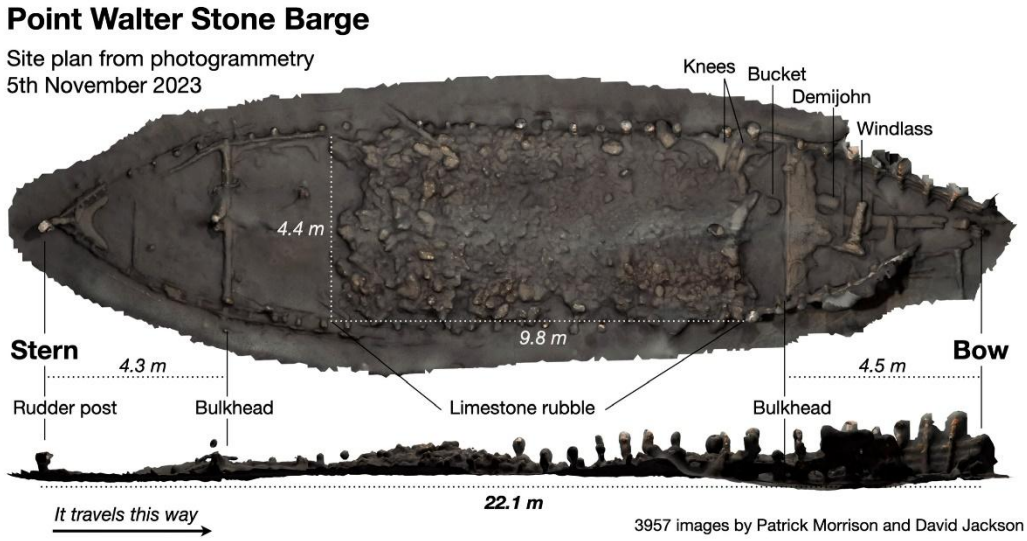

Figure 2. Point Walter Barge Site Plan prepared from photogrammetry (P. Morrison).

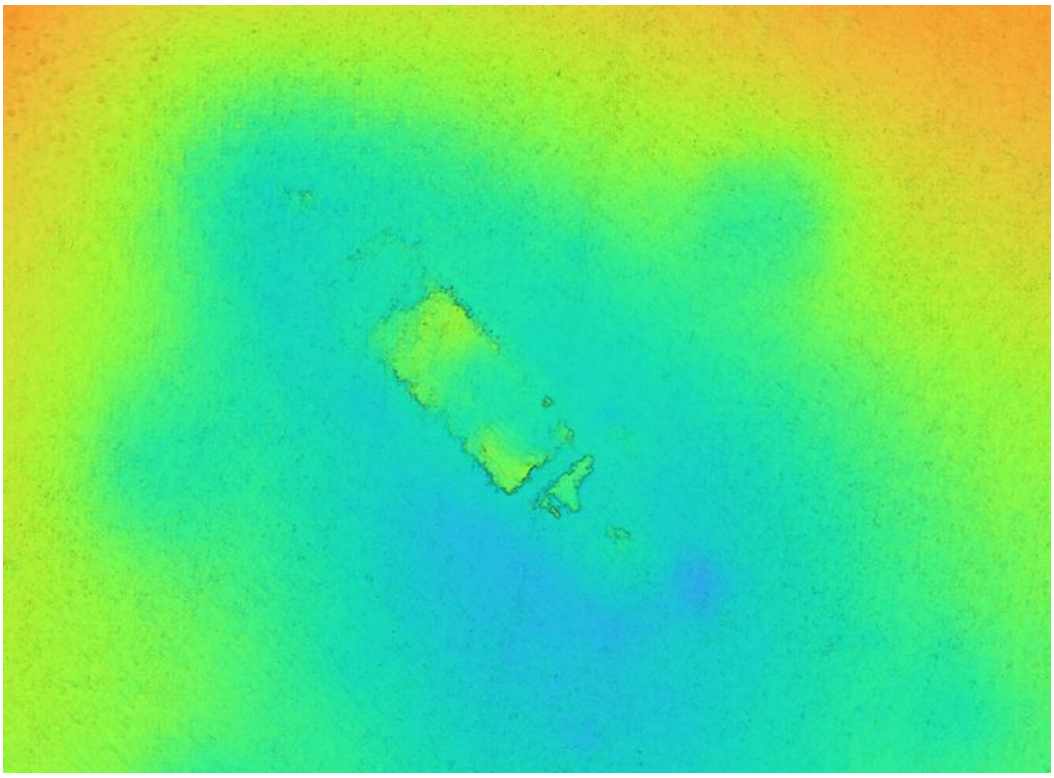

Figure 3. Contemporary multibeam riverbed image showing exposed remains of *Dearden's Flat* (P. Morrison).

Applecross Barge (Jane 1897?)

The Applecross Barge is currently under investigation by WAM after its discovery by MAAWA in October 2023. A formal "Notice of finding a wreck or relic believed to be historic" was lodged with the WA Museum on October 3rd, 2023. As depicted from photogrammetric modelling in Figure 4, it is an unpowered barge about 21m long, with the rudder still intact and the main hull well buried to the waterline (Figure 5, a recent multibeam image of the site).

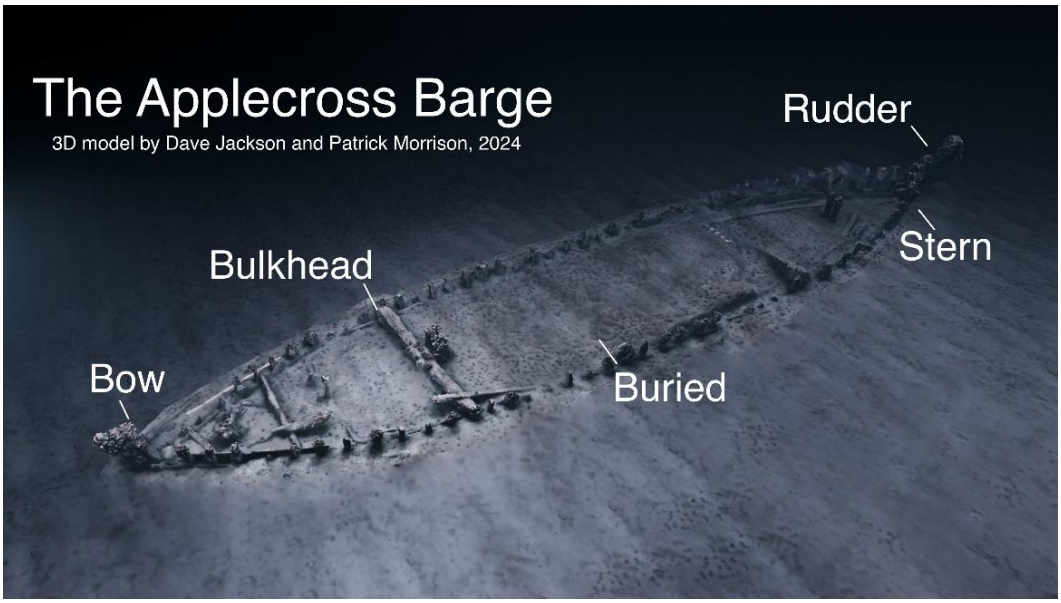

Figure 4. Applecross Barge 3D model prepared from photogrammetry (P. Morrison).

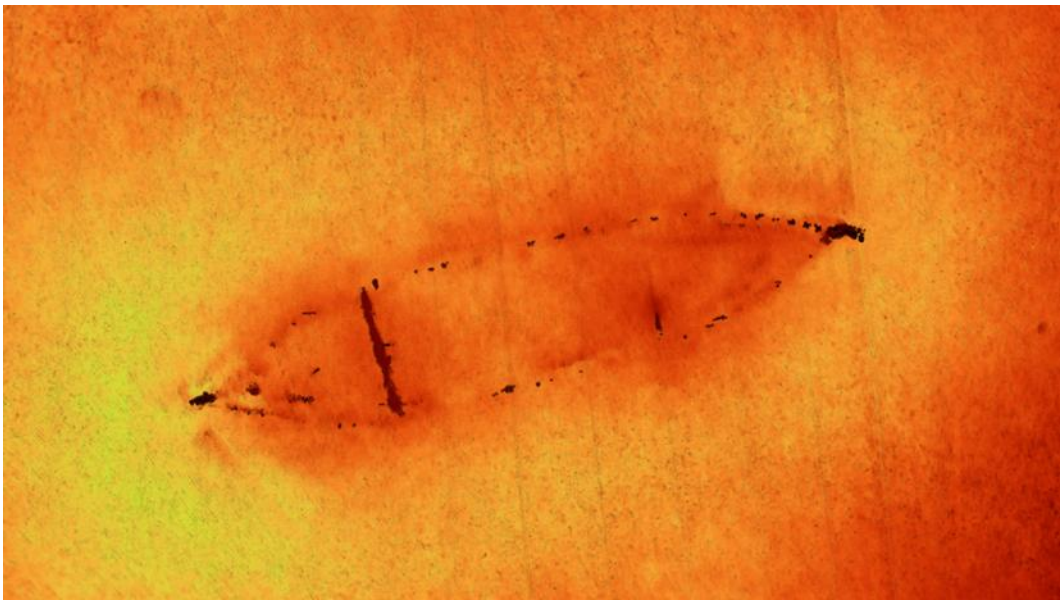

Figure 5. Contemporary multibeam riverbed image showing exposed remains of Applecross Barge (P. Morrison).

The site's position and water depth are consistent with survivor information from the sinking of *Jane (1897).* This tragic event was reported in an historical newspaper article (https://trove.nla.gov.au/newspaper/article/3178326). The sole survivor's account described that *Jane* was returning to Perth having loaded a cargo of bricks from Cannington, when a severe gale was encountered. These conditions were safely weathered until the barge

entered Melville Water, where it anchored overnight. The weather conditions worsened and threatened to sink the boat, so the crew of two began to throw bricks overboard, but after several hours of effort keeping it afloat, the barge sank.

A contemporaneous painting by Valentine Delawarr (1896), held in the Art Gallery of Western Australia, shows a brick loading site with what appears to be a tow barge alongside (Figure 6). Whilst not a sailing barge, this image does provide a good representation of the *Jane* and its cargo.

Confirmation of the site's identity, suspected to be the *Jane,* would result in the wreck's protection under the *Maritime Archaeology Act 1973* as a pre-1900s wreck.

1975/0P17
Valentine Delawarr
Brick loading site
1898
oil on canvas
50.6 x 76.2 cm; 62 x 87.5 cm (frame)
The State Art Collection, The Art Gallery of Western Australia
Purchased 1975

Figure 6. Painting of barge being loaded with bricks on the Canning River (Art Gallery of WA).

Given the site is buried by sediment to its waterline, which is also shown in the multibeam image (Figure 5), subsurface investigation was required for identification and for heritage management planning purposes. To independently assess if the wreck is indeed the *Jane*, the subsurface characterization of a cargo of bricks, bricks on the then adjacent riverbed, and any other material consistent with the late 1800s river industry would be required. The burial in muddy silt suggests a high potential level of subsurface material preservation.

Bull Creek Unidentified (Dugong?)

The *Dugong* is believed to have been the first vessel built, with convict labour, on the Canning River in 1894. A boat was needed to carry supplies from Perth and Fremantle to the *Black Swan*, a dredge operating on both the Canning and Swan Rivers to make them suitable for navigation. As one was not forthcoming from the government, Henry Passmore, the officer in charge

of the Canning convict camp, and his son, George, with the assistance of a Chinese carpenter and some of the convicts already working on *Black Swan*, set to the task of shipbuilding. Timber was hewn from the surrounding bush, and winches and an upright boiler were salvaged from the burnt out *Thornliebank* to construct paddlewheels and provide steam powered propulsion. Later, the Public Works Department (PWD) of Western Australia purchased the *Dugong* and plans of it were drawn in 1896 (Figure 7). To date no records have been found which describe the vessel's fate.

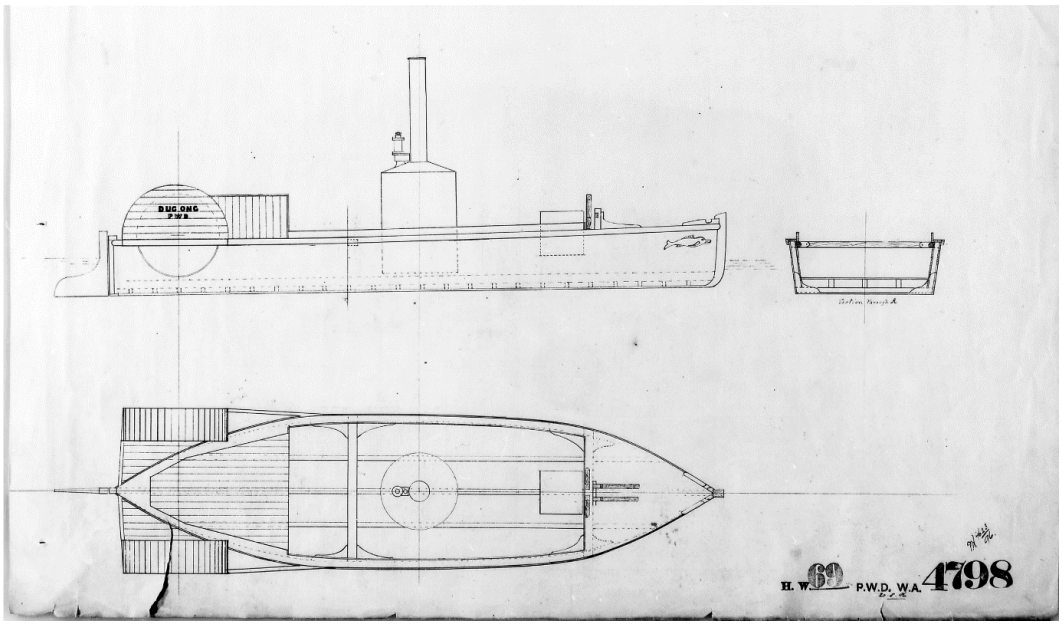

Figure 7. 1896 Public Works Department drawing of the *Dugong* – note no scale bar. (PWD4798, State Library of WA).

Today, the Bull Creek unidentified wreck is a 20 x 3.9 m timber vessel abandoned in Bull Creek (Scrimshaw, 1980). The remnant frames and sternpost partially protrude from the mud and are visible at extreme low tide conditions (Figure 8). The hull is mostly buried under a mud bank of at least one meter thickness. MAAWA have undertaken site surveys and ongoing research since the early 1980s and suspect the unidentified wreck to be the *Dugong,* matching the overall dimensions and visible construction of the PWD recorded drawings.

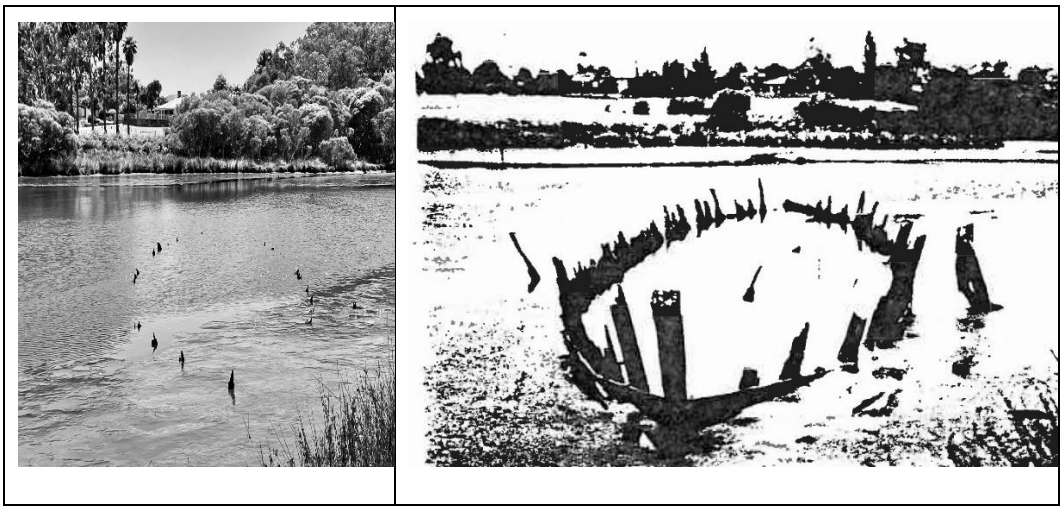

Figure 8. Bull Creek Unidentified site at extreme low tide, present day with remnants of frames protruding above the drying mudbank (left), and photo taken from similar position by C. Scrimshaw in 1981 (right).

The PWD drawings show key construction features that could be used to identify the Bull Creek wreck as the *Dugong*. These features include: 1) a flat-bottomed hull; 2) paddle wheels and/or supporting structure at the stern; 3) a boiler/supporting structure at the centre of the ship; and 4) an engine/paddle wheel drive mechanism. While the paddlewheels and boiler may have been removed prior to abandonment, or subsequently collapsed, evidence of these features, their structural supports and a flat-bottomed hull may still be discernible to subsurface acoustic survey techniques while buried under the riverbed mud.

There is, however, conjecture that the wreck may be a Swan River flat (a working barge carrying timber down the Canning River) or possibly a barge owned by the Bateman family who lived nearby on the riverbank. Signage has been erected by the City of Canning on the eastern riverbank of Bull Creek, as part of the popular local Wadjup-Gabbilju foreshore walk, drawing attention to the remains of several rivercraft in the Bull Creek inlet. A contemporary photograph and description of the remains of the Bull Creek unidentified barge is shown, together with an interpretation of its use by the Batemans' family for carrying cargo while they established their historic property 'Grasmere'. Other signs erected along the foreshore walk interpret the historic riverwork and connections with other early Canning settlers' barges through the upriver shallow delta of the Canning River. Clearly subsurface surveys to identify the Bull Creek barge will have significant heritage impact—either its connection with earliest Canning River navigation improvement works and example as the only known convict-built vessel—or its true connection with the Batemans' family and historic home.

Melville Water Unidentified

Scrimshaw (1980) reported that a wreck surveyed in 1896 was annotated on an Admiralty Chart published in 1904 (Figure 9). This wreck was depicted in Melville Water between Dundas and Pelican Point, as a hazard to navigation, and thus presumed to be more than a leisure vessel. Divers from MAAWA searched the site without success, and a follow-up echo sounding survey conducted in 1979 failed to identify any wreckage on the riverbed surface. In October 2018, the WA Museum identified several magnetic anomalies at the site, indicating the potential for buried material. The seabed is shallow and mostly featureless, so acoustic characterisation of buried targets is the obvious method for testing site presence and extent.

Given that this wreck predates 1900, then if any remains of this wreck buried under the riverbed were found, this site would be of great heritage significance as the oldest know shipwreck on the Swan/Canning and protected under the State's *Maritime Archaeology Act 1973.*

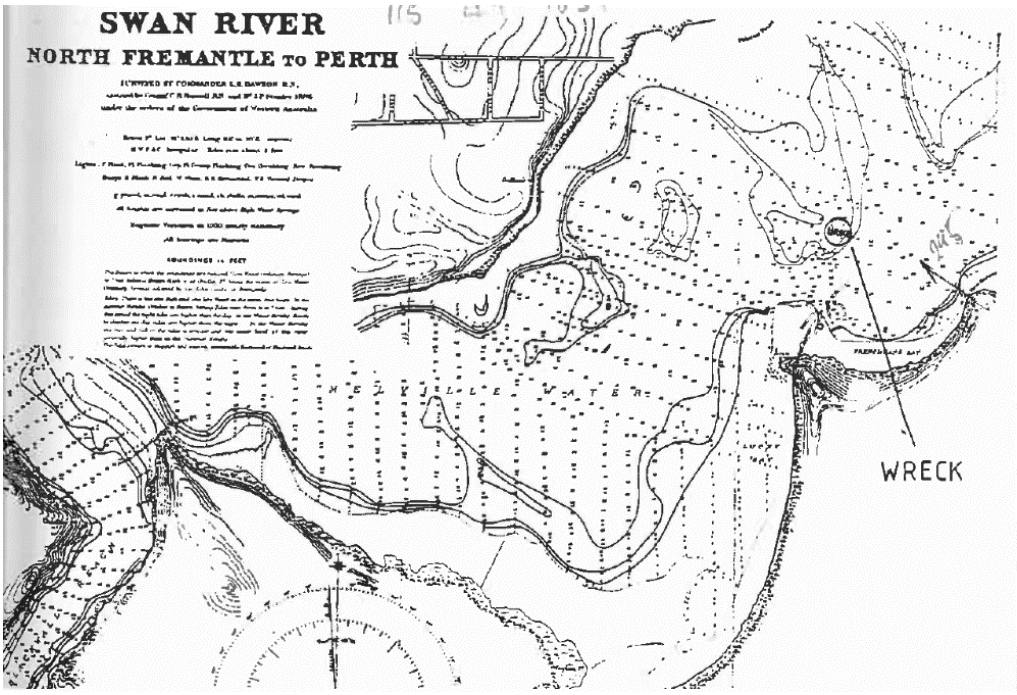

Figure 9. 1896 Admiralty Chart with wreck annotation (from Scrimshaw 1980).

Chapter 3 STUDY APPROACH AND METHODS USED

Study Approach

The project is based on the need to map and interpret key subsurface features associated with four historic and archaeologically significant barges/vessels which are partially or fully buried in the riverbeds of the Swan and Canning Rivers. Quantitative subsurface data will be derived from non-invasive sub-bottom profiler (SBP) surveys and interpreted to provide scaled two-dimensional (2D) and potentially three-dimensional (3D) visualisations of each site. Subsequent analyses will help confirm the likely identification, condition and historical significance of each, as well as provide information vital to the preparation of heritage management planning activities. The results of the project will also be presented to the local communities, and to maritime archaeological practitioners, for educational and training purposes.

Research projects recently undertaken by the proposed Project Leader, using parametric SBP technology and visualisation software, have demonstrated that shallow-buried historic shipwreck material, such as the wreck of *James Matthews* located off Woodman Point, or purpose buried 'sleepers' adjacent to the *James Matthews* site and at Coffee Point, Canning River, can be accurately, reliably and quickly measured and interpreted (Winton 2019a, b, 2020, 2023 and Winton and Bergersen 2023).

To improve the efficiency and survey success for this project, preparatory site work was undertaken including: the determination of accurate site location co-ordinates for known sites; assessment of operational access to each site; and SBP performance suitability. In 2023, MAAWA discovered and accurately recorded site locations for several historic shipwrecks in the Swan River, using existing high-resolution Department of Transport data to search the riverbed (Morrison et. al. 2023). The potential location for the Melville Water wreck remains based, however, on the 1896 Admiralty Chart annotation and the Museum's 2018 magnetometer targets. In late 2022 the Winwell Foundation, in collaboration with MAAWA, undertook a preliminary site survey of the Bull Creek unidentified site. Its purpose was to relocate the wreck's exact position in GPS coordinates, and to ascertain water depths and mud profiles covering the wrecksite. This preliminary survey identified that the site was too shallow for any conventional ship-mounted SBP setup. To ensure accessibility over the full site, a very shallow-draft vessel was required

to operate at highest tidal levels to ensure sufficient water depths to operate over the site.

Following field survey and data analyses tasks, the anticipated outcomes from the data interpretation will potentially be considerable. Site data will help interpret historic and cultural perspectives for at least three, and possibly four maritime sites. Presentations to the Cities of Canning and Melville, and to the broader public, will help educate the community on the importance, identification and conservation of historic heritage places. Close interaction with the maritime archaeologists from WAM will provide them with information which can be used to prepare preliminary heritage site management and protection activities.

Key results of this study were recently presented at the joint AAA/AIMA (Australian Archaeology Association/Australasian Institute of Maritime Archaeology) 2025 conference held in Perth in the first week of December. Results will also be submitted for publication in the Australasian Journal of Maritime Archaeology.

The SBP data from this project provides a uniquely open dataset in Australian maritime archaeology. Most datasets are commercially sensitive, and there are currently no ‘textbook’ examples of sub-bottom profiler data available for students, despite its identification as a crucial ‘best practice’ for maritime projects. These four new datasets are now publicly available through the Winwell Foundation and MAAWA.

This project plan, SBP survey and analysis approach, together with the interaction with WAM, represents best practice and fully aligns with the intent and requirements of the UNESCO 2001 Convention (on the protection of Underwater Cultural Heritage), Commonwealth Legislation and WA State Acts.

Equipment Used

SBP surveys were conducted using vessel-based systems where soundwaves are generated and transmitted vertically downwards through the water column into the seabed, then recorded as these sound waves bounce off either the seabed or subsurface materials (Figure 10). Onboard data processing and live screen viewing allow the operator to control the survey processes. An Innomar ‘Smart’ SBP system was used as this parametric based SBP provides high-resolution imaging used to map fine-scale features, like individual timbers or vessel structure, at each site.

Site-appropriate survey vessels were used at the weather-protected, but very shallow Bull Creek site, and for the other open water and exposed sites on Melville Water (Figures 11 and 12). Vertical ‘slices’ depicting seabed surface and subsurface features along a transit were accurately recorded with the vertically pole-mounted transducer, together with high precision GNSS satellite position recording. Analogous to a human CT scan, the combination of multiple ‘slices’ can then be used to interpret the depth, breadth, length and relative condition of material, such as buried ship timbers or cargo, to be mapped and interpreted. Recent advances by the Winwell Foundation now enable data slices from SBP surveys with very closely spaced survey lines to be processed with 3D visualisation software and seen through virtual reality headsets. For this project multiple SBP survey transects were recorded along and across each location to identify key characteristic features, with a closely spaced multiple line survey undertaken at the Bull Creek site to support interpretation and potential viewing in 3D.

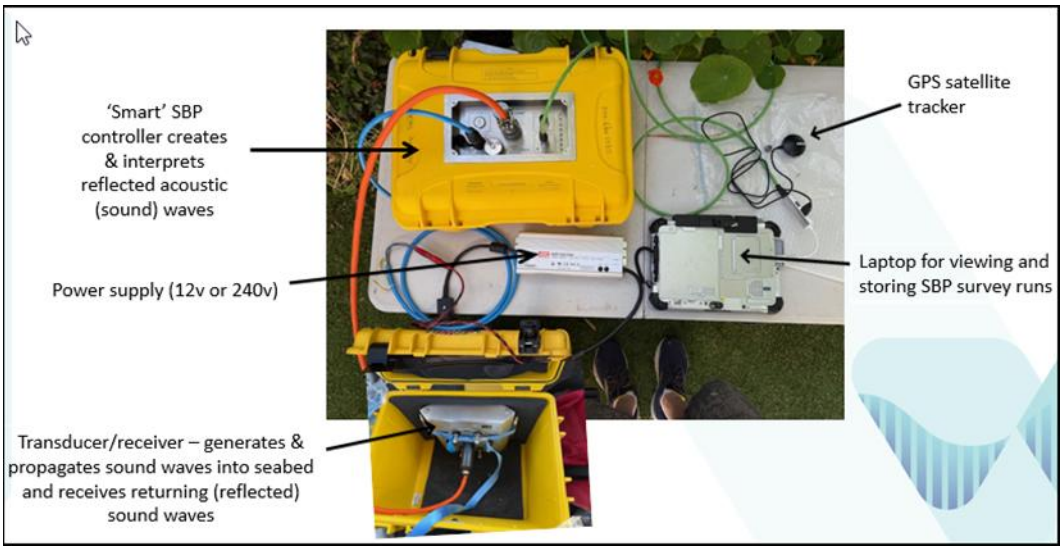

Figure 10. SBP system components used in surveys.

Figure 11. Ultra-shallow draft survey vessel on Bull Cr. with transducer and GNSS satellite receivers bow mounted.

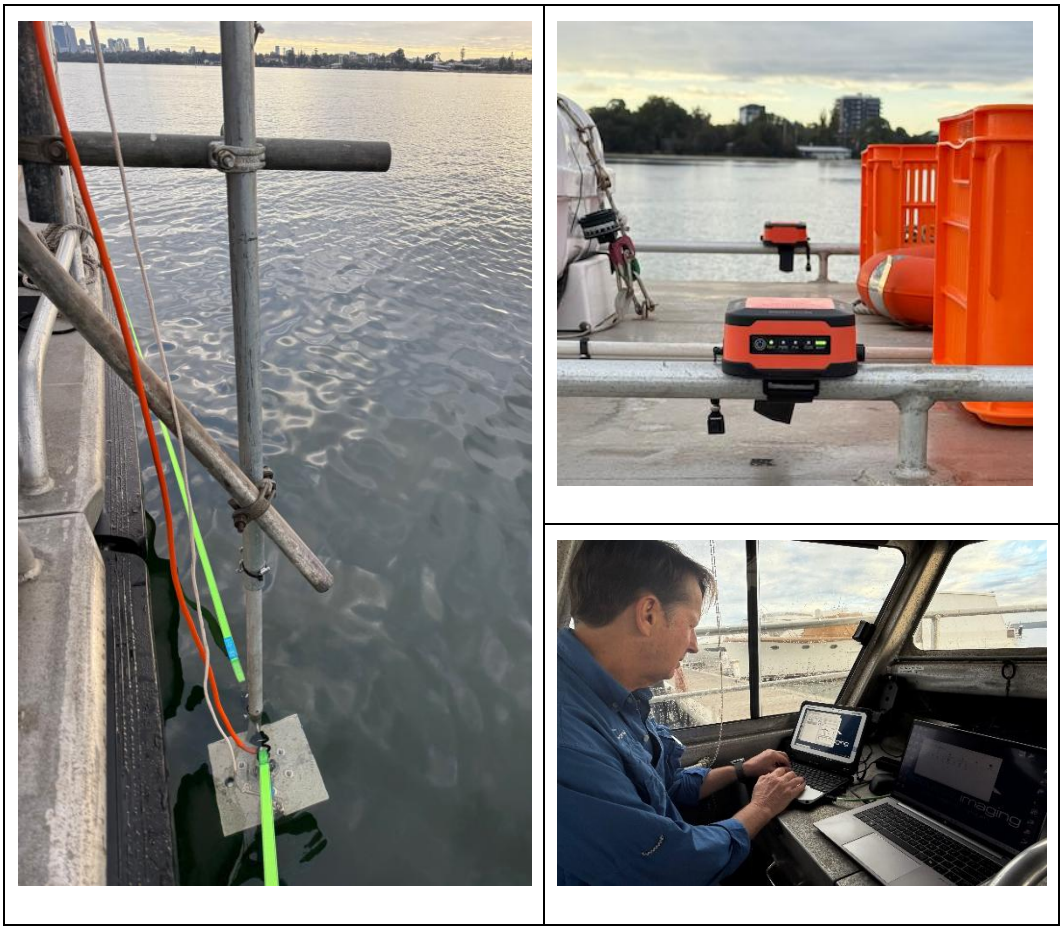

Figure 12. Survey setup on *Dirk Hartog* for the weather exposed Melville Water sites: transducer mounted to starboard hull (left); GNSS receivers offset mounted on cabin roof (top right); onboard data processing and logging (bottom right).

Data Processing

All SBP runs were recorded in .RAW format files. These were processed using Innomar's ISE V2.9.5.79 software package. Initial inspection was undertaken using non-demodulated data files to assess successful recording and coverage of barges at each site. Files were subsequently processed in a demodulated form, using the settings shown in Figure 13, to more clearly delineate and interpret subsurface features associated with the buried remains of each barge.

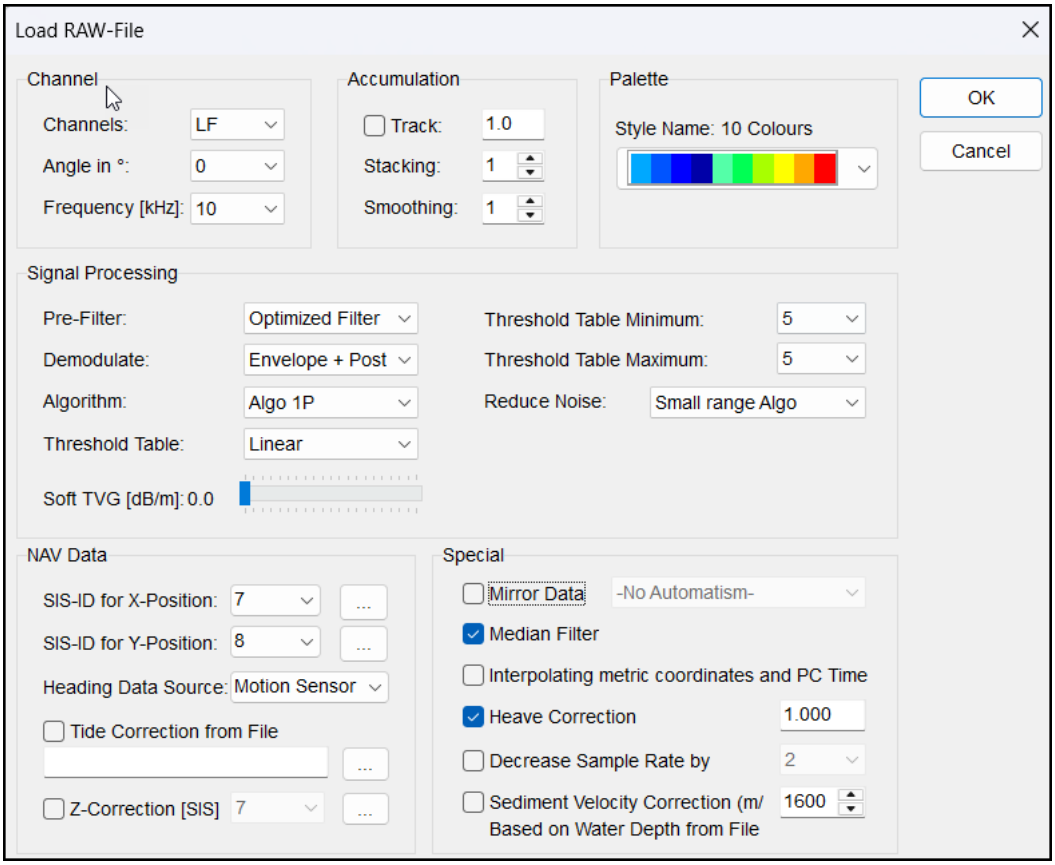

Figure 13. Data analysis settings used to delineate and interpret sub-surface features at each site.

A rectified GeoTiff base map (a map corrected to accurately match GPS coordinates – for this study either satellite imagery, Multi-Beam Echo Sounder [MBES] maps or vertical aerial drone photography) for each survey site were sourced and loaded onto the SonaWiz 8 V8.3.0 software platform. Against each of these respective site base maps, each SBP profile track was plotted using their respective continuously recorded GPS position. This combination permitted a very accurate assessment of where each SBP track crossed, or at least their relative location with, the recognizable features of each respective submerged barge.

Chapter 4 SURVEY OUTCOMES

Pre-survey Activities

From late March 2025 until the end of May, Winwell Foundation undertook a series of activities preparing for the non-technical aspects of the SBP survey plan. The Swan River Trust, having responsibility for the Swan-Canning waterways, was briefed and subsequently issued clearance for the surveys without the need for any permit.

Meetings with environmental, heritage and ranger staff from the Cities of Melville and Canning were held seeking support and Community Social media exposure. Staff reacted very positively, information was supplied regarding historic and recent fires in the immediate catchment area at the head of Bull Creek and both Councils reached out and informed their respective communities on social media. The City of Melville also provided keyed access to Thomas Middleton Park on 31st May to launch/retrieve the SBP survey craft.

Social media from City of Melville attracted a number of interested local residents who visited Bull creek to view and discuss the survey with the survey team. ABC Radio contacted Dr Winton, and a live interview was conducted on the morning of 30th May regarding the project and the upcoming survey in Bull Creek. Channel 9 TV news crew arrived on the morning of May 31 to interview Dr Winton immediately prior to launching the survey vessel, and a short story was later aired during the 6 o'clock news.

Due to constantly changing and adverse weather forecasts (including lightning on the water), the planned schedule for site surveys changed at short notice from late May to early June. Due to the sheltered location of Bull Creek, and the desire to undertake this site survey when interested public would be around and able to watch, this survey was achieved on Saturday 31st May 2025. The open water sites on Melville Water were much more vulnerable to the weather conditions. WAM's boat crew were extremely supportive and flexible, changing dates and times to bring *Dirk Hartog* upriver to undertake these surveys at short notice when weather conditions permitted. Fortunately, the weather cleared for one day and the remaining three surveys were undertaken from dawn to dusk on Sunday 1st June.

Point Walter Barge site – *Dearden's flat* (1882)

Thirty SBP profiles were collected at the Point Walter site over and around the Dearden's Flat submerged barge site during the morning of June 1st. These survey tracks are shown in Figure 14, plotted on the MBES (multi-beam echo sounder) base map [on this base map bluer shading indicates deeper water].

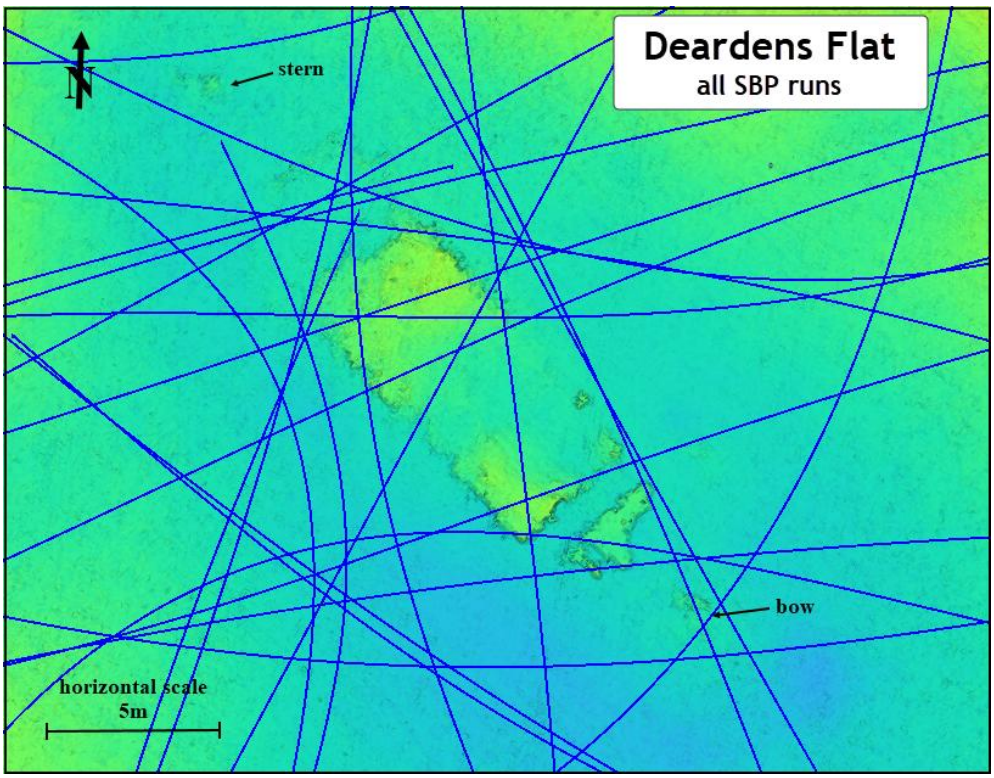

Figure 14. *Dearden's Flat* all SBP survey runs.

All data files were processed using the settings in Figure 13 and examined for surface and sub-surface features aligning with the Dearden's Flat barge. Three representative SBP profiles (runs) were selected as shown in Figure 15.

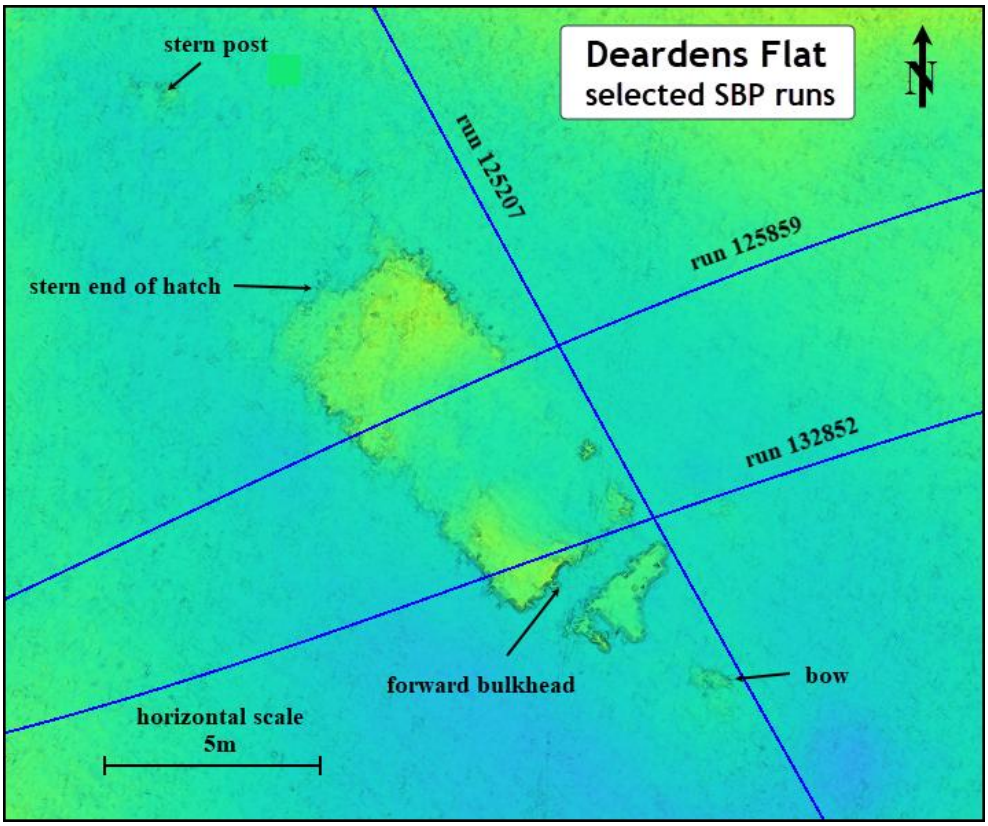

Figure 15. *Dearden's Flat* selected SBP runs.

Cross-sectional runs 132852 and 125859 are shown respectively in Figures 16 and 17. Run 132852 crosses the barge and load of stone just aft of the forward bulkhead and run 125859 crosses the stone cargo further aft around amidships. The riverbed surface (in red) shows the barge sitting at the base of a sandy hollow at 15.5–16m water depth. The vertical exaggeration in these figures which is 5:1 giving the impression that the slope of the hollow is steeper than actual.

The lateral extent of the barge outline is shown on both figures. No clear coherent sub-surface features appear, other than the acoustic shadow roughly 2m below the barge. This indicates that nearly all the acoustic energy of the SBP waves directed downwards at the barge were non-the-less reflected from the buried material, which is quite different from those waves outside of the barge location where these waves continued to penetrate through the sandy substrate.

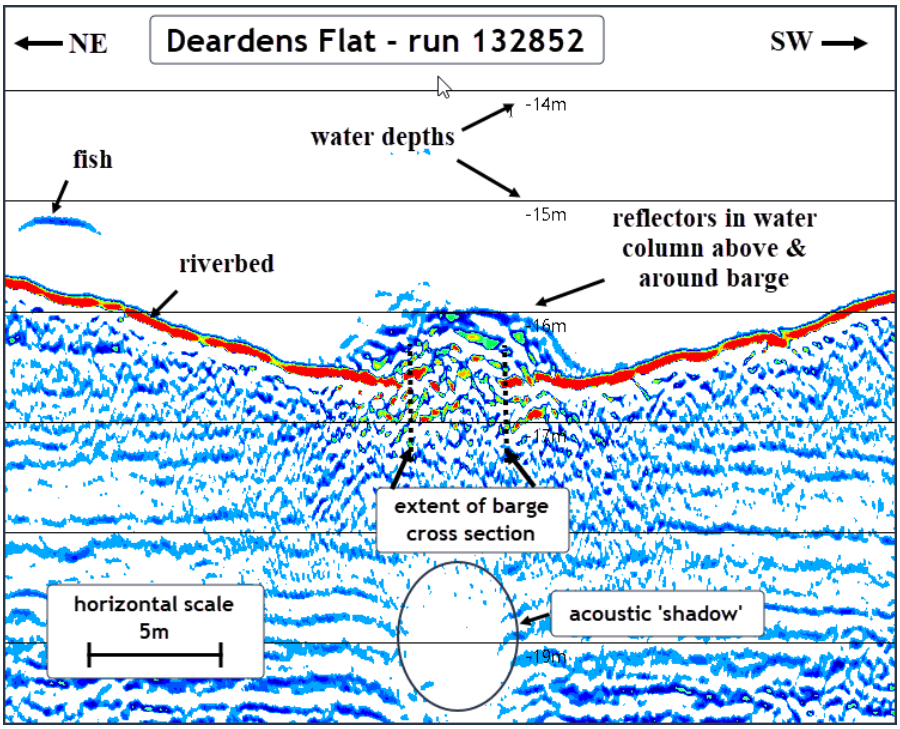

Figure 16. *Dearden's Flat* SBP cross-sectional run 132852.

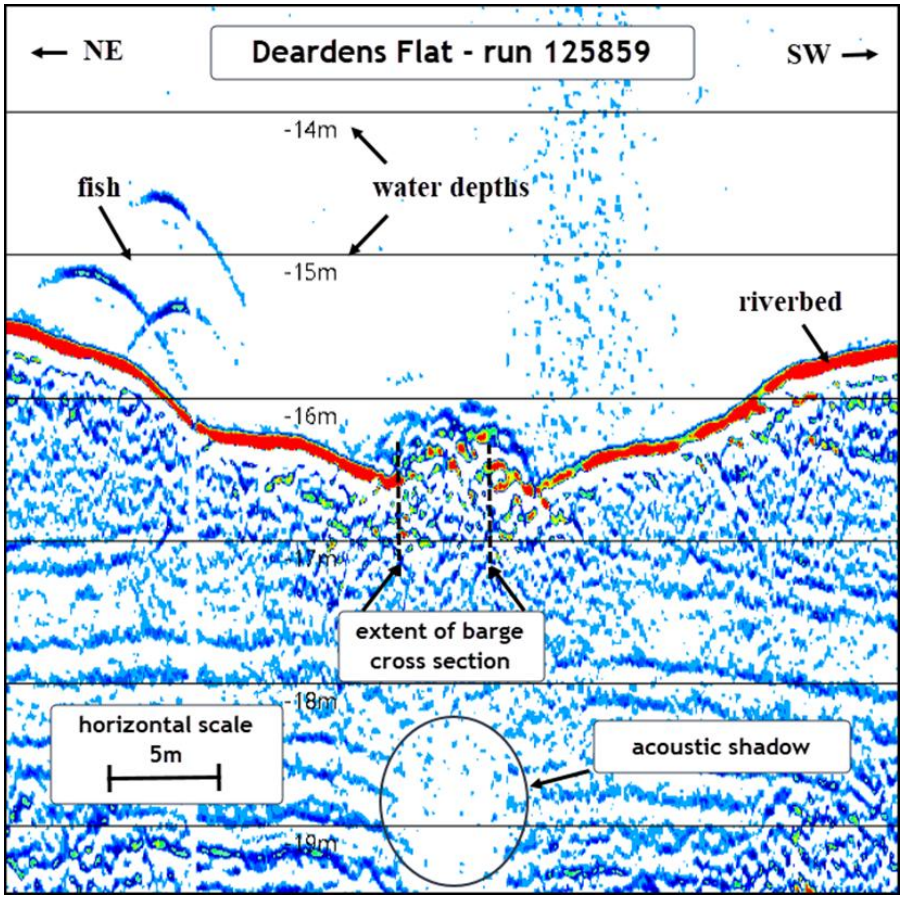

Figure 17. *Dearden's Flat* SBP cross-sectional run 125859.

Above the riverbed surface is a 'mound' of reflectors. This mound extends beyond the barge location by approximately 2m at a maximum height of 1m. The reflector strength of this mound is weaker (not as dense) as the surrounding riverbed surface.

Similar features are seen in the longitudinal section shown in Figure 18 which runs along the outside of the port (NE) side of the barge, very close to the forward bulkhead and bow. The surface mound of reflectors is again seen out to approximately 2m from the barge's location. Isolated and scattered small dense reflectors are seen up to a depth of 60cm below the riverbed alongside the barge. The acoustic shadow is not evident indicating that the SBP waves did not intersect with any thick layers of dense buried material.

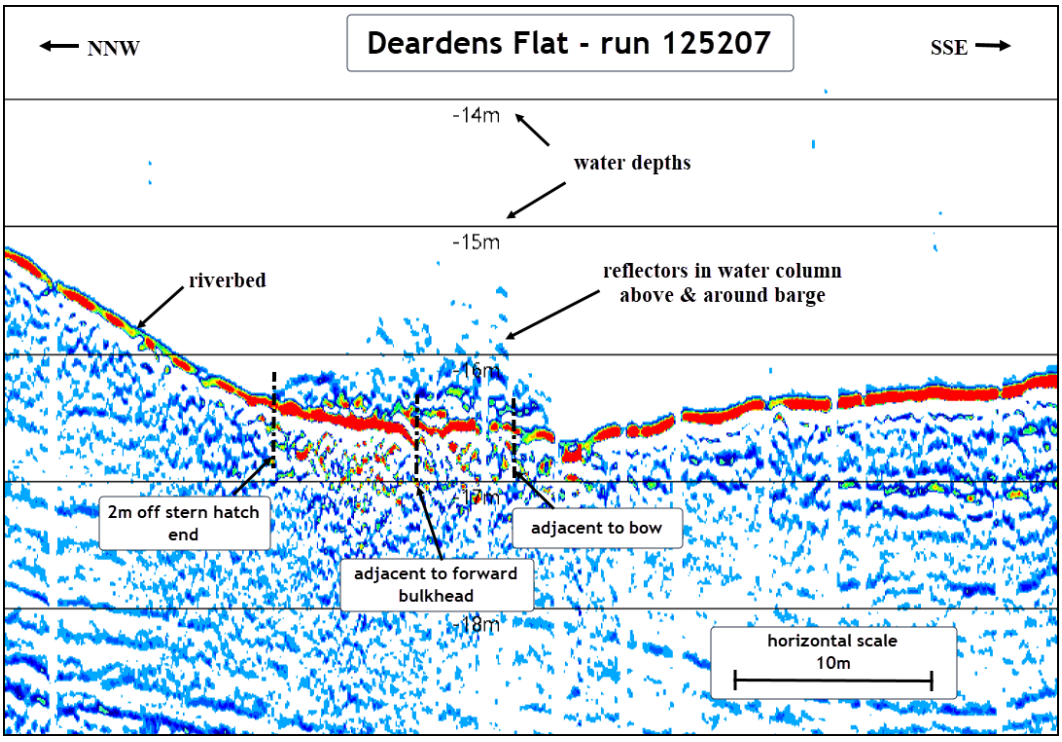

Figure 18. *Dearden's Flat* SBP longitudinal run 125859, adjacent to but outside of barge extent.

Applecross Barge site (Jane 1897?)

The SBP survey at the Applecross Barge site was conducted at first light on 1st June. A total of 42 SBP profile runs were collected (Figure 19) of which 13 transversely crossed over, or in very close proximity to, the barge (Figure 20). There were 15 longitudinal/diagonal runs over or immediately surrounding the barge (Figure 21).

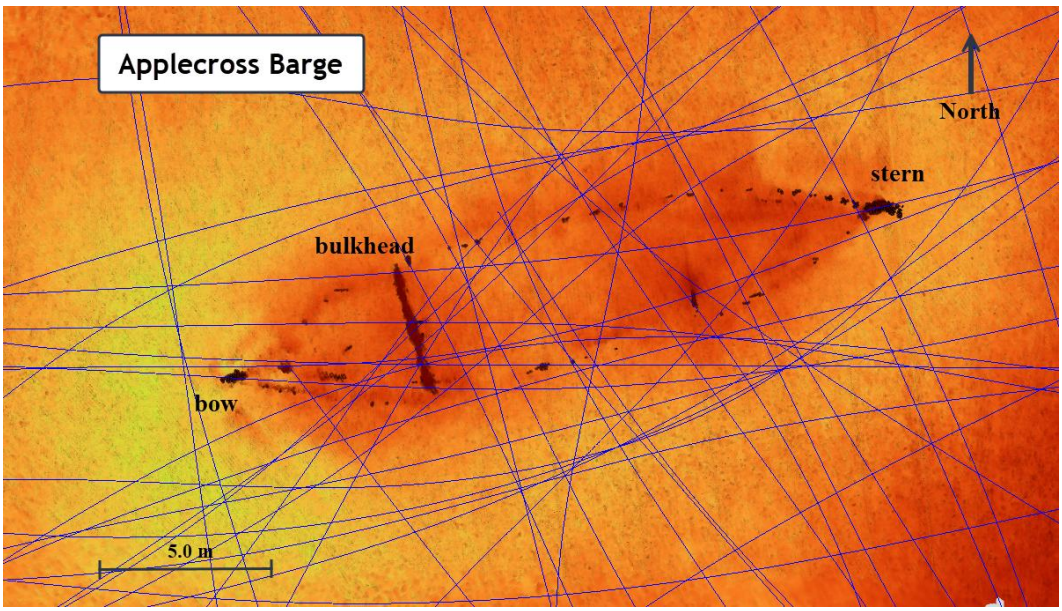

Figure 19. Applecross Barge all SBP survey runs.

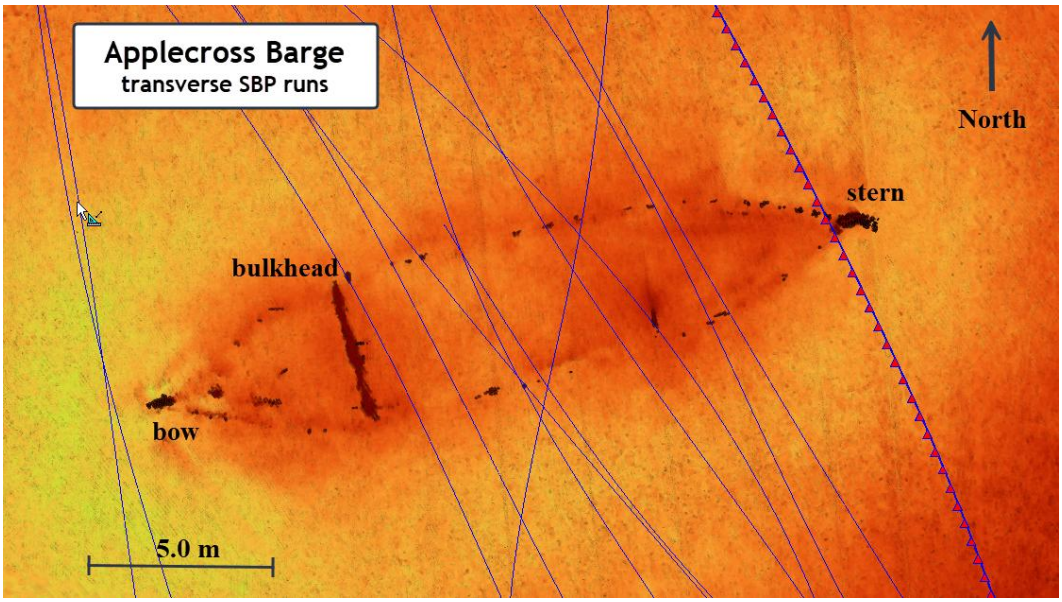

Figure 20. Applecross Barge all transverse SBP survey runs.

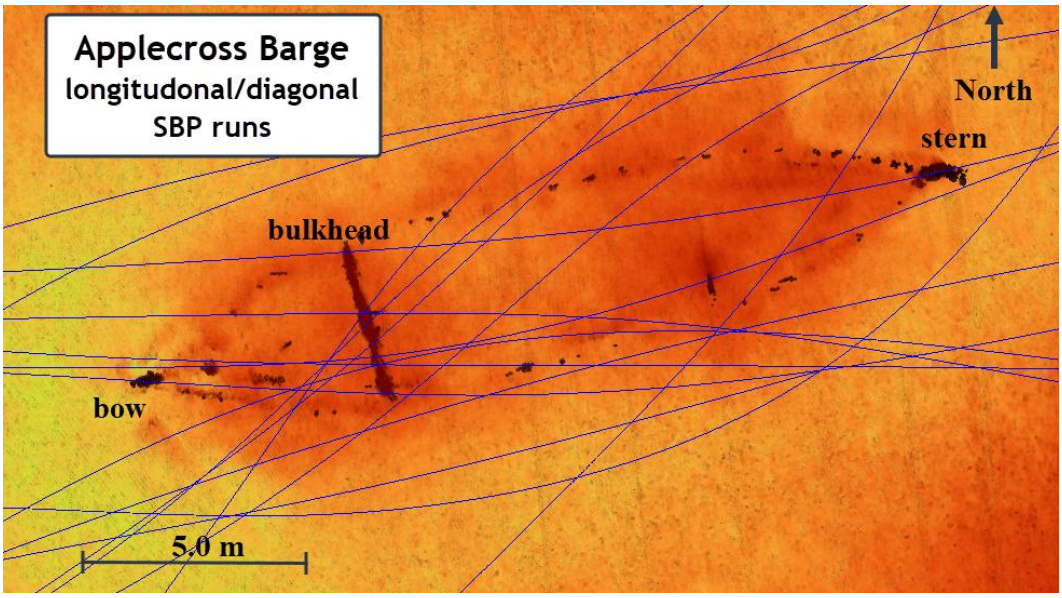

Figure 21. Applecross Barge all longitudinal/diagonal SBP survey runs.

All SBP survey profiles were processed and examined using the settings shown in Figure 13, except with a palette of 15 colours and no post-filter with demodulation. Five typical and representative profiles were selected with their tracks shown in Figure 22. Two of these profiles run longitudinally almost the full length of the barge (Figures 23 and 24) and three transversely cross the barge (Figures 25, 26 and 27).

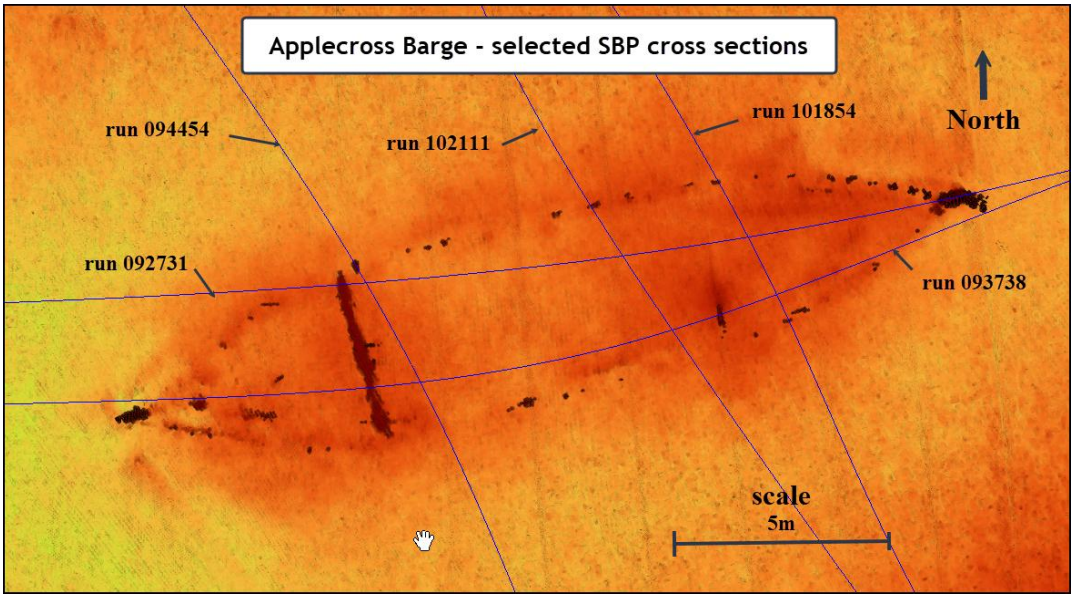

Figure 22. Applecross Barge selected SBP survey runs.

The longitudinal SBP profiles show distinct riverbed surface and sub-surface features associated with the lateral extent of the buried structure. The water depth at this site is a little over 7m, and both Figures 23 and 24 show fish in the water column surrounding the stern rudder, and the bulkhead and ship's equipment exposed on the riverbed surface near the bow. There are two very strong, continuous and horizontal sub-surface acoustic reflectors running from just forward of the rudder to the exposed bulkhead, then tilt downwards slightly and weaken towards the forward bow compartment. The top reflector lies approximately 74–88 cm below the riverbed surface, with the second reflector approximately 18–19 cm further below. The acoustic wave amplitudes of these two strong reflectors are larger in magnitude than the above and surrounding seabed. Underneath the second reflector are one, sometimes two further and deeper (16–19cm) reflectors but these are still distinct, they are much weaker than those above.

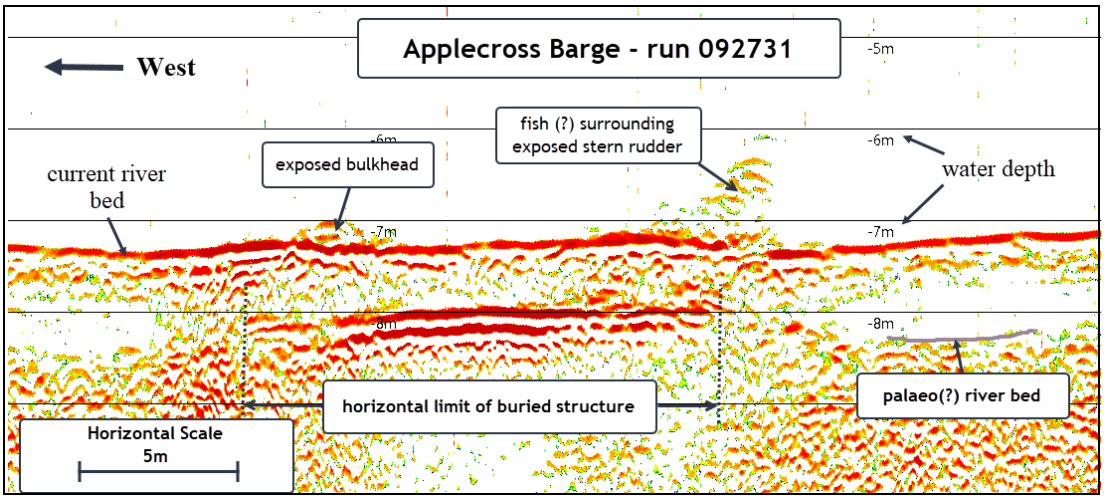

Figure 23. Applecross Barge longitudinal SBP run 092731.

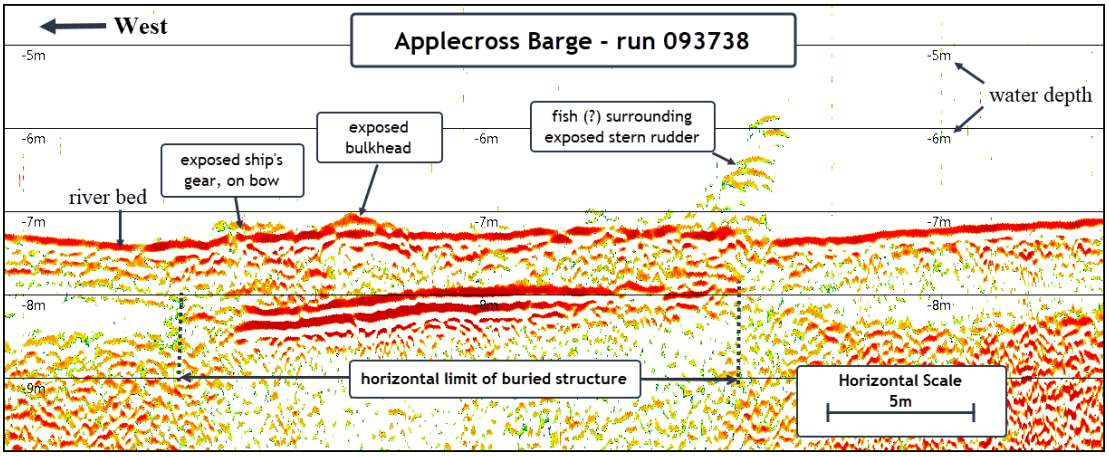

Figure 24. Applecross Barge longitudinal SBP run 093738.

Also seen in the longitudinal profiles within the buried limits of the barge are smaller, inclined reflectors extending from the riverbed surface down to a burial depth of 18–22 cm. Additionally of significance are the sub-surface sediment profiles outside the limits of the buried structure. The immediate riverbed is mapped from the surface to a depth of approximately 50 cm, then the signals weaken or disappear for a further 50cm. Much stronger sediment structures are again recorded from around 1m below the current riverbed surface to the maximum recording depth of 10m. The bottom of the barge sits on this lower riverbed base, with some accumulation of material mounding up against the sides of the buried barge.

Similar riverbed surface and subsurface features are evident of the three cross-sectional profiles. Fish are seen in the water column as well as barge related material on the riverbed surface. The same strong, contiguous and (near) horizontal double sub-surface reflectors are seen extending from one side of the barge to the other in the main cargo hold, with a weaker layer below. In Figure 27, run 101854 tracks aft of the cargo hold and the profile shows weaker, shallower and non-contiguous reflectors present. All figures show a significant weakening, but not near extinguishment (ie. full acoustic shadow), of the strength of the sediment reflectors under the barge. The delineation between the current and former(?) riverbed levels in the sediment profiles is also very evident, as is the probable accumulation of isolated materials adjacent to the sides of the barge.

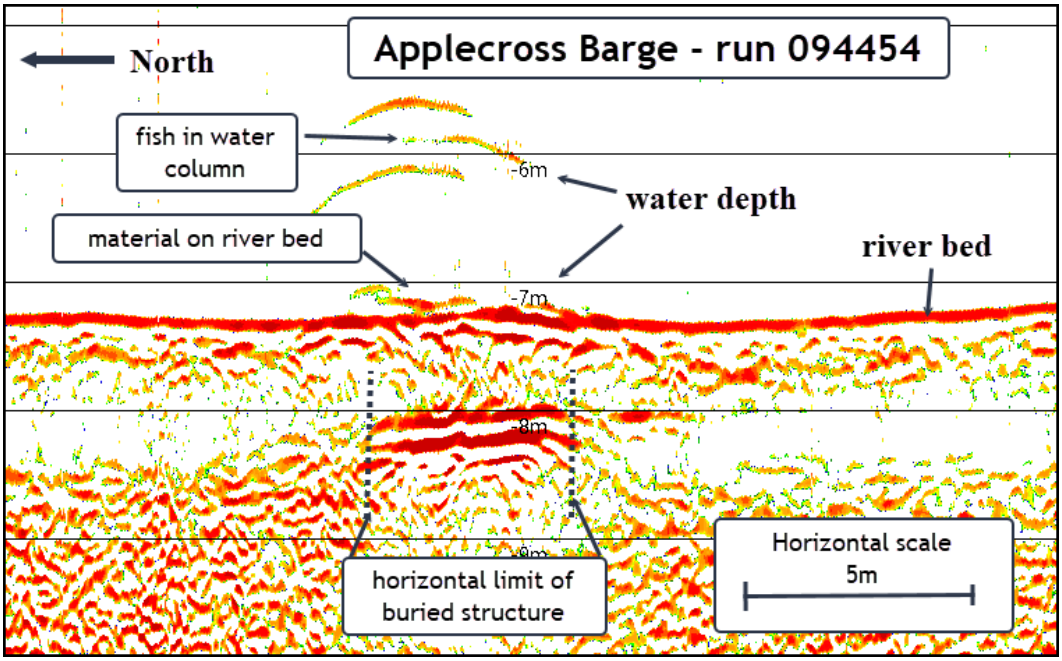

Figure 25. Applecross Barge SBP cross-sectional run 094454.

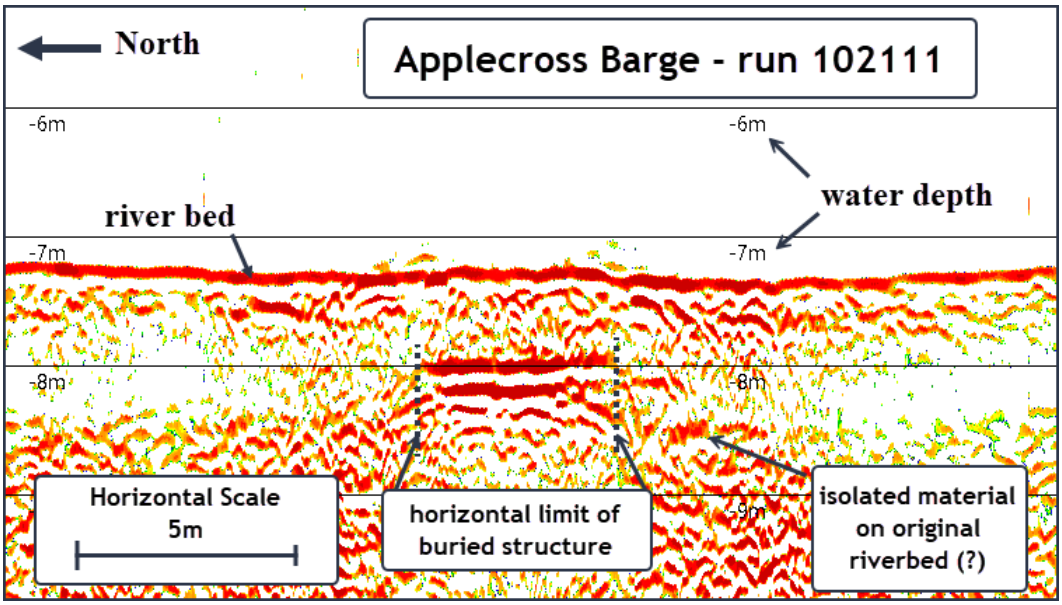

Figure 26. Applecross Barge SBP cross-sectional run 102111.

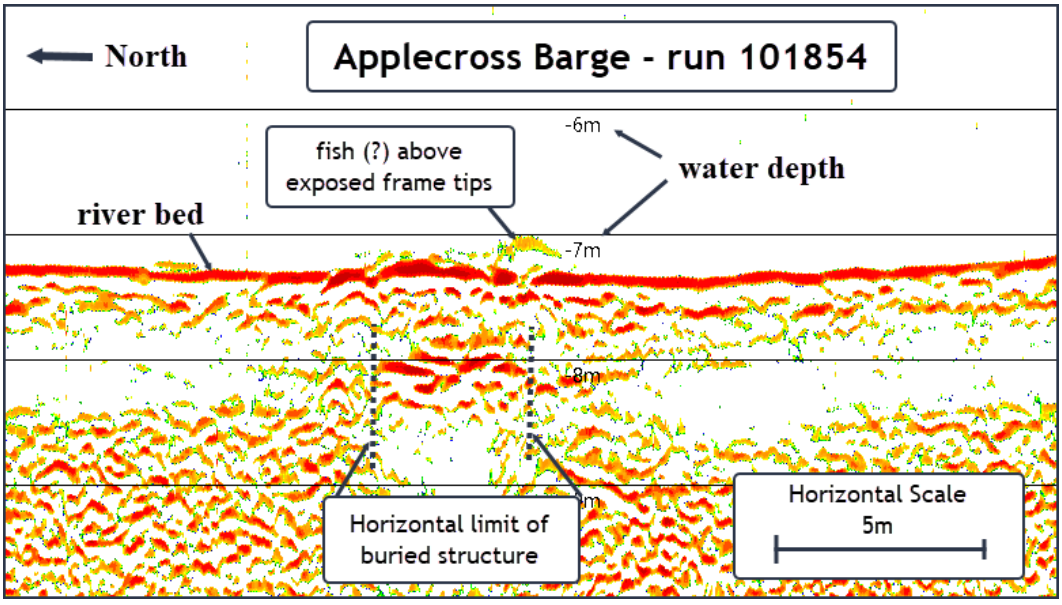

Figure 27. Applecross Barge SBP cross-sectional run 101854.

To help with the potential identification of the Applecross barge, each of the SBP profiles were specifically examined for strong reflectors located adjacent to or near the barge site, sitting on the surface of the riverbed at the time of sinking. Figure 28 shows the location of strong riverbed reflectors with similar reflection magnitudes to those on the strong upper layer within the barge. One of the corresponding profile runs is shown in Figure 29.

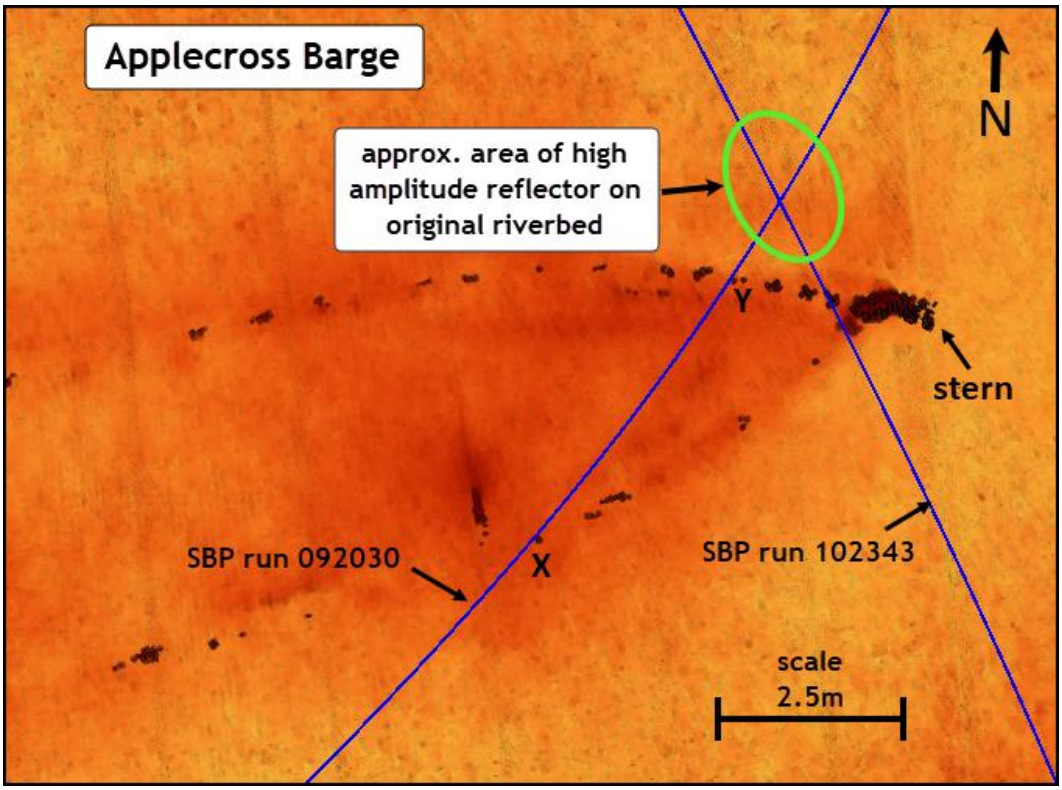

Figure 28. Applecross Barge SBP survey runs revealing high amplitude reflectors on original riverbed.

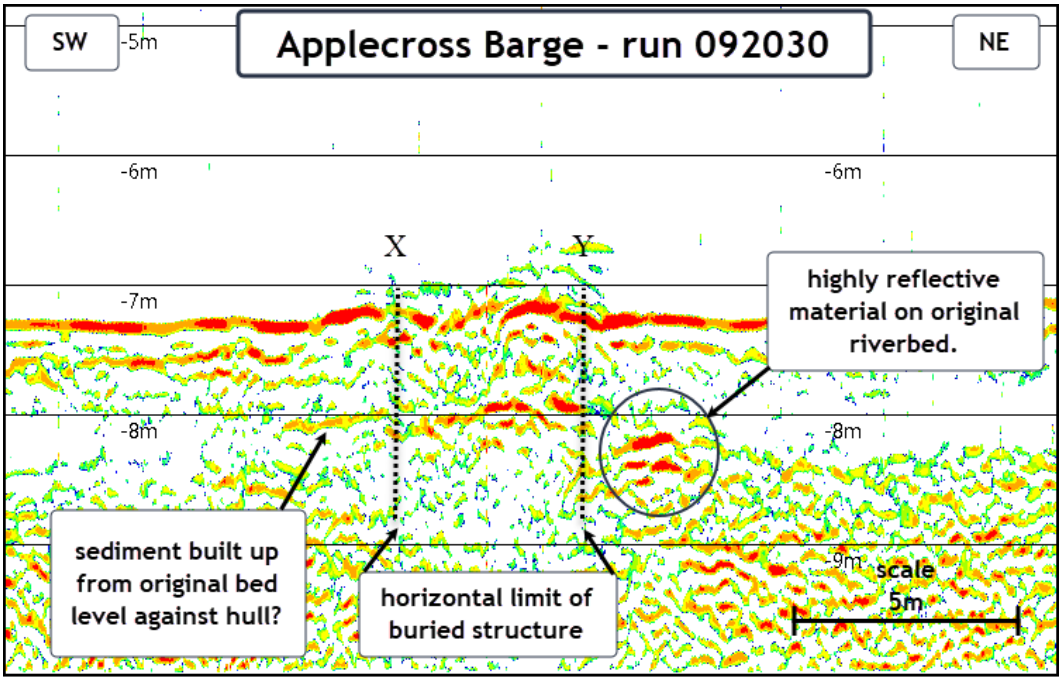

Figure 29. Applecross Barge SBP cross-sectional run 092030 with highly reflective material on original riverbed.

Bull Creek Unidentified (Dugong?) Site

During the highest annual tidal levels predicted for this site, 90 SBP survey runs were completed at the head of Bull Creek on Saturday May 31st from noon to 3pm (Figure 30). Of these survey runs, 26 were recorded transversely across the barge site (Figure 31), and 25 longitudinally over the barge (Figure 32).

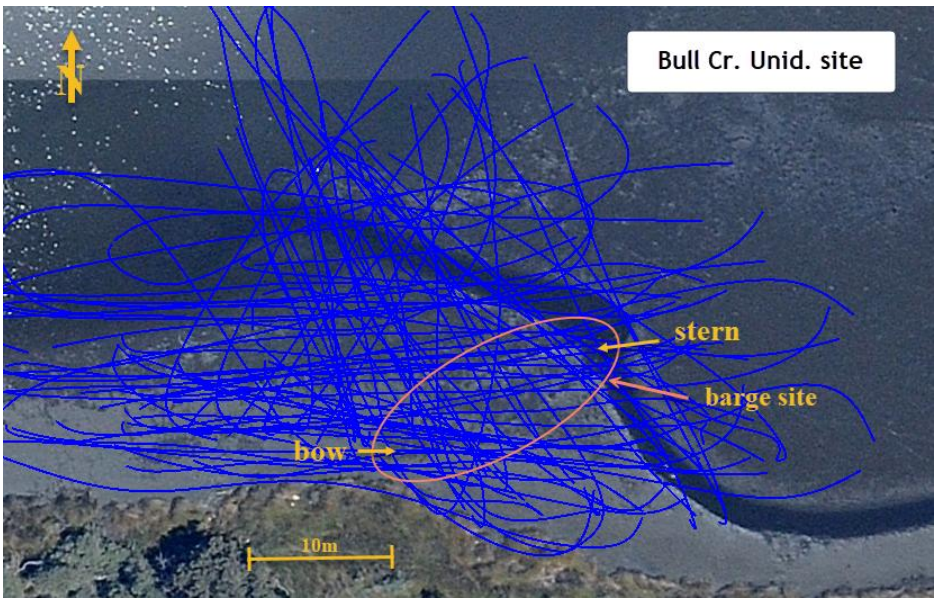

Figure 30. Bull Cr. Unid. site all SBP survey runs.

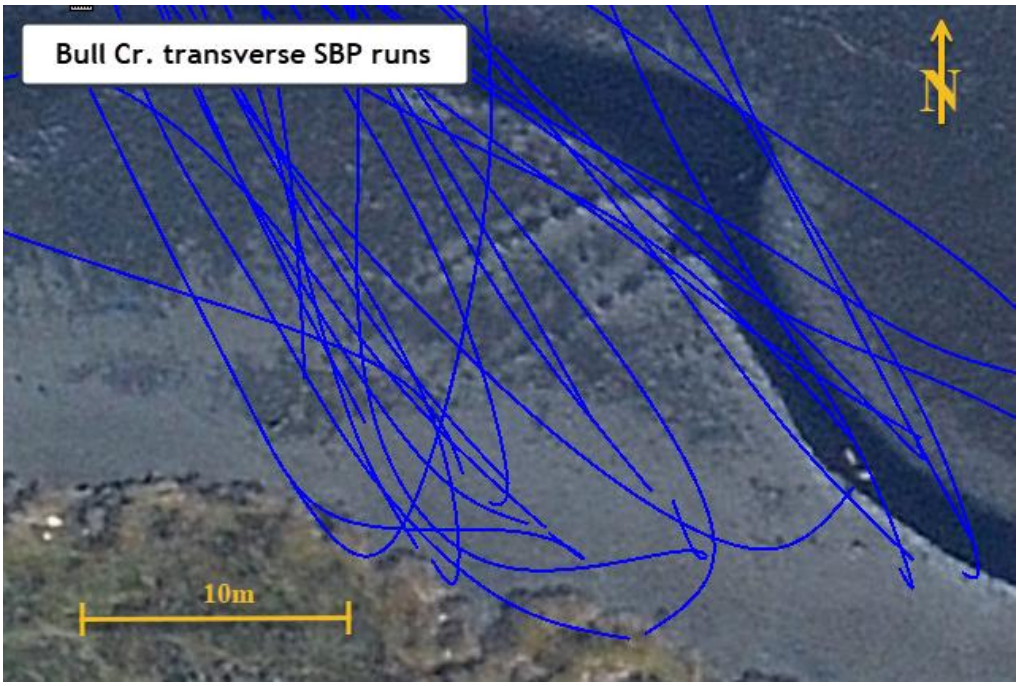

Figure 31. Bull Cr. Unid. site transverse SBP survey runs.

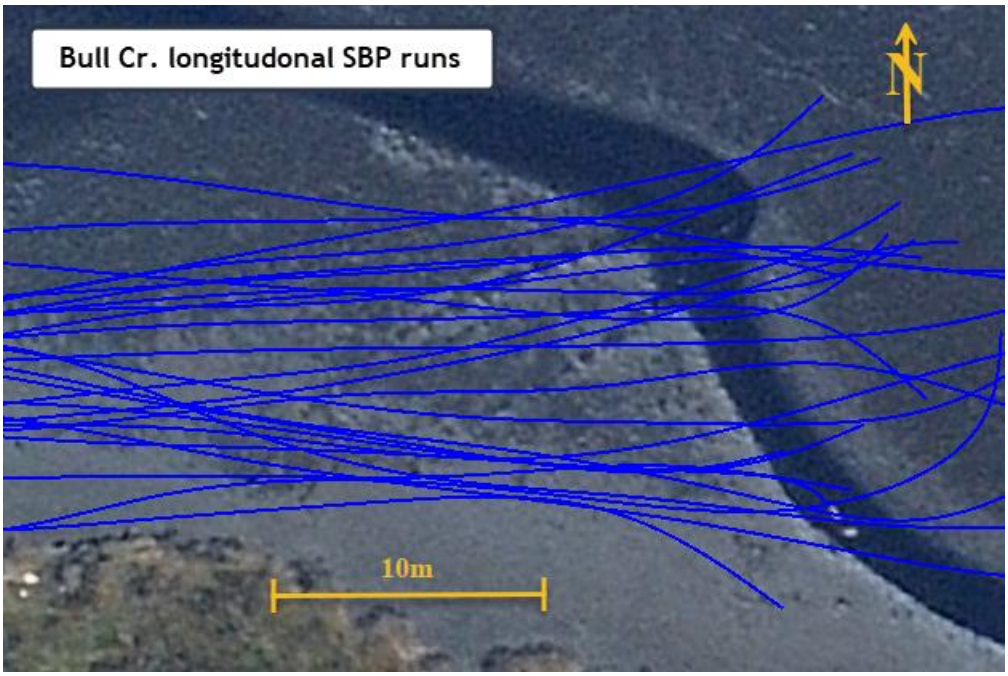

Figure 32. Bull Cr. Unid. site longitudinal SBP survey runs.

All SBP survey profiles were processed and examined using the settings shown in Figure 13. Initially the sub-bottom profiles around and to the south of the barge location showed a very confusing picture with with multiple surface layers and non-coherent buried reflectors. In addition, the ultra-shallow water depths resulted in multiple reflections appearing within the area of interest.

Examination of a single long profile from the very southern end of the waterway extending halfway along the length of Bull Creek (Figure 33) helped interpret the site and unlock the sub-bottom features. Figure 33 reveals two distinct sediment layers. The top layer forms the current bed level of this waterway and gradually increases in water depth from 1m at the head to 1.8m closer to the middle of the waterway. At lower tidal levels some of this surface is exposed as muddy banks. Underneath this layer is another former creek bed surface which is reasonably level at 2m below the water surface.

A local creek enters the Bull Creek waterway just upstream and to the south-east of the barge site. Council Rangers advised that following fire and clearing, many burnt trees and other material fell directly into the Bull Creek waters or were washed down with the local creek. During the day of survey, long term residents told stories about their childhood activities making and abandoning ‘canoes’ and other materials in the creek while playing on the then deteriorating barge.

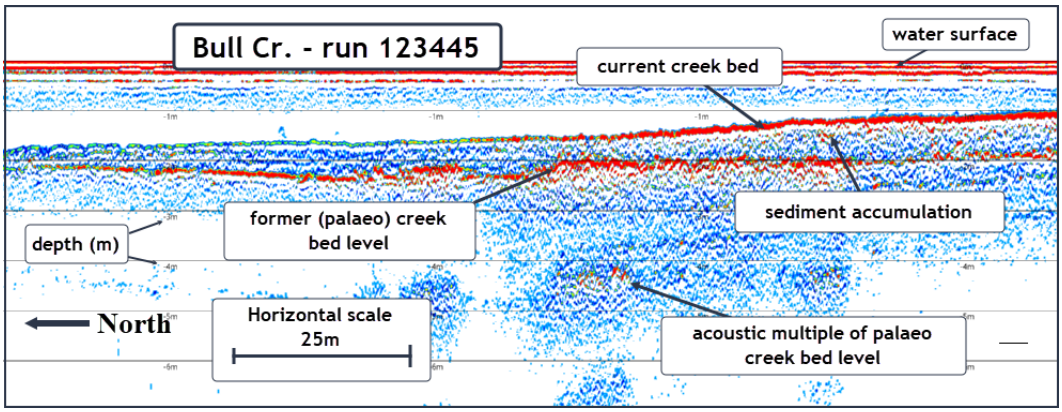

Figure 33. Bull Cr. long SBP survey run 1123445.

With this background understanding and with the overlapping satellite image of the outline of the barge frame tips, the position and appearance of the buried remains of the barge became clearer. Four representative profiles were selected with their tracks shown in Figure 34. One of these profiles runs longitudinally along the midsections of the barge (Figure 35) with the remaining three transversely crossing the barge (Figures 36, 37 and 38).

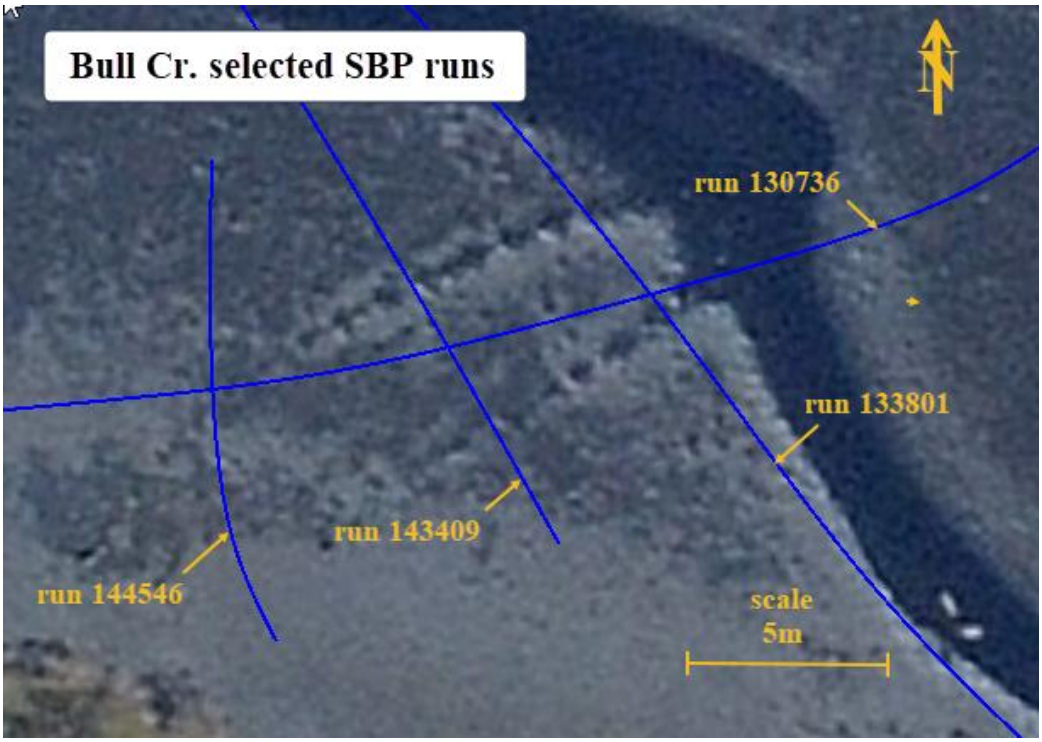

Figure 34. Bull Cr. Selected SBP runs over barge site.

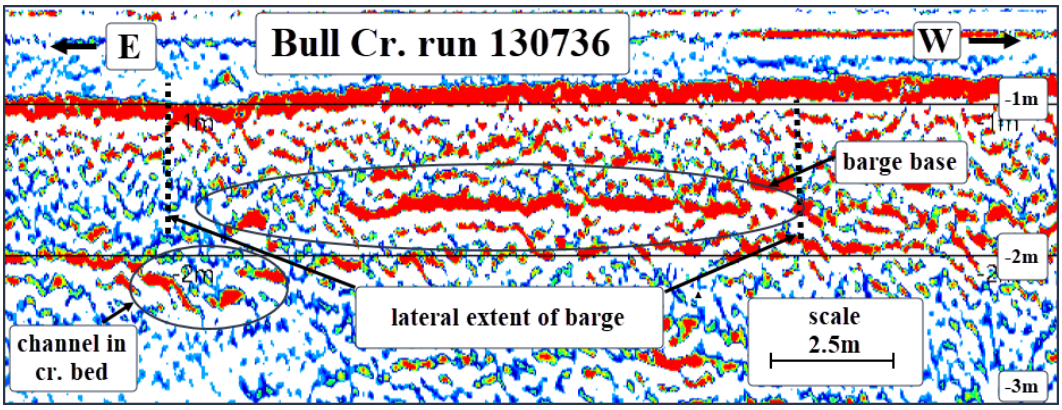

Figure 35. Bull Cr. longitudinal SBP survey run 130736.

A flat strong reflector is seen in Figure 35 from where the run first crosses the barge at the bow end and terminates, with possibly one isolate member, before it reaches the stern end of the barge outline. This reflector, possibly representing the remaining portion of the base of the barge is located approximately 72–78 cm below the current creek bed level. Another weaker but consistent reflector is located 12–16 cm further below. At the stern a depression is seen in the original creek bed, suggesting the original stern of the barge may have been exposed to freshwater creek flows, like the current channel shown in Figure 34, rather than being buried. Many small non-coherent reflectors are buried directly above and to the west of the barge adjacent to the current shoreline. The area to the east of the barge appears clearer of these isolated reflectors.

The track of run 133801 (Figure 36) crosses the aft section of the barge after the stern tapers. The profile shows a flat near contiguous reflector extending from the northern (starboard) side two-thirds of the way across to port side – at a point consistent with where the reflector terminates in Figure 35. There is no evidence in this figure showing any structural supports or other framing outside the line of the barge frames.

Run 143409 (Figure 37) tracks across the barge's amidships and shows a flat but slightly inclined reflector at the same burial depth as the previous figure. This profile also shows clearer reflector multiple which need to be ignored, as well as many more small non-coherent reflectors buried on the south side of the barge's location. More significant isolated reflectors are seen on the southern side near the bow of the barge (Figure 38). There are also non-contiguous reflectors, possibly in two rows, located near the bow which may or may not be associated with the barge's structure.

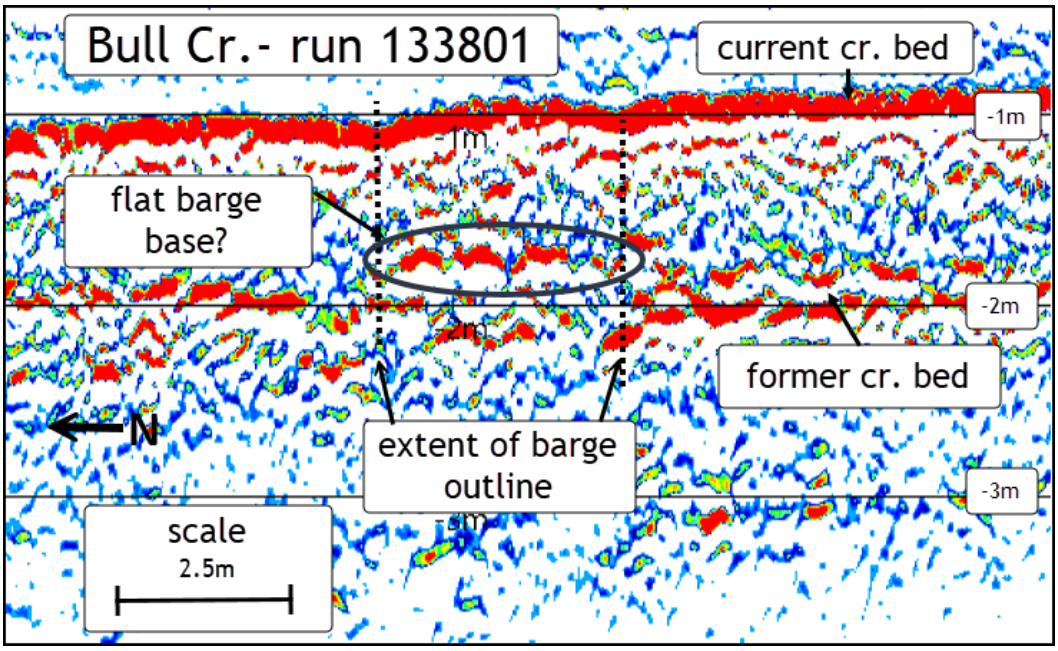

Figure 36. Bull Cr. SBP cross-sectional run 133801.

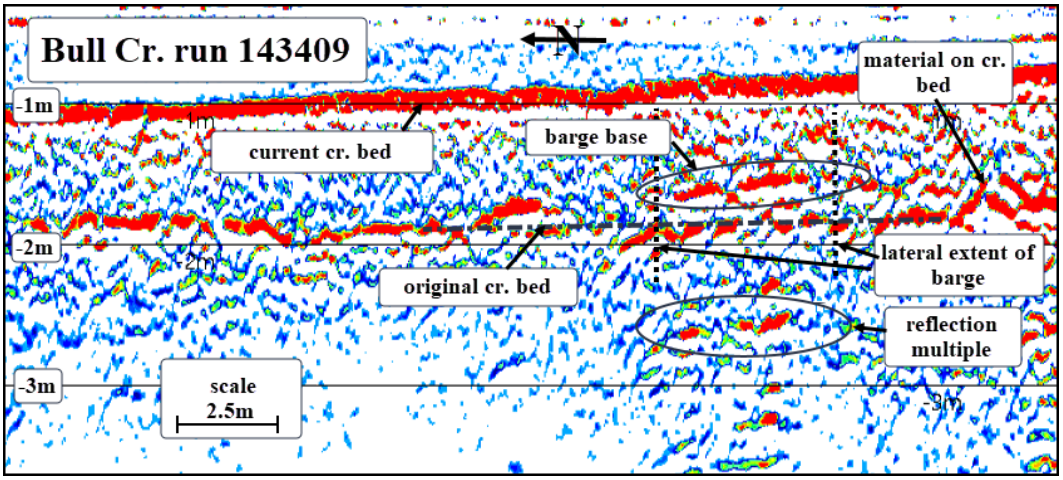

Figure 37. Bull Cr. SBP cross-sectional run 143409.

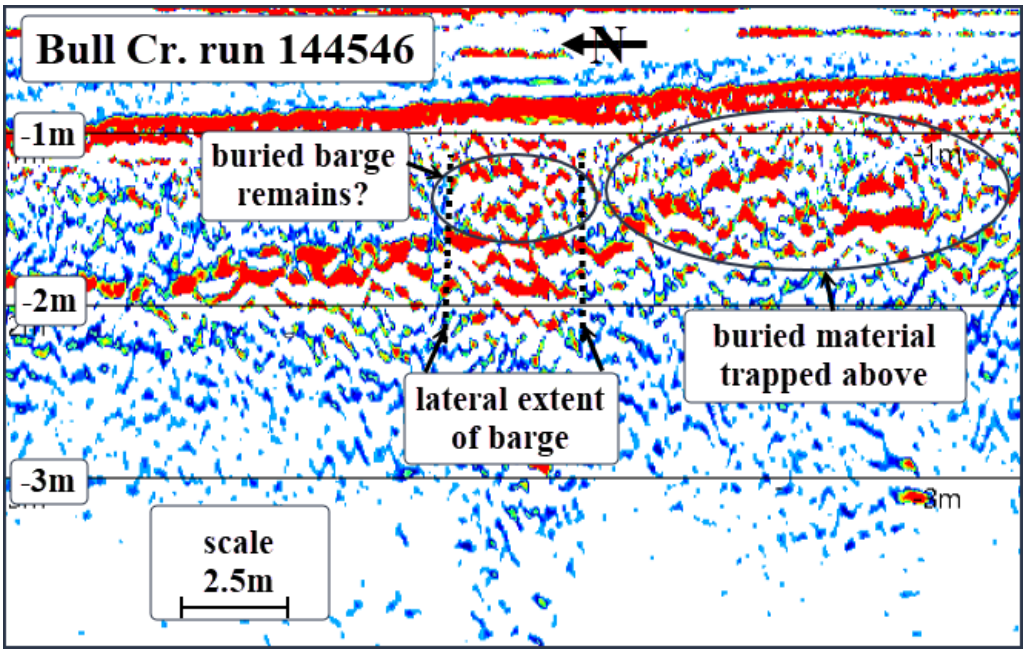

Figure 38. Bull Cr. SBP cross-sectional run 144546.

Melville Water Unidentified Wreck Site

Two potential magnetometer GPS coordinates were obtained from WAM for the Melville Water Unid. Wreck site, however, the most recent record could not be retrieved. On Sunday June 1st 11 SBP survey runs were recorded, centering on the two supplied GPS coordinates. These tracks are shown in Figure 39.

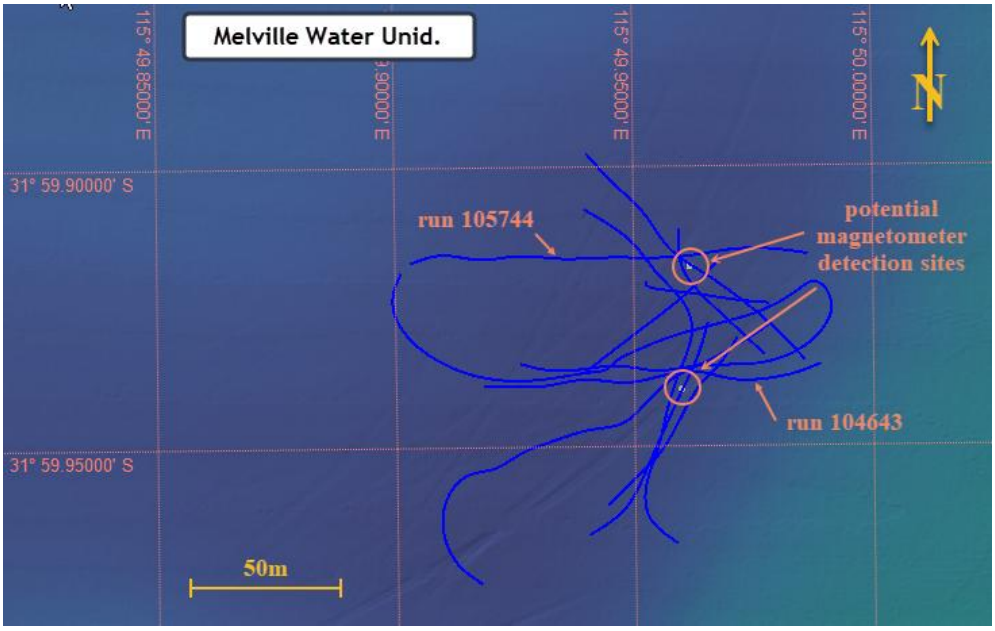

Figure 39. Melville Water Unid. site with all SBP survey runs.

All SBP survey profiles were processed and examined using the settings shown in Figure 13, and two typical and representative profiles were selected with their tracks shown on Figure 39. Detailed examination of run 105744 (Figure 40) and run 104643 (Figure 41) failed to reveal any traces of an historic vessel buried below the riverbed.

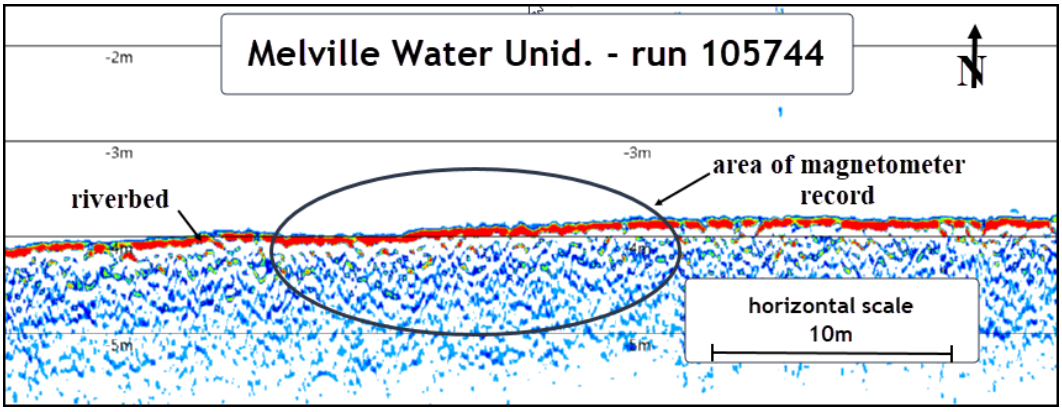

Figure 40. Melville Water Unid site SBP E-W run 105744.

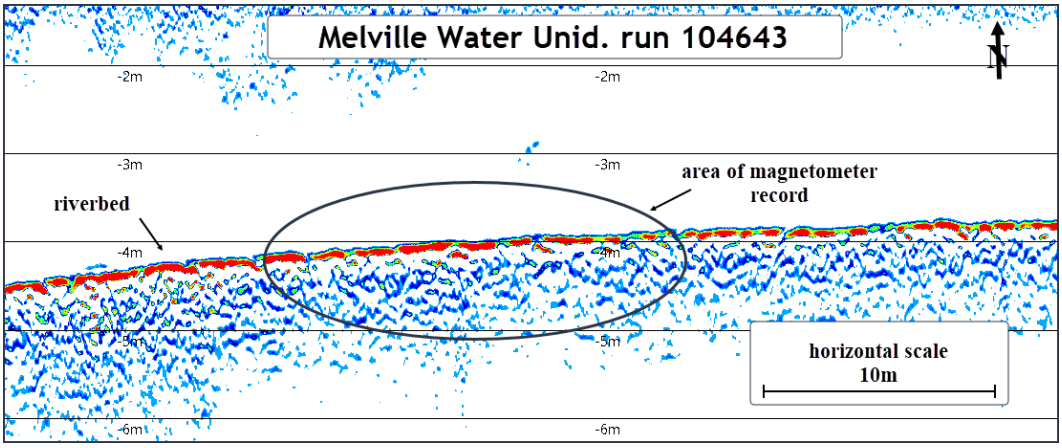

Figure 41. Melville Water Unid. site SBP E-W run 104643.

SBP Data Access

All SBP data files are openly and freely accessible for training and educational purpose. Further details are provided in Appendix A.

Chapter 5 SITE INTERPRETATION AND RECOMMENDATIONS

Interpretation of the SBP data, supplemented with other lines of evidence, has been undertaken to provide information and recommendations regarding the potential identification of the unidentified barge sites, the *in-situ* conditions at all sites, and *in-situ* heritage management concerns and issues.

Point Walter Barge site – *Dearden's flat* (1882)

The SBP survey profiles identified two key items affecting the interpretation for the Point Walter – Dearden's Flat – barge site. Firstly, many small and lower density reflectors formed a mound above and extending beyond the limits of the exposed outline of the barge.

This mound of small reflectors interfered with the SBP acoustic waves, resulting in a lack of definition of the buried material below, although an acoustic shadow was observed 2m under the barge indicating that the SBP waves did penetrate the sub-surface barge material, and that their energy was fully reflected by this material back up to the surface and SBP transceiver.

The question is what caused this mound of reflectors? It is quite possible that a dense school of small fish, hovering above the barge, may be the cause. Also, emergent benthic flora might have the same effect. There have only been several SCUBA dives on this site, so further dives are recommended to assess any seasonal or periodic fish aggregations, benthic changes or other factors which may be affecting this site.

The second significant site factor is that the barge sits at the base of a localised depression in the riverbed in one of the deepest sections of water in the middle estuarine section of the Swan River (McCarthy, A.J. 2025). The slope of the riverbed surface is exaggerated in the SBP profiles due to the vertical:horizontal scale differences (5:1). Never-the-less, the potential issue affecting the long-term management of this site is geomorphic stability. Is this site slowly being covered by sedimentation with riverbed sediments transported from the side slopes by tidal currents, or is it being episodically infilled by fine material/detritus settling from the water column during and after localised flood events? Do tidal flows circulate and flush the overhead water, or do they stagnate in 'the bowl' resulting in changes to the water chemistry and ultimately to the sediment chemistry?

Recommendations

As part of formulating a long-term *in-situ* heritage management plan for this site, the following recommendations are made for consideration by WAM:

- Multiple SCUBA dives be undertaken to assess any seasonal, periodic of episodic events such as fish aggregation, benthic macro-invertebrates or detrital accumulations over this site;
- Revisit the site at an opportune time to undertake a follow-up SBP in 'clear' conditions; and
- Assess the hydrodynamic/geochemistry conditions at the site in terms of current flows, DO profiles under typical tidal flow conditions and following local flood events, and sediment chemistry.

Applecross Barge site (Jane 1897?)

The SBP survey revealed two smooth planar, horizontal layers with high reflection amplitudes extending from gunwale to gunwale, and from close to the stern to just beyond the forward bulkhead of the sub-surface barge. The upper layer is located 74–88 cm below the current riverbed surface. The lower layer lies 18–19 cm below the upper layer.

The depth of the upper layer coincides with probing depths undertaken by WAM, and the high reflection amplitudes imply a reasonably dense material, much denser than the surrounding sediments. The shape of the acoustic waves as they were progressively reflected off the upper, then lower layers, suggests that the upper layer may be slightly less dense than the lower layer. The smooth planar layers suggest that the cargo carried by this barge was evenly packed, and not irregular mounds of rock etc.

The identification of a small area off the starboard aft quarter of the barge, with similar high reflection coefficients as the upper cargo layer, suggests a similar type of material sitting on a lower sediment level.

The smooth planar cargo layers and the similar material found just off the vessel on the former riverbed align with the contemporaneous newspaper survivor's report of the sinking of the brick carrying barge *Jane* (1897). The SBP data strongly supports but does not exclusively prove this identification.

In terms of *in-situ* site conditions, the most striking feature is the very discernable double riverbed layers. The current riverbed sits at a depth of just

over 7m, with only the tips of the barge's frames protruding, as well as the aft rudder, forward bulkhead beam and some ship's gear near the bow. The acoustic sediment wave amplitude returns weaken and drop to very low levels immediately below this current riverbed. However, slightly deeper at approximately at 1m depth below the current riverbed level, stronger sediment returns suddenly re-emerge as a layer, and these stronger sediment returns continue to the lowest depth level of recording. Of importance, the base of the barge appears to sit flat on this lower layer, as do the high amplitude reflectors off the starboard stern quarter of the barge.

This double sediment layer and position of the barge suggests several key features. The lower sediment layer may represent the original riverbed, possibly around 1897, at the time of the barge's sinking. Subsequently a significant period of sediment accumulation of finer, less dense sediment has accumulated, burying the barge up to the gunwales. This burial may well have preserved the vessel's wooden structures up to the topsides, which being exposed above the current bed level, have subsequently been eroded away.

The barge site is located within 1 km of where the Canning River enters the Swan River, and the sedimentation may have come from sediment transported down the Canning River during flood conditions, and settled at this site as flood waters spread and velocities reduced. McCarthy A.J. (2025) studied historic charts of the Swan Canning Rivers, the history of post-settlement extraction of shell beds and other dredging works in the middle and upper estuarine regions of the Swan River, and the resulting changes to riverbed bathymetry and sediment/invertebrate density. McCarthy described how intensive multiple bucket-wheel dredging activities for four decades starting in the 1920s, 'exhausted the subfossil shell deposits off the East Perth and Melville waters and across much of the estuary'. Further McCarthy commented that these extractive activities have profoundly altered the physical character of the Swan-Canning Rver system'.

The upper layer of finer sediment sitting on the Applecross Barge site may have resulted: (i) initially by the disposal of sediment fines into the water column during dredging operations; and (ii) subsequently by the changing hydrodynamic conditions and geomorphic character of middle estuarine section of the Swan River, including sediment deposition from the Canning River outflows.

Recommendations

The recommendations for follow-up actions for this site address both the issue of final confirmation of the barge's identity, as well as longer-term *in-situ* management considerations. These recommendations include:

- Undertake sediment probing off the starboard aft quarter of the barge to confirm the presence and nature of the material sitting on the lower original bed level;
- Collect several long sediment cores in the surrounding riverbed to a depth of at least 1m, and analyse for sediment size and DO profiles;
- Undertake a full '3D' SBP survey, using an Innomar Quattro system at 1m line spacing, and analyse to create a 3D visual and VR model to examine finer details of the cargo profile, timbers (possibly the mast or boom) inclined over the cargo and other details in both the bow and aft compartments; and
- If consideration is given to the attempted recovery of bricks from the site to prove identity, then methods for doing such must consider the nature of and the consequential difficulties of working through the finer overlying sediment layer. The SBP reflection profile suggests that the upper surface of the cargo may be slightly less dense than the lower layer, suggesting that weathering and some deterioration may have occurred at the top more exposed cargo layer. This might provide a non-open excavation option for recover of cargo fragments.

Bull Creek Unidentified (Dugong?) Site

The SBP survey results showed that the barge at this site was flat-bottomed, and that there was no evidence of aft paddle wheel supporting structures. Multiple SBP survey lines over the aft section failed to clearly identify any structural timbers, suggesting that most of the stern features may have been eroded due to the long-term lack of sediment cover caused by the adjacent creek channel. The exception to this is the stern post which was found in previous wading surveys to be splayed out horizontally.

The lack of clear sub-bottom evidence to link the unidentified barge to the Dugong resulted in two other lines of enquiry. Firstly, searches for State-based historic aerial photography failed to find supporting evidence. However, a search through Commonwealth Archives in WA found one roll of film taken in 1942 during the Second World War.

https://aerialphotography.ga.gov.au/Scanned/MAP/MAP1333/MAP1333_frame14117.tif One image extracted from this roll (Map 1333, Frame 14117) shows a double ended barge in the correct location and orientation (Figure 42). It clearly shows the forward deck and the cargo hatch with no indication of a centrally located boiler. The aft section is less clear, but there are no apparent structures nor timbers outside the line of the stern.

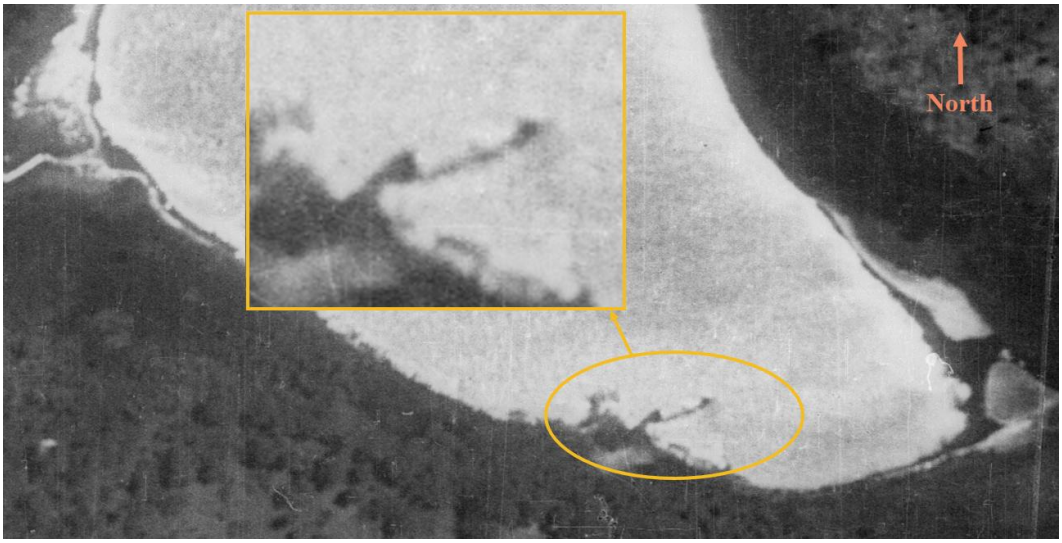

Figure 42. 1942 military aerial photograph of a barge at the head of Bull Creek (P. Morrison).

The second line of enquiry related to the outline shape of the barge. Whilst the 1896 Public Works Department drawing of the *Dugong* (Figure 7) was to scale, there was no scale bar on the plan, and the external dimensions of the Dugong could not be compared to those from the SBP data despite historic assertions that they seemed comparable.

In order to compare the outline shape of the *Dugong* (based on PWD's accurate scale drawing) to the *in-situ* shape of the unidentified barge, a low-level vertical aerial photograph was taken, using a drone over the site in late October during the lowest astronomical tidal level (LAT) conditions. This image was rectified to correctly align with GPS co-ordinates and shows the lines of frame tips just exposed above the mud line and water surface (Figure 43). The outline of the Dugong was then superimposed on this background image. Given the Dugong's scale was unknown, its outline was uniformly stretched to match the *in-situ* dimension amidships. From Figure 43, it can be clearly seen that outline shape of the Dugong does not match the in-situ shape of the unidentified barge. The same conclusion was reached when the Dugong's outline was stretched to meet the overall length of the unidentified barge, and in this case the Dugong's dimension at amidships was much wider that the in-situ frame outline.

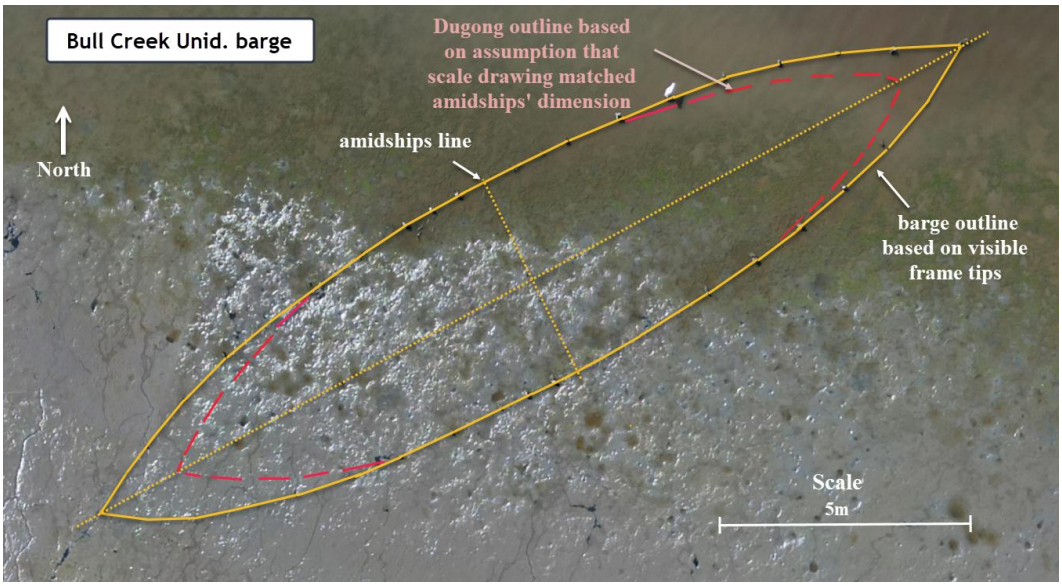

Figure 43. Direct comparison of the outline shape of Dugong to the unidentified barge in Bull Creek.

Based on all lines of evidence the unidentified barge in Bull Creek is a flat-bottomed barge with an overall length and beam of approximately 18.95 m and 4.0 m, respectively, but is not the *Dugong* barge.

So can we determine the identity of this barge? During the Bull Creek SBP survey, the Winwell team met with several interested locals. These included adults, who at the time were children and grandchildren of the first family to settle and build on the eastern bank at the head of Bull Creek, as well as Susan Harris, Convenor of the local Wadjup-Gabbilju group.

Members of the local family recalled playing on and around the barge as kids and told of many make-do rafts being left on site. They also remembered being told that the barge once belonged to the Bateman family who lived on the opposite bank to them and that in total, three barges were abandoned at the head of Bull Creek. Susan Harris recalled a conversation with Alan Bateman (now deceased), who said to her something like “Dad said it's ours" or "Dad said it was ours". The three barges information also came from that source.

While the other two reported barges have not been found, it would appear likely that the unidentified barge at the Head of Bull Creek was once owned and subsequently abandoned by the Bateman family.

Recommendations

- The *Dugong's* demise remains a mystery, so further archival research is recommended to try to find additional PWD records pertaining to this vessel; and
- Additional SBP surveys be undertaken on the western bank of Bull creek to try and identify any trace of the other two historic barges.

Melville Water Unidentified Wreck Site

The SBP survey failed to locate any buried remains of an historic shipwreck in the Melville Water area reported by Scrimshaw (1980). As this SBP survey was based on two potential magnetometer GPS location records, it is recommended that a more thorough magnetometer survey be undertaken in the area. If significant iron 'hits' are subsequently recorded, then a riverbed inspection should be immediately undertaken, and a follow-up SBP survey considered.

APPENDIX A – DATA ACCESS

All SBP data collected for this project is openly available for training and educational purposes. The following link provides access to the project data portal and tabs to download or view data from each site. The project team is currently loading the data onto the internal database which is expected to be fully functional by early 2026.

https://patrick-morrison.github.io/winwell-opendata/

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