COMBER CONSULTANTS

ARCHAEOLOGY – HERITAGE – MEDIATION – ARBITRATION

WOOLLOOMOOLOO BAY SSD 6471
SYDNEY MODERN -
ART GALLERY OF NEW SOUTH WALES
EXPANSION PROJECT

PREPARED BY	DAVID NUTLEY
REPORT TO	GML HERITAGE
VERSION NO	C.2018
DATE	AUGUST 2018

COMBER CONSULTANTS

ARCHAEOLOGY – HERITAGE – MEDIATION – ARBITRATION

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INTEGRATED MANAGEMENT SYSTEM

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EXECUTIVE SUMMARY

The Art Gallery of New South Wales (AGNSW) is proposing the Art Gallery of NSW Expansion Project - Sydney Modern under State Significant Development (SSD) 6471. GML Heritage have been engaged by AGNSW to assist in the preparing of the Heritage Impact Statement for the SSD submission. The proposal for the expansion program includes the use of seawater for temperature control of the new Gallery building. This would involve pumping seawater from Woolloomooloo Bay through an intake pipe and then sending the water back to the Bay through a discharge pipe – each matched with a redundant pipeline as backup.

The potential impact of the proposal has been assessed in two stages. In stage 1, Comber Consultants was engaged to undertake a desktop study. That study provided a preliminary assessment of underwater archaeological potential and significance; identified potential impacts arising from the proposal and described procedures and management strategies for the management of unexpected finds.

The Stage 1 report recommended remote sensing surveys as well as diver-based investigations of targets identified through analysis of those surveys. The remote sensing (Multi-beam sonar, single beam side scan sonar) and dive inspections were conducted in June 2018. The survey coverage included a primary area where two alternative routes have been proposed and an extended area required by the project engineers. This report describes those surveys, analyses the results and provides management recommendations appropriate to the outcomes.

The remote sensing surveys depicted a number of anomalies from which 29 targets were identified and inspected by divers. None of those anomalies were found to be of archaeological significance. In addition, the seabed in the primary survey area did not have any depth of sedimentation that could hold deposits of archaeological material. It is therefore concluded that the installation of the proposed pipeline will not impact on significant items of cultural heritage within the primary survey area.

The extended area includes deeper water (up to 12m depth). Dredging in this area, since at least the early 20th century, has removed any significant accumulation of archaeological deposits and no items of cultural significance were evident. However, due, to the depth, there is some increase in sedimentation. This sedimentation has a low residual potential to have accumulated deposits of archaeological significance.

During the dive survey, the adjacent stone seawall on the western side of Woolloomooloo was also inspected.

The findings arising from the June 2018 remote sensing and diver investigations are that:

1. In view of the remote sensing and diver investigations undertaken in Stage 2, the implementation of Recommendation Number 4 of the Stage 1, desk-top report is not required, ie, it will not be necessary for an archaeological diver to be present during or after the conduct of trenching for installation of the pipelines.

2. As no potential impacts on 'Off-shore' archaeological deposits have been identified within the study area and there is no need for a diver to be present it is not necessary to prepare a research design of excavation methodology.

3. The 'Unexpected Finds Procedure' contained in Section 4.2 of this report should be included in site inductions for all personnel engaged in this project. This includes the requirement that, if any relics are found during trenching, work must cease in that area and advice sought from the archaeologist.

4. The AGNSW should facilitate appropriate materials conservation for any items recovered as a result of the trenching. Archival documentation and appropriate ongoing conservation and storage should also be undertaken for these items.

5. While there are three existing, small openings through the eastern face of the sandstone seawall within the study area, the installation of four large cooling pipes would substantially destroy that section of seawall. The final design of the pipeline will be developed in consultation with GML Heritage to limit impacts on the sea wall. The intent of the design is to install the pipeline below the level of the wall. If the pipelines were installed below the level of the seawall, no items of underwater cultural heritage on the seaward side of that wall would be impacted.

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1.0 INTRODUCTION

1.1 Background

The Art Gallery of New South Wales (AGNSW) is proposing Art Gallery of NSW Expansion Project - Sydney Modern under State Significant Development (SSD) 6471. GML Heritage have been engaged by AGNSW to prepare the Heritage Impact Statement for the SSD submission. The proposal for the expansion program includes the use of seawater for temperature control of the new gallery building. This involves pumping seawater from Woolloomooloo Bay through an intake pipe and then sending the water back to the Bay through a discharge pipe – each matched with a redundant pipeline as backup.

The project is comprised of three areas of investigation: On Shore, Shoreline transition and Off Shore. Impacts on the cultural heritage within the On Shore and Shoreline transition zones, (including the seawall), are being assessed by GML Heritage. This report concerns the Off Shore component but also includes observation of potential impacts on the seawall.

The Heritage Division of the Office of Environment and Heritage (OEH) has recommended conditions to avoid, minimise and mitigate adverse heritage impacts. These conditions include the conduct of a maritime archaeological assessment, tasked with:

1. Identifying the archaeological potential and significance of maritime heritage sites including
   - shipwrecks
   - maritime infrastructure
   - archaeological items and/or relics (both above and below water)
2. Identifying potential impacts arising from the proposal.
3. Providing procedures and management strategies for the unexpected discovery of heritage items and/or relics.
4. Assessing whether there is a need for underwater surveys to be undertaken that may require remote sensing and/or diver based investigations.

The Heritage Division also recommended that a Research Design and Methodology be prepared as soon as possible and before the assessment and determination of SSD 6471.

The fulfilment of the Heritage Division requirements has been conducted in two stages. Stage 1 was a desktop study (Nutley, March 2018) which addressed items 1-4 above. The Stage 1 report recommended remote sensing and dive inspections to inform the need, if any, for archaeological excavations. If excavations were recommended, the Stage 2 report would include a research design and excavation methodology.

The remote sensing and site inspections were conducted in June 2018. This report documents those investigations, analyses the results and addresses the Research Design and Methodology requirement of the Heritage Division.

1.2 Location

The study area lies in Woolloomooloo Bay between the Royal Botanic Gardens (RBG) and the peninsula of Mrs Macquarie's Point to the west and, to the east, Garden Island and Potts Point (Figure 1). It includes the primary area in which the intake and discharge pipes are expected to extend into the bay for some 60m from the shoreline. The project engineers are also undertaking Geotech surveys over an extended area to the north and north-east of the primary survey area.

The Domain and the Art Gallery of New South Wales are to the south-west of the Off Shore study area and Woolloomooloo Finger Wharf is to the east.

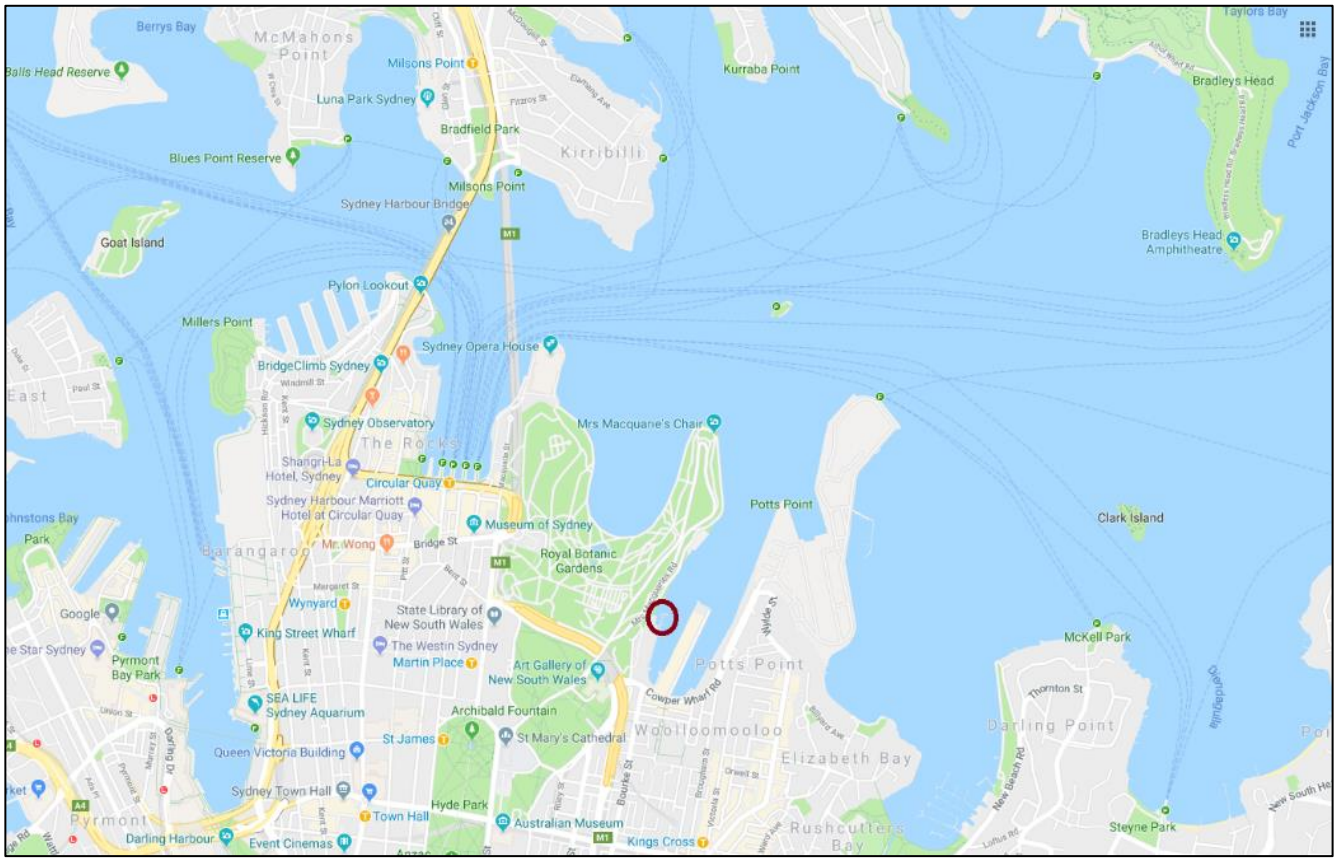


Figure 1: Location of the study area (red circle) (Google Maps 2018)

1.3 Development proposal

The Sea Water Heat Exchange report for SSD 6471) (Steensen Varming 18/02/2018) describes engineering aspects of the mechanical services systems that are proposed.

At the time of the archaeological investigations, the actual locations of the heat exchange pipes were yet to be confirmed by AGNSW pending completion of the detailed surveys of the sea bed. The remote sensing surveys and archaeological assessment included two proposed locations for the pipelines (Figure 2). An extended area being considered by the project engineers to the north and north-east of those locations was also investigated (Figure 3).

The Steensen Varming report indicates that, for redundancy purposes, there will be 2 intake pipes and 2 discharge pipes. The intake pipes have a diameter of 1200mm and the discharge pipes have a diameter of 400mm.

Figure 5.2a of that report (Steensen Varming 2018:7), indicates that the concrete discharge pipes will sit 1000mm above the seabed. The relationship of the intake pipes to the seabed, ie, elevated or buried), is not described but the proposal states that the seawater system pipework is to travel 'below ground from the intake and discharge points to a plant room'. Whether elevated on supports or buried in a trench, some trenching or other seabed disturbance will be required.

The intake from the harbour will incorporate an angled mesh basket (diameter, 1800mm) set out from an intake foot valve and will sit above the seabed.

The pipework will travel to a plant room on the western bank of Woolloomooloo Bay. The plantroom will comprise of a flooded, subterranean component and an above ground component.

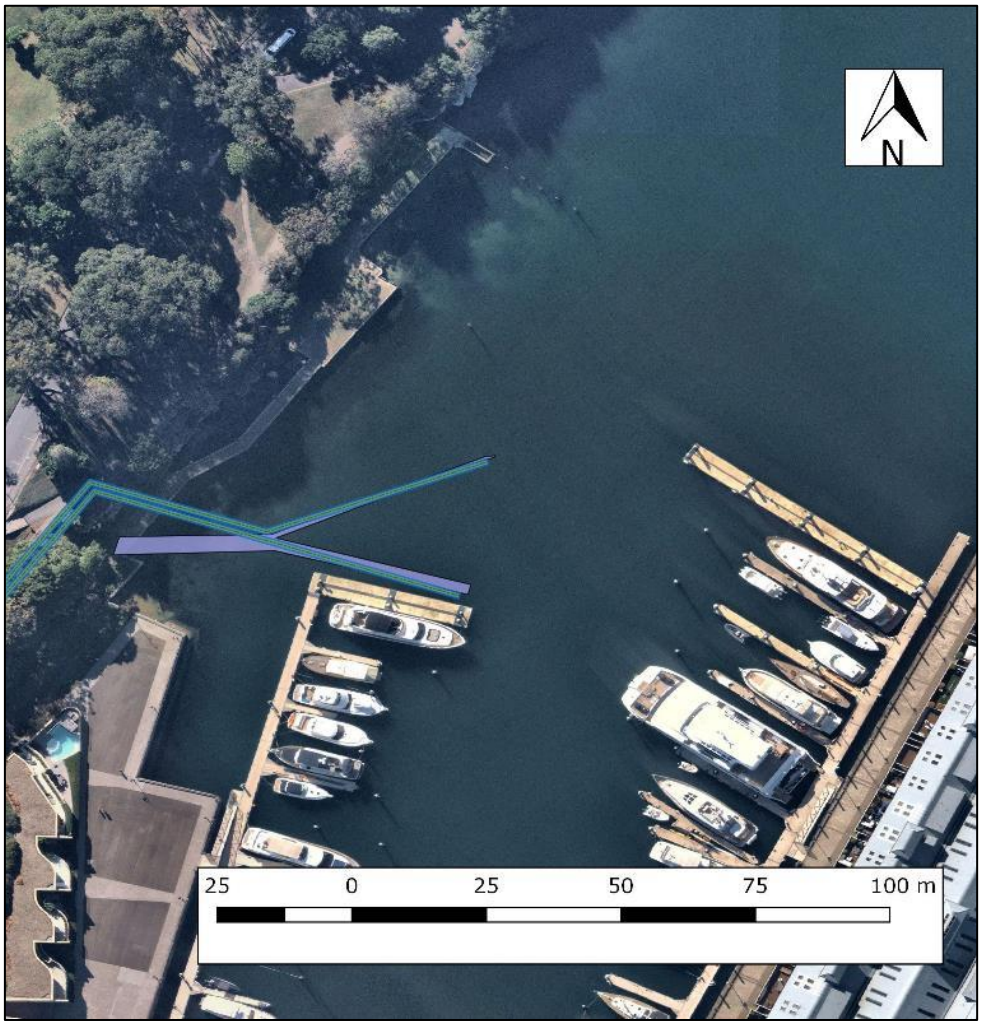


Figure 2: Proposed pipeline route options within the Off Shore area

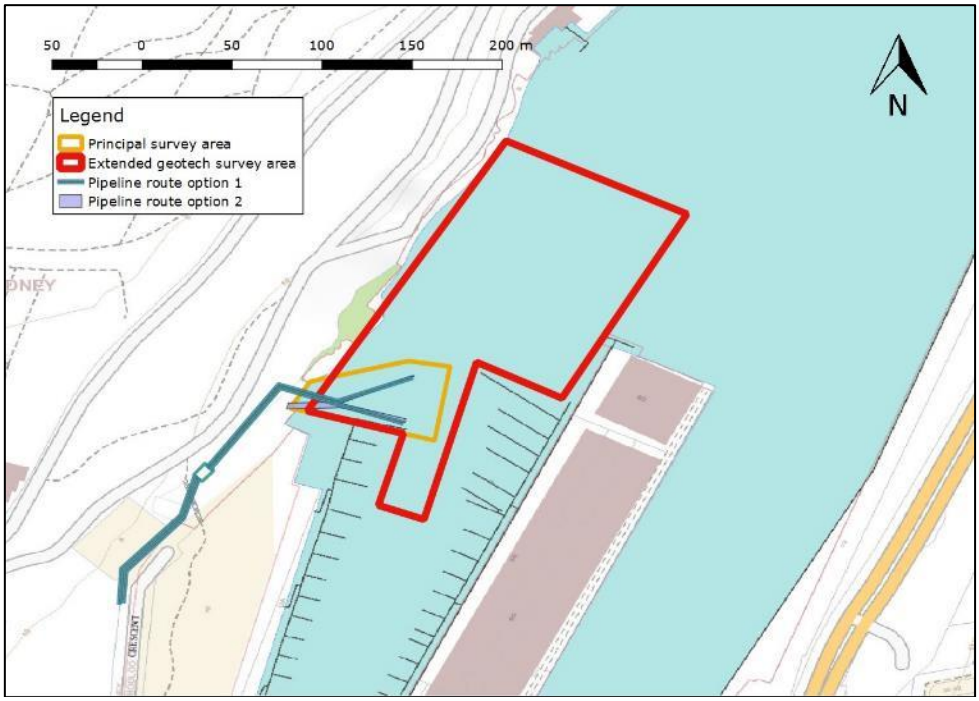


Figure 3: Remote sensing coverage -
Incorporating the area around the proposed pipeline routes (orange) and the extended Geotech survey area (red)

2.0 METHODOLOGY

2.0 METHODOLOGY

2.1 Introduction

This report is a supplement to the Stage 1 report (Nutley 2018). The history, archaeological context and legislation sections in the Stage 1 maritime archaeological report are not repeated in this document.

For the history of the study area, see Section 2 of the March 2018 maritime archaeological report (Nutley 2018). That history is based on the November 2017 Heritage Impact Statement prepared by GML Heritage for the AGNSW: Sydney Modern project.

Section 3 of the Stage 2 report includes a review of a 2004 maritime archaeological assessment to the north of the current study area where two hulks were once stationed during the nineteenth century.

For the archaeological context, see Section 3 of the March 2018 maritime archaeological report (Nutley 2018).

For the relevant legislation, see Section 6 of the March 2018 maritime archaeological report (Nutley 2018).

2.2 Remote sensing

The remote sensing surveys were conducted by Coffey Services Australia Pty Ltd and incorporated both the geotechnical and maritime archaeological requirements. The methodology for the remote sensing was developed in consultation with the project maritime archaeologist. Coffey Services' methodology is detailed in section 3.1 of their report of 13 June 2018 'Seawater Heat Exchange – Offshore Geophysics Stage 1 - Heritage (Hydrographic Survey)' (see Appendix B). The remote sensing survey covered both of the survey areas shown in Figure 3.

In summary, these surveys included multi-beam echo sounding bathymetry (MBES) and side scan sonar (SSS). The following is extracted from the Coffey report but should be read within the context of that report.

> 'The survey was carried out under the control of an H1 Hydrographic Surveyor certified by the Australasian Hydrographic Surveyors Certification Panel (AHSCP).
>
> During survey an integrated digital data acquisition, navigation and positioning system (NavCom SF-3050 StarFireTM Differential GPS receiver with a horizontal accuracy of typically better than 0.5 m) was used for set-out of pre-defined survey lines. This provided a Left/Right helmsman indicator to the vessel master for course correction during data acquisition. Accurate positioning of the vessel and survey operation was achieved using an RTK system connected to CorsNet NSW.
>
> The geodetic parameters were the Geocentric Datum of Australia, 1994 (GDA 94) and Map Grid of Australia projection MGA Zone 56.'

The MBES and SSS imagery were supplied to Comber Consultants as high resolution Geotiff and Shape files. The imagery was loaded into a GIS program and overlaid with historic maps and the projected pipeline routes. MBES imagery provides greater positional accuracy and improved contextual information, eg, in relation to ridgelines and other submerged land forms. SSS provides greater structural detail. An overlay of the two sets of remote sensing imagery was used to compare the apparent anomalies and to identify, and to obtain coordinates of, potential targets for the dive inspections.

For further details of the hydrographic system, System QA & QC checks, see section 3.4 of the Coffey Services report at Appendix B.

2.3 Dive inspection

The dive inspection was conducted with support from 'Colbe Dive and Marine' and 'The Diving Co'. The dive team, including the maritime archaeologist, consisted of a Dive Supervisor, Stand-by diver, diver and boat handler. All personnel were accredited Australian Diver Accreditation Scheme (ADAS) Level 2 or higher under AS2299. Equipment supplied by 'The Diving Co' included Surface Supplied Breathing Apparatus (SSBA) and a work vessel.

The targets identified from the MBES and SSS imagery were plotted onto a map of the survey area along with their coordinates, (latitude and longitude) and depth. The distance between each target was also tabulated to assist the diver to progress from

each target to the next.
To facilitate diver access to the identified targets, the work-boat was positioned in three separate locations. For the purposes of this report, the locations subject to dive inspection are labelled Zone 1, Zone 2 and Zone 3. Zone 1 permitted the diver to inspect all the identified targets in the primary survey area in the preferred location of the pipelines. Zone 2 was positioned 25m to the north of the Finger Wharf marina. Zone 3 was the area that lies between the two lines of cardinal markers on the western side of Woolloomooloo Bay.

Water depth in the survey area ranged from 1m to a maximum 12m and the diver's average depth just 4m. These shallow depths therefore did not constrain dive time for the survey. Water clarity was up to 3m but any disturbance of the fine sediment on the seabed reduced visibility to less than a metre.

The diver was in constant audio contact with the surface support team and provided descriptions of each located target. The diver swam contour lines to provide maximum coverage within Zone 1. The diver's location was monitored from the surface and directions provided by the Dive Supervisor when required to ensure that the dive was conducted within the pre-defined survey area.

In Zone 2, the targets were separated over a total distance of approximately 25m and within a depth of 12m. The diver swam compass bearings. Direction and coverage was assisted by the surface team.

In Zone 3, due to the shallow depth, (~3m), water clarity, proximity and uniformly recognizable nature of the anomalies the diver did not require direction from the surface.

2.0 REVIEW OF 2004 MARITIME ARCHAEOLOGICAL ASSESSMENT

3.0 REVIEW OF 2004 MARITIME ARCHAEOLOGICAL ASSESSMENT

3.1 Review of Andrew 'Boy' Charlton Pool – maritime archaeological assessment

In 2004, Cosmos Archaeology, (Coroneos 2004), undertook a desktop maritime archaeological assessment for a proposed pontoon and Jetty Gangway; Andrew 'Boy' Charlton Pool at Woolloomooloo. That study area was included in an 1845 map, (Woolcott & Clarke's 1854 map of the City of Sydney), that portrays the 'Gentlemen's Baths, approximately 70m north of the northern boundary of the 'extended' Geotech survey area and approximately 240m north of the proposed pipeline routes. The structures forming Robinson's Gentlemen's Baths included a hulk. This is portrayed as an oval shape in the 1845 map and also appears in plans circa late 1850s, (A.O. Plan no 1153), but does not appear in an 1861 plan (A.O. Plan no 5653). The 2004 report contains an image of a bluff bowed hulk at 'Robinson's Hot and Cold Baths' (Figure 4). This sketch is signed by R. Ransome, c1855 (Coroneos 2004:34).

During the current review of the 2004 report, an 1844 painting of Woolloomooloo Bay was obtained from the Mitchell Library. This provided an earlier image of the hulk in this location. and which is consistent with the form shown by Ransome (Figure 5). In the latter image, the hulk has acquired additional superstructure that may have been to provide better ventilation and lighting.

It appears that two different vessels were hulked and used as part of Robinson's Baths, the *Sir William Wallace* and the *Ben Bolt* (Coroneos 2004:33-35). The *Sir William Wallace* was a wooden ship that was built in 1824 and is likely to be the ship depicted in Figures 3 and 4, said to have been broken up in 1851 (Coroneos 2004:34).

The *Ben Bolt* is referenced as serving the Hunter Valley in 1854, 1855 and 1856 (The Maitland Mercury and Hunter River General Advertiser Sat 29/7/1854:p1 Col 1 and Sat 12/04/1856:p1 col1; Sydney Morning Herald Fri 18/5/1855:p1 col 1;). The vessel had been purchased in 1854 from Charles Newton by the Australasian Steam Navigation Company (*Empire,* Thu 2/11/1854:p3 col 6). A notice by the Australasian Steam Navigation Company in the *Shipping Gazette and Sydney General Trade List* (Mon 1/2/1858 p22, col 3) advises that '*The hull of the Ben Bolt, which it was not thought advisable to repair, has been disposed of.'* The 1858 article does not give details of that disposal but Coroneos (2004:34) quotes Parsons (1983), who states that the *Ben Bolt* was hulked in 1857 and purchased by Mr Robinson and converted into a bath house. This is a year earlier than the Shipping Gazette notice but this is not necessarily a contradiction as the process of disposal may have preceded the newspaper article.

In April 1864 there is a report of the hulk sinking at its moorings (Coroneos 2004:35). The report, by a frequent user of the baths, a man called Josephson, detailed that he arrived to find that the hulk had 'vanished'. Josephson stated that it had sunk during the night.

While Josephson may well have been surprised to find the hulk no longer at the baths, it is unlikely that the vessel actually did sink at its moorings. The depth of water is only 3m and, as noted by Coroneos, the superstructure of the hulk would remain visible. If it did sink at its moorings, the hull would have been refloated and, most likely taken to be broken up. Alternatively, if the hulk had broken its moorings, moved off-shore and foundered in deeper water in or near the bay, such an obstacle within navigable waters of Woolloomooloo Bay, or Sydney Harbour would attract media attention. This would be particularly so during any recovery and removal of the shipwreck. In the absence of such documentation, or evidence to date of shipwreck remains in Woolloomooloo Bay, it is more likely that the hulk was actually purposefully removed and taken to a ship breaking yard for disposal.

This review supports the 2004 assessment that neither the *Ben Bolt* nor the *Sir William Wallace* are located in the study area.

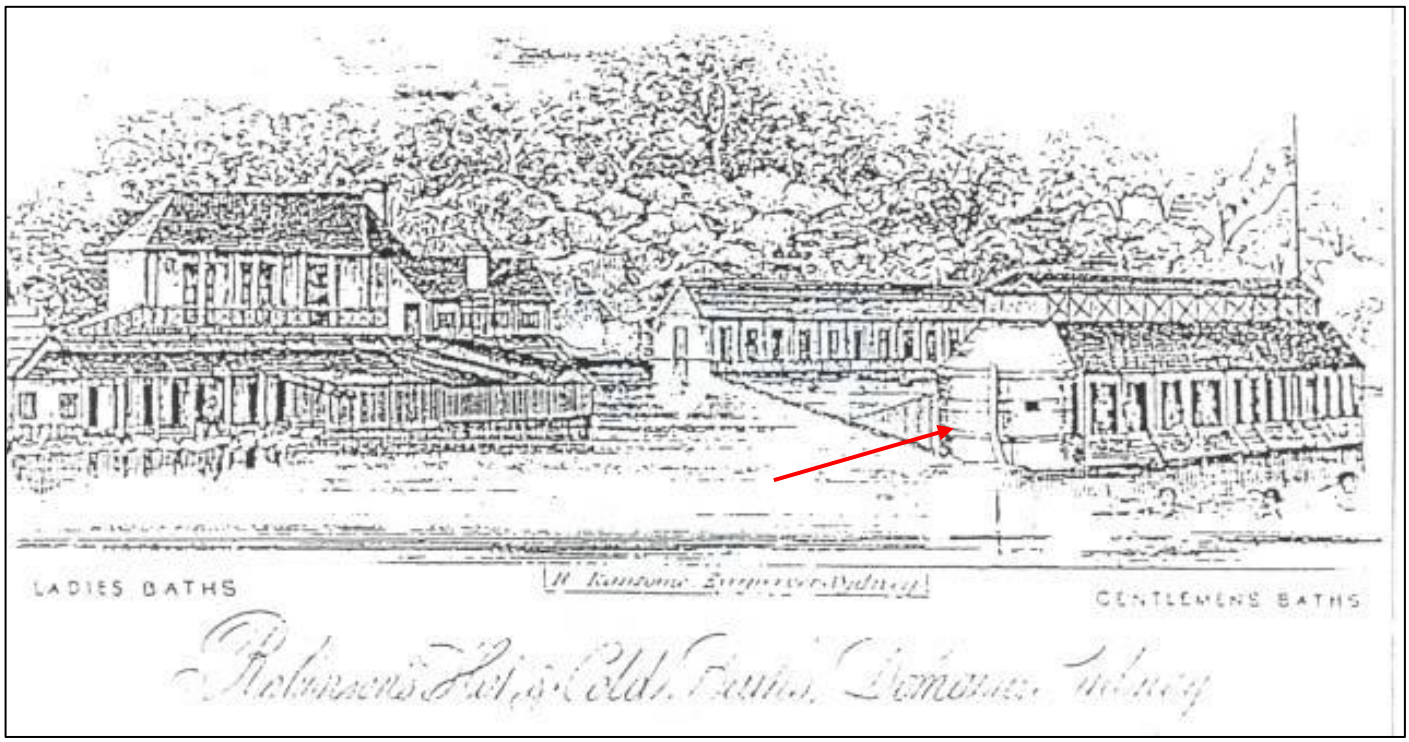


Figure 4: Ransome's c1855 sketch of 'Robinson's Hot & Cold Baths, Domain, Sydney'
With arrow to the bluff bowed hulk (Coroneos 2004:34)

Figure 5: 1844 painting of Woolloomooloo Bay by G.E.P (Peacock)
showing hulk on western shore of the bay (red arrow). Mitchell Library ML 721

4.0 SITE INVESTIGATIONS

REMOTE SENSING - ANOMALIES IDENTIFIED FOR DIVE INSPECTION
DIVE INSPECTION RESULTS

4.0 SITE INVESTIGATIONS

4.1 Remote sensing - anomalies identified for dive inspection

From the MBES and SSS remote sensing imagery, twenty-nine (29) targets were identified for further investigation. Nineteen (19) of these were in Zone 1, four (4) were in Zone 2 and six (6) were in Zone 3 (Figure 4 and Table 1). The MBES imagery is shown in Figure 5 and the SSS imagery is in Figure 6.

Zone 1 included a number of rock ledges and outcrops. These areas can trap and/or disguise deposits of cultural material. Other items were clearly manufactured objects but whose identity could not be determined by the imagery.

The remote sensing imagery showed the greatest concentration of anomalies within Zone 1 and Zone 3 but with very few anomalies in Zone 2, much of which was barren seabed and at a depth of around 12m.

The Zone 2, the SSS imagery shows a set of four parallel lines, each approximately 4m apart and up to 4km in length. This anomaly is not visible in the MBES imagery which has greater positional accuracy. The feature in the SSS imagery is possibly a reflected echo from the northern apron of the Finger Wharf. It did not possess features suggestive of a significant heritage structure. Due to this and to its immediate proximity to the Finger Wharf, it was discounted as an item for further investigation.

As a result of the analyses of the remote sensing as detailed above 29 targets have been identified for a dive inspection, as detailed below.

4.2 Dive inspection results

The identified targets are shown in Figure 7 and listed in Tables 1-3 along with their coordinates, (latitude and longitude) and depth. All identified targets were located during the dive inspection. Each target includes a description of the characteristics observed during the dive survey and an assessment of significance. No targets of potential archaeological significance were observed during the dive inspections of Zones 1, 2 and 3.

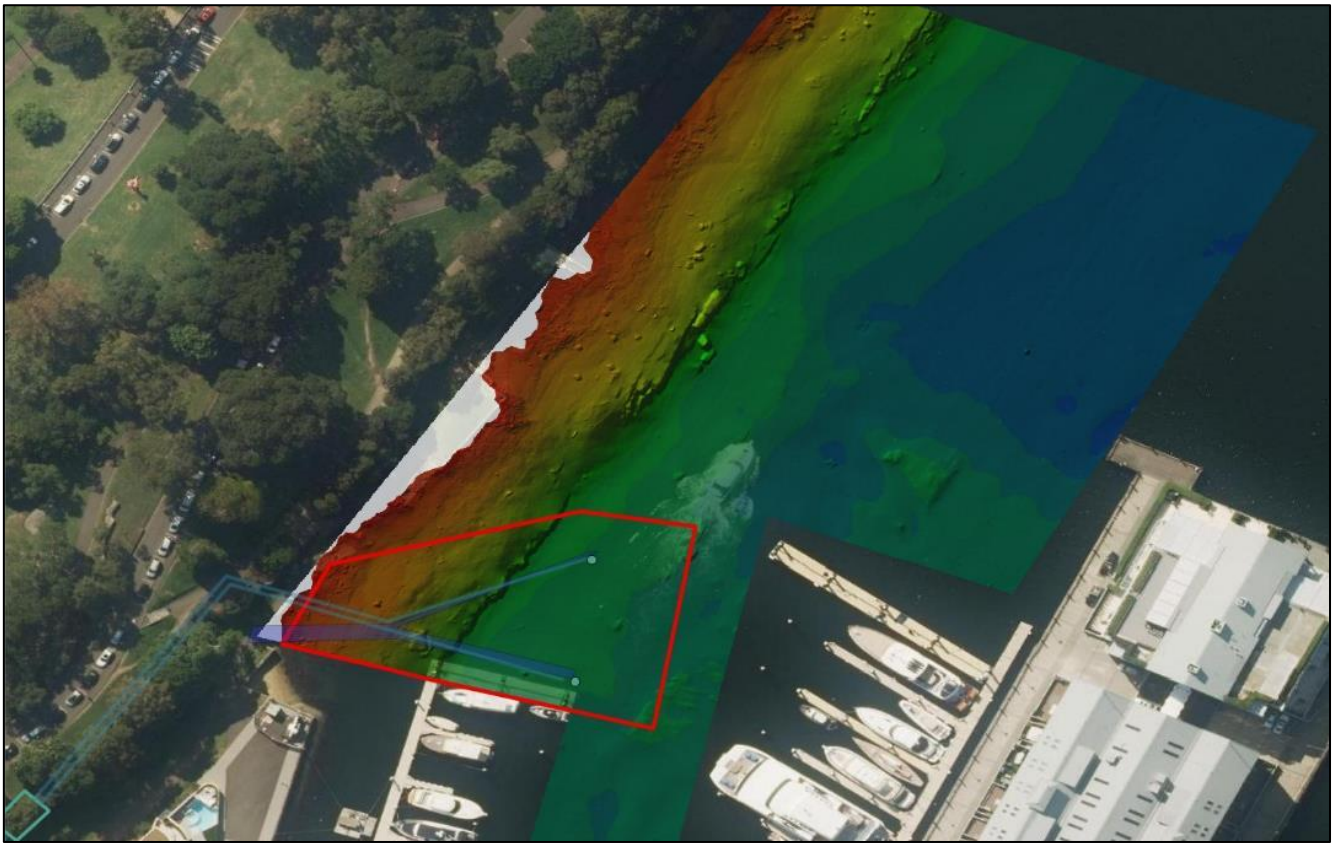


Figure 5: MBES imagery

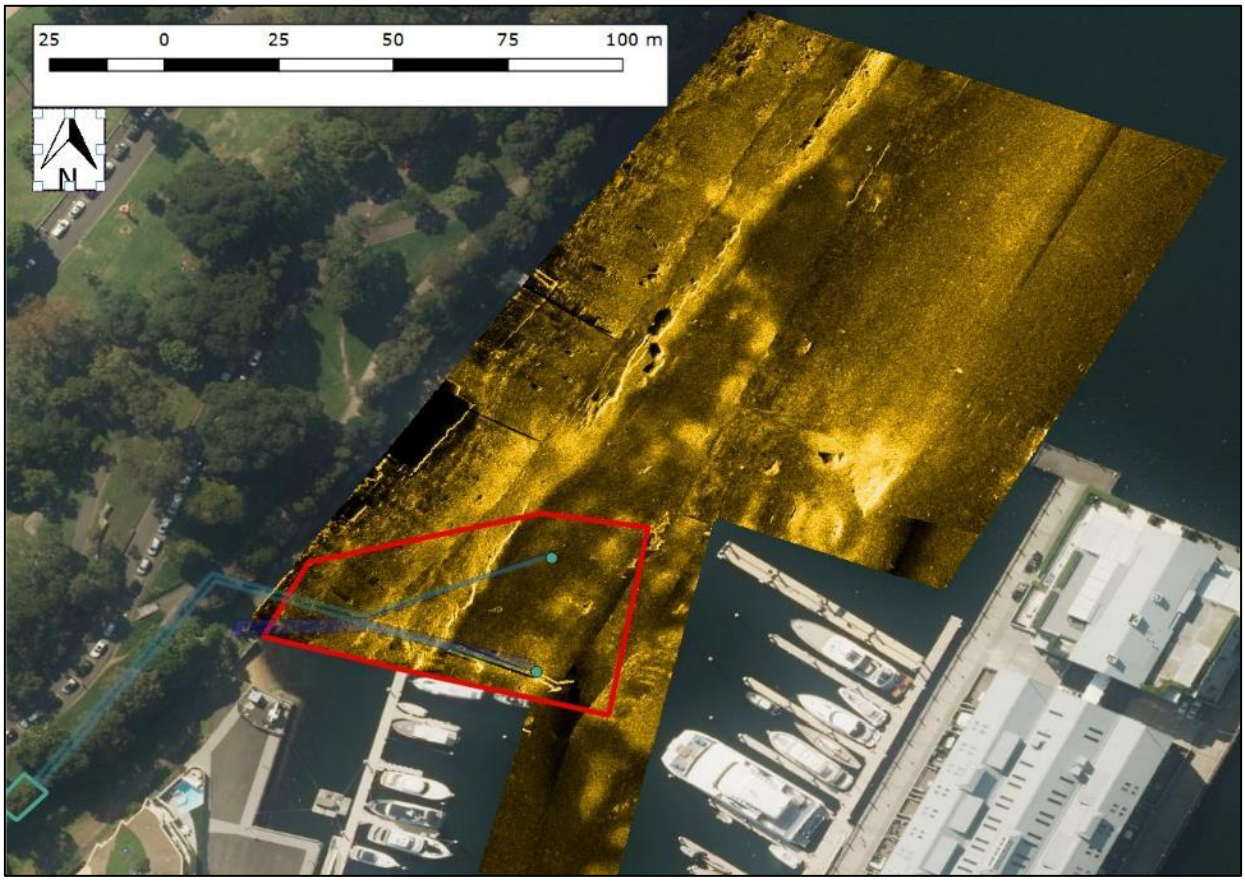


Figure 6: SSS imagery with the primary survey zone outlined in red

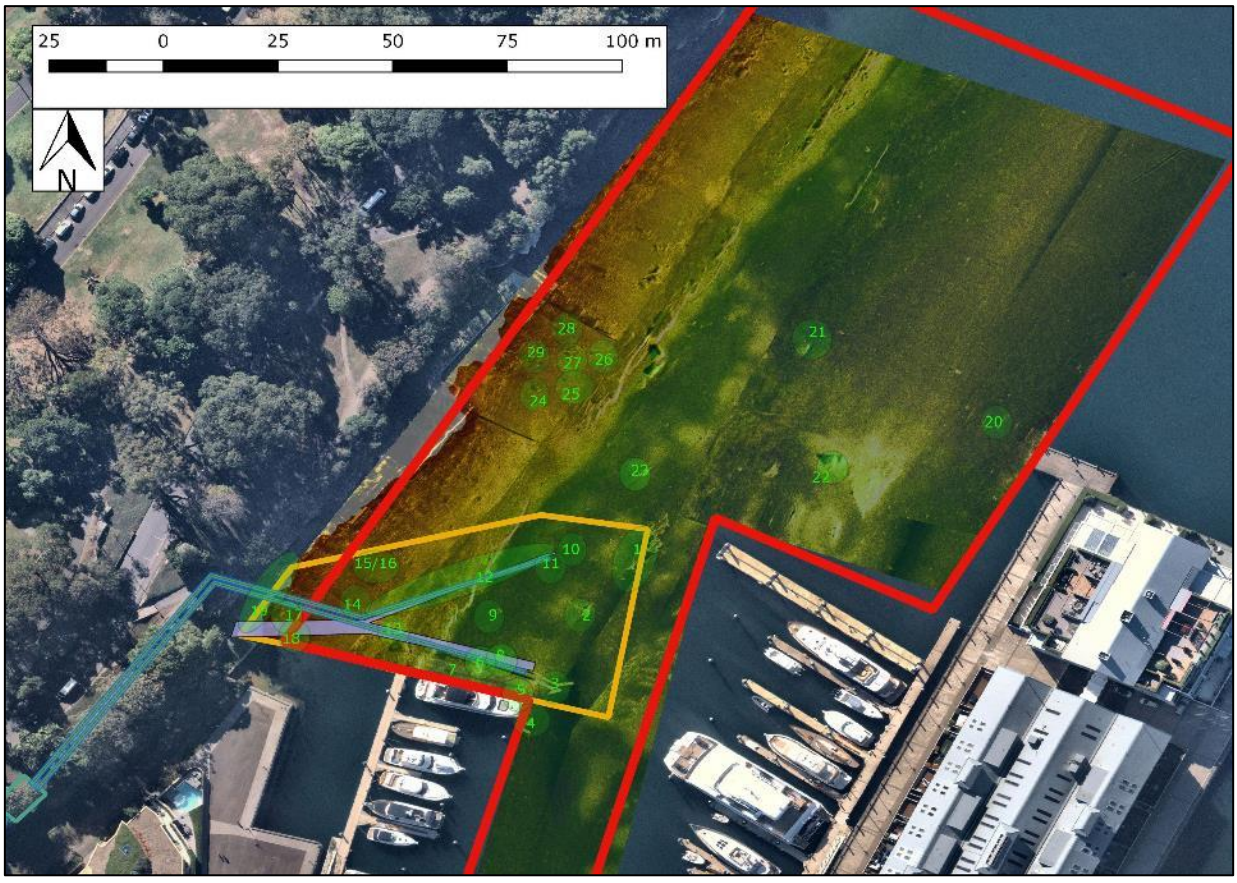


Figure 7: Overlay of MBES and SSS imagery with distribution of targets identified for dive inspection

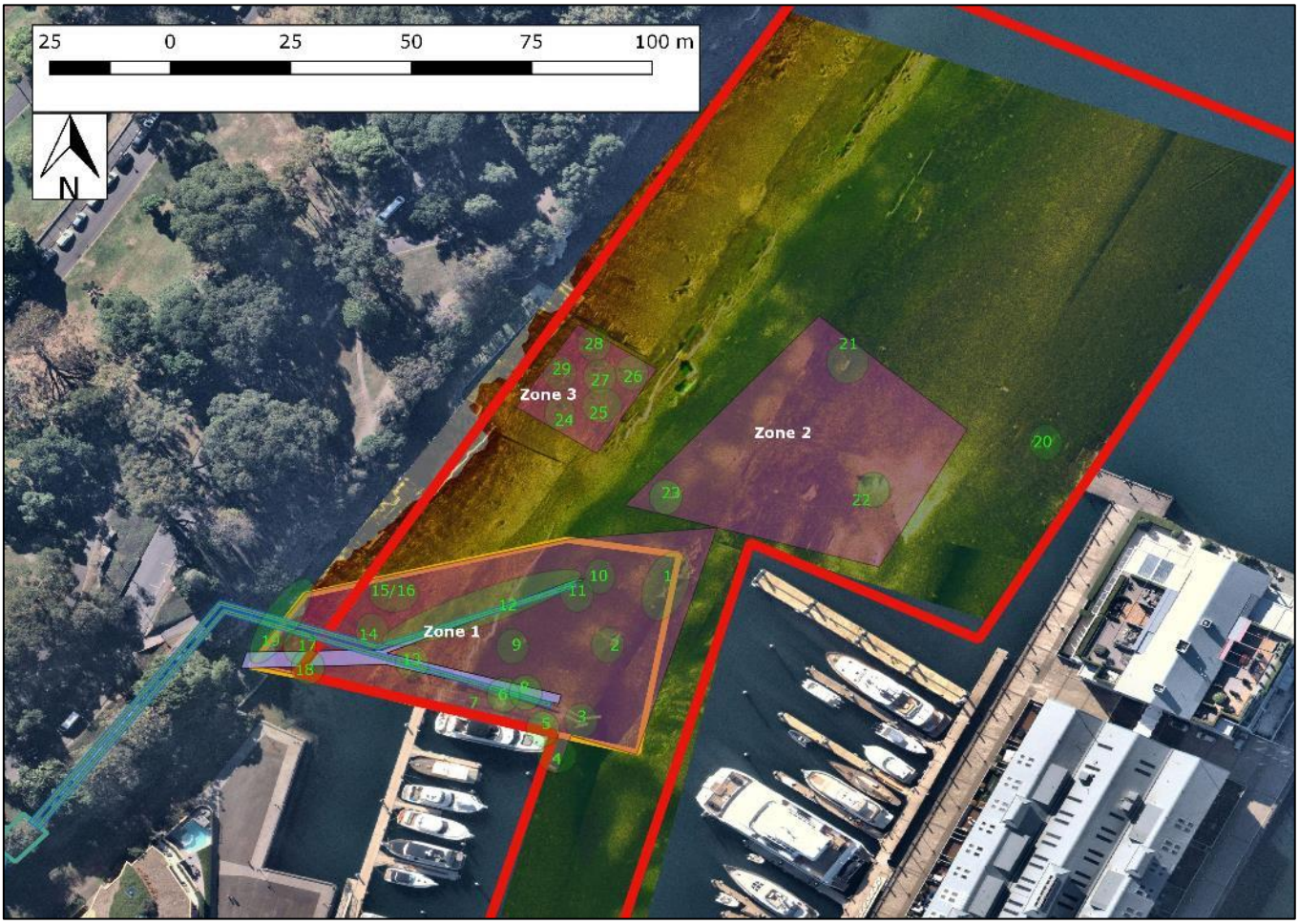


Figure 7: Combined overlay of MBES and SSS imagery with the dive Zones (shaded purple) showing coverage and relationship to identified targets

Visual coverage was 100% within Zone 1, (Figure 7 & Table 1). The dive inspection within Zone 1 (Figure 7 & Table 1) identified sandstone bedrock shelving across the zone. The bedrock was covered with a thin layer of fine sediment. Within this zone, there were no areas of significant sedimentation over the bedrock where cultural deposits could remain buried.

Adjacent to Zone 1 is the sandstone seawall. This runs along the western shoreline and is a vertical wall comprised of 7 courses of sandstone blocks. Three existing pipe penetrations through the eastern face of sandstone wall were visible. The smallest pipe was approximately 100mm diameter and the largest was approximately 300mm.

#	Latitude	Longitude	Length/ breadth (m) or area	Depth (m)	Description	Item/relic under *Heritage Act*?
1	33.8659732	151.2201417	1.6x1.0	10-11	Rock outcrop	No
2	33.8658793	151.2201816	0.3x0.3	10-11	Rock outcrop	No
3	33.8661502	151.2205767	6.0x2.0	10-11	Reflection off 2 marina piles at NE corner of marina	No
4	33.8662678	151.2205600	4.0x1.5	10-11	Steel box and bracing on north eastern side of Wharf Terraces marina.	No
5	33.8661860	151.2205495	1.5x1.5	10-11	Piece of angle iron and rock under marina	No
6	33.8661331	151.2204400	3.8x2.5	10-11	Debris with iron frame and a rock adjacent to marina pile	No
7	33.8661417	151.2203788	1.8x0.2	10-11	Section of PVC pipe beneath marina under marina	No
8	33.8660889	151.2204881	1.0x1.0	10-11	Isolated natural rock	No

9	33.8655564	151.2204897	3.8x1.5	10-11	Section of steel framing	No
10	33.8661003	151.2204873	0.5x0.5	10-11	Isolated natural rock	No
11	33.8658703	151.2206179	-	10	Termination of northern pipelines	No
12	33.8659234	151.2204413	35.0x3.0	2-10	Northern pipelines path - 40m length and across ridge – no artefacts	No
13	33.8660559	151.2202365	5.8x4.8	6-10	Natural rock with maximum depth of sediment <5cm – no artefacts	No
14	33.8659703	151.2201452	2.0x1.5	1-3	Natural rock with maximum depth of sediment <5cm – no artefacts	No
15	33.8658870	151.2201683	0.2x0.2	1-3	Natural rock with maximum depth of sediment <5cm – no artefacts	No
16	33.8658799	151.2201815	0.2x0.2	1-3	Natural rock with maximum depth of sediment <5cm – no artefacts	No
17	33.8659923	151.2200288	10^2m	1-3	Natural rock with maximum depth of sediment <5cm – no artefacts	No
18	33.8660572	151.2199926	14.0x?	1-3	Natural rock with maximum depth of sediment <5cm – no artefacts	No
19	33.8659016	151.2199984	>20.0x1.0	1-2	Seawall. The seawall is in good condition and the eastern face has three extant pipe penetrations ranging from 100-300mm.	Significance assessment by GML Heritage

Table 1: Zone 1 – anomalies

In Zone 2, (Figure 7 & Table 2), the identified targets were isolated within an otherwise barren sea bed. No attempt was made to extend coverage beyond those targets and their immediate surroundings. Both targets were identified. While there was additional sedimentation within Zone 3, the remote survey and dive inspection did not identify any evidence of potentially significant cultural deposits within that sediment.

#	Latitude	Longitude	Length/ breadth (m)	~Depth (m)	Description	Item/relic under *Heritage Act*?
20	33.8655540	151.2216679	16x4	11.5-12	Not located during dive. Feature consists of 4 parallel linear forms 4m apart and up to 4m in length. No evidence in MBES imagery. Possibly a part of northern apron of Finger Wharf	No
21	33.8654181	151.2215663	1.0x1.0	11.5-12	Natural rock	No
22	33.8656464	151.2212755	5.5x5.5	10-12	Irregular feature similar to coral	No
23	33.8656663	151.2208313	4.5x1.5	10-11	Set of stairs with attached handrail	No

Table 2: Zone 2 - anomalies

In Zone 3, (Figure 7, Table 3), the identified targets were identical mooring blocks in shallow, clear water – each within 10-15m of the nearest mooring block. All targets were identified as being concrete mooring blocks, each approximately 1cu metre and with a short length of attached chain. The dive inspection identified sandstone bedrock shelving across the length and breadth of this Zone. The bedrock was covered with a thin layer of fine sediment. There was no indication of areas where cultural deposits could remain buried beneath that sediment.

The origin of the mooring blocks is unknown. They are located on the rock platform once occupied by the 'Ladies Baths' which date from the 1880s to the first half of the 20th century. No documented association with those baths has been found, though it is possible that they may have been used to aid structural stability. Alternatively, they may have been recovered from earlier moorings within the bay and relocated to avoid fowling dredging equipment.

#	Latitude	Longitude	Length/ breadth (m)	~Depth (m)	Description	Item/relic under *Heritage Act*?
24	33.8654744	151.2205821	1.3x1.3	3-6	Mooring block & chain	Low significance but located in the area of the former 'Ladies Baths'
25	33.8655427	151.22106545	1.3x1.3	3-6	Mooring block & chain	"
26	33.8653898	151.2206618	1.3x1.3	3-6	Mooring block & chain	"
27	33.8653894	151.2206619	1.3x1.3	3-6	Mooring block & chain	"
28	33.8653324	151.2206447	1.3x1.3	3-6	Mooring block & chain	"
29	33.8654101	151.2205847	1.3x1.3	3-6	Mooring block & chain	"

Table 3: Zone 3 - anomalies

4.3 Summary of results

No relics within the meaning of the NSW *Heritage Act* 1977 were located as a result of the combined remote sensing and dive inspections within the study area. The mooring blocks in Zone 3 are in the area once occupied by the former 'Ladies Baths'. There is no indication that they were a part of that facility and may have been removed from former mooring sites within the bay.

The assessment does not indicate any potential for significant structures, shipwrecks, anchors or ship's engines or propellers to be present in any of the surveyed areas.

There is no evidence for Zones 1 and 3 to contain significant archaeological deposits. Zone 2 has low archaeological potential.

The inspection of the seawall where the proposed pipelines would enter the bay shows that this structure is in very sound condition and with minimal damage from existing pipe penetrations.

5.0 IMPACT AND MITIGATION

IMPACTS
MITIGATION PRIOR TO INSTALLATION OF THE PIPES
MITIGATION DURING INSTALLATION OF THE PIPES

5.0 IMPACT AND MITIGATION

5.1 Impacts

The proposed routes of the pipelines (Figure 2) do not cross over the footprint of former maritime infrastructure but run between the sites of the Ladies Baths to the north and the Quarantine Jetty to the south.

Within the 'Off-shore' component of the study area no relics have been located as a result of the remote sensing and dive investigations. Due to the lack of any significant sedimentation in Zone 1 it is not anticipated that buried relics will be present in this area.

In Zone 2 there is a potential for a greater depth of sedimentation than on the rock shelving of Zones 1 and 3. However, this is an area that has been subject to dredging that has taken since the early 20th century as documented in Section 2.8 of the Stage 1 report (Nutley 2018:9). In addition, there are no records of shipwreck events occurring in this area. No relics or other items of cultural significance were identified through remote sensing or dive inspections. Significant archaeological deposits are not predicted in this area. However, due to the potential for relics to descend from the shallows to deeper water, and the presence of increased sedimentation in Zone 2, there remains a low potential for archaeological deposits to be present in this area. There is the potential for impact on archaeological deposits in the event that seabed disturbance occurs within the 'extended survey zone' (Figure 2).

Zone 3 is similar to Zone 1 in being characterised by sandstone rock shelving with minimal sedimentation. No relics have been located as a result of the remote sensing and dive investigations. The proposed pipeline routes shown in Figure 2 would not impact on the mooring blocks in Zone 3.

5.2 Mitigation

If any relics are found during trenching or other seabed disturbance associated with the Sydney Modern project, work must cease in that area and advice sought from the archaeologist. Any potentially significant relics should be recovered, archivally documented and provided with appropriate conservation and storage.

An induction should be provided to all personnel engaged in the installation of the proposed heat-exchange pipelines within Woolloomooloo Bay by a suitably qualified maritime archaeologist into the history and significance of the study area, relevant legislation and mitigation procedures as detailed above.

5.3 Research design and methodology

The project brief requires that a research design and excavation methodology be prepared. However, the on-site archaeological investigations as detailed in this report do not indicate a need for archaeological excavation and, therefore a research design and excavation methodology is not necessary.

6.0 RECOMMENDATIONS

6.0 RECOMMENDATIONS

The following recommendations are made on the basis of:

- Legal requirements under the terms of the *Heritage Act 1977*.
- The research and analysis contained in this report.
- Results of the assessment as outlined in this report.

IT IS RECOMMENDED THAT:

1. In view of the remote sensing and diver investigations undertaken in Stage 2, the implementation of Recommendation Number 4 of the Stage 1, desk-top report is not required, ie, it will not be necessary for an archaeological diver to be present during or after the conduct of trenching for installation of the pipelines.

2. As no potential impacts on 'Off-shore' archaeological deposits have been identified within the study area and there is no need for a diver to be present it is not necessary to prepare a research design of excavation methodology.

3. The 'Unexpected Finds Procedure' contained in Section 4.2 of this report should be included in site inductions for all personnel engaged in this project. This includes the requirement that, if any relics are found during trenching, work must cease in that area and advice sought from the archaeologist.

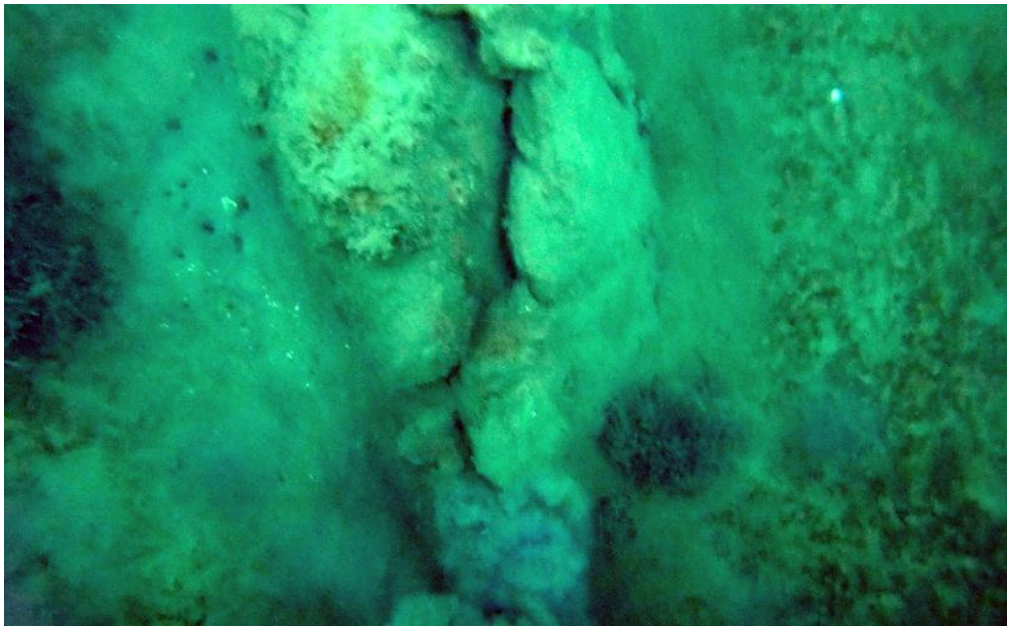
4. The AGNSW should facilitate appropriate materials conservation for any items recovered as a result of the trenching. Archival documentation and appropriate ongoing conservation and storage should also be undertaken for these items.

5. While there are three existing, small openings through the eastern face of the sandstone seawall within the study area, the installation of four large cooling pipes would substantially destroy that section of seawall. The final design of the pipeline will be developed in consultation with GML Heritage to limit impacts on the sea wall. The intent of the design is to install the pipeline below the level of the wall. If the pipelines were installed below the level of the seawall, no items of underwater cultural heritage on the seaward side of that wall would be impacted.

PHOTOGRAPHS

PHOTOGRAPHS

Photograph 1: Target 1 - natural rock



Photograph 2: Target 2 – natural rock

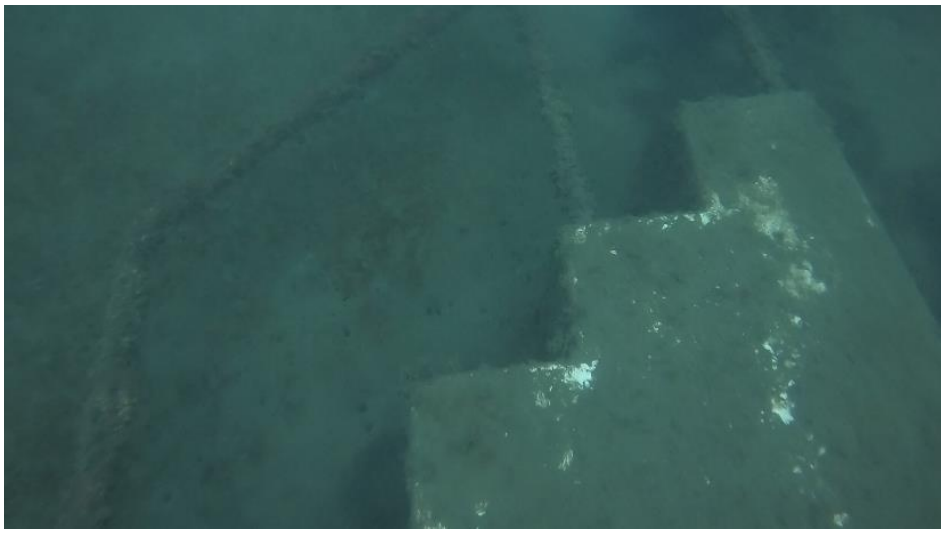
Photograph 3: Target 4 metallic debris

Photograph 4: Target 5 – angle iron and bolt

Photograph 5: Target 6 – small section of scaffolding

Photograph 6: Target 7, natural rock adjacent to pile associated with marina berth

Photograph 7: Target 8 – isolated section of steel framing



Photograph 8: Target 23 – Set of stairs with four risers and handrail

Photograph 9: Target 24 – section of chain lying on one of the six identical mooring blocks in Zone 3

REFERENCES

REFERENCES

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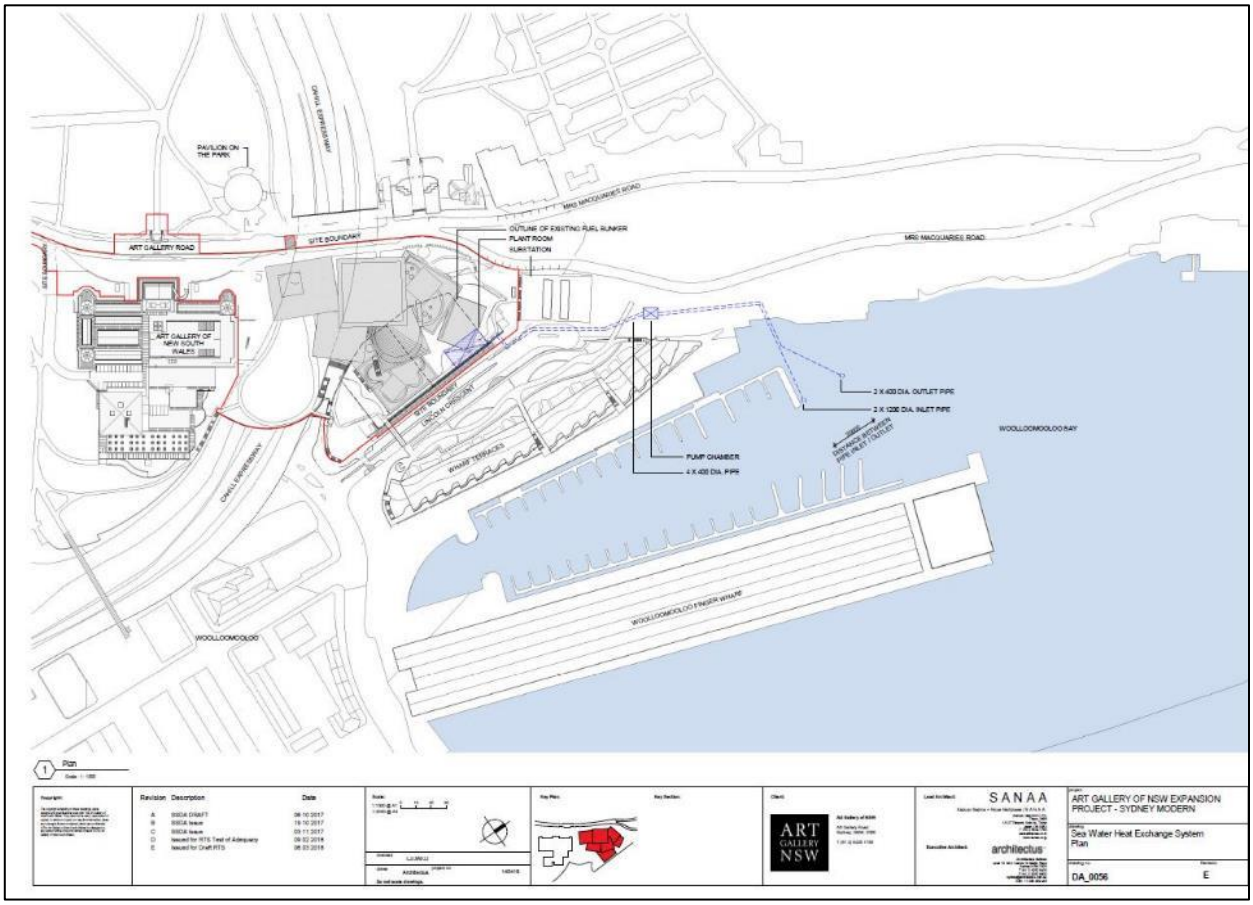
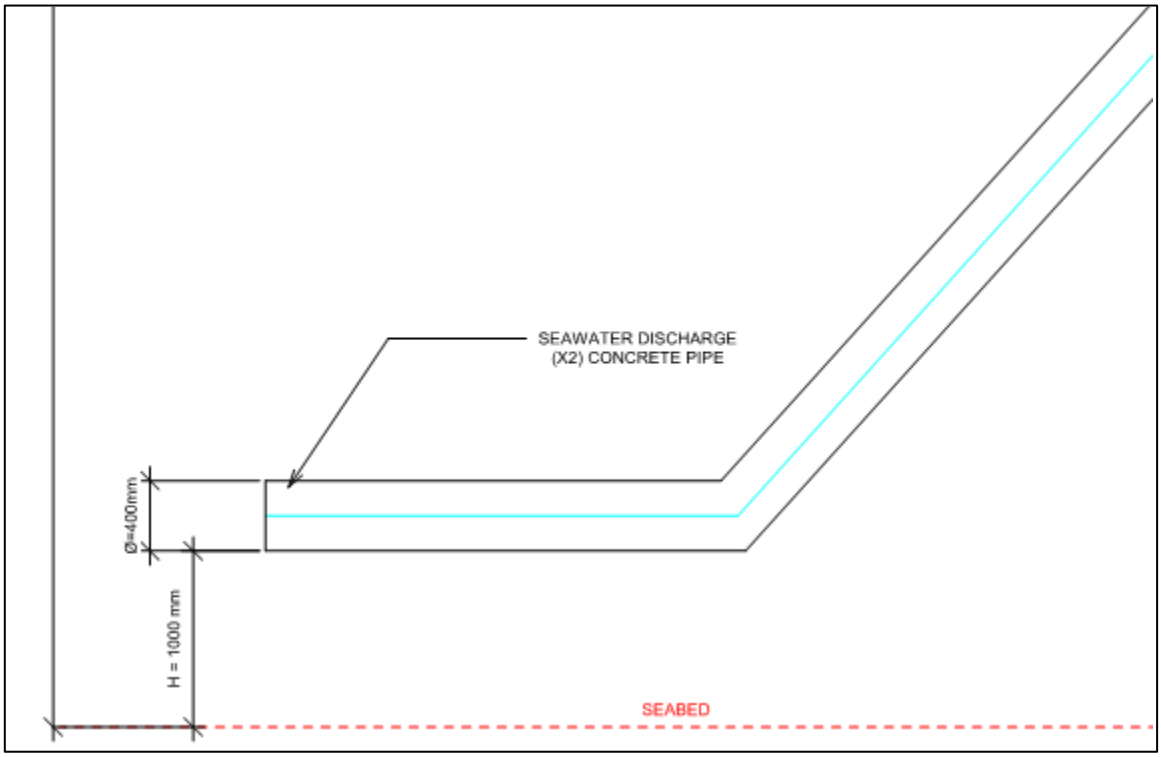
APPENDIX A

PLANS

APPENDIX A – PLANS





Seawater Plantroom Lower Deck (Steensen Varming Feb 18th 2018:7 Fig 5.,2a)

APPENDIX B

REMOTE SENSING REPORT – COFFEY SERVICES

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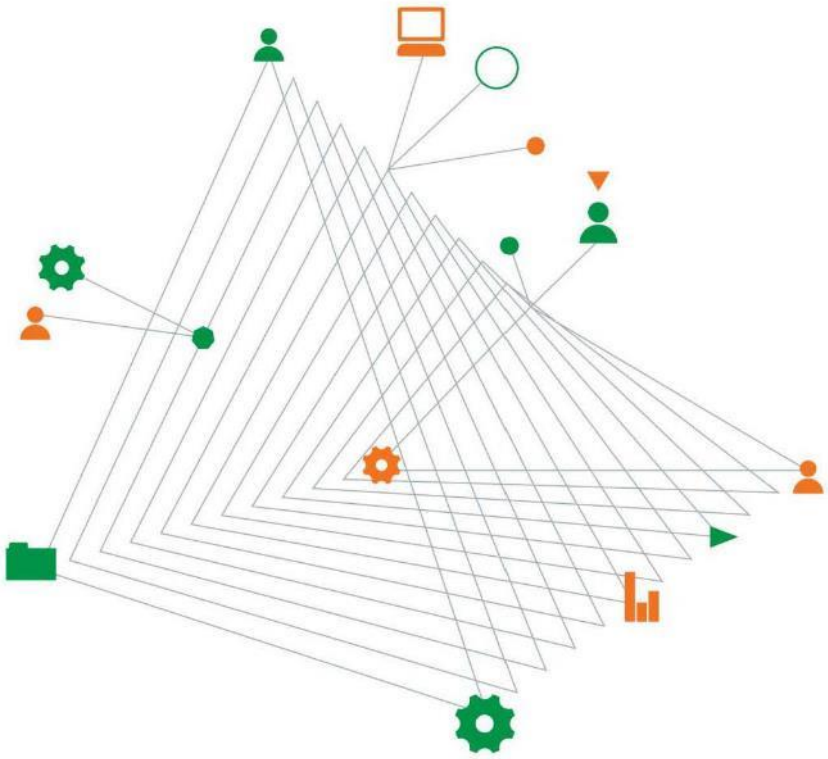
Art Gallery of NSW Trust

Sydney Modern Project

Seawater Heat Exchange – Offshore Geophysics Stage 1 Heritage (Hydrographic Survey)

13 June 2018



Experience comes to life when it is powered by expertise

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Sydney Modern Project – Seawater Heat Exchange
Stage 1 Heritage (Hydrographic Survey)

Art Gallery of NSW – Sydney Modern Project Hydrographic Survey

Prepared for
Art Gallery of NSW Trust
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13 June 2018

Document authorisation

Our ref: SYDGE210394-AO

For and on behalf of Coffey

Simon Stewart

Principal Geophysicist

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
0	Hydrographic Survey	13 June 2018	Josh Jesse	S Stewart	S Stewart

Distribution

Version	Status	Copies	Format	Delivered to	Date
Rev 0	Prelim	1	PDF	Daniel Griffin – Art Gallery of NSW Andrew Phillips - Arup	13 June 2018

Table of Contents

Figures

List of abbreviations and terms

The following abbreviations may be used in this document.

Acronym	Definition
AHD	Australian Height Datum
AS	Australian Standards
ASTM	American Society for Testing Materials
BH	Borehole
CAD	Computer-aided Design
CRP	Central Reference Point
CSP	Continuous Seismic Profiling
DGPS	Differential Global Positioning System
GDA	Geocentric Datum of Australia
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRS	Geodetic Reference System
IHO	International Hydrographic Organisation
IMU	Inertial Measurement Unit
ISO	International Standards Organisation
LAT	Lowest Astronomical Tide
MBES	Multi-Beam Echosounding
MGA	Map Grid of Australia
MRU	Motion Reference Unit
OH&S	Occupational Health and Safety
P	Compressional Wave
PC	Personal Computer
QA	Quality Assurance
QC	Quality Control
RMS	Root Mean Square
RTK	Real Time Kinematics
SBES	Single Beam Echo Sounding
TWT	Two-way Travel Time
USR	Underwater Seismic Refraction
WHS	Work Health and Safety

1. Introduction

The Art Gallery of NSW proposes to undertake a major expansion project adjacent to the Phillip Precinct of the Domain. The expansion site is located north of the existing gallery beyond the Eastern Distributor land bridge and over the disused Navy fuel bunkers uphill of Lincoln Crescent.

The gallery expansion will utilise a heat exchange system that will incorporate a pumping station, chiller room, connecting pipe system and ocean inlet/outlet pipe system. The Sydney Modern Heat Exchange System (SHES) site is located to the north of the existing gallery building and adjacent to Woolloomooloo Bay. The proposed Pump Station is located immediately east of the Wharf Terraces building and beneath an 8m high sandstone cliff adjacent to Mrs Macquarie Road. The Chiller Room is located along the north-eastern edge of the Woolloomooloo fuel bunker. Pipework will run alongside Lincoln Crescent connecting the Chiller Room to the Pump Room. Two sets of ocean inlet and outlet pipes will extend 50m north of the Pump Room and turn east crossing the existing seawall. The inlet and outlet pipes will extend a further 65m to 70m east of the seawall into Woolloomooloo Bay. The ocean pipework will terminate at separate intake and outlet offshore locations.

For investigation purposes, the pipeline has three zones; On Shore, Shoreline transition and Off shore. The scope of geotechnical and geophysical investigation for the SHES site was developed progressively and is summarised in the following Coffey documents:

- SYDGE210394-AI rev1 dated 2 May 2018;

The purpose of this report is to provide information using multi-beam bathymetry (MBES) and side scan sonar (SSS) survey data for Stage 1 Offshore works to assist a third party Cultural Heritage assessment.

The work was commissioned on 28 May 2018 as a variation order addendum to Task 5 investigation with fieldwork completed on 6 June 2018.

2. Local Geology

As detailed in Arup report Geotechnical Desk Study (ref: SMP-Arup-Geo-0001), the majority of the site is underlain by reclaimed fill and estuarine deposits overlying Hawkesbury Sandstone. The 1:100,000 geological sheet and notes describe these units as:

- Reclaimed Fill: Dredged estuarine sand and mud, demolition rubble, industrial and household waste.
- Estuarine Deposits: Clay, silt, shell, very fine to fine-grained lithic-quartz (± carbonate) sand (fluvial-and/or marine deposited).
- Hawkesbury Sandstone: Medium to coarse grained quartz sandstone with minor shale and laminite lenses.

Hawkesbury Sandstone comprises horizontal massive and cross-bedded units of medium to high strength sandstone with minor lenses of siltstone and shale breccia. The sandstone bedding thickness ranges between 1 m to 2.5 m thick and may be continuous for hundreds of meters.

The major joint set in Hawkesbury Sandstone is north-north-east trending sub-vertical joint set (trending about 10° to 15° east of north) with spacing typically between 2m to 5m. Horizontal joint lengths are normally greater than 20 m but vertical continuity is variable and is typically in the order of 5 m. A secondary, orthogonal set comprises near vertical joints with similar continuities as the main set. The secondary east-west trending joints tend to be spaced at 5 m to 15 m intervals. Localised joint swarms where closely spaced joints of 0.3 m to 0.5 m are known to occur.

The majority of the site is likely contained or adjacent to in the western edges of a northeast trending infilled palaeo-channel. An inferred Fault Zone is mapped to trend parallel to the pipework alignment and is likely to be similar to the sub-parallel Woolloomooloo Fault Zone located 300m east. Och et al. (2004) described the Woolloomooloo Fault Zone as comprising multiple crushed zones and closely spaced joint and faulting that show normal and reverse fault offset with an overall width of up to 80 m. The site geology map is attached as Drawing 1.

3. Methodologies & field procedures

3.1. Fieldwork

The hydrographic survey (multi-beam and side scan sonar) was completed in accordance with industry practice and Coffey's Quality System (ISO 9001 accredited). Field operations were supported by approved Work Method Statements and WH&S Plans.

The survey was carried out under the control of an H1 Hydrographic Surveyor certified by the Australasian Hydrographic Surveyors Certification Panel (AHSCP).

All hydrographic surveying complied with the latest versions of all the relevant current Australian codes and standards.

- Schedule A - AAPMA Requirements to Achieve Class A or Class B Survey
- IHO S-44 - Standards for Hydrographic Surveys
- Standards for Hydrographic Surveys within Queensland Waters
- Australian Tides Manual - Special Publication No.9

The following safety, technical and managerial measures were undertaken to ensure the safe acquisition of data that would be adequate for analysis and interpretation:

- Maintenance of vessel speed to (2 to 4 knots) to maximise resolution and quality of data;
- HSSE reporting of all incidents and near misses;
- Adherence to QA procedures and QC checks on all acquired bathymetric, seismic and position data;

No reportable incidents or near misses occurred during the fieldwork.

Figure AO-01 provides a site plan of the investigation area and survey limits for the Stage 1 Hydrographic (Heritage) Survey.

3.2. Geodetic control

During survey an integrated digital data acquisition, navigation and positioning system (NavCom SF-3050 StarFire™ Differential GPS receiver with a horizontal accuracy of typically better than 0.5 m) was used for set-out of pre-defined survey lines. This provided a Left/Right helmsman indicator to the vessel master for course correction during data acquisition. Accurate positioning of the vessel and survey operation was achieved using an RTK system connected to CorsNet NSW.

The geodetic parameters were the Geocentric Datum of Australia, 1994 (GDA 94) and Map Grid of Australia projection MGA Zone 56.

Table 1 lists the GDA 94 / MGA Zone 56 parameters.

Table 1 Geodetic parameters (MGA94)

Parameter	Value
Datum	GDA 94
Ellipsoid	GRS 80
Projection	Transverse Mercator
Zone	56S
Latitude of Origin	0° N
Central Meridian	153° 00'E
False Easting	500,000
False Northing	10,000,000
Scale Factor	0.9996

3.3. Hydrographic system

The survey equipment comprised:

- Multi-beam Echosounder (MBES) – R2 Sonic Wideband (170 kHz – 450 kHz) capable of beam Widths to 0.6° x 0.6° and selectable swath of 10° to 160°. The system was operated with a nominal 0.6/1.0 degree beam and 100 degree swath gridded to 10cm.
- Side Scan Sonar (SSS) - EdgeTech Model 4125.
- POSMV (RTK GPS) - POS MV (model WaveMaster II) providing accurate attitude, heading, heave, position, and velocity data of all vessel and onboard sensors. The POS MV combines the RTK GNSS data with angular rate and acceleration data from an Inertial Measurement Unit (IMU) and heading from the GPS azimuth measurement system.

The relatively short run lines and confined space around Woolloomooloo Bay meant the side scan sonar was fixed to the side of the vessel to maximise site coverage and safe operations.

The POSMV (RTK GPS) data was input into the Edgetech 4125 Side Scan Sonar topside computer to deliver accurate position and heading to the side scan sonar system. This data was then later imported into the post-processing software (Hypack) and processed to produce a combined geo reference mosaic, as well as individual lines to assist in object detection.

3.4. System QA & QC checks

3.4.1. Calibration

The multi-beam system is calibrated for roll, pitch and yaw at the start of every project and periodically checked throughout the project. The calibration process is conducted over both flat and sloping terrain. To calculate the roll value the multi-beam was run over generally flat terrain on reciprocal lines. To calculate the pitch value the multi-beam is run over a sloping terrain on reciprocal lines. To calculate the yaw value the multi-beam is also run over sloping terrain but on parallel lines separated approximately by the depth of water. These values were then used in post-processing to place the beams into the correct orientation and ensure continuity between run lines.

It is difficult to measure the angular differences between the multibeam echo sounder, motion reference unit (MRU) and the GPS antennas. Any errors in the positioning of these items of equipment will lead to errors in the multibeam. The process used to calculate these errors is call the 'Patch Test" and conducting this test correctly results in angular differences between the system components providing the calibration values for the vessel Pitch, Roll and Yaw.

There are 4 values derived:

1. *Latency* - Delay between the position fix and the data arrival time introduces positioning errors, independent of any transducer misalignment.
2. *Roll* - Vertical misalignment, port and starboard, between sonar and MRU can cause depth errors, especially at the outer beams.
3. *Pitch* - Vertical misalignment, forward and aft, between sonar and MRU can cause depth and position errors across the swath.
4. *Yaw* - Misalignment of the sonar and heading sensor relative to the vessel frame can cause position errors.

3.4.2. Field Checks

During survey operations the following field checks were undertaken by the Senior Surveyor and logged in the system start-up checklist:

1. The proper functioning of survey equipment on board was checked
2. The RTK GNSS positioning system was checked for reception of satellites, availability of differential signal and position quality. On the navigation display, the position of the vessel was visually checked.
3. On arrival to the survey ground, a sound velocity profile was recorded and entered in the acquisition software.

3.4.3. Vessel Dimensional Control

For the Survey Vessel a dimensional control survey using terrestrial survey techniques was undertaken to calculate the position of each survey sensor relative to the vessel Central Reference Point (CRP), allowing sensor offsets to be entered into the acquisition software.

3.4.4. Position Check

For the Survey Vessel a check on the quality of the RTK GNSS positioning was undertaken, prior to the start of any survey. This was achieved using an existing independent GNSS positioning system. An offset distance to the vessel's primary GNSS antenna was measured and Northing and Easting compared. The difference between the known coordinates and the observed coordinates should fall within the allowable horizontal position tolerance. The GNSS Position check was also carried out daily with results recorded in the system start-up checklist.

3.4.5. Sound Velocity

On commencement of survey a sound velocity profile was recorded at half metre intervals to the maximum water depth. This profile was stored and entered in the acquisition software in order to correct the multibeam depth measurements. During survey operations the 'dipped' sound velocity was constantly compared to the constant recording sound velocity at the MBES head. If the difference exceeded 2m/s an additional sound velocity profile was recorded.

3.5. Survey Accuracy

The Standards of Hydrographic Surveys within Australian Waters have been developed by Association of Australian Port and Marine Authorities (AAPMA) which reference the International Hydrographic Organisation (IHO) Special Publication S44 (Standards for Hydrographic Surveyors), Maritime Safety Queensland (MSQ) (standards for hydrographic surveys in Queensland Waters & Land Information New Zealand (Standards for Hydrographic Surveying (HYSPEC) V3)

The following performance standards were used as a guideline for the hydrographic survey.

Minimum Horizontal Accuracy

The minimum horizontal tolerance shall be ±0.1 metre at the 2-standard deviation level. This exceeds IHI Special Order standards and standards for hydrographic surveys in Queensland waters.

Minimum Vertical Accuracy

The minimum vertical tolerance shall be ±0.1 metre at the 2-standard deviation level. This exceeds IHI Special Order standards & standards for hydrographic surveys in Queensland waters.

4. Results

The hydrographic survey results are presented in Figures AO-1 to AO-10.

All seabed levels are reported to AHD.

Figure AO-1 to AO-5 presents the results of the multi-beam echo sounding (MBES) bathymetry survey.

Figures AO-6 to AO-10 presents the results of the side scan sonar survey.

5. Important information about your Coffey report

The reader's attention is drawn to the 'Important Information about Your Coffey Report' sheets attached this report.

6. References

Och, D.J., Pells, P., Braybrooke, J.C. (2004). Geological Faults and Dykes in Sydney CBD. The Engineering Geology of the Sydney Region. Australian Geomechanics Society. Sydney Chapter Mini-Symposium, 13 October, 2004.

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Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Coffey Australia and New Zealand
Issued: 9 March 2017

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Sydney Modern Project – Seawater Heat Exchange
Stage 1 Heritage (Hydrographic Survey)

Figures

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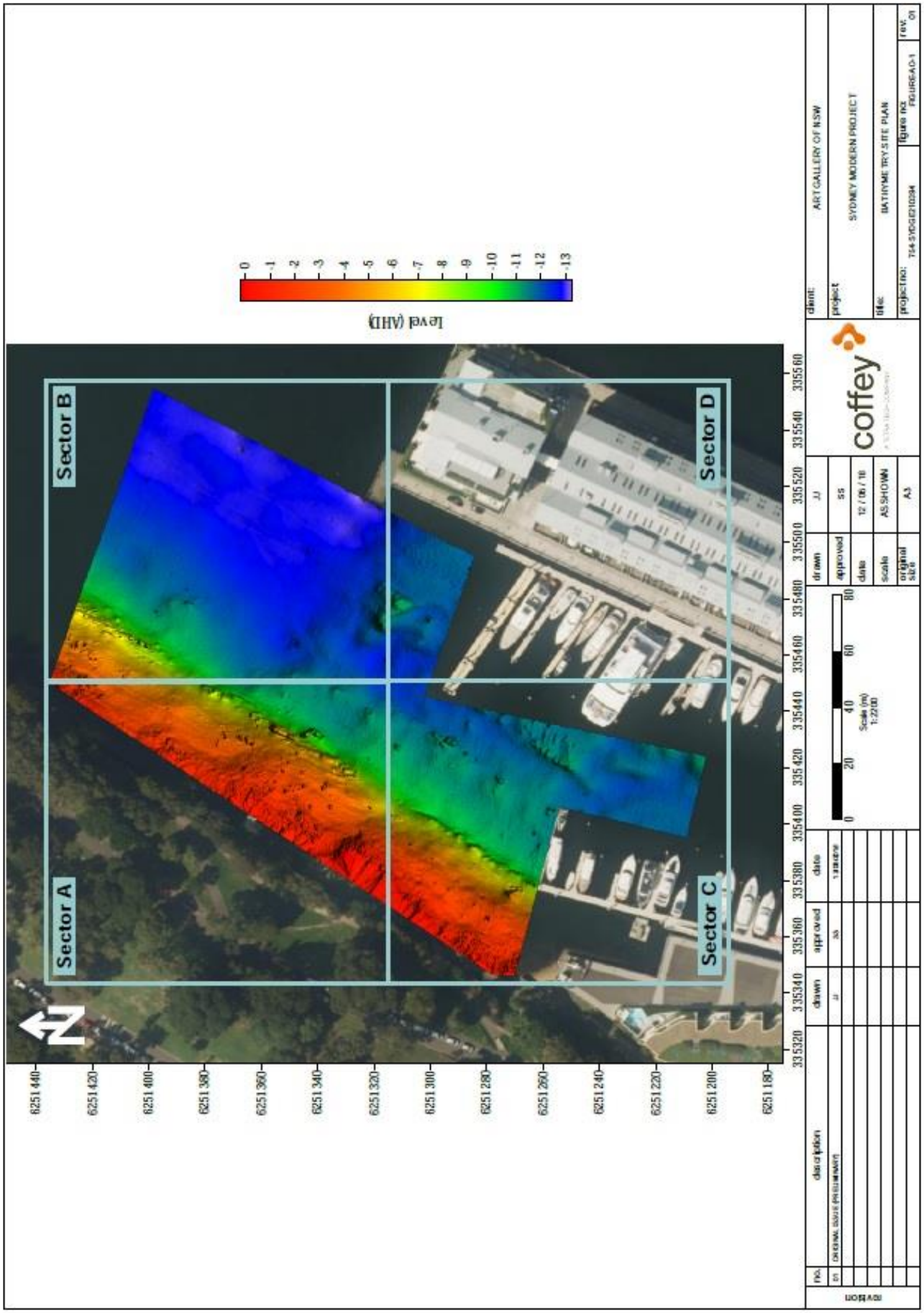
SYDGE210394-AO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coffey
client: ART GALLERY OF NSW
project: SYDNEY MODERN PROJECT
title: BATHYMETRY SITE PLAN
project no: 754-SYDGE010394
figure no: FIGURE A0-1
rev: 01
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date
scale: AS SHOWN
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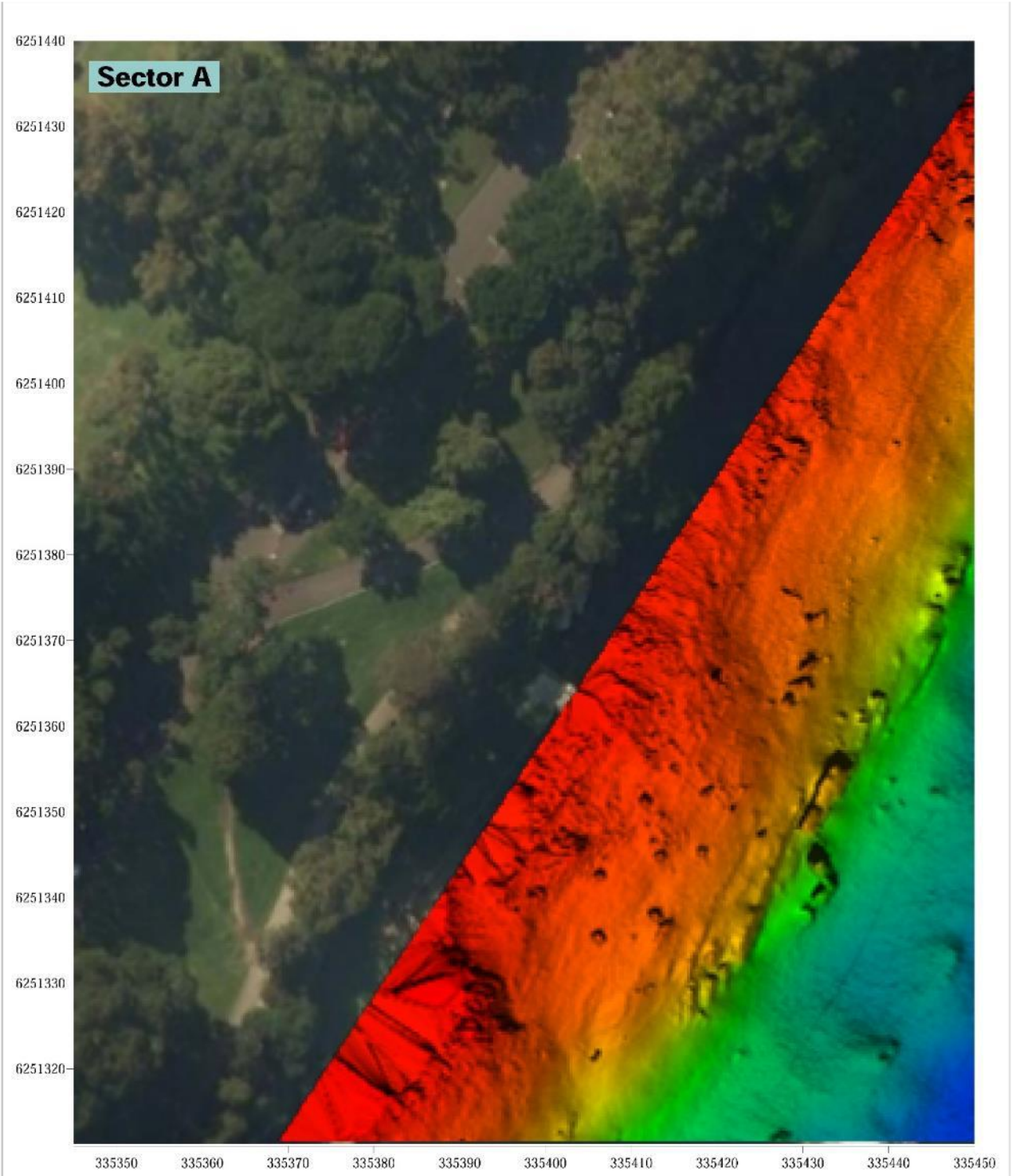

drawn	JJ	coffey A TETRA TECH COMPANY	client:	ART GALLERY OF NSW
approved	SS		project:	SYDNEY MODERN PROJECT
date	12/06/2018		title:	BATHYMETRY - SECTOR A
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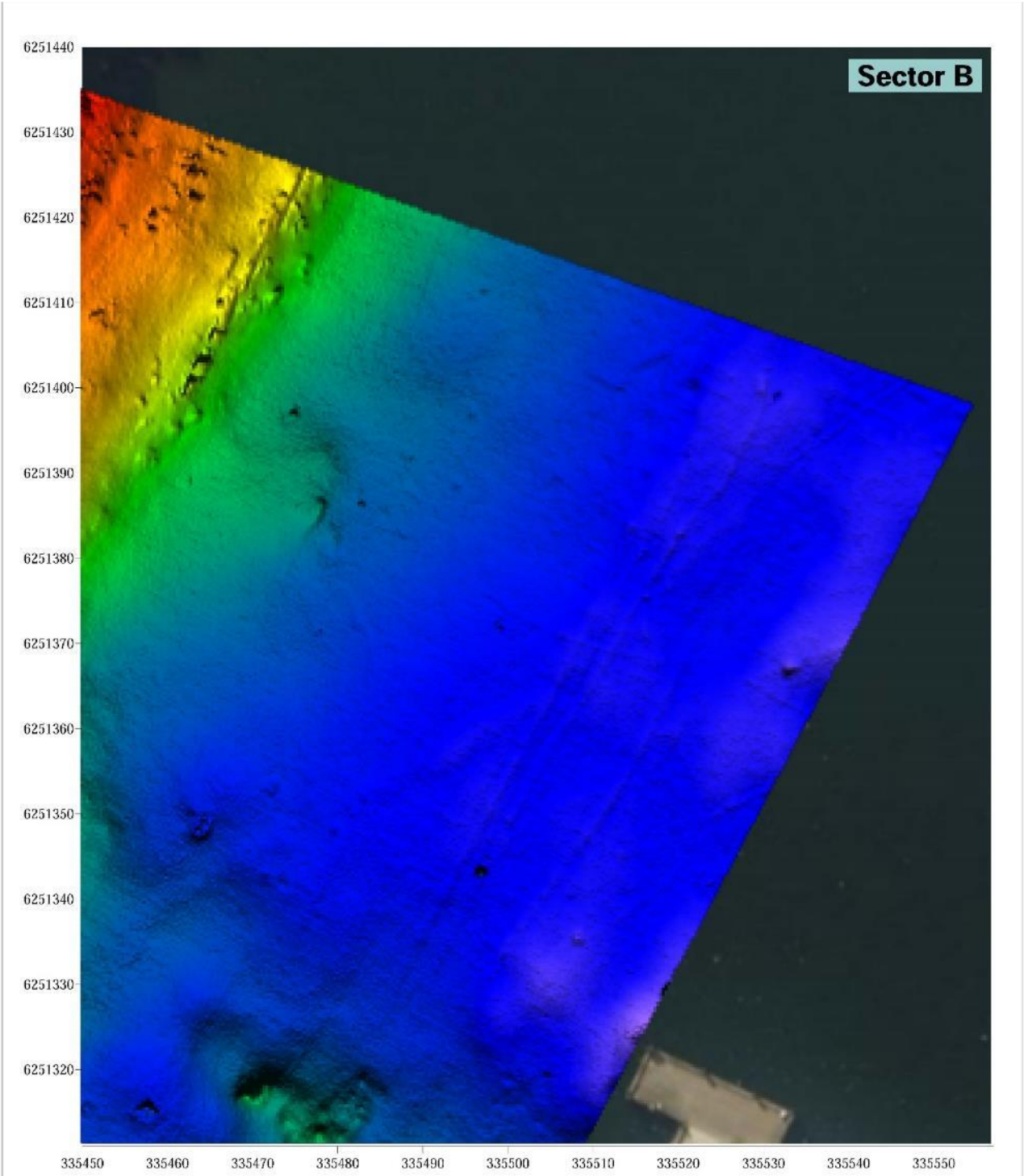
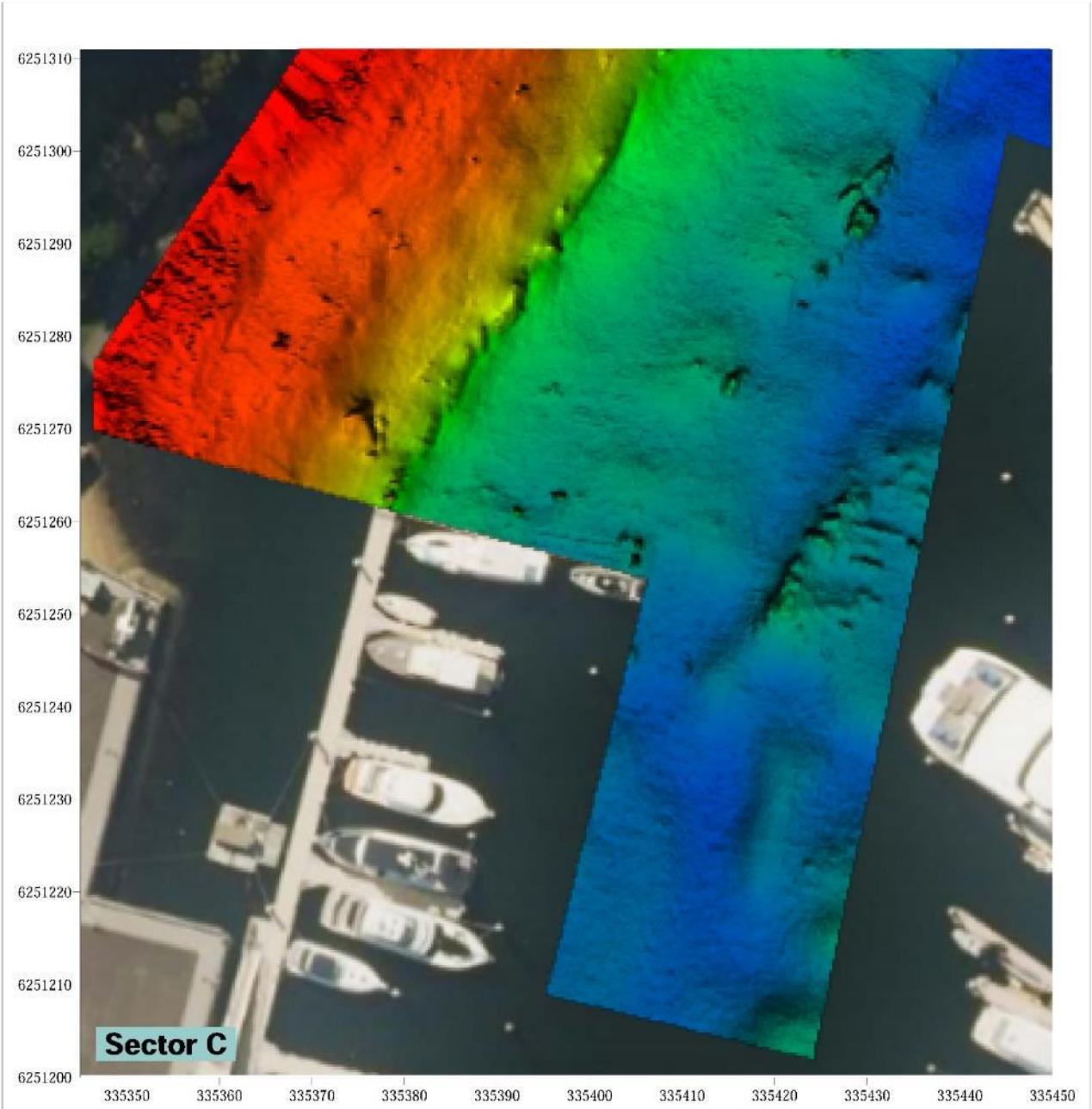
original size	A3			



drawn	JJ
approved	SS
date	12/06/2018
scale	1:2500
original size	A3

coffey
A TETRA TECH COMPANY

client:	ART GALLERY OF NSW
project:	SYDNEY MODERN PROJECT
title:	BATHYMETRY - SECTOR B
project no:	754-SYDGE210394
figure no:	FIGURE-AO-3



drawn	JJ	coffey A TETRA TECH COMPANY	client:	ART GALLERY OF NSW
approved	SS		project:	SYDNEY MODERN PROJECT
date	12/06/2018		title:	BATHYMETRY - SECTOR C
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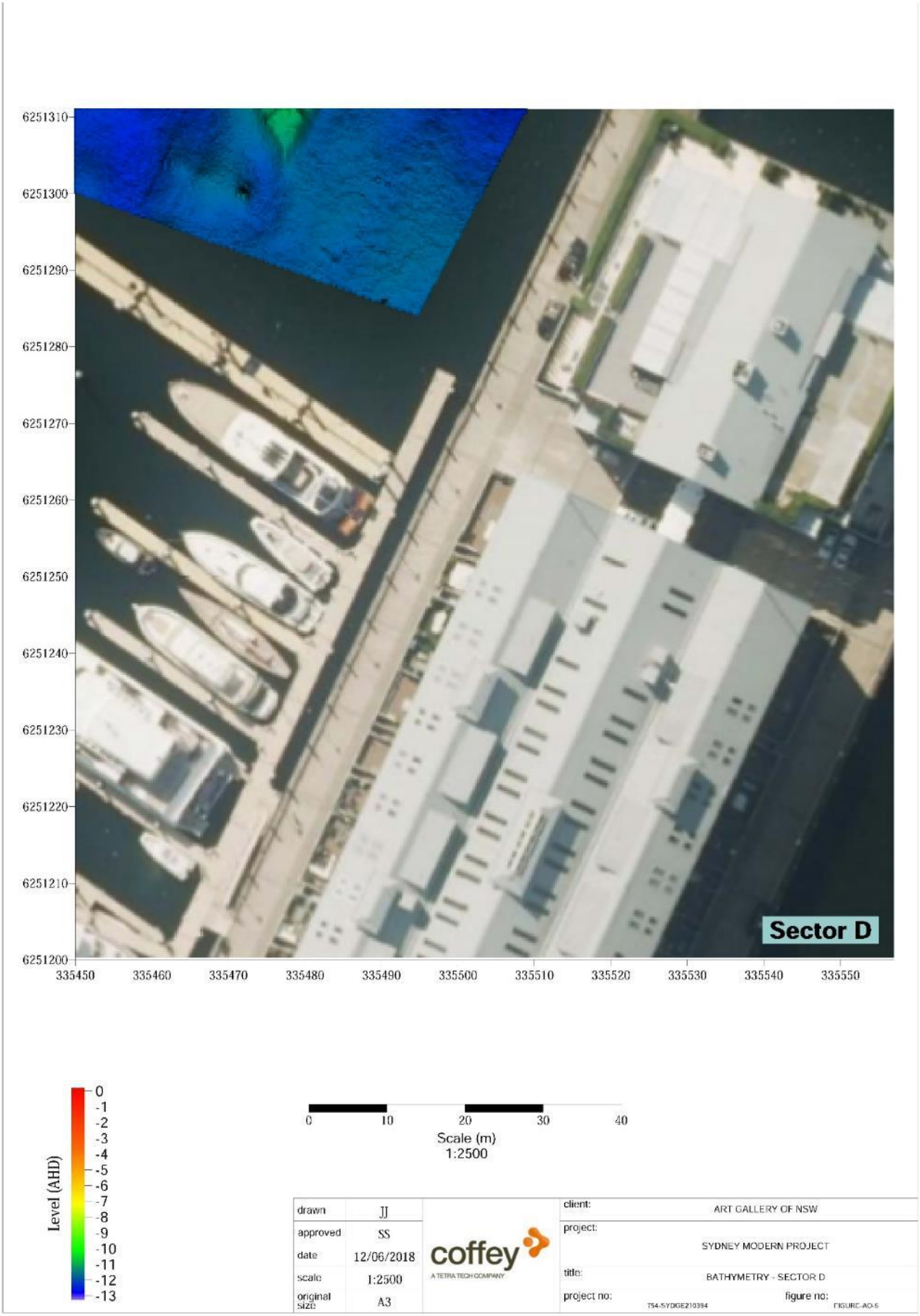
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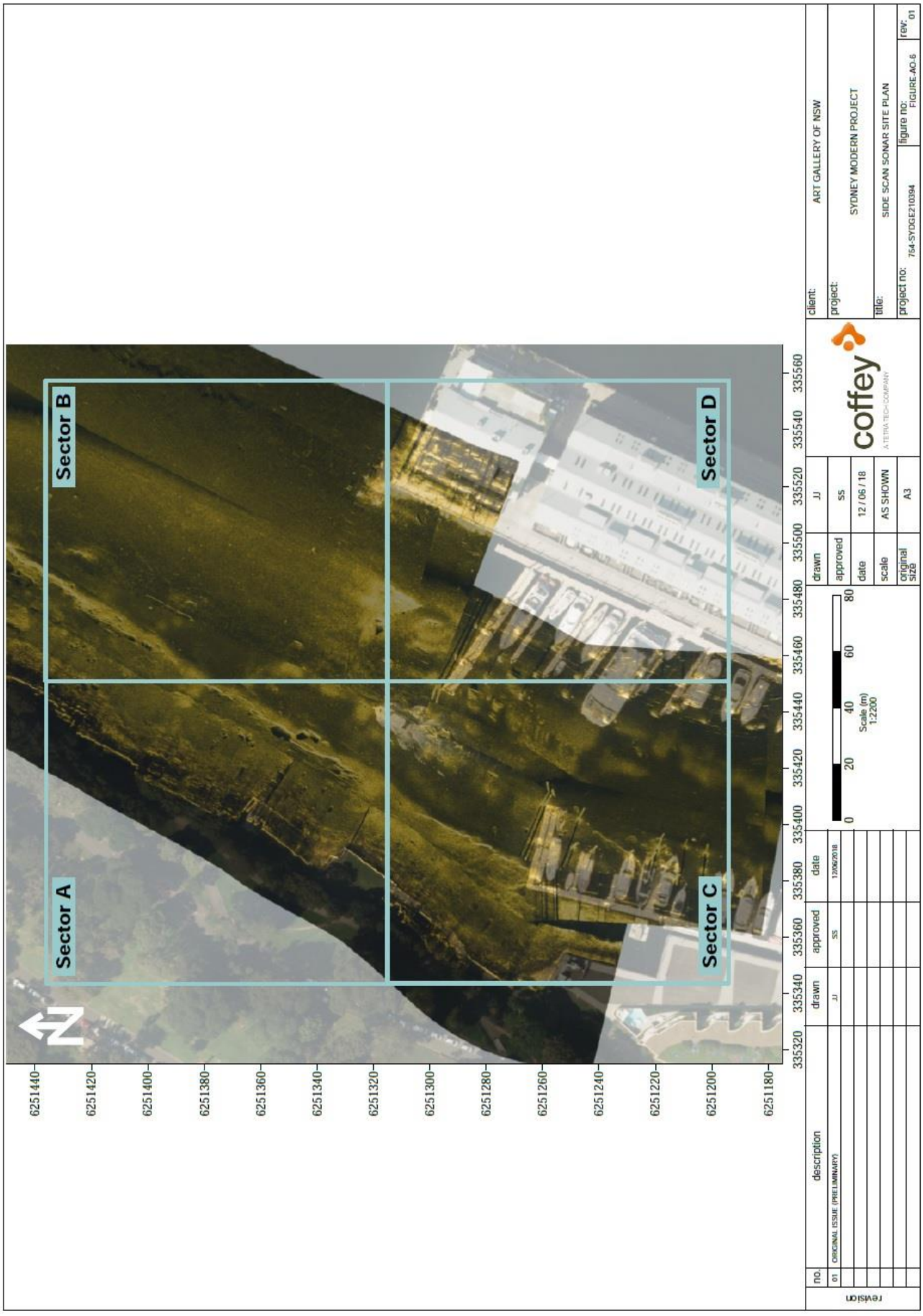
335470
335480
335490
335500
335510
335520
335530
335540
335550
Sector D
Level (AHD)
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
0
10
20
30
40
Scale (m)
1:2500
drawn JJ
approved SS
date 12/06/2018
scale 1:2500
original size A3
coffey
A TETRA TECH COMPANY
client: ART GALLERY OF NSW
project: SYDNEY MODERN PROJECT
title: BATHYMETRY - SECTOR D
project no: 754-SYDGE210394
figure no: FIGURE-AO-5


Sector A
Sector B
Sector C
Sector D
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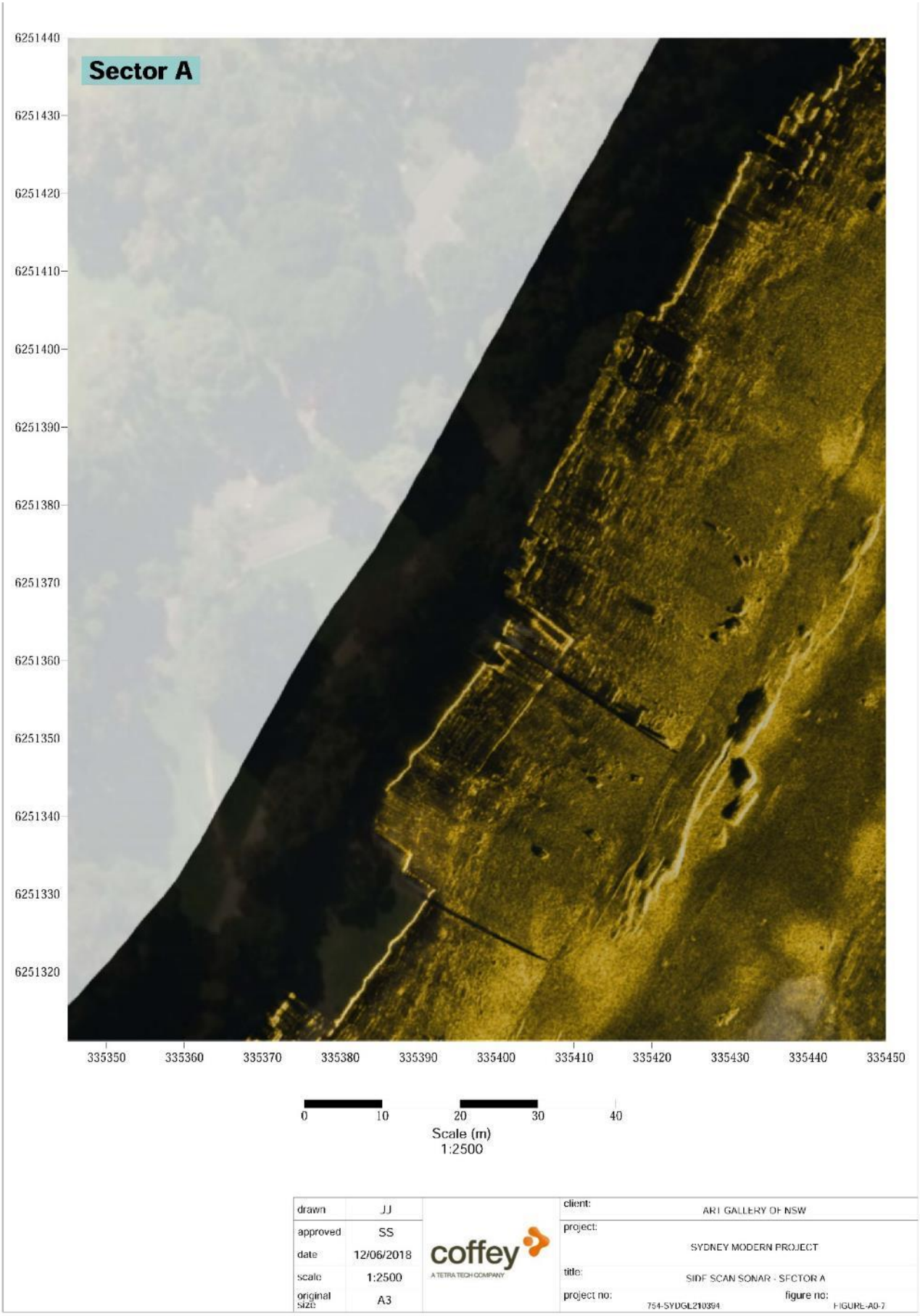
335540
335560
revision
no.
description
drawn
approved
date
01
ORIGINAL ISSUE (PRELIMINARY)
JJ
SS
12/06/2018
0
20
40
60
80
Scale (m)
1:2200
drawn
JJ
approved
SS
date
12 / 06 / 18
scale
AS SHOWN
original size
A3
coffey
A TETRA TECH COMPANY
client:
ART GALLERY OF NSW
project:
SYDNEY MODERN PROJECT
title:
SIDE SCAN SONAR SITE PLAN
project no:
754-SYDGE210394
figure no:
FIGURE AO.6
rev:
01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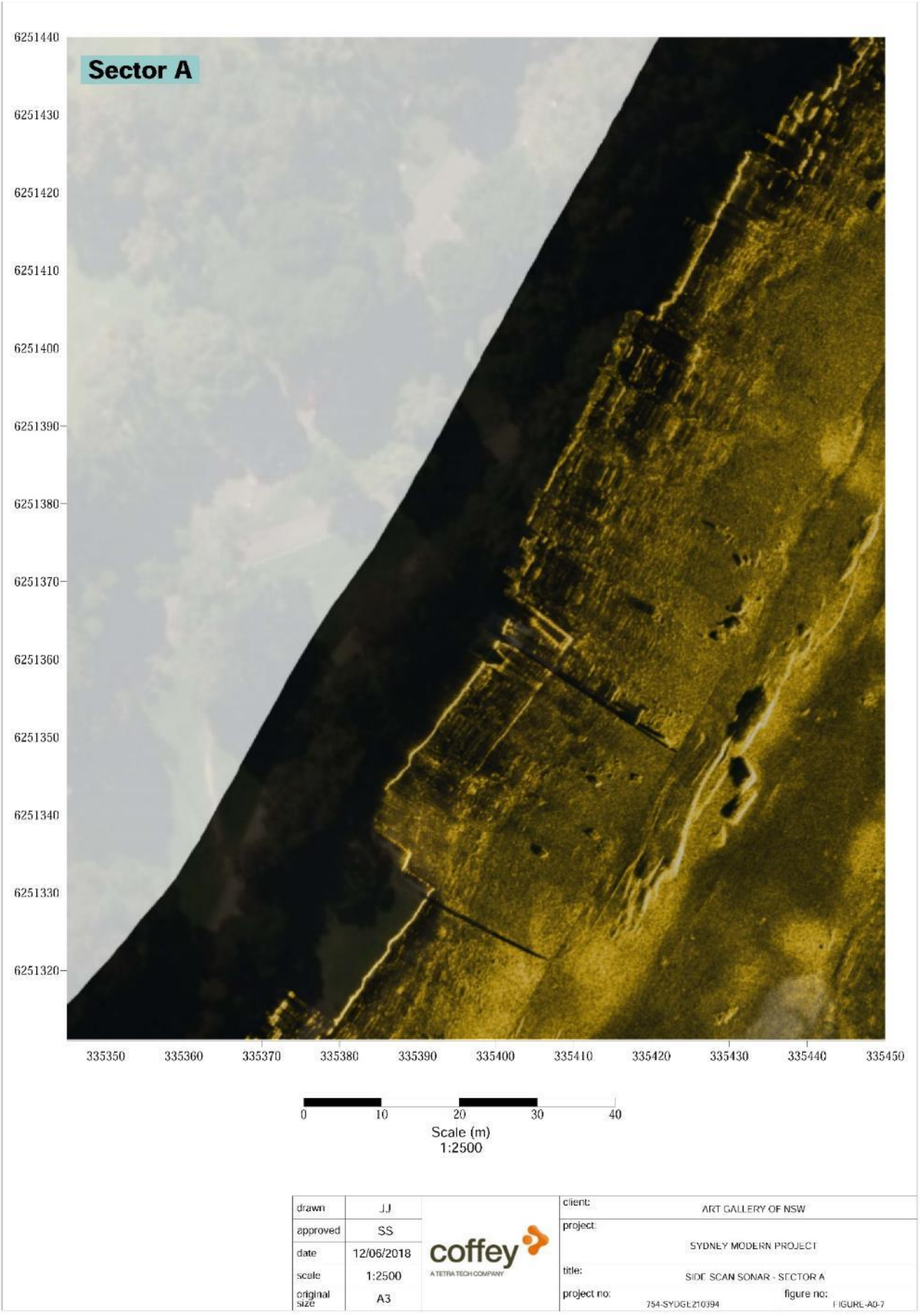
335450
0
10
20
30
40
Scale (m)
1:2500
drawn JJ
approved SS
date 12/06/2018
scale 1:2500
original size A3
coffey
A TETRA TECH COMPANY
client: ART GALLERY OF NSW
project: SYDNEY MODERN PROJECT
title: SIDE SCAN SONAR - SECTOR A
project no: 754-SYDGL210394
figure no: FIGURE-A0-7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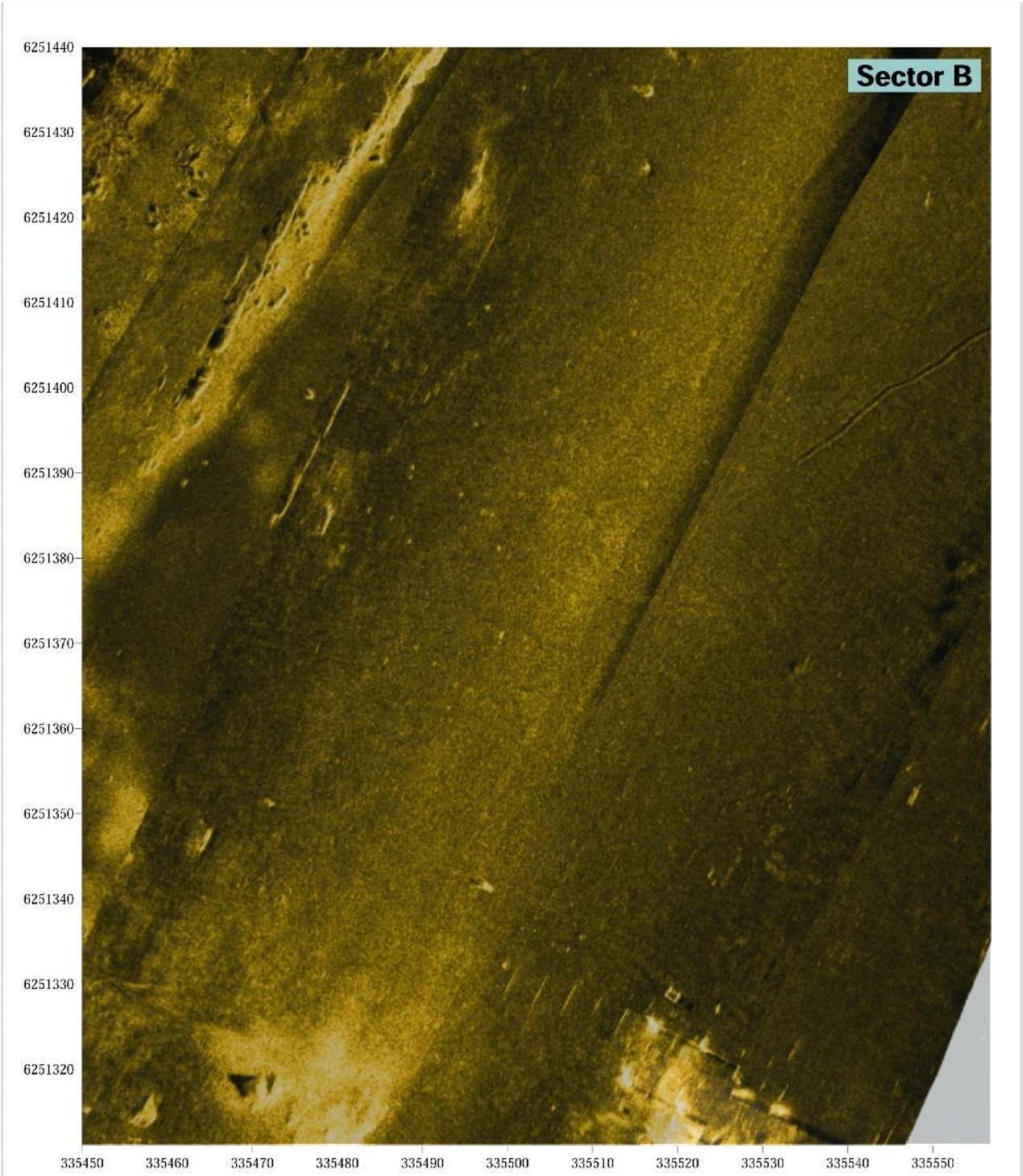
Scale (m)
1:2500
drawn
JJ
approved
SS
date
12/06/2018
scale
1:2500
original size
A3
coffey
A TETRA TECH COMPANY
client:
ART GALLERY OF NSW
project:
SYDNEY MODERN PROJECT
title:
SIDE SCAN SONAR - SECTOR A
project no:
754-SYDGE210394
figure no:
FIGURE-A0-7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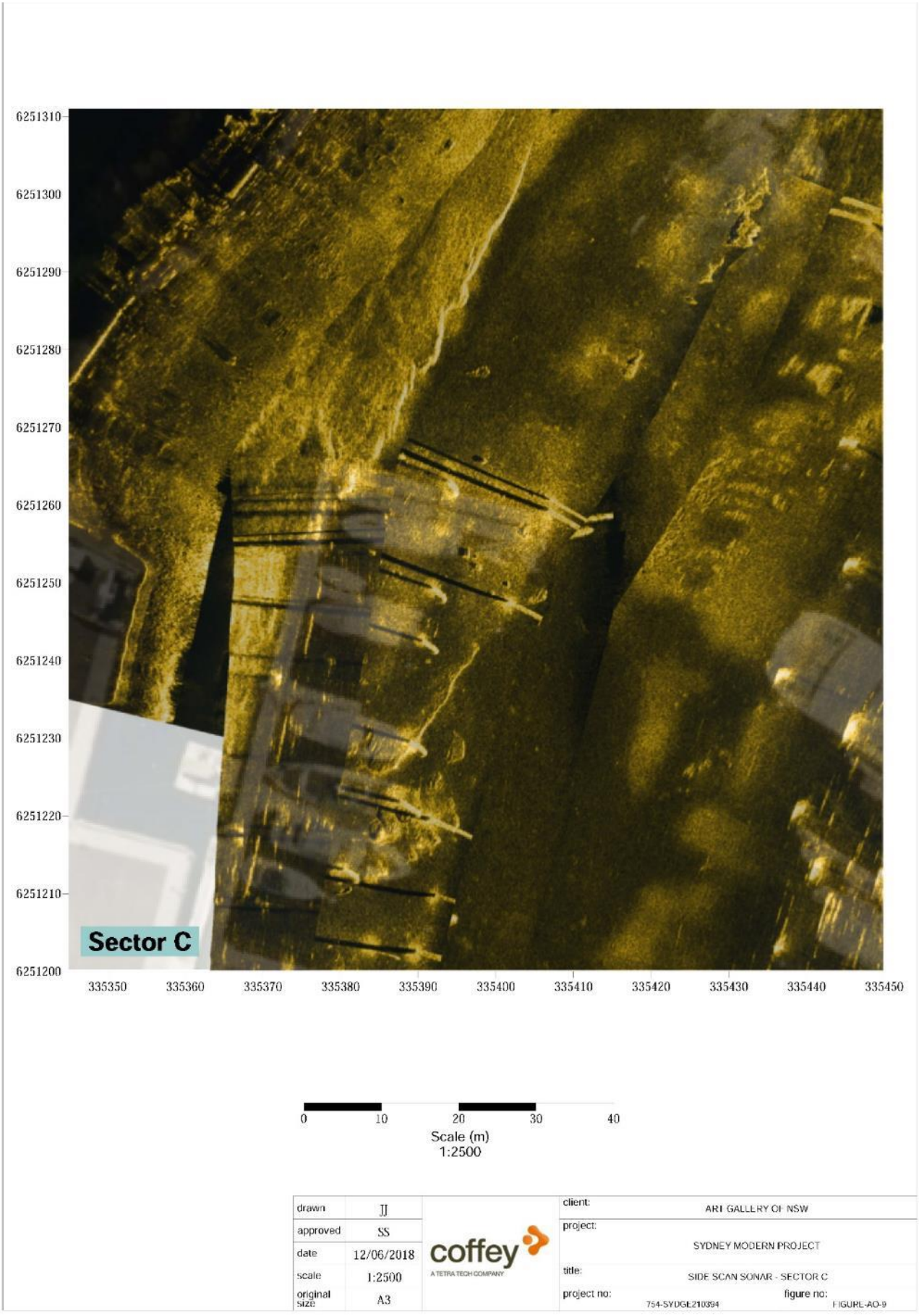
10
20
30
40
Scale (m)
1:2500
drawn JJ
approved SS
date 12/06/2018
scale 1:2500
original size A3
coffey
A TETRA TECH COMPANY
client: ART GALLERY OF NSW
project: SYDNEY MODERN PROJECT
title: SIDE SCAN SONAR - SECTOR B
project no: 754-SYDGE210394
figure no: FIGURE-AO-B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335390
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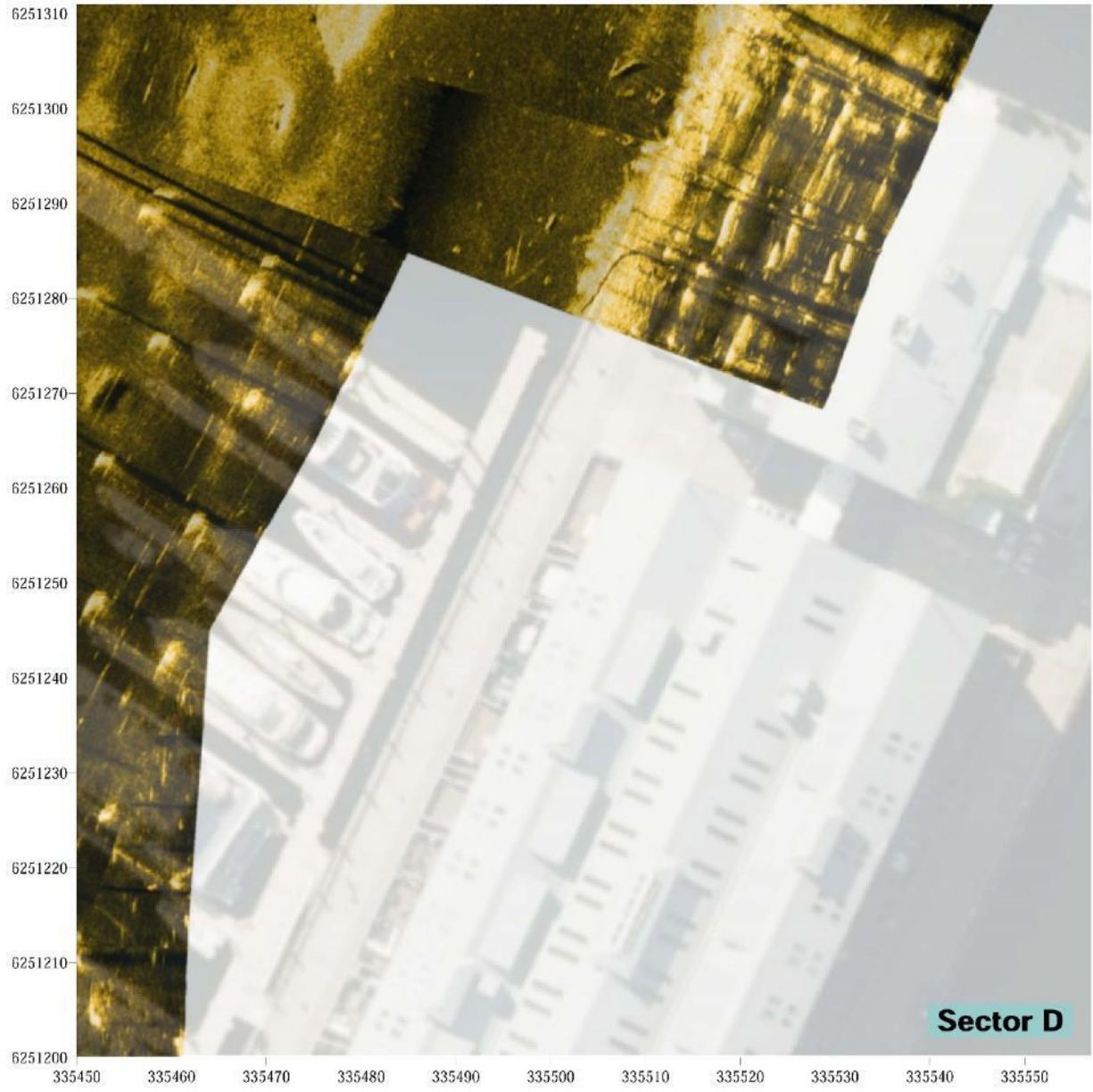
335440
335450
Sector C
0
10
20
30
40
Scale (m)
1:2500
drawn JJ
approved SS
date 12/06/2018
scale 1:2500
original size A3
coffey
A TETRA TECH COMPANY
client: ART GALLERY OF NSW
project: SYDNEY MODERN PROJECT
title: SIDE SCAN SONAR - SECTOR C
project no: 754-SYDGE210394
figure no: FIGURE-AO-9



0 10 20 30 40
Scale (m)
1:2500

drawn	JJ	coffey A TETRA TECH COMPANY	client:	ART GALLERY OF NSW
approved	SS		project:	SYDNEY MODERN PROJECT
date	12/06/2018		title:	SIDE SCAN SONAR - SECTOR D
scale	1:2500		project no: 754-SYDGE210394	figure no: FIGURE-AO-10
original size	A3			

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TORY STENING