CHAPTER FIVE

TORPEDO STATIONS AND TORPEDO STATION ABANDONMENT IN AUSTRALASIA, 1885-1924

> *The…torpedo station reflects specialised experiences of time and place with both its conception and abandonment. The military scenarios which led to its establishment were era specific and relevant only as long as the available military hardware remained immutable* (Wimmer 2008: 45)

Introduction

This chapter discusses the history and archaeology of four land-based installations that served as support bases for Australasia's torpedo boat assets between 1885 and 1924. Three facilities, alternately described in historical sources as *submarine mining stations*, *torpedo stations* or *torpedo boat stations*, were established in or near the New Zealand port cities of Auckland, Lyttelton, and Dunedin. The other, located near the mouth of the Port River in South Australia, was an integral element in the maritime defence of Adelaide, the then-colony's major metropolitan area and centre of government. Each station served as a base for a single Thornycroft Second Class torpedo boat, and the majority featured structures—such as a boat shed and slipway—constructed specifically for the storage and maintenance of these vessels when they were not participating in naval exercises, coastal patrols, or (theoretically) active combat. Because most of these facilities were also tasked with deploying and maintaining static mine fields in adjacent waterways, they also featured several structures associated with these tasks. Table 1 provides a list of buildings and other infrastructure utilised at the torpedo stations discussed in this chapter, and defines their respective roles.

Each station is addressed chronologically according to the year in which it was either constructed for, or officially designated an element of, the torpedo boat defences of its

Table 1. Elements and Function(s) of Australasian Submarine Mining Station Infrastructure

Structure	Function
Office	The submarine mining station's administrative and operational headquarters; in some cases was also used as a lecture hall for the instruction of station personnel in the operation and maintenance of submarine mining equipment
Barracks/Living Quarters	Building used to accommodate officers and enlisted personnel detached to the submarine mining station; also occasionally housed the wives and children of personnel
General Store	Building used to store equipment and supplies not directly associated with submarine mining; i.e., foodstuffs, spare clothing, block and tackle
Carpenter's Shed/Workshop	Building that housed a carpenter's shop and was used primarily to prepare materials and conduct electrical work associated with submarine mining
Blacksmith's Shop and Forge	Building that housed a forge, anvil, grindstone, and bench with vise; was typically used to make small repairs to gun fittings, as well as manufacture fasteners and miscellaneous metal hardware
Gunner's Storeroom	Building where fittings for the service and operation of artillery were stored and maintained
Whitehead Torpedo Store	Building used to store self-propelled (typically Whitehead-manufactured) torpedoes, as well as their associated hardware and apparatus
Loaded Mine Store	Building used to store loaded submarine mines
Oil Store	Subterranean tank used to store (fuel) oil for generators, engines, and other oil-powered machinery used at the submarine mining station
Magazine	Subterranean or semi-subterranean structure where ammunition and explosive material, such as black powder or guncotton, was stored; also occasionally served as a temporary storage area for detonators, fuses, and submarine mines and/or self-propelled torpedoes
Loading/Filling Shed	Building where submarine mine casings were loaded with explosives
Detonator Shed	Building used to store submarine mine detonators
Priming Pit	Subterranean pit used to manufacture and arm primers/fuses used in submarine mines
Test Room/Pit	Subterranean structure where trial detonations of electrically-triggered submarine mine primers/fuses were performed
Mining Cable Tank/Pond	Water-filled tank or subterranean pond used to store, test, and maintain prepared electric cables that were connected to the submarine mine array
Connecting-Up Shed	Building where cables, fuses, and electric apparatus was connected to loaded submarine mines
Tramway	Railway used in conjunction with one or more carts to transport submarine mines and other armament and equipment among the station's many structures, including the jetty/wharf
Jetty/Wharf	Structure that facilitated transport of loaded submarine mines from the shore-based station to a mining steamer or other vessel, which in turn deployed the mines in defensive arrays; also frequently used as a means to transfer equipment and personnel between the station and resupply vessels
Boat Basin	Small, deepwater zone created immediately adjacent to the submarine mining station that facilitated access to its jetty by deep-drafted vessels, and/or provided a temporary anchorage for torpedo boats and other mining watercraft
Torpedo Boat Shed and Slipway	Building used for the storage and maintenance of one Second Class torpedo boat when not in use; the shed's associated slipway facilitated swift deployment of the torpedo boat when summoned to action

respective colony. While the majority of installations discussed in this chapter were built as a direct consequence of the Russian Scares of the 1880s, the North Arm Torpedo Station near Port Adelaide was adapted from a naval depot established on the same site during the 1870s. Particular emphasis is placed on historic *événements* associated with each station's deactivation—for example, dismantling or reuse of buildings and other infrastructure. Significance is also assigned to archival indications of reuse, discard, and abandonment that may have been applied to each facility's constituent materials (i.e., bricks and corrugated metal sheeting), as well as the very land upon which it was located.

All of the torpedo stations discussed below have been the subject of varying degrees of archaeological investigation, including three visual surveys, a Ground Penetrating Radar survey, and a small-scale excavation project conducted as components of this thesis research. The installation at Magazine Bay in Auckland recently was the subject of multiple surveys and excavations carried out in conjunction with efforts to retrofit and incorporate several of its buildings into the new Royal New Zealand Navy Heritage Centre and Naval Museum. Archaeological and archival data collected during these investigations was analysed for evidence of reuse, discard, and abandonment processes unique to each torpedo station, as well as recurring abandonment trends shared among the group as a whole.

North Arm Torpedo Station

In South Australia, the small number of coastal fortifications and gun emplacements built as a consequence of the Russian Scare were augmented by the establishment of a submarine mining station on 13 acres of swampland at the confluence of the Port River and one of its main tributaries, the North Arm. The site's locale was strategically sound, as it was the closest defensive position to the Port River's mouth on the Adelaide side of the

waterway. It was also, as a consequence of its location, very isolated and only reliably accessible via watercraft (Pennock 1997b: 49).

The North Arm Torpedo Station, as the submarine mining facility was officially known, was constructed in 1885 on the site of a preexisting naval depot and initially comprised a torpedo magazine and one other building divided into a gunner's storeroom, carpenter's and blacksmith's workshops, and torpedo room (Figure 7). A small caretaker's cottage was built on the landward (east) end of the magazine (Figure 8) and occupied by the facility's first caretaker, Mr. Parnell. All structures were wood-framed, clad with corrugated iron, and built atop a narrow strip of reclaimed land within the surrounding mangroves. Oriented along an east-west axis in the approximate centre of the station was a tramway that linked all of its buildings to a small jetty made entirely of jarrah wood (*The South Australian Register*, 10 July 1886). The jetty extended 75 yards (68.6 metres) into a 'False Harbour' or dredged embayment that permitted deep-drafted vessels to access the torpedo station from the Port River.

The terminal end of the jetty featured two 'cranes' modified from a pair of old ship's davits by the station's blacksmith in 1886 (*The South Australian Register*, 10 July 1886). Two large mooring posts or 'dolphins' were located approximately 200 feet (61 metres) apart, each positioned to either side of the jetty's terminal end (see Figure 4). They were intended to provide a stationary platform where large, deep-drafted vessels could safely tie up in close proximity to the torpedo station. A 6-inch Elswick Ordnance Company (EOC)/Armstrong breech-loading naval cannon installed near the jetty augmented the station's ability to defend Port Adelaide, and provided a means of self-defence against direct waterborne assault (Rodda 1996; Pennock n.d.; Pennock 1997b; Healey 1999). Originally, two 6-inch guns of this type were to be kept at 'a site near the jetty' for quick deployment aboard one or more

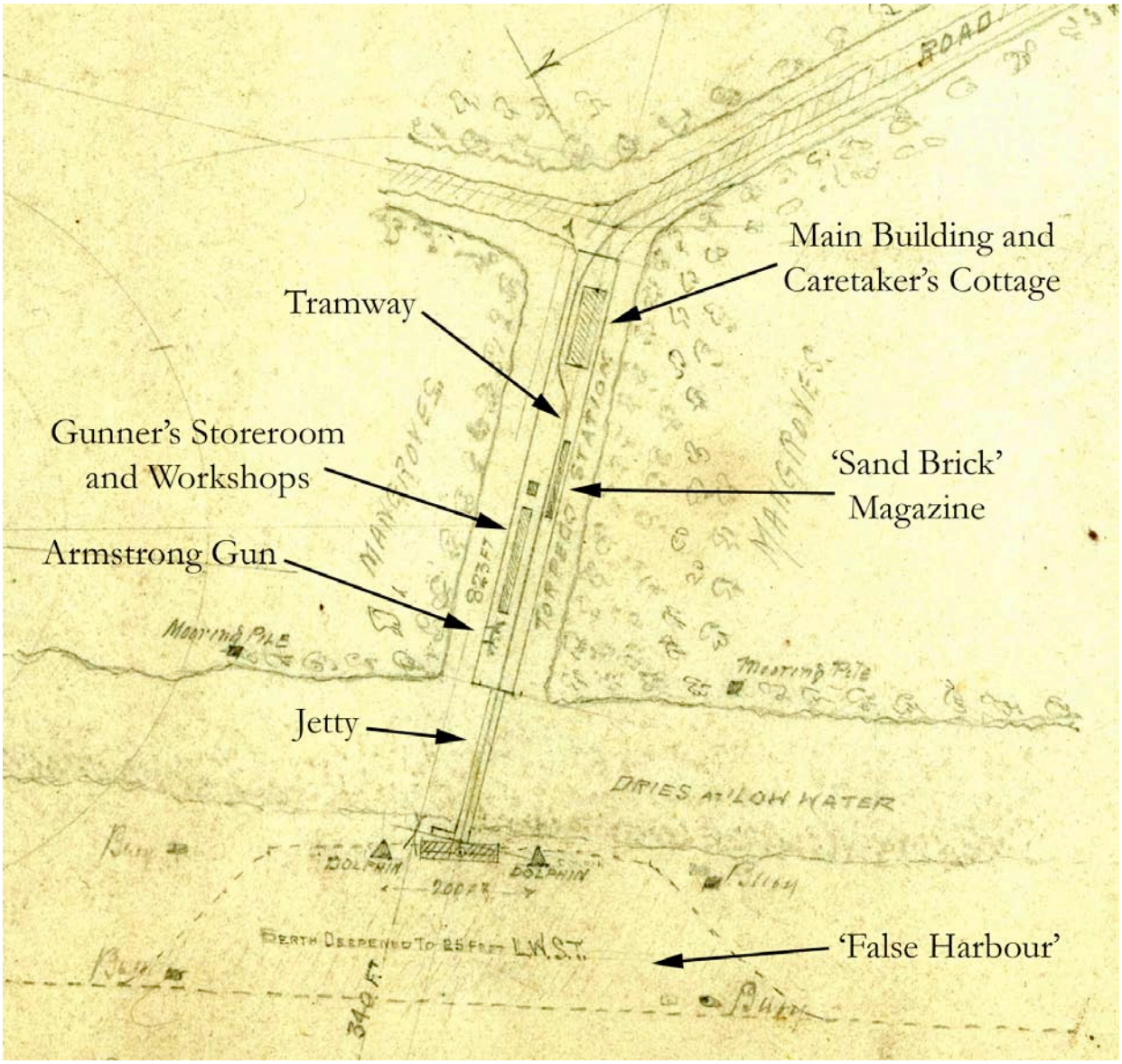

Figure 7. 1903 survey map of the North Arm Torpedo Station, showing the relative locations of most of the installation's land-based structures and jetty. North is to the left of map. Image courtesy of Jan Perry.

converted gunboats in the event of hostilities; however, it is unclear whether both weapons actually arrived at the torpedo station, and if so, what became of the other (*The South Australian Register*, 10 July 1886)

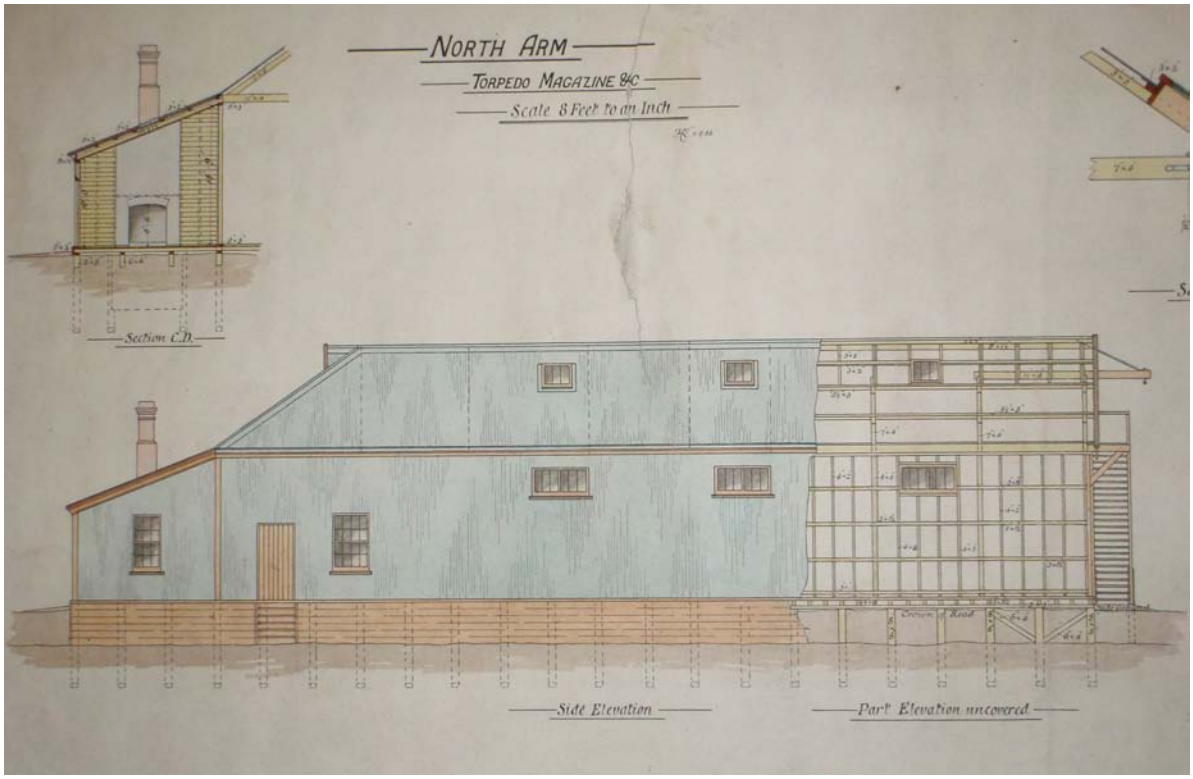

Figure 8. Elevation schematic of the North Arm Torpedo Station's 'Torpedo Magazine' (later the main hall and lecture room), as proposed in 1885. The caretaker's cottage is the small structure with an angled roof and chimney attached to the back (east) end of the magazine building. Image courtesy of the National Archives of Australia (Accession No. D1051/Folder 17/Drawing 14).

In subsequent years, a number of other structures were built at the station, including a detonator shed, water tank, oil store, and mining cable tank (Figure 9). The magazine was later transferred to a second purpose-built structure along the south side of the tramway, and the original magazine building converted to a main hall and lecture room. Significantly, the second magazine was the only standing structure in the station's 40-year existence to not feature corrugated metal and wood framing in its construction. A newspaper account from

1886 states it was to be built of 'old jarrah from the historic Maclaren Wharf' and 'sandbricks [sic] made on the spot' (*The South Australian Register*, 10 July 1886).

Inexplicably, the magazine's construction was delayed until 1890, at which time crewmen from HMCS *Protector* were charged with finally erecting it. The new addition to the station reportedly measured 50 feet by 16 feet (15.2 metres by 4.9 metres), and was to be utilised for the storage of powder and small arms. Sand brick was reportedly no longer considered an element in the structure's composition; the walls would instead be built of 'stone…obtained from Dry Creek'. The old jarrah pilings from Maclaren Wharf, on the other hand, would be used in conjunction with concrete to form its foundation. Once completed, the magazine was predicted to be 'of a very substantial character' (*The* [Adelaide] *Advertiser*, 11 January 1890).

Slightly more than a year later, the *South Australian Register* reported the presence of *two* magazines at the torpedo station. One was constructed of stone while the other, curiously, was manufactured from sand brick. Adjacent to these 'main magazines' was a smaller building for the storage of guncotton (*The South Australian Register*, 28 February 1891). All of the aforementioned were roofed with slate. The floors of each of these structures had also been elevated an additional two feet (0.6 metres) since being constructed to combat damage to the powder and guncotton stores from storm- and tide-induced floodwaters. By 1911, when the torpedo station was entering its final years as an active military installation, the magazine(s) were yet again described in different terms. Official correspondence notes that only *one* magazine was located on site at this time, and that it was manufactured entirely from sand brick. The guncotton storage room was now located either within or immediately adjacent to the magazine and reportedly made of stone (State Library of South Australia [hereafter SLSA]: PR 91426/4/11, 9/8/1911).

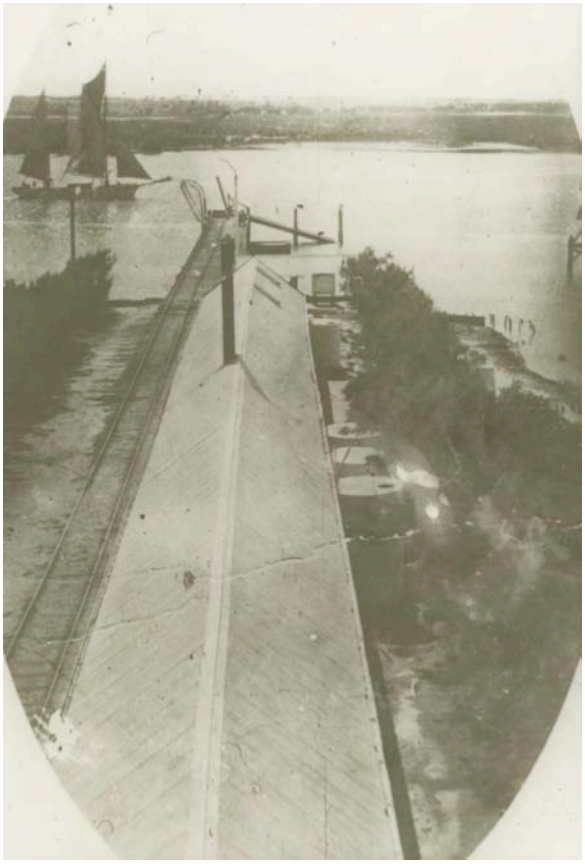

Figure 9. Undated photograph of the North Arm Torpedo Station, showing the roof of the workshop and storeroom building, jetty, mining cable tank (in approximate centre of image beneath the angled jetty gantry), and tramway. The height and location of the photograph suggests it was taken from the station's water tower. Image courtesy of John Bird.

In 1895, Chief Petty Officer Henry Perry succeeded Parnell as caretaker of the torpedo station. Perry immigrated to South Australia from England in 1883 and served the South Australian Naval Force as a crewman aboard *Protector*. In an arrangement unique among the many submarine mining facilities of Australasia, he and his family, including wife Harriet and children Eliza, Mabel, Harry, Hilda, Edith, and Mary, comprised the station's official and 'unofficial' personnel rosters, and would live in the small, two-room caretaker's cottage for nearly 20 years (Figure 10). Occasionally, their meagre living space was shared with other servicemen on short-term assignment to the torpedo station from *Protector*, or visiting friends and family (Healey 1999: 7; Couper-Smartt and Courtney 2003: 287-288).

Figure 10. Undated photograph showing the Perry family and guests posing with the EOC/Armstrong cannon at the North Arm Torpedo Station. The workshop/storeroom building and water tower are visible in the background. Image courtesy of Jan Perry.

Following Federation, South Australia acquired Tasmania's torpedo vessel *TB 191* to augment *Protector*'s naval capabilities. Its arrival also finally provided a platform with which to fire the torpedo station's complement of ten Whitehead torpedoes. The Whiteheads were purchased by South Australia's colonial government in 1887 at a cost of £6,000, but remained in their packing crates unused for lack of a vessel to carry them (Healey 1999: 6). *TB 191*'s arrival also necessitated construction of a corrugated metal boat shed and wooden slipway, which were constructed a short distance away from the torpedo station on a parcel of shoreline fronting the North Arm.

Upon arriving in South Australia, *TB 191* saw very little use and spent the majority of its remaining service life stored in its boat shed. When in operation, it appears to have been used primarily as a launch for ferrying supplies and personnel between the torpedo station and *Protector* (Gillett 1982: 74; Couper-Smartt and Courtney 2003: 287). Despite its age (it had been acquired by the Tasmanian colonial defence forces in 1884) and diminishing value

as a naval asset, the torpedo boat was well cared for while at the North Arm Torpedo Station and, according to a 1911 naval report, still in 'good condition' six years after its transfer from Tasmania (SLSA: PR 91426/4/11, 9/8/1911). The same report also suggested that *TB 191* be engaged as a spare steamer with the Examination Service, but naval administrators ultimately determined it unsuitable for the role.

The torpedo boat all but disappears from the archival record after 1911, and its ultimate fate remains uncertain. A number of historians posit that it was sold out of service, dismantled, and its surviving remnants abandoned in the vicinity of Port Adelaide sometime between 1911 and 1913 (Pennock 1997b: 51; Rodda 1996: 3; Healey 1999: 8; Couper-Smartt and Courtney 2003: 287). Some (Adlam 1981: 29; Gillett 1982: 74) specifically point to Port Adelaide's Harbour Board Dockyard as *TB 191*'s final resting place but do not cite specific documentary sources to support their argument. An archival newspaper article located during this research project confirms that the torpedo boat was effectively abandoned at the Harbour Board Dockyard between the years 1913 and 1927, but that it was also kept out of water and presumably placed under cover for the duration of its time there. The article notes that *TB 191*'s 'red-painted' hull was in 'fair condition', still retained its conning tower, and had recently been purchased by 'Mr. K. Stewart, of [the Adelaide suburb of] Walkerville' (*The* [Adelaide] *Mail*, 19 November 1927). At the time the article was published, Mr. Stewart was in the process of transporting *TB 191*'s hull to his property, where he intended to convert it into a pleasure launch that would feature added superstructure including 'cabins and a deck-house', and a '40-horsepower oil engine' for propulsion (*The* [Adelaide] *Mail*, 19 November 1927). Additional archival research unfortunately did not turn up further evidence of the torpedo boat's disposition and whereabouts after it was removed from Port Adelaide.

The North Arm Torpedo Station remained in active naval service until about 1916, when plans emerged for the land on which the facility was located to be transferred from Commonwealth control to the South Australian state government. By December of the following year, the facility's buildings were reportedly dismantled and their constituent materials removed offsite (National Archives of Australia [hereafter NAA]: D292, 14/1/3 pt. 1, SA 17/7015). However, as the station was operational for the duration of the First World War, and CPO Perry was charged at that time with keeping watch on German merchant ships interned in the Port River near the Torrens Island Quarantine Station, it seems logical that the caretaker's cottage—and the main building to which it was attached—were allowed to remain standing until the end of the conflict. Perry was still listed as a 'general workman' in the torpedo station's employ as late as 1920, but within two years the facility was formally decommissioned and any remaining structures were completely dismantled, removed, and their components reused at other military sites in and around Port Adelaide. The land upon which the station was located transferred from Commonwealth to State ownership on 17 July 1924 (Rodda 1996: 2-4; Pennock n.d: 6; Pennock 1997b: 54; Healey 1999: 8).

Archaeological Investigation of the North Arm Torpedo Station

In September 2000, the North Arm Torpedo Station site was visited by staff and students affiliated with the Department of Archaeology at Flinders University in South Australia. The purpose of the investigation was to conduct a visual survey of the site as a practical component of one of the university's maritime archaeology classes. Survey transects were oriented north-to-south over the torpedo station's proposed location and plotted with a handheld Global Positioning System (GPS) unit. Material culture encountered during the

investigation largely comprised modern construction material and rubbish, with no definitive evidence of artefacts or infrastructure associated with the submarine mining facility (Treloar and Treloar 2001: 7-8).

Although useful in some ways, the methods employed to conduct the 2000 survey resulted in erroneous data with limited utility in the site's analysis and interpretation (Treloar and Treloar 2001: 8-9; Wimmer 2008: 11). Foremost among these was the placement of survey transects, which ultimately only intersected a small portion of the site's western extremity. This problem was only exacerbated by the mapping efforts of the ten individual field participants, each of whom purportedly collected distance estimates for the same artefacts and features 'with varying degrees of accuracy' (Treloar and Treloar 2001: 8). Perhaps the most significant benefit of the project was the discovery of a raised roadway within the approximate footprint of the facility's former tramway. This 'coincident cultural landscape feature' potentially represented the nucleus of the torpedo station site and an area of particular interest for future archaeological investigations (Treloar and Treloar 2001: 9-12).

The North Arm Torpedo Station was the subject of a much more comprehensive Honours archaeology thesis project coordinated by Flinders University student Martin Wimmer in 2004 (see Wimmer 2005, 2008). At the time, the South Australian State Government Land Management Corporation owned the property upon which the site is located, and granted Wimmer and his field team unrestricted access to all site loci under its purview. Archaeological research conducted in 2004 included a pre-disturbance survey of visible material culture, followed by a total station mapping project that plotted all identifiable elements of the torpedo station's structures and other archaeological features and projected them on an ortho-rectified digital chart. Unique vegetation at the site was recorded

in an effort to identify remnant species from the period of the torpedo station's occupation, and wood samples were collected from the surviving stump of a navigational beacon in the site's intertidal zone for purposes of species identification (Wimmer 2005: 36-37).

Additionally, a magnetometer survey of the False Harbour was employed to locate and identify a large steel shield associated with the EOC/Armstrong gun (but reportedly not present during the latter's 1961 recovery from the site—see below), as well as other iron objects that may have originated from the torpedo station (Wimmer 2005: 33-36). Although the shield was not located, a handful of significant magnetic contacts were encountered and identified as worthy of future investigation (Wimmer 2008: 30-31, 52). Field research was complemented by a thorough review of archival sources, including primary and secondary historical material, aerial photographs, maps, and records kept at the Land Titles Office of South Australia. The maps and aerial photographs were later used in conjunction with ortho-rectified spatial data acquired during the total station and magnetometer surveys to create a visual reference system for analysing and interpreting the site. This information would prove beneficial to this research, as it illustrated where the site's surviving sub-surface features were likely to be located and helped facilitate planning decisions as they applied to placement and size of survey tracts and subsequent excavation units.

The 2004 investigation's other great contribution to this thesis project was its use of thematic and theoretical frameworks to derive meaning from the North Arm Torpedo Station. Wimmer's efforts to determine how the site's material culture reflected changing attitudes to South Australian coastal defence between 1877 and 1924 constituted the first theoretically oriented interpretation of archaeological material associated with Australasia's early torpedo boat defences. He observed that the years between the North Arm Torpedo Station's creation and abandonment coincided with Australia's transition from a colony to

federal entity, and that the site consequently 'bridges colonial and national defence theory and practice, and is representative of the evanescent nature of industrial era warfare' (Wimmer 2005: xi, 2008: 57). This was best represented by its visible material culture, the existing features of which were indicative of conceptualised ideals of shore-based fortification and static structures advocated by late-nineteenth century defence theorists. Similarly, the wholesale abandonment of the site, and continuing disinterest in it by Australia's defence forces in the immediate post-Federation era, attested to a shift in defence theory away from static sites to a national naval capability and deterrent (Wimmer 2008: 45-46).

Investigation of the North Arm Torpedo Station associated with this thesis project took place over the course of a two-week period between 10 and 23 May 2010. The general aims of the excavation were to investigate the integrity and extent of archaeological deposits and structures associated with the torpedo station site, and compare the design, composition and construction attributes of its structural features with those revealed by the archaeological remnants of other Australasian submarine mining facilities discussed elsewhere in this thesis. In particular, material culture associated with the site's structural elements was examined for evidence of discard and abandonment signatures. In the weeks prior to the project's commencement, a general call for volunteers was made via online discussion lists associated with the Flinders University Department of Archaeology and Australasian Institute for Maritime Archaeology, as well as Australia's National Archaeology Week website. The request garnered participants from undergraduate and postgraduate archaeology programmes at Flinders University, Victoria's La Trobe University, and the University of New England in New South Wales, as well as community assistance from residents within the Adelaide metro area.

The means by which the site was surveyed, excavated, analysed and interpreted have already been described in considerable detail in Chapter Three, but warrant a quick recap here. The 2010 investigations commenced with a GPR survey of portions of the site thought to contain the footprint of the torpedo station's caretaker's cottage and second magazine (Figure 11). Although the caretaker's cottage was completely dismantled following the station's closure in the 1920s, sub-surface remnants of certain robust structural features associated with it—such as the kitchen fireplace/hearth—were thought to potentially still exist in the archaeological record. The same theory applied to the second magazine, which was constructed of relatively durable material. A particularly promising GPR return in the predicted location of the second magazine helped influence subsequent placement of three excavation trenches (Figure 12).

Ultimately, few structural remnants of either the caretaker's cottage or second magazine were uncovered; however, the earthen embankment upon which the station was constructed was positively identified in two trenches, and appears to have been at least partially evident in the third. It was later determined that this feature was the source of the GPR anomalies. Although intact architectural remains were not encountered, the discovery of specific artefact types in certain areas (i.e., ceramic tableware fragments confined to the predicted location of the caretaker cottage) appeared to confirm the respective locales of 'domestic' and 'military' activity areas at the site. Of particular relevance to this thesis project, however, was the discovery of certain artefacts and features indicative of the manner in which the facility's buildings were constructed and—more importantly—dismantled or abandoned.

Figure 11. Aerial photograph of the North Arm Torpedo Station site, showing the locations of survey and excavation activities, as well as visible archaeological and landscape features. Inset map shows the site's proximity to Port Adelaide. Base images courtesy of Google Maps and Google Earth.

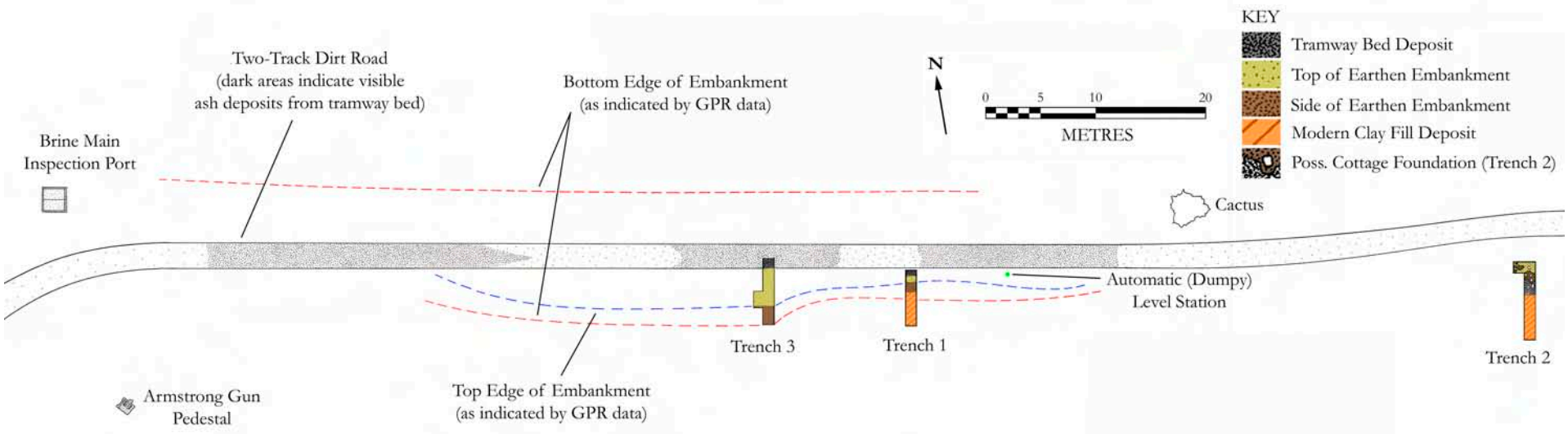

Figure 12. Site plan of the North Arm Torpedo Station, showing the locations of trenches excavated in 2010, as well as other significant site features (including the approximate shape of sub-surface elements of the earthen embankment, as indicated by Ground Penetrating Radar).

Artefact Analysis

A total of 1,481 artefacts with a combined weight of 13.2 kilograms were recovered from the North Arm Torpedo Station during the 2010 investigations. This count includes artefacts that were documented and analysed in the field and later sampled and discarded. Because the torpedo station assemblage is essentially the result of a synchronic (i.e., single occupation) relict military landscape, artefact distributions were primarily assessed according to excavation trench and associated site loci.

Artefacts were categorised within assigned groups: Domestic (n=287), Military (n=218), Structural (n=251) and Unknown (n=725). The high count of Unknown artefacts is a result of 456 small fragments of calcrete recovered from context .005 of Trench 1. If this number is removed, and the skew towards Unknown is adjusted, the site's artefact percentages are as follows: Domestic (28 percent), Structural (25 percent), Military (21 percent), and Unknown (26 percent). Only Military and Structural group artefacts feature in the discussion of abandonment attributes that follows, as artefacts associated with the domestic occupation of the Torpedo Station fall outside the scope of this thesis. The artefact catalogue is presented in Appendix F.

Military

This group contains 218 identified items. The largest component of this group was slag (n=190), included because of its possible association with the torpedo station's tramway, or the caretaker cottage 'yard'. Other military artefacts include sulphur (n=22), lead sheet fragments (n=4), copper sheet fragment (n=1) and lantern glass (n=1). Most of the military group was recovered from Trench 1 (n=105) with the remainder split between Trenches 2 and 3. This correlates with the spread of slag from the tramway bed across the site. The sulphur was recovered from Trench 3, while the lead sheet and lantern glass were recovered

from Trench 1. Both Trench 1 and 3 were excavated within the projected location of the sand brick magazine.

Structural

This group contains 251 identified items. Structural group artefacts include building materials, flat window glass, and architectural hardware. Structural materials are fairly well distributed across the three trenches and are represented as follows: Trench 1 (39 percent), Trench 2 (34 percent), and Trench 3 (27 percent). Hardware (fasteners, metal plate, hinges, nuts, and washers) was concentrated in Trenches 2 and 3, while only one iron fastener was recovered from Trench 1 (in context T1S.001). Trench 2 (the caretaker's cottage) also contained one fragment of black and white patterned linoleum. Roofing tile (n=1) and slate (n=2) were located in Trench 3; this correlates well with archival descriptions of the sand brick magazine's roof.

Building materials were varied and may include some intrusive material. A total of 5.693 kilograms of building materials (roof slate and tile, sandstone, sand brick, brick, bluestone, stone, concrete, and mortar) were recovered and assessed. The assemblage was comprised primarily of mortar (31 percent), but also included 27.5 percent sand brick and 13 percent stone. The remaining percentages of building materials were negligible. Sand brick was recovered from Trenches 2 and 3; however, the majority of material originated from the latter.

Domestic

This group contains 287 identified items and comprises mostly bottle glass (amber, clear, aqua, green, and olive green), ceramics (whiteware, porcelain, and terracotta), two fragments of mammalian long bone, and one ivory fragment. The bones were recovered

from Trenches 2 and 3, while the ivory was located within Trench 2. There is a surprisingly even distribution of domestic materials across the site, comprising 39 percent in Trench 1, 27 percent in Trench 2, and 34 percent in Trench 3.

The Trench 1 assemblage is comprised predominantly of amber and clear bottle glass fragments (beer, soda, milk, and pharmaceutical bottle types). It also includes two undecorated whiteware basal sherds and one gilded porcelain cup rim fragment; these ceramic items were recovered exclusively from contexts 3 and 4. The Trench 2 assemblage contains beer and soda bottle glass fragments, one torpedo-shaped soda bottle base, two fragments of undecorated whiteware, one moulded whiteware rim fragment that originated from a deep plate or bowl, one transfer-printed whiteware rim fragment, and one undecorated porcelain rim fragment. All ceramic and bottle glass types fall within the date range for the occupation of the caretaker's cottage (1880s-1920s).

Unknown

This group contains 725 identified items. It includes 2.3 kilograms of calcrete, which occurs naturally in South Australia and is also a byproduct of soda ash production (the property on which the torpedo station site is located was owned by Penrice Soda during the first half of the 20th century). Other items in the Unknown category include 96 grams of quartz pebble, 691 grams of coal, charcoal, and cinders, 332 grams of shell (oyster, whelk, periwinkle, cockle, and clam), wood fragments (n=12), unidentified rubber (n=1), a tin fragment (n=1), one plastic fragment, hair/fabric matting (n=11), and a small number of unidentified flat iron fragments. Coal, charcoal, and cinder are dispersed across Trenches 1 and 3 and may be associated with the tramway bed. Shell was recovered from Trenches 2 and 3, and two small shell fragments originated from Trench 1. Wood fragments were recovered from Trenches 1 and 3 and may represent remnants of the caretaker's cottage

framing components. Alternatively, they may have once comprised structural components of the sand brick magazine or tramway railway sleepers.

Abandonment Attributes of the North Arm Torpedo Station

The ephemeral nature of the North Arm Torpedo Station is all too evident in the types of material culture—or lack thereof—that have characterised the site since archaeological investigations commenced there in 2000. These data complement archival descriptions of the facility's closure, which provide a general timeframe and description of activities undertaken, but are far less forthcoming as to specific processes of disassembly, discard, and abandonment that occurred in conjunction with particular structures. For the most part, the majority of the site's infrastructure appears to have been thoroughly dismantled and its constituent building material either recycled or salvaged and utilised elsewhere. Evidence of this particular trend, as well as a handful of exceptions to it noted during the 2010 excavations, are discussed below.

Data recovered during the 2000, 2004, and 2010 investigations of the North Arm Torpedo Station reveal that very little remains of its buildings and associated structures. Wimmer's 2004 survey of the intertidal zone surrounding the torpedo station's False Harbour revealed 'no trace' of wooden pile remnants or other structural evidence of the facility's jetty, and the absence of these features were noted a second time during the 2010 investigation. However, the 2004 magnetometer survey of submerged portions of the artificial embayment detected anomalies indicative of a debris field that may represent objects accidentally lost overboard from the jetty, or 'material related to the use of the [submarine] mining cable' (Wimmer 2005: 42-44, 2008: 31). Although Wimmer did not explicitly suggest it, these anomalies could also represent material that was either lost or

intentionally discarded during efforts to disassemble the jetty following the torpedo station's deactivation. Two other large magnetic contacts located during the 2004 investigations were considered potential candidates for remnants of the jetty's mooring dolphins, but these features were not inspected at the time of the survey and have never been positively identified (Wimmer, 2005: 44, 2008: 31).

The absence of robust structural elements associated with the jetty, particularly remnants of the jarrah piles that once served as its foundation, would seem to indicate that some effort was made on the part of the military to reduce or remove them following the torpedo station's closure. Historical sources note the jetty was 'still at the Torpedo Station' in June 1922, but also observe that all sleepers and rails associated with the section of tramway that transited it had by this time been dismantled and removed to the naval depot at Birkenhead (Lieutenant Commander John White, cited in Pennock 1997: 52). The remainder of the jetty's structure appears to have followed suit over the course of subsequent years. A map of the facility produced in 1903 (see Figure 7) reveals that the foreshore beneath the jetty was exposed at low water for almost its entire length; consequently, any piles that remained embedded in the False Harbour floor in the wake of the jetty's disassembly would have posed a potential threat to vessels navigating the Port River. Given these circumstances, it seems likely that military authorities would have ordered the piles and other support structure levelled or removed, although it is unclear whether these items would have been deemed suitable for recycling or reuse in the latter instance.

Neither the 2000 nor 2004 investigations at the North Arm Torpedo Station resulted in definitive material evidence of the facility's various wood-framed and corrugated metal buildings. This correlates well with official military correspondence that notes 'the whole of the buildings at the Torpedo Station [were] taken down and all material removed' by 20

December 1917 (NAA: D292, 14/1/3, pt. 1, SA 17/7015). Included among the items transported from the site were approximately 130 sheets of galvanised iron cladding, 64 of which were subsequently reused in the construction of a Naval Guard shelter overlooking Port Adelaide's Outer Harbour. What remained was incorporated in the refurbishment of a Naval Guard house in the South Australian coastal town of Port Pirie (NAA: D292, 14/1/3, pt. 1). During his survey, Wimmer (2005: 49, 2008: 35-36) observed that the only visible evidence of any of the station's corrugated metal structures was a drastic change in sediment colour and consistency at the projected boundary between the tramway footprint and the western wall of the main building/caretaker's cottage. It was at this point that the 'dark grey colouration' of a fine-grained ash layer associated with the tramway 'stopped abruptly along a straight line' and changed to sediment of much lighter colour and coarser composition (Wimmer, 2005: 49, 2008: 36).

This sediment demarcation was still visible at the time of the 2010 excavation, and played a role in the placement of the trench (Trench 2) intended to identify and delineate remnants of the caretaker's cottage. Removal of dense vegetation from Trench 2's projected footprint revealed an isolated cluster of fragmented historic brick, mortar, and concrete in the hypothesized location of the cottage's kitchen hearth. The largest concrete fragments retained impressions of corrugated metal sheeting along one side (Figure 13), suggesting they may have once comprised sections of the main building/caretaker's cottage foundation, or at the very least an external concrete footer placed around the peripheral walls of one or both structures. No evidence of corrugated sheeting was located in the caretaker's cottage trench, nor were remnants of this material noted in either of the other trenches (Trenches 1 and 3) or during the site survey conducted in conjunction with the excavation. This would appear to support findings of the 2000 and 2004 surveys, as well as archival correspondence

describing the complete removal of metal cladding used to construct the torpedo station's buildings.

Figure 13. Surface scatter of building rubble within Trench 2, showing concrete fragments with corrugated sheet metal impressions. Scale in 20-centimetre increments.

Additional evidence of efforts to dismantle wood-framed/corrugated metal structures at the North Arm Torpedo Station was noted through the presence of other forms of material culture. During the 2010 investigations, six identical threaded iron bolts were recovered from Trench 2 within a hypothesized demolition layer associated specifically with the caretaker's cottage. All were found in direct association with a concentration of building rubble (including fragmented brick, mortar, and stone) and broken historic artefacts, including window and bottle glass, and ceramics. Hardware associated with the bolts was also recovered, including three iron nuts and two thin iron plates (Figure 14). The threaded openings in each nut correspond exactly to the shaft diameters of the bolts, as do a

pair of holes situated at either end of the plates. Interestingly, all three nuts have been 'opened' (i.e., broken) as a consequence of one or more strikes from a cold chisel or similar implement.

Figure 14. Iron hardware used to fasten structural elements of the torpedo station's main building/caretaker's cottage to one another. Note that both nuts have been intentionally broken. Scale in centimetres.

The bolts, plates, and nuts were clearly used in concert to assemble two or more structural components to one another. Because the bolts are relatively short (4.2 centimetres in overall length), it seems reasonable they may have been used to attach sections of corrugated metal sheet to the wooden framework of the main building/caretaker's cottage. Two bolts would have been inserted through the architectural components they were intended to bind together, and then affixed in place with one plate (serving as a backing plate) and a pair of corresponding nuts. Over time, this combination of highly reactive iron hardware corroded and fused together, necessitating the use of a chisel or similar tool to free the nut and bolt from one another when the building they formed a part of was dismantled. No longer of any reuse value, these items were subsequently discarded on site rather than utilised elsewhere.

Archaeological evidence also indicates considerable effort was expended to disassemble and remove all traces of the torpedo station's tramway. Although the tramway bed and earthen embankment upon which it rests are perhaps the site's most obvious visual features (and were, as of 2010, still largely intact as sub-surface deposits based on both stratigraphic and GPR data; see discussion below), material evidence of the tramway itself is largely absent. During his 2004 survey, Wimmer (2005: 50, 2008: 36) noted the presence of 'two parallel divots' within the footprint of the tramway bed and hypothesized their identity as imprints of two of the many narrow-gauge iron trailer sleepers that comprised the tramway's rails. By 2010, even these relic features had disappeared, almost certainly as a consequence of natural erosion and foot and vehicle traffic transiting the dirt road within which the footprint of the tramway is located.

During the 2010 investigations, efforts were undertaken to locate and identify sub-surface remnants of the tramway. A metal detector survey of the entire torpedo station site

included a systematic sweep of the tramway bed's preserved footprint. This was carried out with the goal of locating iron rails or other tramway hardware (such as fasteners) that may have been discarded on site in the wake of the station's closure. The metal detector survey was conducted in conjunction with multiple GPR transits of the same area. Ultimately, neither method revealed evidence of either *in situ* or dispersed and re-deposited tramway features; this in turn would seem to support archival accounts that state this element of the torpedo station's infrastructure was completely disassembled and removed off-site, and that some of its components were later used in the construction of a slipway at the Birkenhead Naval Depot (NAA: D292, 14/1/3, pt.1, SA 19/9950; Lieutenant Commander John White, cited in Pennock 1997: 52).

The ephemeral nature of the North Arm Torpedo Station's construction and use is perhaps best illustrated by results of the archaeological investigation of its (hypothetically) most robust structure—the second 'sand brick' magazine erected during the 1890s. As noted previously, this building was the only example of the installation's primary aboveground infrastructure to feature materials other than corrugated metal and wood as architectural constituents. The relatively resistant qualities of the stone and/or sand brick and slate used to assemble the magazine, as well as the necessity for solid 'bombproof' construction inherent in the task for which it was built, meant that it would have been—theoretically at least—very difficult to dismantle. The idea is supported in part by a 1938 survey map of the torpedo station site, which notes the presence of unspecified 'ruins' in the approximate location of the second magazine, and an aerial photograph from the previous year that shows what appear to be the remnants of a standing structure in roughly the same area (Figure 15). It should be noted that this same feature is notably absent in a series of aerial photographs of the site taken nearly a decade later in 1945.

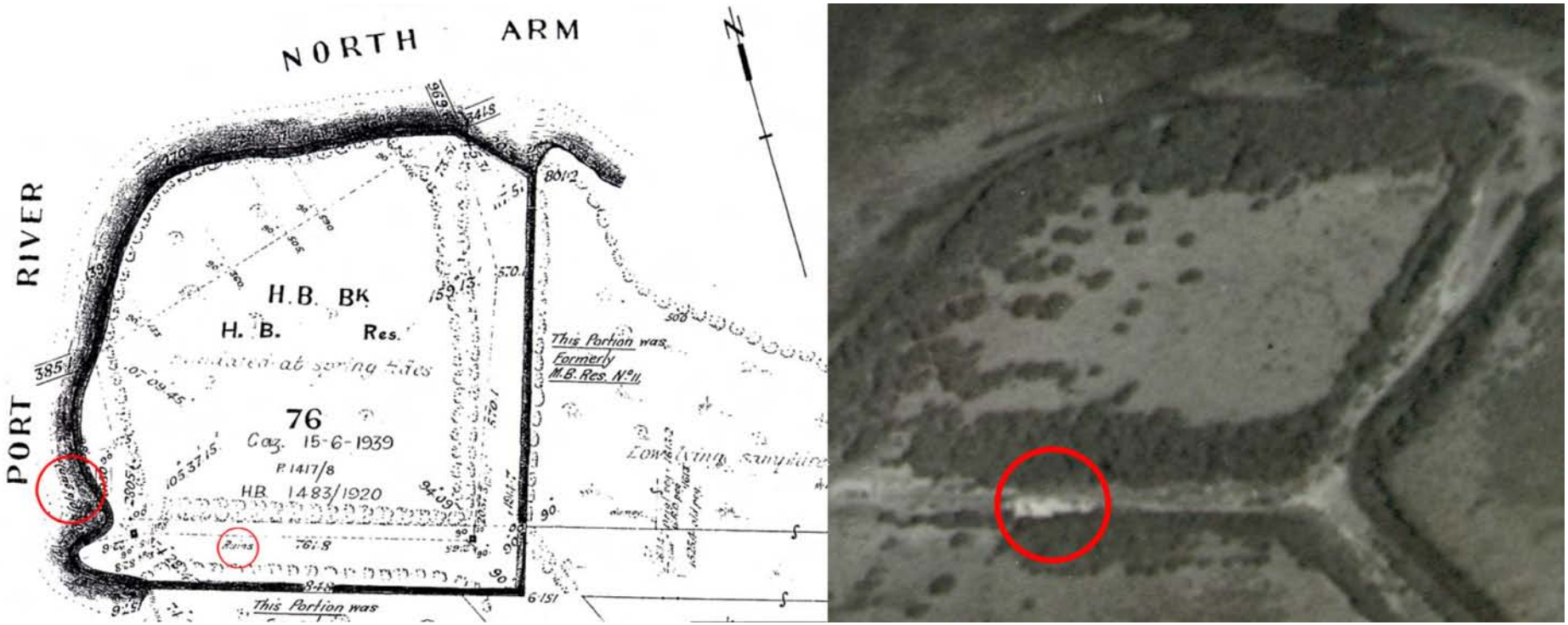

Figure 15. *Left*, 1938 survey map of the abandoned North Arm Torpedo Station site, with annotations for magazine 'Ruins' and an 'Old gun' circled; *right*, 1937 aerial photograph of the site, with the magazine's extant remnants circled (north is at top of image). Map courtesy of the South Australia Land Titles Office; photograph courtesy of Jan Perry.

Although the Treloars (2001: 9) noted the presence of the torpedo station's embankment and elevated tramway bed, they were unable to confirm the location and identity of the sand brick magazine. Similarly, Wimmer (2005: 51, 2008: 37) observed that 'no visible evidence' of this magazine existed above ground at the time of the 2004 survey, although he was also quick to point out that its foundation was potentially still 'largely intact' in sub-surface deposits. The 2010 effort to locate and identify the sand brick magazine's hypothesized sub-surface structure was based in large part on Wimmer's latter supposition.

Results of a GPR survey within the sand brick magazine's projected footprint revealed the presence of a linear feature that exhibited attributes consistent with a wall (Figure 16). Initially, this appeared to justify Wimmer's hypothesis; however, subsequent excavation within Trenches 1 and 3 revealed the linear feature actually represented the top and side of the earthen embankment's southern face. While the embankment ultimately proved to be a dominant feature of the site (see below), identifiable articulated remnants of the magazine's foundation and/or walls were clearly absent from both excavated areas. Even the addition of multiple extensions to Trench 3 along the magazine's proposed footprint failed to uncover evidence of intact structure (Figure 17).

Despite the lack of definable wall or foundation features, a number of artefacts were encountered in Trenches 1 and 3 that point to the magazine's existence. For example, fragments of hard sun-baked clay with one or more intentionally formed edges and deposits of compacted gritty sand were observed atop the upper surface of the earthen embankment in Trench 3 (Figure 18). This material may very well represent remnants of the masonry used in the magazine's construction, although it should be noted that the term 'sand brick' is poorly defined in historical sources, and does not appear at all in current archaeological literature. Indeed, the closest modern-day equivalents are either mud bricks, which are hand-

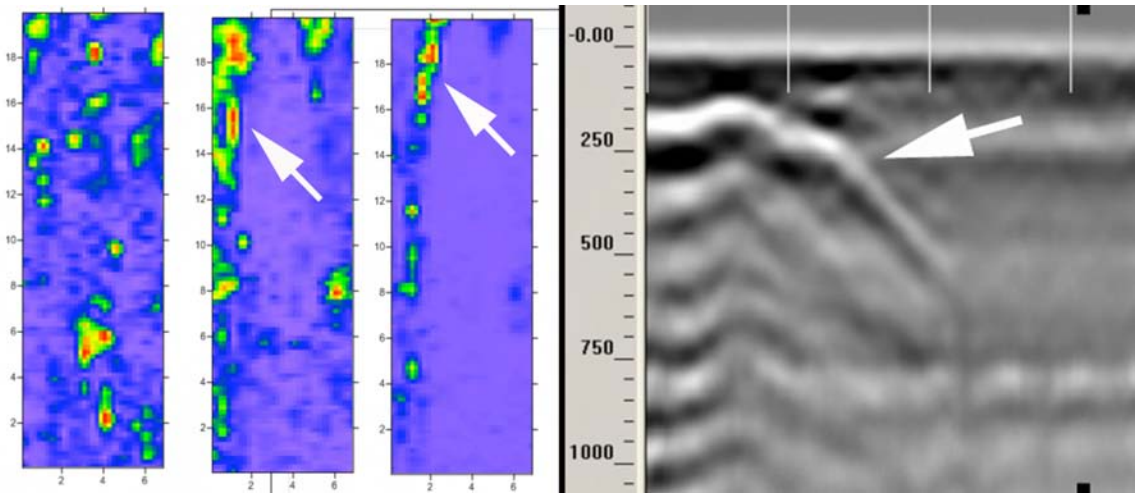

Figure 16. Ground Penetrating Radar imagery of the North Arm Torpedo Station's earthen embankment (indicated by arrows). *Left*, plan view, showing the embankment as a linear feature captured at 20-centimetre depth intervals; *right*, profile view, showing angled southern face of embankment. Images courtesy of Dave Ross.

Figure 17. Overview of Trench 3 at fullest extent of excavation, showing the original land surface atop the North Arm Torpedo Station's earthen embankment. Note the absence of identifiable articulated structure associated with the station's sand brick magazine, as well as the southern edge of the embankment (in foreground). Multiple fragments of calcrete (generated as a byproduct of modern soda ash production) are visible atop the embankment along the eastern wall of the trench. Scale in 20-centimetre increments.

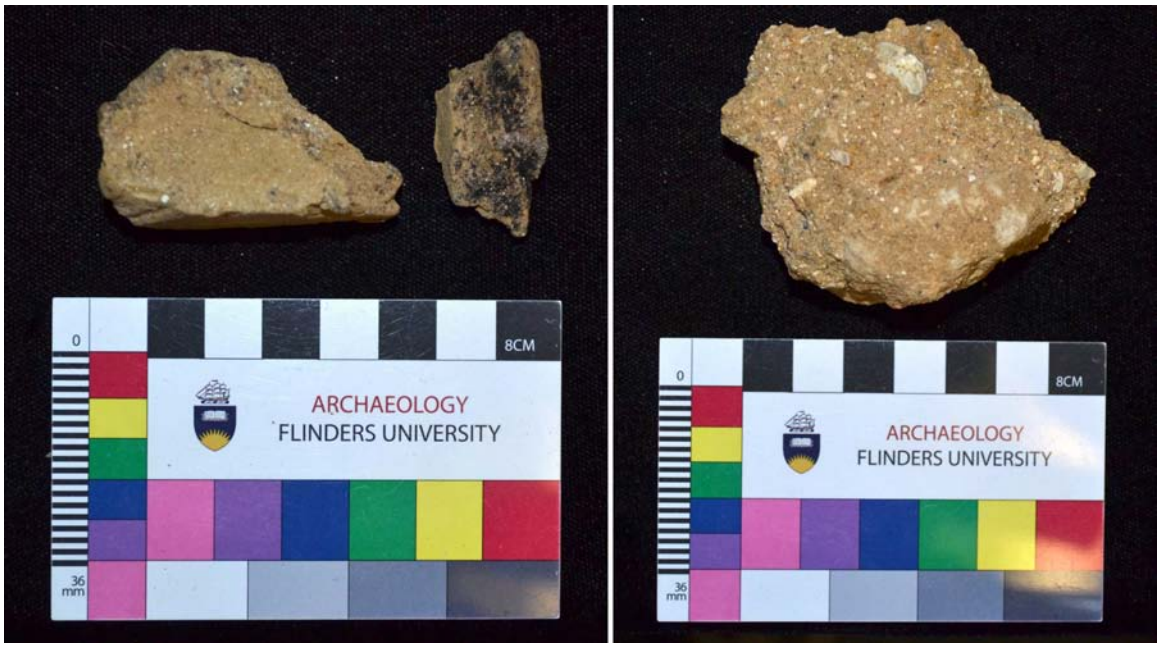

Figure 18. Sand brick samples recovered from Trench 3 at the North Arm Torpedo Station. *Left*, definitive sand brick fragments with formed sides; *right*, conglomerate containing compacted sand mixed with shell and grit temper that may comprise sand brick 'melted' by natural transformation processes.

formed and essentially 'fired' by the heat of the sun, or moulded low-fired variants known alternately as 'sandstock' or 'sand moulded' bricks (see Gemmel 1986; Lewis 2000; Stuart 2005).

Like mud bricks, sand bricks were formed by hand, allowed to partially set up in moulds, and then hardened by direct exposure to the sun for a protracted period of time. However, they were considerably different in terms of composition, as they employed a combination of sand and quicklime. A 1925 article in Adelaide newspaper *The Mail* described the materials and methods necessary in their manufacture:

> To make sand brick, mix the mortar with one part of lime to three parts of sand. Good, new lime is required. Have suitable moulds ready into which the mortar is to be poured. In two to three days the mortar will have set hard enough to enable the moulds to be removed (*The* [Adelaide] *Mail*, 1 August 1925).

An earlier newspaper article from Perth in Western Australia offered a similar recipe, but added the need for 'fresh water' and the removal of 'vegetable matter from…the sand' before the constituents were mixed together (*Sunday Times*, 11 February 1912). Once set sufficiently to retain their shape, the bricks were removed from their moulds and allowed to dry in the sun for three months. While extolling the relative ease and reduced expense with which sand bricks could be produced, the article's author also observed that they were 'not as good as stone or [fired] brick' in building construction (*Sunday Times*, 11 February 1912).

In the case of sandstock or sand moulded bricks, sand was included as a primary constituent to prevent the wet clay of the brick from sticking to its wooden mould during manufacture. Occasionally, the amount of sand in these bricks superseded their clay composition by a considerable margin. For example, sandstock bricks used in the construction of buildings at colonial Port Essington in northern Australia comprised '20% clay and 80% sand, tempered with ironstone nodules' (Allen 1973: 49). Given their low-fired, relatively coarse manufacture, it is perhaps not surprising that sandstock/sand moulded bricks, which are a relatively common feature of colonial-era sites in Australia, have been cited by archaeologists for their 'primitive' and/or 'poor quality' construction (e.g., Allen 1973: 49; Higginbotham 1983: 36).

Whether they were unfired sand bricks or low-fired sandstock variants, it seems logical to assume that the examples used to construct the second magazine were very likely soft and porous—attributes that would have left them susceptible to natural transformation processes, particularly rain and wind erosion. This hypothesis is supported by the deposits of compacted sand interspersed with crushed shell and grit noted on the top of the embankment in Trench 3. These concentrations were not observed elsewhere during the excavation, and are believed to comprise remnants of sand bricks that were gradually

'melted' (decomposed) by long-term exposure to wind-generated sand scour, rainwater, and/or floodwaters associated with periodic king tides or similar high water events. In addition to these environmental factors, it seems likely intact sand bricks and other architectural features associated with the magazine would have been extensively salvaged and/or scavenged for reuse elsewhere.

Other artefacts and features indicative of the sand brick magazine include a fragment of bluestone roof slate and an apparent posthole feature, both of which were discovered in Trench 3 immediately adjacent to the southern edge of the tramway bed. In Trench 1, a small concentration of elemental sulphur (the identity of which was confirmed by a Bruker hand-held X-Ray Fluorescence analyser; see Appendix G) and a fragment of lead sheeting were recovered from immediately atop the embankment feature (Figure 19). The presence of sulphur within the magazine's projected footprint is not surprising, as it was a primary constituent of pre-'smokeless' forms of gunpowder and served as a means of increasing its rate of combustion (for an archaeological discussion of gunpowder and military ordnance, see Cocroft 2000). Because older forms of gunpowder were commonly used in breech-loading Armstrong cannon (like the one installed at the North Arm Torpedo Station), sulphur may very well have been stored in the magazine and used in the manufacture of munitions.

Similarly, the lead sheeting fragment could have a direct association with the magazine. Breech-loading Armstrong guns manufactured between 1858 and 1878 utilised projectiles coated with lead sheeting (Mackinlay 1887: 33). This coating was designed to engage the rifling inside the gun's bore while simultaneously minimising windage (defined in this case as the difference between the bore and projectile diameters). After 1878, concave copper disks called 'gas checks' gradually replaced lead-coated ordnance, although it is

entirely feasible that the North Arm Torpedo Station was outfitted with older projectile variants as a cost-saving measure.

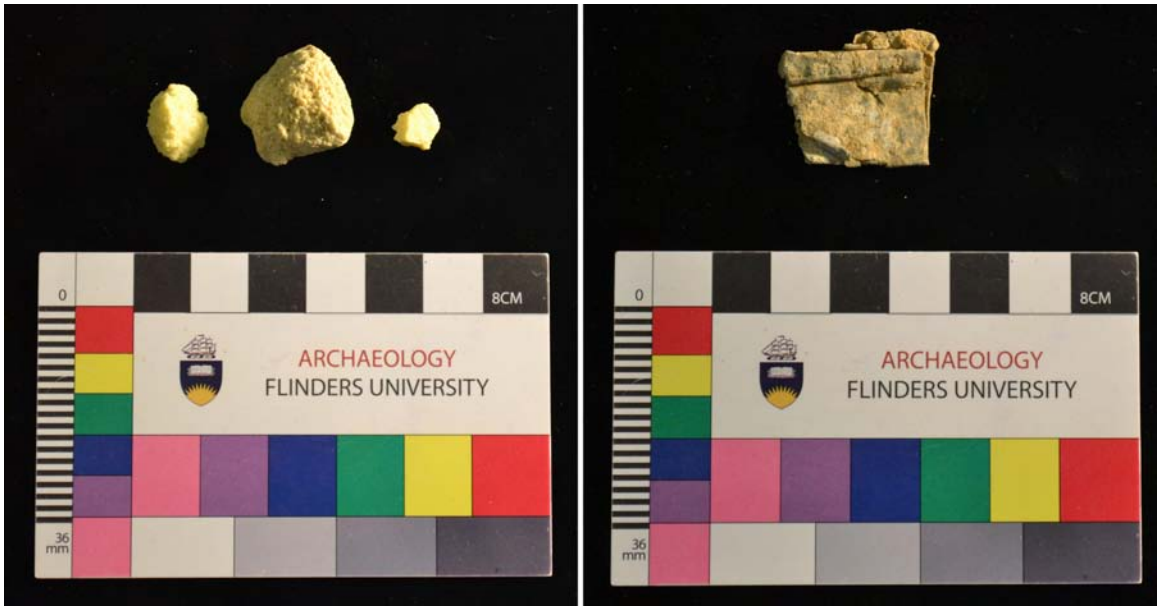

Figure 19. Fragments of elemental sulphur (left) and a small piece of lead sheeting (right) found in association with the projected location of the North Arm Torpedo Station's sand brick magazine.

The 6-in. EOC/Armstrong cannon itself comprises one of the torpedo station's more intriguing abandonment features. In the wake of the facility's closure, the gun was deposited in the foreshore of the False Harbour, below the original high water mark and immediately north of the jetty's former footprint. The archival record is silent regarding this incident, and the circumstances and/or motives for its disposal remain uncertain. It was apparently still visible at the same location a decade later, when it was recorded on a 1938 survey map with the annotation 'Old gun' (see Figure 16). The gun was relocated in 1961 during land reclamation activities (Figure 20), removed from the site shortly thereafter and subsequently displayed at two shore-based naval installations—Birkenhead Naval Depot and HMAS *Encounter*—in Port Adelaide (Rodda 1996: 2-4; Pennock 1997: 54; Healey 1999: 8;

Wimmer 2008: 15). It is currently owned by the South Australian Maritime Museum and kept within a fenced enclosure at a vacant lot in the Port Adelaide suburb of Birkenhead.

Figure 20. *Left*, the North Arm Torpedo Station's EOC/Armstrong gun embedded in the foreshore fronting the torpedo station site, ca. 1961; *right*, the Armstrong gun at its current location in Birkenhead, South Australia. Image at left courtesy of the Port Adelaide Historical Society.

During his 2004 survey of the site, Wimmer (2008: 35-36) noted the presence of a large concrete object he postulated was a portion of the pedestal or platform that once accommodated the Armstrong cannon. Part of this structure is visible in at least one archival photograph of the torpedo station (see Figure 10) and appears fairly robust—an attribute that would be expected, given the gun's five-tonne (5,080-kilogram) weight. When documented in 2004, the concrete feature was completely exposed above ground (it would have been almost completely buried when in use) and located on the southwest side of the tramway, directly opposite the Armstrong gun's original position at the torpedo station. Wimmer (2008: 35) hypothesized it was dug up as a consequence of 'brine pipe trench construction' and subsequently 'broken up and rolled or dragged clear' to the other side of the dirt track.

Between 2008 and 2010, this object was moved further away from the tramway footprint and tipped on its side, almost certainly via the use of heavy equipment (Figure 21). As a result of this process, formerly intact portions of its concrete structure were either broken or removed entirely. In an effort to mitigate further data loss stemming from potential future on-site development activities, its surviving elements were cleaned and documented during the 2010 investigation. Attributes uncovered during this process included approximately half of an iron-lined, capsule-shaped depression that was identified as the recess that accommodated the heavy iron counterweight attached to the base of the Armstrong gun. Additionally, a wooden sleeper and two wooden wedges utilised in the object's manufacture were noted, as was a crude inscription that appears to include a British 'Broad Arrow' device (see Figure 21).

The Broad Arrow was likely placed on all colonial government property at the torpedo station, including the Armstrong gun pedestal. Consequently, its presence provides compelling evidence that the large concrete object was directly associated with the installation, and further supports Wimmer's theory regarding its identity. Given its considerable size and weight, it is not surprising that the pedestal was abandoned at the time of the North Arm Torpedo Station's closure, and that it remained *in situ* until impacted by subsequent excavation of the brine main trench.

Figure 21. The surviving section of the EOC/Armstrong gun pedestal as it appeared in 2008 (*left*) and 2010 (*right*). The Broad Arrow device is circled; the red arrow indicates the location of the Broad Arrow and other inscribed characters on the pedestal when it was upright. Scale in 20-centimetre increments.

Both the 2000 and 2004 surveys recorded the presence of broken masonry in isolated scatters or clusters at several locations along the site's western and northern peripheries (Figure 22). The majority of this assemblage comprised red brick, and almost all diagnostic examples were later identified as having been manufactured after the torpedo station's closure (Treloar and Treloar 2001: 9; Wimmer 2005: 45-46, 2008: 31-33). Other forms of building material, including concrete debris that may have been associated with the installation's water tank stand and gunner's store foundation, were noted approximately halfway along the length of the embankment's northern side. Like the gun pedestal, these structures appear to have been abandoned largely *in situ*, only to be later uprooted and broken up during installation of the brine main (Wimmer 2008: 34).

Figure 22. Cluster of broken brick and concrete immediately adjacent to the brine main footprint that transits the northern periphery of the torpedo station's earthen embankment. Scale in 20-centimetre increments.

Although far removed from the brine main footprint, the hearth and chimney built into the south wall of the caretaker's cottage (see Figure 8) are also no longer evident at the torpedo station site. The GPR survey of the projected location of these features failed to identify anomalies consistent with a large, robust masonry structure (such as the intact hearth and/or its foundation), or even a scattered cluster of intact and fragmented brick, as would be expected with a chimney fall and/or disarticulated hearth. Initially, evidence of the hearth appeared to present itself in the form of a small visible surface cluster of fragmented brick, concrete and mortar within the projected location of the caretaker's cottage (see Figure 13); however, excavation of this feature ultimately revealed it to be an isolated deposit comprising a combination of modern and historic artefacts, with no substantial sub-surface attributes. Excavation within the rest of Trench 2 and its northern extension uncovered

fragmentary mortar, brick and a few large stones, but nothing identifiable as a fireplace or hearth. As a consequence, it would appear this structure and its associated chimney were either demolished or dismantled, and their constituent components largely removed from the site in the wake of the torpedo station's deactivation.

The only structural element of the North Arm Torpedo Station that remains on site and has survived largely intact is the earthen embankment upon which the facility was built. Stratigraphic data collected during the 2010 investigation revealed this feature was buried and subsequently protected beneath successive deposits of intentional infill and wind- and waterborne sediments (Figure 23). Attributes of the embankment's original form and composition, including an area later added to the south of the tramway to accommodate the sand brick magazine, were detected by GPR and integrated within the torpedo station's site plan (see Figure 12). In fact, the only portion of this feature that appears to have been altered in any appreciable manner is its northernmost upper surface, which was partially excavated and its archaeological integrity compromised by placement of the brine main.

Given its robust earthen construction and massive size, it is not surprising the embankment was abandoned *in situ* in the wake of the torpedo station's closure. Like the gun pedestal, tank stand, and other substantial supporting structures at the site, the embankment would have required considerable manpower, time, and money to reduce or demolish. The fact that it was constructed entirely of earth meant that it could not be systematically dismantled, nor would it have had obvious reuse value elsewhere. Ultimately, its upper surface became a benchmark for subsequent infilling episodes within the surrounding mangroves, as well as a support bed for the dirt road that now transits the site.

Figure 23. The western profile of Trench 1 at extent of excavation, showing the earthen embankment and successive layers of infill material—including multiple layers of wind- and waterborne beach sand—deposited over it. Note dark-coloured tramway bed deposit at far right of photograph. Scale in 20-centimetre increments.

Torpedo Bay Submarine Mining Station

As early as 1871, military planners in New Zealand's colonial government contemplated the establishment of a torpedo facility to be used in the seaborne defence of Auckland, the colony's wealthiest and most populated city (Hutton 1871). North Head is a volcanic headland located at the seaward end of a narrow peninsula that juts into Waitemata Harbour almost immediately opposite the city's central business district. Originally the location of a prehistoric Maori *pa* (fortified settlement) site named Maungauika, it provided a commanding view of the harbour and all of its seaward approaches, and was the logical choice for a defensive installation in the wake of the initial Russian Scare of the 1870s. In 1877, a small embayment immediately west of North Head was identified as the ideal locale for a submarine mining base (Pond 1877). Although traditionally known as Haukapua, the shallow, sheltered cove would ultimately assume a name that better reflected the purpose for

which it was to be used during the remainder of the nineteenth century—Torpedo Bay (Plowman 2008: 17).

The defensive potential of Torpedo Bay remained purely theoretical until the Russian Scare of March 1885, when the colony's military planners once again hurriedly drew up preliminary schematics for a stationary mine field between the Admiralty Reserve in Devonport and Point Resolution on Waitemata Harbour's southern shoreline (*Auckland Weekly News*, 21 March 1885). However, construction of a formal submarine mining depot did not commence until three months later. Major Edmond M. Tudor-Boddam, an officer in the British Royal Artillery, oversaw the design and construction of this facility, as well as a shed and slipway for Auckland's sole Thornycroft Second Class torpedo boat, *Waitemata*, at the Admiralty Reserve between June 1885 and December 1887 (Mitchell 1995: 635, 682).

Tudor-Boddam also supervised construction of an auxiliary torpedo station at Biddicks Bay in 1886. This facility was located immediately west of Bastion Point, on the south shore of Waitemata Harbour directly opposite North Head. Both depots formed opposite ends of a stationary mine field that was to be deployed across the harbour entrance during times of conflict (Mitchell 1995: 637). The Biddicks Bay installation featured several structures necessary for the deployment and upkeep of a static torpedo field, including a guncotton tank, loaded mine store, and mine primer test pit. All were built on a small area of reclamation that also featured a wooden jetty from which Auckland's single mine-laying steam launch, *Isabel*, could take on and deploy stationary mines. Although well outfitted for its role, the auxiliary depot was in an isolated location that military officials felt left it vulnerable to both the elements and enemy fire. Consequently, it was decommissioned in 1896 and its facilities subsequently dismantled and amalgamated with the depot at Torpedo Bay (Mitchell 1995: 674; Cooke 2000: 112; Corbett 2003: 36-37; Plowman 2008: 21).

Construction of the nucleus of what would become 'the only comprehensive, professionally laid-out submarine mining facility in New Zealand' commenced in 1886 on a small portion of Torpedo Bay's eastern foreshore (Cooke 2000: 112; Plowman 2008: 23). Originally, the station comprised a static mine store, workshop, and office—all of which were constructed upon compulsorily acquired land measuring one-sixth of an acre, as well as an adjacent zone of reclaimed foreshore (Figure 24). Upon completion of the initial construction phase in 1887, the facility covered an area of one rood (one-fourth acre). An L-shaped wooden jetty extended southwards from the depot into the bay for a distance of 110 feet (33.5 metres) and featured a two-tonne crane and davits to outfit *Waitemata* with its complement of motive torpedoes. Despite its considerable length, the jetty only provided eight feet (2.4 metres) of water at its head at high water, and was completely dry at low water. Even more inexplicable was the relative inaccessibility of the torpedo boat and its facilities (Figure 25), which were located approximately one kilometre west of the main submarine mining station (Mitchell 1995: 682; Cooke 2000: 112; Plowman 2008: 19).

By 1891, existing structures at the Torpedo Bay submarine mining facility comprised a Whitehead torpedo store, offices with two rooms and outbuildings, a general store, two fitting rooms with benches, a blacksmith's shop and forge, and a workshop. The station also featured a building subdivided into seven rooms that served as living quarters for on-duty personnel. All of these structures were timber-framed and clad in corrugated iron; where necessary, some were also timber-lined on their interior walls (Bell 1891; Mitchell 1995: 644-645).

Figure 24. Torpedo Bay Submarine Mining Station, ca. 1888. Note the water level at the jetty head (in centre-right of image), and reclaimed land upon which the station's buildings were constructed. Image courtesy of the Sir George Grey Special Collections, Auckland Libraries (Accession No. 4-2970).

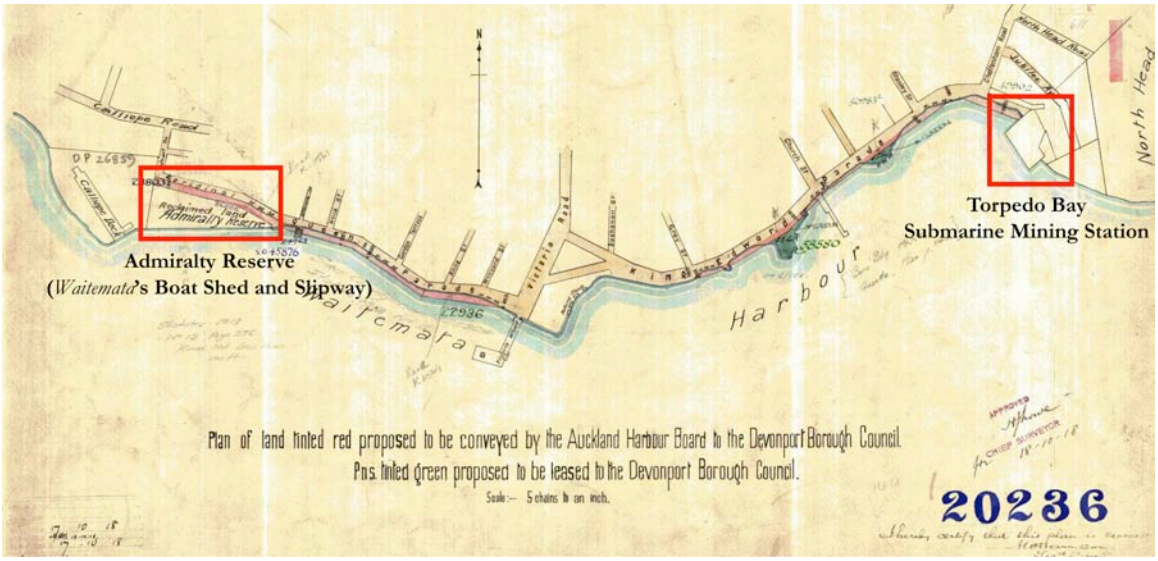

Figure 25. 1918 surveyor's map of the North Shore of Waitemata (Auckland) Harbour, showing relative locations of the Torpedo Bay Submarine Mining Station and Admiralty Reserve (which housed the first boat shed and slipway constructed for the torpedo boat *Waitemata*). Image courtesy of the Auckland Regional Council (Accession No. SO-20236).

The decision to abandon the auxiliary submarine mining station at Biddick's Bay meant the Torpedo Bay facility became the sole means by which Auckland's torpedo defences could be deployed in the event of war. Military officials, including Commandant of

New Zealand Forces Colonel John Francis Fox, recognised that the surviving installation was certainly the best designed and constructed in the colony, but was also apparently 'valueless' to the city's defensive needs in its 1891 configuration (Fox 1893: 4). As a consequence, several proposals were put forth to expand and improve the base, including a suggestion that it be relocated elsewhere. Ultimately, further reclamation was identified as the simplest and most cost effective option, and an additional half-acre of property was created within Torpedo Bay with spoil generated from defence-related excavations at North Head in 1896. The reclaimed material was prevented from eroding into the surrounding waters by a seawall faced with stone recycled from recently dismantled structures at Biddick's Bay (Appendices to the Journals of the House of Representatives [hereafter AJHR] 1897; Mitchell 1995: 648; Corbett 2003: 37; Plowman 2008: 22).

Although the submarine mining depot's land area increased approximately twofold through reclamation activities between 1886 and 1896, this does not appear to have had an immediate influence on the disposition of the boat shed and slipway for *Waitemata*. These structures and the vessel they supported were still located at the Admiralty Reserve in 1892, when the colonial navy relinquished the property to the Devonport Borough Council. Upon realising that the boat and its amenities would have to be moved to another locale as a result of their decision, the naval hierarchy advocated a site closer to the Torpedo Bay depot (NANZ: AD 33/1, Appendix A). However, by the following year the boat shed and slipway still had not been relocated, and Commandant Fox noted that a proper replacement was needed for the latter structure, which he described as 'useless' (Fox 1893: 18). Among other things, the slip's location and design prevented *Waitemata*'s launch during unfavorable weather or at any tidal stage other than maximum high water. In one instance, inclement conditions prevented the torpedo boat's operation for nearly three consecutive weeks, while

another storm in May 1887 necessitated that both *Waitemata* and its shed be 'lashed down to piles' (Mitchell 1995: 682; Cooke 2000: 112).

Reclamation activities at the Torpedo Bay station were completed by 1899, as were a number of new structures, including two recessed cable tanks built of concrete, an observing station, mine test room, and a new barracks. Additionally, the preexisting office was enlarged, and a loaded mine store, priming pits, and a connecting-up shed were all in the final stages of construction. The troublesome jetty was dismantled during reclamation activities, and its replacement subsequently built at the southwest corner of the station. The new structure was built of wood and extended into Torpedo Bay for a distance of 100 feet (30.5 metres) before terminating in a T-shaped head. Although 10 feet (3.0 metres) shorter than its predecessor, the jetty's placement at the seaward end of the most recent episode of land filling meant that it actually extended much further into the harbour from the original shoreline. Consequently, it now offered sufficient mooring depth to *Waitemata* and *Isabel* at all tidal stages (Mitchell 1995: 660; Cooke 2000: 112; Plowman 2008: 23).

During the final phase of the torpedo station's construction, a wood and corrugated metal boat shed measuring 65 feet by 30 feet (19.8 by 9.1 metres) with accompanying slipway was built immediately to the east of the new jetty. An 1897 plan of proposed alterations to the facility reveals that a boat shed measuring 75 feet by 20 feet (22.9 by 6.1 metres) with accompanying slipway was to be constructed for *Waitemata* on the western side of the jetty, but these structures never moved beyond a concept on paper (Mitchell 1995: 656). Consequently, some researchers (Mitchell 1995: 656; Plowman 2008: 23) have inferred that the completed boat shed was built specifically to house *Isabel*; however, no documentary evidence exists to confirm this supposition.

As discussed elsewhere in this thesis, the hulls of Thornycroft Second Class torpedo boats were highly susceptible to corrosion when exposed to seawater, and needed to be slipped when not in use in order to minimise hull fatigue and prolong the life of the vessel. By comparison, *Isabel* was a wooden-hulled sailing boat that was converted to a steam launch in 1886, and so would have been in far less need of regular slipping and hull maintenance. In addition, the size of the boat shed in its completed configuration was significantly larger than its proposed 1896 dimensions of 40 feet by 20 feet (12.2 by 6.1 metres, see Mitchell 1995: Fig. 9.6). Given these observations, and the fact that the extant boat shed could have accommodated *Waitemata*, it seems likely that it was frequently—if not exclusively—reserved for the use of the torpedo boat.

The minefield defences associated with the Torpedo Bay station were finally judged to be in 'a good operational state' by 1904, but in an ironic twist were discontinued only three years later to conform to evolving British imperial policy (McGibbon 1991: 152; Mitchell 1995: 656; Corbett 2003: 37). Equipment associated with the static mine array was placed in storage in the facility's various buildings, and the mining launch *Lady Roberts*—purchased in 1902 to replace *Isabel*—was reassigned to Dunedin. By April 1900, *Waitemata* had outlived its usefulness to such an extent that it was no longer being repaired or maintained, and at least one military officer commented it would soon end its days in a breaker's yard (Royal New Zealand Navy Museum [hereafter RNZNM], D1900/811).

The ultimate fate of the torpedo boat is unclear in the archival record, although theories abound in secondary historical sources. Two (McGibbon n.d.: 6; Wallace 1967: 4) posit that it was dismantled for scrap either by August 1904 or between 1910 and 1913, while a third (Gibson 1968) claims the vessel was dismantled in 1898 and its engines and boiler subsequently sold to a sawmill. Oral tradition in Devonport states *Waitemata* was

stripped of its machinery and equipment, discarded, and eventually buried in the former Admiralty Reserve (now known as Windsor Reserve) with the hulks of several 'old ferry boats' (Mitchell 1995: 682). Incredibly, the original torpedo boat shed and slipway that proved so troublesome appear to have outlived the torpedo boat and were reportedly still located at the Admiralty Reserve as late as 1914. It is unclear from archival sources whether these structures were used in conjunction with *Waitemata* or any other vessels—military or otherwise—in the final years of their existence (Mitchell 1995: 682, 685).

In the wake of the abolition of Auckland's minefield defences in 1907, the submarine mining installation at Torpedo Bay was transferred to the control of the Royal New Zealand Army (RNZA), renamed the Electric Light Yard, and used by units of both the RNZA Engineers and Field Artillery. During the First World War, a number of buildings at the station were converted into detention cells and housed German prisoners of war, including the crew of the German commerce raider SMS *Seeadler* and its commander, Count Felix Graf von Luckner (Mitchell 1995: 662; Plowman 2008: 24). By the 1920s, several structures had been refurbished and were used to accommodate army stores, as well as naval ammunition. Surprisingly, a large amount of equipment and explosive material associated with former submarine mining activities, including 789 pounds (358 kilograms) of dry guncotton and 13 tonnes of wet guncotton, were still being stored in subterranean magazines on the base as late as 1922, when they were declared 'entirely obsolete and useless for defence purposes' (NANZ: AD 10, 16/24, 22/2/1922). In 1933, 10,899 pounds (4,944 kilograms) of the total guncotton store still had not been sold or otherwise disposed of, and was ordered dumped at an unspecified offsite location (Mitchell 1995: 662-665; Corbett 2003: 37).

Army control of the former torpedo station continued through the Second World War, during which time it was utilised primarily as a storage area for military supplies and

matériel. Repairs to several of the buildings occurred in the immediate pre-war years (1934-1938), and the jetty was either repaired or rebuilt on at least four separate occasions between 1913 and 1948. Around 1958 the RNZA moved its field artillery operations to nearby Narrow Neck camp, and relinquished command of the Torpedo Bay site to the Royal New Zealand Navy (RNZN). As recently as 2008, naval use of the facility was limited primarily to offices for the RNZN Band and Naval Auxiliary Sailing Club, and the vast majority of extant structures were in relatively good order. Only a handful of buildings, including the Whitehead torpedo store, forge, offices, and barracks, were demolished in the wake of the 1958 transfer, and their respective footprints were until recently occupied by modern offices and sealed parking areas (Mitchell 1995: 669; Corbett 2003: 37; Plowman 2008: 27, 2009: 25-26). Towards the end of 2008, the former submarine mining station at Torpedo Bay was chosen as the new site for the Royal New Zealand Navy Heritage Centre and Naval Museum. In a ceremony attended by several prominent individuals, including New Zealand's Prime Minister, the Right Honourable John Key, the Museum officially opened to the public on 9 October 2010 (*The Aucklander*, 8 October 2010).

Archaeological Investigation of the Torpedo Bay Submarine Mining Station

In 1994, the submarine mining station at Torpedo Bay was archaeologically surveyed as a component of a doctoral thesis research project conducted by John Mitchell of the University of Auckland (see Mitchell 1995). Although the primary thrust of Mitchell's study involved the acquisition, analysis, and interpretation of previously unstudied archival plans and other documents associated with the facility's construction and occupation, he also conducted a visual inspection and assessment of the site's surviving architectural features (Mitchell 1995: 6-7, 669). He observed that several key structures built (or renovated) during

the station's 1899 expansion, including the wharf, boat shed, connecting-up shed, test room, and mine stores, were all in relatively good order, although the majority were being utilised as offices, workshops, or storage space. Other buildings and architectural features, including all those associated with the original 1886 depot, were either completely demolished or their remnants buried beneath modern building construction and/or automobile parking areas (Mitchell 1995: 669). Visible components of the off-site boat shed and slipway constructed for *Waitemata* also appear to have been victims of redevelopment, although Mitchell did not discount the potential for buried archaeological signatures of these structures within the Windsor Reserve (Mitchell 1995: 685).

Following the Royal New Zealand Navy's 2008 announcement that the Torpedo Bay station was to be the future site of its Heritage Centre and Naval Museum, plans were initiated to redevelop the property and its associated facilities. Because infrastructure upgrade activities conducted as part of the proposed development plan were predicted to impact archaeological features associated with the torpedo facility's earliest phases of construction and occupation, consulting firm Opus International Consultants, Ltd. [hereafter referred to as Opus International] was commissioned to conduct a cultural heritage assessment of these areas (Plowman 2009: 2). In June 2008, archaeologists and built-heritage specialists affiliated with Opus International conducted a visual pedestrian survey within the former submarine mining station's boundary, and assessed surviving elements of the stone seawall along its southwestern perimeter. Sub-surface investigations were not conducted during the survey due to the presence of asphalt and standing structures throughout the site; however, two small sand beaches at its northern and southern ends were inspected for the presence of diagnostic artefacts (Plowman 2008: 5, 25-32).

Opus International's 2008 investigation revealed that only five structures directly associated with the Torpedo Bay submarine mining station survived into the modern era (Plowman 2009: 37-41). All were constructed as part of the facility's 1896-1899 expansion and include the loaded mine store, loading shed, connecting-up shed, testing and fitting room, and test room (Figure 26). The submarine mining cable pond is visible in aerial photographs from the 1930s and also still exists, but was buried as part of development activities at the site in the mid-to-late twentieth century (see Plowman 2009: Figures 29-31). Although associated with the 1899 construction phase, the boat shed and slipway located at the southeast end of the site was not included within Opus International's survey because these structures did not fall within the Naval Museum's development footprint (Plowman 2009: 48).

The 1930s-era photographs also reveal that three of four structures associated with the station's original 1886 layout were extant during the early decades of the twentieth century; however, all were subsequently dismantled, demolished and/or buried, and are no longer visible. Further, archaeological remnants of these features were almost certainly impacted by excavation of utilities trenches throughout the northwestern portion of the site during the twentieth century (Plowman 2009: 39). Nonetheless, Opus International concluded that the site's potential for retention of intact *in situ* sub-surface features and/or material culture was high, and cited a 2002 instance in which intact archaeological remnants that pre-dated the submarine mining station's 1899 construction phase were revealed during an earthworks project (Plowman 2009: 23, 65).

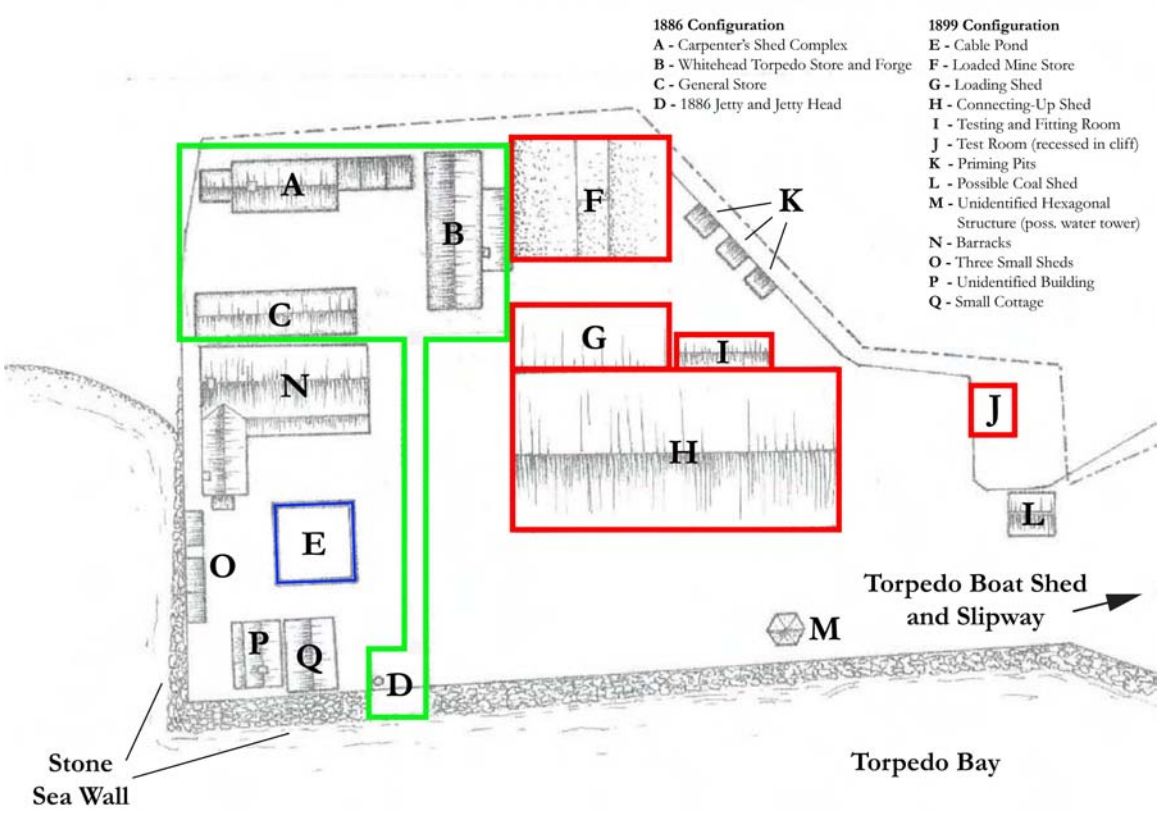

Figure 26. Plan of completed 1899 submarine mining station at Torpedo Bay (after Plowman 2009: 41), showing location(s) and outline of 1886 base and jetty (highlighted in green). Extant buildings are highlighted in red, while the location and outline of the buried cable pond is highlighted in blue. Aboveground components of all remaining structures were removed during the twentieth century. Base image courtesy of Opus International Heritage Consultants.

The author's investigation of the Auckland-based station took place in November 2008, during a research trip to acquire archival and archaeological data associated with New Zealand's early torpedo defences. The Auckland visit corresponded with a maritime archaeology training course hosted by the Australasian Institute for Maritime Archaeology and the Nautical Archaeology Society (AIMA-NAS) at nearby North Head; as a consequence, it employed the assistance of AIMA-NAS trainees to document some of the torpedo station's extant structures as a component of the course's site survey/field mapping exercise. Due to time constraints, students were directed to focus their attention on the surviving boat shed and slipway, as these structures appeared to have undergone the least

amount of physical change since their construction (or renovation), were not in active use at the time of the mapping project, were not among the extant buildings included in Opus International's June 2008 archaeological survey, and were most likely to have been directly affiliated with the station's torpedo boat defensive system (Figure 27).

Figure 27. Aerial photograph of the Torpedo Bay Submarine Mining Station, showing the facility's perimeter (outlined in red) and extant structures documented during the 2008 survey. Inset map shows the site's proximity to Auckland. Base images courtesy of Google Maps and Google Earth.

Baseline-offset and tape-and-compass mapping of the boat shed and slipway was complemented with a total station survey of both structures and digital photography of specific architectural features of interest. In addition, photographs were taken of other

buildings within the station, including the remnants of a stone bathing pool located immediately adjacent to the boat shed and slipway. The pool was once associated with the submarine mining station's bathhouse, and while not directly relevant to the torpedo boat defensive system, is a singularly unique attribute among the sites investigated as part of this thesis project. Consequently, AIMA-NAS participants were directed to document it as well as part of their mapping exercise.

Abandonment Attributes of the Torpedo Bay Submarine Mining Station

The submarine mining establishment at Torpedo Bay is unique among the sites investigated as part of this thesis project because it is the only example that still retains much of its original infrastructure and construction fabric, including a number of wood-framed buildings clad in galvanised iron sheeting. Most of these structures have been altered and reused in a variety of secondary roles over the course of their existence. Although relatively intact, the station also exhibits some material evidence of discard and abandonment, particularly among specialised buildings and structures associated with its nineteenth-century role(s) in submarine mining and torpedo boat defence.

Of the four structures that comprised the Torpedo Bay station's original 1886 configuration, only two—the Whitehead torpedo store and general store—survived into the twentieth century in their original form. By contrast, the carpenter's shed complex was largely dismantled, as was a significant portion of the original jetty, although articulated remnants of the wooden head constructed at the seaward end of the latter were uncovered and identified during Opus International's 2009 archaeological investigations (Figure 28). In 1886, a two-tonne crane was mounted to the jetty head; during expansion of the torpedo station in 1897, this structure was separated from the rest of the jetty, partially buried in land

reclamation, and 'converted' into the crane's base (Ken Phillips, pers. comm., 1 December 2011). The jetty head was originally retained so the crane could remain in operation during the station's expansion, but appears to have continued in the same capacity until at least the 1920s. Ultimately, the crane and the structural timbers to which it was through-bolted were cut away and removed during the 1930s (Ken Phillips, pers. comm., 29 November 2011).

After 1958, the torpedo station's remaining 1886 buildings were demolished to make way for new facilities associated with the RNZN Band and Naval Auxiliary Sailing Club. It was at this time that surviving elements of the jetty head were buried and incorporated into the foundation of the clubhouse constructed for the latter organisation (see Figure 28). The same development activities also resulted in the demolition of multiple structures associated with the torpedo station's 1899 expansion, such as the barracks and torpedo priming pits. Significantly, none of the 1886 and 1899 structures were utilised in primary defensive roles following the station's transfer to RNZA control in 1907, and instead appear to have been relegated to secondary functions, including use as detention cells for prisoners of war or storehouses for various forms of military matériel. Ironically, much of the latter included the former torpedo station's complement of static mines, mining cable, and wet and dry guncotton (Mitchell 1995: 660-661). As time progressed, these items appear to have been largely overlooked or abandoned. Although decried for its general obsolescence and uselessness in the early 1920s, a large percentage of the guncotton remained at the station until well into the next decade. By the 1950s, when the installation reverted to naval control, all vestiges of submarine mining equipment and matériel had been removed, and the buildings that remained on site were either derelict or used as storage and/or office space.

Figure 28. Remnants of the Torpedo Bay Submarine Mining Station's 1886 wooden jetty head, as exposed during archaeological investigations in 2009. Image courtesy of Opus International Heritage Consultants.

Five structures built during the torpedo station's 1899 expansion remain extant today. These include the loaded mine store, loading shed, testing and fitting room, connecting-up shed, and test room (Plowman 2009: 41). With the exception of the connecting-up shed, loading shed, and testing and fitting room—all of which are essentially components of the same wood-framed/corrugated metal building—the surviving structures are of robust concrete construction, partially or completely recessed within the site landscape, or feature a combination of these attributes (Figures 29 and 30). For example, the test room was excavated into the cliff that abuts the eastern boundary of the torpedo station, and constructed of plastered brick walls capped by a concrete roof reinforced with railway sleepers (Mitchell 1995: 669; Pearson 2009: 7). As recently as the 1990s, the majority of these buildings were engaged in a variety of non-defence roles. The test room was used as a carpenter's shop, while the connecting-up shed was partitioned into offices and boat storage

(Mitchell 1995: 669). The 1899 jetty, which has been rebuilt and repaired numerous times since it was first constructed, is currently utilised almost exclusively by the local fishing and boating public.

Figure 29. The former connecting-up shed at Torpedo Bay as it appeared in November 2008, showing wood-framed/corrugated sheet metal construction typical of most of the submarine mining station's 1886- and 1899-era standing buildings.

Dismantled and/or abandoned elements of the Torpedo Bay station include the boat sheds and slipways constructed for the torpedo vessel *Waitemata*, in-ground tanks for the storage of submarine mining cable, and a previously undocumented system of tramlines and tramline turntables that were instrumental in transporting stationary mines and motive torpedoes from their respective storage areas to the jetty for deployment. The first boat shed and slipway built at the Admiralty Reserve apparently outlived *Waitemata* by a number of years, but both structures were ultimately dismantled and most—perhaps all—their constituent elements subsequently removed off site. Mitchell (1995: 685) did not observe remnants of either structure during his survey, nor were they evident during inspection of the Windsor (ex-Admiralty) Reserve in 2008. As this area has been subject to repeated

episodes of extensive foreshore development, it seems likely few if any archaeological indicators of the shed and slipway have survived to the present day.

Figure 30. The Torpedo Bay station's former test room, as it appeared in November 2008. This subterranean structure was built into the cliff face and originally used to test torpedo detonators and other explosive devices. Entrance to the test room was through the yellow door just inside the fenced enclosure.

By contrast, the boat shed and slipway located at the southeast corner of the submarine mining station were still largely intact in 2008, although these structures also bore obvious signs of disrepair, salvage, and subsequent abandonment (Figure 31). Advanced corrosion of the shed's corrugated metal fabric was clearly evident along the base of each of its walls, as well as among portions of the roof eaves. Additionally, its original complement of roof-mounted skylights was absent and the apertures that once housed them closed to the elements with rough-cut sections of corrugated iron sheeting. Corrugated metal 'patches' were also used to close off all of the shed's wall-mounted windows, while the loading doors at either end of the building were sealed shut with plywood sheets (see Figure 31).

Figure 31. The second boat shed and slipway constructed for the Torpedo Bay Submarine Mining Station, as it appeared in November 2008. Note heavy corrosion along the base of the shed's corrugated metal walls, the use of metal sheeting and plywood to seal the windows and front door, and the presence of rubbish and other debris on the slipway.

The boat shed's derelict state is perhaps best represented by its wooden support piles, a number of which exhibit evidence of rot and subsequent breakage (Figure 32). Each pile features a corresponding footer formed from concrete poured into a steel 50-gallon (189-litre) drum. As a consequence of continual exposure to seawater, the metal fabric of these containers eventually disintegrated; however, their impressions survive today in the concrete footers they once encased (see Figure 32). During construction of the pile/footer assembly, each pile was either placed within its respective footer 'mould' first and then surrounded with wet concrete, or inserted into a drum already filled with the semi-hardened concrete mixture. Although seemingly protected by their footers, several of the piles nonetheless appear to have decomposed rapidly as a consequence of protracted exposure to alternating wet and dry tidal conditions. Degradation was particularly acute at the interface

where wood met concrete, and in a handful of instances this resulted in complete structural failure of the pile.

Figure 32. *Left*, concrete boat shed pile footer, as it appeared in November 2008, showing impression of steel 50-gallon drum 'mould'; *right*, broken and partially dislodged wooden boat shed pile. Note deteriorated condition of wooden pile in the latter photograph. Scales in 20-centimetre increments.

Similar damage was noted for at least one support pile associated with the slipway. The pile in question supports a section of slipway that is constructed entirely from wood and connects the front of the boat shed with a stone and concrete ramp that extends the slipway into the waters of Torpedo Bay. In addition to the damaged support pile, many of the slipway's other surviving architectural components exhibited signs of deterioration and disrepair (Figure 33). These included several heavily corroded iron fasteners, a variety of warped, cracked, and partially rotted wooden structural elements (including a skid plate that had become disarticulated from the stone and concrete ramp), and the slipway's rusted iron rails. An accumulation of rubbish and other debris along much of the slipway's length (where exposed above water) provided additional evidence of its protracted disuse and abandonment (see Figure 31). Mitchell (1995: 669) observes the boat shed and slipway were

in 'everyday use and…good order' in 1994; however, the extent of disrepair exhibited by both structures at the time of the 2008 survey would seem to suggest they were abandoned at some point during the following decade—and perhaps as early as the mid-to-late 1990s.

Figure 33. Underside of the Torpedo Bay Submarine Mining Station's extant slipway as it appeared in November 2008, showing deteriorated and damaged wooden pile (in centre of image). Note extensive iron staining on structural supports in foreground, as well as accumulated debris and rubbish.

Although still visible in 1930s-era aerial photographs (see Plowman 2009: Figures 29-31), the recessed concrete tank or 'pond' used to store the Torpedo Bay facility's submarine mining cable was subsequently buried beneath layers of infill and asphalt (Figure 34). Prior to abandonment and burial, it appears the cable pond was completely stripped of its machinery and fittings. These would have included an array of pipes and valves used to fill and drain the pond and several concrete or steel 'cones' around which the mining cable was wound when not in use. Several circular impressions located on the pond floor during Opus International's 2009 excavation of the site are thought to represent the latter feature(s), and

comprise the only surviving physical evidence of the pond's operating mechanisms (Ken Phillips, pers. comm., 13 May 2011).

Figure 34. Remnants of the Torpedo Bay station's submarine mining cable pond, as partially exposed during archaeological investigations of the site in 2009. Image courtesy of Opus International Heritage Consultants.

A similar fate befell the torpedo station's three primer test pits. Elements of these structures situated aboveground were demolished during the latter half of the twentieth century, and the remaining sub-surface pits completely filled with sediment and ultimately paved over with asphalt. Today, the only visible surviving components of the test pits are their concrete rear walls, which were poured against the cliff face that forms the station's northern boundary (see Mitchell 1995: Plate 9.12). Like the cable pond, the primer test pits were designed and constructed for tasks specific to Victorian-era submarine mining; consequently, they would have very likely had little—if any—practical application in other military roles. This shortcoming would have become even more acute and apparent as time

progressed, underwater ordnance technologies changed, and the Torpedo Bay station shifted from a primary to secondary (and eventually inactive) defensive function. Ultimately, what amounted to large useless holes in the ground were filled in and paved over in an effort to eliminate potential safety hazards and create space for car parks and modern buildings associated with the facility's later development phases.

Another aspect of the Torpedo Bay station's infrastructure that was abandoned and buried was its system of tramways. These rail lines once transported static mines and motive torpedoes from their respective storage areas to the jetty for deployment aboard *Waitemata* and *Isabel*. Archaeological remnants of these features include a single tramway associated with the station's initial 1886 construction phase, as well as a much more comprehensive and complex assemblage of concrete railway sleepers and iron 'turntables' laid down in conjunction with its 1899 renovation (Figure 35). Sections of the 1886 tramway were revealed during excavation of the general store and Whitehead torpedo store in 2009, and investigation of other site loci resulted in the discovery of multiple elements of the 1899 network (including three tramway turntables). Interestingly, the latter system proved 'more complex' in its final constructed form than it appeared in a series of 1896 maps and schematics originally proposed by the station's military planners (Mica Plowman, pers. comm., 26 November 2009; see also Mitchell 1995: Figures 9.6 and 9.8).

In a notable departure from practices adopted at the other torpedo station sites discussed in this thesis, the wooden and concrete railway sleepers used to construct the Torpedo Bay installation's tramway system appear to have been intentionally abandoned *in situ*, and subsequently buried and paved over. Further, many of the sleepers still retain their iron fasteners and other hardware. By contrast, the majority of surviving iron tramway rails comprise only 'those mounted in concrete platforms…[directly associated] with extant or

demolished buildings (Ken Phillips, pers. comm., 1 December 2011). All other rails appear to have been removed at the time the tramway network was abandoned, and some may have later been utilised to reinforce concrete floors laid down at the station after 1920.

Figure 35. Intact iron tramway 'turntable' uncovered during 2009 archaeological investigations at the Torpedo Bay Submarine Mining Station. Scale in 20-centimetre increments. Image courtesy of Opus International Heritage Consultants.

The presence of so many extant tramway sleepers is curious, as these components could very easily have been dismantled and reused in a primary or secondary capacity, or the wood, concrete and iron from which they were manufactured recycled for other purposes. It is even more unusual when compared to the near complete removal of the tramway's assemblage of iron rails. The archival record is silent regarding the RNZN's decision to abandon and bury most of the Torpedo Bay station's tramway network; however, general

obsolescence—in conjunction with limited reuse and/or resale value—may have been the most significant factors. In the wake of the facility's transfer to RNZA control and deactivation as a submarine mining base, the need for the tramway very likely would have diminished. Contemporary technological advances, such as shifts from human- or animal-powered modes of transport to mechanised systems, may very well have exacerbated this situation. For example, tramways specifically designed to utilise either steam, electricity, or cable-hauling mechanisms as motive power were introduced to Australia and New Zealand as early as the 1870s, and would have been in common use in both nations by the early 1900s (see Brimson 1983; Stewart 1985; Churchman and Hurst 1991). Whatever the rationale for its abandonment, by the 1930s the Torpedo Bay tramway system was largely—if not completely—buried and paved over, as evidenced by aerial photographs of the facility.

Magazine Bay Torpedo Boat Station

Although Lyttelton, New Zealand received the torpedo boat *Defender* in December 1884 as part of the colony's overall response to the Russian Scare of the early 1880s, at the time of the vessel's arrival specific facilities for its deployment and upkeep did not yet exist (*The* [Lyttelton] *Press*, 26 December 1884; Moffat 1996: 11-12). A submarine mining depot was included in the 1885 construction plans for Fort Jervois on Ripapa Island (near the mouth of Lyttelton Harbour), but the depot's buildings were used instead to house the convict labour responsible for constructing the fort. As originally conceived, the depot comprised a Whitehead torpedo shed, mine store, cable tank, workshop, and primer test pit (Moffat 1996: 19; Cooke 2000: 113). Curiously, a torpedo boat shed and slipway were not included among the planned structures.

In 1885, *Defender* was finally outfitted with its necessary support facilities; not at Ripapa Island as one might expect, but instead 4.2 kilometres to the northwest in a small embayment known alternately as Magazine Bay and Baker's Bay (Mitchell 1995: 207). Ripapa Island's planned submarine mining depot never eventuated due to lack of official support; its buildings were ultimately used to house convict labour rather than serve their intended purpose (Cooke 2000: 113). The boat shed at Magazine Bay was a wooden-framed structure with corrugated iron cladding that measured 70 feet (21.3 metres) in length, 13 feet (4.0 metres) wide, and was 12 feet (3.7 metres) high (Figure 36). The slipway comprised iron rails placed atop wooden piles, and featured a wheeled iron cradle to transport the torpedo boat from the shed to the water for launching. Both structures were constructed on the bay foreshore between the workshop and slipway of Lyttelton shipwright John Grubbs (Watson 2004: 6).

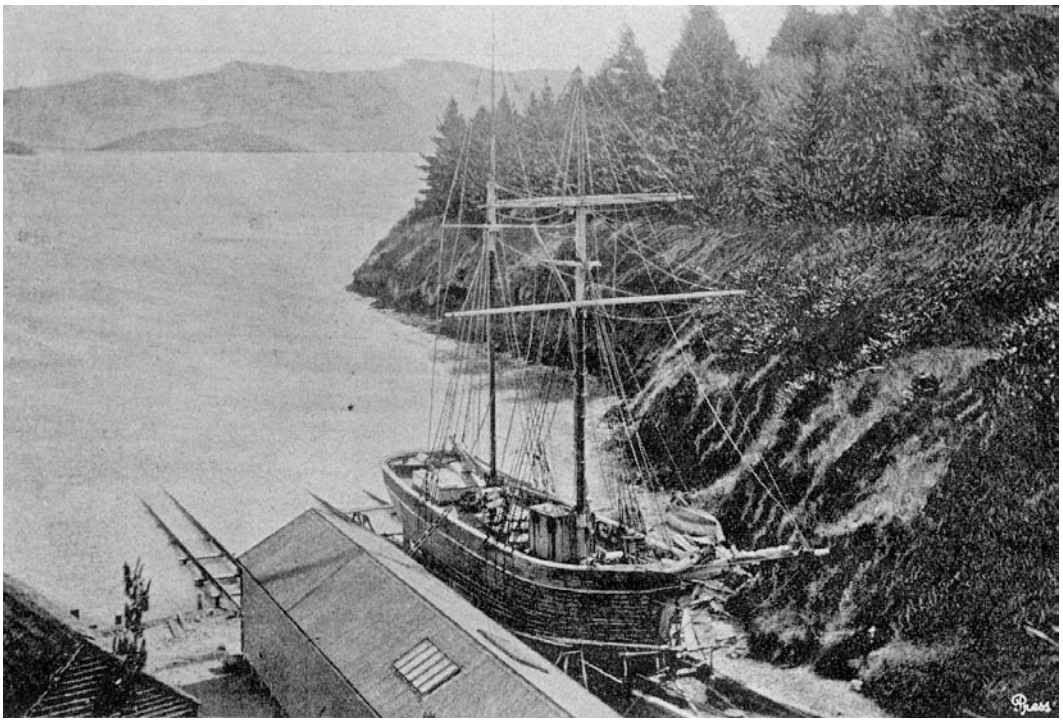

Figure 36. Photograph from *The* [Lyttelton] *Weekly Press* of 27 January 1897, showing the torpedo boat shed and slipway at Magazine Bay (in centre foreground). Image courtesy of the Thornycroft Torpedo Boat Museum (Accession No. TTBM/ILL/24).

In a March 1886 article published in the *Lyttelton Times*, a reporter took issue with the boat shed and slipway, stating these facilities were located in an 'exposed and out-of-the-way position', and that the inclination of the slip was so steep it imperiled the vessel's launch in anything less than calm seas (*Lyttelton Times*, 30 March 1886). In fact, the original slipway constructed at Magazine Bay apparently was too short to effectively launch *Defender*—even at high tide—and reportedly had to be extended by another 90 feet (27.4 metres) (Cooke 2000: 113). For reasons that remain unclear, it was not built to the length originally specified in a construction plan drafted for the torpedo boat installation in May 1885 (Figure 37).

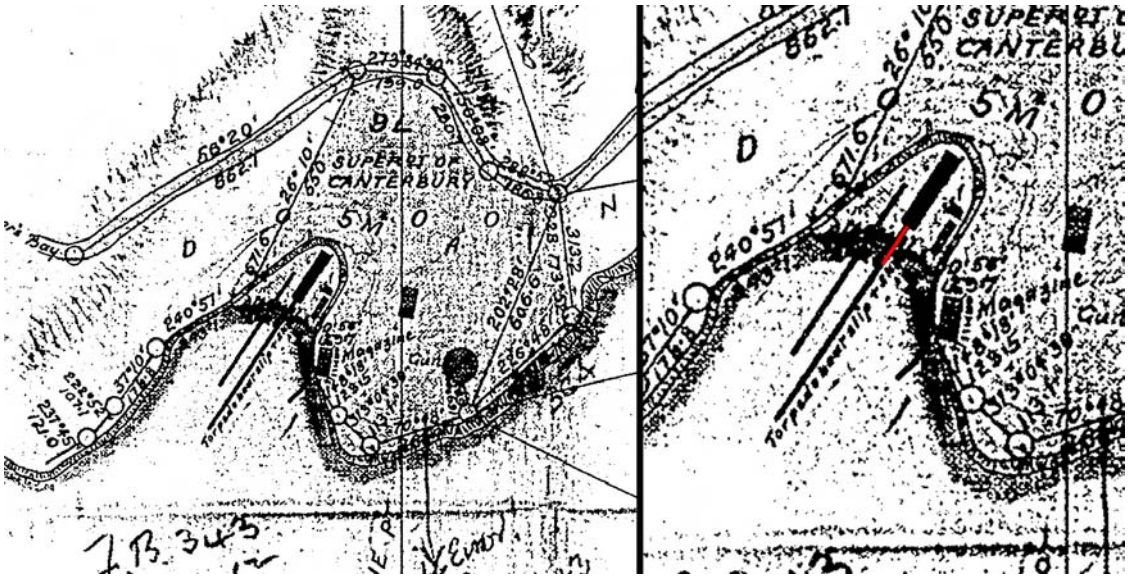

Figure 37. *Left*, Section of map entitled *Land Taken for Construction of Defence Works at Lyttelton, Provincial District of Canterbury* (11 May 1885), showing intended footprint for Magazine Bay torpedo boat shed and slipway; *right*, close-up of both structures, with as-built slipway length highlighted in red. As originally conceived, the slipway would have extended far beyond the bay's extreme low water mark. Image courtesy of the Thornycroft Torpedo Boat Museum [hereafter TTBM] (Accession No. TTBM/ILL/45).

Had these plans been followed, it seems likely tidal fluctuations at Magazine Bay would have had negligible impact on *Defender*'s launch and operation. Ultimately, even extension of the slipway apparently proved ineffective, as the torpedo boat spent the majority of the remainder of its service career moored in Lyttelton Harbour near the port's

dry-dock facilities (Cooke 2000: 113). The historical record is silent regarding the final disposition of the boat shed and slipway following *Defender*'s relocation to Lyttelton's inner harbour, although it is safe to assume that these structures were either dismantled outright, reused for a time and then removed, or abandoned and allowed to fall into disrepair.

Archaeological Investigation of the Magazine Bay Torpedo Boat Station

New Zealand-based consulting archaeologist Katharine Watson performed two investigations of Lyttelton's former torpedo boat shed and slipway in 2001 and 2002 (Watson 2004: 7). The purpose of these projects was to locate and identify the footprint of the boat shed and assist staff of the Lyttelton-based Thornycroft Torpedo Boat Museum (TTBM) in their efforts to interpret the site. The first phase of the project, conducted in November 2001, involved excavation of a one-metre square test pit within the hypothesized location of the shed's foundation, followed by a theodolite survey of the entire site, including the exposed stumps of slipway piles visible within the immediate foreshore. A second investigation, in May 2002, utilised a small mechanical excavator to expose an asphalt feature discovered the previous year (Watson 2004: 7-8; see Figure 40 below).

The initial excavation revealed a layer of asphalt at a depth of 1.03 metres below ground surface, as well as overlying layers of soil and sand capped with a 75-centimetre deep layer of fill that resulted from gravity-generated movement of sediment off hillsides surrounding the site (Watson 2004: 8). The asphalt layer was thought to form the original foundation of the torpedo boat shed; a proposed origin for the sand layer was either consecutive 'high tide and storm incidents dumping sand in the area' or intentional infill following the shed's demolition (Watson 2004: 8). The 2002 investigation expanded the area of excavation and confirmed the identity of the asphalt layer as the shed's foundation.

Additionally, archaeologists identified the full extent of the foundation's width (4 metres or 13 feet, 2 inches) on the side of the shed facing the bay, and revealed specific structural elements, including both wooden rail bearers and iron rail bolts at the junction where the shed connected with the slipway. The recorded distance between the bearers was 1.4 metres (4 feet, 7 inches); each bearer exhibited a maximum width of 12 centimetres (4.8 inches). According to Watson (2004: 8-9), significant outcomes of the 2001 and 2002 investigations included the discovery that the torpedo boat shed had an asphalt foundation, as well as the realisation that the structure's actual width was larger than that indicated by historical sources.

The author conducted a baseline-offset survey of the slipway's extant piles in November 2008 as a component of this doctoral thesis project (Figure 38). In a fortunate turn of events, this visit coincided with an extreme low tide event in Lyttelton Harbour on the 13th of the month, which permitted a thorough walkover inspection of the Magazine Bay foreshore, including areas that are submerged under normal tidal conditions. The furthest extant piles were located 28.5 metres from the seaward end of the asphalt foundation, which was partially exposed due to shoreline erosion (see Figure 40 below). All visible piles were square-hewn timbers—the best preserved of which measured 15 by 14 centimetres (6 by 5.5 inches)—and both pile lines were spaced apart an average of 2 metres (6 feet, 6 inches). The latter dimension corresponds well to *Defender*'s maximum breadth (7 feet, 6 inches or 2.3 metres), and helped confirm the identity of the slipway as that associated with the torpedo boat shed.

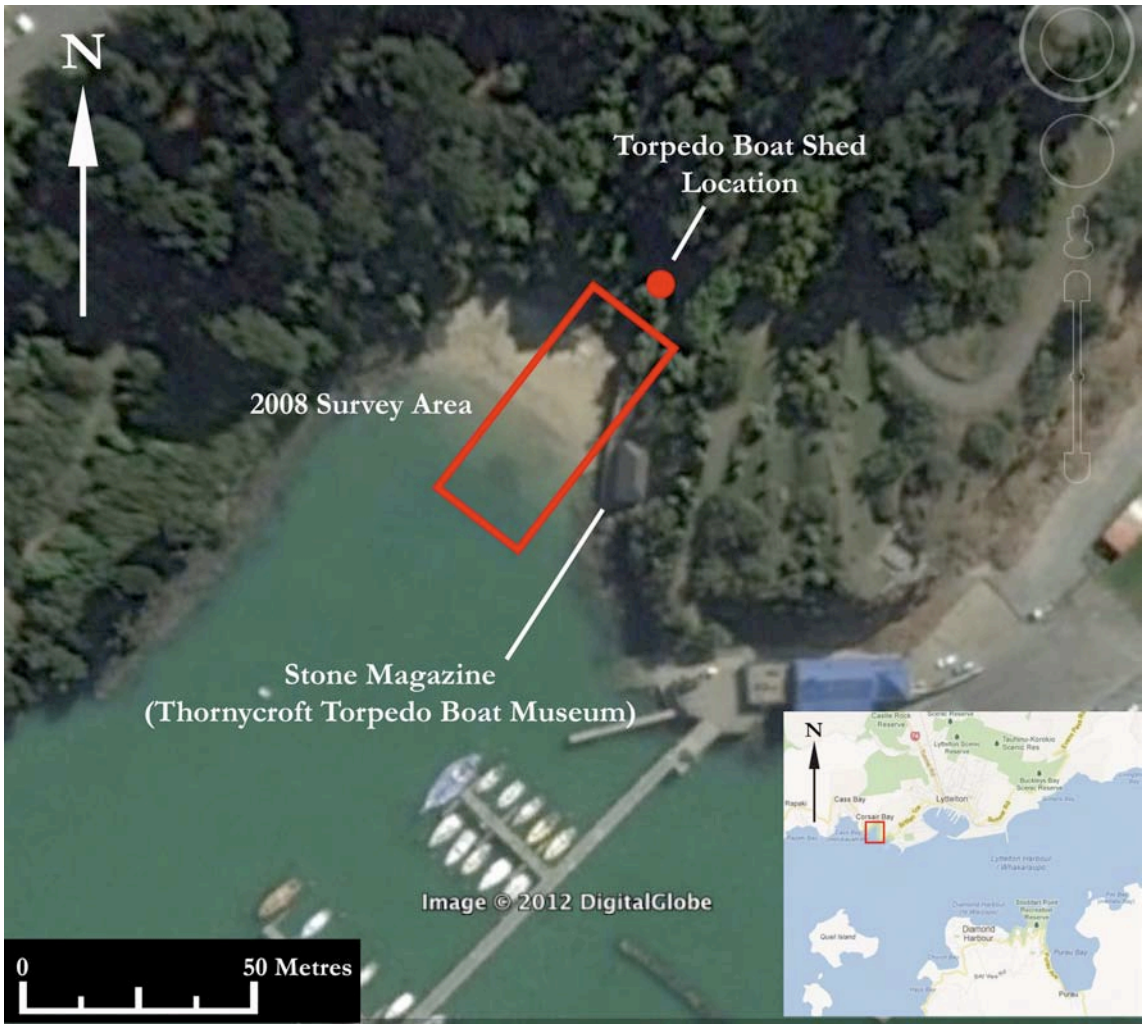

Figure 38. Aerial photograph of the Magazine Bay Torpedo Boat Station, showing the boundaries of the 2008 survey area, the location of the torpedo boat shed excavated in 2001 and 2002, and the historic stone magazine. Inset map shows the site's proximity to Lyttelton. Base images courtesy of Google Maps and Google Earth.

Abandonment Attributes of the Magazine Bay Torpedo Boat Station

As noted previously, the archival record is largely silent about the circumstances surrounding the deactivation and subsequent dismantling of the torpedo boat support facility at Magazine Bay. Consequently, data derived from the archaeological record serves as the only means by which inferences can be made about its process of abandonment. In most cases, archaeological signatures exist that are indicative of on-site activities directly associated with the abandonment event; however, some are also suggestive of long-term endemic

problems that may have culminated in the station's decline and eventual removal from active service.

The results of Watson's 2001 and 2002 excavations at the Magazine Bay station, as well as the 2008 survey, strongly suggest the majority of its standing structures were thoroughly dismantled and removed off-site immediately following deactivation. This is evidenced by the absence of architectural artefacts—or any cultural material, for that matter—in direct association with remnants of either the boat shed's foundation or the slipway. Although Watson (2004: 7) noted the presence of a 'small assemblage of twentieth century items' during her initial site excavation in 2001, these objects were later determined to have originated from a modern fill layer. Similarly, the 2008 survey failed to detect structural elements—such as slipway rails or fasteners—in the immediate vicinity of the surviving slipway piles and their junction with the former boat shed.

In fact, the site's only remnant architectural features comprise those that could not be easily dismantled or carried away intact. Removal of the boat shed's asphalt foundation, and the wooden rail bearers partially covered by it, would have necessitated their physical destruction through the use of hand tools, explosives, or mechanical means. These options were likely neither practical nor desirable to military officials. By the same token, the wooden pilings that once supported the slipway would have proven difficult to extract from the floor of Magazine Bay; consequently, the majority appear to have been left *in situ* at the time the station was dismantled and abandoned. However, it also appears an effort was made—either at the time of abandonment, or at some point thereafter—to reduce their potential as a hazard to navigation. Each remnant pile observed during the 2008 survey protruded only a few centimetres above the bay floor, and at least one example (Figure 39) clearly exhibited

what appear to be deep gouge marks on its upper surface, suggesting it was intentionally cut down with an axe or similar tool.

Figure 39. Wooden pile remnant associated with the Magazine Bay Torpedo Boat Station's slipway, showing cut marks indicative of intentional lowering. Scale is 30 centimetres in length.

The extreme low tide event that allowed access to the piles also may have revealed a significant flaw in the slipway design; specifically, that its overall length was inadequate to successfully launch *Defender* during periods of excessive low water. The last extant pile at the seaward end of the slipway fell short of the day's low tide mark by a distance of approximately 20 metres (Figure 40). In fact, the slipway may have been too short to launch the boat during a *regular* low water event, as the last extant pile is located slightly shoreward of a scour zone comprising exposed shell and rocks. According to TTBM staff, this zone denotes the 'normal' low tide line (David Bundy, pers. comm., 13 November 2008; John

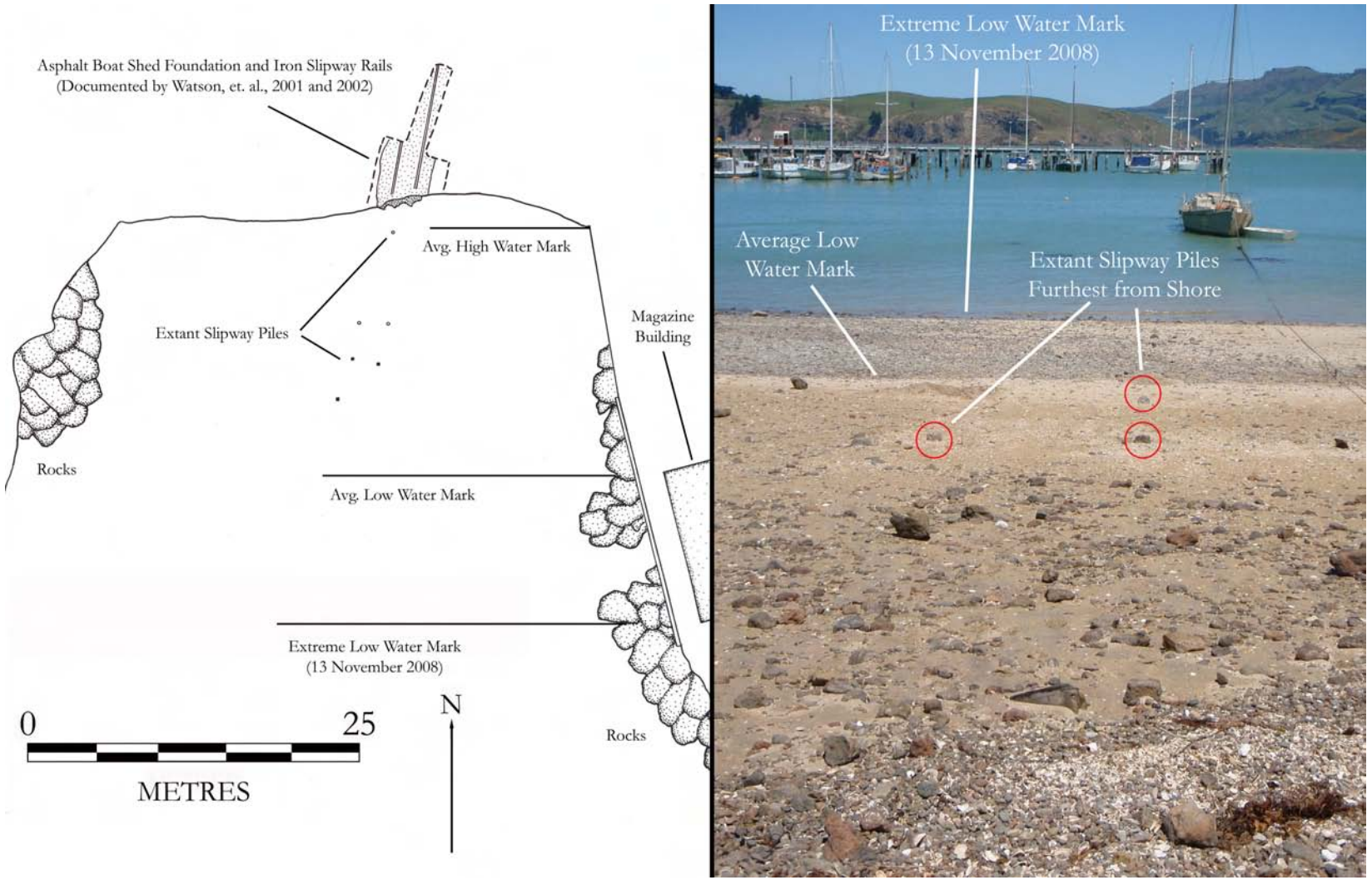

Figure 40. *Left*, site plan of the Magazine Bay Torpedo Boat Station, showing locations of the extant torpedo boat shed foundation, iron slipway rails, and wooden slipway pile stumps; *right*, foreshore fronting the Magazine Bay station, showing tidal level during the extreme low water event of 13 November 2008. Note the location of the furthest seaward slipway piles relative to the 'normal' (average) low water mark. Base map for site plan adapted from Watson (2004: 7).

Cleaver, pers. comm., 12 November 2008).

Of course, the possibility exists that slipway piles may have been placed in deeper water beyond the extreme low water mark, and their remnants are either no longer visible above the bay floor, or were removed via past activities such as waterway dredging associated with harbour development and improvement. However, if the slipway *did not* extend beyond the low water mark, such a marked deficiency in its design would account for *Defender*'s permanent redeployment to Lyttelton's inner harbour, which in turn had an effect on the torpedo boat station's very existence. With *Defender* gone, the shed and slipway were almost certainly no longer useful, providing Lyttelton's military administrators with the motive to either sell or dismantle one or both structures.

Magazine Bay's use as a defensive asset appears to have rapidly waned following *Defender*'s removal. An archival photograph thought to date to the first decade of the twentieth century depicts the wooden vessel *Lota* being broken up along the bay's western shoreline in close proximity to John Grubbs' boatyard (Figure 41). The stone magazine and its associated wharf are visible in the background, as are a number of structures at the top of the bluff overlooking the bay. Notable for its absence in the image is any evidence of the torpedo boat shed and slipway, including remnant piles protruding from the water. Another archival photograph (this one taken during the 1930s) shows a nearly identical scene, the only exceptions being the absence of *Lota*'s partially dismantled hull, and the presence of Grubbs' slipway in the lower left corner of the image (see Figure 41).

It is apparent that shipbuilding (or, at the very least, ship-breaking) activities were still being carried out at Magazine Bay for some time after the torpedo boat station was decommissioned. Because Grubbs' boatyard was located immediately adjacent to the station, and continued to operate in some capacity following its closure, it seems logical he would

have attempted to acquire and utilise a preexisting boat shed and slipway, were such an option available. The fact that neither structure is present in the historic photographs referred to above suggests they were not put up for sale, but rather dismantled and removed in the immediate wake of the station's deactivation.

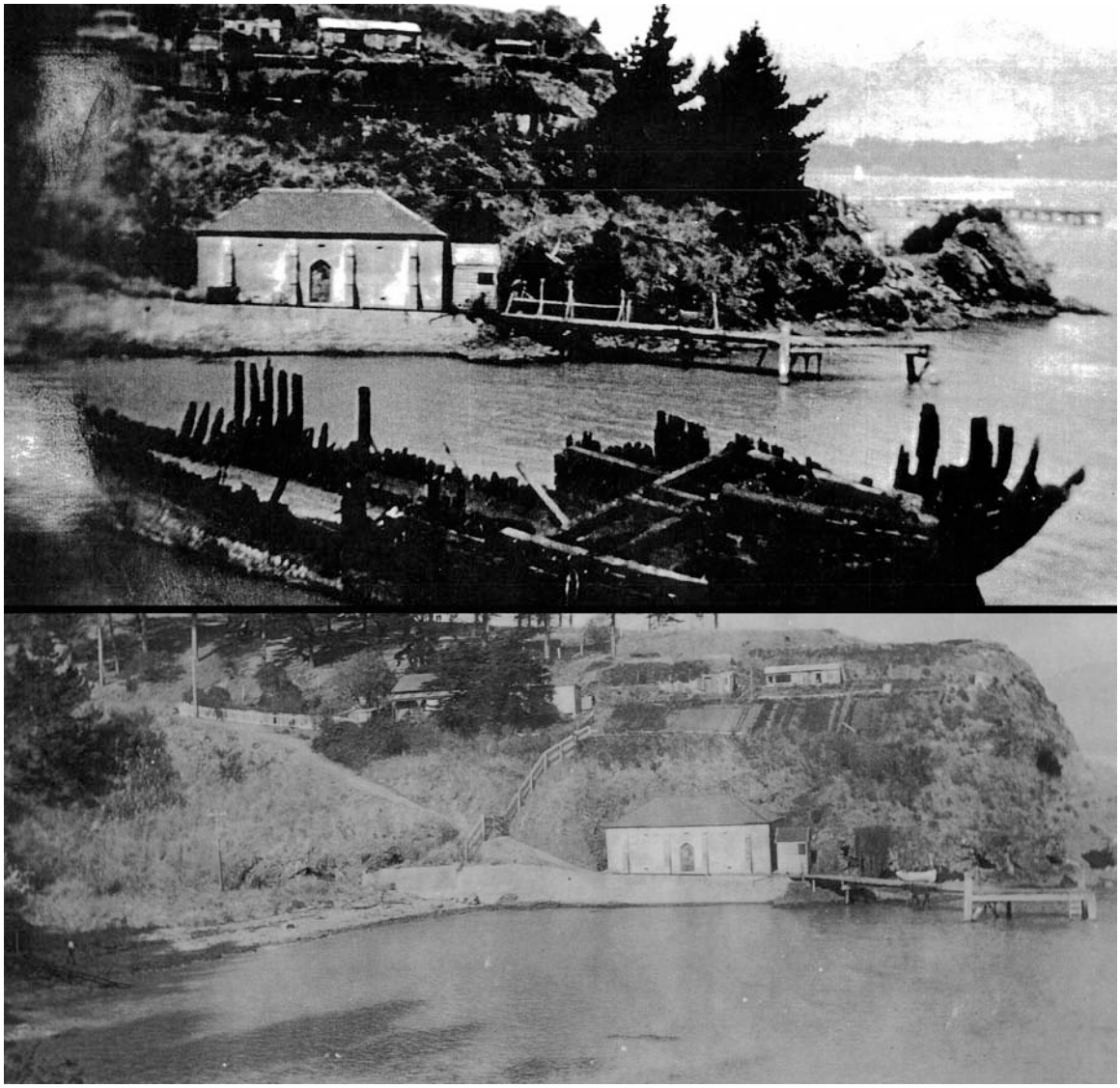

Figure 41. Magazine Bay around the turn of the century (*top*) and ca. 1930 (*bottom*). Note the complete absence of the torpedo boat shed and slipway in both photographs. Images courtesy of the TTBM (Accession Nos. TTBM/ILL/1 and TTBM/ILL/2).

Deborah Bay Submarine Mining Station

A submarine mining facility was constructed at Deborah Bay near the city of Dunedin, New Zealand, between 1886 and 1888. It originally comprised six corrugated metal-clad wooden structures, including a Whitehead torpedo store, connecting-up shed, primer test pit, workshop, general store, and combined office and barracks (Figure 42). A cable tank and 150-foot (45.7-metre) long wooden jetty fitted with a tramway for loading torpedoes and other military matériel aboard *Taiaroa*, the station's Thornycroft Second Class torpedo boat, complemented these buildings (Cooke 2000: 114). On the shoreward end of the jetty was a man-made mole, or breakwater, which served as a large open waterfront storage area and connected the jetty to the land-based elements of the station (Figure 43). The facility's stationary mines and cables were stored at Port Chalmers, and the test and firing rooms used to detonate them were established at nearby Harrington Point (Mitchell 1995: 237).

A unique attribute of the Deborah Bay station is that it never featured a boat shed or slipway—even though a torpedo vessel was assigned there as early as 1884. Historical sources note instead that *Taiaroa* was occasionally slipped and stored at privately owned Isbister's Slip in nearby Carey's Bay (Moffat 1996: 19; Cooke 2000: 114; Ledgerwood 2006: 86). Under normal circumstances, the torpedo boat was moored immediately adjacent to the mole and jetty where the torpedoes and other military stores were kept, but this arrangement only proved effective during high tide, as the depth alongside the jetty averaged 2.5 feet (0.8 metres) at low water (Cooke 2000: 114). Protracted mooring of the vessel in seawater also placed its thin galvanised steel hull at considerable risk from corrosion. Not surprisingly, corrosion-induced leaks were discovered below *Taiaroa*'s waterline in February 1896, and a

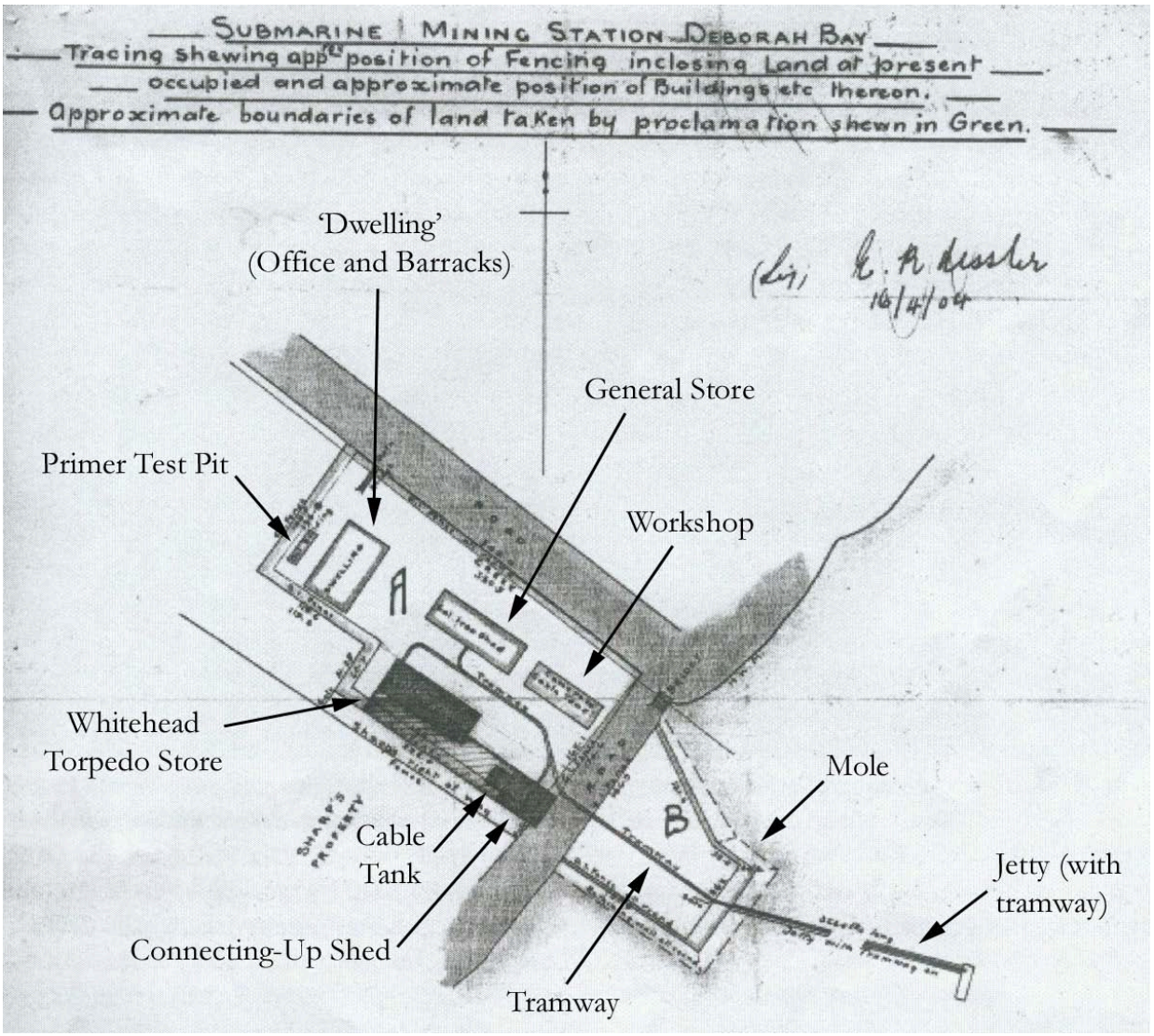

Figure 42. Early twentieth century map of the Deborah Bay Submarine Mining Station, showing the locations of standing structures, the jetty, and the mole. North is at the top of the image. Note the absence of both a boat shed and slipway for the torpedo vessel *Taiaroa*. Image courtesy of Archives New Zealand, Wellington (Accession No. W1-611/23/316).

subsequent petition was placed before Commandant Fox, requesting that a shed and slipway be constructed at Deborah Bay immediately. However, as the cost of constructing these facilities (£750) was more than the total amount of money allocated that year for Dunedin's harbour defence, the idea was ultimately scrapped. In lieu of a designated area to slip the torpedo boat, officials at Deborah Bay opted instead to lengthen the jetty during the latter half of the 1890s so that *Taiaroa* and the Defence Department's steamer, *Gordon*, could moor alongside it at low tide (NANZ: AD 1, 1903/2596, 18/2/1896; 3/12/1896; 4/5/1897; Moffatt 1996: 33; Ledgerwood 2006: 86).

Without its own designated shed and slipway, and access to Isbister's Slip intermittent at best, *Taiaroa*'s maintenance regime was severely limited. Suggestions by the Undersecretary of Defence that it be dragged onto the beach at Deborah Bay whenever its hull needed cleaning or repainting, while helpful, ultimately did little to defray the long-term corrosive effects of seawater on galvanised steel. By August 1905, when *Taiaroa* underwent an engineer's inspection in advance of being put up for sale, a shed and slipway still were not constructed. Not surprisingly, *Taiaroa*'s hull plates below the waterline by this time were reportedly 'very thin', although the vessel's overall condition was apparently 'the best…of all the torpedo boats in the Colony' (NANZ: AD 1, 1903/2596, 18/2/1898; AD 2, 1898/623, 13/2/1900; 13/11/1905).

In 1892, the Torpedo Boat Corps at Port Chalmers was disbanded, and the facility at Deborah Bay subsequently entered a protracted period of disuse and decline. The property was put up for lease by the Defence Department in 1903, but the government failed to negotiate a suitable rental agreement. By 1907, *Taiaroa* was reportedly a rusty hulk embedded in the Deborah Bay foreshore and the torpedo station was all but abandoned; however, another fifteen years would pass before an effort to dismantle and dispose of its various

structures finally got underway. In 1922, the jetty was completely dismantled, as was one of the large store buildings. The barracks and office were sold at auction in February 1926 for less than half their appraised value (£450), while the parade ground was tilled and converted into a vegetable garden. The remaining storehouse was sold to the Deborah Bay Presbyterian Church in 1923 and used as a church and community hall (Mitchell 1995: 237-240; Ledgerwood 2006: 86-88).

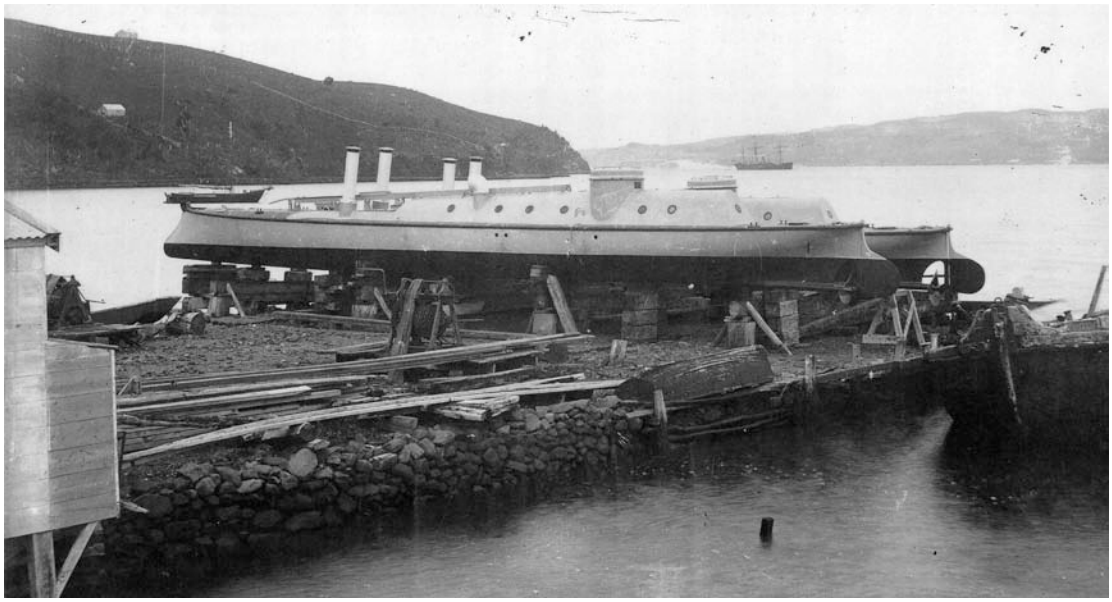

Figure 43. The Thornycroft-built Second Class torpedo boats *Taiaroa* and *Defender* atop the mole at the Deborah Bay Submarine Mining Station, ca. 1884. Image courtesy of the Alexander Turnbull Library, National Library of New Zealand (Accession No. G-003209-1/2).

Archaeological Investigation of the Deborah Bay Submarine Mining Station

University of Auckland doctoral student John Mitchell conducted a cursory examination of surviving elements of the Deborah Bay submarine mining station during his 1994 investigation of colonial-era fortifications around Otago Harbour (Mitchell 1995: 224-240). At the time of his visit, the former storehouse was still in active use as the Deborah Bay community hall, and retained much of its original fabric and appearance (see Mitchell

1995: Plates 3.84 and 3.85). The only other visible remnant of the facility was the mole built to connect the jetty with the remainder of the torpedo station. Utilised as a storage area and later a green-space in the years following the station's closure, it was no longer regularly maintained by 1994 and had become a *de facto* parking area for automobiles. Mitchell reportedly observed sections of the submarine mining station's tramway on the shoreline adjacent to the mole, but did not provide visual evidence of these features in his thesis (Mitchell 1995: 237).

The Deborah Bay station was the subject of this research project in November 2008, and surveyed as a component of an AIMA-NAS training course held at the University of Otago in Dunedin (Figure 44). As with the investigation of the Torpedo Bay site, the Deborah Bay survey enlisted the assistance of AIMA-NAS trainees to map extant features with a combination of baseline-offset and tape-and-compass techniques, as well as digital photography. The primary focus of the survey exercise was the mole, which comprises the one remaining intact feature associated with the submarine mining facility. In the wake of Mitchell's 1994 visit, the stonework that comprised its sides was re-pointed, and signage was erected that addressed the site's historical significance. In an ironic twist, the mole's upper surface was also paved over and the entire structure officially designated a car park. It continues to be used in this capacity today.

A pedestrian survey of the intertidal zone surrounding the mole was initiated in an effort to confirm Mitchell's statement that tramway elements were present at the site, as well as subsequent reports of a discrete scatter of miscellaneous iron objects visible within the nearby foreshore (David Bundy, pers. comm., 21 December 2008). The latter material was of particular interest, as speculation existed that it might represent hull components associated with *Taiaroa*'s discarded hull. The survey resulted in the discovery of multiple elements of

iron hardware, iron plating fragments, and a length of heavily corroded iron chain extending between the artefact scatter and adjacent shoreline. These objects were subsequently documented *in situ* and are discussed below. Finally, a group of AIMA-NAS students was directed to record remnants of Isbister's Slip due to its association with *Taiaroa*'s operation and upkeep. This project was conducted in conjunction with efforts to document surviving elements of discarded watercraft within Carey's Bay.

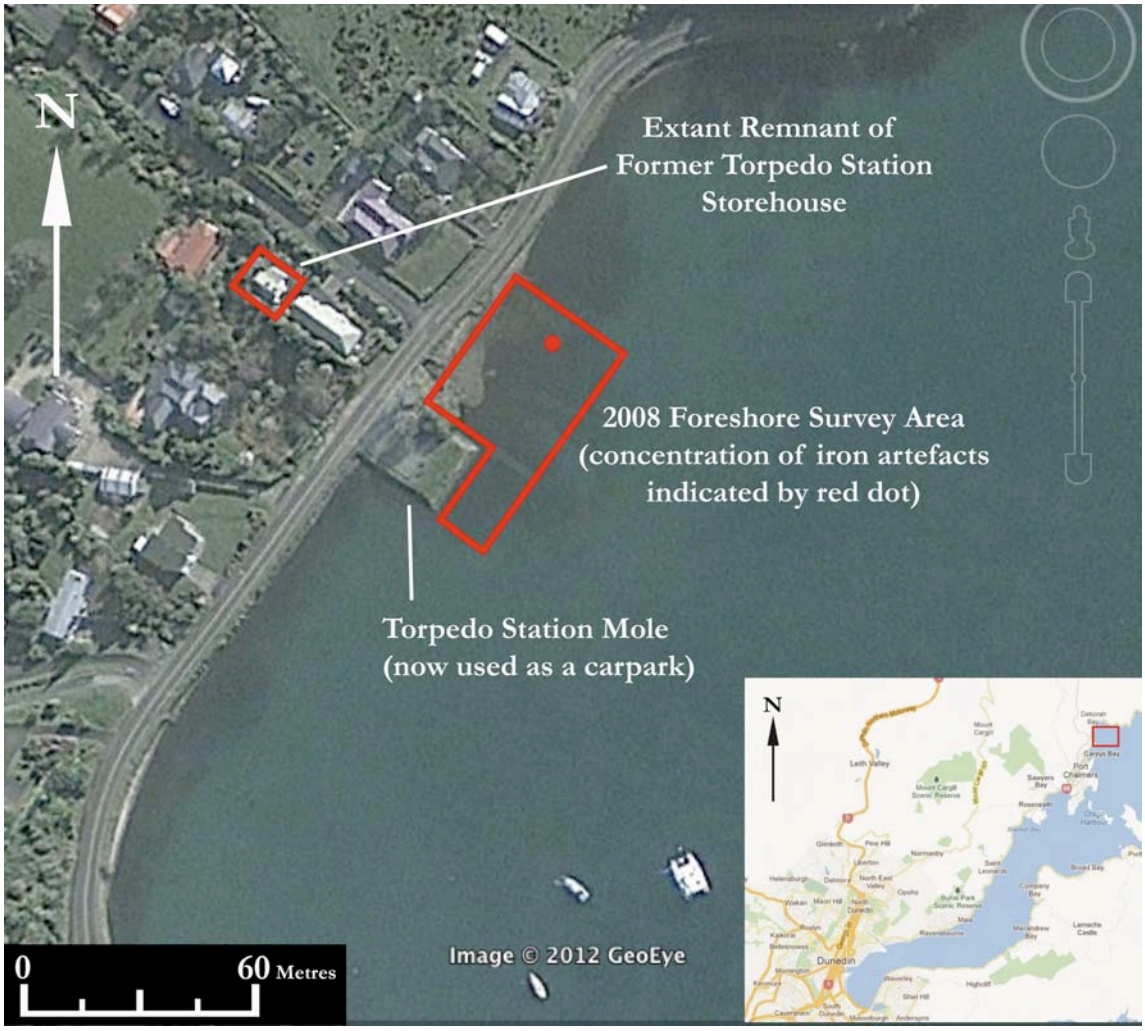

Figure 44. Aerial photograph of the Deborah Bay Submarine Mining Station, showing the locations of the torpedo station's mole and surviving section of the storehouse, as well as the boundaries of the 2008 foreshore survey. Inset map shows the site's proximity to Dunedin. Base images courtesy of Google Maps and Google Earth.

Attempts to record the former storehouse proved difficult, as it was no longer a community hall and instead under private ownership. Efforts to contact the property owner and obtain access to the building were unsuccessful. While this precluded detailed investigation of the entire structure, a visible portion was nonetheless photographed from a distance (Figure 45). Approximately half the storehouse was demolished during the late 1990s to clear a footprint for a new house. The surviving section remained largely derelict and was showing outward signs of deterioration during the 2008 investigation at Deborah Bay. Shortly after the 2008 survey concluded, Dunedin-based artist Rod Eales purchased the property upon which the former storehouse is located. Between 2009 and 2011 it was rebuilt with new construction materials—although some of the original timber beams and other structural elements were retained during renovation—and now serves as Eales' studio (*Otago Daily Times*, 3 March 2011).

Abandonment Attributes of the Deborah Bay Submarine Mining Station

Historical descriptions of the sequence of events surrounding the Deborah Bay submarine mining station's deactivation and eventual abandonment have been, for the most part, general in scope. An indication of the extent to which the facility was dismantled and the majority of its architectural components removed has emerged as a consequence of the 2008 archaeological survey. Data collected during these investigations also tentatively support historical accounts of *Taiaroa*'s abandonment on the Deborah Bay foreshore during the first decade of the twentieth century.

As with the torpedo boat support facility at Lyttelton, structures associated with the Deborah Bay installation appear to have been deconstructed to the greatest extent possible and their constituent parts transported off-site. One notable exception is the storehouse

purchased by the Deborah Bay Presbyterian Church and converted into a community hall. However, even under civilian ownership this building was gradually dismantled and its architectural footprint significantly reduced. By the time of the 2008 survey, the storehouse was approximately one-half its original size, absent all of its purpose-built military features (such as roof-mounted skylight/ventilation windows), and in a state of disrepair. It also featured a number of additions, alterations, or modifications indicative of its post-military role as an external storage building, workspace, and/or living area. These include the addition of one glass-paned window and a front-mounted roll-up door along the building's north and east walls, respectively, as well as a small, wood-framed room with its own access door and window (see Figure 45).

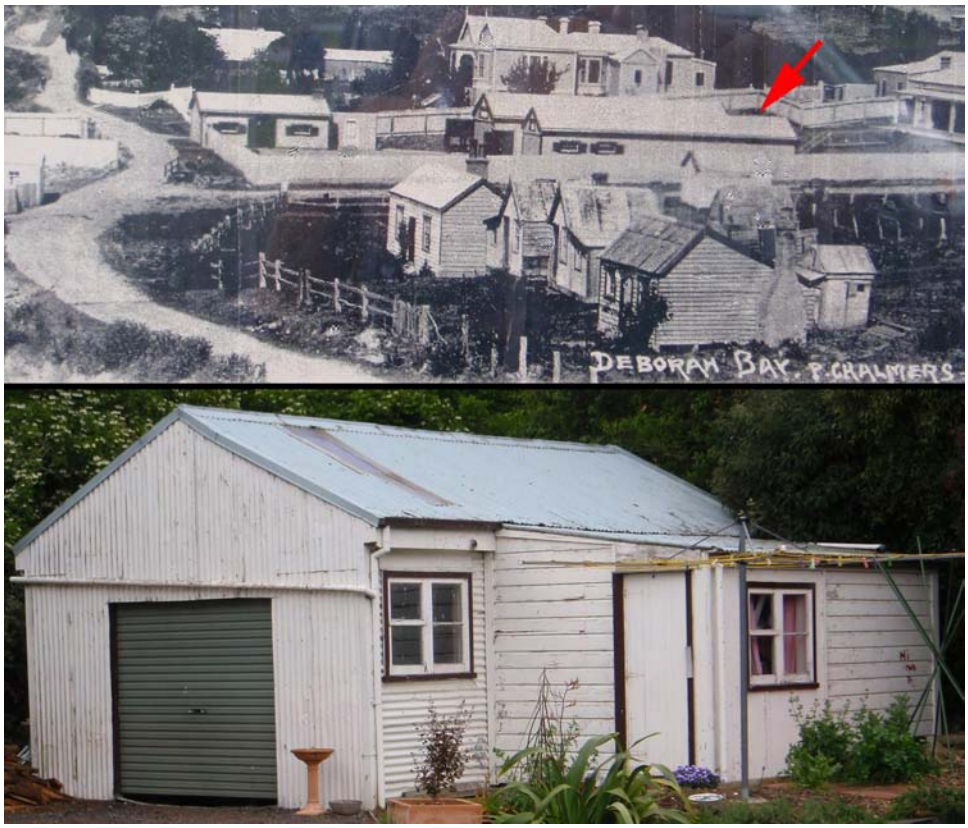

Figure 45. *Top*, Deborah Bay Submarine Mining Station during the first decade of the twentieth century. Red arrow indicates the storehouse that was later converted into a community hall by the Deborah Bay Presbyterian Church; *bottom*, the surviving section of the former storehouse and community hall, as is appeared in November 2008. Top image courtesy of Ian Church.

The Deborah Bay site's only other prominent visible feature is the mole, which no doubt survived to the present day as a consequence of its sheer size and relatively robust construction (Figure 46). Essentially reclaimed land built from tonnes of sediment infill and stone, the mole could only have been effectively 'dismantled' through the use of large-scale manpower, mechanical equipment, and/or explosives. From the military's perspective, these options were likely neither desirable nor practical; consequently, it appears to have been abandoned largely intact when the torpedo station was deactivated in the early 1900s. Subsequent years witnessed the mole's gradual deterioration and intermittent use as a community common area, storage ground, green-space, and—ultimately—car park. The extent to which the mole was allowed to fall into disrepair is best evidenced by the fact that the late-1990s effort to re-point its surviving stonework constituted the first time it had undergone any form of structural maintenance or repair since being removed from military service.

Figure 46. The Deborah Bay Submarine Mining Station mole, as it appeared in November 2008. Note the structure's robust stone and earthen construction, as well as its current use as a car park (signage describing the mole's historic role as an element of the submarine mining station is located immediately to the left of the white car).

In stark contrast to the relative permanence of the mole, little—if anything—appears to remain of the wooden jetty that once extended from its seaward end into the waters of Deborah Bay. The 2008 survey of the torpedo station coincided with a low-tide event that exposed much of the foreshore area surrounding the mole; consequently, an effort was made to locate and identify cultural material indicative of the jetty's processes of construction, military use, and eventual dismantlement. Of particular interest were the sections of tramway noted by John Mitchell (1995: 237) during his 1994 survey of the site, as well as surviving evidence of the jetty's wooden piles or other support structure. Mitchell was not specific in his description of the tramway components he observed; it is therefore unclear whether he was referring to individual sections of iron rail, wooden sleepers, wooden or iron supports and other hardware, or articulated combinations of two or more of these architectural elements. Whatever items may have comprised the tramway sections noted in 1994, they were no longer visible in the foreshore surrounding the mole by 2008 and were most likely removed as a consequence of modern scavenging or collecting activities.

Similarly, no evidence of the jetty's piles or other embedded support structure was noted in the intertidal and shallow water zones extending for a distance of 40 metres from the seaward end of the mole into Deborah Bay. The survey did not traverse the entire length of the jetty's post-1890s footprint because its projected seaward extent falls within an offshore zone that has historically served as an anchorage for shallow-drafted sailing vessels and motorised watercraft. The area still functions in this capacity today, and was occupied by no less than eight moored sailboats at the time of the 2008 survey. Given its long-standing role as an anchorage, it seems likely extant piles and other structural features within this zone were either removed or significantly reduced at the time the jetty was dismantled in an effort to negate their potential as hazards to navigation.

The 2008 survey also confirmed the reported presence of several miscellaneous iron artefacts in the intertidal zone immediately surrounding the mole. One relatively large isolated concentration of material was located within the foreshore approximately 40 metres northeast of the mole's north face. It forms a linear scatter oriented approximately parallel to the mole and perpendicular to the nearest stretch of shoreline (Figure 47). Observed within it were several sheet iron fragments exhibiting thicknesses comparable to the 1/16-inch hull plate used in the construction of New Zealand's Thornycroft torpedo boats, as well as numerous iron fittings, and a large, heavy oval-shaped iron disc filled with concrete that bears some similarity to a torpedo boat conning tower. Significantly, the scatter is confined to a narrow, linear zone measuring 21.26 metres (69.8 feet)—a dimension that approximates well to the overall length (63 feet, or 19.20 metres) of the torpedo vessel *Taiaroa*. Were the concentration of cultural material to represent remnants of the torpedo boat, it would confirm that its stripped hull was effectively abandoned at Deborah Bay following its removal from military service.

A span of heavily corroded chain was observed between the artefact scatter and nearby shoreline. It comprises relatively large (18 centimetre long by 11 centimetre wide) iron links, emerges above the bay floor a short distance from—and in line with—the scatter's shoreward extremity, and extends towards land for a distance of 70 centimetres before disappearing into bottom sediments. Based on the preserved dimensions and physical attributes of its individual links, the chain appears to be of late-nineteenth or early-twentieth century vintage, and could therefore have been contemporaneous with the submarine mining station. If the linear scatter of cultural material were confirmed as remnants of *Taiaroa*, the chain could be directly associated with it and may indicate a form of placement assurance

that kept the torpedo boat's stripped hull from floating away in the wake of its discard on the Deborah Bay foreshore.

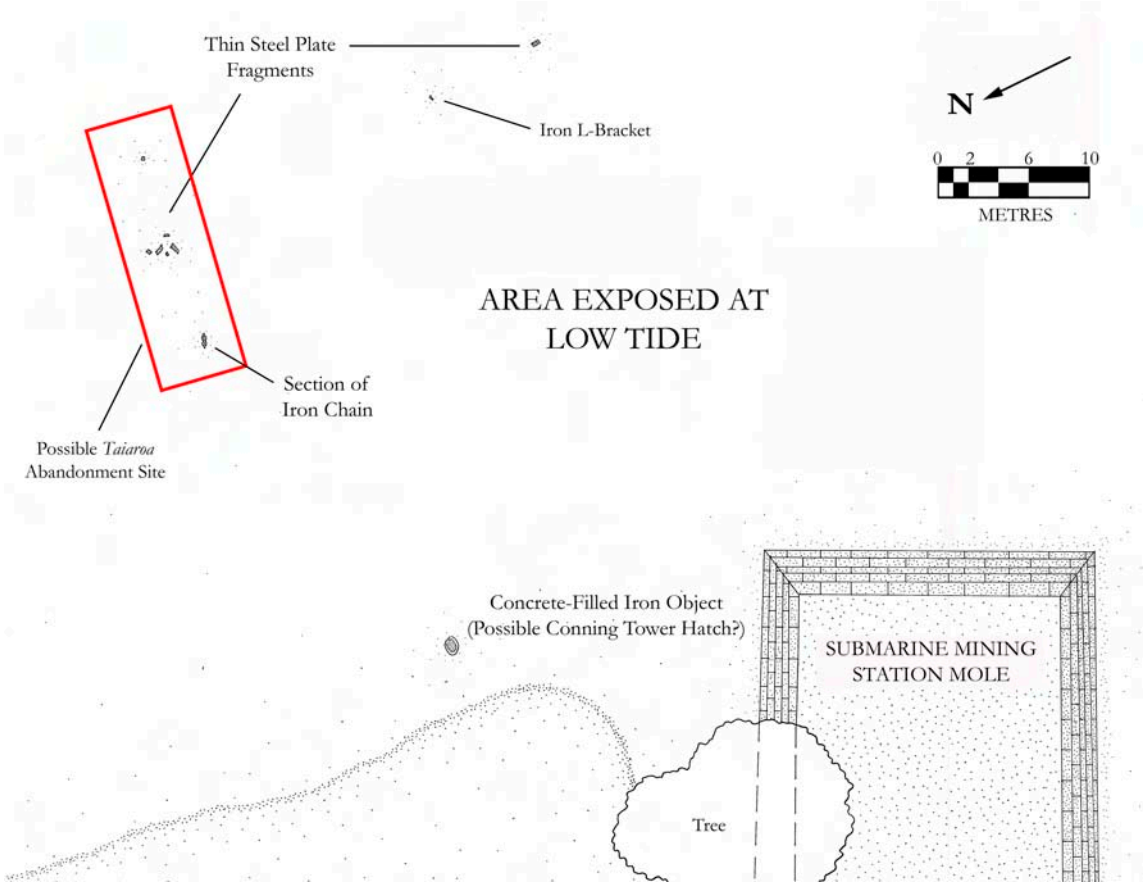

Figure 47. Site plan of the Deborah Bay Submarine Mining Station, showing the surviving mole and adjacent scatter of iron artefacts that may represent the abandonment site of the torpedo boat *Taiaroa*.