Archaeology Wales

Slipways 1 & 2, Carr Jetty, Pembroke Dock, Pembrokeshire

Archaeological Watching Brief

By
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Report No. 1905

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Archaeology Wales

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Non-Technical Summary

This report results from work undertaken by Archaeology Wales Ltd (AW) for Milford Haven Port Authority (MHPA) at Carr Jetty, Edgar Morgan Way, Pembroke Dock, Pembrokeshire, SA72 6TE. The site is centred on grid reference NGR SM 95754 03960. The report details the results of an Archaeological Watching brief (WB) that took place to ensure the preservation by record of any archaeological remains encountered ground works associated with the excavation of nineteen test pits and twelve boreholes during ground investigation (GI) works. The GI works were completed ahead of the construction of a new, wider slipway in the location currently occupied by Slipways 1 and 2 and the quay between them at Carr Jetty, Pembroke Dock.

Previously unseen parts of the slipway walls have been recorded as well as elements of the historic structure that have more recently become sealed below modern concrete floors. Three broad phases of construction can be suggested in the light of the evidence from the archaeological monitoring and associated documentary and cartographic research:

Phase 1 comprises the original construction of the slipways as evidenced by the 1839 Tithe Map of St Mary, Pembroke. All archaeological evidence within the study area for this early phase, or the adjacent Pater Fort, appear to have been removed during to the mid-19th century re-construction.

Phase 2 comprises the construction of the historic Building Slips 1 and 2 at some point between 1841 and 1847-9. This includes the addition of substantial stone plinths supporting monumental granite post bases which in turn may have supported ship building sheds or other supporting structures.

Phase 3 comprises early to mid-20th century modifications. The slipways appear to have been extended to the south and re-floored in concrete. Car Jetty appears to have been constructed at this time along with buildings to the south and east of Slipway 2, and rail tracks along the piers and jetties.

All work was undertaken to the Standards and Guidance for an Archaeological Watching Brief *(2014) as set by the Chartered Institute for Archaeologists (ClfA).*

Crynodeb Annhechnegol

Mae'r adroddiad hwn yn deillio o waith a wnaed gan Archaeoleg Cymru Cyf (AW) ar gyfer awdurdod porthladd Aberdaugleddau (MHPA) yn y Lanfa, Edgar Morgan Way, Doc Penfro, Sir Benfro, SA72 6TE. Mae'r safle yn canolbwyntio ar gyfeirnod grid NGR SM 95754 03960. Mae'r adroddiad yn rhoi manylion am ganlyniadau brîff gwylio archeolegol a gynhaliwyd i sicrhau cadw drwy gofnod o unrhyw olion archeolegol a gafwyd o waith tir a oedd yn gysylltiedig â chloddio naw pwll prawf a deuddeg twll turio yn ystod gwaith ymchwilio tir (GDD). Cwblhawyd y gwaith GDD cyn adeiladu llithffordd ehangach, newydd yn y lleoliad sy'n cael ei feddiannu ar hyn o bryd gan Lithffyrdd 1 a 2 a'r Cei rhyngddynt yn Carr Jetty, Doc Penfro.

Cofnodwyd rhannau o furiau'r llithffordd nas gwelwyd o'r blaen yn ogystal ag elfennau o'r

strwythur hanesyddol a gafodd eu selio islaw lloriau concrit modern yn fwy diweddar. Gellir awgrymu tri cham adeiladu bras yng ngoleuni'r dystiolaeth o'r gwaith monitro archeolegol a'r ymchwil ddogfennol a Cartograffeg cysylltiedig:

Mae cam 1 yn cynnwys adeiladwaith gwreiddiol y llithffyrdd fel y tystir gan fap degwm 1839 y Santes Fair, Penfro. Ymddengys fod yr holl dystiolaeth archeolegol o fewn ardal yr astudiaeth ar gyfer y cyfnod cynnar hwn, neu'r Gaer Pater gyfagos, wedi cael ei symud yn ystod ail-adeiladu canol y 19eg ganrif.

Mae cam 2 yn cynnwys adeiladu slipiau 1 a 2 yr adeilad hanesyddol ar ryw bwynt rhwng 1841 a 1847-9. Mae hyn yn cynnwys ychwanegu plwtonau carreg sylweddol sy'n cynnal safleoedd ôl gwenithfaen enfawr, a allai yn ei dro fod wedi cefnogi siediau adeiladu llongau neu strwythurau ategol eraill.

Mae cam 3 yn cynnwys addasiadau o ddechrau i ganol yr 20fed ganrif. Ymddengys i'r llithffyrdd gael eu hestyn i'r De a'u hail-ffro mewn concrit. Mae'n ymddangos bod glanfa'r car wedi'i adeiladu ar yr adeg hon ynghyd ag adeiladau i'r De a'r dwyrain o Slipway 2, a llwybrau rheilffordd ar hyd y pierau a'r glanfeydd.

Ymgymerwyd â'r holl waith i'r safonau a'r arweiniad ar gyfer brîff gwylio archeolegol (2014) fel y pennwyd gan Sefydliad Siartredig yr Archaeolegwyr (CIfA).

1. Introduction

Location and scope of work

1.1 In June 2020 AW was commissioned by Milford Haven Port Authority (henceforth – the client). to carry out a watching brief at Carr Jetty, Edgar Morgan Way, Pembroke Dock, Pembrokeshire, SA72 6TE. The site is centred on OS grid reference NGR SM 95754 03960, Figure 1). The watching brief was undertaken during ground works associated with the excavation of nineteen test pits and twelve boreholes during ground investigation (GI) works. The GI works were completed ahead of the construction of a new, wider slipway in the location currently occupied by Slipways 1 and 2 and the quay between them at Carr Jetty, Pembroke Dock.

1.2 The purpose of the archaeological mitigation is to ensure that all archaeological and historical components of the site are fully investigated and recorded if they are to be revealed as a result of activities associated with the development.

1.3. A written scheme of investigation (WSI) was prepared by James Evans (AW) prior to the work taking place (Appendix II). This was subsequently approved by DAT-DM. All works were carried out in accordance with the CIfA *Standard and Guidance for the Archaeological Investigation and Recording of Standing Buildings or Structures* (2014) and *Standard and Guidance for Archaeological Watching Briefs* (2014).

1.4. The watching brief was conducted between 30th June and 13th July 2020, by Jerry Bond (AW). The project was managed by Dr John Davey.

Site Description

1.5 The site is located on the southern shore of Milford Haven waterway within the Port of Pembroke, Pembroke Dock (Figures 1 and 2). As part of the port masterplan for Pembroke Port, the Milford Haven Port Authority (MHPA) proposes to construct a new, wider slipway in the location currently occupied by Slipways 1 and 2 and the quay between them to the east of Carr Jetty. Both Slipway 1 (plates 1-3) and Slipway 2 (plates 2 & 4) are listed structures (LB 14391 & LB 14392, respectively).

1.6 The Carr Jetty projects into the Milford Haven waterway east of the Carr Rocks, which are submerged sediment and bedrock features that extend north into the Milford Haven waterway (Quantum Geotechnical Ltd 2008, 4). The geotechnical pits are being excavated on the site of the proposed new slipway which will be approximately 67m wide and approximately 180m long, extending around 40m beyond the existing quay wall, and is centred on NGR SM 95754 03960.

Topography and Geology

1.7 The underlying geology of the site is composed of Dinantian Rocks (undifferentiated), which comprises of limestone with subordinate sandstone and argillaceous rocks. This sedimentary bedrock formed approximately 326 to 359 million years ago in the Carboniferous Period (BGS, 2020).

2. Methodology

2.1 A watching brief complying with the CIfA *Standard and Guidance for Archaeological Watching Briefs* (2014) was undertaken during all intrusive groundwork on the site.

2.2 The watching brief was undertaken to allow the preservation by record of any archaeological deposits or features encountered during the works. The watching brief also provides an opportunity, if needed, for the watching archaeologist to signal to all interested parties that an archaeological find has been made for which the resources allocated to the watching brief itself are not sufficient to support treatment to a satisfactory and proper standard (CIfA 2014).

2.3 The groundworks comprised several different elements: initially seven boreholes (BH101-107) were dug into the dock arranged on either side of Slipways 1 and 2 (Figure 2). A further five bore holes were sunk just offshore from Slipways 1 and 2, although it was not possible to monitor these archaeologically (plates 5 & 6). Next, 16 test pits were excavated by machine in and around Slipways 1 and 2, including the central pier (STP201-16). Three further test pits were excavated into the foreshore just outside Slipways 1 and 2 (STP401-3). Finally, a trial trench was excavated by machine across the central pier separating Slipways 1 and 2 (Central Pier Wall Investigation Trench – CPWIT).

2.4 Photographs were taken throughout the watching brief using a 12MP digital camera. Plans of the excavation were drawn to regular conventions. All the deposits encountered were recorded by means of a continuous context numbering system and recorded on pro-forma context sheets. All features and deposits are described in accordance with CIfA conventions. A register of all contexts and photographs was also made.

2.5 It was not possible to take bulk environmental samples or columns for safety reasons. The test pits were invariably cut through 19th – 20th century deposits to a depth of up to 3.5m rendering it impossible to enter safely and recover samples from lower layers of marine clay. Equally, those test pits that were excavated into the foreshore within the intertidal zone were unstable and not safe to enter.

3. Archaeological and Historical Background

3.1 The Milford Haven waterway, in general, has a rich history. The wide and deep waterway has provided an ideal location for ships and fleets to dock and anchor. In the early medieval period, the area was known as a location where Viking's would shelter and overwinter. In the mid/later medieval period it was also used as a location for a succession of English monarchs to muster fleets and troops to invade Ireland. It was also a landing place for invading armies; French soldiers landed in the early 15th century as part of an alliance between France and Owain Glyndwr in his revolt against England, and Henry Tudor landed here on his way to becoming King Henry VII (Evans, 2020).

3.2 The archaeological and historical background of the development site and Pembroke Dock itself, however, mostly dates to the post-medieval period. Work on the Royal Naval

Dockyard started in 1814. It was constructed to build and fit out warships for the Royal Navy (Hall & Sambrook 2014, 9). The docks underwent an expansion during the 1830s and 1840s. The Grade II Listed Slipways 1 and 2 were built c.1845 (Listed Building Numbers 14391 & 14392, respectively). These slipways represent the focus of the development area.

3.3 Shipbuilding at the dockyard was in decline by the early 20th century, and the last surface warship was launched in 1917. Five submarines were also built here during the First World War, but the end of the war saw the rapid decline of activity and the eventual closure of the Royal Naval Dockyard in 1926. The Royal Air Force took over much of the dockyard in the 1930s and established a base for Sunderland Flying Boats. This base proved to be of great importance to the battle against the U-Boat threat to the Western Approaches during the Second World War. However, the RAF base was closed in 1957 (Hall & Sambrook 2014, 11).

3.4 Listed Building Description Structure 2.15 - Building Slip No. 1

3.4.1 Grade II Listed Building (Designated 18th January 1974). Situated towards north-west corner of dockyard, just east of the Carr Jetty.

3.4.2 Exterior: 20th century concrete base. Sides have lowest step with limestone coping, taller main step (or 'altar'), granite-coped and stepped down at seaward end. Two or three topmost granite steps stepped down at seaward end. Flight of steps inset each side. Considerable 20th century alterations in concrete, the south end extended inland.

3.4.3 Circa 1845 shipbuilding slip with limestone ashlar stepped sides and granite copings. Slips Nos. 1 and 2 were built west of the original dockyard wall, probably 1843-5. In 1841 Slip No. 3 was still called No. 1, and in 1847 the iron shipbuilding sheds for both new slips were begun. Length in 1858 was 265 feet, extended to 329 feet by 1891.

3.4.4 Reason for designation: One of only three of the shipbuilding slips to remain intact out of a total of 13 which were listed in 1981. Group value with other listed structures in Pembroke Dockyard.

3.4.5 The architectural value of the structure is associated with its form and appearance, which clearly illustrates its historic function. The 19th century phases utilise dressed, ashlar stonework with granite copings and stone 'paving' at seaward end, imparting a monumental quality. This architectural quality has been eroded by later 20th century alterations, which utilise functional and unattractive materials that contrast poorly with the earlier phases, although these alterations have ensured the slipway's continued use. The demolition of the associated slipway cover (shipbuilding shed) over No. 1 Building Slip has diminished its architectural interest.

3.4.6 The structure is principally of historic interest as an integral element of the functional 19th century dockyard. Together with the graving dock and 12 other slipways, the dockyard's capacity for the mass-production of wooden warships was unsurpassed in the world. The later alterations reflect the slipway's adaptation for the construction of iron-framed and then iron-hulled warships as the 19th century progressed. Later adaptations relate to the continued use of the western end of the dockyard by the Admiralty to 2008, following the closure of the remainder of the naval dockyard in 1926.

3.4.7 As part of the historic dockyard, Building Slip No. 1 derives interest from the associations with the ships built and launched from the dockyard up to 1926 and with the continued use of the western part of the dockyard by the Admiralty up to 2008.

3.4.8 Building Slip No.1 forms part of an isolated surviving cluster comprising the dockyard's last remaining three slipways along with the Graving Dock (used for repair – Structure 2.17) and the Carr Jetty (used for fitting out – Structure 3.3), all located at the north-western corner of the dockyard.

3.4.9 The intervisibility of Building Slip No. 1 with Buildings Slips Nos. 2 and 4 (Structures 2.16 and 2.19), the Western Camber (Structure 2.18) and the Graving Dock (Structure No. 2.17) contributes to its heritage significance, albeit that all of these structures are now physically isolated from other contemporary dockyard buildings, with the one-time exceptional extent the of the dockyard's building slips having been greatly reduced since 1981.

3.4.10 Experience of the asset: Building Slip No. 1 is part of a fragmented, varied industrial site with no strong, single-overriding purpose. This change in the character of the function of the dockyard context has adversely impacted on its significance.

3.4.11 The slipway still forms part of a small industrial dockyard in the north-western part of the historic dockyard, albeit that it is now used only as an incline for hauling boats onto dry land for repair in sheds. This continuity in use represents a similar function to its historic origins and contributes positively to its significance.

3.4.12 The asset is experienced as part of a group of slipways and a dry dock. As these structures are set below the surface of the dockyard, they are experienced only at close proximity within a part of the dockyard that has no public access.

3.4.13 Together with the Graving Dock, Building Slips Nos. 2 and 4, the Carr Jetty and the Western Camber (Structures 2.17, 2.16, 2.19, 3.3 and 2.18), Building Slip No. 1 also forms part of the broader dockyard 'tableau' when viewed from the Haven.

3.4.14 Associative relationships with other assets: There are strong associations with the adjacent Graving Dock, Building Slips Nos. 2 and 4, Western Camber and Carr Jetty, as well as with the remaining 19th and early 20th century dockyard buildings and wartime Admiralty structures nearby, derived from their shared historic origins and functions. The contribution made by these associative values has been eroded by the partial survival of historic dockyard layout and structures.

3.4.15 Summary of Significance: The interest of Building Slip No.1 is primarily derived from its historic value as a functional part of the 19th and early 20th century working dockyard, together with the other remaining building slips, Graving Dock and Carr Jetty. The original massive stonework elements of the building slip elevate its architectural significance beyond its value as purely a functional structure. The loss of the slipway cover and the later 20th century alterations detract from the architectural interest, although these alterations have ensured the continued use of the slip.

3.5 Listed Building Description Structure 2.16 – Building Slip No. 2

3.5.1 Grade II Listed Building (Designated 18th January 1974). Situated at north-west end of dockyard, between Building Slip No. 1 and Graving Dock.

3.5.2 Exterior: Circa 1845 shipbuilding slip, one of four (now three) remaining from the 13 listed in 1981. Limestone ashlar sides with granite copings, concrete bottom. Battered side walls with two high steps (or 'altars') ending at flight of granite steps each side at north end. Flight of steps in each side wall. North end has slot each side for caisson. Granite coping in three steps each side. South end has been remodelled in concrete, signs of earlier lengthening in rubble stone.

3.5.3 Slips Nos. 1 and 2 were added after 1841 and before 1847-9 when the iron roofs were constructed by George Baker and Son (Report on Navy estimates House of Commons 28/7/1848). The length in 1858 was 265 feet, but 1877 map gives 310 feet.

3.5.4 Reason for designation: One of only three of the shipbuilding slips to remain from 13 listed in 1981. Group value with other listed structures in Pembroke Dockyard.

3.5.5 Architectural Interest: The architectural value of the structure is associated with its form and appearance, which clearly illustrates its historic function. The 19th century phases utilise dressed, ashlar stonework with granite copings and stone 'paving' at seaward end, imparting a monumental quality. This architectural quality has been eroded by later 20th century alterations, which utilise functional and unattractive materials that contrast poorly with the earlier phases, although these alterations have ensured the slipway's continued use. The demolition of the associated slipway cover (shipbuilding shed) over Building Slip No.2 has diminished its architectural interest.

3.5.6 The structure is principally of historic interest as an integral element of the 19th century dockyard. Together with the one graving dock and 12 other slipways, the dockyard's capacity for the mass-production of wooden warships was unsurpassed in the world. The later alterations reflect the slipway's adaptation for the construction of iron-framed and then iron-hulled warships as the 19th century progressed. Later adaptations relate to the re-acquisition of the slipway by the Admiralty in 1940, as part of a small repair yard to employ up to 300 men in the repair of naval vessels including landing craft and larger vessels up to the size of C Class cruisers and destroyers. It was almost certainly also used in connection with the anti-torpedo and anti-submarine boom depot. Around1946 it became part of the private Hayes Shipyard, before passing back to the Admiralty sometime after 1957 and remaining with them until 2008.

3.5.7 As part of the historic dockyard, Building Slip No. 2 derives interest from the associations with the ships built and launched from the dockyard up to 1926 and with the continued use of the western part of the dockyard by the Admiralty up to 2008.

3.5.8 Building Slip No. 2 forms part of an isolated surviving cluster comprising the dockyard's last remaining three slipways, Graving Dock (used for repair) and the Carr Jetty (used for fitting out), all located at the dockyard's north-western corner.

3.5.9 The intervisibility of Building Slip No.2 with Buildings Slips Nos. 1 and 4, the Western Camber and the Graving Dock (Structures 2.15, 2.19, 2.18 and 2.17) contributes to its heritage significance, albeit that all of these structures are now physically isolated from other contemporary dockyard buildings, with the one-time exceptional extent the of the dockyard's building slips having been greatly reduced since 1981.

3.5.10 Experience of the asset: Building Slip No. 2 is part of a fragmented, varied industrial site with no strong, single-overriding purpose. This change in the character of the function of the dockyard context has adversely impacted on its significance.

3.5.11 Building Slip No. 2 still forms part of a small industrial dockyard in the north-western part of the historic dockyard, albeit that it is now used only as an incline for hauling boats onto dry land for repair in sheds. This continuity in use represents a similar function to its historic origins and contributes positively to its significance.

3.5.12 The slip is experienced as part of a group of slipways and docks. As these structures are primarily set below the surface of the dockyard, they are experienced only at close proximity within a part of the dockyard that has no public access.

3.5.13 Together with the remaining Building Slips Nos. 1 and 4, Graving Dock, the Carr Jetty and the Western Camber (Structures 2.15, 2.19, 2.17, 3.3 and 2.18), Building Slip No. 2 also forms part of the broader dockyard 'tableau' when viewed from the Haven.

3.5.14 Associative relationships with other assets: There are strong associations with the adjacent Graving Dock, Building Slips Nos. 1 and 4, and the Carr, as well as with the remaining 19th and early 20th century dockyard buildings and wartime Admiralty structures nearby (notably the former Boom Shed - Structure 4.19), derived from their proximity and shared historic and functions. The contribution made by these associative values has been eroded by the partial survival of historic dockyard layout and structures.

3.5.15 The interest of Building Slip No. 2 is primarily derived from its historic value as a functional part of the 19th and early 20th century working dockyard, together with the other remaining Building Slips, Western Camber, Graving Dock and Carr Jetty (Structures 2.15, 2.19, 2.18, 2.17 and 3.3). The original massive stonework elements of the building slip elevate its architectural significance beyond its value as purely a functional structure. The loss of the slipway cover and later 20th century alterations detract from the architectural interest, although these alterations have ensured the continued use of the slip.

3.6 **Map Regression**

3.6.1 **Plan of the Parish of St. Mary, Pembroke in the County of Pembroke (Pembroke St. Mary Tithe Map) 1839.**

Although not surveyed to the same accuracy of later Ordnance Survey maps, this map shows the relative size and position of Slipways 1 and 2 prior to their reconstruction c.1841-7. The area of the slipways is recorded as field number 432 on the associated apportionment, belonging to and occupied by the Board of Admiralty and named as 'Dockyard and Town'. The plot comprises a total area of 109 acres and 28 perches. Immediately to the west of, and directly bordering Slipway 1 is a fort known as Pater Fort (DAT HER 34639). Building work

started on Pater Fort in 1758 but was abandoned the following year. It was partially destroyed during construction of Pembroke Dockyard in 1814, refortified in 1830, dismantled in 1837 and finally reused as part of Pater Battery (DAT HER 24449) in 1840-42 (Allen & Murphy, 1998, 8-9).

The tithe map suggests that the unfinished Pater Fort may have originally taken the form of an 18th century Star Fort, the northern part of which, if finished at that time, may have been partially destroyed during the construction of the original Slipways 1 and 2 circa 1814.

3.6.2 **OS Town Plan, Pembroke, Pembrokeshire 1864, 1:500**

This map shows building slips 1 and 2 as they were newly constructed circa 1841-9. They form the westernmost pair of a group of 13 building slips located between Carr Rocks (Carr Jetty had not yet been constructed) and the town of Pembroke Dock. They are shown as having a stepped profile with a flat floor to the basin, closed on the seaward side by large gates or caissons. They are angled at the landward end, partially closing them at the head. Galleries are marked along either side and steps are shown at the seaward end of these galleries providing access down into each basin. The bases of rectangular posts are also shown regularly spaced along either side of each slip at the top, potentially the bases of iron structural uprights for a roof built circa 1847-9, or for other supports associated with shipbuilding. Other regularly spaced circular bases may be for fences.

3.6.3 **OS County Series, Pembrokeshire 1869, 1:10,600**

This larger scale map provides much less in the way of detailed information regarding Building Slips 1 and 2 compared to the map above. However, it does show the Pater Battery with associated structures butting up directly against the curtilage of Slipway 1 on its west side, including a sally port to the SW.

3.6.4 **Russian Map, Pembroke 1950 1:10,000**

Subsequent Ordnance Survey maps do not provide any detail of the development of the slipways with the entire Admiralty Dockyard being left blank. Ironically, the next map to show any internal detail of the dockyard is the Russian map of 1950. This shows that railways lines have been constructed along the top of both slipways and leading out to the end of Carr Jetty. The former site of Pater Fort also has a railway terminal. The internal buildings associated with the fort have been lost although part of the original retaining wall with its distinctive 'star' shaped bastions has survived. Substantial buildings have also been constructed around the east and south sides of Slipway 2.

3.6.5 **OS Plan 1967-73 1:2500**

By the time of this map the late 20th century layout of the buildings around the two slipways has been largely established.

4. Watching Brief Results (Jerry Bond)

4.1 A total of seven boreholes, nineteen test pits and one larger trench were monitored during the period covered by the watching brief.

4.2 The Boreholes (Figure 3).

The seven boreholes, numbered BH101 to BH 107 were distributed across the entire investigation area (Figure 2).
The methodology for drilling the bore holes comprised initial cutting through the concrete followed by hand excavation down to a depth of approximately 1.1m, as conditions allowed. All hand dug parts measured 0.3m diameter. The bores were then drilled by machine (concussion rig) through the base of the hand dug borehole. It was only possible to archaeologically monitor the upper hand dug part of these bore holes. Furthermore, due to their narrow diameter, it was not possible to enter the bore holes and all records were made from ground level.

4.2.1 Borehole 101 (plate 7) was in the north western part of the investigation area on the western jetty wall to the west of Slipway 1. The Bore Hole was excavated to maximum depth of 0.8m below the modern ground level by hand the and the concussion rig employed. The basal layer comprised compact sandstone rubble (1012) measuring > 0.4m in thickness. Above this was a shallow layer of topsoil (1011), which comprised a dark brown silty loam measuring 0.3m thick and containing a layer of modern plastic netting.

4.2.2 Borehole 102 (plates 8 & 9) was located centrally to the western jetty wall to the west of Slipway 1. It was excavated by hand to a maximum depth of 0.7m. The basal layer comprised a mid-brown silty clay with angular stones (1022). This represented a compacted hard core and rubble layer measuring at least 0.4m thick. Directly above this rubble was a concrete surface (1021) measuring 0.3m thick.

4.2.3 Borehole 103 was in the south western part of the site within a carpark on top of the western jetty wall to the north of Slipway 1. It was excavated to a maximum depth of 2.8m below ground level. Samples from the lowest layers (1036-1034) were not visible from the surface and were only available for examination as they were collected by the drilling rig crew. The basal layer comprised angular stones (1036) measuring 0.1m thick. Above this was a red brown silty clay (1035) containing angular stones and measuring 0.7m thick. Above this was a grey brown gritty silt (1034) containing angular stones and measuring 0.8m thick. Above (1034) was a red brown silty clay (1033) containing gravels and angular stones measuring 0.8m thick and extending to a depth of 1.2m. Above this was a grey brown silty clay (1032) containing frequent small grits and gravels measuring 0.2m thick. The uppermost layer comprised tarmac (1031) measuring 0.1m thick.

4.2.4 Borehole 104 was located toward the northern end of the central pier. It was excavated by hand to a maximum depth of 1.45m. The basal layer comprised a firm mid-grey-brown silty clay (1043) measuring > 0.25m thick. This lay below a loose gravel and concrete rubble make up layer (1042) measuring 1m thick. The upper surface comprised concrete (1041) measuring 0.2m thick.

4.2.5 Borehole 105 (plate 10) was located toward the northern end of the eastern jetty to the east of Slipway 2, it was excavated by hand to a maximum depth of 0.9m. The basal layer comprised a concrete layer (1053) measuring 0.5m thick. Above the concrete was a heavily cemented brickwork layer (1052) measuring 0.2m thick. This is interpreted as part of the building footings and floors visible to the south and east of Slipway 2. These relatively modern buildings are first visible on the Russian map of 1950 but are not visible on the OS County Series map of 1869. They appear (from cartographic and available historic Google earth imagery) to have been demolished at some time between 1993 and 2006. On top of the bricks was set an upper concrete surface (1051) measuring 0.2m thick.

4.2.6 Borehole 106 was located centrally to the eastern jetty east of Slipway 2. It was excavated by hand to a maximum depth of 1m, although cores were made available for examination for a further 1m depth. The lowest layer observed as a core comprised a layer of angular stones and gravels (1064) measuring at least 0.4m thick. Above this, at a depth of 1.6m was a layer of angular stones and gravels (1064) > 0.4m thick. At a depth of 1m, a red brown clay layer (1063) containing rounded stones measuring 0.6m thick was recorded in the cores. The basal layer in the hand excavated section comprised a red brown silty clay (1062) containing frequent angular stones. (1062) measured 0.8m thick. The upper layer of concrete (1061), within the footprint of a former building, measured 0.2m thick.

4.2.7 Borehole 107 (plate 11) was located to the south of BH105 & BH106 on the eastern jetty and was excavated by hand to a maximum depth of 0.5m. The basal layer comprised silty clay and crushed pale stone (1073) measuring at least 0.2m thick. Above this was a hard-core layer (1072), consisting of compacted stones and measuring 0.1m thick. The upper layer of concrete (1071), within the footprint of a former building, measured 0.2m thick.

4.3 The Test Pits.

4.3.1 A series of nineteen test pits were excavated by mechanical excavator. Three were located on the foreshore in the vicinity of Slipway 1 and the arched jetty (Carr Jetty) in the northern part of the site and a further sixteen test pits were excavated across the remainder of the site area in and around the dockyard and Slipways 1 & 2.

4.3.2 The Dockyard and Slipway Test Pits (STP201-216).

A total of sixteen test pits were excavated by mechanical tracked excavator across the investigation area, including within the two slipways as well as on the jetty and the dock. The test pits were numbered STP 201 to 216 (Figure 2).

4.3.2.1 STP 201 (Figure 4; plate 12) was in the north western part of the site, toward the northern end of the western jetty. It was oriented east to west, measured 4.6m long x 1.6m wide and was excavated to a maximum depth of 3.3m.

The basal layer comprised a blue grey clay (2016) containing black (organic) stains which was excavated to a depth of 3.3m below the current ground surface and had a thickness of at least 0.75m. This is interpreted as the local marine estuarine clay and was also encountered in several of the test pits. Along the western side of STP201, the west face slipway wall [2017] was exposed revealing that the wall had been cut into the existing marine sediments and then was infilled with layers of soil and stone to create the jetty. It was not possible to enter the trench and examine the slipway wall closely for safety reasons. Nevertheless, it appears to have been constructed on its inner face from squared and coursed limestone bonded with lime

mortar containing flecks of lime and charcoal.
Lying to the west, butting against the inner face of the dock wall was a deposit of firm/compacted red brown clay (2015) containing occasional grey blue streaks. This deposit is interpreted as a waterproof seal/lining for the dock [2017] and which was recorded against the dock wall in several the other test pits. This layer was 1.5m thick and extended across the width of the test pit. Above this was a layer of dark grey stone dust and gravels (2013) measuring 0.15m thick. Above this was a compact layer of concrete, pale sand and gravels (2012) forming a makeup/levelling layer below the modern concrete ground surface. This make-up layer measured between 0.22 and 0.25m thick and underlay a layer of reinforced concrete (2011) forming the extant ground surface and measuring 0.2m thick.

4.3.2.2 STP 202 (Figure 4; plate 13) was located toward the southern end of the western jetty, on the west side of Slipway 1. It was oriented north to south against the inner edge of the dock wall, it measured 3.5m long x 1.2m wide and was excavated to a maximum depth of 2.6m.
The water table was encountered at a depth of c. 2.5 m which was also the depth at which the limestone bedrock (2026) was exposed. The internal face of the slipway wall [2024] was exposed along the western side of the test pit. This had a layer of concrete (2025) set against it which was built using corrugated tin sheeting (2027) as shuttering, a feature only seen in this test pit. This concrete reinforcement largely obscured the fabric of the slipway wall and it was not possible to observe the base of the concrete footings for the wall, although it is assumed that they are constructed on top of the bedrock. This test pit lies outside the landward limit of the historic section of Building Slip No. 1, adjacent to the part of the slipway that was extended during the early to mid-20th century. Butting against the shuttering for the wall was a mid-brown sandy silt (2023) containing medium and large angular stones and measuring 2m thick. Above this was a mid-grey brown sandy silt (2022) containing frequent small and medium sized angular stones and mudstone measuring 0.3m thick. The upper layer comprised a concrete surface (2021) measuring 0.3m thick.

4.3.2.3 STP 203 (plate 14) was located within the part of the site used as the contractor compound toward the southern end of the western jetty, just west of the SW corner of Slipway 1. It was oriented north to south, measured 4.15m long x 1.1m wide and was excavated to a maximum depth of 2.65m.
The basal layer comprised a pale brown silty clay (2037) containing frequent large angular stones which continued to a depth of 2.65m whereupon excavation was terminated. Above this was a layer of very compact, mottled dark red brown sandy silt and crushed limestone (2033), containing rust red ferrous staining and CBM and brick fragments (some bearing impressed maker's mark *GOODWICK*). This layer measured 0.8m thick. Layer (2033) was truncated a by modern service trench [2036] which itself truncated an earlier service trench. The newer trench contained a blue plastic pipe whilst the older trench contained a cast iron pipe, and both were marked on the service plan as water pipes. The service trench contained two fills, a lower fill of clean sand (2035) and an upper fill of dark brown silty clay (2034) with moderate quantities of medium sized stones. The service trench was concave in profile, 2.5m wide with a depth of 1.3m and was marked by a blue plastic water marking tape with metal strip. Layer (2033) and the fills of the modern service trenches were overlain by layer of asphalt/tarmac (2031) which measured 0.05m thick and sat atop a layer of mid grey crushed stone, 0.15m thick, which in turn sat upon a plastic sheet.

4.3.2.4 STP 204 (plates 15 & 16) was located inside the northern part of Slipway 1, against the western wall. It was oriented east to west, measured 3.45m long x 1.2 m wide and was excavated to a maximum depth of 0.85m.
At the base of the test pit the limestone bedrock (2046) was exposed, measuring at least 0.2m thick. The base of the internal slipway wall appears to have been faced with large limestone ashlar blocks at this point, although they are partially obscured by salt deposits and barnacles. Above the bedrock and abutting the slipway wall, was a very dark brown black silt (2045), contaminated, and measuring 0.15m thick. Above this was a layer of dark grey and brown/black stained gravels (2044) measuring 0.2 to 0.25m thick. Above the gravels was a pale brown layer of aggregate (2043) measuring 0.2m thick. Above this aggregate was a layer of grey green aggregates/gravels (2042) measuring 0.1m thick, above which was set the concrete surface of the slipway (2041) which had a thickness of 0.2m.

4.3.2.5 STP 205 (plate 17) was located centrally within Slipway 1 and was oriented north to south. It measured 4.3m long x 1.2 wide and was excavated to a depth of 0.8m.
The limestone bedrock (2056) was exposed in the base of the test pit. Above this was a layer of irregular limestone rubble (2053) set with a pink mortar/stone dust, similar to layer (2063) in STP 206 and measuring 0.4m thick. Three large sections of sawn timber plank were also revealed within this layer. A layer of grey stone dust and gravel (2052) measuring 0.25m thick overlay the rubble, which was in turn overlain by the concrete surface (2051) of the slipway, which measured 0.15 thick.

4.3.2.6 STP 206 (plate 18) was located toward the landward end of Slipway 1, against the western slipway wall. It was oriented east to west, measured 2.2m long x 1m wide and was excavated to a depth of 0.6m.
A layer of irregular limestone rubble and pink stone dust (2063) measuring at least 0.2m thick was recorded at the base of the test pit. The layer was similar to (2053) in STP205. This was overlain by a layer of aggregate and concrete (2062) of 0.4m maximum thickness which was laid on a sheet of blue plastic. Overlying the aggregate layer was the concrete surface of the slipway (2061) which measured 0.2m thick.

4.3.2.7 STP 207 (plate 19) was located at the landward, or southern, end of Slipway 1, outside and to the south of the historic 19th century Building Slip Number 1. It was oriented north to south, measured 3.4m long x 1.2 m wide and was excavated to a depth of 2.05m.
the natural limestone bedrock (2075) was exposed at the base of the test pit. This was overlain by a layer of pale brown sandy silt (2074) containing frequent small and medium angular stones and fragments of CBM with the inclusion of large angular rubble. It measured 1.15m thick. The upper 0.3m to 0.5m became less stony (2073). This was overlain by a layer of concrete and aggregate (2072) which measured 0.25m thick. Its uppermost layer comprised the modern reinforced concrete slipway surface (2071) measuring 0.15m thick.

4.3.2.8 STP 208 (Figure 4; plates 20-23) was located centrally within the central pier between the two slipways. It was initially oriented E-W, but it very quickly exposed live services and was extended through 90 degrees and completed on a N-S orientation. This L shaped test pit measured 3.4m long E-W and 4.4m long N-S. The deepest part of the trench measured 1.2m

wide, where a maximum depth of 3m was reached.
In the deepest part of the test pit two steeply sloping concrete walls [2086] & [2087] were exposed at the base. Running east to west across the northern end of the test pit was a large sloping concrete wall set [2086], measuring more than 1m in length, its thickness could not be established but it was visible down to the base of the test pit at 3m. Parallel to it and running east to west at the opposite southern end of the trench, was [2087], a similar large sloping concrete wall. Together, the two walls defined a steep sided V gully oriented east to west. Wall [2087] continued beyond the width of the trench and was observed in plan to be at least 1m thick and at least 3m deep, with rounded flattish stones set into its surface. Above these concrete slabs was a thick layer of mid red brown clay (2085) containing frequent large angular stones measuring at least 2.5m thick. Above (2085) on the east side of the test pit a brick-built sewer main [2084] was recorded with ceramic pipe running NNW to SSE away from the test pit. The brick component was only visible in section for a length of c1m whilst the ceramic drainpipe was visible for 1m toward the south. Also above (2085) was a layer of dark grey brown gritty silt (2083) containing black flecks and a lens of red stone dust at its base, measuring 0.3m thick. The stratigraphic relationship between sewer [2084] and (2083) was unclear. Above (2083) was a 0.05m thick layer of crushed concrete (2082). The upper layer comprised reinforced concrete (2081), 0.15m thick, which was set above a layer of clear plastic.

4.3.2.9 STP209 (plate 24) was located at the southern end of the central pier. It was oriented north to south, measured 3.2m long x 1.2m wide and was excavated to a maximum depth of 3m.
The natural bedrock layer (2096) was exposed at the base of the test pit. Above this was a layer of red brown clay silt (2095) containing charcoal flecks and frequent flattish angular stones, measuring 2.4m thick. Above this was a layer of crushed concrete (2094) measuring 0.3m thick. Above this was a layer of mixed dark brown silty clay and sand (2093) measuring 0.1m thick. Above this was a layer of crushed concrete and sand (2092) which measured 0.05m thick and was laid upon a clear plastic sheet (similar to STP208). Above this was set the surface layer of reinforced concrete (2091) which measured 0.15m thick.

4.3.2.10 STP 210 (plate 25) was located at the southern end of the central pier, it was oriented north to south, measured 3m long x 1.3m wide and was excavated to a depth of 2.7m. The excavation terminated at the upper surface of a compact layer (2105) which, although not clearly observable, was assumed to be a buried surface or bedrock. Above this was a layer of large angular stones and rubble (2104) measuring 1.6m thick. Above this lay a red brown clay (2103) containing frequent angular stones and measuring 0.35m thick. Above this was a dark brown loam (2102) measuring 0.4m thick upon which was set the surface layer of reinforced concrete (2101) measuring 0.15m thick.

4.3.2.11 STP211 (Figure 5; plate 26) was located toward the north eastern end of Slipway 2 in the intertidal zone leading to periodic flooding during ground works. The test pit was oriented north to south and measured 2.1m long x 1.25m wide with a maximum depth of 1m.

The limestone bedrock (2114) was exposed in the base of the test pit. At the eastern limit of the trench the base of the eastern wall of Slipway 2 [2115] was partially exposed. This was constructed on top of the bedrock from large blocks of blue-grey limestone ashlar. Butting against the base of the slipway wall was a layer of irregular limestone rubble and mortar (2113) measuring 0.5m thick. Above (2113) was a lower concrete layer (2112) measuring 0.3m thick

upon which was set on a sheet of blue plastic. This was covered by concrete layer (2111) which formed the slipway floor surface and measured 0.2m thick.

4.3.2.12 STP 212 (Figure 5; plate 27) was located centrally within the base of Slipway 2, it was oriented north to south and measured 3.5m long, 1.5m wide and was excavated to a maximum depth of 0.75m.
The natural limestone bedrock (2124) was exposed in the base of the trench. Above the bedrock was a mixed deposit of red stone dust, limestone rubble and concrete (2122). At least three large timbers (2123) were set within this layer. They are thought to represent reused railway sleepers or possibly ship's timbers. (2123) measured 0.63m thick. Above (2122) and (2123) was the concrete slipway surface (2121) which measured 0.12 m thick.

4.3.2.13 STP 213 (Figure 5; plates 28 & 29) was located at the southern end of Slipway 2, it was oriented north to south and measured 3.8m long x 1.25m wide and was excavated to a maximum depth of 1.5m.
The natural bedrock (2136) was exposed in the base of the trench. Built directly on top of the bedrock were a concrete and steel bollard (2135) located at the east end of the trench; and a brick wall [2134] at the west end of the trench. Above the base of the bollard and abutting the wall was a loose rubble layer (2133) in a pale grey brown sandy silt matrix (25%) and containing 75% sub rounded and sub angular small, medium and large stones. This layer measured 1.5m thick. A large concrete block was removed from this layer with a large steel pin set within it. This layer was overlain by an aggregate and stone dust deposit (2132) of 0.15m thickness. The surface of the slipway, a concrete layer (2131) measuring 0.1m thick overlay both (2132) and the top of brick wall [2134]. The upper part of the large concrete bollard (2135) was still visible above the concrete floor (2131) whilst the brick wall [2134] to the west was not, but both pre-dated the current concrete slipway surface.

4.3.2.14 STP 214 (Figure 6; plate 30) was located in a yard area to the south of Slipway 2, it was oriented north to south, and measured 3.2m long x 1.3 m wide and was excavated to a maximum depth of 1.2m.
The limestone bedrock (2146) was exposed at the base of the test pit. Constructed directly on top of the bedrock was the remains of a brick and stone wall and its footings (2144). This was aligned north to south, was two courses wide and survived to height of two courses. It was constructed from half bricks of varying colours and limestone blocks. It was bonded with grey mortar with black flecks. Also directly above the bedrock, and butting against the wall on its southern side was a compacted layer (2145) of ash and industrial clinker which appeared to be the remains of a floor or other surface measuring 0.25m thick. Above that was a dark grey brown loamy layer (2143) measuring 0.25m thick. This was covered by red brown aggregate layer (2142), measuring 0.15m thick. Above this was the surface layer of reinforced concrete (2141) measuring 0.15m thick and set above a plastic sheet.

4.3.2.15 STP 215 (Figure 6; plates 31-3) was located toward the northern end of the southern jetty east of Slipway 2 and against the inner edge of the slipway wall. It was oriented east to west and measured 4.5m long with an initial width of 1.2m, although a collapse of the northern section meant it became considerably wider. It was excavated to a maximum depth of 2.7m.
At the at the western end of the base of the test pit a loose layer of large angular blocks (2155) was exposed. This butted against a compact red brown clay layer (2156), which is interpreted

as a lining/sealing material to prevent water seeping through the slipway wall into the structure of the jetty. It measured 1m wide and at least 1.5m thick. Directly on top of the loose angular blocks (2155) was a grey and black flecked mortar layer (2154) which extended beyond the trench to north and south with a width of at least 1m and a thickness of 1m. The eastern edge of the slipway wall [2153] was set upon this mortar layer. Wall [2153] measured at least 1m wide and was capped with interlocking dressed granite blocks. The mortar (2154) appears to have been laid to shore up the eastern edge of the slipway wall [2153] where it sat upon the loose blocks (2155). Abutting the wall and its foundations to the east was a thick deposit of mid red-brown sandy silt (2152) containing frequent angular stone. This deposit measured 3m wide and at least 2.75m thick across the entire width of the test pit. Above this lay the concrete surface (2151) measuring 0.2m thick and representing the internal floor of a former structure here.

During the excavation, the collapse of the northern section of the test pit exposed a masonry structure, [2157] that was only recorded in photographs (plate 33), It comprised large dressed granite blocks on top of a square plinth constructed from mortar bonded limestone rubble. It was only partially exposed but appears similar in scale, construction, and relative position to the slipway wall, to another structure [2167] recorded in STP 216 and also in both parts of the central pier wall investigation trench (CPWIT) and is discussed below.

4.3.2.16 STP 216 (Figure 6; plates 34 & 35) was located toward the southern end of the eastern jetty at the top of the eastern wall of Slipway 2. It was oriented north to south parallel with the slipway wall. However, during removal of the concrete, a void was uncovered necessitating the re-orientation of the trench so that its western end butted against the dock wall. It measured 3.3m long x 3.2m wide but it was only excavated to its full depth of 3m within the southern part of the trench.

The basal layer of the test pit comprised a red brown silty clay (2166) containing frequent large angular stones and measuring at least 2m wide x 3m long x 2.7m thick. This clay layer was encountered at a depth of 1m below the ground surface, extended down to at least 3m and was 1m wide as exposed within the test pit. Layer (2166) butted against a large masonry structure [2167] which was exposed in the northern half of the test pit. This comprised a large dressed granite block set upon a square plinth constructed from bonded limestone rubble masonry. The capping granite block had a large carved rectangular recess for a timber post set into its upper surface. This recess had a partially surviving timber within it and measured at least 0.6m x 0.3m in section as exposed but was of unknown depth. Overall, the structure appears to be like [2157] which was partially uncovered in STP 215. It measures more than 1m wide (E-W) and was at least 1.5m long (N-S) and more than 2.7m high.

Layer (2166) also butted against a sequence of deposits on the western side of the test pit. These comprised a compact red brown clay layer (2163) at the base, interpreted as a waterproof layer deposited against the slipway wall. A lens of large angular stones was recorded within the upper part of this layer. Above This was a layer of rubble with grey and black flecked mortar (2165) which extended beyond the test pit to north and south. This measured 0.7m wide and 0.5m thick. Above this, at the western end of the trench was the slipway wall [2164], oriented north to south and capped with dressed granite blocks. Above (2166) in the centre of the test pit was a dark brown clay loam (2162), also 0.15m thick. Above all was concrete surface (2161) measuring 0.15m thick,

4.3.3 The Foreshore Test Pits (STP401-403; Figure 7).

Test Pits STP 401 to 403 were excavated through the foreshore deposits, STP 401 and STP 403 were located against the arched jetty (Carr Jetty), whilst STP 402 was located centrally to the beach and the mouth of Slipway 1 (Figure 2). All three were excavated by a tracked 360 mechanical excavator within the intertidal zone and therefore recorded within certain time constraints and safety considerations.

4.3.3.1 STP 401 (Figure 7; plate 36) was oriented east to west, measured 4.2m x 1m wide and was excavated to a maximum depth of 2m.

The basal deposit within the test pit comprised a layer of mid grey silty sand (4012) at least 0.5m thick, which partly over lay foundation (4013). This foundation comprised a rectangular concrete block, only partly visible within the trench at its northern end, measuring at least 1m x 0.5m x 0.2m thick. Stone arch (4014) was built upon this foundation, forming part of the support for Carr Jetty. This arch it was constructed from large masonry blocks. The overlying deposit comprised beach shingle (4011) a grey silty sand containing 80% gravels and rounded cobbles measuring 0.5m thick.

4.3.3.2 STP 402 (plates 37 & 38) was oriented north west to south east, located to the north of Slipway 1. It measured 4m long x 0.6m wide at the base and was excavated to a maximum depth of 2.8m.

The basal layer of the test pit comprised the natural weathered limestone bedrock (4024), located at a depth of 2.75m below the current beach surface. Above this, at a depth of 1m, was a layer of brown gritty sand containing frequent shell fragments as well as shale and mudstone fragments which measured 1.75m thick. This in turn was below a layer of red brown gritty sandy silt (4023) containing shell fragments and measuring 0.6m thick. This was overlain by a layer of mid grey sandy silt (4022) measuring 0.2m thick. The upper layer comprised a very dark brown/black sandy silt (4021), also 0.2m thick.

4.3.3.3 STP 403 (Figure 7; plates 39 & 40) was oriented north to south, measured 3.75m long x 1m wide and was excavated to a maximum depth of 1.5m. It was located against the same Jetty as STP 401 and a similar sequence of deposits was encountered.

At the southern end the weathered limestone bedrock (4033) was exposed at the base of the test pit. At the northern end concrete plinth (4034) was exposed at the base. This plinth supported masonry arch (4035), which in turn supported the Jetty as described in STP 401. Adjacent to the concrete plinth, a concrete structure (4036) with a curving upper profile, was recorded, similar to a concrete sewer outfall pipe running out into the harbour it measured at least 1m long, was aligned east to west and had a visible width of 0.8m. A deposit of very dark black/brown sandy silt (4032) 1m thick overlay the bedrock and concrete structure (4036) and butted against the concrete plinth (4034). The dark colour was a result of contamination with oil. This layer was overlain by the uppermost deposit, which comprised beach shingle, cobbles and grey silty sand (4031) and measured 0.5m thick.

4.3.4 The Central Pier Wall Investigation Trench (CPWIT; Figures 8-9).

A large trench was excavated in two parts toward the northern end of the Central Pier between Slipways 1 and 2 to investigate the inner face of the slipway walls (Figure 2). It is understood that this central pier is scheduled to be demolished in advance of the construction of the new enlarged slipway. The western part of the CPWIT measured 6.75m long x 3m wide and was

excavated to a maximum depth of 6m. The eastern part was 6.5m long x 3m wide and was excavated to a maximum depth of 6m. It was not possible to enter the trench for safety reasons and all recording was carried out from ground level.

4.3.4.1 The western trench (Figure 8; plates 41 & 42) was excavated to a maximum depth of 6m. At the base was exposed a blue grey marine clay (5006) containing very dark brown/black patches of decayed organic material. This covered the base of the trench and measured more than 1.6m thick.
In the northern section of the trench a large masonry structure [5005] was recorded. This was topped with a concrete slab into which was set a large metal pin. The structure was at least 2.2m wide x 1.75m long and at least 3.5m high, its lowest edge was not clearly visible. However. Above clay (5006) on the eastern side of the trench was a mid-red-brown sandy silt (5004) which contained 80% large angular stones and extended to a depth of 5.5m. This transitioned to a mid-red-brown sandy silt (5002) above containing variable quantities of small, medium, and large stones, both rounded and angular measuring 2.5m thick.
At the western end of the trench the western pier wall [5007] was recorded. This represents the inner (hidden) face of the eastern wall of Slipway 1. It measured more than 1m wide and was at least 4.5m high. The upper course was constructed from very large squared Granite blocks with lower courses of smaller granite blocks and limestone rubble courses towards the base. The stratigraphic relationship between the two structures [5005]/ [5007] and the marine clay (5006) remains unclear. However, it seems reasonable to suggest that the structures are likely to cut the clay and to have been constructed on top of solid bedrock (not seen) below. Butting against wall [5007] was a compact red brown clay (5003) used to seal the slipway wall, it measured 1.3m wide and was 3.7m thick. This clay overlay the blue-grey marine clay (5006). Layer (5004/5002) also butts against and overlies structure [5005] and clay (5003). Deposit (5004/5002) appears to represent an infilling layer to make up the raised ground level of the central pier following the construction of wall [5007] and structure [5005].
Above (5002) lay a very dark brown silty loam (5001) 0.2m thick, which lay directly below reinforced concrete surface (5000) with a thickness 0.15m.

4.3.4.2 The eastern trench (Figure 9; plates 43-45) contained an almost identical sequence to that encountered in the western trench, though there were minor differences in detail. It was excavated to a maximum depth of 6m where the blue grey marine clay (6008) was exposed, containing very dark brown/black organic staining. Although the stratigraphic relationships are unclear, it seems likely that this clay was truncated by the eastern pier wall [6010] and other masonry structures [6005] & [6009].
At the eastern end of the trench the eastern pier wall [6010] was recorded. This was topped with large dressed squared granite blocks measuring 1m x 1m x 1m, laid on top of a wider wall, of at least 1.2m width and constructed from smaller coursed limestone rubble. A layer of compact red brown clay (6004) lay against the wall at the base, containing blue/grey streaks, extending across the width of the trench and measuring 1.5m wide x 2m thick. This layer is interpreted as a waterproof layer designed to prevent water escaping from the slipway when full. A grey and black flecked mortar (6003) was also laid against the wall above (6004), also extending across the entire width of the trench and measuring 1.5m wide x 0.45m thick.
In the southern section of the trench, a large masonry structure [6005] was observed, similar to structures [5005], [2157] & [2167] described above. This structure was topped with large rectangular granite blocks below which were supported by a larger square “plinth” constructed

from smaller limestone rubble masonry, bonded with mortar. The upper granite blocks measured approximately 0.65m x 0.65m, though they were not fully exposed within the trench and their full length could not be established. The plinth below measured 2.2m wide x more than 2.5m high.
Only visible at a depth of 2.9m in the northern section a second masonry plinth [6009] was recorded, it appeared similar to [6005] but could not be closely examined for safety reasons. Infilling the trench between wall [6010] and the two plinths [6005] & [6009] was a pale grey silty clay layer (6007) containing frequent angular stones and cobbles, measuring 0.8m thick. Above (6007) was a thick layer of red brown sandy silt (6002) containing frequent large angular stones and some small and medium stones and CBM fragments. This layer ran across the entire trench and measured 2.5m thick. The uppermost layer within the trench comprised reinforced concrete surface (6000) 0.2m thick, which was set on a blue plastic sheet below which was lower layer of concrete (6001) 0.4m thick.

5. Watching Brief Discussion and Interpretation

5.1 The monitoring of seven 0.3m diameter bore holes produced only limited archaeological information. It was not possible to enter the boreholes which necessitated that all recording was made from ground level. Furthermore, the majority of the boreholes were cut into relatively modern layers such as concrete, asphalt and topsoil.

5.2 The nineteen test pits and the larger Central Pier Wall Investigation Trenches were more useful in allowing a broader examination of the historic structure of the slipways.

5.3 The RE-exposure of features no longer visible at ground level was illuminating and hints at earlier phases in the development of the slipways. The plinth structures [2157], [2167], [5005], [6005] & [6009] were exposed in both of the CPWI trenches and also in STP 215 and STP 216. These substantial structures consist of a square stone plinth or base constructed from bonded limestone rubble and measuring more than 2.2m square and more than 2.5m high. These platforms are topped with a large carved granite block or blocks, squared and with a rectangular slot cut into the top for a timber post measuring at least 600mm x 300mm in section. On one of these structures [5005], the top had been modified with a metal pin set into a concrete block. The positions of these structures approximately coincide with the that of rectangular post bases visible on the 1864 OS Town Plan of Pembroke (see paragraph 3.6.2 above). It is possible that these posts represent the supports for the iron roofs over Slipways 1 and 2 constructed by George Baker and Son in 1847-9. It is interesting to note that the remains of a substantial rectangular timber post measuring 600mm x 300mm in section was recorded in the post base revealed in STP216. It is not clear whether a timber post of this size could have supported an iron roof. It is possible that an early iron superstructure may have been replaced with a timber structure at a later date. Alternatively, the post bases may have provided support for scaffolding or ships within the dock during the shipbuilding process.
The use of limestone rubble for wall footings combined with monumental granite capstones is in keeping with the architectural style of the mid-19th century slipway walls, suggesting that these substantial post bases are broadly contemporary with the slipways.

5.4 The purpose of the two opposing sloping concrete "walls" [2086] & [2087] recorded in STP 208 is less obvious. They are asymmetrical and were only partially exposed but appear to define a gully running E-W across the central pier between Slipway 1 and 2. Whilst the detail afforded by historic maps is limited as is their chronological coverage, it is clear that a variety of dockyard structures were constructed in this vicinity over the life of the slipways and that the docks have been put to a variety of uses including a 'Flying Boat Base' (OS County Series map of Pembrokeshire, 1953 1:10,560). Rail tracks also ran along the central pier adjacent to both slipway walls during the 20th century. It is possible, among other potential uses, that such a gully could have been constructed to duct cables, rods or services beneath the rail tracks.

5.5 STP213 was located at the centre of the head of the Historic Building Slip 2. The excavations revealed at least two phases of use. The modern concrete slipway floor partially covered evidence for an earlier bollard or anchor point comprising a large concrete block with a steel pin set into it. This block may have subsequently been re-used as infill or make up for the modern concrete slipway floor. This modern floor partially covered a concrete and steel anchor point (2135) located at the east end of the trench. This anchor point is one of a pair located on either side of the slipway head, the upper parts of both still visible above ground and potentially in use. A brick wall [2134] at the west end of the test pit may be contemporary but is no longer in use, sealed beneath the modern concrete floor. The wall and the anchor points were both constructed upon the natural bedrock (2136).

5.6 Evidence for former buildings was encountered in STP 208 which contained a brick-built sewer main, whilst the brick walling in STP 214 suggests that a building was located in that area of the site. In fact, the whole southern jetty south of Slipway 2 had visible signs at ground level of the remains of buildings, elements of which were encountered in STP 215 & STP 216 as well as in BH 104. These buildings are clearly shown on maps dating from at least 1950 and are perhaps likely to be associated with the WWII use of the site. Cartographic evidence shows that they were still standing in 1993. Available aerial photographs show that they had been demolished by 2006, although visible evidence of their footprints remain on the ground.

5.7 Evidence from the offshore test pits STP401 & STP403 revealed that the foundations of the arches that support the southern section of Carr Jetty comprised concrete blocks. Carr Jetty is not visible on the OS County Series 1:10.560 map of 1909, but it is visible on the Russian map of 1950. This might suggest that the southern section of Carr Jetty, linking it to the land, was constructed as part of the early to mid-20th century naval development of the site.

5.8 The Slipway walls were also exposed in several of the test pits, as well as in both sections of the Central Pier Wall Investigation Trench. Two test pits (STP201 & STP202) were excavated against the western face of the western wall of Slipway 1. This face was not designed to be seen, buried below the made ground that supports the raised dock. Thus, the excavation of these test pits has revealed structural detail not seen during the recording of the fabric of the historic dock. STP201 was excavated against the back of the historic west wall of Building Slip 1 and revealed that it was constructed from coursed and squared limestone blocks bonded with lime mortar. These walls supported and were capped with monumental squared granite blocks that were designed to be seen above ground. STP202 however was located adjacent to the southern section of Slipway 1, a section that did not form part of the historic Building Slip 1 but was extended southwards in the early to mid-20th century. These slipway walls were constructed on their hidden western face from concrete formed with corrugated iron shuttering.

5.9 The internal face of the western wall of the historic Building Slip 1 was exposed at its base in STP204. The wall appears to have been constructed directly on to the limestone bedrock and appears to have been faced with large limestone ashlar blocks at this point, although they are partially obscured by salt deposits and barnacles.

5.10 The normally covered external faces of the eastern wall of Slipway 1 and the western wall of Slipway 2 were only exposed in the Central Pier Wall Investigation Trench. They were shown to be of similar construction. They measured more than 1m wide and were at least 4.5m high. The upper course was constructed from very large squared Granite blocks with lower courses of bonded limestone rubble.

5.11 The normally covered eastern face of the eastern wall of Slipway 2 was exposed in STP215 & STP216. The wall measured at least 1m wide and was capped with interlocking dressed granite blocks which were laid upon a grey and black flecked mortar layer, which in turn was set on top of loose rubble blocks.

5.12 The base of the internal west facing face of the eastern wall [2115] of Slipway 2 was partially exposed within STP211. The base of this wall was constructed from large blocks of blue-grey limestone ashlar.

5.13 Where the normally hidden faces of the historic slipway walls were exposed across the site they were revealed to have been backed up with deposits of puddled clay to prevent the ingress of water through the slipway walls where it could undermine the structure of the docks and piers. The slipways were designed to hold water when the Caisson gates were closed, assisted by the puddled clay on the back the walls.

6. Finds

Table 1: Finds inventory

Context	quantity	Type/description	Provisional Date
2016	1x	Wooden plank	19th-20th century
2033	1x	CBM/brick	20th century
2062	1x	Ferrous rivet	n/k
2074	1x	Ferrous bar	n/k
2074	1x	CBM	20th century
2104	1x	Stone and mortar	n/k
2104	2x	CBM/brick and mortar	n/k
2133	1x	Ferrous object	n/k
2133	2x	CBM/brick	20th century
2144	1x	CBM and mortar	20th century
2162	1x	Spent bullet case	20th century
5004	1x	Worked wood, boat part?	19th-20th century
6002	1x	CBM/brick	20th century
6003	4x	Mortar/cement	n/k

A Brick bearing the maker's mark *Goodwick* was recovered from (2033). The Goodwick Brickworks were located on the Pembrokeshire coast near Fishguard and were in operation between 1910 and 1969. Peak production of 120,000 bricks per week was reached during WWII (Fishguard and Goodwick Heritage Centre).

7. Conclusions

Whilst the restricted size, considerable depth and loose sides of all of the test pits and bore holes meant that accurate recording of the archaeological features within them was not always possible for safety reasons. The watching brief has nevertheless been able to throw further light on the history and development of the historic structures associated with Building Slips 1 and 2 at Pembroke Dock.
Previously unseen parts of the slipway walls have been recorded as well as elements of the historic structure that have more recently become sealed below modern concrete floors. Three main phases of construction can be suggested in the light of the evidence from the archaeological monitoring of the geotechnical test pits.

Phase 1 comprises the original construction of the slipways prior to the mid-19th century re-construction as evidenced by the 1839 Tithe Map of St Mary, Pembroke. No evidence for this early phase, or the adjacent Pater Fort were revealed during the watching brief. In several places it was revealed that the Phase 2 mid-19th century slipways structure was constructed directly on the limestone bedrock and it may be that any evidence for the earlier slipways were lost at this time.

Phase 2 comprises the construction of the historic Building Slips 1 and 2 at some point between 1841 and 1847-9. This includes the addition of substantial stone plinths supporting monumental granite post bases which in turn may have supported ship building sheds or scaffolding circa 1847-9. The construction style of the slipway walls and post bases are consistent and likely to be broadly contemporary.

Phase 3 comprises early to mid-20th century modifications potentially associated with one or both of the world wars. Historic mapping evidence is lacking for the period 1909 to 1950 but it is in this period that the slipways appear to have been extended to the south and re-floored in concrete. The southern part of Car Jetty appears to have been constructed at this time along with buildings to the south of Slipway 2 and rail tracks along the piers and jetties.

The buildings to the south of Slipway 2 appear to have been lost at some time between 1993 and 2006. Cartographic evidence suggests that the rail tracks may have been dismantled between 1985 and 1989.

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Oldmaps.co.uk
https://www.old-maps.co.uk/#/Map/195754/203960/13/101280

Maps consulted:

Plan of the Parish of St. Mary, Pembroke in the County of Pembroke (Pembroke St. Mary Tithe Map) 1839.

OS Town Plan, Pembroke, Pembrokeshire 1864, 1:500

OS County Series, Pembrokeshire 1869, 1:10,600

OS County Series, Pembrokeshire 1908, 1:2,500

OS County Series, Pembrokeshire 1909, 1:10,600

Russian Map, Pembroke 1950 1:10,000

OS County Series, Pembrokeshire 1953, 1:10,600

OS Plan 1964 1:10,560

OS Plan 1967-1973 1:2500

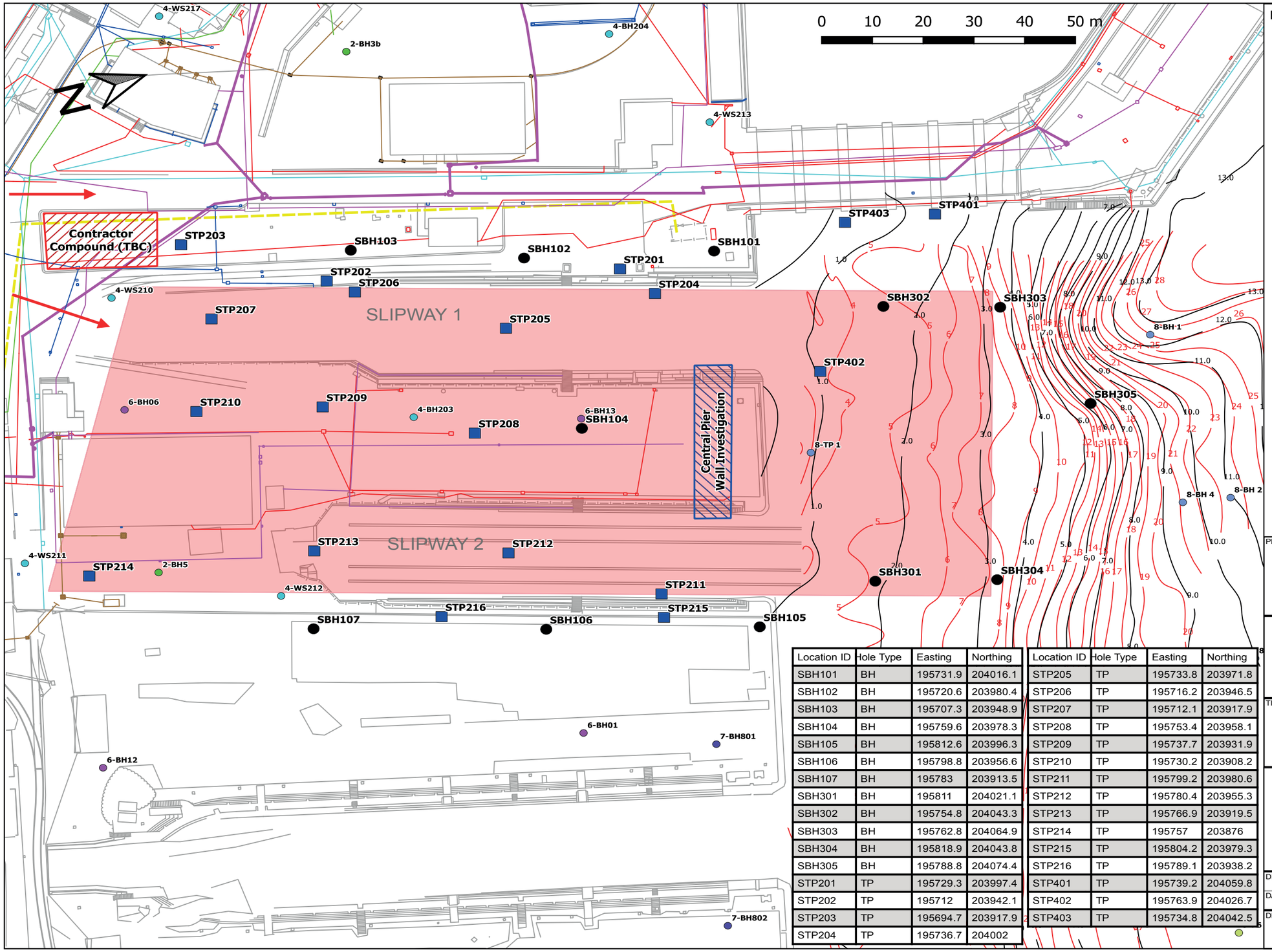
OS Plan 1971-1976 1:10,000

OS Plan 1985 1:10,000

OS Plan 1989 1:2,500

OS Plan 1993-1994 1:10,000

Figure 1. Location of proposed development / works



NOTES

1. All Dimensions in metres unless otherwise noted
2. All levels to Ordnance Datum unless otherwise noted.
3. Geophyiscal survey - postive values are below 0mOD, negative values above 0mOD.
4. Sequence and location specific information shall be as given in the specification.

LEGEND

Proposed Investigation Points

- Proposed Borehole
- Proposed Trial Pit

Historic Location Details

- _2 GIBB Environmental '01
- _4 Enviro '07
- _6 Quantum '16
- _6 RPS '19
- _7 Quantum '08

Utilities

- Stormwater
- Water
- New Water
- Gas
- Foul Water
- Electric
- BT
- 11kV

General

- Bathymetric Survey 2015
- Horizon 1 2015
- Proposed Slipway
- Proposed Contractor Compound Location (TBC)
- Investigation Area for Slipway Walls

Location ID	Hole Type	Easting	Northing
SBH101	BH	195731.9	204016.1
SBH102	BH	195720.6	203980.4
SBH103	BH	195707.3	203948.9
SBH104	BH	195759.6	203978.3
SBH105	BH	195812.6	203996.3
SBH106	BH	195798.8	203956.6
SBH107	BH	195783	203913.5
SBH301	BH	195811	204021.1
SBH302	BH	195754.8	204043.3
SBH303	BH	195762.8	204064.9
SBH304	BH	195818.9	204043.8
SBH305	BH	195788.8	204074.4
STP201	TP	195729.3	203997.4
STP202	TP	195712	203942.1
STP203	TP	195694.7	203917.9
STP204	TP	195736.7	204002

Location ID	Hole Type	Easting	Northing
STP205	TP	195733.8	203971.8
STP206	TP	195716.2	203946.5
STP207	TP	195712.1	203917.9
STP208	TP	195753.4	203958.1
STP209	TP	195737.7	203931.9
STP210	TP	195730.2	203908.2
STP211	TP	195799.2	203980.6
STP212	TP	195780.4	203955.3
STP213	TP	195766.9	203919.5
STP214	TP	195757	203876
STP215	TP	195804.2	203979.3
STP216	TP	195789.1	203938.2
STP401	TP	195739.2	204059.8
STP402	TP	195763.9	204026.7
STP403	TP	195734.8	204042.5

PROJECT

Pembroke Dock Slipway

Port of Milford Haven

TITLE

Proposed Ground Investigation Locations

Royal HaskoningDHV
Enhancing Society Together

DRAWN	CHECKED	APPROVED
MGD	EA	CH
DATE: Nov '19	SCALE AT A3: 1:750	REF: -

DRAWING No.: PB8556-ZZ-XX-DR-Z-0022

Revision: C0

Figure 2. Location of boreholes and test pits.

ARCHAEOLOGY WALES
Revealing the past, informing the future

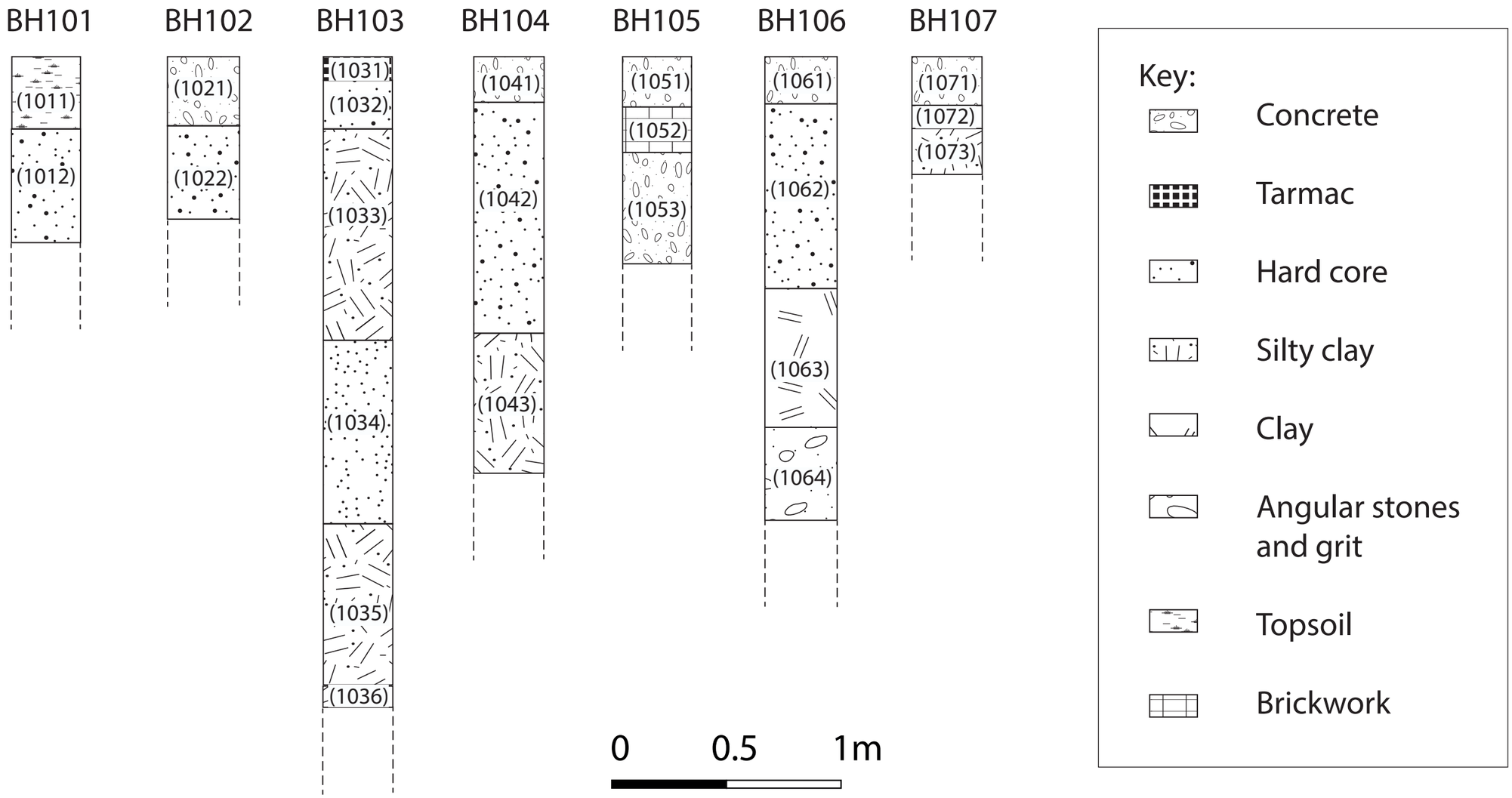
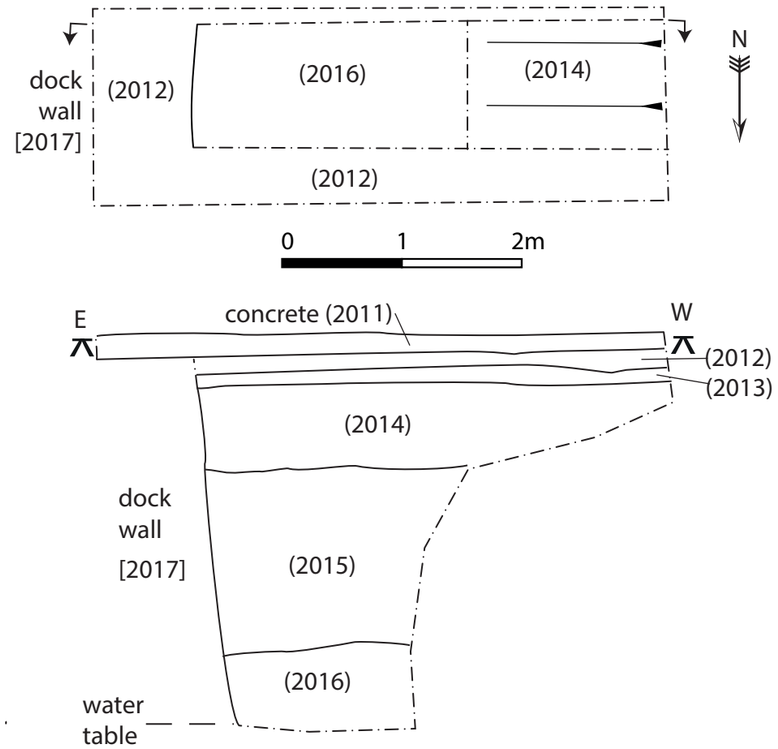
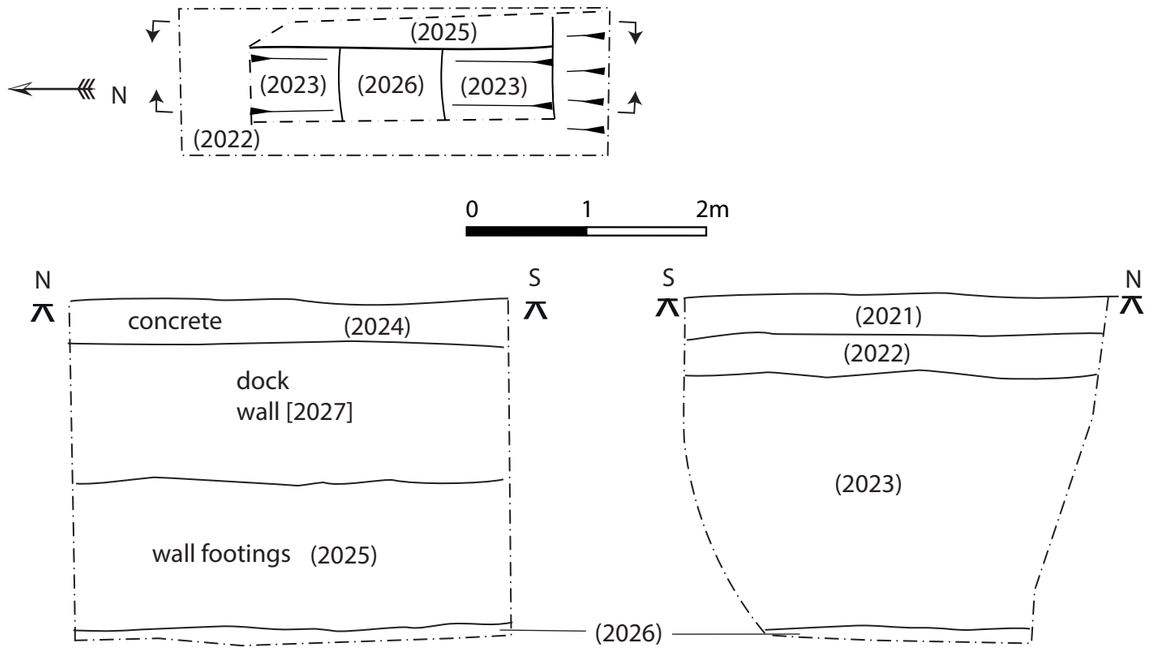


Figure 3. Schematic Bore Hole Sections.

STP201 Plan and N Facing Section



STP202 Plan and W Facing Section (below left) and E Facing Section (below right)



STP208 Plan and E Facing Section

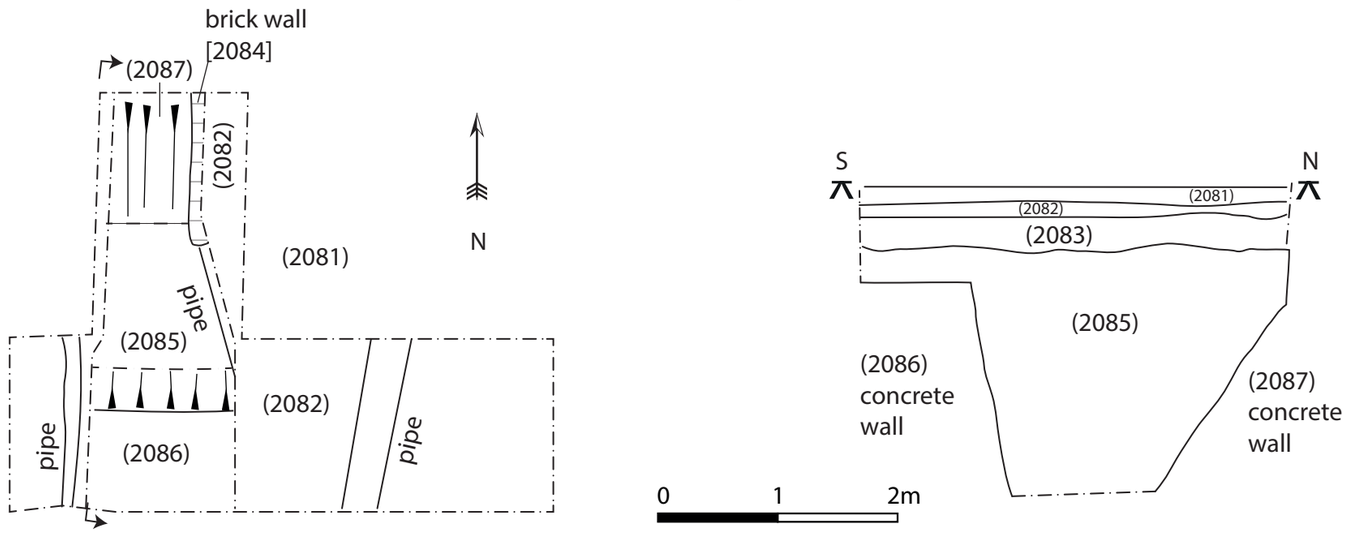
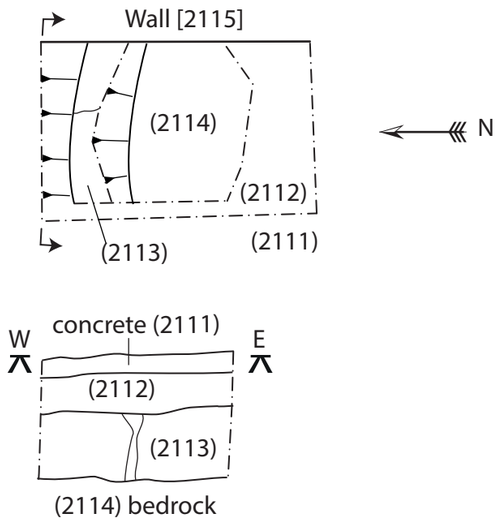
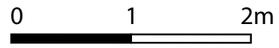


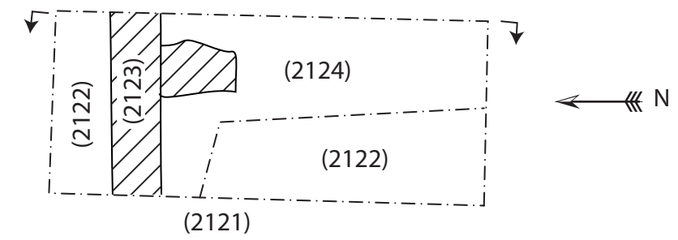
Figure 4. Key Test Pit Plans and Sections: STP201 (top left); STP202 (top right); STP203 (bottom).

STP211 Plan and S Facing section

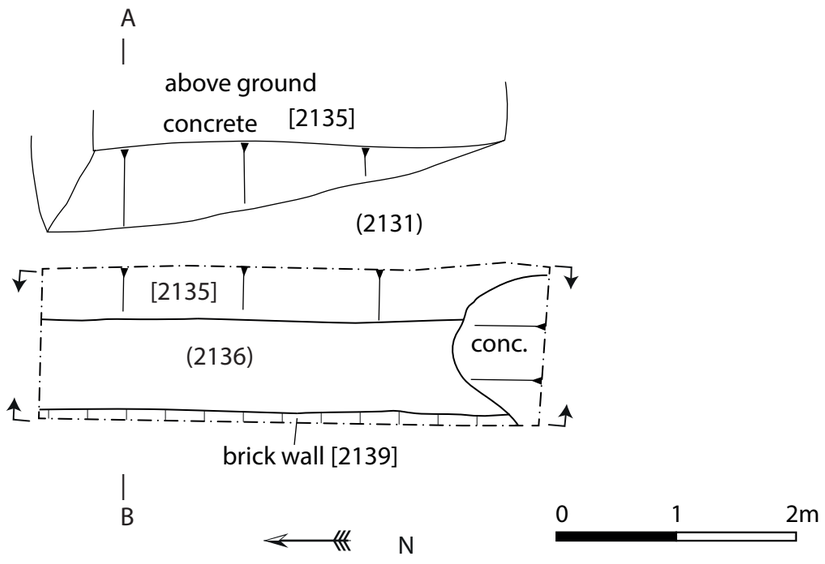


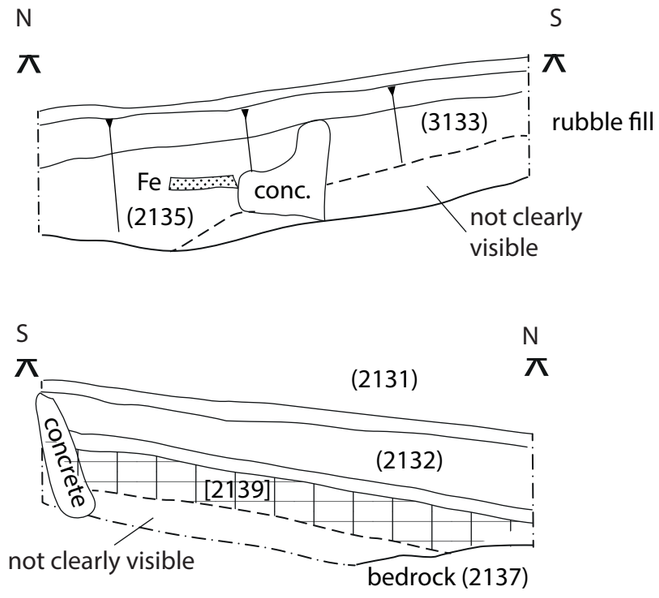


STP212 Plan and W Facing section



STP213 Plan (bottom left), W Facing Section (upper middle), E Facing Section (lower middle), and sketch profile (bottom right, not to scale)





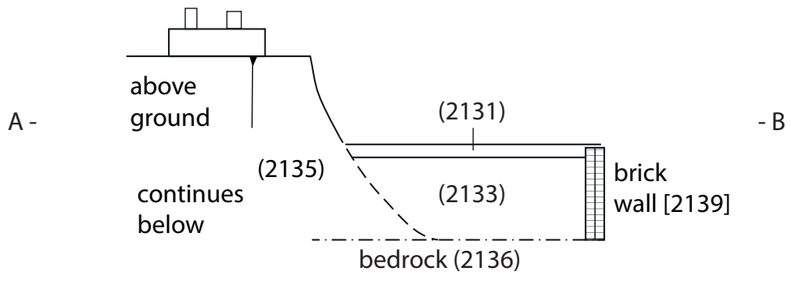
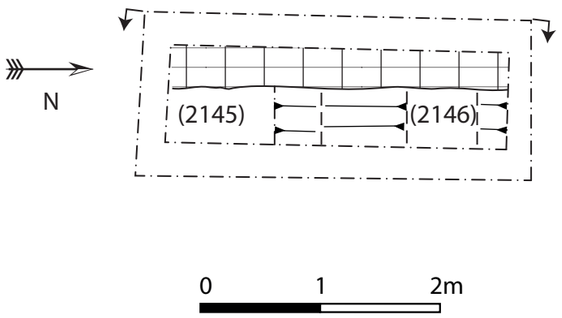
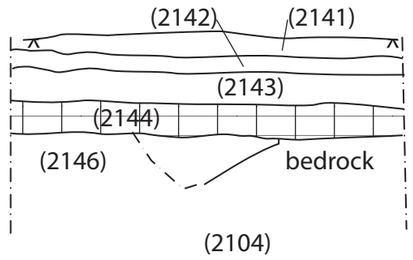


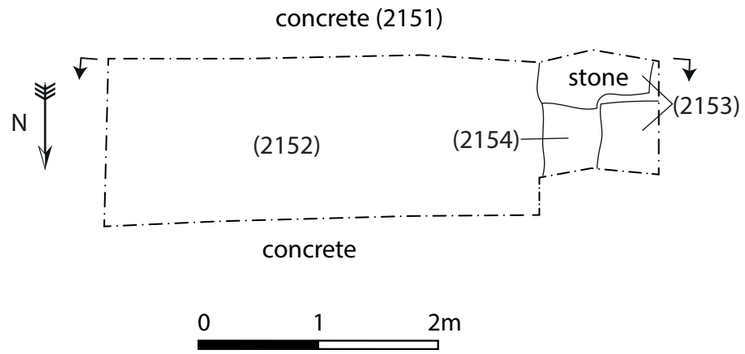
Figure 5. Key Test Pit Plans and Sections: STP211 (top left); STP212 (top right) and STP213 (bottom).

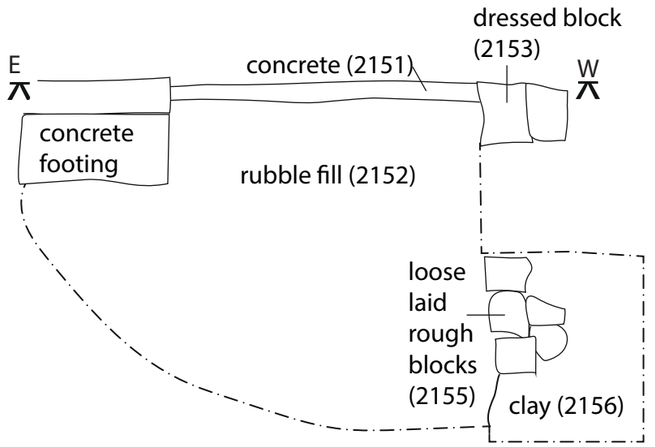
STP214 Plan and E Facing Section



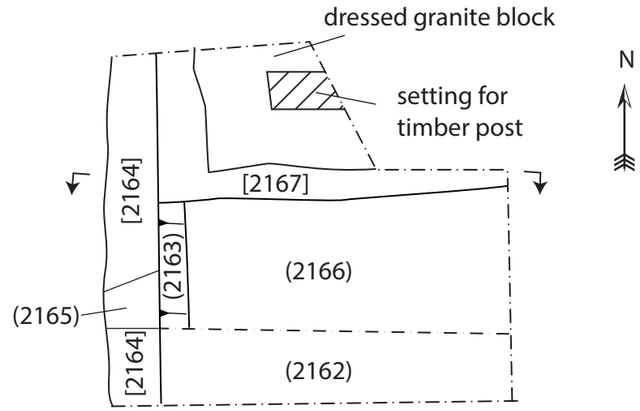


STP215 Plan and N Facing Section





STP216 Plan and S Facing Section



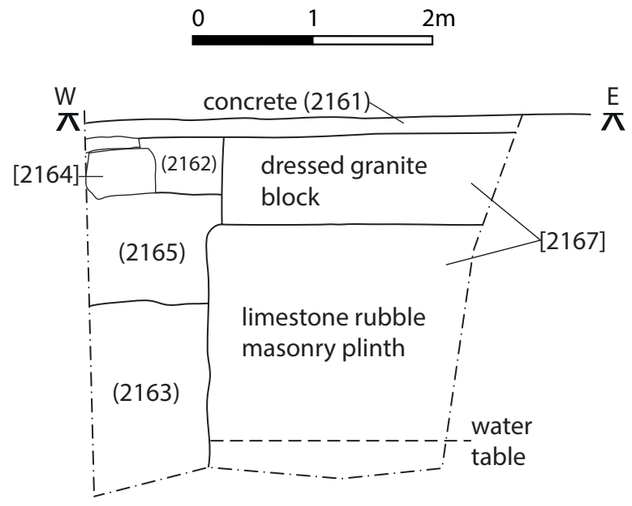
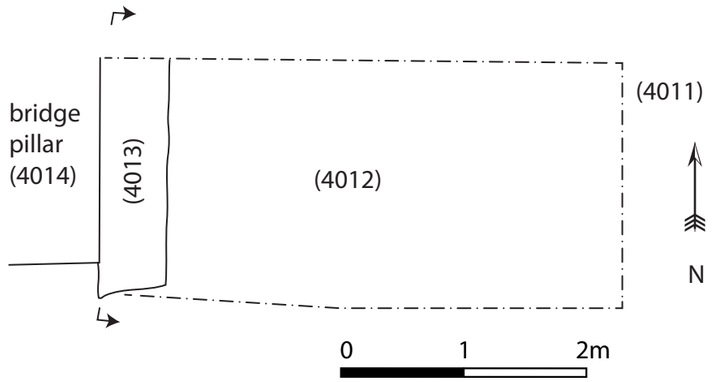
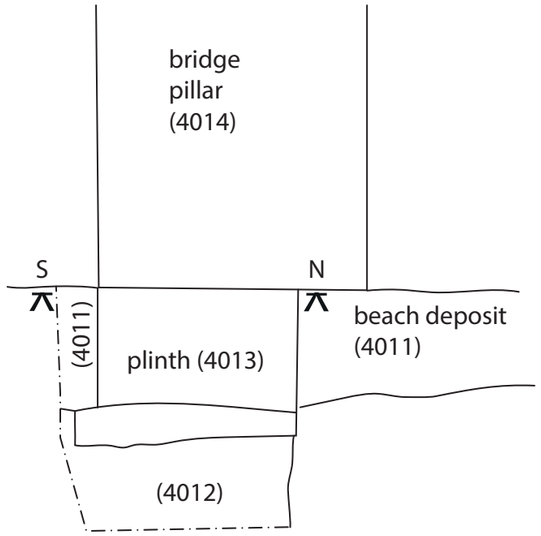


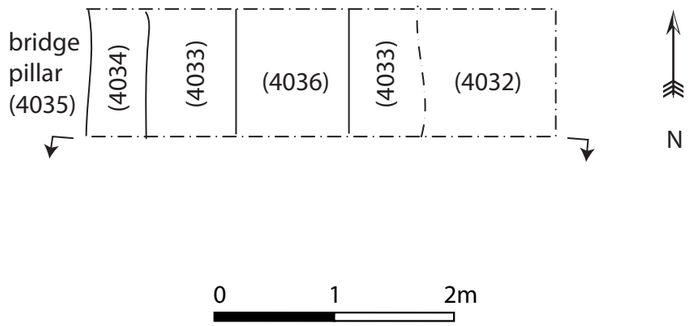
Figure 6. Key Test Pit Plans and Sections: STP214 (left); STP215 (centre); and STP216 (right).

STP401 Plan and E Facing Section





STP403 Plan and S Facing Section



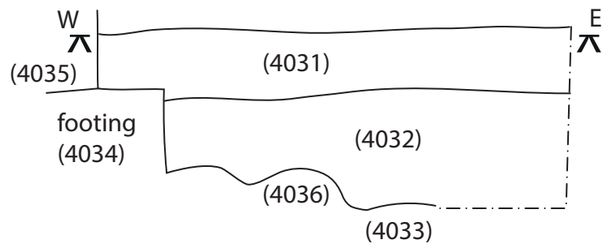
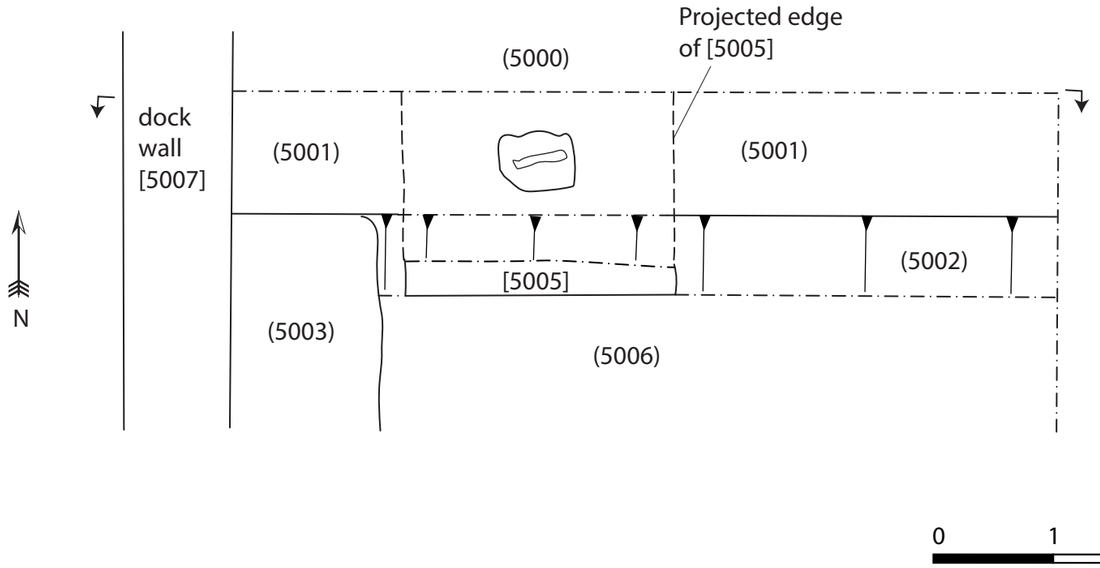


Figure 7: Key Foreshore Test Pit Plans and Sections: STP401 (left) and STP403 (right).



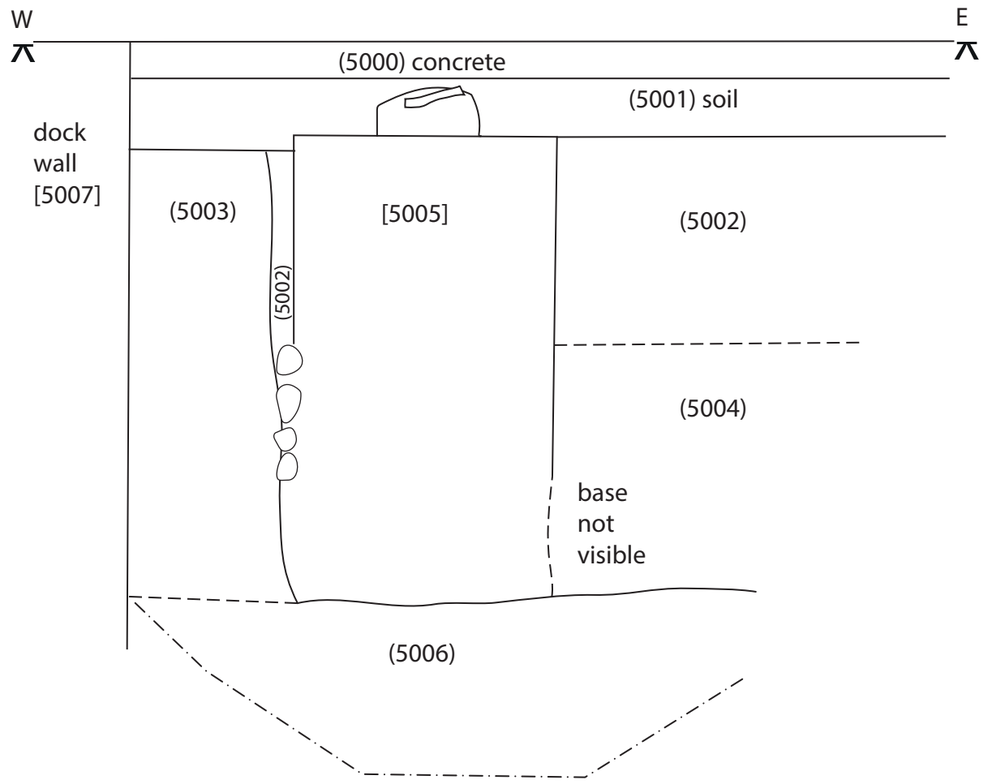


Figure 8: The Central Pier Wall Investigation Trench (Western Part) Plan (left) and S Facing Sections (right).

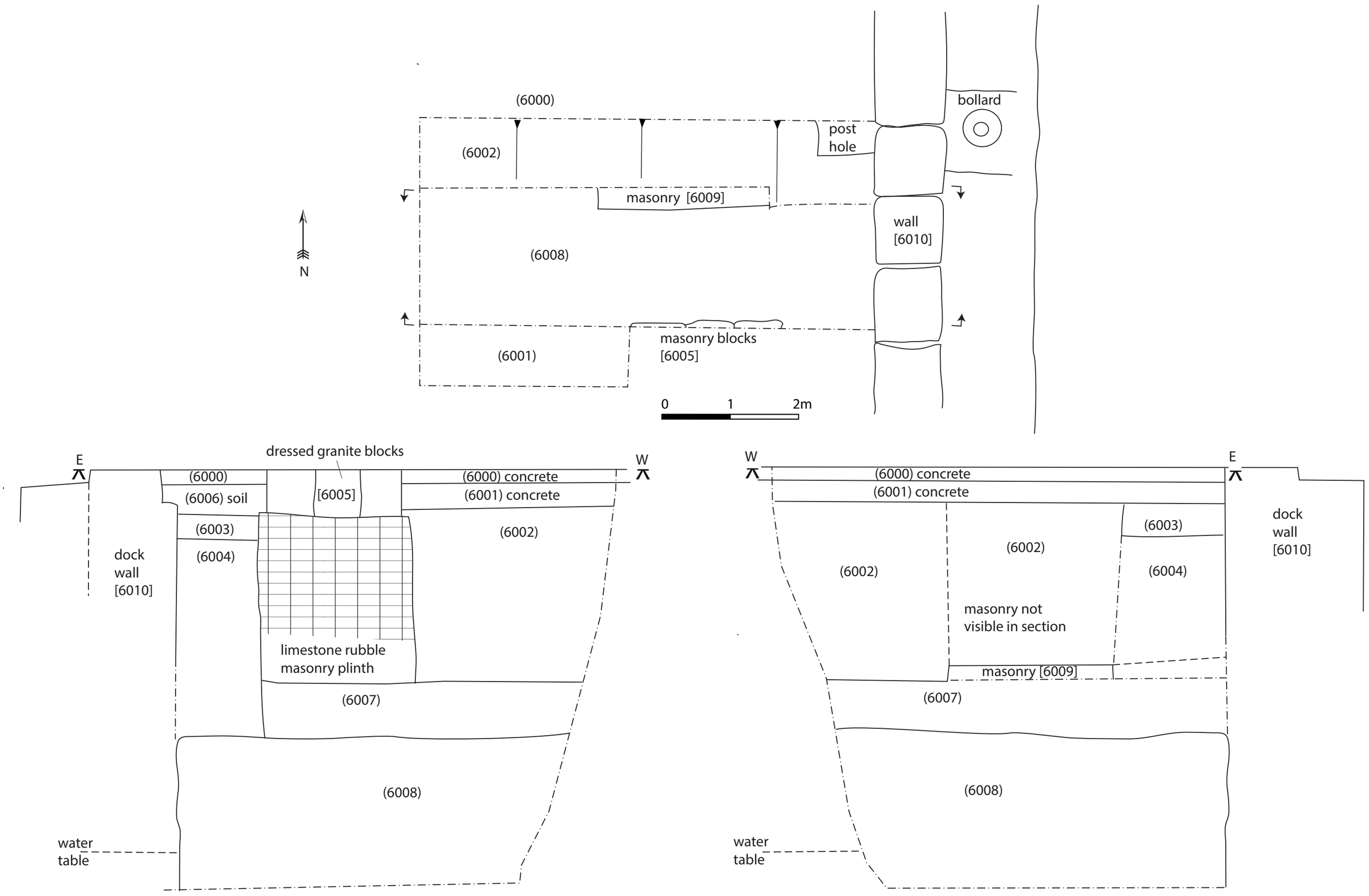


Figure 9: The Central Pier Wall Investigation Trench (Eastern Part) Plans and Sections: Plan (top); N Facing Section (bottom left); S Facing Section (Bottom Right)

Plate 1: Historic Building Slip Number 1, view to NNW.

Plate 2: Overview of the site taken from Carr Jetty showing Slipway 1 (centre) and Slipway 2 (left), View to the S.

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Plate 3: Slipway 1, view to the NNE.

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Plate 4: Slipway 2, View to the N.

Plate 5: Offshore drilling rig at high tide with Carr Jetty behind, View to the NW.

Plate 6: Offshore drilling rig at low tide, View to the N.

Plate 7: BH101 drilling rig in action, view to the north.

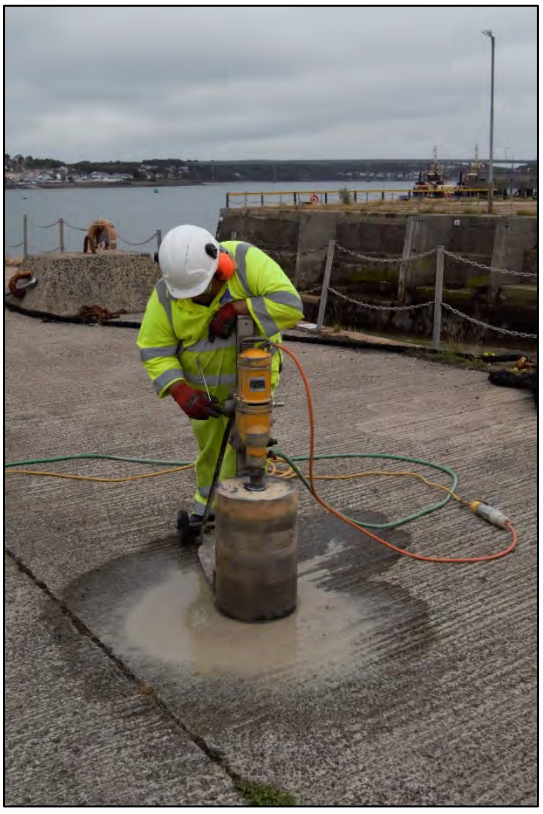

Plate 8: BH102: cutting concrete, view to the NE

Plate 9: BH102 at 0.5m, 0.5m scale.

Plate 10: BH105 showing brickwork (1052) and lower concrete layer (1053) below, 0.5m scale.

Plate 11: BH107, concrete (1071) removed to reveal hard core layer (1072), 0.3m scale.

Plate 12: STP201 detail of Slipway 1 western wall [2017], west face. Clay layer (2015) visible in section, view to the east.

Plate 13: STP202 west face of Slipway 1 western wall [2025] and corrugated iron shuttering (2027), view to east, 2m scale.

Plate 14: STP203 east facing section, working shot showing modern services, view to west.

Plate 15: STP204 the base of east face of the western wall of Slipway 1, view to the west, 1m scale.

Plate 16: STP204, N facing section, view to the south, 1m & 2m scales.

Plate 17: STP205, west facing section, view to the east, 1m & 2m scales.

Plate 18: STP206 N facing section, layer (2063) exposed, view to the south, 0.5m & 2m scales.

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Plate 23: STP208, brick culvert [2084], view to the east, 1m scales.

Plate 24: STP209, east facing section, view to the west, 2m scale.

Plate 25: STP210 east facing section, view to the west, 1m & 2m scales.

Plate 26: STP211, showing the base of the eastern wall of Slipway 2, view to the east, 1m & 2m scales.

Plate 27: STP212, west facing section, view to the east, 1m & 2m scales.

Plate 28: STP213 east facing section showing wall [2139], view to the west, 1m & 2m scales.

Plate 29: STP213 mid excavation, looking SE showing winch or anchor point [2135], view to SE, 1m & 2m scales.

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Plate 37: STP402 SE facing section, view to the NW, 1m scale.

Plate 38: STP402 working shot, view to the NNE.

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Plate 42: CPWIT west S Facing section showing plinth [5005], view to the north, 2m scale.

Plate 43: CPWIT East, detail of west face of western wall of Slipway 2, view to the east, 3m scale.

Plate 44 CPWIT East, N Facing section showing the interface between plinth [6005] and the western wall of Slipway 2 (extreme left), view to the south, 2m & 3m scales.

Plate 45: CPWIT East, west face of western wall of Slipway 2 and plinth [6005], view to the east, 4m scale.

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APPENDIX I:
Context Inventory

Context Inventory

location	Context	type	description and depth below ground level
BH 101	1011	layer	Top soil, dark brown silty loam, 0-0.3m
	1012	layer	Rubble, 0.3-0.8m
BH102	1021	surface	Concrete surface, 0-0.2m to 0.3m
	1022	layer	Silty clay, mid brown and rubble, 0.3-0.7m
BH103	1031	surface	Asphalt/tarmac car pack surface, 0-0.1m
	1032	layer	Grey brown, gritty silty clay, 0.1-0.3m
	1033	layer	Red brown, gritty silty clay and angular stones, 0.3 – 1.2
	1034	layer	Grey brown gritty silt with frequent angular stones, 1.2-2m
	1035	layer	Red brown clay and angular stones, 2-2.7m
	1036	layer	Angular stones, 2.7 to 2.8
BH104	1041	surface	Concrete surface, 0-0.2m to 0.3m
	1042	layer	Loose gravel and concrete rubble, 0.2-1.2m
	1043	layer	Mid-grey brown firm silty clay, 1.2-1.45m
BH105	1051	surface	Concrete surface, 0-0.2m to 0.3m
	1052	structure	Brick bonded/cement, 0.2-0.4m
	1053	structure	Concrete footings/surface, 0.4-0.9m
BH106	1061	surface	Concrete surface, 0-0.2m to 0.3m
	1062	layer	Red brown silty clay with frequent angular stones, 0.2-1m
	1063	layer	Red brown clay, rounded stones, 1m -1.6m
	1064	layer	Angular stones and gravel, 1.6-2m
BH107	1071	surface	Concrete surface, 0-0.2m to 0.3m
	1072	layer	Hardcore, 0.2-0.3m
	1073	layer	Pale crushed stone and silty clay, 0.3-0.5m
STP201	2011	surface	Concrete surface, 0-0.2m
	2012	layer	Concrete, gravel and pale sand, 0.2-0.45m
	2013	layer	Dark grey stone dust and gravel, 0.45-0.6m
	2014	layer	Fill. Mid red brown sandy silt with moderate small, medium And large angular stones, 0.6-1.45m
	2015	layer	Firm red clay- dock lining/puddle clay, 1.45-3m
	2016	layer	Blue-grey marine clay, 3m+
	2017	structure	Dock wall with concrete capping, constructed of masonry?, 0-3m+
STP202	2021	surface	Concrete slipway surface, 0 to 0.3m
	2022	layer	Mid grey brown sandy silt with frequent small and medium angular stones and mudstone, 0.3-0.6m
	2023	layer	Mid brown sandy silt, medium and large angular stones, 0.6-2.6
	2024	structure	Dock wall
	2025	structure	Concrete footing for dock wall, 1.5-?
	2026	layer	Limestone bedrock, 2.5m
STP203	2031	surface	Tarmac car park surface, 0 to 0.05m
	2032	layer	Stone dust and dark grey silt on terram sheet, 0.05-0.2m
	2033	layer	Very compact mottled dark red brown sandy silt and crushed limestone, ferrous staining, hardcore including CBM and plastics, 0.2-1m
	2034	fill	Fill of 2036. Dark brown silty clay with moderate small angular stones, 0.2-1m
	2035	fill	Fill of 2036. Clean sand with blue plastic pipe. 1-1.3m
	2036	cut	Concave linear cut of service trench for water pipes, 0.2-1.3m

	2037	layer	Pale brown silty clay with frequent large angular stones, 1m – 2.2m
STP204	2041	surface	Concrete slipway surface. 0 – 0.2m
	2042	layer	Grey-green aggregate/gravels, 0.2-0.3m.
	2043	layer	Pale brown aggregate/gravels, 0.3-0.5
	2044	layer	Dark brown, black and grey contaminated gravels, 0.5-0.7m
	2045	layer	Very dark brown black silt, contaminated, 0.7-0.85
	2046	layer	Limestone bedrock, 0.85 +
STP205	2051	surface	Concrete surface of slipway. 0-0.15m
	2052	layer	Grey stone dust and gravel, 0.15-0.4m
	2053	layer	Compacted limestone blocks and pink stone dust; includes 3 timber planks. 0.4-0.8m
	2054	layer	Limestone bedrock, 0.8m+
STP206	2061	surface	Concrete slipway surface, 0-0.2m
	2062	layer	Aggregate and cement fill, 0.2-0.6m
	2063	layer	Limestone bedrock. Geologist said it was bedrock, but I was uncertain. See 2053 in Test Pit 205.
STP207	2071	surface	Concrete surface. 0-0.15m
	2072	layer	Concrete and aggregate levelling deposit, 0.15-0.4m
	2073	layer	Pale brown sandy silt with frequent small and medium angular stones and CBM, 0.4-0.8m
	2074	layer	As above, but very frequent large angular and rounded stones, 0.8-2.05m
	2075	layer	Limestone bedrock, 2.05m +
STP208	2081	surface	Concrete surface, 0-0.15m
	2082	layer	Crushed concrete and plastic sheet, 0.15-0.2m
	2083	layer	Make-up/levelling deposit. Dark grey brown gritty silt with black flecks and lens of red stone dust at base, 0.2-0.5m
	2084	structure	Structure. Brick built, sewer main and pipe. 0.2-0.5m
	2085	layer	Deposit of mid red brown clay with frequent large angular stones, 0.5-3m+
	2086	structure	Structure. Sloping concrete wall, runs E-W, facing north. 0.5-3m+
	2087	structure	Structure. Sloping concrete wall, runs E-W, facing south, 0.5-3m+
STP209	2091	surface	Concrete surface. 0-0.15m
	2092	layer	Crushed concrete and plastic sheet, 0.15-0.2m.
	2093	layer	Mixed dark brown silty clay and sand, 0.2-0.3m
	2094	layer	Crushed concrete, 0.3-0.6m
	2095	layer	Mid red-brown clayey silt with frequent flattish angular stones and charcoal flecks, 0.6-3m
	2096	layer	Limestone bedrock, 3m+
STP210	2101	surface	Concrete surface, 0-0.15m
	2102	layer	Dark brown loam, 0.15-0.55m
	2103	layer	Red brown clay with frequent angular stones, small and medium. 0.55-0.9m
	2104	fill	Backfill layer, mostly of large angular stones including brick and stones with mortar on them/rubble. 0.9-2.5m
	2105	surface	Partly exposed concrete surface/structure, 2.5-2.7m
STP211	2111	surface	Concrete slipway surface, 0-0.2m
	2112	layer	Concrete hardcore, 0.2-0.5m
	2113	layer	Limestone blocks and mortar, 0.5-1m
	2114	layer	Bedrock 1m+

STP212	2121	surface	Concrete surface of slipway, 0-0.12m
	2122	layer	Hardcore. Red stone dust and limestone blocks and concrete, 0.12-0.75m
	2123	timber	Timber, 3x railway sleepers/planks; possibly part of an earlier slipway.
	2124	layer	Limestone bedrock at 0.75m+
STP213	2131	surface	Concrete surface, 0-0.1m
	2132	layer	Stone dust and gravel/aggregate, 0.1-0.25m
	2133	fill	Rubble fill, including concrete blocks, slabs and CBM and a plastic bottle, 0.25-1.5m
	2134	structure	Brick/masonry wall. 0.25-1.5m
	2135	structure	Sloping concrete bollard, partly above ground, buried by concrete surface 2131.
	2136	layer	Limestone bedrock, 1.5m+
STP214	2141	surface	Concrete surface, 0-0.15m
	2142	layer	Aggregate layer. Small red brown stones. Plastic sheet between this and layer above. 0.15-0.3m
	2143	layer	Dark grey brown clay loam. 0.3-0.55m
	2144	structure	Brick wall/footing with dark grey flecked mortar, 0.55-0.8m
	2145	Fill/surface	Levelling deposit of compacted clinker/ash—industrial waste. Possibly a floor surface. 0.55-0.8m.
	2146	layer	Limestone bedrock, 0.8- >1.2m
STP215	2151	surface	Concrete surface-- remains of a structure floor. 0-0.2m
	2152	fill	Rubble fill, 0.2-2.75m
	2153	structure	Dressed masonry blocks, 0-2.75m
	2154	layer	Grey mortar with black flecks, 1m thick, 1-1.5m
	2155	structure	Loose laid rough blocks/footings, 1.5-2.5m
	2156	layer	Compact red brown clay 'puddle clay', dock lining, 1.5-3m
	2157	structure	Dock wall, 0-3m
STP216	2161	surface	Concrete surface, 0-0.15m
	2162	layer	Topsoil, dark brown clay loam, 0-0.15m
	2163	layer	Red brown clay, dock lining, 1m-3m
	2164	structure	Dock wall: dressed masonry blocks with concrete cap, 0-0.62m
	2165	layer	Dark grey mortar with black flecks, under inner dock wall capping/facing stones 0.62-1.1m
	2166	layer	Red brown silty clay with frequent angular stones, 0.12-3m
	2167	structure	Masonry under 2163. Random rubble coursing and pinkish mortar, 0.65->2m
STP401	4011	layer	Beach shingle/cobbles. 0-0.5m
	4012	layer	Beach sediment. Very dark sandy silt, 0.5+
	4013	structure	Structure: Jetty arch base.
	4014	structure	Structure: Jetty arch
STP402	4021	layer	Very dark brown/black silt, 0-0.2m
	4022	layer	Mid grey silty sand, 0.2-0.4m
	4023	layer	Red brown gritty sand with shell fragments, 0.4-1m
	4024	layer	Brown gritty sand with shell fragments + shale/mudstone, 1m-2.75
	4025	layer	Weathered limestone bedrock, 2.75m+
STP403	4031	layer	Beach shingle, 0-0.5m
	4032	layer	Very dark sandy silt—oil stained. 0.5-1.5m
	4033	layer	Weathered limestone bedrock, 1.5m+

	4034	structure	Structure: Concrete plinth for jetty arch
	4035	structure	Structure: Jetty arch
	4036	structure	Structure: N-S aligned arched concrete/sewer pipe? Or part of jetty structure. 1.2m +
CPWIT-west	5000	surface	Concrete surface, 0-0.15m
	5001	layer	Very dark brown silty loam with occasional small angular stones, 0.15-0.35m
	5002	layer	Mid red brown sandy silt, variable quantities of small, medium and large stones, both rounded and angular, 0.35-?
	5003	layer	Firm reddish clay; dock wall lining. 0.9-1.6m
	5004	layer	As 5002, with higher % of large stones/cobbles, 2.5-4.5m
	5005	structure	Concrete topped stone built plinth, random rubble masonry. Fixed anchor point/reinforcement. 0.75-?4m
	5006	layer	Blue grey marine clay, 4.5m+
	5007	structure	Dock wall. 0-?6m
CPWIT-east	6000	surface	Concrete surface, 0-0.2m
	6001	layer	Concrete layer below blue plastic sheet, 0.2-0.6m
	6002	Fill/layer	Fill. Red brown sandy silt with frequent large angular stones plus smaller medium stones, includes CBM/Brick. 0.6-3m
	6003	layer	Grey mortar with black flecks, 0.6-1m
	6004	layer	Compact red brown clay with occasional grey streaks
	6005	structure	Structure: masonry plinth, 0-4m+
	6006	layer	Dark brown silty loam, 0.2-0.65
	6007	layer	Pale grey-brown silty clay with frequent angular stones, 3m-3.75m
	6008	layer	Mottled firm blue grey marine clay with black organic streaks, 3.75-6m+
	6009	structure	Structure: masonry plinth, 0.2-4m+
	6010	structure	East dock wall of pier area, 0-6m+

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APPENDIX II: Written Scheme of Investigation

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Revealing the past, informing the future

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WRITTEN SCHEME OF INVESTIGATION

FOR AN ARCHAEOLOGICAL WATCHING BRIEF AT

CARR JETTY, EDGAR MORGAN WAY, PEMBROCK DOCK

Prepared for:

Milford Haven Port Authority

Project No: 2811

June 2020

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Figure 1. Location of proposed development / works

Figure 2. Location of boreholes and test pits

1. Introduction & Planning Background

1.1.1. This Written Scheme of Investigation (WSI) details a programme of archaeological mitigation to be undertaken by Archaeology Wales Ltd (henceforth – AW) at the request of Milford Haven Port Authority (henceforth – the client).

1.1.2. The archaeological mitigation will consist of a watching brief and will be undertaken during ground works associated with the excavation of nineteen test pits and twelve boreholes during ground investigation (GI) works. The GI works are to be completed ahead of the construction of a new, wider slipway in the location currently occupied by Slipways 1 and 2 and the quay between them at Carr Jetty, Edgar Morgan Way, Pembroke Dock, Pembrokeshire, SA72 6TE, centred on grid reference SM 95754 03960.

1.1.3. This WSI has been prepared by James Evans PCIfA, Desk-Based Assessment Officer, (Archaeology Wales).

1.1.4. The methodology set out in this WSI has been agreed with Dyfed Archaeological Trust–Heritage Management (henceforth – DAT-HM) who are acting as advisors to the local planning authority, Pembrokeshire County Council (henceforth – PCC). DAT-HM has recommended that a watching brief is undertaken during groundworks to ensure there is no accidental damage to the Listed Buildings (beyond the excavation of the test pits) and to ensure that any archaeological remains that are encountered are recorded.

1.1.5. The purpose of the archaeological mitigation it to provide the local planning authority with sufficient information regarding the nature of archaeological remains on the site of the development, the requirements for which are set out in Technical Advice Note (TAN) 24: The Historic Environment (2017). The work is to ensure that all archaeological and historical components of the site are fully investigated and recorded if they are to be revealed as a result of activities associated with the development.

1.1.6. All work will be undertaken to the standards and guidance set by the Chartered Institute for Archaeologists (2020). AW is a Registered Organisation with the CIfA.

2. Site Description

2.1.1. The site is located on the southern shore of Milford Haven waterway within the Port of Pembroke, Pembroke Dock (Figures 1 and 2). As part of the port masterplan for Pembroke Port, the Milford Haven Port Authority (MHPA) proposes to construct a new, wider slipway in the location currently occupied by Slipways 1 and 2 and the quay between them to the east of Carr Jetty. Both Slipway 1 and Slipway 2 are listed structures (LB 14391 & LB 14392, respectively).

2.1.2. The Carr Jetty projects into the Milford Haven waterway east of the Carr Rocks, which are submerged sediment and bedrock features that extend north into the Milford Haven waterway (Quantum (Geotechnical) Ltd 2008, 4). The geotechnical pits are being excavated on the site of the proposed new slipway which will be approximately 67m wide and approximately 180m long, extending around 40m beyond the existing quay wall, and is centred on NGR SM 95754 03960.

2.1.3. The underlying geology of the site is composed of Dinantian Rocks (undifferentiated), which comprises of limestone with subordinate sandstone and argillaceous rocks. This sedimentary bedrock formed approximately 326 to 359 million years ago in the Carboniferous Period (BGS, 2020).

3. Archaeological & Historical Background

3.1.1. The Milford Haven waterway, in general, has a rich history. The wide and deep waterway was the ideal location for ships and fleets to dock and anchor. In the early medieval period, the area was known as a location where Viking's would shelter and overwinter. In the mid/later medieval period it was also used as a location for a succession of English monarchs to muster fleets and troops to invade Ireland. It was also a landing place for invading armies; French soldiers landed in the early 15th century as part of an alliance between France and Owain Glyndwr in his revolt against England, and Henry Tudor landed here on his way to becoming King Henry VII.

3.1.2. The archaeological and historical background of the development site and Pembroke Dock itself, however, mostly dates to the post-medieval period. Work on the Royal Naval Dockyard started in 1814. It was constructed to build and fit out warships for the Royal Navy (Hall & Sambrook 2014, 9). The docks underwent an expansion during the 1830s and 1840s. The Grade II Listed Slipways 1 and 2 were built c.1845 (Listed Building Numbers 14391 & 14392, respectively). These slipways represent the focus of the development area.

3.1.3. Shipbuilding at the dockyard was in decline by the early 20th century, and the last surface warship was launched in 1917. Five submarines were also built here during the First World War, but the end of the war saw the rapid decline of activity and the eventual closure of the Royal Naval Dockyard in 1926. The Royal Air Force took over much of the dockyard in the 1930s and established a base for Sunderland Flying Boats. This base proved to be of great importance to the battle against the U-Boat threat to the Western Approaches during the Second World War. However, the RAF base was closed in 1957 (Hall & Sambrook 2014, 11).

4. Objectives

4.1.1. This WSI sets out a program of works to ensure that the watching brief will meet the standard required by The Chartered Institute for *Archaeologist's Standard and Guidance for Archaeological Watching Briefs* (2020).

4.1.2. The objective of the watching brief will be:

• to allow the investigation and recording of any archaeological features that are uncovered during the proposed groundworks within the application area.

• to provide the opportunity, if needed, for the watching archaeologist to signal to all interested parties, before the destruction of the material in question, that an archaeological find has been made for which the resources allocated to the watching brief are not sufficient to support the treatment to a satisfactory or proper standard.

4.1.3. A written report will be compiled following the fieldwork. Sufficient desk-top research will be undertaken to ensure that the results of this work are properly understood, interpreted and reported.

4.1.4. The report will include a comprehensive assessment of the historic context within which the archaeological evidence rests and will aim to highlight any relevant research issues within regional, national and, if relevant, international research frameworks.

5. Timetable of Works

5.1. Fieldwork

5.1.1. The watching brief will be undertaken, in the targeted area discussed above, during ground works associated with the proposed development. AW will update DAT-HM with the exact date.

5.2. Report delivery

5.2.1. The report will be submitted to the client and to DAT-HM within three months of the completion of the fieldwork. A copy of the report will also be sent to the regional HER.

6. Fieldwork

6.1. Detail

6.1.1. The work will be undertaken to meet the standard required by The Chartered Institute for Archaeologist's Standard and Guidance for Watching Briefs (2020).

6.1.2. Excavations should be undertaken using a tracked 360 degree excavator equipped with a flat-bladed bucket and will be monitored by a suitably qualified archaeologist.

6.1.3. The site archaeologist undertaking the watching brief will be afforded the required access by the main contractor in order to observe and where necessary to record any archaeological remains revealed. Groundwork will not be undertaken without the presence of the site archaeologist. The site archaeologist will record finds and less significant archaeological deposits and features without significant delay to the work program.

6.1.4. Where significant or complex archaeological deposits or features are encountered there will be a requirement for those areas to be fenced off and highlighted to all contractors employed on the site. Machines or contractors shall not enter this area until archaeological recording has been completed. If significant archaeological features are revealed during the work a meeting between the client, DAT-HM and AW will be called at the earliest convenience.

6.1.5. If significant archaeological features are encountered contingency arrangements will be made. Contingency costs will be agreed in advance before any extension to the programme commences and will follow a site meeting between Archaeology Wales, the client and DAT-HM.

6.2. Recording

6.2.1. Recording will be carried out using AW recording systems (pro-forma context sheets etc) using a continuous number sequence for all contexts.

6.2.2. Plans and sections will be drawn to a scale of 1:50, 1:20 and 1:10 as required and related to Ordnance Survey datum and published boundaries where appropriate.

6.2.3. All features identified will be tied into the OS survey grid and fixed to local topographical boundaries.

6.2.4. Photographs will be taken in digital format with an appropriate scale, using a 12MP camera with photographs stored in Tiff format.

6.2.5. The archaeologist undertaking the watching brief will have access to the AW metal detector and be trained in its use.

6.3. Finds

6.3.1. The professional standards set in the Chartered Institute for Archaeologists' *Standard and guidance for the collection, documentation, conservation and research of archaeological (2014)* will form the basis of finds collection, processing and recording.

6.3.2. All manner of finds regardless of category and date will be retained.

6.3.3. Finds recovered that are regarded as Treasure under *The Treasure Act 1996* will be reported to HM Coroner for the local area.

6.3.4. Any finds which are considered to be in need of immediate conservation will be referred to a UKIC qualified conservator (normally Phil Parkes at Cardiff University).

6.4. Environmental sampling strategy

6.4.1. Deposits with a significant potential for the preservation of palaeoenvironmental material will be sampled, by means of the most appropriate method (bulk, column etc). Where sampling will provide a significant contribution to the understanding of the site AW will draw up a site-specific sampling strategy alongside a specialist environmental archaeologist. All environmental sampling and recording and will follow English Heritage's *Guidelines for Environmental Archaeology* (2nd Edition 2011).

6.5. Human remains

6.5.1. In the event that human remains are encountered, their nature and extent will be established, and the coroner informed. All human remains will be left *in situ* and protected during backfilling. Where preservation *in situ* is not possible the human remains will be fully recorded and removed under conditions that comply with all current legislation and include acquisition of licenses and provision for reburial following all analytical work. Human remains will be excavated in accordance with the Chartered Institute for Archaeologist's *Excavation and Post-Excavation Treatment of Cremated and Inhumed Human Remains: Technical Paper Number 13* (1993).

6.5.2. A meeting with DAT-HM, and the client and AW will be called if the human remains uncovered are of such complexity or significance that the contingency arrangement (6.1 above) would not be of sufficient scope.

6.6. Specialist advisers

6.6.1. In the event of certain finds, features or sites being discovered, AW will seek specialist opinion and advice. A list of specialists is given in the table below although this list is not exhaustive.

Artefact type	Specialist
Flint	Kate Pitt (Archaeology Wales)
Animal bone	Richard Madgwick (Cardiff University)
CBM, heat affected clay, Daub etc.	Rachael Hall (APS)
Clay pipe	Charley James-Martin (Archaeology Wales)
Glass	Rowena Hart (Archaeology Wales)
Cremated and non-cremated human bone	Malin Holst (University of York)/Richard Madgwick (Cardiff University)
Metalwork	Kevin Leahy (University of Leicester)/ Quita Mold (Freelance)
Metal work and metallurgical residues	Dr Tim Young (GeoArch)
Neo/BA pottery	Dr Alex Gibson (Bradford University)
IA/Roman pottery	Jane Timby (Freelance)
Roman Pottery	Rowena Hart (Archaeology Wales)/ Peter Webster (Freelance)
Post Roman pottery	Stephen Clarke (Monmouthshire Archaeology)
Charcoal (wood ID)	John Carrot (Freelance)
Waterlogged wood	Nigel Nayling (University of Wales – Lampeter)
Molluscs and pollen	Dr James Rackham

Charred and waterlogged plant remains	Wendy Carruthers (Freelance)

6.7. Specialist reports

6.7.1. Specialist finds and palaeoenvironmental reports will be written by AW specialists, or sub-contracted to external specialists when required.

7. Monitoring

7.1.1. DAT-HM will be contacted approximately five days prior to the commencement of archaeological site works, and subsequently once the work is underway.

7.1.2. Any changes to the WSI that AW may wish to make after approval will be communicated to DAT-HM for approval on behalf of Planning Authority.

7.1.3. Representatives of DAT-HM will be given access to the site so that they may monitor the progress of the watching brief. DAT-HM will be kept regularly informed about developments, both during the site works and subsequently during post-excavation.

8. Archive and Reporting programme

8.1. Site archive

8.1.1. An ordered and integrated site archive will be prepared in accordance with: Management of Research Projects in the Historic Environment (MoRPHE) (Historic England 2006) upon completion of the project.

8.1.2. The site archive (including artefacts and samples) will be prepared in accordance with the National Monuments Record (Wales) agreed structure and deposited with an appropriate receiving organisation, in compliance with CIfA Guidelines (Standard and guidance for the creation, compilation, transfer and deposition of archaeological archives', 2014). It will also conform to the guidelines set out in 'The National Standard and Guidance to Best Practice for Collecting and Depositing Archaeological Archives in Wales 2017' (National Panel for Archaeological Archives in Wales 2017). The legal landowner's consent will be gained for deposition of finds. The project will adhere to the Welsh Archaeological Trust's joint Guidance for the Submission of Data to the Welsh Historic Environment Records (2018).

8.2. Analysis

8.2.1. Following a rapid review of the potential of the site archive, a programme of analysis and reporting will be undertaken. The report will adhere to the Welsh Archaeological Trust's joint Guidance for the Submission of Data to the Welsh Historic Environment Records (2018).

8.2.2. This will result in the following inclusions in the final report:

- A bilingual non-technical summary
- Location plan showing the area/s covered by the watching brief, all artefacts, structures, and features found
- Plan and section drawings (if features are encountered) with ground level, ordnance datum and vertical and horizontal scales.
- Written description and interpretation of all deposits identified, including their character, function, potential dating and relationship to adjacent features. Specialist descriptions and illustrations of all artefacts and soil samples will be included as appropriate.
- An indication of the potential of archaeological deposits which have not been disturbed by the development
- A discussion of the local, regional and national context of the remains by means of reviewing published reports, unpublished reports, historical maps, documents from local archives and the regional HER as appropriate.
- A detailed archive list at the rear listing all contexts recorded, all samples finds and find types, drawings and photographs taken. This will include a statement of the intent to deposit, and location of deposition, of the archive.

8.3. Reports and archive deposition

Report to client

8.3.1. Copies of all reports associated with the watching brief, together with inclusion of supporting evidence in appendices as appropriate, including photographs and illustrations, will be submitted to the client and DAT-HM upon completion.

Additional reports

8.3.2. After an appropriate period has elapsed, copies of all reports will be deposited with the relevant county Historical Environment Record, the National Monuments Record and, if appropriate, Cadw.

Summary reports for publication

8.3.3. Short archaeological reports will be submitted for publication in relevant journals; as a minimum, a report will be submitted to the annual publication of the regional CBA group or equivalent journal.

Notification of important remains

8.3.4. Where it is considered that remains have been revealed that may satisfy the criteria for statutory protection, AW will submit preliminary notification of the remains to Cadw.

Archive deposition

8.3.5. The final archive (site and research) will, whenever appropriate, be deposited with a suitable receiving institution, usually the relevant Local Authority museums service. Arrangements will be made with the receiving institution before work starts.

8.3.6. Although there may be a period during which client confidentiality will need to be maintained, copies of all reports and the final archive will be deposited no later than six months after completion of the work.

8.3.7. Copies of all reports, the digital archive and an archive index will be deposited with the National Monuments Record, RCAHMW, Aberystwyth.

8.3.8. Wherever the archive is deposited, this information will be relayed to the HER. A summary of the contents of the archive will be supplied to DAT-HM.

Finds deposition

8.3.9. The finds, including artefacts and ecofacts, excepting those which may be subject to the Treasure Act, will be deposited with the same institution, subject to the agreement of the legal land owners.

Staff

8.3.10. The project will be managed by John Davey (AW Project Manager) and the fieldwork undertaken by AW Staff. Any alteration to staffing before or during the work will be brought to the attention of DAT-HM and the client.

9. Health and Safety

9.1. Risk assessment

9.1.1. Prior to the commencement of work AW will carry out and produce a formal Health and Safety Risk Assessment in accordance with *The Management of Health and Safety Regulations* 1992. A copy of the risk assessment will be kept on site and be available for inspection on request. A copy will be sent to the client (or their agent as necessary) for their information. All members of AW staff will adhere to the content of this document.

9.2. Other guidelines

9.2.1. AW will adhere to best practice with regard to Health and Safety in Archaeology as set out in the FAME (Federation of Archaeological Managers and Employers) health and safety manual *Health and Safety in Field Archaeology (2002)*.

10. Community Engagement and Outreach

10.1.1. Wherever possible, AW will ensure suitable measures are in place to inform the local community and any interested parties of the results of the site investigation work. This may occur during the site investigation work or following completion of the work. The form of any potential outreach activities may include lectures and talks to local groups,

interested parties and persons, information boards, flyers and other forms of communication (social media and websites), and press releases to local and national media.

10.1.2. The form of any outreach will respect client confidentiality or contractual agreements. As a rule, outreach will be proportional to the size of the project.

10.1.3. Where outreach activities have a cost implication these will need to be negotiated in advance and in accordance with the nature of the desired response and learning outcomes.

11. Insurance

11.1.1. AW is fully insured for this type of work and holds Insurance with Aviva Insurance Ltd and Hiscox Insurance Company Limited through Towergate Insurance. Full details of these and other relevant policies can be supplied on request.

12. Quality Control

Professional standards

12.1.1. AW works to the standards and guidance provided by the *Chartered Institute for Archaeologists*. AW fully recognise and endorse the Chartered Institute for Archaeologists' *Code of Conduct*, *Code of Approved Practice for the Regulation of Contractual Arrangements in Field Archaeology* and the *Standard and Guidance for archaeological watching briefs* currently in force. All employees of AW, whether corporate members of the Chartered Institute for Archaeologists or not, are expected to adhere to these Codes and Standards during their employment.

Project tracking

12.1.2. The designated AW manager will monitor all projects in order to ensure that agreed targets are met without reduction in quality of service.

13. Arbitration

13.1.1. Disputes or differences arising in relation to this work shall be referred for a decision in accordance with the Rules of the Chartered Institute of Arbitrators' *Arbitration Scheme for the Institute for Archaeologists* applying at the date of the agreement.

14. References

Chartered Institute for Archaeologists, 2014. *Standards and guidance for the collection, compilation, transfer and deposition of archaeological archives*

Chartered Institute for Archaeologists, 2014. *Standards and guidance for the collection, documentation, conservation and research of archaeological materials*

Chartered Institute for Archaeologists, 2020. *Standards and guidance for an archaeological watching brief*

English Heritage, 2002. *Guidelines for Environmental Archaeology*

English Heritage, 2006. *Management of Research Projects in the Historic Environment (MORPHE)*

Quantum (Geotechnical) Ltd, 2008. *Milford Haven Port Authority, Carr Jetty Investigations, Pembroke Dock: Factual Ground Investigation Report* (Report Number: X7949)

Hall, J. & Sambrook, P., 2014. *Port of Milford Haven, Pembroke Dock, Pembrokeshire: Historic Environment Assessment* (Trysor Project No. 2014/406)

National Panel for Archaeological Archives in Wales, 2017. *The National Standard and Guidance to Best Practice for Collecting and Depositing Archaeological Archives in Wales*

Welsh Archaeological Trusts, 2018. *Guidance for the Submission of Data to the Welsh Historic Environment Records (HERs)*

Websites

British Geological Survey: Geology of Britain viewer, www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html (accessed 23/06/20)

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