FLOOD DEFENCE IMPROVEMENT, TREARDDUR BAY, ANGLESEY

ARCHAEOLOGICAL ASSESSMENT

GAT PROJECT NO. G1949

REPORT NO. 677

Prepared for Haskoning UK Ltd

June 2007

By George Smith
MA, MIFA

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Cover: Early Medieval cemetery during excavation Trearddur Bay, 2004

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SUMMARY

An archaeological assessment was carried out in advance of engineering works to enhance the sea defenses at Trearddur Bay, near Holyhead, Anglesey. The assessment involved the consultation of existing documentary records, maps, aerial photographs and a field search. No new features were recorded but four features that were existing Historic Environment Records were found to be relevant and require mitigation measures.

1 INTRODUCTION

Gwynedd Archaeological Trust was asked by Haskoning UK Ltd to carry out an archaeological assessment in advance of proposed improvements to sea defences around Trearddur Bay, Holyhead centred on NGR 225460 378870 (Fig. 1). The works proposed are outlined in the Project Appraisal Report by Faber Maunsell Ltd dated 09/05/06 and in an Environmental Scoping Report by Haskoning UK Ltd, dated 11/12/06.

2 SPECIFICATION AND PROJECT DESIGN

The work was carried out according to a brief provided by the Gwynedd Archaeological Planning Service (Appendix 3). The basic requirement was for a desk-top survey and field search of the proposed area, in order to assess the impact of the proposals on the archaeological features within the area concerned. The importance and condition of known archaeological remains were to be assessed, and areas of archaeological potential and new sites to be identified. Measures to mitigate the effects of the construction work on the archaeological resource were to be suggested.

Gwynedd Archaeological Trust's proposals for filling these requirements were as follows:

- To identify and record the cultural heritage within the defined study area.
- To evaluate the importance of what has been identified
- To recommend ways in which the impact on the cultural heritage can be avoided or minimized.

The archaeological assessment consists of

- Desktop study of records and historical documents
- Field walkover
- Initial report

This report covers these three stages.

This might be followed by a field evaluation if it is considered that there might be features that cannot be assessed just by a field walkover. The field evaluation might take the form of geophysical survey or trial excavation. Such an evaluation would then be followed by a further report stage.

3 METHODS AND TECHNIQUES

3.1 Desk top study

This comprised the consultation of maps, documents, computer records, written records and reference works, which form part of the Gwynedd Historic Environment Record (HER), Bangor. The records held at the Anglesey Archives, Llangefni were also consulted as well as aerial photographs held by the Countryside Council for Wales, Bangor. Further information, particularly concerning standing buildings

was consulted by means of the CARN (Core Archaeological Index) which is the online index of the Royal Commission on Ancient and Historic Monuments, Wales.

Sites, buildings and find spots listed in the GAT HER and RCAHMW records were identified within 1km of the survey area (Fig. 1 and Appendix 2). Most of these give the general background to the potential for past landscapes, which might not be visible in above ground features. Those on or close the proposed works give a more direct indication of the possible presence of features.

3.2 Field search

The proposed works affect a limited area of which most is built environment and already well-known. The main requirement was therefore to assess the potential for buried features, as no new above-ground features could be expected.

All records are archived in Gwynedd Archaeological Trust under the project number G1949.

3.3 Report

The available information was synthesized to give a summary of the archaeological and historic background and of the assessment and recommendations, as set out below. The separate features, their evaluation and recommendations are listed separately, and a summary of the overall assessment of the area is given at the end.

The criteria used for assessing the value of features was based upon those used by the Secretary of State for Wales when considering sites for protection as scheduled ancient monuments, as set out in the Welsh Office circular 60/96. The features were then assigned to one of five categories of importance, A-E, A: National Importance, B: Regional or County Importance, C: District or local importance, D: Minor or damaged sites, E: Sites needing further investigation. The definitions of these categories and those used for Impact, Field evaluation and Mitigation are set out in Appendix 1.

4 ARCHAEOLOGICAL RESULTS

4.1 Topographic description

Trearddur Bay lies on the west-facing coast of Holy Island, an area separated from the main part of Anglesey by a shallow tidal channel, the Inland Sea. The bay itself is deeply indented by erosion of softer deposits in a former channel between hard igneous rock outcrops that form the sides of the entrance to the bay. The erosion is exacerbated because the bay faces the prevailing winds and waves. Behind the bay is a low valley only a little above maximum sea-level and 400m to the east is a shallow estuary which is a branch of the Inland Sea tidal channel.

4.2 Archaeological and historical background (Fig. 1)

The eroding channel in which the bay lies was formerly a branch of the Inland Sea, which still approaches at the east to within 400m of the sea wall of the bay. Much of the intervening land in the valley of this channel is low and marshy. The road behind the sea front of the bay is therefore built on a narrow causeway across the valley. Whittow (1965, 110-11) believes that the channel was originally that of the Afon Alaw in the early post-glacial period, prior to sea erosion of the glacial deposits forming its northern bank and the river now exits into the Inland Sea. This early Alaw channel and other low-lying land was later flooded as sea-level rose during the Post-glacial to its maximum at about 4m above the present (the maximum transgression) at about 5000 BC, dividing Holy Island into three (Fig. 2). The maximum of sea-level rise has been calculated by dating of a peat level beneath a raised beach at Garreg Lwyd, 1.5km south of

Trearddur (Hopley 1963). Sea level later fell again and the Trearddur channel may have been blocked by sand.

On the shore of Trearddur, several metres below present high water, beneath the beach sand and occasionally exposed after storms is a layer of peat with remains of trees. This was one of several such deposits around Anglesey first noted by Greenly (1917). This old forest land surface could represent a stand-still or retreat phase during the gradual Post-glacial rise in sea-level, predating the maximum transgression. A sample of wood from a similar intertidal forest peat bed at Llanddwyn Island, Anglesey has been dated to 5987-5662 BC, at 2 sigma (SRR-5265) and this provides a possible similar date for Trearddur. However, another similar forest bed at Porth Neigwl, Llŷn has produced a flint knife of probable Neolithic date (GAT HER). The Trearddur peat lies above and beneath layers of grey estuarine clay. The clay beneath the peat is one of only two examples in North Wales where clay containing a fresh-water mollusc, *Scrobicularia*, has been found (Whittow, 1965, 114). This indicates that the River Alaw was still flowing out here during this period, but then ceased, allowing the peat and forest to develop. Recent sampling though the peat at Trearddur has shown it to have been associated with a woody environment with reed and with sphagnum moss becoming more important in the upper sample (Caseldine 2002). The possible value of the peat layer is increased because cattle bones have been found in what must be an extension of it, near Porth Diana at the south side of the bay, and these could have been associated with human activity (TAAS 1931, 142).

The peat found in the intertidal area is likely to continue to the east beneath the blown sand deposits of the valley to the east of the sea-wall. The channel may also contain lower peat levels from earlier transgression and retreat phases in the Post-glacial period. At a similar situation in the former estuarine valley of the River Ganol, Rhos on sea, sampling identified up to three levels of peat at depths within depths -0.8m to -2.5m (Dorning 1999). However, the dates obtained for the upper two levels indicate that they post-date the peat layer at Trearddur. It was probably therefore the lowest level that was of about the same period as Trearddur and this accords with their similar depths. It is possible therefore that higher levels of peat survive in the valley deposits protected behind the sea wall.

The trial pits and boreholes excavated for the Trearddur Bay Coastal Study (Faber Maunsell 2006) cut into the relict river channel deposits and show the peat to be present beneath the main part of the beach at around 2.0 to 2.5m below present ground level, about 1.0 to 0.5 OD. Grey estuarine clay with some organic remains was recorded above and below the peat and layers of alluvial sand and gravel beneath. In the centre of the bay (DP4), drilling was stopped at -8.5m still continuing through alluvial material. The earliest valley floor may be much lower as sea-level dropped to at least 33m below present levels during the glacial period. At Malltraeth the floor of the mouth of the valley of the River Ceint, at the south west of Anglesey, was found at -33.5m OD (Greenly 1919 quoted in Whittow 1965, 100).

The upper layers encountered during the rest-pitting and drilling were either blown sand or silt (probably glacial till) but made ground was found in the two inland test pits dug along Ravenspoint Road (at -0.4 to -2.6m in WS 6 and at -0.8 to -1.4m in WS7). Both of these were associated with modern masonry structures but the deeper deposits may have been at least pre-modern and possibly prehistoric. Ravenspoint Road was already in existence in 1841 (Fig. 7). The made ground deposits overlay blown sand and probable glacial till.

Anglesey is extremely rich in prehistoric remains from the Neolithic period onwards. The greatest concentration of Neolithic monuments is in the south of the island but Holy Island itself was a focus of activity. There is a very well-preserved Neolithic chambered tomb at Trefignath, 1.5km to the north and the remains of one at Trearddur 1km to the north of the bay. Elsewhere on Holy Island are the possible remains of four more such tombs that have been destroyed in the past. These suggest that Holy island was well-settled in the Neolithic period and this has been confirmed by numerous finds of that period during recent excavations close to the Trefignath tomb. The distribution of Neolithic monuments around North Wales shows a coastal and river valley bias, suggesting the importance of sea travel. The sheltered inlets and the low-lying land of the Holy island area would have been desirable for landing and settlement. Sandy areas with light soils may have been particularly attractive. Evidence of this period within the development area is provided by the find of a Neolithic stone axe on the beach (Thomas 1917).

Activity in the second millennium BC in this area is demonstrated by the presence of burial cairns and of standing stones within Holy Island, although not within the development area. Three burial cairns were found in the valley close to the beach at Porth Dafarch, just to the north of Trearddur bay. One large standing stone is not far from the Trefignath chambered tomb, 1.5km north of Trearddur and another setting of two stones at Penrhos Feilw further north. Close to Trearddur is only one stone. Within the present area, at its east, is another smaller standing stone (PRN 2009) but its age is uncertain. Settlement tin this period is unknown in Holy Island but is scarce everywhere and may have been at least partly nomadic. However, there was probably settlement quite close to the Porth Dafarch burials and the distribution of standing stones in Anglesey is quite even suggesting that the whole area was quite well settled in this period (Smith 2003).

During the first millennium BC and through the Roman period settlement remains become quite numerous in Holy Island. Most notable is the walled fort of Caer y Twr on Holyhead Mountain and there are several groups of roundhouses, some discovered quite recently (Davidson 2002a, 2003) including two close to Trearddur at Porth Dafarch just to the north and at Cwm just to the east (PRN 2015) (Livens 1962). There is also a vague record of another settlement of uncertain date at Porth Diana at the south side of the bay, remains of which were seen when houses were being built there in the 1930's (PRN 2010) (Burton 1914).

The low-lying land of Trearddur Bay itself, prior to modern drainage and development was mostly sand and marsh and unsuitable for settlement. However, the estuary at its east side provided a sheltered landing place and such pools were often used for ceremonial deposition of bodies and objects during the Iron Age. One of the best British collections of later Iron Age metal objects came from a similar pool at Llyn Cerrig Bach, 5km to the south-east, just on the other side of the Inland Sea and the possibility of similar finds should be considered in similar situations (Lynch 1991, 285-314).

Native roundhouse settlements continued to be occupied and flourished during the Roman period until raids from Ireland probably caused problems of security, resulting in the building of a fort, perhaps as a naval base at Holyhead. Probably symptomatic of this, during the third and fourth centuries are the finds of hoards of coins. One large hoard (Fig. 1 PRN 2012) dating from the 3rd century AD was found under a stone close to the Trearddur chambered tomb. A small hoard of 13 late 3rd to late 4th century coins (PRN 2012) was also found somewhere close by in the early 19th century and these are of interest because they include some of the latest coins before the Roman garrisons abandoned North Wales.

No Roman roads as such have yet been found on Anglesey although tracks associated with settlements have been found at Cefn Cwmwd, Llangefni and nearer by at Ty Mawr, on the east side of the Inland Sea. An overland route through Anglesey to Holyhead, from a probable ferry point from the fort at Segontium, probably to Rhydd Gaer on Anglesey is likely. Such a road would have almost certainly crossed the Inland Sea at or near to the existing Four Mile Bridge which was the only route in historic times until the construction of the Stanley embankment in the mid 19th century. The road over this bridge than crossed the Trearddur valley and its status as a narrow open causeway is made quite apparent by a sketch of it made in 1776 (Fig. 3b). This causeway route may therefore have been in use from Roman times and before.

The 1776 sketch was made primarily to show the most important historic feature of Trearddur Bay. This was the presence of a medieval chapel on a large mound that was formerly in the centre of the bay. The chapel mound was used as a property boundary marker, the being the division between two estates in the 1841, Tithe Survey (Fig. 7), a boundary that probably had much earlier origins. The chapel was known as Capel Sanffraid, dedicated to St Bridget, an Irish saint of the 6th century AD. The first description of it was by Lewis Morris in 1737, who used it as a landmark feature when completing a coastal chart of Anglesey. His description was of... 'the ruins of a small chappel on Top of a Green Hill on the waterside, showing thus from the west a Mile off' (Fig. 3a). This shows both gables still standing, the western probably with a bell turret or pinnacle. The mound was already subject to erosion at the seaward side by the time of the 1776 sketch, when the western gable had collapsed (Fig. 3b) although the other walls were still standing. It was reported that quarrying of the sand of the mound as agricultural fertilizer hastened its decay and this is shown by the unnaturally steep face of the landward edge of the mound in the 1776 sketch. The chapel was said to have completely collapsed by 1846 but graves belonging to the cemetery around it continued to be

discovered as the seaward side of the mound eroded, exposing stone-built cists of probable early medieval date. The site was scheduled as an ancient monument and attempts were made to protect it but as storm erosion continued the site was eventually excavated in 1997, 2003 and 2004 (Davidson 1999, 2002b and 2002c). Over 100 burials were excavated, the majority being simple dug graves dating from the 8th to the 12th centuries AD. There were also a group lower in the mound in stone cist graves and these dated to the 6th to 8th centuries AD. There have been many finds of human bone from the seaward side of the eroding mound in the past but also a few other finds that relate to it. The most important of these is part of a penannular brooch found in 1980 in ground disturbed by previous strengthening of the sea wall close to the chapel mound. The brooch had traces of gilding and animal motif decoration and dated stylistically to the 8th to early 9th century AD and very interestingly with its strongest parallels with similarly decorated objects from Ireland (Lewis 1982). Other chance finds have been reported from the bay and comprise a lead cross and lead pendant, exact find spots unknown. These items were probably medieval pilgrim keepsakes and therefore related to Capel Sanffraid.

The excavations in 1997, 2003 and 2004 at Capel Sanffraid showed that the stone cist graves of the earlier cemetery were associated with an area of intact land surface that had been rapidly buried by blown sand. A metre of sand then accumulated before another soil layer developed associated with the later phase of chapel construction and digging of a further phase of graves. An intact sealed land surface from the Early Medieval period is a rare and valuable find. The surface was removed at the west and north by erosion but dipped down to the east and south, where it was traced for some distance. Another similar layer was later encountered about a metre down while trial trenching in the car park at the east side of the mound. There is the potential for the discovery of further parts of these land surfaces elsewhere along the bay, buried beneath blown sand and any construction works could produce further evidence.

The Early Medieval land surface itself developed on blown sand, so it seems that the mound itself was a dune and deeper there is the possibility of even earlier land surfaces. The position of the present sea front has retreated some way from what it would have been in the Early Medieval period. The construction of the sea wall halted this retreat. Prior to that it was a natural open, dune-fringed beach. No change was noted between the 1889 Ordnance Survey map and the construction of the sea wall. However, the coastline shown on the 1841 Tithe map (Figs 7 and 8)) suggests a retreat of about 35m. This would be enough to cause the erosion reported to have happened by 1846. The mound was planned at that date (Stanley 1846, 228) (Fig. 4), when it was recorded as about 70m diameter, of which about half in plan is left today (Fig. 11, A), so a retreat of about 35m would have removed half the mound. At the time of the Early Medieval cemetery the mound would probably have been some way from the sea although the burial of the cemetery by blown sand shows that the situation was deteriorating. However, blown sand can move some way inland. Whittow (1965, 112-3) recorded retreat rates of between 8 to 19 inches per annum along the soft drift parts of the south Caernarfonshire coast, depending on the orientation of the coast towards the maximum wave conditions. Over 1400 years this rate would mean erosion at Trearddur of between 285-675m. Even at the minimum estimate it means that the inset bay had hardly begun to form and the coast edge was at about the position of the rocky shoulders of the present bay. At the maximum estimate of erosion the bay had not begun to form and the coast edge was some way west of the entrance to the present bay and part of the general coast edge (Fig. 11). It is clear that the early medieval cemetery was founded some way inland on what was then a low mound in a marshy valley.

The bay began to be developed by the late 19th century as a summer holiday resort (Figs 8-10) but this was quite low key and the sea wall was not constructed until much later. The main feature of the landward side of the bay after World War II was a cafe called the Sea Shanty, in a large shed just behind the chapel mound, but that has since been demolished.

4.3 The Archaeological Survey (Fig. 11)

20 archaeological or historic features are recorded within the overall assessment area by the Gwynedd HER (Fig. 1) and 26 by the RCAHMW (Appendix 1). The latter are mainly post-medieval buildings, World War II military structures or shipwrecks. The HER features include seven that are directly relevant to the works of which three are just chance find spots. The latter comprise a Neolithic stone axe (not previously

recorded) and two lead objects, possibly medieval pilgrim badges or keepsakes (PRN 11397 and 19615, see Appendix 1, below). No new features were discovered from the field visit as the area is already well known and is all either modern built environment or sand dunes. The four relevant features are described below with recommendations for further assessment and mitigatory measures, where appropriate and their locations are shown on Fig. 11.

Feature 1 Towyn y Capel Mound (PRN 2001)

SH 2560 7900
Period: Early Medieval-Medieval

Category: A. Impact: Likely

A former scheduled ancient monument. The site of a later medieval chapel and early medieval cemetery. Largely excavated but shown to have buried soils that continue beyond the excavated areas. Human bones deriving from the cemetery, but spread by erosion were also widespread in the area. Other chance finds of Medieval from the area of the mound show that similar finds could still be made in the area.

Recommendations for further assessment: None

Recommendations for mitigatory measures: *Watching Brief and detailed recording if required*

Feature 2 Buried old land surface (PRN 17237)

SH 2560 7900 (Centre)
Period: Roman (Pre-Early Medieval)

Category: A. Impact: Likely

Excavation has shown that within the remains of the chapel mound described above was a sealed old land surface on which the first cemetery was placed in about the mid-7th century AD. Such a sealed land surface is very rare and of great potential value. The buried soil lay over the mound and continued at a lower level away from the mound. This soil or contemporary parts of it are likely to exist elsewhere within Trearddur Bay, with the greatest potential in the undisturbed dune area to the north of the chapel mound. A small strip of former dunes also exists between the car park and the promenade at the southern part of the bay.

Recommendations for further assessment: None

Recommendations for mitigatory measures: *Watching brief and detailed recording if required*

Feature 3 Peat deposit (PRN 16572)

SH 2540 7890 (Centre)
Period: Late Mesolithic/Early Neolithic

Category: C. Impact: Possible

This peat bed lies at a depth of *c*. 2m below present ground levels adjoining the bay and extends into the intertidal area where it is occasionally exposed after storms. It has the remains of trees and reeds. It probably continues beneath the terrestrial area of the bay behind the sea front and beneath the modern settlement within the valley to the east. As a natural layer it is of interest but localized impacts are not significant. However, bovid bones have been found in it in the past, suggesting that there may have been human activity close by and this is supported by the find of a Neolithic stone axe in the bay.

Recommendations for further assessment: None

Recommendations for mitigatory measures: *Watching brief*

Feature 4 Possible prehistoric settlement Porth Diana (PRN 2010)

SH 2530 7850 (Approximate)
Period: Prehistoric?

Category: C. Impact: Unlikely

This was a scantily described discovery and lies just beyond the area of impact of the proposed works. However, it shows that there was early activity on the fringes of the bay and other associated activity could be found close by. Trial pits for the present scheme dug in this area do show a considerable depth of 'made-ground'. This could be entirely modern but might also consist partly of earlier deposits.

Recommendations for further assessment: None

Recommendations for mitigatory measures: *Watching brief*

5 SUMMARY OF RECOMMENDATIONS FOR MITIGATORY MEASURES

There are relatively few known archaeological features within the immediate area of Trearddur Bay but the few that are present are of value. There are also a number of archaeological and historic features in the surrounding area that indicate that there is considerable potential for prehistoric and more recent activity. Much of the area of the proposed works has been modified by 20th century construction. However, there is still potential for further discoveries, particularly in the vicinity of the chapel mound in the centre of the bay and beneath the undeveloped dune area to its north.

Table 1 Summary of assessment and recommended mitigation

Feature No.	Type	Category	Impact	Further assessment	Proposed mitigation
1	Medieval chapel mound	A	Likely	None	Watching brief with detailed recording
2	Old land surface	A	Likely	None	Watching brief with detailed recording
3	Peat deposit	C	Possible	None	Watching brief
4	Possible prehistoric settlement	C	Unlikely	None	Watching brief

Archaeological mitigation in relating to the recommended construction works

A final assessment cannot be made until the exact design of the construction works is known. The following gives the response to the works recommended in the Project Appraisal Report (Faber Maunsell 2006, 35).

1. Replacement of sea wall along Ravenspoint Road. Considerable excavation envisaged. Exposure of made ground, potentially containing prehistoric deposits (Feature 4). Watching brief.

2. Refurbishment of promenade and sea wall by dumping of rock. Some excavation at toe of sea-wall with possibility of stray finds associated with the chapel mound (Feature 1) and possibly exposing medieval deposits behind (Feature 2) and possibly the lower peat deposit (Feature 3). Watching brief in area of chapel mound and dunes.

3. Enhancement of undeveloped dune/scrub area. No soil intrusion expected. No response.

4. Works in hinterland to reduce effects of wave overtopping. Expected to include new wall construction. Watching brief for any intrusive work.

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6.3 Cartographic sources

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John Evans Map of North Wales 1795, Half inch to a mile.
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Ordnance Survey 3rd ed. 1:2500, 1924.
Saxton, Map of Caernarfonshire and Anglesey 1578.
Tithe map for the parish of Holyhead, *c*. 1841.

6.4 Aerial Photographic sources

Countryside Council for Wales 2000. National cover colour verticals.

Appendix 1

Table 1 Archaeological and Historic records within 1km of Trearddur Bay recorded in the Gwynedd HER

Prn	*Sitename*	*Ngr*	*Class*	*Glossary_Sitetype*	*Period*
1641	Stone Implement - Findspot, Nr. Trearddur Bay	SH25507950A	Object	FINDSPOT	Unknown
2001	Towyn Y Capel Mound	SH25607900	Religious, Ritual and Funerary	CIST GRAVE CEMETERY	Early-Medieval
2006	C18th Windmill, Trearddur Bay	SH26607886	Industrial	WINDMILL	Post-Medieval
2009	Standing Stone (Poss.), Stanley Mill	SH26647888	Religious, Ritual and Funerary	STANDING STONE	Prehistoric
2010	Possible Settlement, Porth Diana	SH25307850A	Domestic	SETTLEMENT	Prehistoric
2011	Penannular Brooch - Findspot, Trearddur Bay.	SH25607900A	Object	FINDSPOT	Early-Medieval
2012	Roman Coin Hoard - Findspot, Trearddur Bay	SH25607880A	Object	FINDSPOT	Roman
2015	Site (No Details), Trearddur Bay (Poss. Dupl. 2003	SH26607890A	Domestic	ENCLOSED SETTLEMENT	Prehistoric
7212	Tidal Mill (Site Of), Felin-Heli	SH26577977A	Industrial	TIDE MILL	Medieval?
8142	Towyn	SH25867937	Religious, Ritual and Funerary	NONCONFORMIST CHAPEL	Post-Medieval
8143	Noddfa	SH25807881	Religious, Ritual and Funerary	NONCONFORMIST CHAPEL	Post-Medieval
8144	Towyn	SH25947876	Religious, Ritual and Funerary	NONCONFORMIST CHAPEL	Post-Medieval
8145	Ty-Capel	SH26057855	Religious, Ritual and Funerary	NONCONFORMIST CHAPEL	Post-Medieval
11397	Lead Pendant - Findspot, Towyn Y Capel	SH25607890A	Object	FINDSPOT	Unknown
11798	Stanley Windmill, Trearddur Bay	SH26577887	Industrial	CORN MILL	Post-Medieval
16572	Peat Deposit, Trearddur Bay	SH25407890A	Unassigned	PEAT DEPOSIT	Prehistoric
17114	Trearddur/Four Mile Bridge Character Area	SH25327907	Unassigned	LANDSCAPE	Multi-period
17212	Former Cricket Ground, Trearddur Bay	SH25767898	Recreational	CRICKET GROUND	Modern
17237	Buried Soil, Trearddur Bay	SH25607900C	Agriculture and Subsistence	BURIED SOIL	Roman?
19615	Lead Cross, Findspot, Trearddur Bay	SH25507900A	Object	FINDSPOT	Medieval?

Table 2 Archaeological and Historic records within 1km of Trearddur Bay recorded in the RCAHMW Core record

Nprn	*Name*	*Ngr*	*Broadclass*	*Type*	*Period*
8669	Crecrist Chapel (Calvinistic Methodist;Ty Capel), Trearddur ,	SH26157855	Religious, Ritual and Funerary	CHAPEL	Post Medieval
8675	Tywyn Chapel (Welsh Calvinistic Methodist), Trearddur	SH25867937	Religious, Ritual and Funerary	CHAPEL	Post Medieval
11866	Noddfa Welsh Baptist Church, Trearddur	SH25807881	Religious, Ritual and Funerary	CHAPEL	Post Medieval
11867	Towyn Chapel (Calvinistic Methodist), Trearddur	SH25947876	Religious, Ritual and Funerary	CHAPEL	Post Medieval
33912	St Ffraids Church Trearddur Bay	SH25877884	Religious, Ritual and Funerary	CHURCH	Medieval; Post-Medieval
40360	Stanley Windmill, Trearddur Bay	SH26577887	Agriculture and Subsistence	WINDMILL	Post Medieval
43566	Capel Gwyngenau, Site Of;Capel Gwyn	SH26147853	Religious, Ritual and Funerary	CHAPEL	Medieval
43652	Towyn-Y-Capel;Capel Sant Ffraid	SH25647898	Religious, Ritual and Funerary	CEMETERY	Medieval?
268066	Trearddur	SH246795	Civil	VILLAGE	General
270317	Pillbox (Variant), Holyhead	SH25467934	Defense	PILLBOX (VARIANT)	Post Medieval
270320	Pillbox (Variant), Holyhead	SH26117939	Defense	PILLBOX (VARIANT)	Post Medieval
270321	Pillbox (Variant), Holyhead	SH25577981	Defense	PILLBOX (VARIANT)	Post Medieval
270425	Pillbox (Variant), Holyhead	SH252796	Defense	PILLBOX (VARIANT)	Post Medieval
270426	Pillbox (Variant), Holyhead	SH252793	Defense	PILLBOX (VARIANT)	Post Medieval
271907	John O'Gaunt	SH2579	Maritime	WRECK	Post Medieval

272006	Rowan-Tree	SH2579	Maritime	WRECK	Post Medieval
272051	Titania	SH2579	Maritime	WRECK	Post Medieval
272089	Ann Jane	SH2579	Maritime	WRECK	Post Medieval
272228	Jane	SH2579	Maritime	WRECK	Post Medieval
272229	Amity	SH2579	Maritime	WRECK	Post Medieval
272230	Pronto	SH2579	Maritime	WRECK	Post Medieval
272240	Sarah Ellen	SH2579	Maritime	WRECK	Post Medieval
302269	Stanley Mill, Standing Stone	SH26647888	Unassigned	STANDING STONE	Unknown
302764	Cae Grugog	SH25467955	Domestic	HOUSE	Post Medieval
402424	Trearddur Village	SH256789	Civil	VILLAGE	General
402428	Lifeboat Station, Trearddur	SH254791	Maritime	LIFEBOAT STATION	Modern

APPENDIX 2

Categories used for assessing the value of archaeological features (Welsh Office circular 60/96)

1 Categories of importance

The following categories were used to define the importance of the archaeological resource.

Category A - Sites of National Importance.

Scheduled Ancient Monuments, Listed Buildings of grade II* and above, as well as those that would meet the requirements for scheduling (ancient monuments) or listing (buildings) or both.

Sites that are scheduled or listed have legal protection, and it is recommended that all Category A sites remain preserved and protected *in situ*.

Category B - Sites of regional or county importance.

Grade II listed buildings and sites which would not fulfill the criteria for scheduling or listing, but which are nevertheless of particular importance within the region.

Preservation *in situ* is the preferred option for Category B sites, but if damage or destruction cannot be avoided, appropriate detailed recording might be an acceptable alternative.

Category C - Sites of district or local importance.

Sites which are not of sufficient importance to justify a recommendation for preservation if threatened.

Category C sites nevertheless merit adequate recording in advance of damage or destruction.

Category D - Minor and damaged sites.

Sites that are of minor importance or are so badly damaged that too little remains to justify their inclusion in a higher category.

For Category D sites, rapid recording, either in advance of or during destruction, should be sufficient.

Category E - Sites needing further investigation.

Sites, the importance of which is as yet undetermined and which will require further work before they can be allocated to categories A - D are temporarily placed in this category, with specific recommendations for further evaluation. By the end of the assessment there should be no sites remaining in this category.

2 Definition of Impact

The impact of the road development on each site was estimated. The impact is defined as *none, slight, unlikely, likely, significant, considerable or unknown* as follows:

None:
There is no construction impact on this particular site.

Slight:
This has generally been used where the impact is marginal and would not by the nature of the site cause irreversible damage to the remainder of the feature, *e.g.* part of a trackway or field bank.

Unlikely:
This category indicates sites that fall within the band of interest but are unlikely to be directly affected. This includes sites such as standing and occupied buildings at the margins of the band of interest.

Likely:
Sites towards the edges of the study area, which may not be directly affected, but are likely to be damaged in some way by the construction activity.

Significant:
The partial removal of a site affecting its overall integrity. Sites falling into this category may be linear features such as roads or tramways where the removal of part of the feature could make overall interpretation problematic.

Considerable:
The total removal of a feature or its partial removal which would effectively destroy the remainder of the site.

Unknown:
This is used when the location of the site is unknown, but thought to be in the vicinity of the proposed road.

3 Definition of field evaluation techniques

Field evaluation is necessary to fully understand and assess class E sites and to allow the evaluation of areas of land where there are no visible features but for which there is potential for sites to exist. Two principal techniques can be used for carrying out the evaluation: geophysical survey and trial trenching.

Geophysical survey most often involves the use of a magnetometer, which allows detection of some underground features, depending on their composition and the nature of the subsoil. The fairly level land in the floor of the Conwy valley probably has a subsoil of even composition, such as silt or gravel and this would be suitable for geophysical survey.

Trial trenching allows a representative sample of the development area to be investigated at depth. Trenches of appropriate size can also be excavated to evaluate category E sites. Trenching is typically carried out with trenches of between 20 to 30m length and 2m width. The topsoil is removed by machine and the resulting surface is cleaned by hand, recording features. Depending on the stratigraphy encountered the machine may be used to remove stratigraphy to deeper levels.

4 Definition of Mitigatory Recommendations

None:
No impact and therefore no requirement for mitigation measures.

Avoidance

Where possible, features that may be affected should be avoided. Sometimes this could mean a change in layout, design or route. More usually it refers to the need for care during construction to avoid accidental damage to a feature. This may be achieved by marking features or areas, for example with warning tape, before work starts, or in sensitive cases carrying out a watching brief.

Detailed recording:
Detailed recording requires a photographic record, surveying and the production of a measured drawing prior to the commencement of the works on site.

Archaeological excavation may also be required depending upon the particular feature and the extent and effect of the impact.

Basic Recording:
A photographic record and full description, and limited measured survey where applicable.

Watching brief:
Requiring observation of particular identified features or areas during works in their vicinity. This may be supplemented by detailed or basic recording of exposed layers or structures.

APPENDIX 3

DESIGN BRIEF FOR AN ARCHAEOLOGICAL ASSESSMENT
Gwynedd Archaeological Planning Service

Site: Trearddur Bay, Ynys Môn

Client: Cyngor Sir Ynys Môn

Agent: Royal Haskoning UK Ltd.

Date: 16 April 2007

National Grid Reference: centred on 225460 378870

This design brief is only valid for six months after the above date. After this period Gwynedd Archaeological Planning Service (GAPS) should be contacted.

It is recommended that the contractor appointed to carry out the archaeological assessment visits the site of the proposed development and consults the Regional Historic Environment Record (HER) for north-west Wales before completing their specification. Gwynedd Archaeological Planning Service cannot guarantee the inclusion of all relevant information in the design brief.

Key elements specific to this design brief have been highlighted.

1.0 Site Location and Description

1.1 For the purposes of this brief the proposed development comprises coastal improvement works at Trearddur Bay, Ynys Môn, north-west Wales.

1.2 Trearddur Bay is an indented sandy bay located on the west coast of Ynys Caergybi (Holyhead Island). To the east there is a tidal inlet which stops a few hundred metres from the bay, almost cutting Ynys Caergybi into two parts.

2.0 Archaeological Background

2.1 The most well-known archaeological site in Trearddur Bay is a sandy mound known as Towyn y Capel, or Capel St. Ffraid, the site of a former early medieval chapel and cemetery situated adjacent to the beach (**P**rimary **R**ecognition **N**umber (PRN) 2001). Severe erosion led to its excavation in 2002 and 2003, when approximately ten cist burials were excavated. Previously a scheduled ancient monument, the site has been de-scheduled.

2.2 Several significant archaeological finds have also been found at Trearddur Bay, including a Roman coin hoard (PRN 2012), an early medieval brooch (PRN 2011), and lead crosses (PRN 11397, PRN 19615), some of which may relate to the chapel and cemetery.

2.3 The identification of rare and important pre-sixth century buried soils (PRN 17237), during the recent excavation at Towyn y Capel indicates the potential for

similar deposits to survive elsewhere along the shoreline. The soils include evidence for plough marks in a buried soil approximately 1m deep.

2.4 In addition to the potential for archaeological evidence relating to early cultivation, peat deposits may survive at a greater depth. Prehistoric peat deposits have been exposed on the shoreline at Trearddur Bay (PRN 16572): their survival relates to a sequence of flooding, marshland and woodland that occurred many thousands of years ago when the Afon Alaw flowed out to sea at this point.

2.5 Along with environmental evidence, peat deposits provide dating evidence and preserve archaeological remains, in particular organic material such as wood and bone, normally absent from terrestrial sites because of unfavourable conditions. Several phases of deposition may occur.

2.6 Documentation

The final report for the Towyn y Capel excavations has not yet been published but interim results must be obtained from Gwynedd Archaeological Trust.

Davidson, A. 1999. Excavation Report, Towyn y Capel, Trearddur Bay. Gwynedd Archaeological Trust Report 325. Unpublished report held in the Historic Environment Record, Gwynedd Archaeological Trust.

Davidson, A. 2002a Holyhead Waste Water Treatment Works Improvements: Southern Pipeline (Villages) route. Gwynedd Archaeological Trust Report 465. Unpublished report held in the Historic Environment Record, Gwynedd Archaeological Trust.

Davidson, A. 2002b. Towyn y Capel, Trearddur Bay. *Archaeology in Wales*, volume 42: 124

Davidson, A. 2002c. Towyn y Capel, Trearddur Bay: archaeological recordings and consolidation. Gwynedd Archaeological Trust Report 440. Unpublished report held in the Historic Environment Record, Gwynedd Archaeological Trust.

Davidson, A. 2003. Holyhead Waste Water Treatment Works Improvements: Southern Pipeline (Villages) route (revised). Gwynedd Archaeological Trust Report 465. Unpublished report held in the Historic Environment Record, Gwynedd Archaeological Trust.

Jones, S. & Davidson, A. 1996. Coastal Erosion Survey - Anglesey. Gwynedd Archaeological Trust, report 251. Unpublished report held in the Historic Environment Record, Gwynedd Archaeological Trust.

Smith, G. 2002. North-west Wales Intertidal Peat Survey. Gwynedd Archaeological Trust Report 450. Unpublished report held in the Historic Environment Record, Gwynedd Archaeological Trust.

3.0 The nature of the development and archaeological requirements

3.1 This is a design brief for an **archaeological assessment** to be undertaken according to guidelines set out in Welsh national planning guidance (*Planning Policy Guidance Wales 2002*) and Welsh Office Circular 60/96 (*Planning and the Historic Environment: Archaeology*). The assessment will comprise a **desk-based study and field visit**.

3.2 The object of this programme of archaeological works is to make full and effective use of existing information in establishing the archaeological

significance of the site to assess the impact of the development proposals on surviving monuments or remains.

3.3 Following desk-based assessments field evaluation work may also be required in order to further assess the presence or absence of remains, their extent, nature, quality and character before determining the appropriate mitigation strategy, whether it be preservation *in situ*, archaeological excavation or a combination of the two.

4.0 Desk-based assessment detail

4.1 This *brief* should be used by archaeological contractors as the basis for the preparation of a detailed archaeological *specification*. The specification must be submitted to the archaeological curator for approval before the work commences.

4.2 The assessment must consider the following:

a) The nature, extent and degree of survival of archaeological sites, structures, deposits and landscapes within the study area through the development of an **archaeological deposit model**. This deposit model should reflect accurately the state of current knowledge and provide a research framework for further work if necessary. [See 4.3 below for further details]

b) The **history of the site**. [See section 4.4 below for further details]

c) The potential impact of any proposed development on the ***setting* of known sites of archaeological importance**. [See section 4.5 below for further details]

d) A **methodology for non-intrusive survey and intrusive evaluation** to determine the location, extent, date, character, condition, significance and quality of any surviving archaeological remains liable to be threatened by the proposed development. [See section 4.6-4.8 below for further details]

4.3 The **archaeological deposit model** will involve the following areas of research:

a) Collation and assessment of all relevant information held in the HER, including listed building records.

b) Assessment of all available excavation report and archives including unpublished and unprocessed material effecting the site and its setting.

c) Assessment of all extant aerial photographic (AP) evidence and, where relevant, a re-plotting of archaeological and topographic information by a suitably qualified specialist at an appropriate scale. Many of the main archaeological aerial photographic records can be consulted at the Royal Commission on Ancient and Historical Monuments in Wales (RCAHMW), Aberystwyth. However, the Countryside Council for Wales (CCW), Bangor, also holds AP collections including 1940s Luftwaffe photographs, and these may be equally suited to the requirements of the desk-based study.

d) Assessment of records held at the RCAHMW and University College Bangor, if appropriate.

e) Assessment of the environmental potential of the archaeological deposits through existing data or by inference.

f) Assessment of the faunal potential of the archaeological deposits through existing data or by inference.

g) Assessment of the artefactual potential of the archaeological deposits through existing data or by inference.

h) Assessment of all available geotechnical information for the area including the results of test pits and boreholes.

i) Assessment of the present topography and landuse of the area through maps and site visits.

4.4 **Historical research** will involve the following:

a) An analysis of relevant maps and plans. Cartographic evidence is held at the County Record Offices, including Tithe Maps, Enclosure Act Plans, Estate Maps and all editions of the Ordnance Survey. Place and field-name evidence from these sources must be considered.

b) An analysis of the historical documents (e.g. county histories, local and national journals and antiquarian sources) held in museums, libraries or other archives, in particular local history and archives library.

4.5 When considering the **issue of setting** for scheduled ancient monuments, listed buildings and other sites of national and/or regional significance, the HER should be consulted to determine if the development falls within any designated landscape areas, such as World Heritage Sites and landscape character areas. Of particular importance are the *Register of Landscapes of Outstanding Historic Interest in Wales*, the *Register of Landscapes of Special Historic Interest in Wales*, published by Cadw: Welsh Historic Monuments in 1998 and 2001 respectively.

4.6 The **evaluation methodology** must consider the use of the following techniques:

a) Building recording.

b) Ground survey within the core area.

c) The use of geophysical survey.

d) A programme of trenching and/or test pits to investigate the deposit model in more detail.

4.7 The evaluation should aim to determine the location, extent, date, character, condition, significance and quality of any surviving archaeological remains liable to be threatened by the proposed development. An adequate representative sample of all areas where archaeological remains are potentially threatened should be studied.

4.8 The evaluation should carefully consider any artefactual and environmental information and provide an assessment of the viability (for further study) of such information. It will be particularly important to provide an indication of the relative importance of such material for any subsequent decision making regarding mitigation strategies.

5.0 Results

5.1 The results must be presented in a report and should be detailed and laid out in such a way that data and supporting text are readily cross-referenced. **The HER Officer should be contacted to ensure that any sites or monuments not previously recorded in the HER are given a Primary Recognition Number (PRN) and that data structure is compatible with the HER**. The historical development of the site must be presented in phased maps and plans comprising clearly, the outline of the site.

5.2 The deposit model should be presented graphically in plan and, where appropriate, in profile and at a scale that is commensurate with subsequent use as a working document.

5.3 Within the report an attempt should be made to indicate areas of greater or lesser archaeological significance and the sites should be ranked in level of overall archaeological importance (locally, regionally and nationally).

5.4 All relevant aerial photographs, re-plots and historic maps must be included and be fully referenced.

5.5 The report should specifically include the following:

a) a copy of the design brief

b) a location plan

c) all located sites plotted on an appropriately scaled plan of the development

d) a gazetteer of all located sites with full dimensional and descriptive detail **including grid reference and period**

6.0 General requirements

6.1 The archaeological assessment must be undertaken by an appropriately qualified individual or organisation, fully experienced in work of this character. Details, including the name, qualifications and experience of the project director and all other key project personnel (including specialist staff) should be communicated to the development control archaeologist and all written work attributed to an author (s).

6.2 Contractors and subcontractors are expected to conform to standard professional guidelines, including the following:-

- English Heritage's 1991 Management of Archaeological Projects (MAP2).
- Richards, J. & Robinson, D. 2000. Digital Archives from Excavation and Fieldwork: *Guide to Good Practice.* Second Edition. The Archaeology Data Service Guide to Good Practice. Oxbow Books. http://ads.ahds.ac.uk/project/goodguides/excavation/
- The Institute of Field Archaeologists 1985 (revised 2006) Code of Conduct.
- The Institute of Field Archaeologists 1990 (revised 2002) Code of Approved Practice for the Regulation of Contractual Arrangements in Field Archaeology.

- The Institute of Field Archaeologists 1994 (revised 2001) Standard and Guidance for Archaeological Watching Briefs.
- The Institute of Field Archaeologists 1994 (revised 2001) Standard and Guidance for Archaeological Desk-Based Assessment.
- The Institute of Field Archaeologists 1994 (revised 2001) Standard and Guidance for Archaeological Field Evaluation.
- The Institute of Field Archaeologists 1994 (revised 2001) Standard and Guidance for an Archaeological Watching Brief.
- The Institute of Field Archaeologists 1995 (revised 2001) Standard and Guidance for Archaeological Excavation.
- The Institute of Field Archaeologists 1996 (revised 2001) Standard and Guidance for the Archaeological Investigation and Recording of Standing Buildings or Structures.
- The Institute of Field Archaeologists 2001 Standard and Guidance for the Collection, Documentation, Conservation and Research of Archaeological Materials.

6.3 Many people in North Wales speak Welsh as their first language, and many of the archive and documentary references are in Welsh. Contractors should therefore give due consideration to their ability to understand and converse in Welsh.

6.4 Where relevant, specialist studies of environmental, economic and historical data must include a *statement of potential*. All specialist reports used in the preparation of this study must be reproduced **in full** in the desk-based study.

6.5 A full archive including plans, photographs, written material and any other material resulting from the project should be prepared. All plans, photographs and descriptions should be labelled, cross-referenced and lodged in an appropriate place (to be agreed with the archaeological curator) within six months of the completion of the project.

6.6 Two copies of the bound report must be sent to the address below, one copy marked for the attention of the Development Control Archaeologist, the other for attention of the HER Officer, who will deposit the copy in the HER.

6.7 The involvement of Gwynedd Archaeological Planning Service should be acknowledged in any report or publication generated by this project.

7.0 Glossary of terms

7.1 *Archaeological Contractor*
A professionally qualified individual or an organisation containing professionally qualified archaeological staff, able to offer an appropriate and satisfactory treatment of the archaeological resource, retained by the developer to carry out archaeological work either prior to the submission of a planning application or as a requirement of the planning process.

7.2 *Archaeological Curator*
A person, or organisation, responsible for the conservation and management

of archaeological evidence by virtue of official or statutory duties. In north-west Wales the archaeological advisor to the Local Planning Authorities is the Development Control Archaeologist based at Gwynedd Archaeological Planning Service, who works to the Welsh Archaeological Trust's Curators' Code of Practice.

7.3 *Archive*
An ordered collection of all documents and artefacts from an archaeological project, which at the conclusion of the work should be deposited at a public repository, such as the local museum.

7.4 *Assessment*
A desk-based archaeological assessment (also known as a *desk-top assessment*) is a detailed consideration of the known or potential archaeological resource within a specified area or site (land-based, intertidal or underwater), consisting of a collation of existing written and graphic information in order to identify the likely character, extent, quality and worth of the known or potential archaeological resource in a local, regional or national context as appropriate.

7.5 *Brief*
The Association of County Archaeological Officers (1993) defines a *brief* as an outline framework of the planning and archaeological situation which has to be addressed, together with an indication of the scope of works that will be required.

7.6 *Evaluation*
A limited programme of non-intrusive and/or intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site; and, if present, defines their character and extent, and relative quality. It enables an assessment of their worth in a local, regional, national or international context, as appropriate. The programme of work will result in the preparation of a report and archive.

7.7 *Historic Environment Record (HER)*
A documentary record of known sites in a given area. In north-west Wales the HER is curated by the curatorial division of the Gwynedd Archaeological Trust. Formerly known as the Sites and Monuments Record (SMR).

7.8 *Specification*
The Association of County Archaeological Officers (1993) defines a *specification* as a schedule of works outlined in sufficient detail to be quantifiable, implemented and monitored.

8.0 Further information

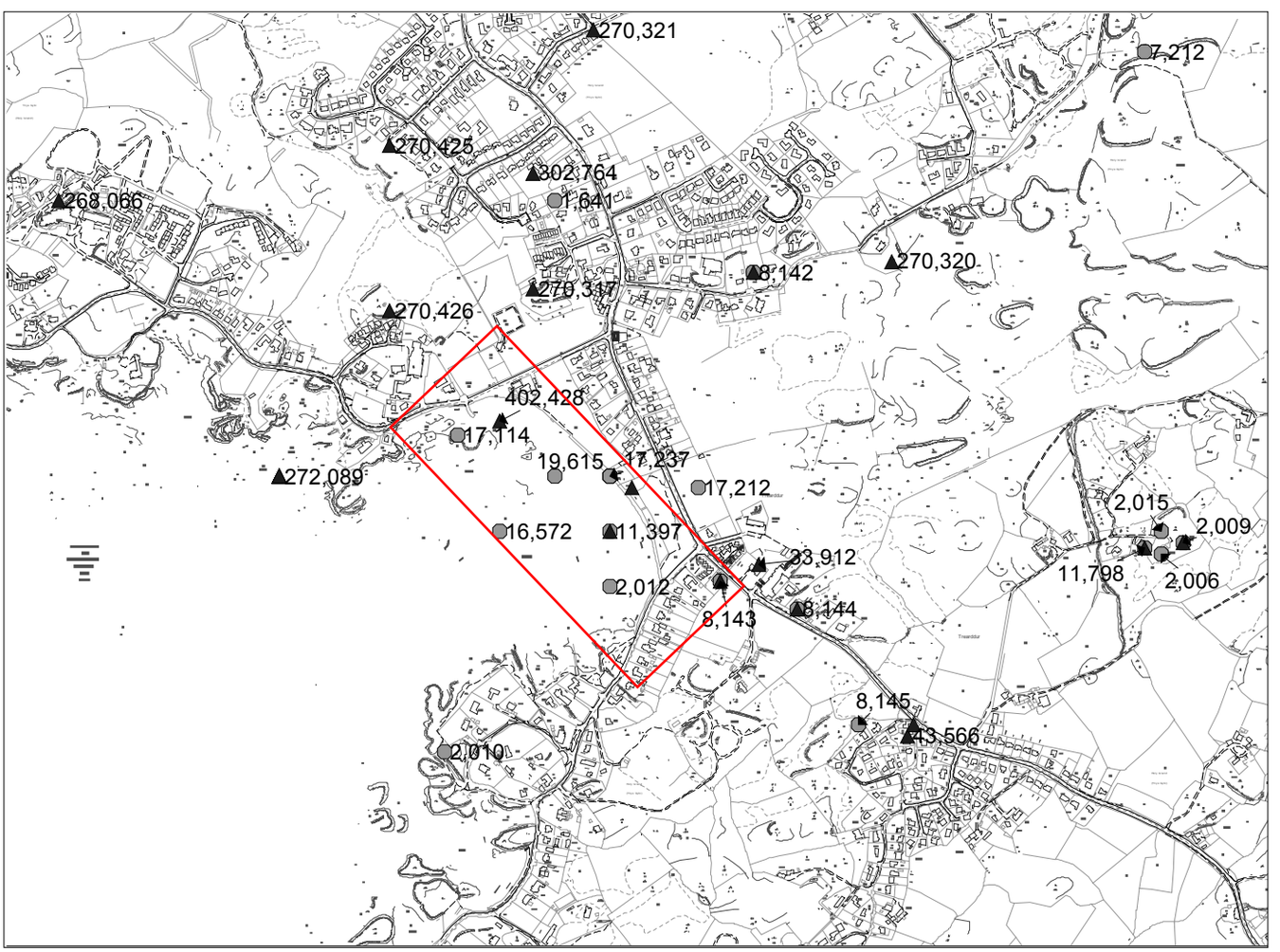
8.1 This document outlines best practice expected of an archaeological assessment but cannot fully anticipate the conditions that will be encountered as work progresses. If requirements of the brief cannot be met they should only be excluded or altered after gaining written approval of Gwynedd Archaeological Planning Service.

8.2 Further details or clarification of any aspects of the brief may be obtained from the Development Control Archaeologist at the address below.

Emily La Trobe-Bateman

Senior Development Control Archaeologist

Gwynedd Archaeological Planning Service, Craig Beuno, Ffordd Y Garth, Bangor, Gwynedd LL57 2RT
Ffon/Tel: 01248 370926 Ffacs/Fax: 01248 370925
emily@heneb.co.uk



Trearddur Bay Flood Defences Improvement

Fig. 1 Location of the flood defence improvement area (red) and of relevant historic environment records within 1km

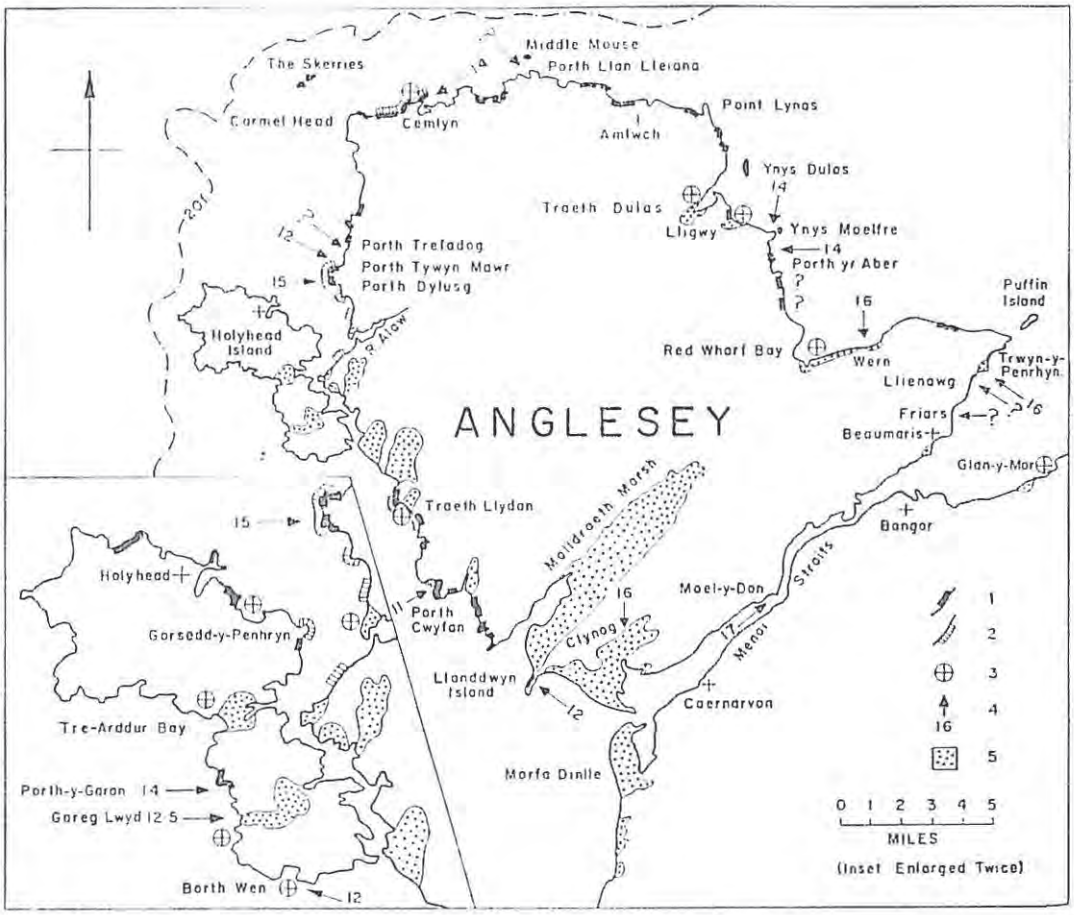


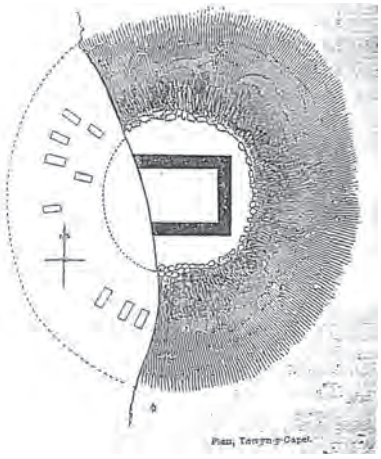
Fig. 23. Anglesey and the Menai Coast of Caernarvonshire.
1. 25-foot marine platform (Pre-Drift Raised Beach Platform).
2. 10-foot marine platform.
3. Site of coastal peat.
4. Site of post-Glacial raised beach (Figure refers to height in feet O.D).
5. Land probably inundated at maximum of post-Glacial transgression.

Trearddur Bay Flood Defences Improvement

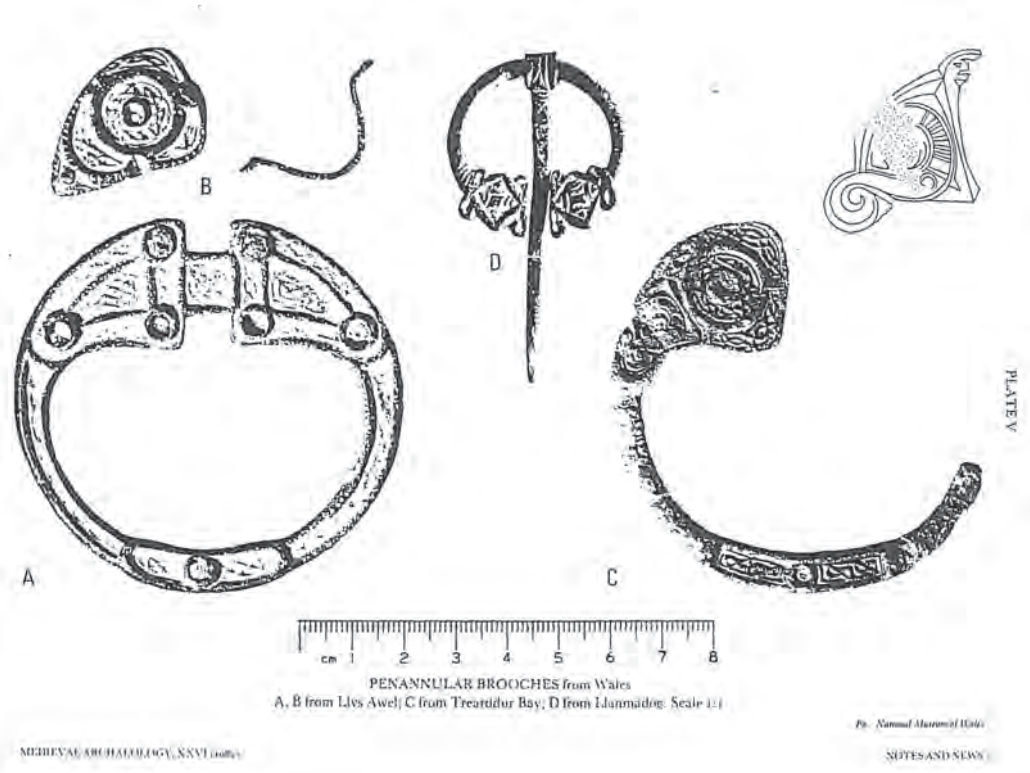
Fig. 2 Map of Anglesey by Whittow (1965) showing areas of maximum marine transgression in the Post-glacial period and the location of intertidal peat deposits and other coastal features

Trearddur Bay Flood Defences Improvement
Fig. 3a Sketch of Trearddur Bay and the Towyn y Capel mound in 1737, from the west

Trearddur Bay Flood Defences Improvement
Fig. 3b Sketch of the Towyn y Capel mound in 1776, from the south-east

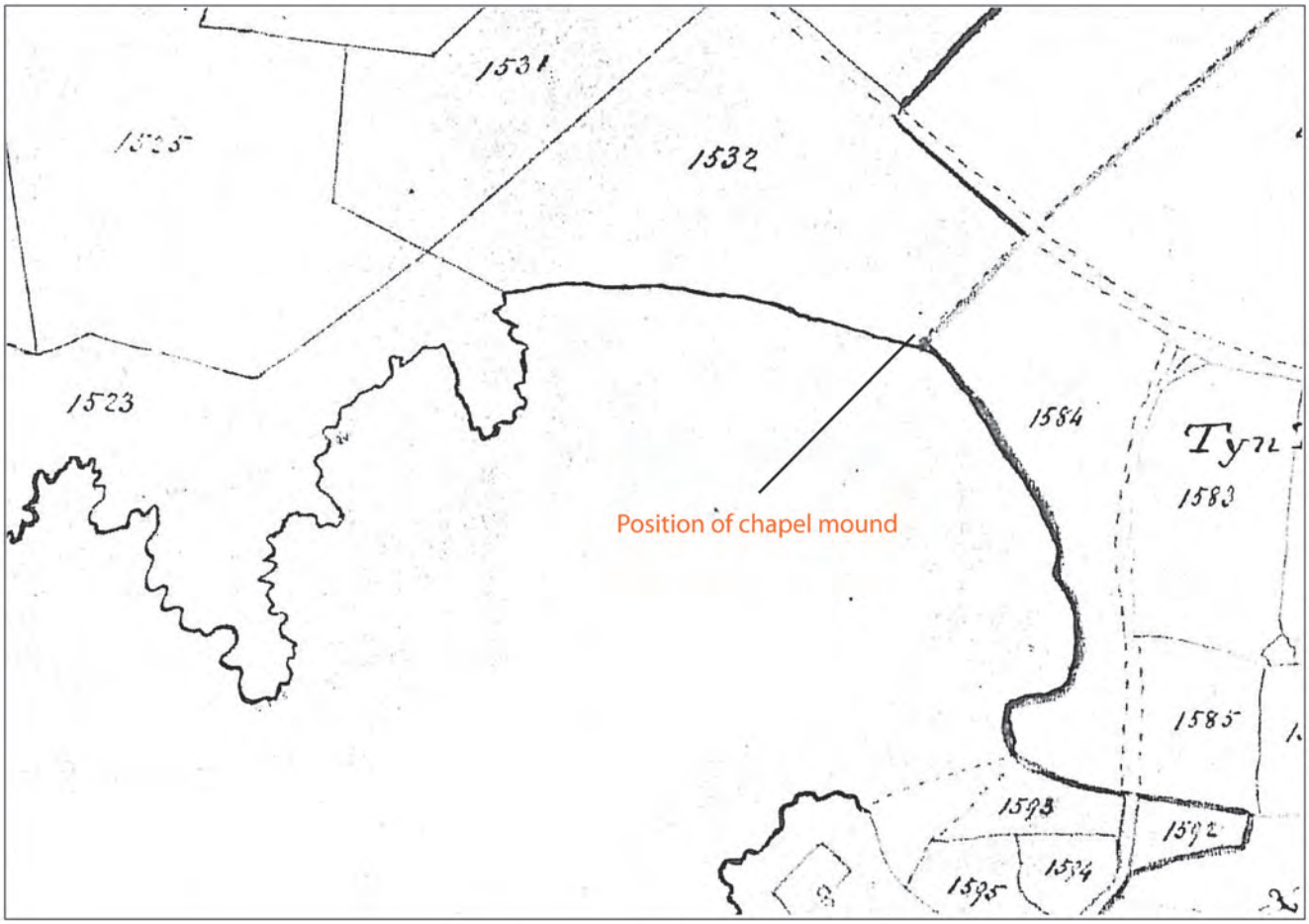


Trearddur Bay Flood Defences Improvement
Fig. 4 Plan of the Towyn-y-Capel mound as it existed in the early 19th century (Stanley 1846)

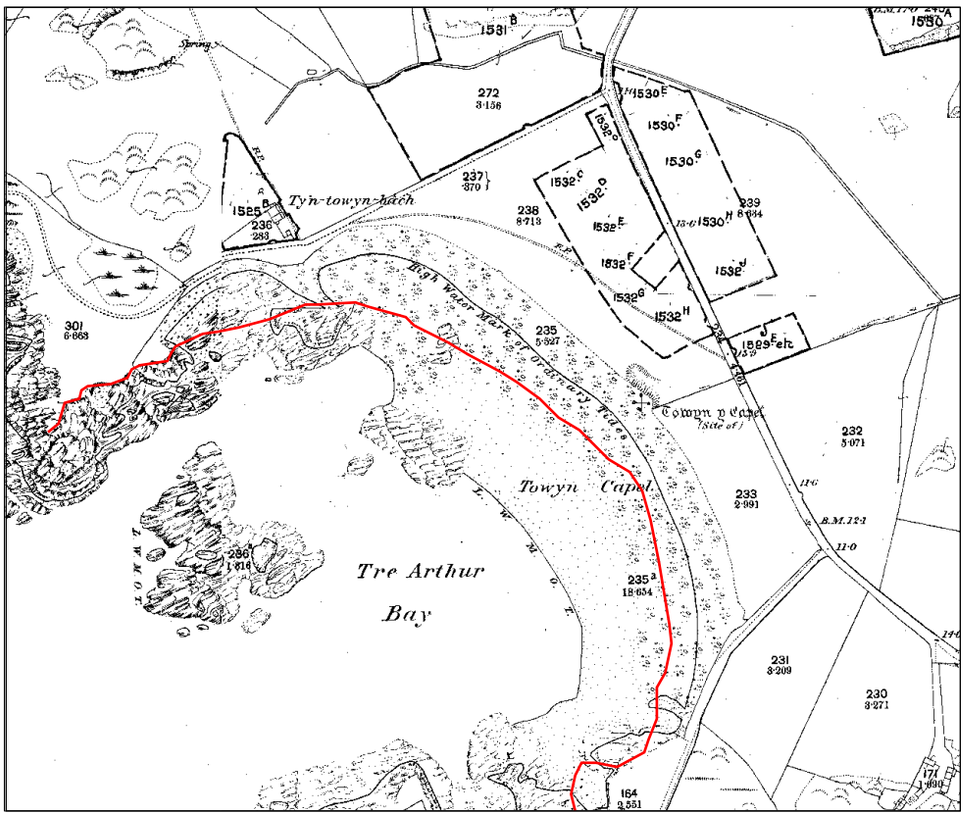


Trearddur Bay Flood Defences Improvement
Fig. 5 Early Medieval penannular brooches found in Wales (Lewis 1982).The Trearddur brooch is C.

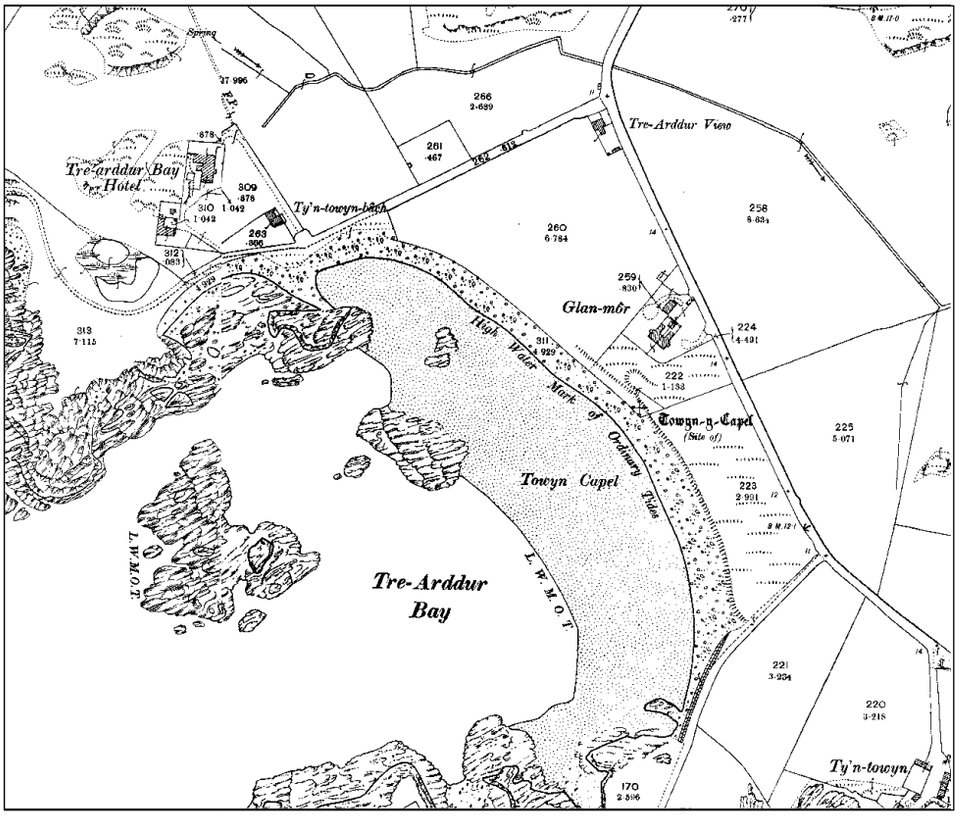
Trearddur Bay Flood Defences Improvement
Fig. 6 Excavation of the Early Medieval cemetery at Towyn y Capel, Trearddur Bay 2004, from the south-east



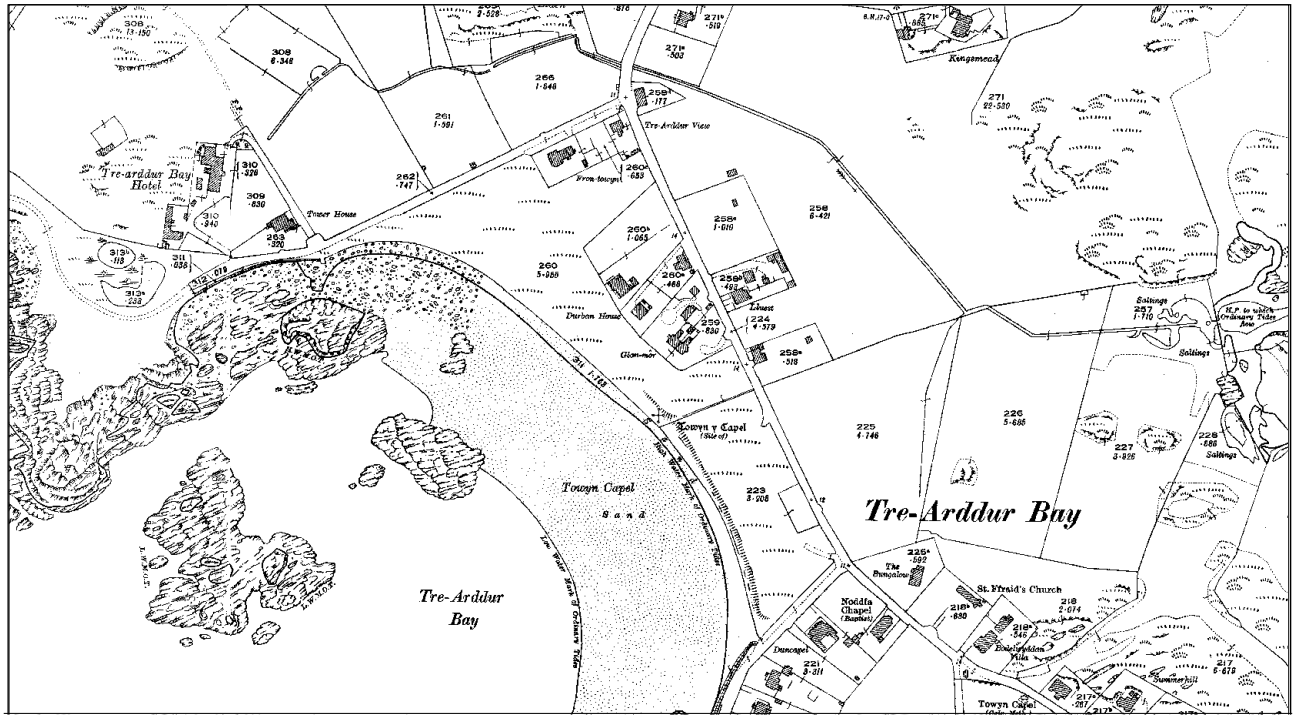
Trearddur Bay Flood Defences Improvement
Fig. 7 Trearddur Bay as shown on the Holyhead Parish Tithe map, 1841.



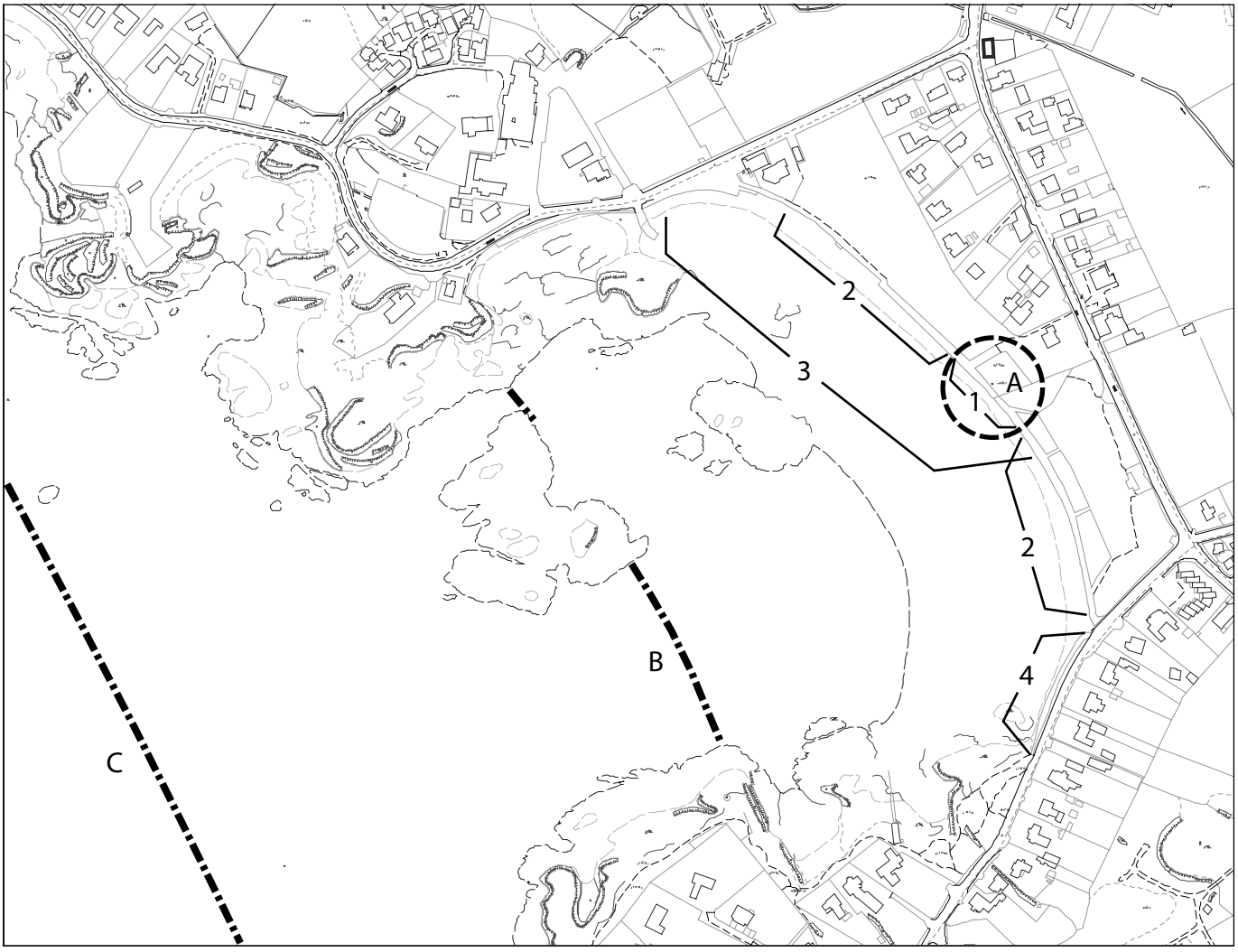
Trearddur Bay Flood Defences Improvement Fig. 8 Trearddur Bay shown on the Ordnance Survey 1:2500 First Edition 1889. Not to scale. The coast edge shown on the 1841 Tithe map is overlaid in red



Trearddur Bay Flood Defences Improvement Fig. 9 Trearddur Bay shown on the Ordnance Survey 1:2500 Second Edition 1900. Not to scale.



Trearddur Bay Flood Defences Improvement Fig. 10 Trearddur Bay shown on the Ordnance Survey 1:2500 Third Edition 1924. Not to scale.



Trearddur Bay Flood Defences Improvement

Fig. 11 Trearddur Bay showing the areas of archaeological potential (1-4), projected extent of the medieval chapel mound (A), and the projected position of the former coastline about 600 AD according to minimum (B) and maximum (C) estimates of coastal erosion by Whittow (1965). Not to scale.

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