16 Marine Physical Environment

Introduction

16.1 This section of the Screening and Scoping Report describes the baseline marine physical environment and identifies potential impacts of the Proposed Marine Works which includes the following:

- Removal and dismantling of two pylons and their foundations (4ZC030R and 4ZC031 and the associated temporary access tracks to these locations),
- Removal of the foundations of the previously dismantled pylon 4ZC030,
- The temporary access to enable the dismantling of pylon 4ZC032 (although the pylon itself is within the terrestrial environment).

16.2 The rationale for excluding certain pressures is provided where the level of impact is considered to be minimal and therefore not significant.

16.3 The marine physical environment is defined as the footprint of the Proposed Project below the Mean High-Water Mark (MHWM) which are either within the saltmarsh, or the estuary channel, and includes the excavated sediments as well as the properties of the waterbody that flow up and downstream past the areas of foundation excavation.

Data and information

16.4 This Screening and Scoping Report has been informed by baseline data compiled from publicly available sources. The primary information sources include:

- Designated habitat features of the Special Area of Conservation[1] (National Resources Wales (NRW) 2018);
- Detailed topographic levels across the saltmarsh, provided by NRW composite LIDAR data (www.lle.gov.wales/Catalogue/Item/LidarCompositeDataset);
- Goggle Earth aerial imagery, providing indications of previous channel alignments and saltmarsh extents;
- Water level measurements from Porthmadog, provided by NRW for period 1993 to 2018;
- Pont Briwet Environmental Statement[2] (Gwynedd Council, 2011), with reference to:
    - Ground investigation surveys[3] (Norwest Holst, 2009);
    - Hydraulic modelling study[4] (Civil Engineering Solutions, 2011);
    - Geomorphological report [5](Fluvio, 2011); and,
    - Scour and sediment modelling study[6] (Gwynedd Council, 2011).

1 Natural Resources Wales. (2018). Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation. Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017.

2 Gwynedd Council. (2011). Pont Briwet - Transportation Improvement Scheme. Non Technical Summary. (80406 GC 644 ED 04)

3 Norwest Holst. (2009). Report on a Ground Investigation at Pont Briwet, North Wales

4 Civil Engineering Solutions. (2011). Pont Briwet. Transportation Improvement Scheme. Hydraulic Modelling Report

5 Fluvio. (2011). Geomorphological assessment of the Pont Briwet replacement on the Afon Dwyryd: July 2011 update.

6 Gwynedd Council. (2011). Pont Briwet- Transportation Improvement Scheme. Scour and Sedimentation Modelling Report (80406 GC 644 ED 09).

- Environmental Statement for the erection of Pylon 4ZC030R[7] (National Grid, 2015).

16.5 The Pont Briwet Project represents recent major construction works in an area immediately upstream of the saltmarsh and provides both relevant baseline information as well as direct evidence of how the estuary has responded since works were completed.

Legislation and Policy

16.6 The legislation and planning policies relevant to the marine physical environment include:

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, as applied to River Basin Management.
- Western Wales River Basin Management Plan (including Dwyryd Estuary) (Natural Resources Wales, 2015).
- UK Technical Advisory Group on the Water Framework Directive, for issues such as dissolved oxygen standards for transitional and coastal waters[8] (UK Technical Advisory Group on the Water Framework Directive, 2008).

16.7 The legislation and policies that apply to designated habitat features within the SAC (i.e. estuary, sandflats and saltmarsh) are considered in Section 17 - Marine Ecology.

Baseline Environment

16.8 The baseline is described in the context of the Proposed Marine Works Area within the Area of Search for Permanent and Temporary Works. The main features are the saltmarsh and the adjacent estuary channel cutting through shallow inter-tidal sandflats. These features work together to form the Dwyryd Estuary which is considered here as the macro unit.

Estuary

16.9 The Dwyryd Estuary is a bar-built estuary that has characteristic sand bars across the mouth. The estuary can also be described as a partially drowned river valley, formed by Holocene glaciation, that has subsequently been largely infilled with marine sands creating expansive drying conditions around low water[9] (Countryside Council for Wales, 2001).

16.10 The tidal confluence of the estuary with Tremadog Bay is around 10.2km downstream of the Proposed Marine Works (estimated along the low water thalweg[10]). Ordnance Survey mapping indicates that the normal tidal limit (NTL) is at the A496 bridge near Maentwrog a further 6.3km upstream.

16.11 The estuary mouth is around 1.4km wide whilst at the Proposed Marine Works, this narrows to around 0.36km for the main channel and sandflats, or up to 0.91km including the saltmarsh.

16.12 Pont Briwet is around 0.38km upstream and represents a major narrowing in the channel due to (geological) higher ground either side of the estuary. This natural narrowing favoured the location of the bridge crossing which now includes stone causeways to further constrict the channel to around 0.11km wide. The narrowing focus tidal flows passing under the bridge

[7] National Grid. (2015). Emergency erection of a replacement tower and ancillary works near Penrhyndeudraeth, Gwynedd. Non-technical summary.
[8] UK Technical Advisory Group on the Water framework Directive. (2008). UK Envrionmental Standards and Conditions (Phase 1). Final Report.
[9] Countryside Council for Wales. (2001). Site of Special Scientific Interest Citation: Morfa Harlech, Gwynedd
[10] a line connecting the lowest points of successive cross-sections along the course of a valley or river.

and develops an over-deepened scour feature which appears to extend furthest on the upstream side of the bridge.

16.13 The tidal exchange with Tremadog Bay creates ebb and flood flows which cut a series of braided channels through the sands and over time (decadal to sub-decadal) these channels meander from bank to bank through the main body of the estuary.

16.14 In many places the estuary is bordered by extensive areas of saltmarsh. The fronts of these saltmarshes are susceptible to bank erosion when channel meandering cuts in their direction, however, in a few places there are hard structures that limit channel meandering and these areas are commonly devoid of any fronting saltmarsh (e.g. developed land such as the sea wall in front of Porthmadog).

16.15 Figure 16.1 provides an overview of the Dwyryd Estuary which includes an overlay of saltmarsh areas presented on a Google Earth image from low water on 2nd June 2016.

Figure 16.1: Overview Dwyryd Estuary (satellite image ©2018 Google)

Waterbody

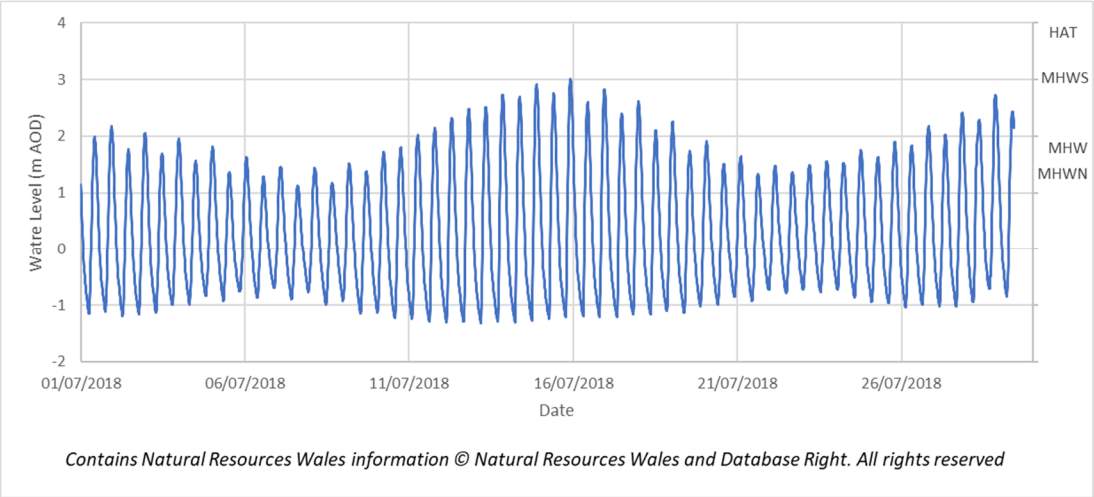
16.16 The waterbody within the estuary fluctuates in level (and volume) due to tidal influences from Tremadog Bay. Tides at Criccieth have a mean spring range of around 4.24m and a mean neap range of 1.83m. The narrowing shape and shallowing environment of the estuary act to (further) steepen the flood tide and lengthen the duration of the ebb in an upstream direction until the tidal wave becomes fully dissipated at the tidal limit. This asymmetry in the tide leads to a pulse of relatively stronger flood flows and weaker ebb flows.

16.17 At low water, the tide retreats to expose large areas of sandflats across the estuary. At this time, the remaining flows coming from the Afon Dwyryd provide a source of freshwater draining off the upstream catchment. The volume of freshwater passing through the estuary is relatively small in comparison to the tidal prism (the amount of water exchanged through a section of estuary between high and low water), but these river flows also persists while the tide has retreated to help develop and maintain the low water channel thalweg.

16.18 Water levels are measured by NRW behind Porthmadog Cob, on the tidal sluices of Afon Glaslyn. Whilst this site is around 7.8km downstream of the Proposed Marine Works the tidal variations are still considered to provide a good indication of local water levels. Figure 16.2

illustrates a 28-day sequence of water level variation which encapsulates a full lunar cycle of spring-neap-spring tides for July 2018. This period of observations includes close approximations to both MHWS (around 16 July 2018) and MWHN (around 22 July 2018) tides.

Figure 16.2: Water level observations from Porthmadog



Sandflats and channels

16.19 The estuary contains extensive areas of sandflats comprising of material considered to be largely of marine origin that has infilled the estuary.

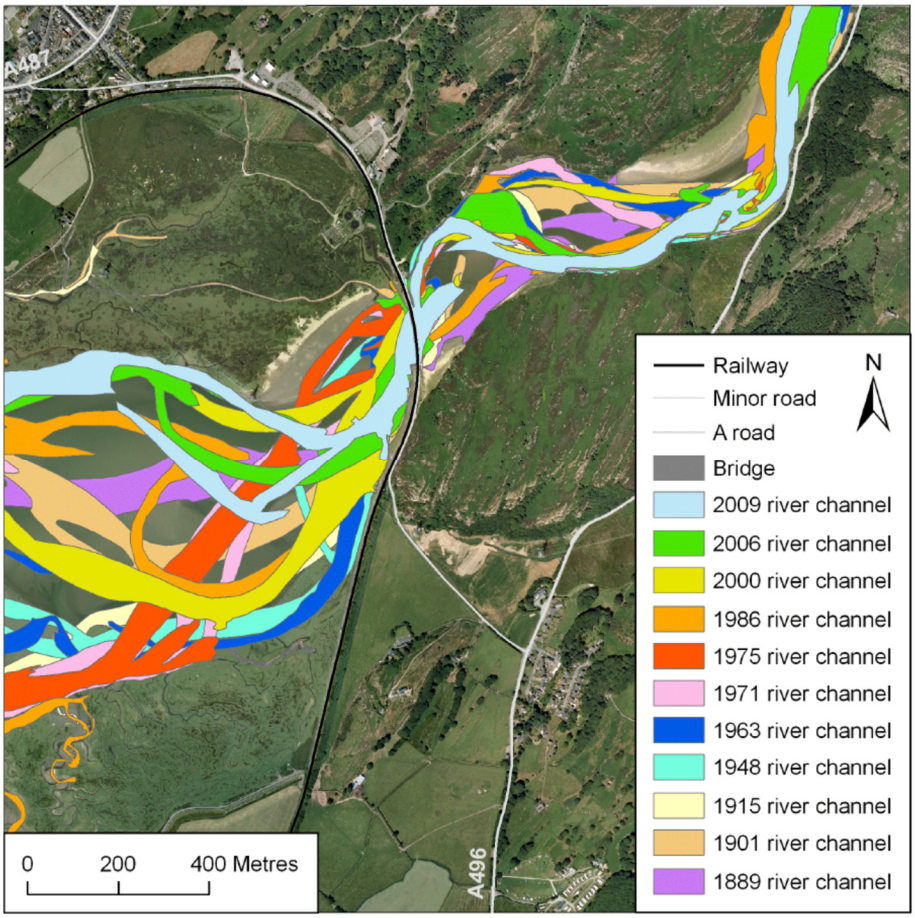
16.20 Borehole samples from several locations in the estuary channel, just downstream of Pont Briwet, indicate that the depth of sands is over 13m below the channel bed with the top layer of material (2 to 3m below channel bed) comprising of 98% sands and 2% silts (Norwest Holst, 2009). The general description of this material is given as '*loose brown grey slightly silty fine to medium SAND with a few coarse sand sized to gravel sized shell fragments'*.

16.21 The sediment gradings analysis indicates a D50 of 0.150mm, equivalent to fine sands. In addition, the organic content of the soils was assessed to be <0.1 %. The description of loose material suggests this material is mobile, with the comment about shell content endorsing a marine origin.

16.22 A series of braided channels cut through the sandflats due to tidal and river flows. From time to time these channels migrate from bank to bank, a process which can also lead to erosion of the corresponding saltmarsh edge.

16.23 Figure 16.3 shows evidence of past channel migration compiled from old maps covering the period 1889 to 2009. The analysis of channel migration suggested that within a 2km reach of the estuary, centred on Pont Briwet, 92% of the active channel environment (defined by sandflats and channel) has been reworked[7] (Fluvio, 2011).

Figure 16.3: Channel migration over the period 1889 to 2009 (Fluvio, 2011)



16.24 Composite LIDAR data (available from NRW) provides detailed levels across the saltmarsh and sandflats. The nature of the composite data means this information is an amalgamation of surveys spanning different (unspecified) years. The profile of local sandflats, based on the available LIDAR data, suggests a variable height of between 1.2 and 1.9m above Ordnance Datum Newlyn (AODN). The level of mean high-water neap (MHWN) tides is estimated as 1.34m (based on Porthmadog) suggesting that some areas of the higher standing sandflats remain exposed during neap tides. The corresponding mean high water spring (MHWS) level is estimated as 3.04m AODN (based on Porthmadog) indicating that the sandflats are fully submerged during high water periods of spring tides. On this basis, only spring tides can be responsible for sediment mobility and transport across the shallowest areas of the sandflats.

Saltmarsh

16.25 There are extensive areas of saltmarsh bordering the estuary. The LIDAR data indicates that the saltmarsh sits relatively high in the tidal frame at heights of between 2.3 to 2.6m AODN. These levels are only reached by high water periods on spring tides. Based on the water level data from Porthmadog, high water periods of neap tides would be insufficient to inundate the saltmarsh.

16.26 During periods of inundation there is an opportunity for saltmarsh levels to “warp up” with any sediments carried in suspension onto these areas that are also able to settle out. Typically, these will be fine sediments such as silts and muds held in suspension.

16.27 Mudflat areas appear to be present (and are mapped as such by NRW) in some of the creeks draining and bordering the saltmarsh. The source of muddy material is likely to be from the

upstream catchment which is mainly rural and partly forested, with inputs heightened during periods of increased rainfall creating a washload.

16.28 The site investigation work for Pont Briwet included a trial pit (TP04) on the edge of the saltmarsh [7] (Norwest Holst, 2009). The top layer (above bedrock at this location) to 1.3m below ground level was described as '*Brown silty fine to coarse SAND'.*

16.29 A photograph of the trial pit (Figure 16.4) shows the uniform composition of material covered with a relatively thin layer of grass. Whilst other areas of the saltmarsh may have different types of vegetation the sub-soils are still expected to be similar to TP04. Apart from the surface vegetation, the organic content in trial pits was assessed to be <0.1%.

Figure 16.4: Trial pit at edge of saltmarsh, TP04 (Norwest Holst, 2009)

Sediment transport

16.30 Present evidence points to sediment supply to the estuary of mainly marine sands from Tremadog Bay, especially sources in the littoral zone at the mouth of the estuary. Silts and muds may also be supplied from the upstream catchment by the river and carried downstream as a suspended sediment load, albeit these concentrations appear very low during typical conditions due to observed good water clarity. The further sources of sediment are from reworking of sandflats and erosion of the saltmarsh edge, although these areas may switch between acting as temporary sources to acting as temporary sinks, depending on conditions acting upon them.

16.31 Sediment transport occurs when the movement of the water body through the estuary creates flow conditions that exceed a threshold for sediment mobility allowing the material to be moved either as suspended load or bedload. Such thresholds depend on many issues, but principally the particle size for non-cohesive sediments. Transport ceases when flows drop below the level to hold material in suspension or below the level to overcome friction on the bed.

16.32 Whilst flood and ebb flows may both act on sediments and carry material upstream and downstream, the asymmetry in magnitude and duration between flood and ebb determines the direction of net transport. Present information suggests the stronger flows on spring flood tides provide the mechanism for upstream transport of sands, whereas the longer duration of

the ebb (for both spring and neap tides) is likely to create net downstream transport of silts and muds, when present in suspension. Whilst conditions in the main body of the estuary provide areas for sand deposition, the muds only deposit in areas where flows are weaker and allowing for material to settle out of suspension. These areas include shallower margins of the estuary, across the saltmarsh or within small tidal creeks.

16.33 Scouring is observed around the Pont Briwet bridge piers and causeways, a local current deflecting wall and at the remaining foundations of 4ZC030. Once the foundations of 4ZC030 are removed, the scour hole is expected to infill. The rate of infilling depends on the availability of sediments and rates of local sediment transport. At 4ZC030, the local scour hole is now coincident with the alignment of the low water channel and appears to be (partly) holding the channel in this location rather than letting the channel migrate as normal.

Potential Impacts

16.34 The Proposed Marine Works represent a short-term pressure on the marine physical environment involving temporary trackway access roads across the saltmarsh, plus excavation of pylon foundations which will dig up small areas of saltmarsh. These activities are not expected to interfere with marine processes.

16.35 In the case of 4ZCO30, the method of excavation includes a temporary work platform which will locally interfere with flood and ebb flows and may extend the existing scour hole present around the foundation for the period of time it is in position. The excavation activity may also disturb some local sandy sediments.

16.36 The excavated soils and disturbed sediments are unlikely to contain any contaminants or sources of pollution as the area has no immediate connection with an industrial past and previous capital works in the near vicinity (e.g. Pont Briwet, Norwest Hole, 2009) in the area did not encounter this as an issue either.

16.37 Other risks to the local environment could arise from accidental spills of diesel, however, good site management will provide sufficient mitigation for such risks.

16.38 A review is provided below to determine which pressures are considered to require a more detailed examination and those which can be scoped out.

Hydrological changes - Water flow (tidal current) changes – local

16.39 The potential changes to local water flows are relevant to the removal of cofferdam and foundation piles at 4ZC030 and 4ZC030R. 4ZC030 is fully within the estuary channel, whereas 4ZC030R is presently forming a ‘hard’ promontory into the channel, acting as an extension of the saltmarsh edge.

16.40 In comparison, site 4ZC031 is at a level and location on the saltmarsh where inundation by tides is infrequent. Site 4ZC032 is at a location on the floodplain, beyond the saltmarsh, and would only become inundated during rare flooding events. Both these sites are scoped out of further consideration of this pressure.

16.41 During extraction of foundations at 4ZC030, there will be a short period (estimated to be 28 days) when a temporary work platform is extended into the estuary channel to provide access to plant. This work platform will half infill the existing scour hole around 4ZC030. During this period, the hard structure of the work platform will locally deflect flows, noting that flows in this area are already being impeded by the existing foundation. The existing scour hole is expected to become temporarily extended upstream and downstream by the work platform and at a comparable scale to the volume and shape of the platform. There is a chance that the work platform may encourage the channel to be displaced away from the edge of the saltmarsh, however, such channel movement is also considered to be within the envelope of natural variation, as demonstrated in the baseline description.

16.42 Once the pylons and foundations are removed, any scour holes (former scour around 4ZC030 and extended holes due to the work platform) are unlikely to remain for very long with the dynamic channel migration process quickly overwhelming their former position, infilling any over-deepened locations. A similar estuary response arose during the construction of the new bridge at Pont Briwet when temporary causeways further narrowed the passage for flows leading to a large area of local scour developing. When the bridge was completed, and the gap between causeways reverted back to a similar scale as pre-construction, the estuary channel and sandflats quickly reverted back to a more natural arrangement (Figure 16.5).

Figure 16.5: Channel evolution (construction of the new bridge, Pont Briwet)

Pre-construction (May 2013) Construction (October 2013) Post-construction (June 2016)

16.43 The removal of pylon 4ZCO30R cofferdam and foundations has the potential to indirectly impact (alter) water flow at this location in the Dwyryd Estuary because once these artificial barriers are removed the channel has the potential to (and will continue to) migrate northwards at this location (at some time in the future, see Section 16.49 below), noting though this migration should be considered as a reinstatement of a more natural process. The (immediate) direction of channel migration (north or south) is likely to be linked to how the estuary responds to the temporary work platform at 4ZC030.

16.44 An additional issue considered is that water may need to be pumped out of the cofferdam during excavation of the foundation. The assumption is that this water will drain back into the estuary or be directed there by pipe. These water volumes are likely to be minimal in relation to passing flows and insufficient to have any affect in isolation. This aspect will therefore be scoped out of the Environmental Assessment Report and not considered further.

16.45 Based on the discussion presented above, and the understanding of the baseline physical environment within the estuary, the screening and scoping review concludes that the Proposed Marine Works will result in the removal of artificial barriers which will allow the estuary to reinstate natural channel migration processes. This is in-line with NRW objective for the project, i.e. to return the estuary to a natural state of equilibrium, recognising that this may take time. It is therefore proposed that this pressure is scoped out of further assessment.

Physical changes - sediment transport changes – local

16.46 The excavation and backfill of sediments excavated around 4ZC032 and 4ZC031 are unrelated to any sediment transport process as the material is unlikely to be inundated by the tide and any flows across the saltmarsh are also likely to be insufficient to move sandy material. Both these sites are proposed to be scoped out from further consideration of this pressure.

16.47 The main anticipated change in sediment transport is related to the formation of temporary and localised scour pits for the work platform placed into the estuary channel to provide access for the excavation of 4ZC030. The volume of sediments that are displaced to create the scour hole will become integrated into the wider sediment transport process and will most likely become part of adjacent sandflats and therefore all material be retained within the estuary. In addition to volumes of sediment that may be displaced during scouring there may be smaller volumes of sediment disturbed during the placement and removal of the work

platform and the removal of piles. The fate of this material is likely to be the same as the fate of any scoured sediments. These changes are considered not to lead to any significant effect on the estuary or sandflats and are proposed to be scoped out from further consideration.

16.48 At 4ZC030R, during the excavation activity, water may need to be pumped out from the cofferdam. The water may include small amounts of fine sediments (silts representing 2% of the in-situ sediment volume). The anticipated small volumes of pumped water and small volumes of sediment are unlikely to lead to the development of any sediment plume, as such it is proposed that this pressure is scoped out from further assessment.

16.49 After excavation is completed, the new edge of the saltmarsh will be the length revealed by the back of the cofferdam. This edge may be susceptible to erosion as the estuary channel adjusts to a new equilibrium. Previous studies discussed within the Environmental Statement (National Grid, June 2015) have shown that this area of saltmarsh is currently undergoing a period of erosion, after reaching its maximum extent in 1977. Recent shoreline monitoring data indicates that this saltmarsh is continuing to erode with losses of between 5m and 15m since October 2014. It is likely that the habitats within the southwestern half of the cofferdam would have been lost by now if the cofferdam had not been installed. On removal of the cofferdam and foundations at 4ZC030R, it is likely that this northerly erosion of the saltmarsh will continue. TEP (2017) state that "Given that erosion is taking place on this area of saltmarsh it is likely that saltmarsh accretion will be occurring elsewhere in the estuary as part of the natural estuarine process. This would ensure that the overall area of saltmarsh within the system remains relatively constant."

16.50 Removing 4ZC030R and 4ZC031 and the base of 4ZC030 will allow the estuary to return to a natural state of equilibrium, in-line with NRW objective for the Proposed Project. It is therefore proposed that this pressure is scoped out of further assessment.

Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

16.51 All access will use temporary trackway road structures to alleviate damage from vehicles. The use of the temporary roads will help displace any heavy load to the surface of the saltmarsh. Any compression of soils is expected to be minimal and limited to these tracks.

16.52 All excavations that disturbed substrate below the surface of the seabed to remove artificial material (i.e. foundations) are considered reversible (to a pre-foundation condition) with no lasting (permanent) impact on geomorphology. The profile of surface soils appears relatively homogeneous over the depths of excavation so there are no anticipated changes to soil type or structure. The bulk density of the backfilled soils may be lower in the short-term but settlement due to periods of tidal inundation and groundwater variations are expected to alleviate this over time.

16.53 Site 4ZC031 will be backfilled and 4ZC030R is considered to infill as part of the natural channel and sandflat process. At 4ZC030R, if there is a residual void then the assumption is this will also infill by natural processes. It is proposed that this pressure is scoped out from further assessment.

Physical damage (reversible change)– Changes in suspended solids (water clarity)

16.54 Excavations at 4CZ031 and 4CZ032 are essentially land based and are unlikely to have any effect on suspended sediments. If sites became inundated during the excavation process, then flows across the saltmarsh are considered to be too weak to create any periods of suspended sediments and no material would be lost from the saltmarsh. It is proposed that this pressure is scoped out from further assessment for these two locations.

16.55 During excavation of 4CZ030R water may need to be pumped out of the cofferdam which may contain small amounts of silts (2% of the sediment volume). However, the anticipated small volumes of pumped water and silts are unlikely to create any sediment plume that would affect water clarity.

16.56 At 4CZ030 there is a requirement to build a temporary work platform, excavate the foundations and remove the platform. During this period of activity there is a potential to mechanically disturb the local seabed as well as creating scour around the platform. The majority of the disturbed sediment is considered to be sandy sediments with a D50 of 0.15mm. The same sediments exist on the sandflats and would be susceptible to the same periods of transport to elevate general levels of suspended sediments, therefore, any locally disturbed sediments would simply become part of the same elevated levels when the sandflats become mobile. It is proposed that this pressure is scoped out from further assessment.

Changes in water quality

16.57 As a general consideration, the potential exists that disturbed sediments in the marine environment may impact on water quality through issues such as releasing retained contaminants or anoxic sediments that impact on levels of dissolved oxygen within the waterbody. However, the understanding of the baseline derived from site-specific data e.g. Pont Briwet, show that local sediments are clean, have no associated contaminants, have low levels of organics (and therefore have limited potential to be anoxic). In addition, no water quality issues arose during the construction of Pont Briwet, a period of construction works which would have involved greater volumes of disturbed sediment. It is proposed that this pressure is scoped out from further assessment.

Pollution/ other chemical changes- Transition elements and organo-metal contamination

16.58 At present, there is no evidence for any contaminated sediments within the estuary and the site has no association with any industrial activity of any scale. The upstream catchment is mainly forest and agricultural. It is proposed that this pressure is scoped out from further assessment.

Pollution and other chemical changes - Deoxygenation

16.59 At present, the available evidence from site investigations supporting the construction of Pont Briwet[7] (Norwest Holst, 2009) indicate that surface sediments in the near vicinity to the depth of excavations have a very low organic content and are not expected to be anoxic. It is therefore proposed that this pressure is scoped out from further assessment.

Proposed Assessment Methodology

16.60 The screening and scoping review undertaken is largely qualitative at this time but is also considered proportionate to the scale, type and duration of the Proposed Marine Works, and the opportunity to reinstate a more natural behaviour for the estuary. The environmental assessment and supporting studies developed for the new bridge at Pont Briwet also represent a useful analogue to how the estuary responded to a much larger scale and longer lasting construction activity in the same general area.

16.61 Of the Proposed Marine Works, only works at 4CZ030 and 4CZ030R have footprints of activity that may lead to any direct and indirect changes on estuary flows, sediment transport (scouring) and a link with natural channel migration and saltmarsh erosion, these have been considered but are subsequently scoped out of the assessment. Sites 4CZ031 and 4CZ032

are scoped out from further assessment due to their location and limited and infrequent connection with marine processes.

16.62 It is proposed that all issues are scoped out on the basis that they are considered unlikely to create any permanent pressure on the marine physical environment or lead to significant impacts. This is based on a review of the existing baseline, and acknowledgement that the removal of the artificial barriers (i.e. the pylons and foundations at 4CZ030 and 4CZ030R) will allow the estuary to return to a state of natural equilibrium in future. This is a primary objective for NRW; the key stakeholder in this process. Any impacts associated with sediment movement effects on European designated sites are addressed in Section 17 of the Screening and Scoping Report.

Proposed Mitigation Measures

16.63 No mitigation is proposed at present beyond best practice which has been embedded into the project design and is discussed in the project description.

Issues to be Scoped Out

16.64 Table 16.1 summarises the issues which are proposed to be scoped out:

Table 16.1: Pressure descriptions to scope out

Pressure description	Receptors			
	Estuary channel / body	Estuary sandflats	Saltmarsh sediments	Suspended sediments
Hydrological changes - water flow (tidal current) changes – local	✓	✓	✓	
Physical changes - sediment transport changes – local	✓	✓	✓	
Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.			✓	
Physical damage (reversible change) – Changes in suspended solids (water clarity).				✓
Changes in water quality	✓			
Pollution and other chemical changes - Transition elements & organo-metal contamination				
Pollution and other chemical changes - Deoxygenation				

Overview of the Likely Significance of Effect

16.65 From a review of the information currently available, all issues are proposed to be scoped out of the assessment on the basis that they are considered unlikely to create any permanent pressure on the marine physical environment or lead to significant impacts. This is based on

a review of the existing baseline, and acknowledgement that the removal of the artificial barriers (i.e. the pylons and foundations at 4CZ030 and 4CZ030R) will allow the estuary to return to a state of natural equilibrium in future. This is a primary objective for NRW; the key stakeholder in this process.