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Brockhole Stream Flood Alleviation Scheme

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Coastal Processes Assessment	5122859/100098397	30 September 2026

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Coastal Processes Assessment

Brockhole Stream Flood Alleviation Scheme, Blackpill, Swansea Bay

1. Introduction

This Coastal Processes Assessment has been prepared in accordance with Natural Resources Wales (NRW) *Guidance Note GN019: Completing a Coastal or Physical Processes Assessment for Small-Scale Projects*¹ and *Evidence Report: Advice on Physical Processes for Small-scale marine and coastal projects*². The assessment considers the potential effects of the proposed Brockhole Stream Flood Alleviation Scheme (FAS) outfall works on coastal and physical processes within Swansea Bay.

The Proposed Works form part of a wider FAS intended to reduce flood risk associated with Brockhole Stream. The marine licence element comprises construction of a new outfall through the sea wall at Blackpill and associated channel modification and scour protection works below Mean High Water Springs (MHWS).

2. Project Definition

2.1 Site Location

The Proposed Works are located within Blackpill, Swansea, a small coastal district approximately 5km southwest of Swansea city centre on the northern shore of Swansea Bay. Blackpill occupies a prominent position along Mumbles Road (A4067), forming part of the highly valued coastal corridor that connects Swansea with Mumbles Head and the wider Gower coastline. The area is characterised by a combination of urban development, recreational open spaces, coastal habitats and active transport infrastructure, making it an important destination for residents and visitors.

The site is centred at National Grid Reference (NGR) SS 61954 90510 and is situated immediately adjacent to the intertidal zone of Swansea Bay. The surrounding area includes the Blackpill seafront, coastal promenade, cycle route, beach frontage and associated public amenities.

The location of the Proposed Works is illustrated in Figure 1 and Figure 2. These figures show the regional context of the site within Swansea Bay and the specific location of the Proposed Works within Blackpill.

¹ Natural Resources Wales (2024) GN019 Completing a coastal or physical processes assessment for small-scale Projects. Available at: [GN 019 Completing a coastal or physical processes assessment for small-scale projects](#) (Accessed August 2026)

² Natural Resources Wales (2022) Advice on Physical Processes for Small-scale Marine and Coastal Projects. Available at: [Advice on Physical Processes for Small-scale Marine and Coastal Projects](#) (Accessed August 2026)

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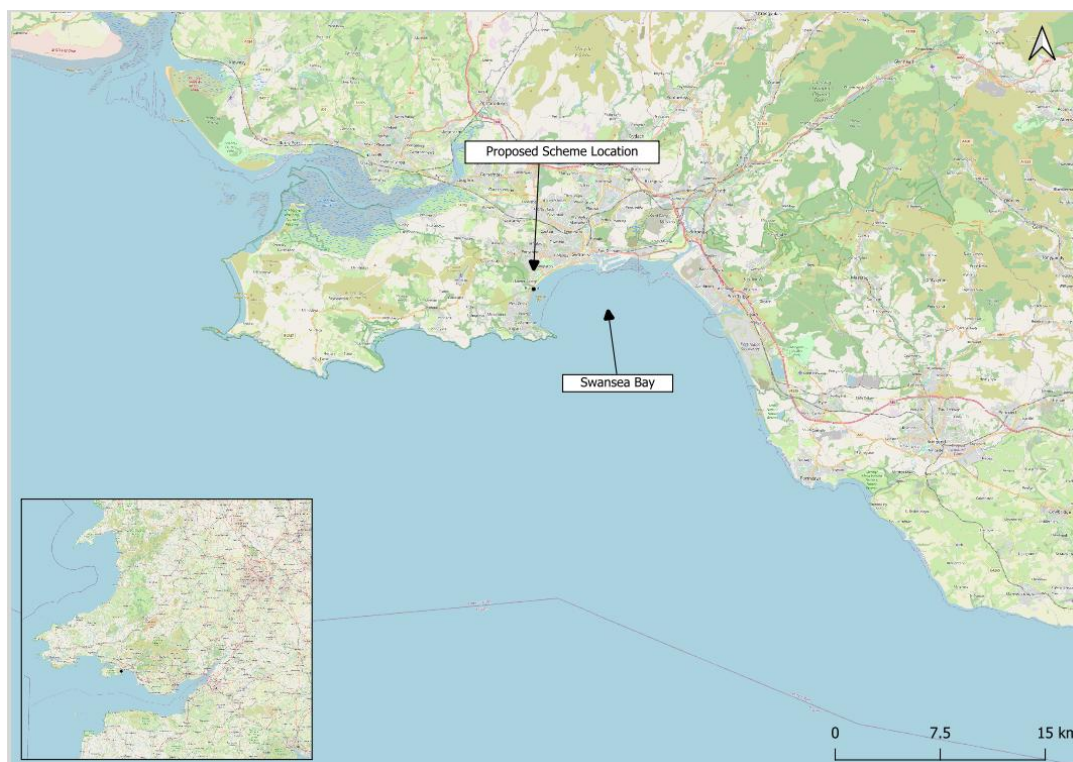


Figure 1 - Location of the Proposed Scheme within Swansea Bay



Figure 2 - Location of Brockhole Marine Licence Application Boundary (green line)

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The site is located within an existing coastal defence setting, comprising a sea wall that extends across the beach frontage at Blackpill (Figure 3). The sea wall forms the principal coastal structure within the area and influences local wave and tidal interactions along this section of shoreline. An existing surface water outfall passes through the sea wall and discharges onto the upper foreshore. Landward of the sea wall lies the Swansea Bay Cycle Path, a well-used pedestrian and cycling route that follows the coastline.



Figure 3 - Existing Outfall at the Proposed Scheme Location in Blackpill, Swansea

Figures 2 and 3 show the location of the Proposed Works within the upper foreshore at Blackpill. The site occupies the light-coloured sandy upper beach surrounding the existing Brockhole Stream outfall and is situated around the level of MHWS. The darker intertidal sediments visible seaward of the site represent areas that are subject to more frequent tidal inundation. The position of the works demonstrates that the majority of the scheme is confined to the upper beach environment, where interaction with marine processes is largely limited to higher tidal states, elevated water levels, storm conditions and periods of significant wave run-up. The Proposed Works are expected to interact only intermittently with tidal and wave processes compared with areas located further seaward within the intertidal zone.

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2.2 The Proposed Works

The Proposed Works form part of a wider FAS being delivered through a combination of planning permission and Permitted Development Rights. The Brockhole Stream FAS is situated in Blackpill, Swansea. The Scheme is required to address long-standing and recurrent flooding associated with the Brockhole Stream, linked to flash flooding during periods of heavy rainfall due to limited channel capacity and blockage. This flooding poses a risk to residential and commercial properties, the local community, and Mumbles Road.

The detailed works will be executed through a sequence of controlled activities, including:

- Construction of a new 1050mm diameter buried culvert on land behind the existing sea wall, with discharge to Swansea Bay.
- Excavation and redistribution of existing sediment and sand on the beach to form a new wider channel to accommodate the new outfall pipe.
- Saw-cutting and break-out of the existing concrete sea wall to accommodate the new outfall pipe.
- In-situ concrete placement to form the sea wall around the new outfall pipe.
- Installation of 89 1m x 1m x 1m blockstones to form the banks of the widened open channel as part of the permanent works and will extend for 25m. The blockstone will lie upon geotextile and be set within concrete.
- Installation of 124 0.5m x 0.5m x 0.5m blockstones to the channel invert for a length of 9m to provide scour protection.
- Associated fencing, access gates and vegetation removal to allow construction of the works.

It should be noted that the construction methodology presented is an outline approach based on AtkinsRéalis knowledge and experience of construction methods typically used for this type of work. The appointed contractor's detailed method statement may vary. The full method of works and marine elements are in Figure 4 and Appendix A.

 AtkinsRéalis

3. Existing Coastal Environment

3.1 Coastal Setting

The Proposed Works are located at the Brockhole Stream outfall within Blackpill, Swansea Bay, on the northern shoreline of Swansea Bay. The works comprise construction of a new outfall through the existing sea wall, widening of the existing outfall channel, redistribution of beach sediment and installation of permanent scour protection using blockstones. The marine licence works are restricted to the foreshore around MHWS.

Swansea Bay forms part of the northern Bristol Channel and comprises an extensive sandy intertidal and shallow subtidal environment. The Blackpill frontage is situated within the western part of the bay and consists predominantly of a wide sandy foreshore backed by a sea wall, promenade and Mumbles Road. The frontage therefore represents a modified shoreline, although the beach remains subject to active tidal, wave and sediment transport processes³.

The Proposed Works are located around MHWS, at the transition between the upper beach and active intertidal zone. The site is subject to intermittent marine influence, with the greatest interaction occurring during spring tides, elevated water levels and periods of increased wave activity³.

3.2 Coastal Geomorphology

3.2.1 Swansea Bay Sediment System

Swansea Bay is a large sedimentary bay, characterised by extensive sandy beaches and broad intertidal flats⁴. The present morphology of the bay reflects the long-term interaction of tidal processes, wave action, sediment transport and shoreline configuration.

Swansea Bay is an open coastal environment and is exposed to wave action generated within the Bristol Channel, as well as wave energy originating from further offshore. Although the bay benefits from some shelter provided by the shape of the coastline between Mumbles Head and Swansea Docks, wave action remains an important influence on shoreline behaviour, particularly during periods of strong south-westerly winds and storm events. Together with tides, waves play an important role in moving and redistributing sediment throughout the bay^{3,5}.

Regional seabed sediment mapping undertaken by the British Geological Survey identifies much of Swansea Bay as comprising deposits of sand and muddy sand, with localised gravelly sediments occurring across parts of the wider Bristol Channel⁶. These extensive unconsolidated sediment deposits provide the principal source material for the modern beaches and intertidal flats of Swansea Bay. The Swansea Bay Tidal Lagoon Environmental Statement⁵

³ Swansea Bay Coastal Engineering Group (2001). *Swansea Bay Shoreline Management Plan*.

⁴ United Utilities (2003) Scarweather Sands Offshore Wind Farm Environmental Statement, Volume 1. Warrington: United Utilities.

⁵ Swansea Lagoon Swansea Bay Environmental Statement Chapter 6: Coastal Processes, Sediment Transport and Contamination.

⁶ BGS (British Geological Survey) (1986) Bristol Channel and Approaches: Sea Bed Sediments and Quaternary Geology. 1:250,000 Geological Series. Keyworth, Nottingham: British Geological Survey.

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further identifies Swansea Bay as a shallower and more sediment-rich environment than the adjacent Central Bristol Channel, reflecting the contrasting hydrodynamic and sediment transport conditions operating across the region.

Swansea Bay functions as an active sedimentary system in which sediment is continually exchanged between the nearshore, intertidal and beach environments. The Swansea Bay and Carmarthen Bay Shoreline Management Plan³ identifies the bay as a coastal behaviour system characterised by ongoing sediment redistribution and natural morphological adjustment. The Swansea Bay Tidal Lagoon Environmental Statement⁵ similarly notes that fluctuations in beach morphology occur over a range of temporal scales, from short-term storm-driven adjustment through to longer-term redistribution of sediment across the wider bay. Variations in beach levels and sediment distribution are considered characteristic features of the baseline environment.

Sediment transport within Swansea Bay occurs through a combination of tidal and wave-driven processes. Sediment moves both alongshore and cross-shore, with transport pathways controlled by tidal circulation patterns, wave climate and local bathymetry³. The Swansea Bay Tidal Lagoon Environmental Statement⁵ identifies a distinct process divide between the deeper Central Bristol Channel and the shallower waters of Swansea Bay, broadly following the 20m contour. South of this divide, sediment transport is principally controlled by strong tidal currents, whereas within Swansea Bay wave action exerts a much greater influence on sediment mobility and shoreline behaviour. During storm events, wave-driven sediment transport may become the dominant mechanism controlling sediment redistribution across both the shallow subtidal and intertidal areas.

The Blackpill frontage forms part of this wider sediment transport system. Site observations indicate that the beach is composed largely of sand, consistent with the wider sedimentary character of Swansea Bay identified through regional seabed sediment mapping⁶. Sediment transport occurs through a combination of alongshore and cross-shore processes, with transport pathways influenced by tidal currents, wave climate, beach morphology and local bathymetry^{7,8}.

At Blackpill, wider sediment transport processes interact with local sediment movements associated with Brockhole Stream discharge. The site therefore forms part of the wider Swansea Bay sediment transport system rather than a separate or isolated sediment compartment.

3.2.2 Upper Foreshore Morphology

The Blackpill frontage occupies the western part of Swansea Bay and comprises a wide sandy beach backed by a sea wall, promenade and transport infrastructure associated with Mumbles Road. The frontage differs from sections further east within Swansea Bay in that the upper beach widens locally around existing outfalls and drainage features, where sediment accumulation can occur. The beach lies in front of historic dunes that are now largely occupied and constrained by coastal defence infrastructure, indicating that shoreline morphology is influenced by both natural coastal processes and existing anthropogenic controls⁶.

⁷ Collins, M.B. and Ferentinos, G. (1984) 'The Hydrodynamics and Sedimentology of a High-Velocity Tidal Sand Sheet, Swansea Bay, Bristol Channel, UK', *Marine Geology*, 54, pp. 325-349.

⁸ Horrillo-Caraballo, J., Yin, Y., Fairley, I., Karunaratna, H., Masters, I. and Reeve, D. (2019) 'Effects of a Tidal Lagoon on the Hydrodynamics of Swansea Bay, Wales, UK', *Journal of Marine Science and Engineering*, 7(3), 78.

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The Proposed Works are located at the existing Brockhole Stream outfall within the upper foreshore, adjacent to the strand line. Review of publicly available LiDAR data⁹ and aerial imagery¹⁰ indicates that the works are situated broadly around MHWS (Figure 2 and Figure 3). The site occupies the transition between the upper beach and the active upper intertidal zone.

The position of the works means that marine processes remain an important influence on site conditions. Whilst tidal currents and wave action are generally less energetic than those acting on the middle and lower foreshore, sediment within the upper beach can nevertheless become mobilised during spring tides, elevated water levels and periods of significant wave run-up. The sandy nature of the frontage supports the conclusion that localised sediment mobility and redistribution are natural and ongoing features of the site^{5,6,7}.

The existing Brockhole Stream outfall channel forms a pathway for both freshwater discharge and sediment movement and exhibits evidence of ongoing erosion, scour and deposition visible within available aerial imagery¹¹. The interaction of marine processes and freshwater discharge contributes to periodic changes in channel morphology and adjacent beach levels, demonstrating that the site is already characterised by active geomorphological processes.

The Proposed Works are located within a part of the foreshore that remains connected to the wider Swansea Bay sediment transport system. Assessment of potential effects has therefore considered not only the position of the works relative to MHWS, but also sediment mobility characteristics, existing channel behaviour and the potential pathways through which sediment may be redistributed under prevailing tidal and wave conditions.

3.2.3 Existing Morphological Behaviour

The Blackpill frontage exhibits characteristics typical of a dynamic sandy coastline. The existing beach morphology reflects the interaction of tidal currents, wave action and sediment supply operating across Swansea Bay^{3,8}. The existing outfall channel represents a naturally dynamic geomorphological feature that is subject to localised erosion, scour and sediment deposition. Freshwater discharge, tidal inundation and wave action combine to influence channel alignment, depth and morphology, resulting in periodic adjustment of channel form and adjacent beach levels.

The upper foreshore surrounding the outfall experiences periodic sediment redistribution associated with storm events, wave run-up and spring tidal inundation. These processes result in localised but ongoing changes in beach elevation and channel morphology, demonstrating that the site is already subject to natural physical process variability under baseline conditions. The Swansea Bay Tidal Lagoon Environmental Statement⁵ identifies wave-driven sediment transport as an important control on beach behaviour within the bay, particularly during energetic storm conditions when wave interaction with the shallow seabed becomes the dominant mechanism driving sediment mobility.

Historical beach profile analysis undertaken for the Swansea Bay Tidal Lagoon Environmental Statement⁵ identified a general reduction in beach and intertidal levels along the western Swansea Bay frontage between approximately 1998 and 2013. Monitoring at West Cross and Lower Sketty identified reductions in beach elevations of approximately 0.3m to 0.5m over the 15-year monitoring period, together with slight landward movement of Highest Astronomical Tide (HAT) and MHWS. These observations indicate a gradual tendency towards net erosion across parts of the western bay, although the magnitude of change remains relatively modest when considered over timescales.

⁹ Natural Resources Wales (2026) National LiDAR Programme Data. Available at: <https://datamap.gov.wales> (Accessed: 8 September 2026).

¹⁰ Google Earth Pro (2026) Blackpill, Swansea Bay, Wales. Satellite Imagery. Available at: <https://earth.google.com> (Accessed: 8 September 2026).

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The same study⁵ identified that Blackpill forms part of a wider defended frontage extending between Swansea Docks and Mumbles Head, characterised by extensive intertidal flats and locally variable beach morphology. Whilst historical profile analysis demonstrates evidence of gradual long-term adjustment, these changes occur within a wider context of ongoing sediment redistribution and natural morphological variability rather than rapid shoreline recession.

Although no suitable beach profile monitoring record was identified immediately adjacent to the Brockhole Stream outfall, review of historical aerial imagery¹⁰ and published coastal studies indicates that the Blackpill frontage functions as a dynamic but generally stable section of coastline. Observed morphological change is principally associated with localised fluctuations in beach levels and adjustment of the existing outfall channel, rather than sustained large-scale shoreline advance or retreat³.

The Swansea Bay Shoreline Management Plan³ identifies this frontage as part of a managed urban coastline where maintenance of existing coastal defences is required to manage flood and erosion risk. The current management approach is therefore consistent with a Hold the Line policy. The presence of the sea wall and associated coastal infrastructure provides a significant control on shoreline position, limiting the potential for substantial coastal recession along this section of frontage.

3.2.4 Summary

Overall, the geomorphological baseline at Blackpill can be characterised as a naturally dynamic sandy foreshore that forms part of the wider Swansea Bay sediment transport system. The site lies in the upper foreshore and contains an established outfall channel associated with Brockhole Stream. Although the surrounding coastline experiences ongoing sediment redistribution and morphological adjustment, the works are located within a small and already modified section of foreshore where the sea wall and existing outfall provide local controls on morphology. The receiving environment therefore has a natural capacity for localised adjustment whilst remaining connected to the wider Swansea Bay coastal system.

3.3 Hydrodynamic Regime

3.3.1 Water Levels and Tides

Swansea Bay is located within Bristol Channel, a macro-tidal environment characterised by one of the largest tidal ranges in the world. Water levels are dominated by semi-diurnal tides, producing two high and two low waters each tidal day. Mean spring tidal ranges are typically between 8m and 10m, whilst neap tidal ranges are generally between 4m and 5m^{11,12}. Table 1 summarises key tidal levels in Swansea Bay.

These large tidal fluctuations represent the principal control on coastal inundation, exposure of the foreshore and sediment mobility throughout the bay. The extensive tidal range results in the exposure of broad intertidal sandflats at low water and influences the periodic interaction between marine processes and the upper foreshore.

¹¹UK Hydrographic Office (2025) Admiralty Tide Tables: United Kingdom and Ireland. Taunton: UK Hydrographic Office.

¹²HR Wallingford (2011). Understanding the Physical Processes of the Severn Estuary and Bristol Channel.

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Table 1 – Tidal Levels for Swansea Bay (from 2020 Admiralty Tide Tables)

Tidal Levels	Swansea Bay (Ordnance Datum Newlyn)
Highest Astronomical Tide (HAT)	5.1
Mean High Water Springs (MHWS)	4.5
Mean High Water Neaps (MHWN)	2.20
Mean Sea Level (MSL)	0.10
Mean Low Water Neaps (MLWN)	-1.90
Mean Low Water Springs (MLWS)	-4.1
Lowest Astronomical Tide (LAT)	-5.0

Marine influence at the site varies with tidal state, with interaction increasing during spring tides, elevated water levels and storm events. Whilst the frequency and duration of inundation are lower than across the middle and lower foreshore, the site remains subject to the tidal and wave processes responsible for sediment transport and morphological adjustment within the wider bay.

3.3.2 Tidal Currents

Tidal currents within Swansea Bay are relatively strong and vary spatially across the bay in response to bathymetry and coastal configuration. A study by Collins and Ferentinos⁷ recorded tidal current velocities in excess of 2 m/s within parts of Swansea Bay and concluded that tidal forcing exerts a major control on water movement and sediment transport throughout the bay.

Tidal current velocities vary spatially in response to bathymetry, shoreline configuration and water depth. The strongest currents generally occur offshore and within deeper channels, whilst current velocities within the upper foreshore are reduced due to shallower water depths and shorter periods of tidal inundation.

At a regional scale, investigations undertaken by HR Wallingford¹³ identified strong tidal asymmetry, large tidal prisms and complex circulation patterns as defining characteristics of the Severn Estuary and Bristol Channel system. These processes generate vigorous water movement and exchanges between intertidal, nearshore and offshore environments, demonstrating that Swansea Bay forms part of a much larger hydrodynamic system extending throughout the Bristol Channel.

Hydrodynamic modelling undertaken for the Swansea Bay Tidal Lagoon Environmental Statement⁵ identified tidal forcing as the primary control on circulation patterns within Swansea Bay and demonstrated that suspended sediment can be transported over distances of several kilometres during a tidal cycle. However, sediment located within the

¹³ HR Wallingford (2011). Understanding the Physical Processes of the Severn Estuary and Bristol Channel.

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upper foreshore must first become entrained through tidal inundation or wave action before it can interact with these wider transport pathways.

3.3.3 Wave Climate

In addition to tidal processes, wave action exerts a significant influence on hydrodynamic conditions and sediment transport within Swansea Bay. Wave climate is controlled predominantly by south-westerly winds and meteorological systems propagating through the Bristol Channel⁵.

Although Swansea Bay benefits from a degree of shelter provided by Mumbles Head and the configuration of the coastline, wave action remains an important control on shoreline behaviour. Wave energy influences sediment transport, beach profile adjustment and erosion-deposition cycles within both the intertidal and upper beach environments.

The Swansea Bay Tidal Lagoon Environmental Statement identified wave-driven transport as an increasingly important mechanism within the shallow waters of Swansea Bay. Whilst tidal currents dominate wider circulation patterns, wave action exerts a greater influence on sediment mobility within the intertidal zone and may become the dominant sediment transport mechanism during energetic storm events⁵.

During periods of elevated wave energy, wave run-up can extend marine influence further landward across the upper foreshore and contribute to localised sediment movement within and around the Brockhole Stream outfall channel. These conditions represent the periods during which sediment mobility and morphological adjustment are likely to be greatest.

Data collected through the Cefas WaveNet¹⁴ programme demonstrates that high-energy wave conditions periodically affect the South Wales coastline, particularly during winter months. These events can increase sediment mobilisation and contribute to short-term changes in beach conditions.

3.3.4 Suspended Sediment

Swansea Bay is naturally characterised by elevated levels of suspended sediment due to the regular mobilisation of unconsolidated sediment by tidal currents and wave action. Therefore, suspended sediment concentrations vary considerably in response to tidal state, wave conditions and seasonal storm activity^{5, 6, 8}. The bay therefore represents a naturally turbid coastal environment in which sediment is continually mobilised, transported and redeposited. Increased concentrations commonly occur during spring tides and periods of elevated wave energy, when greater levels of sediment entrainment occur across the extensive intertidal flats. Short-term increases in suspended sediment concentrations arising from localised works may occur within a receiving environment already characterised by significant natural variability¹⁵.

¹⁴ Cefas WaveNet. Wave Monitoring Network Data for the Bristol Channel and South Wales Coast.

¹⁵ Callaway, R., Fairley, I. & Horrillo-Caraballo, J. (2020). *Natural Dynamics Overshadow Anthropogenic Impact on Marine Fauna at an Urbanised Coastal Embayment*. Science of the Total Environment, 716, 137009.

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3.3.5 Summary

Overall, Swansea Bay is a dynamic macro-tidal environment in which hydrodynamic conditions are controlled primarily by tidal forcing, with wave action exerting an important influence on sediment transport and beach morphology, particularly during storm events. The Blackpill frontage forms part of this wider hydrodynamic system but occupies a location close to the upper limit of regular tidal influence.

4. Defining the Types of Change

In accordance with NRW GN019, potential impacts on coastal and physical processes are assessed under three broad categories:

- Sediment disturbance;
- changes to seabed or beach level; and
- blockage effects associated with structures or obstacles.

The proposed Brockhole Stream outfall works have the potential to give rise to each of these forms of change, as described below.

4.1 Sediment Disturbance

4.1.1 Construction Phase

Construction will disturb sediment through excavation and widening of the existing outfall channel, redistribution of approximately 292 m³ of beach sediment, plant movements and installation of geotextile and blockstone protection. These activities will temporarily mobilise predominantly sand and gravel-sized material within and adjacent to the existing channel.

All suitable uncontaminated excavated sediment will be retained within the local Swansea Bay sediment system and redistributed in layers in the vicinity of the works, avoiding permanent loss of sediment from the coastal environment. An estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions (Figure 2). Much of the disturbed material will remain on the upper foreshore unless subsequently mobilised during higher tidal levels or elevated wave conditions.

Where disturbance coincides with tidal inundation, temporary increases in suspended sediment may occur. Given the nature of the material, relatively small volume of sediment involved and intermittent marine influence across the works area, any plume is expected to be short-lived and concentrated around the outfall channel. Sediment settling from suspension may result in minor local deposition, which would remain available for subsequent reworking by tidal, wave and stream processes. Plant movements may also result in temporary rutting, compaction and shallow depressions. These changes will be restricted to the working area and are expected to be progressively reworked following construction.

Overall, construction will result in temporary near-field sediment disturbance associated with excavation, sediment redistribution and installation of the blockstone protection. Any sediment plume generated during construction is expected to be temporary and localised. The disturbed material comprises predominantly sand and gravel-sized

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sediment, which is expected to settle relatively rapidly following cessation of disturbance. Material settling from suspension may result in minor and temporary deposition within or immediately adjacent to the works area. As uncontaminated excavated material will be redistributed locally in accordance with NRW requirements, generally in layers no greater than 300 mm thickness where practicable, changes associated with sediment settlement and redistribution are expected to remain within the near-field. No material far-field changes to beach morphology, sediment availability or sediment transport processes within Swansea Bay are anticipated.

4.1.2 Operational Phase

During operation, the blockstone protection will influence sediment behaviour in the immediate vicinity of the outfall. The primary purpose of the blockstones is to stabilise the outfall channel, maintain a clear flow path and reduce the build-up of sediment that could otherwise lead to partial blockage of the outfall.

The existing outfall channel is subject to natural erosion and sediment deposition, which can alter channel geometry, reduce hydraulic conveyance and increase maintenance requirements. The proposed blockstones are designed to maintain a stable channel form by reducing erosion of the channel margins and limiting the build-up of sediment within the outfall channel. This is expected to improve the long-term stability and performance of the outfall.

The blockstone protection is not expected to result in measurable changes to longshore sediment transport either east or west of the outfall. The proposed protection follows the alignment of the existing outfall channel and occupies a relatively small area within the upper foreshore. Whilst some localised scour, sediment accumulation or changes to flow velocities may occur around individual blockstones and the edge of the protection works, these effects are expected to remain confined to the immediate vicinity of the outfall channel and scour protection footprint. More pronounced localised erosion or accretion may occur following periods of elevated wave energy, storm events or high stream discharge; however, such changes would be consistent with the dynamic nature of the existing foreshore and are not expected to influence wider sediment transport pathways along the Blackpill frontage.

Overall, the operational effect of the blockstone protection is expected to be beneficial in relation to channel stability and hydraulic conveyance. The works will stabilise the outfall channel, reduce sediment accumulation and maintain hydraulic conveyance for Brockhole Stream. Any associated changes to erosion, deposition, scour or flow patterns are expected to remain highly localised, with no measurable influence on wider sediment transport processes, coastal morphology, flood risk or sediment supply within Swansea Bay.

4.2 Changes to Beach Levels

4.2.1 Construction Phase

During construction, localised changes to beach levels will occur as a result of excavation and widening of the existing Brockhole Stream outfall channel and installation of the permanent blockstone scour protection. Approximately 292 m³ of beach sediment will be excavated to create the widened channel and facilitate installation of the outfall and associated protection measures. Excavation will temporarily lower beach levels within the channel footprint; however, uncontaminated excavated material will remain within the Swansea Bay sediment system and be redistributed locally, resulting in no net loss of sediment from the wider coastal environment.

In accordance with NRW advice, excavated sediment will be redistributed within the local beach system in a layer no greater than 300 mm thickness, where practicable. This approach is intended to facilitate recovery of affected benthic

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habitats by avoiding excessive burial of the seabed and maintaining conditions comparable to the surrounding foreshore. Where practicable, redistributed sediment will be placed towards the upper foreshore below MHWS level whilst avoiding deposition on the strand line. This will ensure sediment remains within the local coastal system whilst minimising potential impacts on beach morphology, intertidal habitats and natural shoreline processes.

As uncontaminated excavated sediments will be retained and redistributed locally within the Swansea Bay sediment system, no sediment extraction from the coastal cell will occur. There will be no reduction in sediment supply to adjacent or downdrift coastal areas. Furthermore, redistribution of material has been designed to avoid significant localised mounding that could alter drainage pathways, interrupt overland flow routes or increase local flood risk during tidal inundation.

Permanent changes to beach levels will result from installation of the blockstone protection, geotextile and concrete bedding. The works will create both localised depressions associated with channel excavation and raised features associated with the protected channel invert and margins. These modifications are an intentional element of the scheme, designed to create a more stable and hydraulically efficient outfall channel.

Given the limited footprint of the works and retention of uncontaminated excavated sediment within the local beach system, construction will result in localised changes to beach levels without a net loss of sediment from the wider coastal system. Effects on beach morphology beyond the immediate works area are therefore expected to be limited.

4.2.2 Operational Phase

During operation, the completed works will result in a permanent near-field alteration to beach morphology around the Brockhole Stream outfall. The widened channel and blockstone protection will create a more defined and stable channel form than occurs under baseline conditions.

The existing channel is naturally subject to erosion, sediment deposition and changes in profile and alignment. The blockstone protection will constrain these processes within the works footprint by stabilising the channel invert and margins, reducing channel migration and sediment accumulation, and maintaining a defined flow path through the outfall.

Minor adjustments to erosion and deposition may occur around individual blockstones and along the margins of the protection as the surrounding beach responds to stream discharge, tidal inundation and wave action. However, these changes are expected to remain within the near-field. An estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions, limiting the frequency of interaction between the permanent works and marine processes.

The works will result in permanent changes to beach levels within the channel and scour protection footprint. However, uncontaminated sediment excavated during construction will be retained within the local coastal system and the permanent modification represents a small proportion of the wider Blackpill foreshore. The works will not alter the wider shoreline alignment or reduce beach width and are therefore not expected to result in a material change to coastal flood risk or the functioning of the existing sea wall.

The works are also not expected to contribute to coastal squeeze, as they do not involve reclamation of the intertidal area, seaward extension of the existing coastal defence or creation of a barrier to landward habitat movement.

Overall, the Proposed Works will result in a permanent but localised near-field change to beach levels and channel morphology, principally through stabilisation of the existing Brockhole Stream outfall channel. Local adjustment of

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adjoining sediments is expected to continue around the margins of the protection; however, no material far-field changes to beach levels, shoreline morphology, sediment supply or sediment transport pathways across the wider Blackpill frontage or Swansea Bay are anticipated.

4.3 Blockage effects

4.3.1 Construction Phase

During construction, temporary blockage effects may arise from the presence of plant, temporary works and stockpiled materials within the working area. These features have the potential to locally alter flow pathways associated with Brockhole Stream and may temporarily influence the movement of water and sediment within the existing outfall channel. However, such effects will be short-term in nature and confined to the active construction period.

Construction activities will be undertaken within the existing outfall channel and upper foreshore, with an estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions. Opportunities for temporary construction features to interact with wider marine processes are limited. Any localised changes to flow patterns during construction are therefore expected to remain confined to the immediate vicinity of the works area.

Temporary construction features, including plant, stockpiled materials and working platforms, may locally influence water movement and sediment transport within the outfall channel. However, these features will be removed on completion of the works and any associated effects on hydrodynamic conditions are expected to be short-term, highly localised and fully reversible. Given the limited extent of marine inundation across much of the works area, significant effects on waves, currents or wider coastal processes are not anticipated.

4.3.2 Operational Phase

The operational phase represents the principal potential for blockage effects associated with the permanent outfall and blockstone protection. The Proposed Works comprise a new 1,050mm diameter outfall through the sea wall, with blockstone protection along the channel invert and margins.

Under baseline conditions, the Brockhole Stream channel is subject to erosion, sediment deposition and changes in channel alignment. The proposed blockstone protection will stabilise this existing drainage pathway and maintain a defined flow path between the outfall and Swansea Bay, rather than introducing a new obstruction across the wider foreshore.

The permanent works will result in near-field modification of flow and sediment behaviour within and immediately adjacent to the outfall channel. Local changes in flow velocity may occur around individual blockstones and at the margins of the protection, potentially resulting in minor scour or deposition. However, these changes are expected to remain confined to the outfall channel and immediate works area.

An estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions, limiting interaction with tidal currents and waves. In addition, the structure does not extend across the wider intertidal frontage and will therefore not form a significant barrier to alongshore sediment movement or sediment supply to adjacent areas.

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The blockstone protection is intended to reduce sediment accumulation and maintain hydraulic conveyance through the outfall, thereby reducing the potential requirement for future maintenance excavation. Although the works will permanently modify local flow and sediment behaviour, no material far-field effects on tidal circulation, wave propagation, shoreline evolution or alongshore sediment transport within the wider Blackpill frontage and Swansea Bay are anticipated.

5. Potential Spatial Extent of Change

5.1 Sediment Disturbance

The potential extent of sediment disturbance was estimated using the screening methodology set out in NRW Evidence Report 624 for small-scale marine and coastal projects². The guidance identifies sediment type, water depth and current speed as the principal controls on the distance that disturbed sediment may be transported before settling. The Blackpill frontage comprises predominantly sandy sediment identified during the baseline, which is expected to settle relatively rapidly from suspension. A conservative assessment was undertaken assuming a representative inundation depth of 2m over the works area and a peak current velocity of 2m/s, based on published hydrodynamic studies for Swansea Bay⁵. Using the NRW screening approach for medium sand (settling velocity of 0.05 m/s), the indicative transport distance is approximately 80 m.

Table 2 - Inputs Used to Estimate Sediment Disturbance Extent

Parameter	Value	Source
Sediment Type	Medium sand	Site observations and through BGS sediment mapping.
Settling velocity	0.05m/s	NRW Report 624, Table 2.
Water depth	2m	Conservative assumption for inundated upper foreshore conditions.
Peak current speed	2.0m/s	Conservative value based on published Swansea Bay current velocities ⁵ .
Calculated distance	80m	NRW Report 624, Table 2.

This screening extent is considered conservative given the upper foreshore location of the works below MHWS, the intermittent exposure of the site to tidal inundation, and the retention and local redistribution of uncontaminated excavated sediment within the existing beach system. Whilst temporary sediment mobilisation may occur within this screening area during construction, measurable changes in sediment levels or morphology are anticipated to remain substantially more localised and largely confined to the existing outfall channel and adjacent upper foreshore. Although an indicative sediment transport distance of approximately 80m has been identified through application of the NRW

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screening methodology, any discernible erosion, deposition or morphological response is expected to remain concentrated within the immediate vicinity of the channel works.

5.2 Changes to Beach Levels

The Proposed Works will create a widened outfall channel, localised depressions associated with excavation, raised features associated with blockstone channel protection, and a more defined and stable channel geometry. NRW guidance indicates that where beach levels are altered, associated changes to marine and coastal physical processes may extend beyond the area directly modified. However, the scale of any effect is strongly influenced by the dimensions of the feature and its location within the wider coastal system. For identification of the potential maximum extent of bed-level related changes, NRW guidance advises that where bed-level modifications exceed approximately 5% of local water depth, changes to physical processes could theoretically occur over a distance of up to five times the maximum dimension of the modified area. Applying this precautionary approach to the proposed channel modification, which has a maximum dimension of approximately 45 m (the length of the proposed changes from the addition of blockstone but also from excavated sediment) (Figure 4), results in a theoretical maximum screening extent of approximately 225 m from the modified channel footprint.

Table 3 - Calculation of Potential Spatial Extent of Bed-Level Changes

Parameter	Value
Maximum channel width	10m
Maximum channel length	45m
Maximum dimension	45m
NRW screening multiplier	5
Calculated screening extent	225m

This screening extent is considered conservative given the relatively small scale of the proposed channel modification, the upper foreshore location of the works below MHWS, and the existing dynamic nature of the Brockhole Stream outfall environment. Whilst localised changes to beach levels may occur as the beach adjusts to the modified channel geometry and blockstone protection, any associated erosion, accretion or redistribution of sediment is anticipated to remain substantially more localised than the adopted screening extent and concentrated around the engineered channel and adjacent upper foreshore. Localised scour or sediment accumulation may occur following periods of elevated wave energy, storm events or high-water levels; however, these responses are expected to remain confined to the immediate vicinity of the works and are not anticipated to influence wider beach morphology or sediment transport pathways within Swansea Bay. The adopted screening extent therefore represents a precautionary maximum area within which beach-level related changes could theoretically occur, rather than the predicted extent of measurable morphological change.

5.3 Blockage Effects

The proposed outfall and blockstone protection represent small-scale structures within an existing drainage channel. NRW guidance indicates that, for small coastal structures, the maximum potential extent of blockage-related effects may extend to approximately ten times the maximum dimension of the structure, although in most cases measurable effects are expected to be substantially smaller.

The purpose of the blockstone protection is to:

- stabilise the channel invert and margins;
- reduce erosion;
- reduce sediment accumulation; and
- maintain hydraulic conveyance at the outfall.

The proposed outfall and blockstone protection will alter local flow patterns within the immediate vicinity of the channel. Minor localised changes in erosion and deposition may occur around individual blockstones and along the margins of the protected channel. However, the structures are positioned within the upper foreshore above and below MHWS, where marine influence is intermittent and generally less energetic than across the wider intertidal zone. The blockstone protection occupies a relatively small footprint and is aligned with the existing outfall channel, such that it does not represent a substantial new obstruction to sediment transport processes operating along the Blackpill frontage.

Applying the NRW screening methodology, the maximum dimension of the blockstone protection is approximately 25m. A precautionary screening extent of ten times the maximum structure dimension has therefore been adopted, resulting in a theoretical maximum extent of influence of approximately 250m from the structure footprint

Table 4 - Calculation of Potential Spatial Extent of Blockage-Related Changes

Parameter	Value
Maximum blockstone width	10m
Maximum blockstone length	25m
Maximum dimension	25m
NRW screening multiplier	10
Calculated screening extent	250m

This screening extent is considered highly precautionary and represents a theoretical maximum area within which blockage-related changes could occur. In practice, any interruption of sediment transport pathways, localised scour or sediment accumulation is expected to remain confined to the immediate vicinity of the outfall channel and blockstone protection works. Whilst some localised erosion or accretion may occur following storm events or periods of elevated wave energy, these changes are not anticipated to result in measurable alterations to wider sediment transport pathways or beach morphology within Swansea Bay.

5.4 Zone of Influence

Based on the assessment above, the greatest theoretical extent of change is associated with blockage effects which may extend up to approximately 250m from the sea wall. This distance has therefore been adopted as a precautionary overall Zone of Influence for the purposes of identifying sensitive receptors and assessing potential effects in accordance with NRW GN019.

Table 5 - Summary of change type and maximum extent

Change Type	Maximum Extent
Sediment Disturbance	80m
Changes to Beach Levels	225m
Blockage Effects	250m
Overall Zone of Influence	250m



Figure 5 - Total Zone of Influence for Proposed Scheme

6. Sensitivity of the project setting

In accordance with NRW Evidence Report 624, the overall Zone of Influence (ZoI) for the Proposed Works has been defined by the largest of the identified screening extents associated with sediment disturbance, bed-level change and blockage-related effects. The maximum ZoI is therefore considered to extend up to approximately 250m from the works footprint.

A review of environmental receptors within and adjacent to the ZoI has been undertaken to identify features that may be sensitive to changes in marine and coastal physical processes. Potentially sensitive receptors include:

- Designated nature conservation sites.
- Intertidal habitats and associated ecological features.
- Water Framework Directive (WFD) waterbodies.
- Bathing waters.
- Existing coastal defences and infrastructure.
- The wider Blackpill foreshore and associated sediment transport pathways.

The works are located within an existing outfall channel and disturbed upper foreshore environment around MHWS. The area is already subject to periodic erosion, deposition and channel adjustment associated with the interaction of tidal processes, wave action and freshwater discharge. The Proposed Works do not extend into subtidal habitats and do not involve the removal of sediment from the wider Swansea Bay sediment system.

A WFD Assessment was completed prior to the preparation of this coastal processes assessment as part of the Marine Licence application process. The assessment considered the potential implications of the Proposed Works for relevant WFD objectives and supporting hydromorphological conditions of Swansea Bay Coastal water body. Accordingly, WFD considerations have already been assessed separately and have informed the conclusions of this coastal processes appraisal.

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Figure 6 - Sensitivity of project setting

6.1 Blackpill Site of Special Scientific Interest (SSSI)

The Proposed Works are located within the Blackpill SSSI. The SSSI is 467.4 ha in size and is designated for its importance as an overwintering and migratory bird site, with the ecological value of the designation closely linked to the availability and condition of intertidal habitats and the natural coastal processes that maintain them¹⁶.

Significant effects on the physical processes supporting the Blackpill SSSI are not anticipated. Intertidal habitat outside the ZoI will remain unaffected by the Proposed Works and will continue to be available for use by qualifying birds. More widely, intertidal areas along the adjacent coastline will remain available for feeding and roosting throughout the construction period. The principal potential impact on the SSSI would arise during the construction phase through temporary disturbance to overwintering and migratory birds using the adjacent foreshore. However, works will be undertaken outside the sensitive overwintering bird period through the implementation of a seasonal timing restriction.

¹⁶ Countryside Council for Wales (1984) Blackpill Site of Special Scientific Interest Citation. Available at: [BLACKPILL, SWANSEA SSSI](#)

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With these measures in place, disturbance effects are expected to be temporary, localised and unlikely to affect the integrity of the habitats supporting the qualifying bird interests of the SSSI.

Sensitivity: High

Magnitude of Change: Low

Potential Effect: Low (not significant)

6.2 Swansea Bay West Shellfish Water Protected Area

The Proposed Works are located within the Swansea Bay West Shellfish Water Protected Area. Shellfish waters are sensitive to changes in water quality and physical processes that may influence suspended sediment concentrations and sediment deposition patterns.

Construction activities will be undertaken during low tide periods and predominantly within dry working conditions. Furthermore, the majority of the works footprint is located outside the area routinely inundated during normal tidal conditions. Uncontaminated sediment excavated during the works will remain within the local beach system and be redistributed locally, thereby minimising the potential for sediment loss into the wider marine environment.

The principal potential impact would arise during the construction phase through temporary increases in suspended sediment concentrations and localised sediment redistribution. Under a worst-case scenario, Zol is estimated to extend up to 250m from the Proposed Works. Any changes in suspended sediment concentrations or sediment deposition are therefore expected to be short-term and spatially limited, with effects principally confined to the immediate vicinity of the outfall and within the identified Zol. Given the upper foreshore location of the works, the predominantly dry working conditions, and the limited spatial extent over which sediment disturbance could occur, effects on the wider physical processes supporting the Swansea Bay West Shellfish Water Protected Area are not anticipated to be significant.

Sensitivity: High

Magnitude of Change: Low

Potential Effect: Low (not significant)

6.3 Swansea Bay Bathing Water

The Proposed Works are also located within the Swansea Bay Bathing Water. Bathing waters can be sensitive to activities that result in substantial changes to water quality or sediment mobilisation. The works will be undertaken predominantly in dry conditions within the upper foreshore. An estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions and any disturbed sediment will remain within the local beach system. As a result, the opportunity for works-related sediment to interact with the wider bathing water is limited.

The principal potential impact would arise during the construction phase through temporary increases in suspended sediment concentrations and associated turbidity. Under a worst-case scenario, the Zol is estimated to extend up to 250m from the Proposed Works. Any sediment disturbance is therefore expected to be short-term and spatially limited to the vicinity of the works and within the identified Zol. Swansea Bay forms part of the wider Bristol Channel and Severn Estuary system, which is characterised by naturally high levels of suspended sediment and turbidity. Against this naturally turbid background, and given the upper foreshore location of the works, predominantly dry working conditions and limited extent of sediment mobilisation anticipated, any temporary increase in turbidity associated with

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the Proposed Works is expected to be small in the context of natural variability. Significant effects on the physical processes or water quality characteristics supporting the Swansea Bay Bathing Water designation are therefore not anticipated.

Sensitivity: High

Magnitude of Change: Low

Potential Effect: Low (not significant)

6.4 Swansea Bay Coastal Water body

The Swansea Bay Coastal Water body comprises a large and dynamic coastal environment characterised by extensive intertidal and shallow subtidal habitats influenced by tidal currents, wave action and natural sediment transport processes. Intertidal habitats extend across Swansea Bay, including within the Proposed Works area. Habitats within the Zol comprise predominantly lower-sensitivity intertidal sediments, including sand, mixed sediment, gravel and cobble habitats, which are naturally subject to regular erosion, deposition and sediment reworking.

Higher-sensitivity habitats, including mussel beds, are located outside the Zol and are therefore not anticipated to be affected by sediment disturbance, temporary increases in suspended sediment concentrations or localised changes in coastal processes arising from the Proposed Works.

The Swansea Bay Coastal Water body is sensitive to activities that may influence sediment transport, seabed morphology and hydrodynamic processes. The principal potential impact would occur during construction through temporary and localised sediment disturbance associated with excavation and placement of blockstone protection. However, the Proposed Works are confined to a small area of the existing Brockhole Stream outfall on the upper foreshore, with an estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions. Uncontaminated excavated sediment will remain within the local coastal system and be redistributed in the vicinity of the works.

Under a worst-case scenario, the Zol extends up to 250m from the Proposed Works. Any changes to suspended sediment concentrations, sediment transport pathways, beach morphology or local hydrodynamic conditions are therefore expected to be temporary and spatially limited. The proposed blockstone protection is intended to stabilise the existing outfall channel, reduce sediment accumulation and maintain hydraulic conveyance, rather than alter wider coastal processes.

Given the limited extent of the worst-case Zol, the predominance of lower-sensitivity habitats within this area, and the location of higher-sensitivity habitats, including mussel beds, outside the Zol, any effects on coastal processes and associated intertidal habitats are expected to remain localised. The Proposed Works are therefore not anticipated to result in significant effects on the physical processes or habitats of the wider Swansea Bay Coastal Water body.

Sensitivity: Medium

Magnitude of Change: Low

Potential Effect: Low (not significant)

6.5 Existing Coastal Defences and Infrastructure

Existing coastal defences and infrastructure in the vicinity of the Proposed Works are sensitive to changes in local beach levels, sediment transport patterns and coastal erosion processes, as these factors can influence their long-term stability and performance. The Proposed Works are confined to the existing Brockhole Stream outfall channel and comprise the installation of blockstone protection to stabilise the channel and reduce ongoing maintenance requirements associated with sediment accumulation. The works are not intended to modify wider coastal processes or alter sediment supply across the broader foreshore. Any changes to beach morphology, sediment transport pathways or local hydrodynamic conditions are expected to be highly localised to the vicinity of the outfall. Given the small scale and nature of the Proposed Works, these localised changes are not expected to result in far-field changes to sediment transport, beach morphology or coastal processes along the wider frontage. Significant effects on the stability, function or performance of nearby coastal defences and infrastructure are therefore not anticipated.

Sensitivity: Medium

Magnitude of Change: Negligible to Low

Potential Effect: Negligible to Low adverse (not significant)

6.6 Wider Blackpill Foreshore and Sediment Transport Pathways

The wider Blackpill foreshore forms part of a dynamic coastal system where natural sediment transport processes maintain beach morphology and support intertidal habitats. Sediment transport pathways are sensitive to interventions that interrupt sediment movement or substantially alter coastal hydrodynamics across a wider area. However, the Proposed Works are limited to a small section of the existing outfall channel on the upper foreshore and do not introduce structures of a scale likely to influence sediment transport beyond the Zol. Uncontaminated excavated sediment will be retained within the local coastal system and redistributed in the vicinity of the works, thereby maintaining sediment continuity.

Under a worst-case scenario, the Zol extends up to 250m from the Proposed Works. Any changes to sediment movement, beach levels or local hydrodynamic conditions are expected to be confined within this area and to remain highly localised. Given the limited scale of the Proposed Works and the retention of uncontaminated excavated sediment within the local coastal system, these changes are not anticipated to result in far-field effects on sediment transport or beach morphology across the wider Blackpill foreshore or Swansea Bay.

6.6.1 Socio-economic pathways

Potential socio-economic effects could arise indirectly where changes to coastal processes affect the use or function of the Blackpill frontage, including recreational use, access, coastal infrastructure or the performance of the existing sea wall and drainage infrastructure.

The Proposed Works will result in localised near-field changes to beach morphology, sediment movement and flow conditions around the Brockhole Stream outfall. However, the assessment has identified no material far-field changes to shoreline morphology, sediment transport, tidal circulation or wave conditions. There is no identified physical-process pathway through which the works would materially affect the wider use or function of the Blackpill frontage.

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The Proposed Works also form part of the wider Flood Alleviation Scheme (FAS), which is being undertaken to provide socio-economic benefit through improved management of flood risk. The outfall works support this wider objective by maintaining an effective discharge pathway for Brockhole Stream. This wider benefit does not alter the assessment of coastal process effects but provides important context for the purpose and function of the works.

Overall, no material far-field coastal-process changes capable of giving rise to adverse socio-economic effects are anticipated.

Sensitivity: Medium

Magnitude of Change: Negligible to Low

Potential Effect: Negligible to Low adverse (not significant)

6.7 Overall Sensitivity of the Project Setting

The identified sensitive receptors comprise Blackpill SSSI, Swansea Bay West Shellfish Water Protected Area, Swansea Bay Bathing Water, the Swansea Bay Coastal Water body, existing coastal defences and infrastructure, and the wider Blackpill foreshore and associated sediment transport pathways. These receptors are sensitive to changes in sediment transport, beach morphology, hydrodynamic processes and water quality, although the degree of sensitivity varies according to receptor type and location.

The Proposed Works are confined to the existing Brockhole Stream outfall channel on the upper foreshore, with an estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions. The works are designed to stabilise the existing channel and maintain hydraulic conveyance rather than alter wider coastal processes. Uncontaminated excavated sediment will remain within the local coastal system and be redistributed in the vicinity of the works.

The assessment identifies temporary near-field sediment disturbance and changes to beach levels during construction, together with permanent local modification of channel morphology, flow and sediment behaviour associated with the outfall and blockstone protection. Under a worst-case scenario, the Zol extends up to 250m from the Proposed Works. Changes to suspended sediment concentrations, sediment transport, beach morphology and local hydrodynamic conditions are expected to remain spatially limited within this Zol. These localised changes are not anticipated to result in material far-field changes to sediment transport pathways, beach morphology, tidal circulation, wave conditions or sediment supply across the wider Blackpill frontage or Swansea Bay.

As no material far-field alteration to coastal processes is anticipated, no significant indirect effects on the identified environmental receptors, coastal defences or infrastructure are expected. Higher-sensitivity habitats identified outside the Zol would remain beyond the area potentially affected by localised physical-process changes. Similarly, no physical-process pathway has been identified through which the Proposed Works would materially affect the wider use or function of the Blackpill frontage.

Overall, although some receptors are of high sensitivity, the predicted changes are predominantly localised, near-field changes of negligible to low magnitude within a worst-case Zol of up to 250m. These changes are not expected to propagate into the wider coastal system or result in material far-field effects. No significant adverse effects on designated sites, water quality receptors, coastal infrastructure, the wider Blackpill foreshore or the broader Swansea Bay coastal process regime are therefore anticipated.

7. Mitigation Measures

The following mitigation measures have been incorporated into the design and construction methodology to minimise impacts on coastal and physical processes:

- All uncontaminated excavated sediment will be retained within the local Swansea Bay sediment system and redistributed within the vicinity of the works, ensuring there is no net loss of sediment from the coastal environment.
- Sediment redistribution will be undertaken in accordance with NRW Advisory advice. Where practicable, redistributed sediment will be placed in a layer no greater than 300 mm thickness to facilitate recovery of affected benthic habitats and minimise excessive burial of the existing foreshore.
- Where practicable, redistributed sediment will be deposited towards the upper foreshore below MHWS level, whilst avoiding placement on the strand line. This will help maintain natural beach morphology and reduce the potential for impacts on coastal processes and ecological receptors.
- In accordance with NRW Advisory advice, no movement or deposition of sediment will take place during the winter period (September – March), thereby avoiding disturbance to overwintering and roosting waders and preventing alteration of important foraging habitat associated with the Blackpill SSSI.
- Construction activities within the marine licence area will be undertaken during low tide periods and predominantly within dry working conditions to minimise interaction with the coastal water body, which will reduce the potential for sediment mobilisation
- The proposed blockstone protection has been designed to stabilise the channel invert and margins, reduce sediment accumulation around the outfall and maintain hydraulic conveyance. This will reduce the likelihood of future maintenance intervention and associated sediment disturbance.

8. Conclusion

This assessment has been undertaken in accordance with NRW Guidance Note GN019 and NRW Evidence Report 624. The Proposed Works have the potential to result in sediment disturbance, changes to beach levels and blockage effects. However, these changes are expected to be highly localised due to:

- The small scale of the works;
- the location of the scheme within an existing outfall channel;
- an estimated 80% of the works footprint is located outside the area routinely inundated under normal tidal conditions;
- retention and local redistribution of excavated sediment within the Swansea Bay sediment system; and
- the stabilising function of the proposed blockstone protection.

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The precautionary Zol has been assessed as extending up to 250m from the outfall works. Within this area, Blackpill SSSI, Swansea Bay West Shellfish Water Protected Area, Swansea Bay Bathing Water, the Swansea Bay Coastal Water body, existing coastal defences and infrastructure, and the wider Blackpill foreshore and associated sediment transport pathways have been identified as sensitive receptors.

Taking account of the scale of the works, the embedded mitigation measures and the localised nature of predicted physical process changes, significant adverse effects on coastal processes, sediment transport pathways, shoreline morphology or designated receptors are not anticipated. The Proposed Works are expected to provide a long-term beneficial in relation to channel stability, reduction in sediment accumulation and maintenance of hydraulic conveyance at the Brockhole Stream outfall.

Appendix A. Method of Works

The works below MHWS involve the installation of a new 1050mm diameter concrete culvert to improve outflow from Brockhole Stream into Swansea Bay. Activities include site mobilisation, creation of temporary beach access ramps, removal of sediment and widening of the existing outfall channel, excavation for the new culvert alignment, coring through the sea wall, installing the new pipe and manhole interfaces, scour protection, and reinstating the stream channel and surrounding areas.

The works in relation to the outfall below Mean High Water Springs (MHWS) associated with this marine licence application are anticipated to require approximately six months of construction activity. The timing of the works will be subject to the seasonal restrictions identified within the mitigation measures and, where required, construction may therefore be phased across more than one permissible working window.

A.1.1 Site Mobilisation and Compound Establishment

Prior to commencement of construction activities, a temporary site compound will be established above MHWS, located to the south of Mumbles Road as shown on the relevant site compound drawing. The compound will be fenced and gated to ensure site security and will accommodate site welfare facilities, offices, plant storage areas and material stockpiles. A designated, bunded fuel storage and refuelling area will be provided within the compound. All fuel storage, refuelling and maintenance activities will be carried out in accordance with best practice pollution prevention guidance, with spill kits available at all times.

Construction materials, including granular backfill and pipe sections, will be delivered to the site by road, via Mumbles Road, and temporarily stored within the compound. This arrangement ensures that materials are stored above MHWS and only transferred near to the foreshore when required for the works.

A.1.2 Temporary Beach Access and Working Areas

Temporary access ramps to the beach will be achieved via two access ramps constructed from the cycle path down onto the beach on either side of the outfall, as shown on Figure 3. Each ramp will be formed by placing a geotextile layer directly onto the beach surface, overlaid with compacted clean granular stone material to provide a stable and defined access route for plant and equipment.

The ramps will remain in place for the duration of the marine works (approximately six months), enabling controlled movement of excavators and materials between the site compound and the beach. Access routes below MHWS will be clearly delineated, and plant movements will be restricted to these routes to minimise disturbance to beach sediments and adjacent habitats.

A.1.3 Excavation and Management of Beach and Channel Sediment

The existing outfall channel below MHWS will be widened and deepened by means of controlled excavation undertaken using a tracked excavator operating from the beach. Prior to the commencement of these activities, a temporary bypass channel or an over-pumped outfall extension will be installed to divert flows around the excavation and discharge flows further down the bay. This will ensure that plant operates within predominately dry working conditions. Excavation will be carried out using an excavator on the beach and will be in short, sequential sections,

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progressing in a seaward direction, in order to maintain stability of channel banks and to avoid excessive disturbance of beach material.

Sediment, sand and gravel removed during excavation are anticipated to be non-contaminated. This material will be temporarily stockpiled within the working area and subsequently redistributed within the vicinity of the works, thereby retaining sediment within the local coastal system. If any contaminated sediment is encountered during the works, it will be removed from site and disposed of at an appropriately licensed waste facility. Silt control measures, such as silt fencing, settlement tanks or silt bags, will be deployed as required to limit sediment mobilisation and prevent release into the wider marine environment.

A.1.4 Cutting through the existing sea wall

Cutting through the existing sea wall will be undertaken during suitable low-tide periods to allow safe working access and to minimise environmental risk. Prior to cutting, a geotextile or impermeable membrane will be placed on the beach surface at the base of the wall to capture debris and prevent concrete fragments from entering the marine environment. Concrete cutting will be carried out using disc cutters in controlled stages to prevent uncontrolled breakout. A small cut will be made both vertically and horizontally. This will be broken out with an excavator-mounted breaker to break out the required size to accommodate the 1050mm pipe. All slurry, cutting water and concrete arisings will be fully contained on the protected working surface and collected for removal from site. At no point will cutting residues or debris be permitted to enter the tidally influenced area.

A.1.5 Installation of culvert through the sea wall

Once the opening through the sea wall has been formed, the culvert outfall will be lifted into position using an excavator fitted with certified lifting equipment. The pipe will be aligned and temporarily supported before localised backfilling is carried out to provide initial stability.

Formwork will then be installed around the opening and in-situ concrete will be placed to reinstate the sea wall around the pipe. Geotextile and containment measures will remain in place throughout concreting works to prevent washout or pollution. All concreting activities will be completed within low-tide windows, and no concrete, wash water or slurry will be permitted to enter the marine environment. The concrete to be used will have special anti-washout additives for use in a marine environment. All concrete poured will be sealed within the timber formwork and falsework.

A.1.6 Scour Protection and Channel Reinstatement

Following culvert installation, the outfall channel below MHWS will be reinstated to the design profile. All sand material will be redistributed around the beach. A geotextile separation layer will be placed within the scour protection footprint to limit settlement and to prevent washout of underlying material. 89 Blockstone units measuring approximately 1m x 1m x 1m and 124 blockstone units measuring approximately 0.5m x 0.5m x 0.5m will then be installed using an excavator on the beach with a grab attachment to aid placement. The blockstone to the invert will provide long-term scour and erosion protection at the outfall. Blockstone to the sides will be used to form the new channel sides. The blockstone used will be bedded on a layer of concrete to ensure stability over the design life of the scheme. These works will be undertaken at low tide and working in the dry.

To provide even more certainty of working in the dry the contractor will use the material excavated from the channel to create a bund around the working area and above the MHWS level.

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Channel bed and bank levels will be trimmed to achieve a stable tie-in with the culvert outlet and the widened channel. All works will be completed within low-tide windows to ensure environmental protection and safe working conditions.

A.1.7 Removal of Temporary Works and Demobilisation

On completion of the works below MHWS, all temporary access ramps, geotextiles, and other temporary works will be removed. The beach will be reinstated to its pre-construction condition as far as reasonably practicable, and all plant and materials will be removed from the working area.