

# CARDIGAN TIDAL FLOOD RISK MANAGEMENT SCHEME

## Green Infrastructure Statement

Client's project no. CE0587

BUKL project no. 4021883



Prepared for:

Natural Resources Wales

March 2026

Revision P03



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## Details of document preparation and issue:

Through development of the project, changes to the green Infrastructure Statement can occur. It is therefore important to maintain document control and record the different versions.

Version no.	Prepared	Checked	Reviewed	Approved	Issue date	Issue status
P01	H Goodrick	D Johnson	A Burwood	A Humphreys	16/01/2026	S3
P02	H Goodrick	D Johnson	A Burwood	A Humphreys	26/03/2026	S3
P03	H Goodrick	D Johnson	A Burwood	L McCarthy	30/03/2026	S3

BUKL project no. 4021883                      Client's reference no. CE0587

File name:                      4021883-BUK-ZZ-00-RP-EN-00006

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# Green Infrastructure Statement – Cardigan Tidal Flood Risk Management Scheme

## 1.0 Introduction

This document demonstrates the positive multi-functional outcomes that are being delivered as part of this project. The stepwise approach has been applied at all stages of project development to avoid, minimise and mitigate impacts to the environment. In this context the environment is considered in its widest sense, but the statement also draws out specifically the net benefit for biodiversity (NBB) and ecosystem resilience.

This report has been produced for the Cardigan Tidal Flood Risk Management Scheme (TFRMS), hereafter referred to as the 'Scheme'. The Scheme Area is located towards the centre of Cardigan town, Ceredigion, in west Wales (Figure 1-1). The main Scheme Area (excluding remote, temporary construction compounds) is positioned along the right bank (northern bank) of the River Teifi (Afon Teifi), upstream of Cardigan Bridge.

Two remote temporary construction compounds are proposed: one east of the roundabout that forms the A487/A484 junction, and one in the Pentood Industrial Estate on the south side of the Afon Teifi (Figure 1-1). The areas to be used at both locations comprise existing hard standing with existing road access, and will be retained as such after the Scheme has been completed, and so are not considered further in this document.

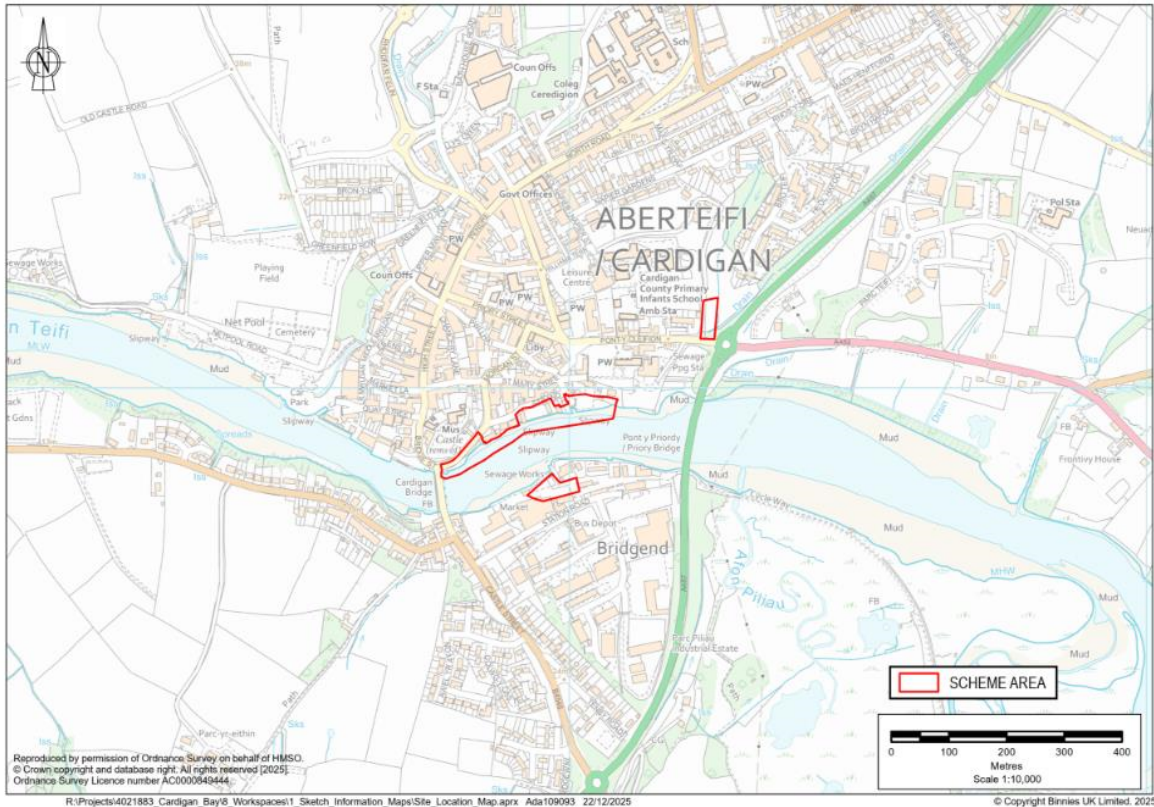


Figure 1-1: Scheme Area Location Plan

The Scheme is required to reduce the risk of tidal flooding to the town and community of Cardigan, which has historically been subject to flood events.

The Scheme is described in the Environmental Statement (Binnies UK Ltd, 2026a) and illustrated on the Environmental Masterplan in Appendix A. The Environmental Masterplan shows the Scheme design, highlighting environmental and green infrastructure design, and illustrating the multiple benefits the Scheme will provide.

In summary, the Scheme comprises the following elements:

- Construction of a flood defence wall and engineered riverbank along the right (northern) bank of the Afon Teifi. The flood defence wall will be clad in natural slate with a pre-cast concrete coping, and top of wall height will range from 1.1m to 2.0m high above adjacent dry side ground level. The flood defence wall will vary between sheet pile and reinforced concrete core. The existing riverside wall from the Bathroom Centre to Gloster Row car park will be removed to ground level and buried behind the new flood defence wall.
- The engineered riverbank will be constructed using a granular fill, and covered in stone-filled nets (rock rolls), with the crest and upper slope covered with a growing medium and seeded with a salt-tolerant estuarine mix.
- A small section of existing flood wall which juts out into the river by Cardigan Bridge will be retained on the wet side of the new flood defence wall; the retained 'plateau'

on top of the existing wall will be sown and planted with the same salt-tolerant estuarine mix as the upper slope and crest of the engineered riverbank.

- On the dry side of the flood defence wall along Strand between Cardigan Bridge and the Bathroom Centre, a public amenity space will be created with a widened pavement, ornamental planting, street trees and seating.
- Two existing slipways next to Cardigan Bay Active and the west end of Gloster Row car park will be closed permanently, replaced with a new 'up-and-over' canoe and kayak access ramp with flood gate provided through the flood defence at the Old Foundry site. This canoe and kayak access ramp will be for the use of the Sea Scouts and other permitted organisations.
- The flood defence wall will be set back from the river at Gloster Row car park, to allow space for mitigatory intertidal habitat to be created. There will be no engineered riverbank created in front of Gloster Row car park; instead an existing upper gabion wall will be removed and ground levels lowered so the area can be regularly flooded by the tide. Some of the existing car parking spaces would be lost as a result of the set-back design.

The following Scheme documents are also relevant to this Green Infrastructure Statement:

- Environmental Constraints and Opportunities Record (ECOR) (Revision P03, Binnies UK Ltd, 2024)
- Preliminary Ecological Appraisal Update (Revision P02, Binnies UK Ltd, 2025)
- Design and Access Statement (Binnies, 2026b)
- Area 1 Landscape General Arrangement (4021883-BUK-ZZ-00-DR-L-01002).

In order to further the multiple benefits that the Scheme will provide, NRW intend to undertake the following off-site enhancements in addition to the Scheme. It should be noted that whilst the intent is to deliver each of these enhancements, delivery will be subject to obtaining the necessary landowner agreement.

- Hafod wen unimproved grassland: The Teifi Estuary Woodlands and Marshes Site of Special Scientific Interest (SSSI) covers an area of 144.5ha. Hafod Wen is a 1.7ha area of unimproved pasture which forms part of the designated site, situated at the edge of the plateau immediately above the Teifi gorge woods. Over recent years the unimproved pasture has become undermanaged, resulting in willow and scrub heavily encroaching the meadow. NRW intend to restore the grassland by selectively cutting back encroaching scrub, coppicing blackthorn hedgerows, and installing new stock proof fencing.
- New Pergola at Netpool Park: A pergola once stood within the park, but was removed in 2025 when it fell into disrepair. NRW intend to build a new pergola, in partnership with Ceredigion County Council.
- Prince Charles Quay tree planting: Five trees were previously planted at Prince Charles Quay, but have failed. NRW intend to plant five new trees as replacements.

## 2.0 Baseline

### 2.1 Green Infrastructure Assessment & Strategic Context

#### Biodiversity

Ceredigion County Council Green Infrastructure Assessment (GIA) (WSP, 2020) notes that by far the largest broad habitat type found within Cardigan (including a 2km buffer zone) is grassland, which covers 1,919ha (approximately two thirds of the land area), followed by woodland which covers 275ha and urban at 211ha. Much of the grassland is improved, which provides less biodiversity benefit than semi-improved grassland. Other smaller areas of habitats include coastal, farmland, open water, amenity grassland, swamp, rocks and waste, tall herb and fern, and hedgerows. Although not covering the majority of Cardigan's land area, Cardigan does have large areas of swamp, open water, coastal water, rocks and waste and farmland when compared to the other major towns in Ceredigion. Some of these habitats form priority habitats: all of the swamp and open water, most of the coastal water habitats, some woodland (i.e. broadleaved semi-natural woodland), and a small proportion of the rocks and waste habitat (i.e. inland cliff and scree) and the grassland habitat (i.e. the acid grassland). The GIA notes that these ecological assets are largely located within the 2km buffer zone around Cardigan rather than within the urban area, and that these assets are moderately well connected as habitat networks via stepping stones and linear corridors. Within the urban area there are some stepping stone habitats, but a lack of linear corridors.

Tree Cover in Wales' Towns and Cities (NRW, 2016a) notes that towns in Ceredigion have an urban tree canopy cover of 15.7%, and Cardigan town of 15.5%. Both are slightly below the Welsh national average of 16.3%, which itself has decreased from 17.0% recorded in 2009. Canopy cover in Ceredigion and Cardigan are both also noted as having decreased; county canopy cover fell by 1.5% between 2009-2013, and 0.8ha of woodland appeared to have been lost in Cardigan between 2011-2014. The report also notes that urban canopy cover is linked to its surrounding landscape character; it is often lower than average in coastal towns compared to urban valley environments, although several Cardigan Bay and Pembrokeshire towns have canopy cover above the national average.

Town Tree Cover in Ceredigion (NRW, 2016b) shows that tree canopy cover is even lower within individual wards in the town centre, with the Teifi ward (within which the Scheme Area lies) at 3.74% cover, Rhyd-y-Fuwch ward at 11.64% cover, and Mwdlan ward at 6.65% cover.

There are four statutory designated sites for nature conservation within 2km of the Scheme Area: Afon Teifi Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) within the Scheme Area and Teifi Estuary Woodlands & Marshes SSSI and Coedmor National Nature Reserve (NNR) 1.1km and 1.5km respectively south-east of the Scheme Area (hydrologically linked upstream). Reasons for designation include a range of riverside habitats and species as described in the Preliminary Ecological Appraisal Update, including but not limited to invertebrate populations, butterfly species,

otter, breeding and wintering bird communities, saltmarsh and mudflats. The Afon Teifi is a valuable green infrastructure asset, which Cardigan benefits from. The designation of the river as well as the nearby coastline as a SAC highlights the importance of the river and coastal habitat for nature conservation.

No sites have officially been designated as Sites of Importance for Nature Conservation (SINCs) in Ceredigion. However, there are areas that Ceredigion County Council (CCC) considers as meeting SINC criteria and that can provide stepping stone habitat, but that are currently unprotected. The GIA notes that for the Cardigan area including the 2km buffer zone, areas meeting SINC criteria make up the majority of the area's GI assets, with a total of 573 ha.

Priority Ecological Networks (PENs) in the terrestrial environment show areas of connectivity between Protected Sites. They provide a framework to inform the location of actions to build functional resilient ecological networks based on Wales' most important places for biodiversity. Typical actions would be habitat improvement, restoration, or creation, located within the boundaries of a PEN, or situated at its margins. PENs are identified for woodland to the south and east of Cardigan, extending for approximately 5km from the town. There are localised scattered grassland PENs, the closest of which to the Scheme Area is within Teifi marshes, and there is a fen PEN along the Afon Teifi as it passes through and upstream of Cardigan, which includes much of the land within the Scheme Area. A marine PEN is identified along the coastline and up the Afon Teifi past the Scheme Area.

Resilient Ecological Networks (RENs) show habitat corridors through which species can move and exist at three levels: core, local and focal networks. RENs for woodland cover much of the land to the south east of Cardigan, as well as scattered coverage in all other directions. There are small areas of woodland local network scattered within Cardigan town, the closest of which to the Scheme Area is within the castle grounds. Grassland RENs are also scattered around Cardigan to the south and east, and to a lesser extent the north and west, with the closest to the Scheme Area being on the east side of Priory Bridge, on both banks of the river. Fen RENs correspond to the Fen PENs, being identified along the Afon Teifi and its banks as it passes through and upstream of Cardigan, and within Teifi marshes.

## Health and wellbeing of the local community

Cardigan is within the 10-50% most deprived areas in Wales according to the Welsh Index of Multiple Deprivation (WIMD) 2025, with the Cardigan Teifi ward within the most 10% deprived and the Cardigan Rhyd-y-Fuwch ward in the 20-30% most deprived. The level of deprivation decreases outside of the urban area. The Cardigan Teifi ward in which the Scheme lies is ranked in the 10% most deprived for income, employment, community safety and physical environment; the 20% most deprived for health and housing; and 30% most deprived for education and access to services.

Green space provision in Cardigan correlates with the WIMD. The Cardigan Teifi ward, with the highest levels of deprivation, is also the ward with the poorest access to green space.

Green infrastructure is linked to physical wellbeing through providing space for physical activity, and to mental wellbeing through the perceptual qualities of green infrastructure assets. Cardigan has a high level of deprivation when compared to the other major towns within Ceredigion (WSP, 2020) and the GIA recommends that Cardigan would benefit from accessible greenspace to address issues of poor physical and mental health, as well as connecting green spaces.

The amount of green space available for households in Ceredigion is relatively low, with only 55% of households in proximity to accessible green space compared to 77% nationally (ECOR, Binnies UK Ltd, 2024,). Ceredigion has a slightly lower rate of mental health conditions than Wales overall, and a lower percentage of people with self-declared disabilities than in Wales overall, but 19.9% of adults in Ceredigion have a GP-recorded mental health condition and 17.8% have a self-declared disability. Overall, this data suggests that identifying opportunities to encourage physical activity, and to improve or enable access for people with disabilities, would be beneficial.

Cardigan benefits from the Wales Coast Path allowing access to the coast, and, including its 2km buffer, contains 9km of active travel routes, 7km of cycle routes, 10km of coastal path and 32km of PRow (WSP, 2020). National Cycle Network Route 82 runs along a section of the Afon Teifi at Cardigan on the southern landward bank, before heading southwest towards Fishguard, and connects Cardigan to Teifi Marshes wildlife centre for cyclists and pedestrians along a disused railway line.

Cardigan also benefits from 40ha of sports grounds, 6ha of playing fields and 9ha of village green. Whilst this is a comparatively high proportion of sports grounds, it is a low quantity of playing fields per population compared to other major towns in Ceredigion. When compared to other major towns in Ceredigion, Cardigan is noted as having a high proportion of coastal paths and active travel routes, but poor provision of accessible greenspace, and a lack of connectivity between greenspaces. The GIA notes that Cardigan has 5-10% coverage of accessible green infrastructure provision (including all publicly open spaces).

The Cardigan Place Plan (Ceredigion County Council, 2024) notes that travel and connectivity is an issue within Cardigan, with bus services declining and 27.8% of households not owning a car/van, and public consultation indicating a lack of parking availability within the town. An opportunity for enhanced environments for walking and relaxing is noted.

Ceredigion County Council has produced Active Travel Network Maps (ATNMs) to inform proposals to improve walking and cycling within the county, and which includes aspirational Future Routes (Ceredigion County Council, 2022).

## Amenity and sense of place

A higher percentage of people in Ceredigion feel there is sense of community compared to the national picture, and a greater percentage of the community also volunteer, indicating that a sense of community is important (ECOR, Binnies UK Ltd, 2024).

English is widely spoken as a main language in Cardigan; however, the Welsh language is also in use, in both spoken and written form. A relatively high percentage of Ceredigion residents can speak, read and write Welsh (38.8%); and 53% of the population of

Cardigan identifies as Welsh only, compared to 47% in Ceredigion and 55% in Wales nationally (Ceredigion County Council, 2024). Cardigan Town Council has a Welsh language policy, requiring that signs and services be produced in Welsh and English. More directional signage throughout the town is noted as an opportunity for enhancement in the Place Plan.

The documents reviewed to understand the Strategic Context for the Scheme were consistent in identifying that amenity and sense of place along the riverside within Cardigan, and particularly along Strand, could be improved.

Cardigan Regeneration Strategy (Rural Office, 2023) seeks to raise awareness of the importance of the river in shaping the history and culture of the town, and of the Ceredigion coastline. The strategy encourages a ribbon of interconnected improvements and key project sites through Cardigan town. One of the key project sites targeted is described as Strand and encompasses the riverside area on the northern bank between Prince Charles Quay and the Priory bridge, connected westwards to Quay Street through Prince Charles Quay, and north and south along High Street and Castle Street. The vision for the space is a series of community-based spaces and local business opportunities connected by improved pedestrian and cycle networks, boat launching areas, boardwalks and civic spaces around the riverbank. The Regeneration Strategy notes the opportunity for a flood defence scheme implemented by NRW to include some public realm enhancements along the river frontage, but also the need for regeneration to be in line with flood defence proposals. Regeneration in this area is considered to have the potential to bring social value through job creation, and increase in footfall, dwell time, visitor numbers and land value.

The Cardigan Place Plan (Ceredigion County Council, 2024) identifies two main areas within the town requiring development to improve their sense of place: the riverside from the Strand to Netpool, and the Mwdan, and identifies Strand as a 'key focal point for development'. The Place Plan suggests enhancements on the themes of placemaking and the environment.

Ceredigion: A Strategy for Greening 6 Towns (Ceredigion County Council, 2025) notes a key opportunity for Cardigan's green-blue infrastructure network is the Cardigan Otter Walk, which would start from the otter statue next to Cardigan Bridge, passing around the town and along both banks of the river. On the route of the otter walk three amenity spaces are identified: Prince Charles Quay, Quay Street car park and the currently disused open space along the riverside by Strand. It describes opportunities to improve the Strand open space, including reopening it as part of NRW's planned flood defences, planting wildflowers or a kitchen garden, tree planting along the northern edge to block views and noise of traffic, creation of a quiet rest stop, access down to the river and educational boards.

Cardigan Conservation Area Appraisal (CAA) (Griffiths Heritage Consultancy, 2025) also notes that there are opportunities for environmental enhancement within the town, and that consultation has been undertaken with the local community to identify sites for environmental improvement. One such site identified was the riverside site next to the bathroom centre on Strand, although the CAA does not provide information on the nature of the potential enhancements.

The historic environment plays an important role in determining sense of place within Cardigan, with the town containing three Scheduled Monuments: Cardigan Castle, Cardigan Bridge and Cardigan Town Walls. Cardigan Castle is also a Historic Park and Garden. There are also several Listed Buildings within Cardigan, and a Conservation Area.

The CAA describes important views from the Registered Historic Park and Garden at Cardigan Castle towards the south and south-east, as well as views across Cardigan Bridge, along the Afon Teifi, of the Castle and of certain other historic buildings as being important in maintaining sense of place. The retention of small public open spaces plays a key role in retaining these views.

## Pollution, Air Quality & Noise

The Ceredigion Green Infrastructure Assessment (WSP, 2020) highlights Cardigan as one of two towns in Ceredigion with the poorest air quality, with the average annual emissions of particulate matter in Cardigan being over 10.5 µg/m<sup>3</sup> (though this is under the World Health Organisation recommended limits of 20µg/m<sup>3</sup>). Ceredigion: A Strategy for Greening 6 Towns also notes that Cardigan has the poorest air quality when compared to Ceredigion's other main towns, citing traffic and industry as the main contributors, and notes the potential to improve air quality through tree planting and promotion of walking and cycling.

Trees may provide several ecosystem services, including cleaning air and water, storing carbon and reducing water runoff. Ceredigion's Green Infrastructure Assessment identifies Cardigan as having an opportunity for more tree planting; and A Strategy for Greening 6 Towns states that whilst tree cover is reasonable in some parts of Cardigan, there is a comparative lack of trees along the river frontage and in the town centre. The GIA (WSP, 2020) also notes that the tree cover is patchy and does not form connected networks. Cardigan, which is a comparatively densely populated town in Ceredigion, would benefit from tree and hedge planting to absorb particulate air pollutants.

The Wales Noise and Air Quality Viewer (Extrium) shows noise pollution from roads, railways and industry. Noise pollution of over 75db is identified along the A487, from the B4546 junction south of Cardigan as far as Tan-y-groes to the north east. The average noise level reduces to 55db at the eastern extent of the Scheme Area (i.e. the closest part of the Scheme Area to the A487). Noise pollution from the A487 extends further over Priors Bridge, in the open river corridor where there are no buildings to block or screen noise. No industry or other road noise is identified in Cardigan or the surrounding area, and there is no railway.

The Afon Teifi is affected by pollution from upstream, particularly phosphates, and litter is a problem within the watercourse (Cardigan Place Plan). In WFD terms, the Overall Status of the Teifi Estuary and Headwaters is classed as Moderate. In the wider area, the Afon Teifi SAC has been found to be in unfavourable condition with the primary negative effect being pollution impacts on water quality (discharge from wastewater treatment, forestry and agricultural run-off, and legacy metal mining pollution) (Preliminary Ecological Appraisal Update, Binnies UK Ltd, 2025).

## Climate change resilience

The State of Natural Resources Report 2025 (NRW) describes that Wales will experience hotter and drier summers, warmer, wetter winters, and more frequent and extreme weather events, which will impact all ecosystems in Wales. The UK Climate Change Risk Assessment 2017 Evidence Report Summary for Wales notes that Cardigan has a medium social vulnerability to high temperatures in future (Committee on Climate Change 2017).

The Climate Change Adaption Report (Nature Positive, 2025) has projected the following changes in temperature and precipitation in the Cardigan area: maximum summer air temperature rising by +2.34°C by 2069 and +4.91°C by 2099; spring precipitation decreasing by 22.83% by 2069 and 37.06% by 2099; and autumn precipitation increasing by 12.90% by 2069 and 27.52% by 2099. Sea level is expected to rise by 0.8m by 2100, and 1.04m by 2120.

The recent *INVEST: Investigating the vulnerability of estuaries to climate change* (Environment Agency, 2026) undertook a modelling exercise on 52 English estuaries to characterise water quality impacts of projected climate change. The study found that:

*“...estuarine responses to climate change are likely to be highly variable and driven by different combinations of drivers, with some estuaries being noticeably more vulnerable than others in terms of their water quality.....The heterogeneity in drivers and changes of estuarine water quality demonstrates a need to consider processes in estuaries at a local level when planning adaption measures.”* (Environment Agency, 2026).

Estimating the effects of sea level rise on tidal range and therefore intertidal habitat is impacted by more factors than sea level rise alone. Understanding the resulting effects on intertidal habitats extent from these impacts is however more generally predictable and this is assumed reduced intertidal areas for the purposes of climate change impacts on estuaries. This is because sea level rise is expected to reduce the range of intertidal volume of the estuary, experienced under neap and spring tidal conditions (Environment Agency 2026). Whilst this study focused on English rivers (no equivalent large scale modelling is available for Welsh rivers) the study findings are likely broadly applicable to Welsh rivers.

The Cardigan Place Plan highlights a need for improving the existing river defence along Strand. Tidal flooding is currently a constraint in the town, as is surface water flooding, both of which would be exacerbated by extreme weather events and sea level rise linked to climate change. A Strategy for Greening 6 Towns also states flood risk as being one of the key issues facing Cardigan and notes that creating defences whilst maintaining the river as an attractive asset poses a challenge. Other key challenges noted in A Strategy for Greening 6 Towns are equal access and connectivity to greenspace, making walking and cycling more accessible and attractive, increasing tree cover and connectivity between trees and woodland, and improving air quality through increasing tree cover and promotion of walking and cycling.

Ceredigion has an aim to become a carbon neutral county by 2030. Tree planting as well as reduction in carbon emissions would help towards this goal, although the scale of tree planting the Scheme could deliver is unlikely to have a significant impact on carbon neutrality.

## 2.2 Project Baseline & how it relates to the GIA

The baseline condition of the Scheme Area is as described in the Preliminary Ecological Appraisal update (Binnies UK Ltd, 2025) and Environmental Statement (Binnies UK Ltd, in progress). Key information only relating to green infrastructure within the Scheme Area and surrounding area, along with how it relates to the wider strategic context as described in Section 2.1 of this report, is summarised below.

### Biodiversity

Habitats within the Scheme Area comprise dense scrub, broadleaved scattered trees, running water, intertidal mudflats, saltmarsh, amenity grassland and poor semi-improved grassland. Intertidal habitats comprising seaweeds and lichen on littoral rock are present immediately downstream of Cardigan Bridge on both banks of the river. There are also hardstanding and buildings in the Scheme Area.



*Plate 2-1: Saltmarsh and mudflat habitat is exposed at low tide: view looking north west across the Afon Teifi towards Gloster Row car park.*

Intertidal mudflats and saltmarsh have high biodiversity value as a result of supporting large numbers of predatory birds and fish and their associated prey (aquatic and terrestrial invertebrates); provide feeding and resting areas for internationally important populations of migrant and wintering waterfowl; and are important nursery areas for flatfish. They also provide foraging areas and commuting corridors for otter. As a result of this, certain biotopes of these habitat types (Intertidal mudflats and saltmarsh) are defined as Habitats of Principal Importance (HPI) under Section 7 of the Environment (Wales) Act (2016). These habitats are maintained by a constant fluctuation of tide level and limited

disturbance. Current intertidal areas within the Scheme Area (with the exception of slipways) are backed by vertical walls associated with existing structures; sea level rise without the Scheme would, in a future baseline scenario, see the total loss of intertidal habitats as there is no realistic expectation for the removal of present-day levels of coastal protection in Cardigan.

Trees, scrub and grassland within the Scheme Area were noted as being in poor to moderate condition and not being prevalent over a wide area. Extensive areas of hard surfacing present in the Scheme Area provide limited biodiversity value. There could be potential as part of the Scheme to enhance the condition of these habitats, and to increase their extent. Large areas of hard surfacing could be replaced with planting to improve biodiversity value. The Green Infrastructure Assessment noted prevalence of low diversity amenity grassland within the Cardigan area; management activities for amenity grassland within the Scheme Area could be changed to instead promote semi-improved grassland.

Habitat connectivity could also be improved through the Scheme in line with the Ceredigion Green Infrastructure Assessment, which noted a lack of linear corridors and stepping stone habitats within the urban area. A PEN and REN for fen habitat is identified within the Afon Teifi and along its banks as it passes through the Scheme Area, and enhancement of fen habitat here could therefore contribute to the enhancement of functional ecological networks. Furthermore, creation of small areas of trees within the Scheme Area could provide stepping stones of woodland habitat to connect existing woodland blocks as part of a woodland REN, in particular to the local woodland REN within the castle grounds immediately adjacent to the Scheme Area. Creation or enhancement of linear habitat corridors, which the GIA notes a particular lack of, should be prioritised. It should be noted however that the Scheme Area is not large, and some of it comprises buildings which will not be removed to facilitate habitat creation; although the Scheme could contribute to habitat creation goals, it would be on a small scale.

Otter have been identified as using the area of the foreshore in Cardigan as a regular commuting corridor and likely foraging area. Without the Scheme, this activity would likely be affected in the long term by coastal squeeze as a result of climate change. The reduction in foreshore habitat as a result of raised sea levels could result in reduced activity in the area overall or increased risk of traffic collision as otter are forced onto the shoreside of the defence at high tide.

Bat roosts are known to be in close proximity to the Scheme Area, including a long-term roost for greater horseshoe bats within Cardigan Castle, and for brown long eared and soprano pipistrelle bats within the former hospital building approximately 80m northeast of the Scheme Area. The Preliminary Ecological Appraisal Update (Binnies UK Ltd, 2025) highlights that whilst limited survey information is available for how the bats enter and leave the castle grounds, it is suspected that the bats follow the main driveway from the house (located to the east of the main house) using the hedgerows and walls, before crossing Strand and joining the Afon Teifi before moving out into the wider countryside. A previous change of the street lighting on Strand to white LED may have had a detrimental influence on bat summer activity levels, likely to be exacerbated by the felling of a large mature ash tree on the castle walls required due to safety concerns. There may be potential as part of the Scheme to improve the habitat for commuting bats by working with Ceredigion County Council to change the existing white LED lamps to a lamp with less blue light component, and by planting screening trees to reduce light spill onto the Afon

Teifi and to reduce the habitat “gap” (via a canopy connection) to the mature trees in the Castle Grounds.

Planting as part of the Scheme could also provide improved habitat for a variety of species in terms of providing foraging material. Fruiting shrubs could act as food source for birds and invertebrates, and flowering plants that can act as source of nectar for insects.

## Health and wellbeing of the local community

The Ceredigion Green Infrastructure Assessment notes that Cardigan would benefit from accessible greenspace to address issues of poor physical and mental health, and from connections which promote access to greenspaces. The Scheme Area includes a small area of publicly accessible land at Gloster Row, which could potentially be enhanced as part of the Scheme, although it is not large enough to provide a playing field or recreational ground. As the perceptual qualities of spaces are linked to mental wellbeing, the Scheme could provide an improvement to mental wellbeing by providing high quality design with planting to boost mood. Greenspace provision can enhance both health and wellbeing and.

The Scheme Area also includes two slipways providing access for boat users onto the Afon Teifi: one next to Cardigan Bay Active (Sea Scouts slipway) and the other at Gloster Row car park (Gloster Row / St Mary’s Street slipway). The Sea Scouts slipway is for use by the Sea Scouts and other permitted organisations only, the Gloster Row / St Mary’s Street slipway is publicly accessible. Figure 2-1 shows the relationship of the Scheme Area to existing public rights of way, national cycle network and slipways.

The Scheme Area includes a short length of roadside footpath along Strand between Cardigan Bridge and the bathroom centre, along which there is a bus stop. Strand is noted as an existing walking route in Ceredigion County Council’s ATNM, at the western end traversing Cardigan Bridge and connecting to the High Street via Bridge Street; and at the eastern end moving north from the bathroom centre up Carrier’s Lane to Priory Street. This route is also noted as a future cycling route in the ATNM.

Providing high quality design and improving the experience of pedestrians along this footpath could encourage walking. The bus stop has no seating or shelter, and is alongside a busy road with associated noise and pollution. Public consultation undertaken by NRW in 2025 in relation to the Scheme showed that several members of the public were unaware of the location of the bus stop. The Scheme may be able to contribute to an improvement in bus use by enhancing the experience of using the bus stop. Increased use may in turn help halt the decline of bus services noted in the Cardigan Place Plan. The Place Plan also identifies a need for a pedestrian route to connect the adjacent Prince Charles Quay with the Quay Street car park, which Strand could form an extension of. As the pavement here is of limited width, and the Scheme Area does not extend into the highway, it is not practical for the Scheme to provide either on or off road improvements for cyclists.

It should be noted however that there is only a small section of footpath and one bus stop in the Scheme Area, and whilst the Scheme can contribute to improving active travel and public transport use, it would provide greater benefit if undertaken in combination with other interventions within the town.

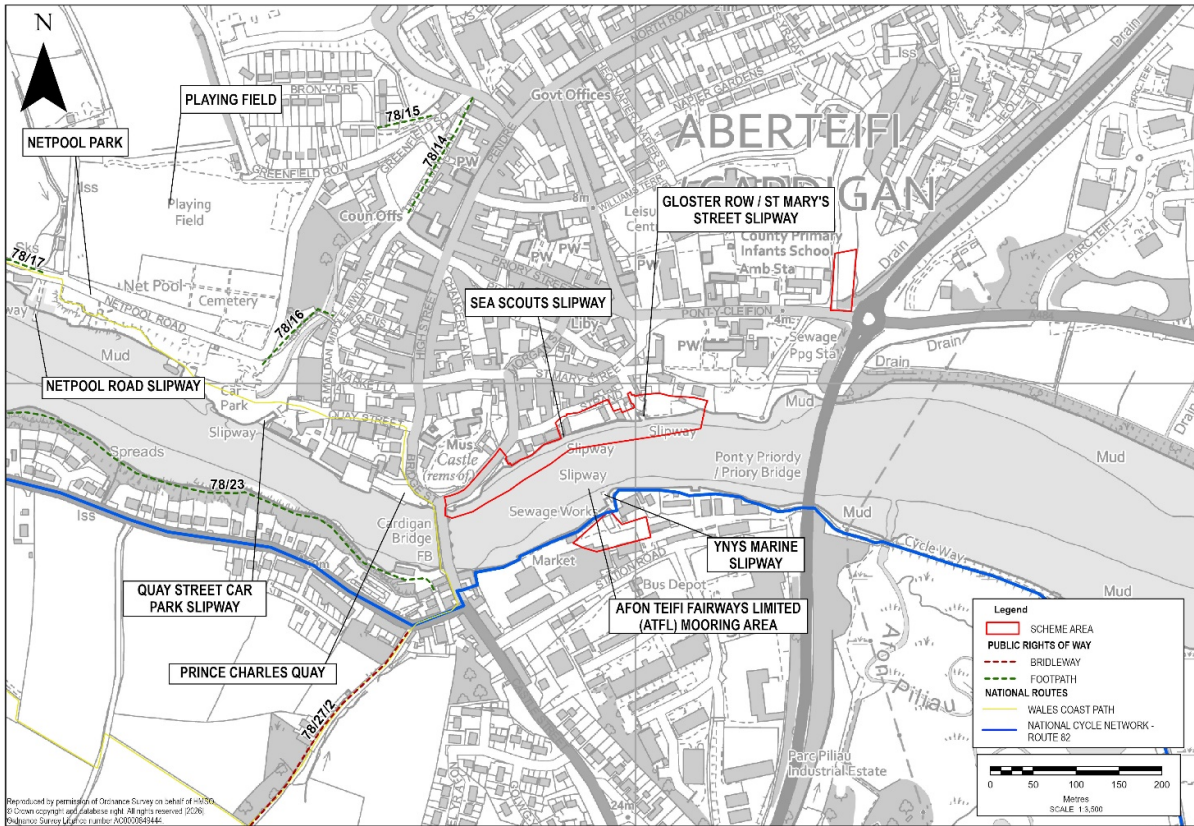


Figure 2-1: Access connections to the Scheme Area.

## Amenity and sense of place

The Scheme Area includes a section of riverside along Strand, which is noted within several published sources as a space which should be enhanced. At present, the space between the Afon Teifi and Strand footpath comprises a lower plateau from which public access is restricted by a wall alongside the footpath. The plateau surface is paved, with metal railings along the riverside edge, and has become overgrown.

There is an opportunity to improve the area of Strand between Cardigan Bridge and the bathroom centre as part of the Scheme, incorporating some of the interventions suggested within the Cardigan Regeneration Strategy, Place Plan and A Strategy for Greening 6 Towns. Some interventions suggested are likely to be impractical however in combination with the planned flood defences which form the primary purpose of the Scheme, as flood defences by nature can provide a visual and/or access barrier. For example, implementation of stepped access down to the riverside and introduction of floating walkways are suggested as potential amenity enhancements to improve connectivity with the river in A Strategy for Greening 6 Towns; however, implementation of the flood defence would restrict access to such features.

Public consultation undertaken by NRW in June 2025 regarding public realm enhancements along Strand indicated that residents were in favour of a widened pavement and addition of trees and planting to create a 'greener' environment, as well as

use of natural stone including slate to tie the area into its surroundings. Several respondents who are parents or carers noted that the existing pavement is too narrow

The Scheduled Monuments of Cardigan Castle (also a Registered Park and Garden and Grade I Listed Building) and Cardigan Bridge are immediately adjacent the Scheme Area to the west, and Cardigan Town Walls Scheduled Monument is 150m to the east of the Scheme Area. There are also several Listed Buildings in proximity to the Scheme. Important views from Cardigan Castle look over the Scheme Area, and consultation with Ceredigion County Council and Cadw has resulted in a request that the defensive part of the castle remains visible in views towards it from the south. The Scheme can contribute to the sense of place offered by historic assets by retaining visibility of these assets, including retaining small open spaces which play a key role in retaining these views according to the Conservation Area Appraisal. The Scheme can also consider use of materials and styles that will complement the existing historical character. This is most applicable to the western end of the Scheme adjacent to Strand, where the majority of the nearby heritage assets are found.



*Plate 2-2: View west along Strand from the bus stop showing the riverside wall, railings and overgrown inaccessible space in between. Cardigan Bridge Scheduled Monument can be seen in the background.*



*Plate 2-3: View from the south bank, looking towards the defensive part of Cardigan Castle alongside Strand in the foreground and Cardigan Bridge on the left.*

## **Pollution, Air Quality & Noise**

As noted in the GIA (WSP, 2020) and A Strategy for Greening 6 Towns, Cardigan has poor air quality when compared to other towns in Ceredigion, and both documents recommend potential measures to address this. The GIA recommends hedgerows as screening from pollutants in towns, and tree planting to remove air pollutants; and A Strategy for Greening 6 Towns notes the potential to improve air quality through tree planting and promotion of walking and cycling. The strategy describes interventions to green the town centre, by introducing planted rain garden borders to streets which would deliver multiple benefits including slowing the flow of water and providing wildlife corridors; street planters with integrated seating along wider roads; and planting to separate seating spaces from traffic.

The Scheme Area includes small areas of open space where it may be possible to plant trees to help reduce pollution, either through screening or absorption, in line with the GIA Recommendations. There are constraints to planting trees within the Scheme Area which must be considered, including proximity to the flood defences and underground services which tree roots can potentially damage, maintaining easements for operational access to services, and blocking of historically important views in order to maintain sense of place.

The greatest need for screening from pollution within the Scheme Area is along Strand, where it is adjacent to a busy road, and within an area of the town noted as being particularly lacking in tree cover. Tree planting, as well as other interventions suggested in A Strategy for Greening 6 Towns, such as streetside planting and setting pedestrians back from the road, could potentially be incorporated in this localised area.

The second small area of open space is at the eastern end of the Scheme Area at Gloster Row car park. Here, there is no adjacent highway to provide screening from and only

occasional traffic noise will be created by cars entering and leaving the car park, although planting that could absorb pollutants may still provide a benefit in terms of reducing pollution in the Cardigan area overall.

Tree and other planting can offer a range of multifunctional benefits, not only reducing pollution but enhancing habitat extent and connectivity, and improving physical and mental health through encouraging exercise and boosting mood. However, the Scheme Area is not large and whilst there is scope for improvement, it would be on a small scale, and localised.



*Plate 2-4: Gloster Row car park and surrounding open space.*

## Climate change resilience

Cardigan has a history of tidal flooding occurring due to the presence of the Afon Teifi. Major flood events have occurred between 2000–2020. In 2007, flood depths exceeded 0.5m, and further tidal floods occurred in 2008, 2012, and twice in 2014. One 2014 event was caused by surface water during low tide, while the most severe tidal flood on 3 January 2014 inundated 29 properties on St Mary’s Street. The lower quayside, including the Strand and Cattle Market, also flooded in 2007.

Low-lying residential and commercial properties, particularly on Strand, are highly vulnerable, with thresholds below 3.1m Above Ordnance Datum (AOD) and exposure to annual tidal flooding. The projected 0.5% Annual Exceedance Probability (AEP) (1 in 200) tidal level, including 100 years of climate change, is 4.75m AOD, which is well above current ground levels and therefore poses a risk of significant flooding.

As noted, fluvial and tidal flood events could become more frequent and severe in the future as a result of climate change; the Scheme has the opportunity to prevent flooding, including as a result of climate change. Community concern regarding flood risk is high, with around 45% of Ceredigion residents worried about flooding to their local area (2021 Populations and Communities report (Binnies, 2021)), and National Survey for Wales data from 2022-2023 indicates that the proportion of residents worried about flooding to their local area has not changed significantly. Flood prevention that the Scheme could provide could also alleviate anxiety, improving wellbeing.

As noted in the Biodiversity section, coastal squeeze as a result of climate change related sea level rise could harm important intertidal habitats of saltmarsh and mudflats which exist in the Scheme Area, reducing their extent. These existing habitats are not resilient against climate change and the Scheme may have the opportunity to improve the resilience of these habitats. Saltmarsh and mudflat habitats also contribute to local sense of place, with their flat, sweeping nature a defining characteristic of the river corridor, with which the town of Cardigan has a strong association. This character could also be affected by sea level rise as a result of climate change.

### 3.0 Implementation of the Stepwise Approach

The stepwise approach is described in Planning Policy Wales 12, Section 6.4.15 and applies a hierarchical approach to maintain and enhance biodiversity and ecosystem functioning. It comprises: step 1: avoid damage to biodiversity; step 2: minimise damage; step 3: mitigate/restore where damage is unavoidable; step 4: compensate on site or off site where sufficient mitigation/restoration cannot be achieved. Opportunities to provide enhancements should be identified throughout the design process, and are described in Section 4.0 of this document. Step 5 is to develop a long-term management plan (see Section 5.0) to deliver the measures under steps 1 to 4 and the agreed enhancement measures. Step 6 is to refuse planning permission if PPW12 requirements cannot be met.

The principles of the stepwise approach have been embedded into the design process for the Scheme and have been applied to all green infrastructure. The steps taken within the design process following selection of the preferred option are summarised below. Further detail is provided in the Environmental Statement. A summary of the long list to short list and selection of the preferred option is set out in Chapter 3 (Alternatives and Design Evolution) of the Environmental Statement (Binnies UK Ltd, in progress) and is not repeated here.

#### Biodiversity

During the design development process, consideration was given to the alignment of the flood defence wall in order to limit intertidal habitat loss along the north bank of the Afon Teifi. As described in section 2.2, intertidal mudflats and saltmarsh are defined as HPI and are of national importance. The flood defence wall alignment could not avoid the river channel completely without demolition of some properties along the north bank of the river, therefore some loss of intertidal habitat will occur. This is mitigated for by setting back the alignment of the flood defence wall by Gloster Row car park, where no buildings would require demolition. The area of intertidal habitat created by Gloster Row car park is sufficient to mitigate for that lost in other areas of the Scheme. The flood defence wall at

Gloster Row has been set back as far as possible without impacting an adjacent DCWW rising main.

Area 4 will be landscaped to include a natural channel, pools and raised bank all within the expected natural tidal range in order to create semi natural niches for the establishment of intertidal habitats, similar to a natural backwater or cove. Once created the habitats will be left to naturally recolonise with plants and the river allowed to naturally dump and regrade the silt with tidal action. The design proposed will allow conditions for natural deposition of river silt immediately and it is likely that local native estuarine species and habitats will have colonised the area within five years. This area is connected to the natural saltmarsh habitats to the east of the site via the retained area of semi-natural saltmarsh on gabions as a result it is highly likely that these species will be among the early colonisers of areas where the tidal inundation conditions are suitable. The habitats within Area 4 when established will likely be a mixture of intertidal muds, saltmarsh and reedbed. The design will allow the habitats to change and adjust over time driven by the tidal processes of the Afon Teifi, with ratio of mud to vegetated habitats likely changing in response to larger flood events.

During the design development process, consideration was given to the future baseline scenario where rising sea levels against the existing vertical walls result in the loss of intertidal habitats. The Scheme design includes an engineered riverbank in front of the sheet pile wall to provide multiple benefits, both provide structural support to the flood wall (reducing size of the required piles) and provide an opportunity for habitats to adapt to rising tidal levels. The proposed engineered riverbank structure (Areas 1-3) is designed with opportunities for accretion of sediment and establishing of habitat niches within the constructed form, using materials that can support those objectives. The habitats that can then develop on the structure would provide a greater functionality (access by faunal species, variation in habitats, opportunities for fish, invertebrate and prey species) than would otherwise be maintained by existing wall structures. The habitats present on the structure will represent the estuarine habitat context, with riparian and brackish-tolerant planting growing down from above mean high water springs to create a mixed habitat in this upper zone. This interface area is also considered suitable for saltmarsh species to take hold, as has occurred on gabion basket structures within the Scheme Area baseline, along with sheltered suitable areas within the wider Scheme design such as slipways and Area 4. This design contributes to providing Net Benefit for Biodiversity, as set out in Section 4, and is shown on the illustration in Plate 3-1.



*Plate 3-1: Illustration showing the proposed engineered riverbank with intertidal habitat development, with the flood wall visible along the crest.*

In line with Planning Policy Wales 12, where trees are removed to facilitate development, they must be replaced at a ratio of three trees planted for every one tree removed. As part of compensation planting, five trees will be planted within a roadside planting bed along Strand, and a further three small trees will be planted in the raised planting bed by the bathroom centre along Strand. This complies with the need for riverside tree planting as identified within the Green Infrastructure Assessment and A Strategy for Greening 6 Towns. As the trees being planted (hawthorn) are flowering and fruiting varieties which offer increased habitat value compared to those being lost (common lime and laburnum), this is also considered an enhancement. As noted within section 2.2, placement of trees in this location could provide a habitat connection to the trees within the Castle Grounds identified as a local woodland REN, as well as providing screening for bats exiting the Castle along the Castle driveway.

Due to setting back the flood defence wall at Gloster Row car park to provide intertidal habitat compensation, an area of semi-improved grassland will be lost. A further area of semi-improved grassland will be lost from the steep bank between Cardigan Bridge and the Bathroom Centre. The area lost at Gloster Row car park will be minimised through retention of the area of this habitat that remains on the landward side of the wall. Although this landward area will become shaded by the proposed flood defence wall, introduction of shade-tolerant grasses and wildflowers (of species similar to those found at the bases of hedgerows) can be introduced to ensure longevity of the sward's diversity and condition. The loss of both these two areas of semi-natural grassland will be compensated for by seeding the plateau. As more semi-improved grassland will be reinstated than that lost, this is also considered an enhancement.

## **Health and wellbeing of the local community**

In order to set the wall alignment back at Gloster Row car park, a small area of grassland will be partially lost which is currently accessible to the public and known to be incidentally used by dog walkers. The total area of the existing grassland is approximately 300m<sup>2</sup>, and approximately half will be lost due to setting back of the flood wall to facilitate intertidal habitat creation, which will be a loss of both habitat and recreational space. The remaining area will still however be able to provide the function of incidental use by dog walkers.

The Afon Teifi is an important blue infrastructure asset supporting rare habitats, symbolising Cardigan's character and is used for recreation. An 'up-and-over' canoe and kayak access ramp with flood gate from the Old Foundry site will be provided through the proposed flood defence wall as part of the Scheme, maintaining access to the river for the Sea Scouts and other permitted organisations even though the existing Sea Scouts slipway will be closed. The Gloster Row / St Mary's Street slipway, which is publicly accessible, will also be closed but not replaced. It is understood that the public use of this slipway is limited and is not used by emergency services to access the river.

## Amenity and sense of place

Sense of place has been strongly influenced by the river and nationally important heritage assets including Cardigan Castle, Cardigan Bridge, and Town Walls, which the Scheme has sought to retain by use of materials in keeping with the surrounding landscape and heritage assets, and by not blocking views of assets.

Following consultation with Cadw and Ceredigion County Council, blocking of views of the defensive part of the Castle through street tree planting was avoided, and significant views from the Castle maintained, by siting proposed street trees further along Strand towards the bathroom centre.

The Scheme has further minimised the impact on heritage assets and the sense of place created by them by use of slate cladding for the flood defence wall to match the appearance of Cardigan Castle, integrating the defences into their surrounding environment. In line with the Conservation Area Appraisal, alignment of the flood defence wall away from Strand will create a more open space to maximise visibility of these assets. Although the flood defence wall will cause some separation of the town from the river, the impact on sense of place that new features such as walls could introduce has been minimised by use of appropriate materials choice. The holistic nature of the flood defence wall cladding along the length of the Scheme will tie the currently varied built form together, enhancing sense of place. Although some characteristic mudflats will be reduced in size due to construction of the engineered riverbank, the riverbank has been designed to minimise effects on sense of place by incorporating mud and rock habitats similar to those found downstream of Cardigan Bridge, by planting of a locally appropriate grass and flower mix along the riverbank crest and upper slope, and by creation of the new intertidal habitat where the defence is set back by Gloster Row car park.

Planting design minimises separation from the river, by continuity through planting design. Some species from the planting palette used for the riverside plateau and upper riverbank slope are brought into the roadside planting bed, to provide a link with the riverside setting.

## Pollution, Air Quality & Noise

With the exception of the flood gate provision across the new slipway, the Scheme has been designed to operate passively with no mechanised components. Therefore, it will not provide any new sources of pollution, emissions to air or noise. The Scheme will not alter traffic and bus use of Strand, and the change in capacity and layout of Gloster Row car park will not result in any measurable changes on noise and emissions from cars. No mitigation is necessary.

## Climate change resilience

Improving the river defence is the primary purpose of the Scheme, which is designed to provide protection from fluvial and tidal flood events, which could become more frequent and severe in the future as a result of climate change.

The height of the flood defence has been designed to mitigate for the effects of climate change. The Scheme has been designed to a standard of 1 in 200 annual exceedance probability (AEP) with allowance for 100 years of climate change, which is considered to be a conservative level of flood defence. Therefore, the capacity for future upgrades is not considered necessary taking into account the lifespan of the Scheme.

As described in the biodiversity section, the mud and rock habitat of the engineered riverbank and the vegetated upper slope and crest will be resilient to sea level rise and coastal squeeze as a result of climate change, due to the vertical range of these designed habitats. The species mix for the vegetated upper slope and crest has been based on an upper and fringe saltmarsh community, tolerant of a range of climatic conditions and to salt water. Whilst the species composition within the mix may change over time due to climatic conditions, the community as a whole will be resilient and will continue to provide biodiversity and amenity benefits which are resilient to climate change.

## 4.0 Net Benefit for Biodiversity & Wider Environmental Benefits

### 4.1 Net Benefit for Biodiversity

This section describes the enhancement measures to be delivered through the Scheme which will result in a net benefit for biodiversity (NBB) as defined by the DECCA Framework set out in Planning Policy Wales, Implementing the Section 6 Duty (Welsh Government, 2024). The DECCA framework comprises four attributes of ecosystem resilience: Diversity, Extent, Condition and Connectivity (DECC), with these attributes determining the Adaptability of an ecosystem to change. The combination of enhancement in line with the DECCA Framework and implementation of the step-wise approach (section 3) will provide a net benefit for biodiversity.

The baseline habitats within the Scheme Area, the DECC baseline, and mitigation and compensation measures required to address predicted loss and detriment to existing habitats as a result of the works, are described in the Preliminary Ecological Appraisal Update (Binnies UK Ltd, 2025) and Chapter 6 of the Environmental Statement (Binnies UK Ltd, in progress) with key issues relevant to achieving NBB summarised in Section 2.2 of this Green Infrastructure Statement.

The Scheme has identified opportunities to improve the attributes of ecosystem resilience with regards to the existing DECC baseline. For each attribute of ecosystem resilience, several sub-attributes were considered (Table 4-1). If several DECC sub-attributes are

enhanced, then the Scheme can be considered to provide NBB and improve the Adaptability of ecosystems.

**Table 4-1 DECC Sub-attributes**

Environment (Wales) Act 2016 Ecosystem Resilience Aspect	DECC Framework Attribute	Sub-attributes of DECC	Description of sub-attribute
Diversity between and within ecosystems	Diversity	Di1	Diversity within a species, for example genetic variability and lifecycle requirements of a species.
		Di2	Diversity between species, for example the variety of flora and fauna species present within an ecosystem.
		Di3	Diversity within a habitat, for example diversity in structure, age and composition of habitat(s).
		Di4	Diversity between habitats, for example habitat mosaics, which reflect the variability of geodiversity.
The scale of ecosystems	Extent	Ex1	Area of habitat/ecosystem reduced/maintained/enhanced. Enhancement includes restoration and creation.
		Ex2	Area - ha/km <sup>2</sup> impacted by the proposal.
The condition of ecosystems	Condition	Cond1	Negative effects of climate change on biodiversity.
		Cond2	Negative effects of pollution on biodiversity.
		Cond3	Negative effects of land use change/ management on biodiversity.
		Cond4	Negative effects of INNS, pests and disease on biodiversity will be/are reduced.
		Cond5	Negative effects of over-exploitation on biodiversity.
The connections between and within ecosystems	Connectivity	Conn1	Connectivity allowing genetic exchange within species.
		Conn2	Movement of individuals and provision of habitat to meet life-cycle needs including migration, and daily up to multi-generational movement.
		Conn3	Movement and adaptation responses to global change, including climate change.
		Conn4	Connectivity to allow recovery and recolonisation after disturbance.
		Conn5	Ecological processes such as sediment transport or nutrient cycling. E.g. Water level management, Reconnecting rivers to their floodplains.
		Conn6	Prevention of undesired flows to enhance function and recovery of ecosystems such as creating fire breaks, reducing light pollution, preventing the spread of INNS.

## Diversity

The DECC baseline in the “Preliminary Ecological Appraisal Update” identified that the poor semi-improved grassland, amenity grassland and scrub in the Scheme Area lack species and structural diversity, and that the Scheme provides an opportunity for improvements.

The Scheme achieves an enhancement in three of the Diversity sub-attributes:

- *Di3 - Diversity within a habitat.*

The proposed engineered riverbank in Areas 1-3 and the created intertidal habitat within Area 4 incorporate a variety of habitat niche opportunities not present in the current area. Most notably the increased bank slope, bank height and inclusion of rock rolls of the engineered embankment and the varied topography of Area 4 will provide a much wider variation of opportunities for habitat establishment within the tidal range. In the short-term this will lead to more opportunity for colonisation by intertidal saltmarsh as well as other tidal margin habitats. In the longer term the increased bank height and bank slope will improve climate change resilience by providing an improved profile for the movement of estuarine habitats in response to rising sea levels when compared to the existing defence and bank profile.

The Scheme will result in an increase in floral diversity of habitats in the Scheme Area. The use of the estuarine seed mix on the crest and upper 600mm of engineered riverbank and with management to prevent scrub encroachment will result in a more diverse sward compared to habitats that it will replace. It will also be of greater diversity than the amenity grassland areas currently present within the Scheme Area.

- *Di4 - Diversity between habitats.*

The additional landscaped area behind the sea wall at the west end of the Scheme opposite Cardigan Castle (Area 1) will provide a new habitat type (tree planting and ornamental planting) to complement the adjacent estuarine grassland, and will be an enhancement compared to the paved area currently present in the area. Tree and ornamental planting include flowering and fruiting species which will be a nectar and food source for foraging insects and birds.

- *Di2 - Diversity between species*

The proposed engineered riverbank in Areas 1-3 and the created intertidal habitat within Area 4 incorporate a variety of habitat niche opportunities not present in the current area. Most notably the increased bank slope, bank height and inclusion of rock rolls of the engineered riverbank and the varied topography of Area 4 will provide a much wider variation of opportunities for species within the tidal range. This will lead to more opportunity for colonisation by intertidal faunal species such as crab and fish and increasing prey availability for Otter. In the longer term the bank profile of the engineered riverbank will improve climate change resilience by ensuring that the suitable intertidal zone is retained for longer than would be possible with the existing defence layout.

In summary, Diversity sub-attributes Di2, Di3 and Di4 will be enhanced through the scheme. Sub attribute *Di1- Diversity within a species* is maintained at its current level within the Scheme.

## Extent

The DECC baseline identified the Scheme Area as comprising a band of saltmarsh and intertidal mudflats fronting the existing flood wall, with urban habitats including patches of grassland and scrub habitat landwards of the flood defence. The intertidal habitat is restricted to a limited corridor adjacent to the existing river wall with urban development built up to the river wall. Opportunities to increase overall habitat extent are very limited due to the limited Scheme Area, and so the focus for the Scheme in terms of Extent is to maintain the existing area of habitat.

- *Ex1 - Area of habitat/ecosystem.*

The Scheme is considered to maintain the existing extent of the habitats and ecosystems present, although there will be some change in habitat distribution within the Scheme Area. There will be a minor loss in the project area of amenity grassland and semi-improved grassland habitats to the new intertidal habitat on the riverward side of the defence at Gloster Row car park. However, this will be offset by the seeding of the crest and upper 600mm of the new engineered riverbank with an estuarine mix selected to provide a community similar to that found in natural upper and fringe saltmarsh habitats. This is designed to provide a suitable transitional habitat that would be present in a natural estuarine environment.

- *Ex2 Area impacted by the proposal.*

The post construction habitats will comprise:

- New flood wall: 489m<sup>2</sup>
- Landscape planting on dry side of sea wall, Area 1: 131.5m<sup>2</sup>
- Engineered riverbank: littoral mud and rock habitats, estuarine species mix: 2147m<sup>2</sup>
- Intertidal habitat on the riverward side of the defence at Gloster Row car park (littoral mud and rock habitats and saltmarsh): 489m<sup>2</sup>.

In summary, Sub-attributes *Ex1 and Ex2* are maintained at their current level within the Scheme.

## Condition

The DECC baseline identified that that habitat condition is currently limited by species and structural diversity (see Diversity, above) and that habitats are vulnerable due to their urban location, including from litter, human intrusion and pollution impacts on water quality. The existing vertical flood defence wall also does not allow intertidal habitats to adapt to rising sea levels.

The Scheme achieves an enhancement in three Condition sub-attributes.

- *Cond1 - Negative effects of climate change on biodiversity.*

The vegetated top 600mm of the new embankment and the new intertidal habitat on the riverward side of the defence at Gloster Row car park are graded in such a way to provide suitable transitional areas for marginal estuarine habitats as tidal frequency and height increases throughout the lifetime of the Scheme. The current defence is a vertical wall, meaning that once sea levels rise to the point where inundation frequency increases beyond the capacity of marginal habitats they would be lost permanently.

- *Cond2 - Negative effects of pollution on biodiversity.*  
The presence of the flood defence will result in a reduction in flood events when compared to the existing defence. This will result in a minor reduction in uncontrolled pollution event as materials from the urban terrestrial environment are drawn back into the river including road dust (including car exhaust, brake and tyre wear waste) and litter along with receding flood waters. This will reduce pollution pressures on the Afon Teifi SSSI, SAC and the intertidal habitats.
- *Cond3 - Negative effects of land use change/management on biodiversity.*  
During the operational phase the impact of anthropogenic disturbance will be reduced when compared to the existing baseline as a result of the following elements built into the Scheme design; the number of slipways reduced from two to one, and access to habitats in front of the flood defence will be restricted to maintenance access only. This restriction in access will block the existing access to the informal footpaths through the intertidal habitats reducing the disturbance impact from dog walkers and fishermen.

In summary condition Sub-attributes *Cond1*, *Cond2* and *Cond3* are considered to be enhanced as result of the Scheme whilst Sub-attributes *Cond4* and *Cond5* are not changed by the Scheme when compared against existing baseline.

## **Connectivity**

The DECC baseline and section 2.2 of this report identify that connectivity for greater horseshoe bats commuting between their roost in Cardigan Castle and the Afon Teifi, which in turn provides connectivity to the wider environment could be affected by existing light disturbance along Strand. Section 2.2 of this report also notes a potential long-term risk to Otter commuting and foraging activity presented by climate change.

The Scheme achieves an enhancement in two Connectivity sub-attributes.

- *Conn 3 - Movement and adaptation responses to global change, including climate change.*  
The height and profile of the engineered embankment will improve climate change resilience by ensuring the intertidal zone is retained for longer in response to rising sea levels when compared to the existing defence and bank profile. This will ensure that species such as otter will be able to continue to use the foreshore habitat for foraging and commuting for the majority of the life of the new embankment (100 years). Reducing the risk of abandonment of this area of the river and the risk of otters being forced to use the dry side of the defence with the increased risk of traffic collision that would pose.
- *Conn 6 - Prevention of undesired flows... such as ... reducing light pollution.*  
A reduction in light pollution is proposed as an enhancement along Strand in Area 1, by changing the light spectrum of street lighting to have less blue light component, to reduce the light spill to the minimum level whilst maintaining the minimum required for public health and safety. This is subject to detailed lighting design to ensure the change would not compromise highway standards. In addition, proposed tree planting along Strand will provide screening of light spill onto the river from the street lighting on the opposite side of Strand. These proposals have been designed with the concept of improving the connectivity between the river and Cardigan Castle driveway for bats

using the Greater Horseshoe roost present there. However, they will also provide a night-time benefit for other bat species and nocturnal species such as otter using the river at this location.

In summary, the proposed scheme would present an enhancement in connectivity for sub-attributes *Conn3* and *Conn6*. The remaining other Connectivity sub-attributes, *Conn1*, *Conn2*, *Conn4*, *Conn5* are not considered to be changed by the scheme when compared against the existing baseline.

### **Off-site biodiversity enhancements**

As well as biodiversity improvements through the Scheme, NRW intend to undertake off-site biodiversity enhancements at Hafod Wen.

At Hafod Wen, NRW intend to restore an area of unimproved grassland within the Teifi Estuary Woodlands and Marshes Site of SSSI by selectively cutting back encroaching scrub, coppicing blackthorn hedgerows, and installing new stock proof fencing. Over recent years the unimproved pasture has become undermanaged, resulting in willow and scrub heavily encroaching the meadow. The SSSI Citation<sup>1</sup> notes:

*“the site is of exceptional entomological interest and is a prime example of the juxtaposition of mosaics of habitat that are becoming increasingly rare nationally. Twenty-six species of butterfly have been recorded, including strong populations of white letter hairstreak *Strymonidia w-album*, brown hairstreak *Thecla betulae* and holly blue *Celastrina argiolus*. The diversity and abundance of the meadow flora is undoubtedly of great significance to the invertebrates occurring within the adjacent ancient woodland. For instance many woodland moths fly to the meadow to feed, including several scarce species such as the dotted carpet *Alcis jubata*, double kidney *Ipimorpha retusa* and white line snout *Schrankia costaestrigalis*. The hornet robber fly *Asilus crabroniformis*, a species of vulnerable status in Britain, preys upon grasshoppers in the meadows”.*

Selectively cutting back encroaching scrub will create a more open grassland to support the diverse flora which the invertebrates require. Coppicing blackthorn hedgerows will promote re-growth to support the priority species of brown hairstreak. The meadow is currently ungrazed as the boundary fence is in disrepair, which has led to scrub establishing. A new 600m stock-proof boundary fence will be erected to allow the site to be grazed by livestock, which will enable the desired future maintenance to be achieved.

These improvements at Hafod Wen will enhance DECC sub-attributes Di3 (Diversity within a habitat), Cond3 (Negative effects of land use change/ management on biodiversity).

### **Conclusion of overall net benefit**

Based upon the above assessment the Scheme can be considered to have minor overall benefit on three attributes of ecosystem resilience (Diversity, Condition and Connectivity) and therefore improve ecosystem Adaptability and provide a net benefit to biodiversity.

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<sup>1</sup> [https://cdn.cyfoethnaturiol.cymru/648762/SSSI\\_0660\\_Citation\\_EN0016474.pdf](https://cdn.cyfoethnaturiol.cymru/648762/SSSI_0660_Citation_EN0016474.pdf)

Table 4-2 summarises the attributes and sub-attributes enhanced or maintained through the Scheme.

**Table 4-2 DECC Sub-attributes**

DECC Framework Attribute	Sub-attributes of DECC	Overall change
Diversity	Di1	Maintained
	Di2	Enhanced
	Di3	Enhanced
	Di4	Enhanced
Extent	Ex1	Maintained
	Ex2	Maintained
Condition	Cond1	Enhanced
	Cond2	Enhanced
	Cond3	Enhanced
	Cond4	Maintained
	Cond5	Maintained
Connectivity	Conn1	Maintained
	Conn2	Maintained
	Conn3	Enhanced
	Conn4	Maintained
	Conn5	Maintained
	Conn6	Enhanced

## 4.2 Health and wellbeing of the local community (inc. Active Travel)

By providing flood defences, the Scheme provides a benefit to mental health and wellbeing by reducing anxiety related to potential flood risk. This is of particular importance in Cardigan where the WIMD indicates that some areas of Cardigan are among the 10% most deprived areas in Wales, and there is a high proportion of vulnerable groups within the town; as these groups have a lower capacity to adapt to change.

As part of the Scheme, a widened pavement with planting beds and street trees is proposed along Strand, which is currently a predominantly hard surfaced area. Trees and planting are known to have mental health benefits, as well as improving habitat diversity, extent and connectivity, and absorbing pollutants. The widened pavement will improve access, encouraging use and allowing space for pedestrians to be set back from the road, away from traffic, and responds to consultation feedback (NRW, 2025). The open space along Strand has been designed to integrate into its surroundings, with high quality materials such as natural slate paving rather than concrete or tarmac products; as such people's perception of the space will be more positive, which can also boost mood as

noted in section 2.2. The inclusion of these public realm enhancements along Strand will therefore have a positive influence on health and wellbeing of the local community.

As noted in section 2.2, the footpath along Strand between Cardigan Bridge and the bathroom centre is part of an existing walking route within Ceredigion County Council's ATNM, with links to Cardigan Bridge, to the High Street via Bridge Street, and along Carrier's Lane to Priory Street. Enhancement of the footpath along Strand as part of the Scheme could encourage use of this route. A bus stop is located along this footpath, and the Scheme will also improve the experience of people using the bus by providing benches for those waiting for the bus, and by providing an environment of a higher perceptual quality than at present. Benches have arm rests and are designed at two seating heights (470mm and 410mm) to provide comfortable seating to a range of people. As described in section 2.2, enhancement of the bus stop could contribute to an improvement in bus use and help halt the decline of bus services noted in the Place Plan.

NRW also intend to undertake off-site enhancements at Netpool Park and Prince Charles Quay which will provide benefits including improving health and wellbeing of the local community.

Ceredigion: A Strategy for Greening 6 Towns identifies Netpool Park in Cardigan as a community green space where there is opportunity to increase biodiversity and expand the range of community uses. The park is currently used by community groups to hold events and also by the local schools for outdoor learning, including the pilot project Stori Wyllt<sup>2</sup> which holds nature themed workshops with schools within the park. Outdoor learning is a vital component of a modern curriculum that seeks to meet the varied and complex needs of pupils today. A pergola previously stood within the park, but was removed in 2025 when it fell into disrepair. Following the removal of the pergola, there is no shelter within the park, which has been identified as a problem when holding events and outdoor learning activities at the park.

To help expand the range of community use of the park, a new pergola will be built to replace the one that was removed.

At Prince Charles Quay, five trees will be planted to replace five existing trees that have failed. This is in accordance with A Strategy for Greening 6 Towns which identifies the need for greening Cardigan town centre to connect biodiversity, tree cover and improve the experience of moving through and using the town.

### 4.3 Amenity & Sense of Place

Public realm enhancements are proposed along Strand between Cardigan Bridge and the bathroom centre, which is in line with Cardigan Regeneration Strategy, The Cardigan Place Plan, Ceredigion: A Strategy for Greening 6 Towns, and Cardigan Conservation Area Appraisal which all note opportunity for enhancement of this small area. As part of the Scheme, the pavement will be widened through setting back of the flood defence wall and surfaced with slate to connect the area to adjacent open spaces at Prince Charles Quay and the entrance to Cardigan Castle. This will integrate Strand, which is currently a disconnected space in terms of amenity and sense of place, into its surroundings. Setting

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<sup>2</sup> <https://storiwyllt.cymru>

the flood wall back, widening the pavement and addition of trees and planting responds to needs identified through public consultation (NRW, 2025), and to interventions suggested within A Strategy for Greening 6 Towns. An indicative illustration of the Scheme looking west from Strand is shown in plate 4-1.



*Plate 4-1: Illustration of enhancements to Strand including widened pavement, seating and planting.*

If other public realm enhancement is taken forwards in the surrounding area, enhancement of Strand as part of the Scheme could contribute to the ribbon of interconnected improvements noted in the Cardigan Regeneration Strategy, or the Cardigan Otter Walk as noted in Ceredigion: A Strategy for Greening 6 Towns. Enhancement of Strand could provide a catalyst for ongoing enhancement interventions in the surrounding area which could form a connected network of improvements.

As noted in section 2.2, the Conservation Area Appraisal describes important views from Cardigan Castle towards the south and south-east, as well as views of and to other historic buildings, as being important in maintaining sense of place, and that the retention of small public open spaces plays a key role in retaining these views. Setting back of the flood defence wall around the heritage assets of Cardigan Castle and Cardigan Bridge aligns with this need to retain small open spaces to maximise visibility of heritage assets and retain the sense of place that these assets provide. The raised bed and benches within the public realm enhancements along Strand run parallel to the Castle walls, enhancing visibility of the Castle.

As described in Section 3.0, the holistic nature of the flood defence wall cladding along the length of the Scheme will tie the currently varied built form together and the engineered riverbank will incorporate mud and rock habitats similar to those found downstream of Cardigan Bridge as well as a locally appropriate grass and flower mix along the riverbank crest and upper slope.

## 4.4 Pollution, Air Quality & Noise

Planting of street trees along Strand as part of the Scheme, combined with setting pedestrians back from the road by widening the pavement and introducing roadside planting, will move pedestrians away from traffic, a source of pollution, air quality and noise, and planting will help absorb particulate air pollutants. This is particularly important as Cardigan was highlighted in the GIA (WSP, 2020) and A Strategy for Greening 6 Towns describe Cardigan as a the town with poor air quality when compared to Ceredigion's other main towns. Ceredigion: A Strategy for Greening 6 Towns suggests interventions such as street planters with integrated seating along wider roads, and planting to separate seating spaces from traffic, which have been implemented within the Scheme design.

## 4.5 Climate Change resilience

Improved flood resilience from implementation of the flood defence will provide an enhancement within the wider area of Cardigan, a benefit which is likely to be needed with greater frequency in future as climate change leads to greater intensity and frequency of extreme weather events such as storms and heavy rainfall. The proposed flood defence has been designed to allow for an assumed sea level rise due to climate change.

The engineered riverbank (and need for the Scheme) has been developed around providing an adaptable pathway for habitats to avoid the impacts of coastal squeeze in this location. Current intertidal areas within the Scheme Area (with the exception of slipways) are backed by vertical walls associated with existing structures; sea level rise with the Scheme will, in a future baseline scenario, see the total loss of intertidal habitats as there is no realistic expectation for the removal of present-day levels of coastal protection in Cardigan.

The Scheme will result in a greater area of soft landscaping, and a decreased area of hard landscaping, than at present. Proposed trees and planting will absorb and collect rainwater. This will contribute to managing surface water runoff.

A bespoke seed mix has been designed for the upper 600mm of the flood defence embankment to be adaptive to climate change. The mix contains a range of species tolerant of salt, which can survive both dry and seasonally wet conditions, required as the upper embankment will be occasionally inundated. As such, the created habitat is expected to be able to adapt to changing environmental conditions such as increased wet or dry periods or sea level rise. The composition of the species mix may change, with different species within it becoming more dominant as climatic conditions alter, but the habitat as a whole will prevail.

## 4.6 Carbon Storage

A carbon calculator has been produced for the Scheme. The highest carbon cost in terms of materials is expected from the sheet piles, concrete infill and rock rolls used to form the flood defence, with smaller carbon costs from granular fill and aggregates, stone facing, and copings. A sum of approximately 1,082 CO<sub>2</sub>e (t) is expected to arise from materials used within the Scheme.

Further carbon will be produced from transportation of materials to site, fuel for construction plant, as well as a minor carbon cost for maintenance and repairs of the flood defence asset.

Decisions made during design development which have reduced the embedded carbon of the Scheme are:

- Aligning the flood defence wall as close to the existing river wall reduces the need for significant quantities of material to fill the gap between the existing river wall and the proposed flood defence wall.
- Reducing the length of sheet piles by supporting shorter piles with a berm (embankment).
- Incorporating the engineered granular fill, used to construct the temporary construction haul route on the river side, into the permanent berm (embankment).
- By designing the flood defence to a design standard of 1 in 200 years annual exceedance probability (AEP) with allowance for climate change with a design life of 100 years reduces the need for future upgrades or rebuilding.
- Trees and planting proposed as part of the Scheme will absorb some carbon, which will help in a small way towards Ceredigion County Council's goal to become a carbon neutral county by 2030.

## 5.0 Long Term Management Plan

This section describes how green infrastructure and NBB created as part of the Scheme can be achieved into the long term. Implementation of the Scheme, including its green infrastructure, will be undertaken by NRW. NRW will continue to provide establishment maintenance activities for all soft landscaped areas of the Scheme for five years following completion of the Scheme via a maintenance contract, after which the responsibility for maintaining these areas will be handed over to the respective landowners or managers.

The table below lists the soft landscaped areas within the Scheme and their land owner or manager.

Scheme Area	Land owner / manager
Intertidal habitat created on the riverward side of the defence	Managed by NRW as part of the flood defence asset
Reinstated grassed area at Gloster Row car park	Owned and managed by Ceredigion County Council
Ornamental planting and street trees along Strand	Owned and managed by Ceredigion County Council
Prince Charles Quay tree planting	Owned and managed by Ceredigion County Council
Hafod Wen unimproved grassland	Private landowner

Maintenance and management activities for each of the soft landscaped areas, and how they will differ from the present situation, are described below.

### **Intertidal habitat**

As the intertidal habitat created lies on their flood defence asset, NRW will retain responsibility for its maintenance, which will be undertaken by their operations and maintenance team and funded through NRW's Flood and Coastal Risk Management Maintenance budget. Intertidal habitat refers to the set-back area on the riverward side of the flood defence wall at Gloster Row car park, the rock rolls on the engineered riverbank, and the seeded areas on the engineered riverbank and the riverside plateau near Cardigan Bridge.

Maintenance activities for all intertidal habitat areas will involve annual inspections and removal of any invasive or undesirable species (such as buddleia, which could undermine the integrity of the flood defence).

The seeded area at the upper extent of the engineered riverbank and riverside plateau will be strimmed 2-3 times a year up until a time when saline inundation and natural intertidal habitat transition is such that strimming will no longer be required.

Strimming and removal of invasive or undesirable species will enable the diversity of the sward to be maintained over the long term.

It is expected that following initial establishment of vegetation in the set-back area behind Gloster Row car park, that this habitat will be predominantly self-sufficient, and not require strimming, although annual inspections and removal of any invasive or undesirable species will still be undertaken.

### **Grass and wildflower area at Gloster Row car park**

An existing semi-improved grassland area with wildflowers at Gloster Row car park will be reinstated following construction of the flood defences, with a shade tolerant grass and wildflower mix as the new flood defence wall will partially shade the area. This area is currently maintained by Ceredigion County Council as a wildflower area. Maintenance activities post-Scheme will comprise cutting the area twice per year (once after flowering, then again after 6-8 weeks) with all arisings removed. Arisings from the first cut should be left for between 2-7 days to shed seed before removal. This will be carried out by Ceredigion County Council and funded through the same mechanism as the present situation.

Occasional cutting following flowering will enable the diversity of the sward to be maintained over the long term.

### **Ornamental planting and street trees along Strand**

The proposed planting and street trees along Strand will be a new addition to a currently hard landscaped site and will require maintenance after they have established, to be carried out by Ceredigion County Council. The ornamental planting comprises the following areas:

- A roadside planting bed alongside the highway to separate pedestrians from road traffic. Species selected are up to 0.6m high to maintain visibility for pedestrians, and the species mix changes gradually along the bed to tie in with species in the riverside planting on the plateau (at the west end near Cardigan Bridge) and raised planting bed (at the east end).
- Five street trees are to be planted within the roadside planting bed, at the eastern end so as not to block views of the defensive part of the Castle. Fastigate trees (trees with a narrow, column-like shape) have been selected so as not to overhang the highway or bus stop, and so as not to cause a tunnelling or secluded feel to the footway.
- A raised planting bed near the bathroom centre where the wall height is up to 1.8m high above pavement level. This bed is planted with shade tolerant species due to the flood defence wall shading the bed, and contains taller growing species to filter the visual mass of the flood defence wall. Some species tie in with roadside planting bed for continuity. Benches for seating is incorporated into the low wall which retains the raised bed.

Maintenance activities will include pruning, weeding, fertilising, topping up mulch and removal of litter and dead plant material. Visits will be undertaken as necessary for pruning, weeding and litter removal in ornamental planting beds, and annual visits undertaken to replace dead plant material, supply fertiliser and top up mulch.

Although trees along Strand have been designed not to overhang the highway, they will be inspected annually to ensure they are not overhanging the carriageway or bus stop to a height of 4m, and pruned if required.

### **Prince Charles Quay tree planting**

As an off-site habitat enhancement, NRW plan to plant five trees at Prince Charles Quay to replace five existing trees which have failed.

NRW plan to undertake the capital works as part of the Scheme, and undertake establishment maintenance activities for five years following completion of the Scheme via a maintenance contract. After the establishment maintenance period, the responsibility for longer term management of this area will be handed over to Ceredigion County Council and funded through the same mechanism as the present situation.

### **Hafod Wen unimproved grassland**

As an off-site habitat enhancement, NRW plan to restore a 1.7ha unimproved pasture within the Teifi Estuary Woodlands and Marshes SSSI, returning it to its desired condition.

NRW plan to undertake the capital works as part of the Scheme. On completion of the above works the site will be returned to the landowner for future management, with site monitoring and compliance of the SSSI undertaken by NRW Ceredigion Environment Team.

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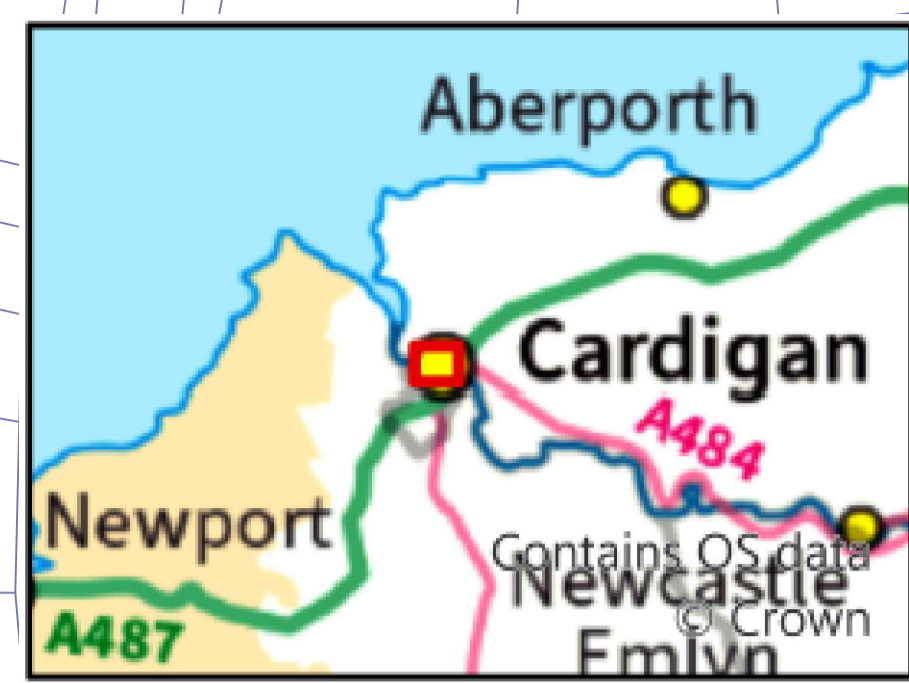
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# Appendix A Environmental Masterplan

Document reference 4021883-BUK-ZZ-00-DR-L-00004



**Key to mitigation and enhancement types**

- B Biodiversity
- H Health and wellbeing of the local community
- A Amenity and sense of place
- P Pollution, air quality & noise
- C Climate change resilience
- M Mitigation
- E Enhancement
- M/E Mitigation and enhancement

Note: The limits, including the height and depths of the Works, shown in this drawing are not to be taken as limiting the obligations of the contractor under Contract.

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**SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS OR RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, THE FOLLOWING SIGNIFICANT RESIDUAL RISKS SHOULD BE NOTED. FURTHER DETAILS ARE INCLUDED IN THE CDM DESIGN RISK MANAGEMENT REGISTER

CONSTRUCTION :	NOT FOR CONSTRUCTION
MAINTENANCE, CLEANING AND OPERATION :	NOT FOR CONSTRUCTION
DECOMMISSIONING OR DEMOLITION :	NOT FOR CONSTRUCTION

- Legend**
- Scheme Area
  - Flood defence wall
  - ← Important views from Cardigan Castle Registered Park and Garden
  - ▨ Littoral mud and rock habitat
  - ▨ Afon Teifi / River Teifi
  - ▨ Habitats of Principal Importance: Saltmarsh and Mudflats
  - ▨ Area of new intertidal habitat
  - ▨ Salt-tolerant estuarine vegetation
  - ▨ Wildflower meadow
  - ▨ Ornamental planting
  - New trees
  - Existing tree cover
  - Existing Public Right of Way
  - Wales Coast Path
  - Ceredigion County Council Active Travel Network Route
  - ← Access route connection to Scheme and distance from Scheme Area
  - ▨ State paving along Strand
  - ▨ Slate walls along Strand
  - ▲ New seating location

P01	HR	TD	AB	AH	16/01/26	For review and comment
P02	HR	HJR	AB	AH	26/03/26	For client acceptance
P03	HR	HJR	AB	LJM	27/03/26	For client acceptance
Rev	Drawn	Chkd	Rwd	Apprvd	Date	Description

Designed by: \_\_\_\_\_ Date: \_\_\_\_\_

Status: S2 Suitable for information



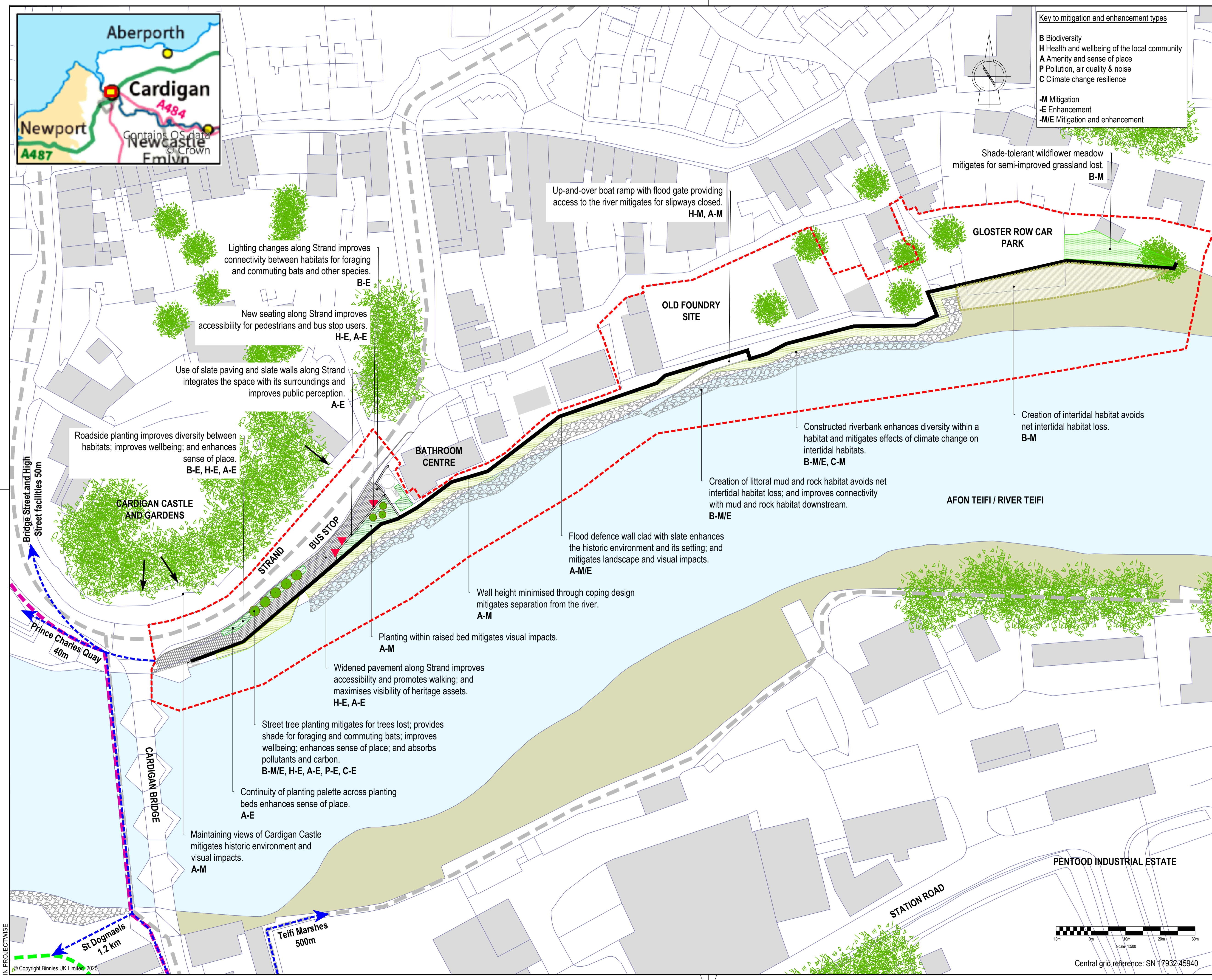
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Project: **CARDIGAN TIDAL FRMS DETAILED DESIGN**

Drawing title: **ENVIRONMENTAL MASTERPLAN**

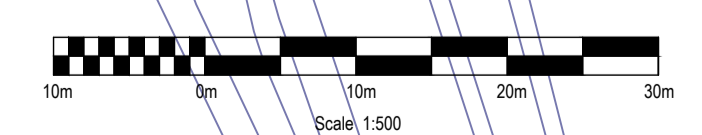
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Drawing no. 4021883-BUK-ZZ-00-DR-L-00004 Revision P03



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