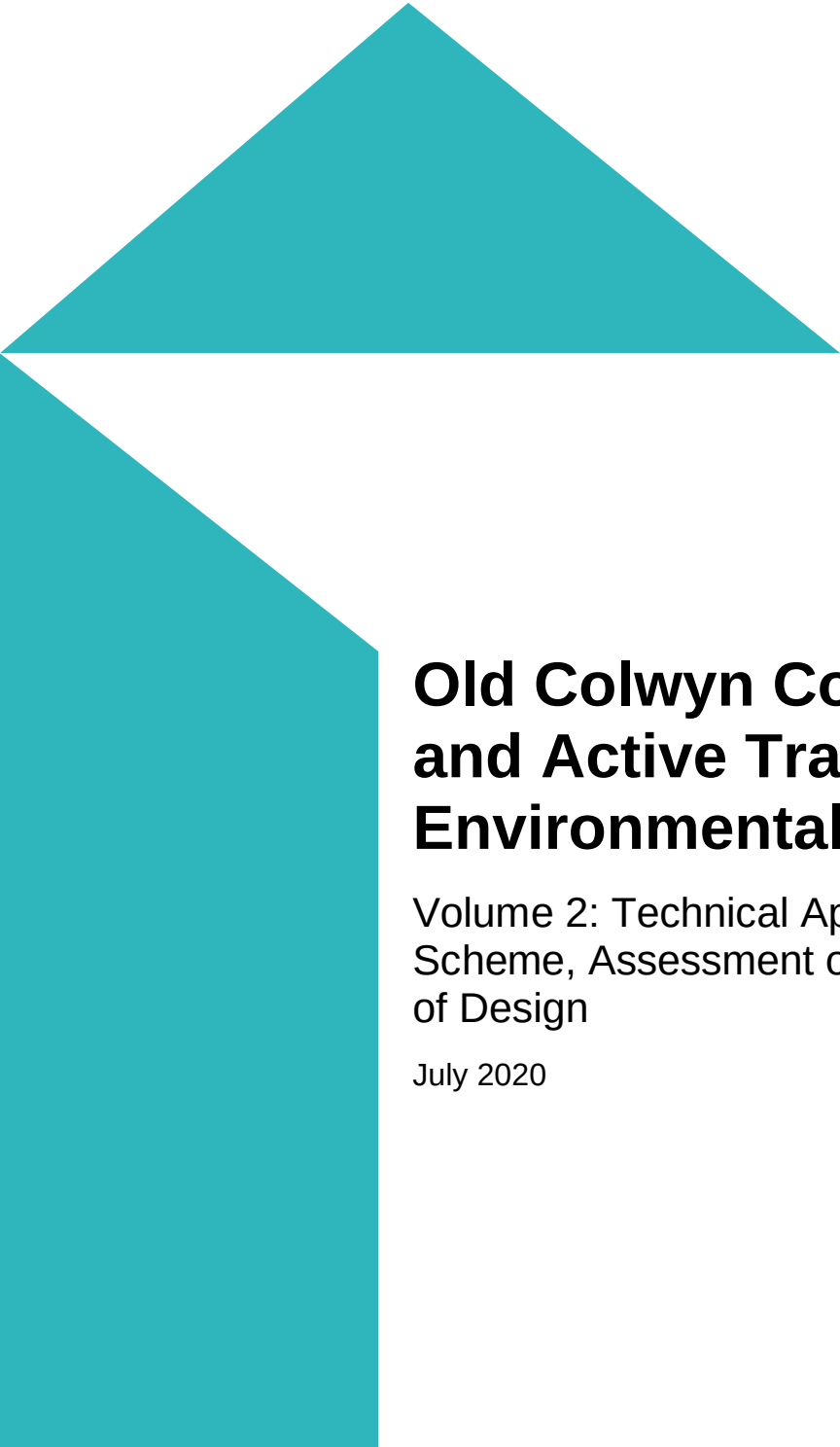




Old Colwyn Coastal Defence and Active Travel Scheme Environmental Statement

Volume 2: Technical Appendix 2 - Need for
Scheme, Assessment of Alternatives and Basis
of Design

July 2020

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of Design**

July 2020

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
P01	July 2020	A. Jones	N. Spofforth	C. Williams	First Issue

Document reference: 415437-MMD-00-XX-RP-N-1704

Information class: Standard

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Appendix 2.1 – Colwyn Bay Waterfront Project Phase 3 Phasing Review

Colwyn Bay Waterfront Project Phase 3 – Phasing Review



Draft Report for Stakeholder Distribution **August 2019**

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Colwyn Bay Waterfront Project

Phase 3 – Phasing Review

August 2019

CEUK Project Ref: 03/1810

Document History Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date
1	0	Draft for Client Comment	11/04/19
2	1	Final Draft for Client Comment	12/06/19
3	2	Draft Report for Stakeholder Distribution	29/08/19

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Metadata

Addressee	Conwy County Borough Council
Audience	Council Officers
Contributor(s)	Coastal Engineering UK Ltd
Coverage	Colwyn Bay
Creator	Coastal Engineering UK Ltd
Date	Created: 2019-02-25 Draft Report Issued: 2019-04-11 Final Draft Issued: 2019-06-12 Draft Report for Stakeholder Distribution Issued: 2019-08-29
Description	Report to review and update potential phasing arrangements for the 3 rd phase of coastal defence and promenade regeneration improvements at Colwyn Bay
Format	Text, medium=digital file
Identifier	03/1810
Keywords	Colwyn Bay, Waterfront, Coastal Defence, Promenade
Language	English
Location	Conwy County Borough Council, Environment Roads & Facilities, Council Offices, Conway Road, Mochdre, Colwyn Bay, LL28 5AB
Mandate	Council Order
Publisher	Conwy County Borough Council
Relation	Colwyn Bay Waterfront Development
Rights	Copyright: Conwy County Borough Council
Status	Draft
Subject	Colwyn Bay Waterfront Coastal Defence Works
Title	Colwyn Bay Waterfront Project: Phase 3 – Phasing Review
Type	Text/report
Date of metadata update	29/08/2019

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EXECUTIVE SUMMARY

This report was commissioned by Conwy County Borough Council (CCBC) to investigate and review options for implementing the third phase of the proposed Colwyn Bay Waterfront Project (CBWP) and to examine potential arrangements to move the project forward with regard to partnering with key stakeholders to deliver the project.

The Colwyn Bay Waterfront project was conceived in 2007 as a result of a strategic assessment of options for future flood and coastal erosion risk management and comprises the provision of improved coastal defence and associated waterfront regeneration, spread over three phases.

Construction commenced in 2011 and to date the Phase 1 coastal defence and waterfront regeneration works, and Phase 2a waterfront regeneration works, comprising construction of a new shoreline promontory at Porth Eirias, importation of approximately 500,000m³ of sand beach recharge, sea wall improvements and the provision of improved shoreline infrastructure, have been completed at a total cost of £28.6 million.

In late 2018 Welsh Government approval was given, to proceed with the detailed design of the Phase 2b beach recharge and associated works at an estimated cost of £14 million. This work is programmed for construction in 2020-21.

The proposed Phase 3 works comprise raising the promenade and constructing approximately 1200 metres of linear rock revetment coastal defence between Porth Eirias and Cliff Gardens, Old Colwyn at a current estimated cost of £35 million, which includes a 30% contingency/estimate bias/risk allowance.

The Phase 3 frontage comprises a near vertical masonry sea wall that dates from the early 1900s that abuts a generally sandy foreshore. The beach in front of the wall is vulnerable to erosion during storms that has required construction of additional toe works in the past to prevent undermining of the wall. Recently, across approximately half of the frontage length an emergency rock toe has been installed following storms to combat erosion and improve wall stability. Immediately landward of the wall is a part paved/part tarmac surfaced dual usage (pedestrian and cycle path) promenade, which adjoins the public highway. To landward of the promenade and highway is the Chester to Holyhead railway line, which is located some 10-15 metres above the highway supported on an embankment. A masonry wall demarcates railway property from the public highway across the entire length. Landward of the railway is the A55 dual carriageway trunk road.

The crest level of the sea wall across the frontage is low being less than 0.5 metres above the highest predicted astronomical tide level in places. Accordingly, when spring tides combine with onshore westerly to northerly winds, overtopping takes place causing potential disruption and damage to infrastructure, closure of the promenade and diversion of traffic. During autumn and winter seasons when there are consecutive days of high tides and onshore winds, or when repairs are required following storm damage, the promenade can remain closed for a few days or longer at a time.

Assessment of the condition and stability of the existing sea wall identifies the wall to be in poor condition with numerous defects and where there are no significant toe defences the beach in front is at continued risk of erosion leading to loss of support to the wall and an immediate threat of damage and failure.

Conwy County Borough Council currently manage the coastal defences and the risk to hinterland assets and the general public by:

- Regular monitoring of beach topography;
- Use of NRW flood warning systems to close the public highway to vehicles and pedestrians;
- Proactive maintenance of railings, sea wall and promenade identified during quarterly coastal defence asset inspections by Authority staff;
- Reactive maintenance to damaged railings, sea wall and promenade surfacing following storms.

In the near future however, it is highly likely that a decision will have to be made as to whether to carry out repairs and should the decision be that repairs will not sustain the defences further then a decision to permanently shut the promenade, with the associated consequences for users would have to be made.

If no further work is carried out to maintain the defences then the overall consequences would be:

- Regular overtopping of defences causing damage to the sea wall structures and promenade surfacing, exposing fill material, requiring closure of promenade access to pedestrians, cycles and vehicles (including emergency services);
- Failure of defences arising from storm damage, with damage spreading rapidly longshore;
- Loss of utilities' services buried beneath the promenade;
- Loss of boundary wall and erosion of the embankment and bridges supporting the railway leading to closure of the railway; and
- Loss of access/egress to the A55 from the promenade; and
- Loss of the A55. The area where there is the greatest risk to this will be at the eastern end where the bridge supports are immediately to landward of the railway bridge.

If the sea wall were to fail during a storm then this would render the services located under the promenade unusable immediately. Also, the toe weight to the railway embankment that is currently retained by the sea wall would be compromised with the potential for rotational failure of the railway embankment that would immediately threaten the operation of the railway.

The local impacts of the above scenario would be to cause widespread traffic chaos in the Colwyn Bay area which would, as well as causing significant disruption to the local population, adversely affect the response times of the emergency services. In addition, there would be potential wider local, regional and national impacts.

Both the Chester to Holyhead railway and the A55 are of regional and national importance in the conveyancing of both freight and passengers to/within North Wales, both commercially and from a commuter/tourism/amenity perspective.

Both of these pieces of infrastructure provide a significant link between the UK and the Republic of Ireland, with Holyhead the 3rd ranked port in Wales for tonnage of freight handled. In 2012 there were over 8,000 average daily HGV/LGV traffic movements on the A55 near Colwyn Bay and over 6,000 on the same road to the west near Bangor, contributing approximately 20% of all traffic movements on the A55.

The Chester to Holyhead railway provides an important route for passengers with hourly direct or connecting services to/from London Euston via Chester as well as commuter routes connecting the North Wales coast to the urban conurbations of Liverpool and Manchester particularly and disruption to this service would have a major impact on people who use the rail services.

Tourism is a major factor in the economy of North Wales and tourists coming into the area predominantly use the railway or the A55. In 2017, the Conwy Borough attracted 6.71 million tourism day visitors with associated annual expenditure of over £200 million. More than 60% of this expenditure is associated with the wider Llandudno, Colwyn Bay and Conwy area, all of which require access to be gained through Colwyn Bay.

The primary stakeholders with an interest in the Phase 3 frontage are:

- Conwy County Borough Council as Lead Coastal and Flood Risk Management and Highway Authority;
- Sustrans, whose National Cycle Route 5, runs along the promenade directly behind the defences;
- Dŵr Cymru Welsh Water (DCWW) and Scottish Power Systems, whose utilities' assets are directly protected by the coastal defences;
- Network Rail, whose Chester to Holyhead railway is located immediately to landward of the coastal defence line; and
- The Welsh Government Network Management Division, who have responsibility for the A55 trunk road.

Conwy County Borough Council have received 75% grant aid from Welsh Government's predecessor to its current Coastal Risk Management Programme. For this phase however WG have identified that no funding will be available from this source, as the works do not provide direct protection to residential and business properties, which is the key indicator used in prioritising Welsh Government's Flood & Coastal Erosion Risk Management (FCERM) spending, suggesting that those public and private bodies that receive direct benefit from the defences should contribute to the cost.

Of the above key stakeholders DCWW have contributed in the past to the costs of making good the existing defences, when a void appeared in the promenade close to their services. Network Rail have engaged in previous discussions and have indicated that whilst they see it as CCBC's responsibility to maintain the coastal defences, in the event that this function ceased, they would not allow for long term disruption to their network. Welsh Government Network Management Division have indicated that they do not currently envisage any significant impact on the A55 at present should the sea defences fail "due to the fact that the rail track provided a buffer".

In economic terms if there was no collaboration between the interested parties the following is envisaged:

- Permanent closure of the promenade and highway to pedestrian and vehicular traffic at an estimated cost of about £30,000 per annum to the Local Authority;
- Modification to highway signage and implementation of a permanent vehicular diversion route through Colwyn Bay, cost unknown but estimated to be of the order of £20-30,000 per annum;
- Construction of terminal works at the interface with already completed sections of the Colwyn Bay Waterfront to safeguard the investment made here. Estimated to cost £3-5 million.
- Diversion of part of the National Cycle Route 5 through the centre of Colwyn Bay with the associated risks and costs (new signage, routing etc.) this would entail;
- Permanent diversion of Dŵr Cymru Welsh Water services at a high level estimated cost of £4-5 million;
- Abandonment of low voltage electricity supply at a cost of £5000 to Scottish Power; and
- Provision of temporary and subsequently permanent protection to the railway embankment at a cost to Network Rail, estimated by this study, to be of the order of £20-30 million, to ensure the long term operation of the railway is maintained. This approach would, it is expected, lead to some short term disruption to services e.g. requiring the provision of rail replacement bus services, whilst such measures were put in place.

At face value, the response from the Welsh Government Network Management Division suggests that they do not see there being any requirement on them to invest in protection works to their infrastructure, however that would only be the case if Network Rail carried out works to protect their asset. If they didn't then ultimately there would be a risk to the Trunk Road network, which could potentially cost conservatively up to £30 million to manage.

Under a collaborative approach it is appropriate that contributions made by individual stakeholders would not exceed the estimated costs that the stakeholder would incur if no works were promoted.

Without funding support from Welsh Government promotion of the scheme would require the remaining individual public and private bodies to contribute the full costs of the works, currently estimated to be approximately £35 million.

If the scheme were eligible under CRMP then Conwy County Borough Council would have to fund 25% of the cost. This would equate to £7-8 million, which roughly equates to the estimated direct costs they would incur in the event that the existing defences were allowed to deteriorate and fail. Based on the estimates provided a DCWW contribution would be of the order of £5 million, leaving a shortfall of £22-23 million to be found from other sources, primarily Network Rail and potentially Welsh Government Network Management Division.

Welsh Government have to date been involved in promoting dialogue between interested parties and the AM for Clwyd West has proposed that a summit of interested parties be convened to move things forward. Dŵr Cymru Welsh Water have co-operated with Conwy CBC in carrying out maintenance due to storm damage and have indicated a willingness to co-operate in developing proposals further, however the value of their infrastructure alone combined with potential Council contributions would only provide a third of the expenditure required and a significant financial burden potentially falls on Network Rail and the Welsh Government Network Management Division.

At the present time there appears to be a lack of willingness by both these parties to engage on this matter and this needs to be the focus in the short term. In Network Rail's case the consequences of inaction or willingness to co-operate could lead to costs and/or damage on potentially a similar scale to that which occurred at Towyn 30 years ago.

The longer it takes to develop a way forward the greater the risk of catastrophic failure of the current defences. The frontage is at risk of overtopping and therefore promenade closure and potential damage on every spring tide

period, particularly if onshore west to north west winds occur concurrently. Accordingly, there is only a finite time (probably less than 5 years based on condition assessments of the existing defences and likely storm frequency) that the Council are going to be able to continue their current policy of “make do and amend” and decide that this approach is no longer sustainable financially. In such a case the decision would have to be made to close the promenade permanently and nature would take its course requiring the other stakeholders to adopt their own action plans to protect their infrastructure.

The immediate risk of damage could be reduced by construction of a rock toe along that section of frontage where one doesn't exist, over approximately 40% of the length, at an estimated cost of £2.0 million, which would contribute to safeguarding the integrity of the existing defences, where they are currently weakest and would also reduce the overtopping taking place across this part of the frontage. This would buy some time to develop arrangements for permanent improvements.

However, this only represents a short-term solution, that does not address the longer-term risk to infrastructure across the frontage, although the rock imported would be available to be re-used in the proposed works when they are implemented.

Notwithstanding the benefits that implementing this option in the short term would have, it is important that adopting this approach is not allowed to lead to complacency amongst potential partners/collaborators, assuming that the proposed Option 3 works would then not need to be implemented. This would have a perceived negative affect on Colwyn Bay, by not delivering fully on the objectives for the Waterfront Project, that were set out at the outset, and therefore not fully delivering the wider benefits identified for the overall Colwyn Bay frontage.

Accordingly it is suggested that development of a collaborative approach between Conwy CBC, Welsh Government, Network Rail, the Welsh Government Network Management Division and Dŵr Cymru Welsh Water to a point where there is a binding agreement to contribute to the Option 3 works is made, albeit at a date in the future that is mutually acceptable to all parties, before there is a commitment by Conwy CBC to implement the stop gap works, should those funds be available.

GLOSSARY OF TERMS AND ABBREVIATIONS

A55	North Wales Expressway National Trunk Road
APE or (APO)	Annual Probability of Exceedance or (Annual Probability of Occurrence) in relation to tide levels
CBWP	Colwyn Bay Waterfront Project
CCBC	Conwy County Borough Council
CEUK	Coastal Engineering UK Ltd
CRMP	(Welsh Government's) Coastal Risk Management Programme
DCWW	Dŵr Cymru Welsh Water
FCERM	Flood and Coastal Erosion Risk Management
Highest Astronomical Tide - (HAT)	The highest tide level predicted to occur under any combination of astronomical conditions.
HRW	HR Wallingford
Mean High Water Spring Tide - (MHWST)	The average height of high waters occurring at the time of spring tides.
NMWTRA	North and Mid Wales Trunk Road Agency
NR	Network Rail
NRW	Natural Resources Wales
ODN	The vertical height or level of a feature or tide level relative to the Ordnance Datum, Newlyn
Overtopping	The passage of water over the crest level of a shoreline structure or natural feature
Return Period	The average predicted time period over which an event of given magnitude will occur e.g. 1 in 20 years. Usually used in relation to the occurrence of specific still water levels or wave heights and periods.
Rock armour	Quarried stone commonly used in coastal defence works
SMP	Shoreline Management Plan
Spring Tide	Tides of highest range occurring twice a month, when the moon is new or full.
SP	Scottish Power
SRA	Strategic Regeneration Area
Topography	The arrangement of the natural and artificial physical features of an area e.g. beach or dunes.
UKCP	United Kingdom Climate Projections
WCB	Whole Circling Bearing. The angle in relation to north, clockwise from north.
WG	Welsh Government
Wave Height	The vertical distance between the peak and trough of a wave
Wave Period	The time taken for successive peaks or troughs in a wave train to pass a fixed point

1. INTRODUCTION & BACKGROUND

The report presented here has been commissioned by Conwy County Borough Council (CCBC) to investigate and review options for implementing the third phase of the proposed Colwyn Bay Waterfront Project (CBWP), which commenced in 2011, and to examine potential arrangements to move the project forward with regard to partnering with key stakeholders to deliver the project.

The report comprises the following sections:

- Background to the development of the CBWP and progress to date;
- Definition of the current conditions applying across the Phase 3 frontage;
- Definition and examination of potential options for constructing the proposed works for the Phase 3 frontage;
- A Public Services Impact Review, re-assessing the physical and economic implications of failure of the existing sea wall in the event that works are not carried out based on specific information provided by service providers whose infrastructure is currently protected by the existing coastal defences;
- Examination of arrangements for collaboration and suggested way forward to deliver the project.

A location plan showing the Waterfront frontage (in red box) is provided in Figure 1.

1.1 BACKGROUND

The Colwyn Bay coastline between Rhos Point and Tan Penmaen Head is approximately 3.5 km in length. Defences were constructed for much of the coastline in the late nineteenth century and in general comprised vertical seawalls in either masonry or concrete.

As a result, during the 20th century, the frontage experienced a gradual lowering of beach levels in front of the defences requiring ongoing maintenance and repairs to the toe of the defences to ensure their integrity and stability. Groynes that were constructed in response to beach lowering, to retain the wide sand beach, ultimately failed or became redundant due to a lack of ongoing maintenance. As a result, the foreshore was typically a shallow gradient, variably thin, sandy beach overlaying fluvio-glacial sands, gravel and glacial tills. To the rear of the foreshore adjacent to the seawalls, there was some sand, shingle and cobbles that were the remains of the original shingle ridge on which the defences had been built and which now formed a narrow upper beach in places.

In the late 20th century specific localised works were carried out to extend the life of the existing sea walls and control movement of the beach. This included a 650m rock revetment along the worst affected stretch of seawall constructed in 1987, and a series of low level rock groynes in 1990.

Since the 1990's routine maintenance of the existing structures was carried out to extend their residual life. This has included patch repair of the concrete and masonry walls as well as the addition of protective rock toes and revetment facings in some areas. Emergency works, comprising the addition of further piled and rock toes, were also carried out in several locations along the seawalls, notably at Old Colwyn, in response to the rapid lowering of beach levels following severe storms.

The Colwyn Bay Waterfront project was conceived in 2007 as a result of the Strategic assessment of options for future flood and coastal erosion risk management (Conwy CBC, October 2007).

It was identified at an early stage of the strategic assessment process that merely improving the ageing linear defences alongside improved promenade facilities would not attract people back to Colwyn Bay, as such an approach would not fully address the issue of low beach levels. There was therefore a local determination, with public support, to investigate more innovative solutions and use the improvements to the coastal defences as a catalyst for wider regeneration of Colwyn Bay.

In 2008, the Welsh Government designated the North Wales coast as a Strategic Regeneration Area (SRA). Subsequently, in early 2009, and to give focus and direction to regeneration in Colwyn Bay, Conwy County Borough Council established the Bay Life+ programme which provided the framework for development of the Colwyn Bay Waterfront Project to combine the renewal of coastal defences with

regeneration improvements to the promenade, creating a modern, sustainable and attractive waterfront, which would be an asset to the local community and an attraction for visitors - *"Integrating coastal protection with regeneration delivering innovative solutions and value for money"*.

Realising the project relies on obtaining funding from different sources and an integrated approach to funding management through development of a clear vision and programme of for delivery that enables the Council to draw upon different funding as necessary, as the scheme progresses through different phases

Concurrently with development of the Bay Life+ programme, the Council commissioned further studies to establish detailed proposals for elements of the waterfront project, which identified three phases of works, as follows:

- Phase 1: Construction of a terminal rock groyne, the raising of 100 metres of promenade and construction of rock revetment to provide a shoreline promontory, opposite Eirias Park – subsequently denoted Porth Eirias. Also, the importation of approximately 500,000m³ of sand to artificially recharge the beach over approximately 1km of frontage between Porth Eirias and Marine Drive. Associated with this, Phase 1 comprised the erection of a new waterfront building at Porth Eirias and promenade/sea wall regeneration works along this stretch of frontage;
- Phase 2: Comprising the importation of a further 500,000m³ of sand recharge between Marine Drive and Rhos-on-Sea, including modification of the terminal rock groyne on the south side of the harbour and regeneration works to the promenade behind the existing sea wall; and
- Phase 3: Works to raise the promenade and construct approximately 1200 metres of linear rock revetment coastal defence between Porth Eirias and Cliff Gardens, Old Colwyn.

To date the Phase 1 coastal defence and waterfront regeneration works and Phase 2 waterfront regeneration works have been completed at a total cost of £28.6 million.

In late 2018 Welsh Government approval was given, to proceed with the detailed design of the Phase 2b beach recharge and associated works at an estimated cost of £14 million. This work is programmed for construction in 2020-21.

The current estimate for the cost of the Phase 3 works is approximately £34 million, which includes a 30% contingency/estimate bias allowance. There are at present a number of uncertainties relating to conditions behind the existing sea wall that require investigation, the results of which may impact on current cost estimates.



Figure 1: General Location Plan

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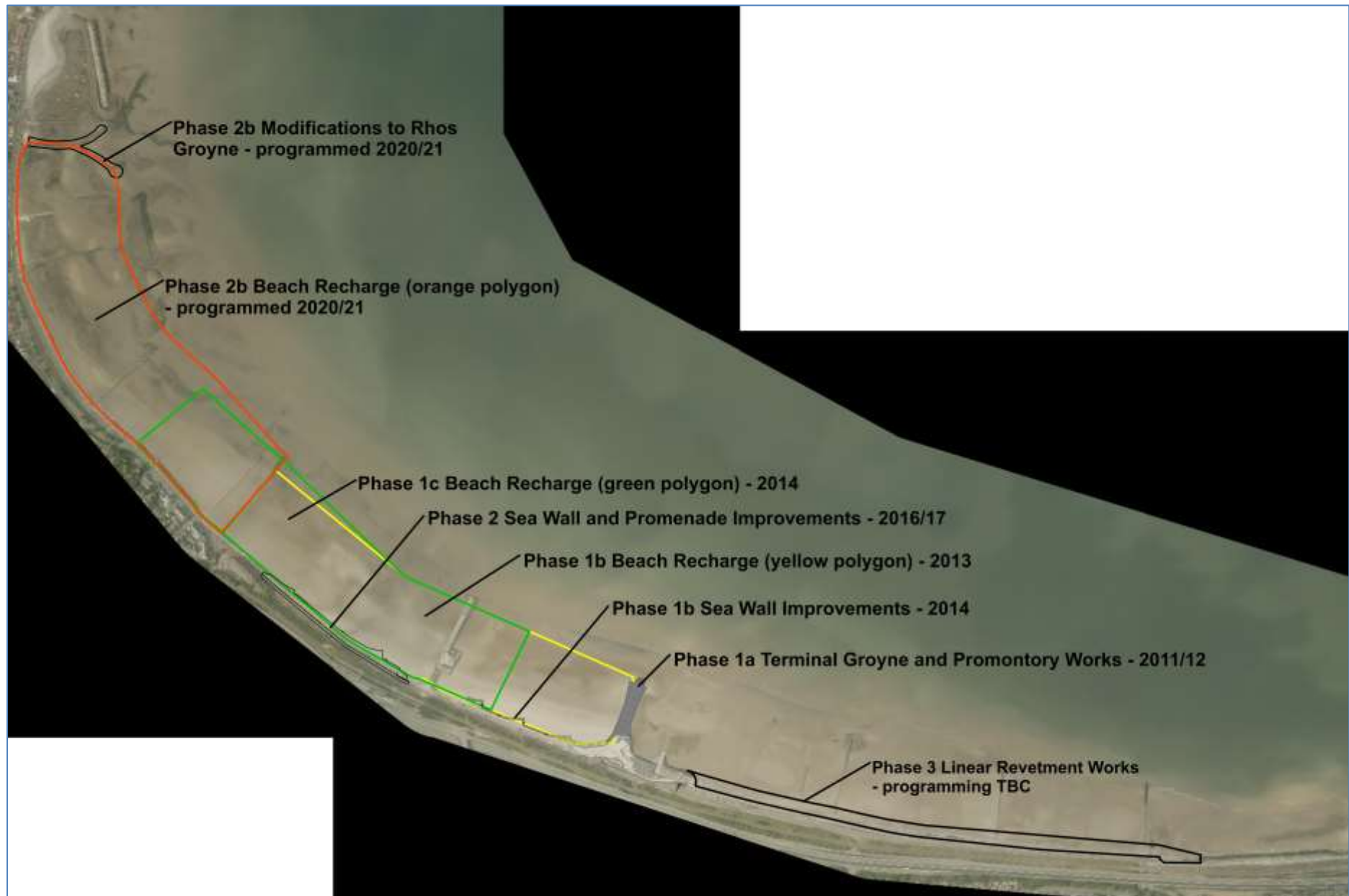


Figure 2: Colwyn Bay Waterfront – Phasing Arrangements (Completed and Future Proposed)

2. **PHASE 3 CONDITIONS APPLYING**

2.1 **EXISTING FRONTAGE DESCRIPTION**

The Colwyn Bay Waterfront Phase 3 frontage covers approximately 1km of coastline within the limits shown in Figure 3.

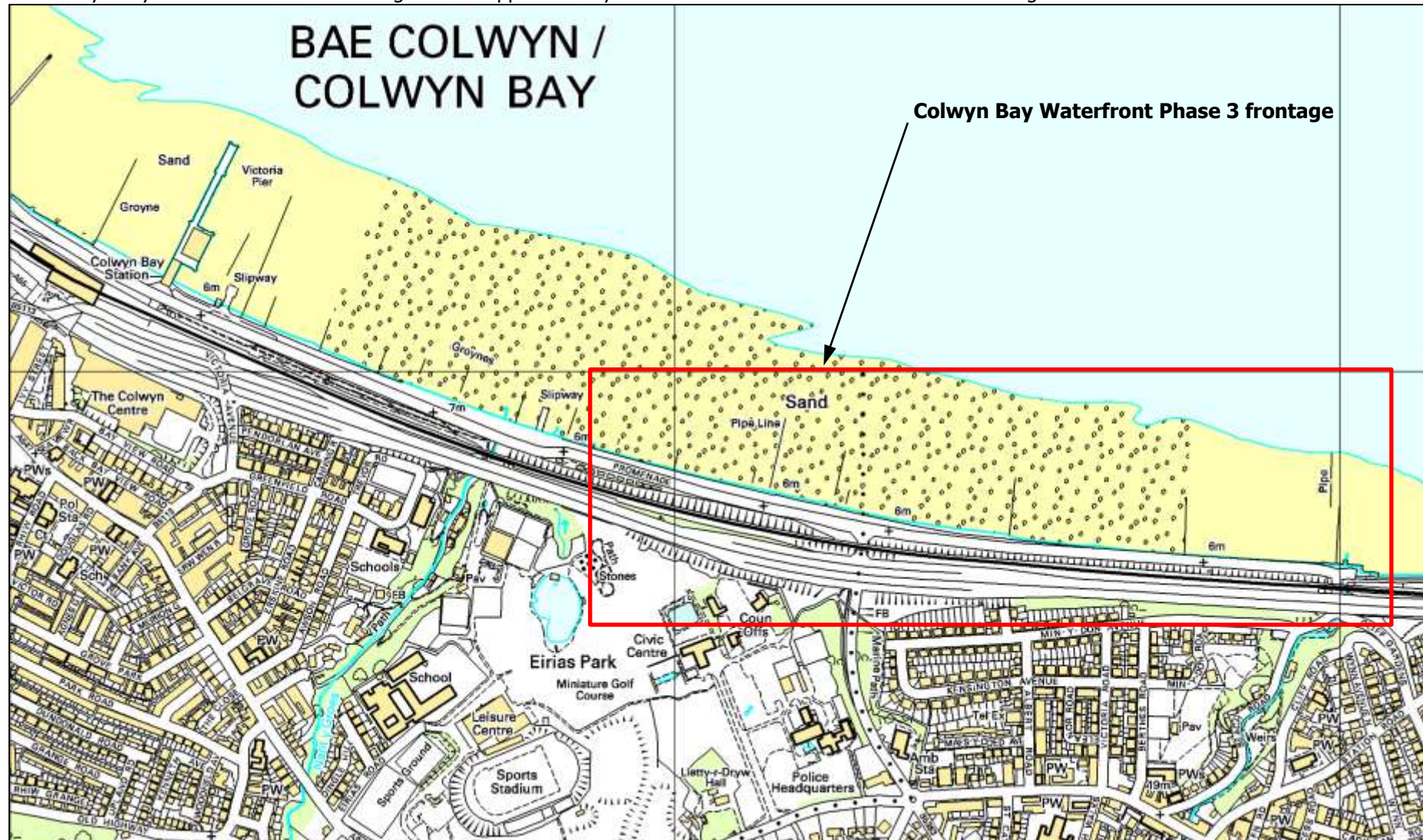


Figure 3: Phase 3 Frontage Plan

(Note Phase 1 works not shown on background mapping, reproduced from the Ordnance Survey Mapping with the permission of the Controller of H.M.S.O. Crown Copyright. Conwy County Borough Council, 100023380, 2019)

The frontage comprises a near vertical masonry sea wall that abuts a generally sandy foreshore, locally mixed, particularly along the toe of the wall, with natural gravels. Across the first 200 metres of frontage the wall has a recurved section running along the crest, at an elevation of approximately 6.1m above Ordnance Datum Newlyn (ODN). The promenade behind is approximately 1.0m lower. Over the remainder of the frontage there is no recurve and the crest level is the same as the promenade (varying 5.1-5.9m, average 5.5m ODN).

The toe of the sea wall has been protected from erosion and undermining by a variety of constructions. Across the first 650 metres west to east, rock armour has been placed directly in front of the wall. Over the remainder the toe has been protected either by reinforced concrete aprons or steel sheet piling.

Immediately landward of the wall is a part paved/part tarmac surfaced dual usage (pedestrian and cycle path) promenade, which adjoins a public highway. Moving west to east, the public highway increases in height to meet the incoming link road from Old Colwyn (Rotary Way) and provide access to the A55 (Junction 22) before dropping down to the same level as the top of the sea wall over the remainder of the length.

To landward of the promenade and highway is the Chester to Holyhead railway line, which is located some 10-15 metres above the highway supported on an embankment. A masonry wall demarcates railway property from the public highway across the entire length. Landward of the railway is the A55 dual carriageway trunk road.

Photographs showing the general arrangement of current coastal defence and promenade/highway infrastructure is provided in Figure 4, running west to east along the sea wall (ref a-i) and east to west along the promenade (ref j-n).

Figure 4: Photographs of Existing Coastal Defences and Promenade



(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)



(i)



(j)



(k)



(l)



(m)



(n)

2.2 **HISTORICAL EVOLUTION**

Examination of historical OS Mapping, carried out for the Colwyn Bay Waterfront Phase 1 Ground Investigation Preliminary Desk Studies Report (Grontmij, August 2010), identifies the following key points in relation to the Colwyn Bay Waterfront Phase 3 frontage:

- Construction of the Chester to Holyhead railway pre-dates the construction of any promenade or coastal defence works across the frontage. The 1878 mapping shows the railway running along an embankment on its current alignment;
- Construction of the promenade had commenced by 1898 and by this time a promenade existed across the majority of the frontage from Penrhos College in the west, to the current location of Rotary Way.
- The promenade was extended eastwards to its current eastern most extents during the first decade of the 20th century and was shown to be complete on the historical map from 1911.
- In places, the promenade appears to have been constructed to the seaward side of the high water mark of medium tides on areas that were formerly beach, indicating that land was reclaimed from the sea. The location and near vertical profile of the wall were contributory factors to the lowering of beach levels in front of the defences that subsequently occurred and the consequent increased exposure conditions that have applied across the frontage to the present day;
- Timber groynes were constructed across the frontage in the 1950's in an effort to stabilize beach levels.

It is not known if the current wall section is the original wall section but the construction suggests it could well be. HR Wallingford's (HRW) Colwyn Borough Sea Defence Review (HR Wallingford, October 1991) identifies that the recurve section at the western end was added in the 1950s and that the first instance of undermining occurred in the 1930s requiring concrete toe extensions and sheet piles which are still visible today (ref Figure 4 (g), (h)). In 1990, a series of longer low level rock groynes were constructed to replace some of the timber groynes between Rhos-on-Sea and Old Colwyn to encourage beach stabilisation and in addition rock armour toe protection was placed in discrete sections. Contemporarily, the following changes have been made:

- Following a storm in February 2005, a new section of sheet pile and concrete toe was installed to the west of the steps between Rotary Way and Beach Rd/Cliff Gardens ((ref Figure 4 (e)), following reductions in beach levels of about 1 metre;
- Following similar beach losses during a further storm in March 2010, rock armour was installed along the toe over approximately 150 metres immediately east of the steps between Rotary Way and Beach Rd/Cliff Gardens (ref Figure 4 (d));

As part of the Phase 1b Waterfront works in 2013, the rock armour toe protection across the eastern half of the Phase 3 frontage was reconstructed to a uniform profile – a 3.5-metre-wide crest at 4.0m ODN and a 1 in 2.5 slope to seaward, utilising existing rock supplemented by imported material as necessary (ref Figure 4 (a)-(d)) and Figure 5.

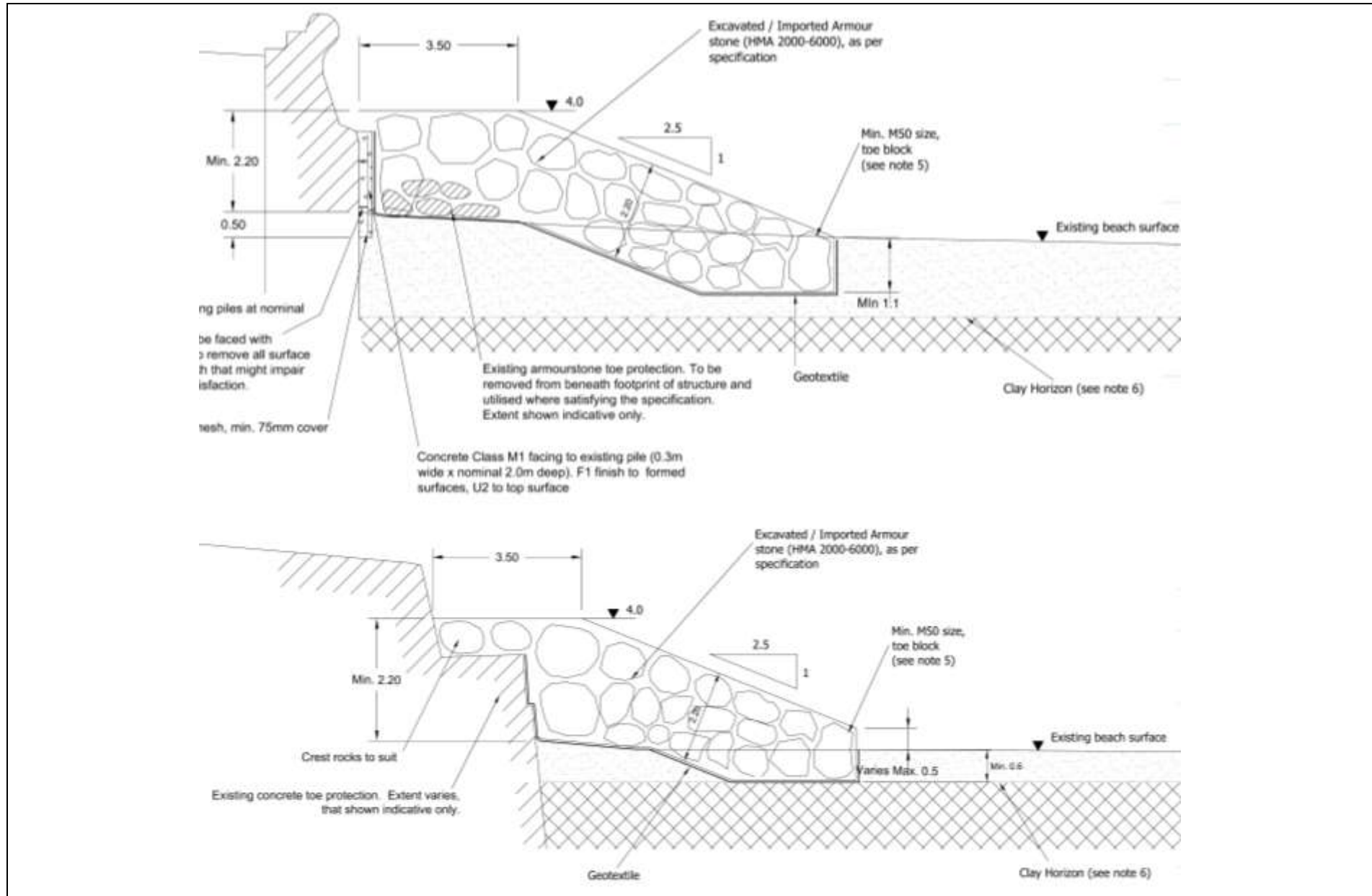


Figure 5: Typical Cross Sections through Existing Rock Armour Protection to Sea Wall

2.3 **CURRENT BEHAVIOUR AND IMPACTS**

The 1991 Colwyn Borough Sea Defence Review identified that "Overtopping, which occurs regularly when onshore winds coincide with spring tides, results in large quantities of shingle and cobbles being thrown over the wall. The road...is closed up to a dozen times a year for several days at a time while the shingle is cleaned back onto the beach".

As identified in section 2.1, the level of the sea wall, where there are existing railings, varies in the range +5.1-5.9m ODN. To put this in context the Mean High Water Spring Tide (MHWST) Level is +4.0m ODN and the predicted Highest Astronomical Tide (HAT) level is +4.6m ODN. Accordingly, on HAT there is only between 0.5 and 1.3 metres of freeboard between the tide level and the top of the wall, even without considering the action of waves.

Current estimates of extreme tide levels for Colwyn Bay (Environment Agency, February 2011), base date 2008, where the predicted astronomical tide level is increased due to meteorological influences e.g. low air pressure, provides the following:

- Tide level with an estimated 10% probability of occurrence in any year = 5.15m ODN;
- Tide level with an estimated 2% probability of occurrence in any year = 5.35m ODN;
- Tide level with an estimated 0.5% probability of occurrence in any year = 5.49m ODN;

In addition to the above wave conditions defined as part of the Colwyn Bay Waterfront modelling studies (Royal Haskoning, July 2010), identified that on a HAT tide, waves approaching the shoreline could, due to low beach levels applying, be up to 3.0 metres in height.

Furthermore, with sea levels predicted to rise in the future, due to anticipated climate change, medium estimates of predictions are that the above tide levels will be at least 0.3 metres higher by the middle of the century and 0.7 metres higher by the end of the century (UK Climate Projections User Interface, 2019). Accordingly, under these scenarios, by the end of the 21st century the tide will reach at or about the crest of the wall on each spring tide i.e. every 2 weeks and the wall along the toe of the railway embankment would be impacted by waves rather than water that overtops the sea wall, as at present.

The impact of present day conditions is shown in visual and recorded evidence from more recent storm events - February 2005, March 2007, March 2010, December 2013, December 2016, December 2017, February/March 2018, January 2019 etc, which confirms the overtopping behaviour identified by HRW but also identifies the following as taking place:

- Damage/Loss of Railings;
- Damage to promenade/highway surfacing and removal of fill behind sea wall;
- Damage to boundary wall and erosion at toe of railway embankment;
- Lowering of beach levels in front of the wall;
- Undermining of sea wall and
- Removal of facing blocks to the sea wall.

These impacts are shown in Figure 6. Typical behaviour during a storm can be seen by clicking on the following link [Old-Colwyn-Promenade-Storm](#).

Figure 6: Examples of Current Behaviour



Typical overtopping on spring tide (March 2013)



Damage to railings



Damage to promenade surfacing



Damage to NR boundary wall and embankment



Reduction in beach levels in front of wall



Sea Wall Undermining



Loss of Blocks to Sea Wall

2.4 **RISK ASSESSMENT**

2.4.1 **Assets Protected**

The current sea wall provides protection to the following assets located in the hinterland:

1. The pedestrian promenade and designated cycle path, which is part of the National Cycle Network Route 5;
2. The public highway, linking Old Colwyn to Rhos-on-Sea;
3. The Chester to Holyhead railway embankment and line;
4. The A55 trunk highway; and
5. Utilities services buried underneath the promenade or highway surfacing.

The relative location of assets (1) to (4) is shown in Figure 7.

Information obtained from Utilities service providers has identified the following with regard to services that are located underneath the promenade and highway.

- There are a number of Dŵr Cymru Welsh Water (DCWW) underground sewerage services running beneath the promenade and highway along the frontage:
 - A 450mm dia. vitrified clay combined sewer that feeds into a 600mm dia. concrete sewer at location SH86785702. This runs under the highway along the entire Phase 3 length;
 - A 900mm dia. concrete combined sewer that feeds into a 1500mm dia. sewer at location SH86781900. This runs under the seaward promenade/cycle path along the entire Phase 3 length before turning landward at location SH85788895 and feeding into the above 600 dia. pipe. At location SH86786702 it moves from the landward edge of the promenade to closer to the sea wall;
 - A surface water service from the highway crosses under the promenade and outfalls through the sea wall at location SH86785711
 - A 450mm dia. concrete foul service runs down Rotary Way and connects into the 600mm dia. concrete combined sewer at the junction with the promenade highway;
 - A 900mm dia. concrete surface water service runs parallel to the foul sewer down Rotary Way before turning west at the junction with the promenade highway. From here there are three separate services located parallel to the two combined sewers:
 1. A 900mm dia. concrete pipe runs parallel (on the seaward side) to the 600mm dia. combined to location SH86781780 before turning seaward and outfalling through the sea wall;
 2. An 1800mm dia. concrete pipe crosses the 600mm dia. combined then runs parallel (on the landward side) before joining the 600mm dia. combined; and
 3. A 1200mm dia. concrete pipe runs parallel (on the seaward side) to the 900mm surface water service (ref 1) before crossing it and then also joining the 600mm dia. combined
 - A 300mm dia. vitrified clay foul service runs diagonally SE to NW under the A55 and railway embankment before joining the 600mm dia. combined service at location SH86780801.
- There is a Low Voltage underground Scottish Power (SP) service running along the landward promenade footpath to just west of Rotary Way where it crosses over to the seaward footpath for the remainder of the frontage before moving inland under the railway embankment and A55 at Beach Rd/Cliff Gardens. In addition, there is a spur about halfway between Rotary Way and Beach Rd/Cliff Gardens that runs under the railway embankment and A55 connecting to the housing estate at Min-Y-Don;
- There are street lighting and illuminated signs located along the frontage, which are fed from the SP service, which are the responsibility of Conwy CBC;
- There are no Openreach services located underneath the promenade and highway;
- There are no Gas services located underneath the promenade and highway;

Plans showing the arrangement of the SP and DCWW services are provided in Appendix I. The depths of these services are presently unknown.



Figure 7: Location of Assets Protected

2.4.2 Existing Conditions

Sea Wall

As identified in Section 2.1 above the existing masonry block wall forms the main body of the coastal defence. There is presently no specific information relating to the exact construction of the wall but it is reasonable to assume that the wall is of a similar construction to others built in the locality at the same time (ref Figure 8).

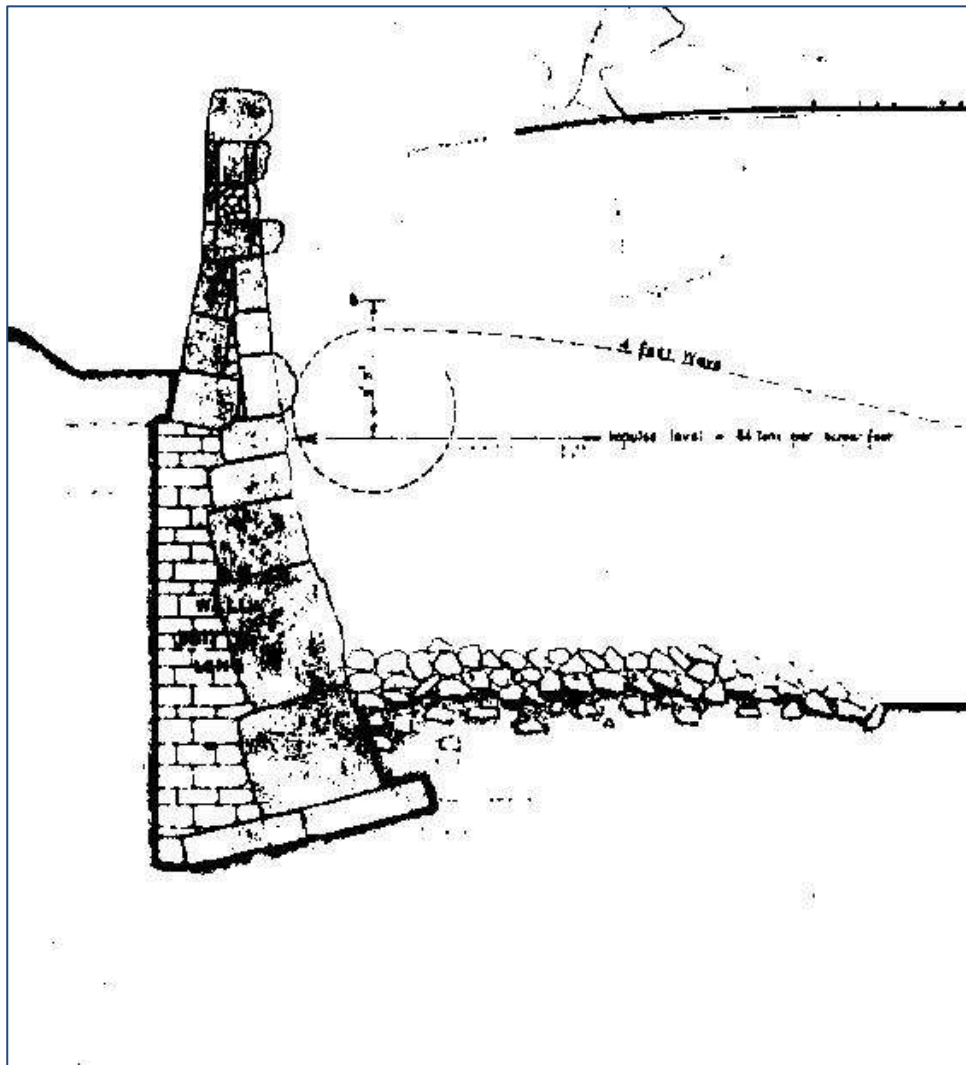


Figure 8: Typical late 19th/early 20th century Masonry Wall Construction (ex LMSR)

In 2010, prior to commencement of Phase 1 of the Colwyn Bay Waterfront Project, a structural condition assessment of the existing walls was undertaken (Mott MacDonald, September 2010). Overall this identified the existing walls along the Phase 3 frontage as being generally in poor condition with numerous defects noted.

With regard to structural stability, the report identified the following:

- Undermining of seawalls foundations is more likely due to falling beach level providing less scour protection to the seawall base. This will not only increase the risk of the actual wall collapsing but also could cause the road or footpaths along the promenade to collapse, because the backfill material from behind the wall could be washed out;
- The passive resistance of the seawall is being reduced by toe erosion; therefore the seawalls susceptibility to sliding failure has increased;

- The retained height is increased by toe erosion; therefore the lateral earth pressure acting on the seawall has increased due to the height being squared, thus the moments are significantly amplified due to the lever arm increasing. Therefore, the seawalls overall susceptibility to overturning failure is significantly greater.
- Where steel sheet piles have been installed with an upper portion of concrete encasement. Once the beach level falls below the upper concrete encasement, then the rate of steel degradation will be higher than originally considered because the steel is exposed to direct cyclic wetting by sea water with tidal fluctuation and is subjected to direct abrasion by foreshore particles driven into contact with the steel by tide and wave currents.
- Where steel sheet piles have been installed for additional sliding resistance and scour protection, once the beach level has fallen below the underside of the concrete foundation, the sheet piles are induced to additional lateral earth pressure and bending moments. This will increase the stresses in the steel piles, possibly above the intended recommended working stresses, which will also accelerate the corrosion rate.

Additionally, toe erosion has had a detrimental effect on the sea defending capacity of the seawall due to the following reasons:

- The falling beach level has exposed a greater vertical extent of wall which can be impacted from direct wave action. Therefore, the risk of instability has increased because the total load has escalated.
- Toe erosion could lead to the backfill material behind the seawall being washed out. This would compromise the passive resistance of the seawall to withstand wave action; therefore, the risk of collapse would be increased.
- If toe erosion has also lowered the slope of the approaching beach, the dissipation of energy from the waves will have decreased, which will have increased the wave force on the seawall. Additionally, the greater reflective extent of wall will cause further accelerate toe erosion.

As identified in section 2.2, since then formal rock armour has been placed across the western half of the phase 3 frontage, which provides additional passive resistance in front of the wall, dissipates some of the wave energy decreasing loading on the wall and provides a better interface between the defences and the beach, reducing scour at the toe.

Notwithstanding the above there is still a significant length of wall at the eastern end, where the risks to wall integrity identified in 2010 remain.

Ground Conditions

Behind the wall past ground investigations provide some information as to the likely conditions that exist. Two borehole records have been identified.

Firstly, a borehole recorded in 1973, prior to construction of the A55 junction at Rotary Way, in the location of what is now the westerly ramp up to the junction but what was then in the landward verge behind the promenade highway. This identified below the topsoil of the verge, approximately 3.5 metres of brown sand and fine gravel with bands of clay to +2.5m ODN. Below this was a further 4.5 metres of red-brown sand with a trace of gravel. The borehole terminated at approximately -2m ODN.

In 2010, as part of the ground investigation works for Phase 1, a borehole was sunk in the promenade behind the sea wall, approximately 160 metres west of the Phase 1/Phase 3 boundary. This identified below the tarmac surfacing, approximately 4 metres of made ground to +1.34m ODN, comprising dark brown sandy gravel with low cobble and boulder content. Below this was a further 4 metres of medium dense dark brown silty sand to -2.6m ODN, 0.2 metres of brown gravel and 4 metres of dense orange brown very silty gravelly sand brown, to -4.8m ODN. Below this was 3.4 metres of very stiff thickly laminated dark brown slightly sandy gravelly clay, overlying the mudstone bedrock at -8.2m ODN.

Also, in 2010, a Groundcheck® geophysical survey of approximately 220 metres of promenade between Rotary Way and the next set of beach access steps to the east (Zetica Ltd, May 2010). The objective of

the survey was to locate areas of potential voiding and loosely compacted fill within the sea wall, associated with washout of material from the base of the wall during the storms in March 2010.

The survey identified a number of localised anomalies that were potentially indicative of wash out of fill materials from the base of the sea wall. The most significant areas of disturbance were identified within the area adjacent to what was then the western end of the rock toe support, centred on grid reference 286446E, 378750N and within the central area of the site centred on grid reference 286501E, 378744N. The survey results are summarised in Figure 9.

The report recommended that a selection of the identified anomalies be investigated further through a targeted drilling or trial pitting program and identified suggested exploratory positions.

In summary, boulder clay is visible from time on the beach directly in front of the defences, notably after storms when the mobile sediments have been stripped away by wave action. Based on the above evidence it is likely that these are just lenses of clay rather than clay horizon.

Overall the backing to the wall comprises a mixture of made ground and glacial material, with evidence that there may be intermittent voids present. If the sea wall was to fail or damage of the surfacing led to exposure of this made ground, exposure to on-going tide and wave action would, it is suggested, lead to rapid erosion.

Draft

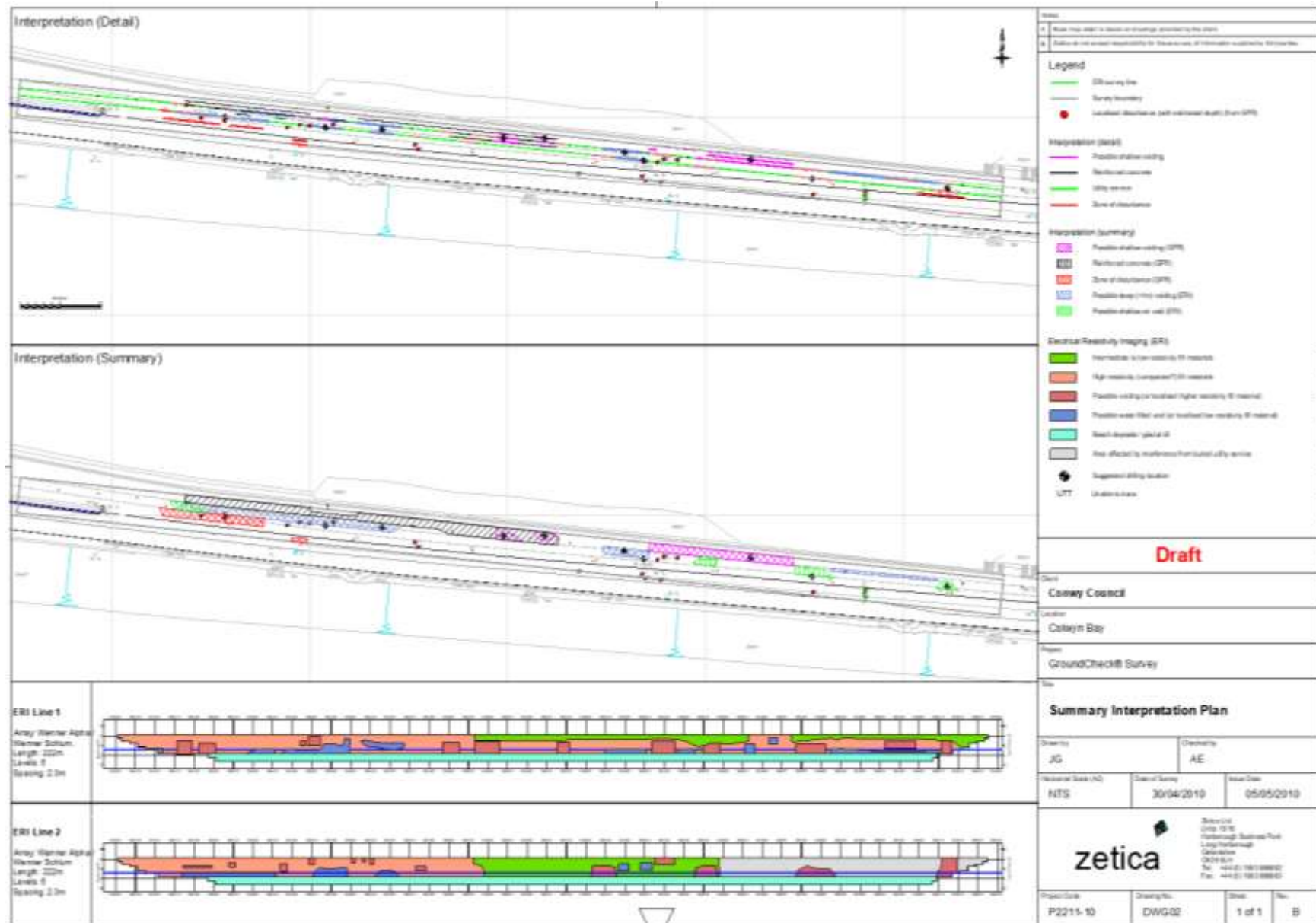


Figure 9: Groundcheck Survey Summary Results
(Zetica Drawing P2211-10DWG02-B -Summary Interpretation Plan)

2.4.3 Future Behaviour

Assessment of what would happen to the sea wall in the absence of any further investment in the coastal defences forms part of the overall project appraisal and development of the business case for investment presented to Welsh Government, in support of grant aid.

Two baseline conditions are examined in this respect:

1. The 'Walkaway' scenario, formerly known as 'Do-Nothing', in which no further capital or maintenance investment is carried out on the defences; and
2. The 'Business as Usual' or minimum investment scenario, in which the Council continues its current management regime. In this case it would involve regular monitoring and reactive maintenance, of the sea wall and promenade, generally following storm damage.

Effectively the second of these is just an option that delays the onset of Option 1, by effectively applying a 'sticking plaster' to the defences until such time that the approach is unsustainable in economic or operational terms.

It is against these two cases that options for increased investment are judged.

For the Colwyn Bay Waterfront project, the investment case has been made and accepted on a bay wide basis, not a phase by phase basis.

Following completion of the Colwyn Bay Coastal Defence Strategy in 2007, a preliminary project Appraisal was produced (Coastal Engineering, August 2008) which identified, from then available information, what would happen in the event of no further investment in the coastal defences at Colwyn Bay. Table 2.1, reproduced below identifies the predicted timeline of effects, assessed at the time.

Term	Years	Predicted Behaviour
Immediate	2007-2012	• Overtopping of defences causing damage to structures and temporary closure of the promenade to traffic
Short	2013-2027	• Overtopping of defences causing damage to structures and temporary closure of the promenade to traffic • Initial failure of the defences leading to immediate closure of the promenade to traffic from Toad Hall to Beach Road, Old Colwyn (years 10-20)
Medium	2028-2057	• Continued overtopping of intact defences • Erosion of embankment supporting the railway and closure of the railway (year 30-40) • Gradual longshore and inshore spread of recession leading to failure of more lengths of defences • Potential loss of a number of properties along the front between the Pier and Cayley Promenade (year 40-50) • Probable detachment of the pier from the shoreline (year 50)
Long	2058-2107	• Continued overtopping of intact defences • Loss of the A55 (year 50-60) • Further longshore and inshore spread of recession leading to failure of more lengths of defences • Loss of a number of properties in the centre of Colwyn Bay and along the front between the Pier and Cayley Promenade (year 50-100)

In 2010, utilising additional data collected, including the structural condition assessment, the preliminary PAR was updated as part of the formal submission to Welsh Government for Grant Aid (Mott MacDonald, October 2010) with the following future behaviour assessment provided:

"The recession lines from the Draft PAR have been updated on the basis of a greater understanding of the frontage developed from new studies including the SMP2, modelling reports and ground investigations. The existing defences are considered to have failed in Year 5. After this, it can be anticipated that the ground behind will quickly suffer the effects of washing out as it comprises mainly made ground under the

existing promenade and road. Access along the promenade road for traffic, and hence access to a number of residential and commercial properties will be prevented. It is assumed that this also occurs in Year 5 as once the defences have failed the promenade and promenade road cannot be considered safe for use. The railway embankment to the rear of the promenade road comprises earthworks and is therefore vulnerable to the effects of inundation and erosion following the collapse of the promenade and promenade road. This is therefore considered to be unsafe for use once the coastline has reached within 5.0m of its base. It is considered that this will be in Year 10. From Year 20 onwards, the new erosion rate presented for Colwyn Bay in the SMP2 of 0.3m per year until Year 50 and then 0.7m per year from 50-100 has been applied. This results in the loss of the A55 in Year 55".

The above forms the basis for the overall justification for all three phases of the Waterfront Project.

With the construction of phase 1 of the Waterfront project there would be some modification of the above, considering Phase 3 on a stand-alone basis. However, notwithstanding this, given that there has been no change in conditions applying across the eastern half of the phase 3 frontage, the risks associated with the defences remain as previously identified and outlined above i.e.

- Regular overtopping of defences causing damage to the sea wall structures and promenade surfacing, exposing fill material, requiring temporary closure of the promenade to traffic in the first instance and, if repairs cannot sustainably be carried out, total closure of promenade access to pedestrians, cycles and vehicles (including emergency services);
- Failure of defences arising from storm damage, with damage spreading rapidly longshore;
- Loss of utilities' services buried beneath the promenade;
- Loss of boundary wall and erosion of the embankment¹ and bridges supporting the railway leading to closure of the railway; and
- Loss of access/egress to the A55 from the promenade; and
- Loss of the A55. The area where there is the greatest risk to this will be at the eastern end where the bridge supports are immediately to landward of the railway bridge (ref Figure 10 (R) below).

Figure 10: Existing Highway Gates



(L) Promenade/Rotary Way Junction

© Google Maps



(R) Promenade/Cliff Gardens Junction

Current CCBC Management Arrangements

The current actions undertaken in relation to managing the coastal defences and the risk to hinterland assets and the general public are as follows:

- Regular monitoring of beach topography;

¹ It should be noted here that whilst Network Rail routinely carry out asset inspections in relation to the condition of the embankment down to the boundary wall with the highway, it must be recognised that failure/breaching of the sea wall would lead to an instantaneous loss of support to this embankment and potential rotational failure of the embankment which would compromise the operation of the railway.

- Use of NRW flood warning system to close the public highway between Rotary Way and Beach Rd/Cliff Gardens, using the existing gates (ref Figure 10);
- Proactive maintenance of railings, sea wall and promenade identified during quarterly coastal defence asset inspections by Authority staff;
- Reactive maintenance to damaged railings, sea wall and promenade surfacing following storms, including provision of additional toe works as necessary e.g. as carried out in 2005.

CCBC have a current operational procedure in relation to managing the risk to promenade users from high tides and or damage (Conwy CBC, May 2017), the key elements of which are summarised below:

- The trigger conditions for potential closure of the promenade is a tide level of 3.9m ODN or greater, which typically is predicted to occur for periods of up to 7 days at a time, 1-2 times per month, concurrently with strong onshore winds, from directions NW to NE.
- Following review of the data the decision for closure is taken by Council staff from the Flood Risk and Infrastructure (FR&I), Open Spaces (OS) and Harbourmaster (HM) departments. County Councillors for the immediate location are informed directly and CCBC's marketing department inform the general public via social media.
- The road barrier at Cliff Gardens is closed first, followed by a walk through the Promenade length to inform remaining cars, followed by closure of the road barrier at Rotary Way junction.
- When the high tide has passed, an inspection of the coastal defence is carried out by FR&I to record condition and to ensure that the promenade is safe to re-open. Any debris thrown up onto the Promenade during the storm is cleared before re-opening.
- County Councillors for the immediate location are informed directly and CCBC's marketing department inform the general public via social media that the promenade has been re-opened.

During autumn and winter seasons when there are consecutive days of high tides and onshore winds, or when repairs are required following storm damage, the promenade can remain closed for a few days or longer at a time.

In the near future, it is highly likely that a decision will have to be made as to whether to continue to carry out repairs and should the decision be that repairs will not sustain the defences further then a decision to permanently shut the promenade, with the associated consequences for general users and, particularly the emergency services, would have to be made.

2.4.4 Wider Impacts of Lack of Investment

As well as the specific local impacts on infrastructure identified above there are wider local, regional and national impacts that the failure of the defences would have.

Both the Chester to Holyhead railway and the A55 are of regional and national importance in the conveyancing of both freight and passengers to/within North Wales, both commercially and from a commuter/tourism/amenity perspective.

Both of these pieces of infrastructure provide a significant link between the UK and the Republic of Ireland, with Holyhead the 3rd ranked port in Wales for tonnage of freight handled (3 million tonnes per annum in 2012). At that time there were over 8,000 average daily HGV/LGV traffic movements on the A55 near Colwyn Bay and over 6,000 on the same road to the west near Bangor, contributing approximately 20% of all traffic movements on the A55 (ref Figure 11).

The Chester to Holyhead railway provides an important route for passengers with hourly direct or connecting services to/from London Euston via Chester as well as commuter routes connecting the North Wales coast to the urban conurbations of Liverpool and Manchester particularly. The railway is also an

important freight asset with up to four trains a day transporting ballast, from the quarry at Penmaenmawr, through Colwyn Bay for use on the UK rail network.

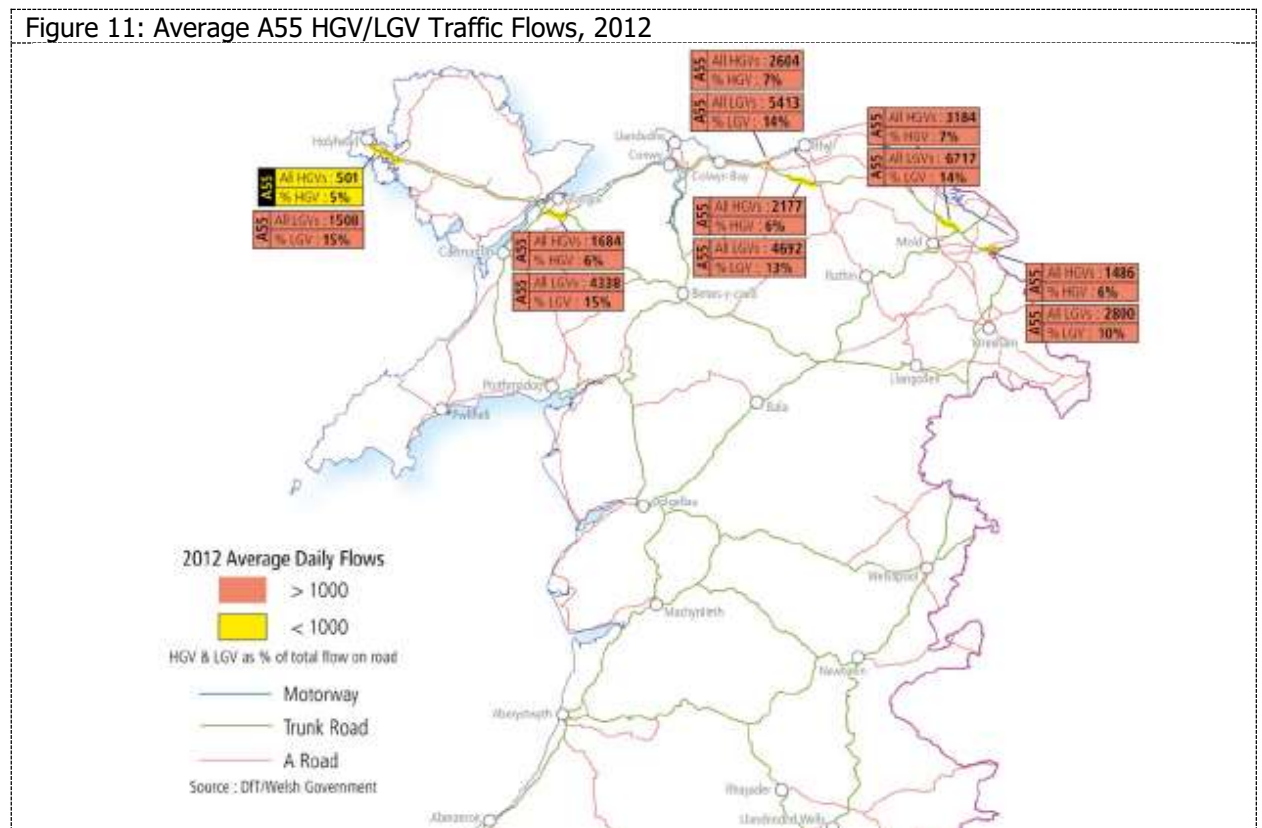
Tourism is a major factor in the economy of North Wales and tourists coming into the area predominantly use the railway or the A55. In 2017, the Conwy Borough attracted 6.71 million tourism day visitors (STEAM data 2017) with associated annual expenditure of over £200 million. More than 60% of this expenditure is associated with the wider Llandudno, Colwyn Bay and Conwy area, all of which require access to be gained through Colwyn Bay.

In 2014 an estimated 90,000 people commuted from Wales into England on a daily basis, whilst this covers the whole of Wales, thousands of people in North Wales are estimated to use the railway and A55 for this purpose, as well as people making the reverse journey.

In April 2012 the MV Carrier grounded on the coastal defences which protect the A55 at Llanddulas to the east of Colwyn Bay necessitating the A55 to be closed in both directions for over 24 hours. The disruption this caused in terms of clogging up local roads and increased journey times had a significant effect on both the local population and the movement of freight vehicles.

It is clear from the above that any disruption to the A55 and/or the North Wales coast railway will have a significant economic impact on both the local community as well as the wider regional economy of the area and accordingly it is considered imperative that solutions are found to fund such works that safeguard the present coastline and the infrastructure located behind it.

Figure 11: Average A55 HGV/LGV Traffic Flows, 2012



3. PHASE 3 ARRANGEMENTS

3.1 OBJECTIVES

The primary objectives associated with the Phase 3 element of the Colwyn Bay waterfront project are:

- To limit overtopping of the existing defences to appropriate levels commensurate with the primary hinterland receptors;
- To mitigate the risk of failure of the coastal defences and the erosion of the shoreline that would take place without on-going shoreline management;
- To safeguard the utilities, rail and transport infrastructure at risk from damage resulting from overtopping and/or erosion;
- To regenerate the promenade area and provide improved amenity commensurate with the overarching waterfront regeneration plan.

3.2 HYDRAULIC PERFORMANCE

The Colwyn Bay Waterfront modelling work undertaken included flume modelling of new linear defences (Royal Haskoning, July 2010) that would reduce overtopping to acceptable limits in relation to the primary hinterland receptors, pedestrians, cyclists and vehicles, in accordance with then best practice guidance (EurOtop, August 2007) and at the same time provide opportunities for promenade regeneration in accordance with the project objectives.

Suggested allowable overtopping parameters identified in the current version of EurOtop (EurOtop, 2018) in relation to the primary hinterland receptors are provided in Table 3.1 below, with criteria applicable to the Phase 3 frontage are highlighted.

Table 3.1: EurOtop 2nd Edition (2018) suggested mean allowable/tolerable overtopping limits and max overtopping volumes for effects on pedestrians, vehicles and property			
Hazard type and reason discharge		Mean discharge (q) (l/s/m)	Max Volume Vmax (l/m)
Overtopping limits for Pedestrians			
People at structures with possible violent overtopping, mostly vertical structures		No access should be permitted	No access should be permitted
People at seawall / dike crest. Clear view of the sea.	H _{m0} = 3 m	0.3	600
	H _{m0} = 2 m	1	600
	H _{m0} = 1m	10-20	600
	H _{m0} < 0.5 m	No limit	No limit
Overtopping limits for Vehicles			
Cars at seawall / dike crest, or railway close behind crest	H _{m0} = 3 m	<5	2000
	H _{m0} = 2 m	10-20	2000
	H _{m0} = 1m	<75	2000
Highways and roads, fast traffic		Close road before debris in spray becomes dangerous	Close road before debris in spray becomes dangerous
Overtopping limits for Property behind defence			
Building Structure Elements	H _{m0} = 1-3 m	≤1	<1000
Damage to equipment set back 5-10m		≤1	<1000
Note			
Calculated overtopping is in reality zero when value is less than this figure	H _{m0} = 1m	0.03	
	H _{m0} = 3 m	0.16	
	H _{m0} = 5 m	0.4	
	H _{m0} = 7 m	0.6	

The modelling examined a series of eight different defence profiles under a range of 19 different tidal and wave combinations (with annual probabilities of occurrence between 1% and 10% - equivalent to return periods of 1 in 10 to 1 in 100 years) from which an optimum preferred profile was identified, in terms of wave overtopping performance, structural stability and other wider frontage objectives – amenity, regeneration etc. This profile is shown in Figure 12. As well as the coastal defences as detailed, this option would require raising of the highway and associated ancillary works level across the frontage

For the purposes of comparison of the proposed works with the conditions currently applying, EurOtop equations were used to provide an estimate of the overtopping that currently takes place across the Phase 3 frontage, with the results as detailed in Table 3.2 below.

Scenario	Nearshore Wave Conditions ²			Mean Wave Overtopping Discharge q (l/s/m)		
	Water Level (m ODN)	Inshore Wave Height H _{mi} (m)	Peak wave Period T _p (Secs)	Phase 3 Design Profile	Existing ³ (Wall only section)	Existing ² (Wall with rock toe)
TC9	4.80	2.4	12.1	0.02	319.74	204.66
TC10	4.80	2.8	11.6	0.09	372.21	238.24
TC11	4.80	3.3	11.5	0.30	433.94	277.75
TC12	4.80	3.4	12.0	0.44	471.57	301.84
TC17	4.80	2.4	8.6	0.02	212.27	135.87
TC18	4.80	3.2	12.8	0.26	482.19	308.64
TC13	5.80	1.6	6.6	0.00	484.81	211.10
TC14	5.80	1.8	6.6	0.00	561.94	246.09
TC15	5.80	2.3	6.8	0.05	413.72	347.98
TC16	5.80	2.6	6.6	0.15	460.82	387.59
TC19	5.80	2.4	8.5	0.05	552.98	465.11
TC20	5.80	2.6	11.0	1.26	800.49	673.29
TC21	5.80	3.2	11.8	5.34	1042.69	877.01
TC22	4.30	2.5	8.9	0.02	133.81	56.94
TC23	4.30	3.0	12.3	0.07	254.67	108.37
TC24	4.30	3.4	12.1	0.17	281.49	119.78
TC25	5.30	1.5	7.0	0.00	169.29	91.11
TC26	5.30	2.7	11.3	0.20	556.99	423.52
TC27	5.30	3.1	12.1	0.59	696.16	529.34

The above shows that the new works proposed provide a significant improvement that accords with current guidance and would significantly reduce the overtopping taking place.

Reference to the existing conditions shows that for all the conditions modelled there would be significant overtopping taking place that would swamp the promenade and highway, as witnessed by the observations that have been made during storm events.

However to examine what level of overtopping could be expected during normal tide conditions and coincident waves under existing conditions, EurOtop calculations were run for a Mean High Water Spring Tide (MHWST) - 3.85m ODN - and a Highest Astronomical Tide (HAT) - 4.60m ODN - which occur on a fortnightly basis and typically twice yearly frequency respectively, in combination with a number of the

² The wave conditions for the existing conditions were transformed from the model location used in the physical modelling studies to a point at the toe of the existing defences using the one-line wave transformation model - Swan One - (Delft, TU, n.d.)

³ The crest level used in these calculations is the average level applying of 5.66m ODN (range 5.1-5.9m ODN).

lower wave conditions used in the physical modelling, which represent conditions that would be expected to occur a number of times in any year. These results are provided in Table 3.3 below.

Table 3.3: Existing Defence Overtopping performance for Astronomical Tide Levels with waves						
Scenario	Nearshore Wave Conditions ⁴			Mean Wave Overtopping Discharge q (l/s/m)		
	Water Level (m ODN)	Inshore Wave Height H _{mi} (m)	Peak wave Period T _p (Secs)	Phase 3 Design Profile	Existing (Wall only section)	Existing ⁵ (Wall with rock toe)
MHWST1	3.85	1.6	6.6	NC	18.09	NC
MHWST2	3.85	1.8	6.6	NC	28.96	NC
MHWST3	3.85	2.3	6.8	NC	89.71	NC
MHWST4	3.85	2.6	11.0	NC	177.14	NC
MHWST5	3.85	3.2	12.8	NC	248.07	NC
HAT1	4.60	1.6	6.6	NC	49.11	28.09
HAT2	4.60	1.8	6.6	NC	69.59	39.80
HAT3	4.60	2.3	6.8	NC	175.39	100.31
HAT4	4.60	2.6	11.0	NC	312.39	178.66
HAT5	4.60	3.2	12.8	NC	418.20	239.18

These results confirm that even under typical tide and wave conditions, the overtopping experienced across the frontage under present defence conditions is in excess of the appropriate values for the primary hinterland receptors (ref Table 3.1).

⁴ The wave conditions for the existing conditions were transformed from the model location used in the physical modelling studies to a point at the toe of the existing defences using the one-line wave transformation model - Swan One - (Delft, TU, n.d.).

⁵ Values not calculated by EurOtop when the water level is below the crest level of the armour toe.

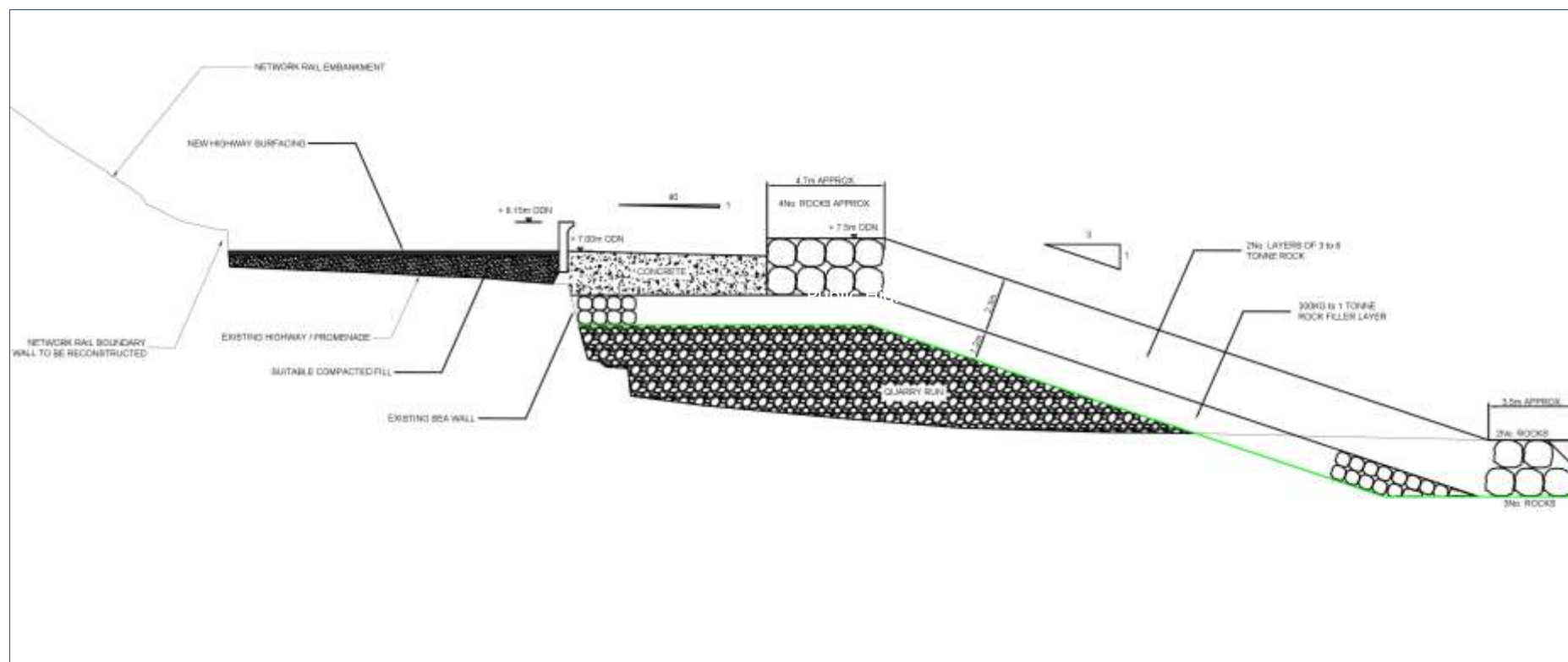


Figure 12: Typical suggested Phase 3 concept design defined from physical model tests

3.3 DEFENCE OPTIONS

3.3.1 Strategic Context

The current Shoreline Management Plan (SMP2), which includes the CCBC shoreline east of the Great Orme at Llandudno, was completed in 2010 and subsequently adopted by CCBC (Halcrow, July 2010).

In the SMP2 Colwyn Bay is located within policy unit 11a PU2.2 – Rhos-on-Sea to Llanddulas. The agreed future policies and approaches for management across this frontage is provided in Table 3.4 below:

Table 3.4 - Sub Cell 11a SMP2 – Policy & Approach				
Location (Policy Unit)		Policy and Approach (from 2011)		
		0-20 years	20-50 years	50-100 years
2.2	Rhos on Sea to Llanddulas	Hold the Line – By maintaining and improving / raising the existing defences. A strategy study needs to be undertaken to confirm the long term economic viability	Hold the Line – By maintaining and improving / raising the existing defences, subject to confirmation through the strategy study.	Hold the Line – By maintaining and improving / raising the existing defences, subject to confirmation through the strategy study.

The justification in the SMP for these policies was as follows:

- Socially the policy manages risk to the railway and other infrastructure as well as other assets in the erosion risk zone, including the cycleway and coastal path; and
- Economically, the viability of the policy depends on the estimated costs for relocating railway and road infrastructure which would be at long term risk.

The Colwyn Bay Coastal Defence Strategy (Conwy CBC, October 2007) developed the SMP policy, examined in detail options through development of the Project Appraisal Report [PAR] (Mott MacDonald, October 2010) and identified the economic risks associated with adopting a Do-Nothing (Walkaway) scenario.

3.3.2 Defence Phase 3 Options

The primary function of works across the Phase 3 frontage is to safeguard the integrity of the shoreline, provide protection to local and national infrastructure and safeguard life.

Essentially there are three options available to the Authority with regard to the Phase 3 frontage:

- Option 1: Continuation of the current management regime in relation to damage to the sea wall, promenade and highway and existing emergency response in relation to closure of the public highway during storm events. This is currently the default position for the Authority, as detailed in section 0;
- Option 2: Continuation of Option 1 + extension of the existing rock armour protection along the whole of the frontage;
- Option 3: Implementation of the Phase 3 works in the form identified from the physical modelling or in some other modified arrangement;

Continuation of Option 1 may prolong the useful life of the current arrangements beyond the residual life estimated under the walkaway scenario (ref section 2.3) but it does not represent a long term sustainable approach to coastal defence management that can be continued for any significant length of time.

Option 2 has a twofold benefit compared to Option 1 in that it:

- a) would provide additional passive resistance in front of the wall that would reduce the risk of failure/collapse;

- b) may reduce the frequency of road closures required in respect of the typical events that occur year on year. However, under more extreme events, whilst mean overtopping rates would be expected to be lower (ref Table 3.2) the overall impacts expected would be similar.

Overall, Option 2 would delay the onset of damage but with predicted climate change in the future, the risk of damage would increase until such time that maintaining the defences in that form would become unsustainable.

Option 3 meets all the overall objectives for the frontage in that it provides:

- a) improved coastal defence to existing hinterland infrastructure assets;
- b) reduced coastal defence and highway maintenance expenditure;
- c) opportunities for improved amenity;
- d) improved highway usage; and
- e) opportunities for re-generation of the public realm.

The extent of works for Options 2 and 3 are shown in Figure 13 and Figure 14 respectively.

3.3.3 **Cost Estimates**

At the present time the average costs for Option 1 are £30-40,000 per annum.

The capital cost estimate for providing a further length of rock toe across the remaining 400 metres of frontage, to the same profile as the existing (ref Figure 5) – Option 2 – is estimated to be approximately £2.0million.

The capital cost estimate, including a 30% contingency/estimate bias allowance, for providing the coastal defences for Option 3 as detailed in Figure 12, is as follows:

Coastal Defence Works:	£24.2 million
Associated Highway Works:	£ 6.2 million
On-costs, profit etc:	£ 3.6 million
 Total estimated cost:	 £34.0 million

This figure may be subject to change resulting from further ground and structural investigations to be carried out and detailed design work.

3.3.4 **Economic Justification**

The economic basis / business case for investing in the Colwyn Bay Waterfront project was originally provided in the 2010 PAR.

This quantified the direct economic damages associated with the following:

1. The cost associated with local diversion of traffic that uses the promenade, in terms of additional distance and journey time for users;
2. The direct (like for like) replacement cost of services underneath promenade/highway;
3. The cost of delay to rail users associated with loss of the rail line at Old Colwyn and the cost of providing a rail replacement bus service between Abergelle & Pensarn and Llandudno Junction stations;
4. The cost associated with diversion of traffic in the event of loss of the A55 highway, in terms of additional distance and journey time for users; and
5. The value of commercial and residential properties that would be lost in the event of erosion, across the Phase 1 & 2 lengths.

In addition, the economic benefit of the improved tourism that the provision of a sand beach across the Phase 1 & 2 frontage would provide, compared to the dis-benefit of providing a rock armour revetment was evaluated. No allowance for potential "Risk to Life" was included in the economic assessment.

These figures were updated in the Phase 2 PAR review (Conwy CBC, May 2018). This identified that overall, based on a 100 year appraisal period, the total discounted economic damages prevented by incorporation of all three phases of the Waterfront Scheme was estimated to be between £330million and £450million. The range representing the uncertainty associated with the timing of failure of the current defences.

Looking at the phase 3 frontage in isolation it can be seen that the majority of the direct damages are associated with this length of frontage, with estimated discounted damages of between £295million and £415million, associated with items 1-4 above.

For this exercise, the direct damages calculated associated with the diversion costs for rail and road users, assume that the diversions/replacement services remain in place from the time they commence until the end of the appraisal period (year 99).

This only provides estimates of direct damages and but does consider the wider impact on the economy that damage to or loss of the A55 and/or the railway would have on the wider North Wales and National economy particularly in respect of impacts on tourism, on which the local economy relies, and on the movement of people and freight across the area, as discussed in section 2.4.4 above.

It should also be noted that if Option 2 works were carried out, the direct damages would reduce to an estimated £150million, assuming the rock toe works bought an extra 20-30 years before the defences failed.

3.3.5 Stakeholder Engagement

It is clear from the above and from the information collated earlier in the report that there are a number of key stakeholders that will benefit from improved protection to their infrastructure and the introduction of improved coastal defence measures across the Phase 3 frontage, namely:

- Conwy County Borough Council as Lead Coastal and Flood Risk Management, Highway Authority and Harbour Master;
- Sustrans, whose National Cycle Route 5, runs along the promenade directly behind the defences;
- Dŵr Cymru Welsh Water⁶ and SP Systems, whose utilities' assets are directly protected by the coastal defences;
- Network Rail, whose Chester to Holyhead railway is located immediately to landward of the coastal defence line; and
- The Welsh Government Network Management Division, who have responsibility for the A55 trunk road.

Critically however in respect of potential funding, the frontage does not provide direct protection to residential and business properties, which is the key indicator used in prioritising Welsh Government's Flood & Coastal Erosion Risk Management (FCERM) spending.

The Welsh Assembly Minister for Environment, Energy and Rural Affairs made a statement on Flood and Coastal Erosion Risk Management to the National Assembly on 12th March 2019 (Senedd.tv, 2019). With regard to funding future works she confirmed that the proposals for the Phase 3 frontage were not included for in the current programme (to financial year 2021-22) as they don't meet the priority for funding identified above.

Coincidentally, on the same day the Deputy Director of the Water and Flood Division of Welsh Government wrote to Conwy CBC confirming that any scheme at Old Colwyn would be ineligible for CRMP funding (Appendix II).

⁶ DCWW have previously contributed to the costs of making good the existing defences, when a void appeared in the promenade close to their services, following storms in Spring 2018.

Furthermore, the Minister highlighted the need for Welsh Government, National Resources Wales and Local Authorities to work in partnership with e.g. utilities and transport bodies that benefit from the provision of coastal defences with regard to sharing responsibility for expenditure where there are clear benefits to these operators, highlighting in response to a question, that this approach was being adopted with regard to proposals for the Colwyn Bay Waterfront Phase 3 frontage.

Also, whilst acknowledging that WG officials had had contact with Conwy CBC and Network Rail officials in relation to proposals for this frontage, the Minister however highlighted that it was Conwy CBC's responsibility to bring other stakeholders together, in relation to proposals for this frontage. In response to this the Assembly Member for Clwyd West suggested that a summit should be convened to find a way forward for this scheme, involving all stakeholders, otherwise he felt that there was a low chance of the scheme going ahead (Darren Millar AM, 2019).

In addition, the local MP – the RT Hon David Jones – contacted the UK Government's Secretary of State for Transport requesting assistance from Westminster but was advised that whilst the strategic importance of the infrastructure at risk was acknowledged, this was a matter for the relevant parties identified above.

3.4 POTENTIAL PHASING OPPORTUNITIES

In terms of potential options for sub-phasing the proposed Phase 3 works, there are limited options available due to the nature of the works. Given the precarious nature and poor condition of the existing defences, Option 1 can only be considered as a temporary measure in the immediate term, until such time that improved arrangements can be put in place.

In broad terms, potential phasing arrangements are considered to be limited to:

1. Implement Option 2 works in the short term and the full phase 3 proposals further down the line;
2. Implement Option 3 proposals in stages, doing a section of frontage at a time;
3. Consider options for purchasing and stockpiling materials ahead of construction for Phase 3;

Considering each of these in turn.

3.4.1 Option 2 then Option 3

Implementing Option 2 in the short term would provide immediate benefits in terms of reducing the risk of failure of the existing defences, by providing improved passive resistance in front of the wall. Overtopping of the wall would still take place, albeit at an estimated 50-85% of the mean rate that would occur under current conditions. Over time the rate would increase with predicted climate change, such that in <50 years predicted overtopping rates with the armour toe would be $\geq$ present day conditions without the toe.

In respect of the anticipated damages, this would not significantly alter the risk of damage to CCBC operated infrastructure – railings, promenade, highway etc. and the operational restrictions in terms of road and promenade closures would be largely remain as at present.

The risk of loss of Utilities' infrastructure resulting from sea wall failure would reduce but with continuing damage to the promenade and highway surfacing the risk of service exposure and/or damage would remain.

The reduction in expected overtopping would reduce but not eliminate the risk of damage to the Network Rail boundary wall under current conditions although that risk would increase with time, associated with predicted climate change.

Finally, this approach increases the timescale until A55 highway infrastructure becomes threatened.

When the Option 3 works are commissioned, the rock imported for the toe works would be suitable for re-use in the full works, thereby reducing the cost of importing additional rock at the time.

Overall, whilst accepting that this approach does reduce the risk to infrastructure in the short term it does not, until Option 3 is completed, meet the wider objectives of supporting regeneration of the promenade area and the provision of improved amenity commensurate with the overarching waterfront regeneration plan.

Adopting this approach would add an estimated 2-3% to the cost of constructing Phase 3 outright.

3.4.2 Option 3 in sections

The potential for construction of Option 3 in sections is essentially limited to construction in multiple longshore lengths.

Such an approach would see an increase in overall costs associated primarily with some or all of the following:

- Multiple site mobilisation/demobilisation and temporary work e.g. road diversion costs;
- Multiple materials mobilisation/demobilisation costs e.g. setting up of facilities within quarries to produce the estimated 300,000 tonnes of rock fill required
- As the works provide for an increase in overall crest level of the promenade and associated raising of the highway, dependant on the lengths of sections, a tie-in would be required to be constructed at the boundary of new and old construction each time and then removed when the works re-commence.

With the risk being higher at the eastern end it would make sense for the works to commence at the this end of the frontage and proceed in a westerly direction, although this would mean that the working face would be facing into the prevailing wind/wave direction, which would mean it would be at potentially greater risk of disruption during storms.

It is estimated that each set up could potentially add up an estimated 3-5% of the overall cost.

Constructing the work in two sections would most appropriately be done between Rotary Way and Beach Rd/Cliff Gardens firstly and then from Rotary Way to the western end of the Phase 3 frontage. This would avoid temporary highway tie-in construction as the first phase would tie-in to levels on the easterly side of the ramp.

The anticipated split of costs for this approach would be:

Section 1: £25.3 million;

Section 2: £11.0 million.

Total Cost: £36.3 million

Alternatively, if Section 1 was further split into two, based on constructing the full profile over the length that doesn't presently have any rock toe (approx. 400 metres) then the split would be:

Section 1: £17.2 million;

Section 2: £ 9.2 million;

Section 3: £11.0 million.

Total Cost: £37.4 million

The above costs are subject to the caveats identified above in respect of contingencies/estimate bias allowance and present design uncertainties.

Such approaches require a commitment from funding agencies that monies will be available to complete all phases of the works.

The approximate locations of the sub sections are shown on Figure 14.

3.4.3 Stockpiling materials

Purchasing of bulk materials by the Client would require them to come to an agreement for rock to be produced and then set aside as the Client's property ahead of construction being confirmed. The rock would have to be stockpiled either at source or at a location that the Client has available.

This option has a higher risk to the Client if agreement is not in place that the Works will take place, in that it will have paid for rock which, in the event that the scheme does not go ahead or is temporarily shelved, it may not have an immediate alternative use for.

Purchasing of rock will have storage costs associated with it if it is stored at source and additional double handling costs and/or transport costs if it is stored away from the source. Conversely this would be offset to a degree by the extra cost that the rock would cost if purchased in the future.

This option has a higher risk associated with it than the other options and if the costs or monies available are equivalent to say that to construct Option 2 then it would be more appropriate to consider carrying out that work in-situ rather than purchasing and temporarily stockpiling the rock elsewhere, notwithstanding that the additional cost of building and taking down (approx. £500,000) may be more expensive than stockpiling it.

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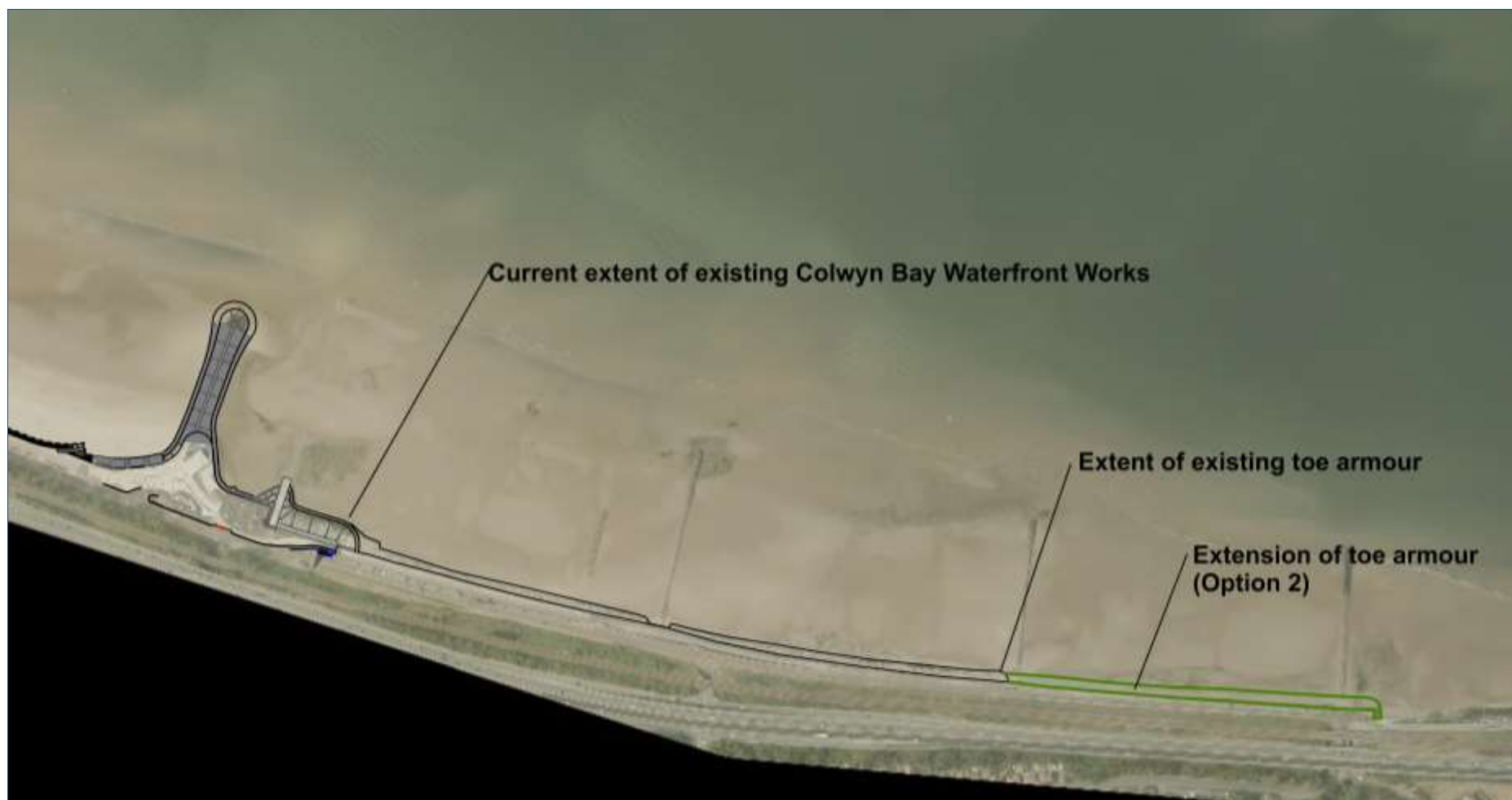


Figure 13: Proposed Works Extents – Option 2

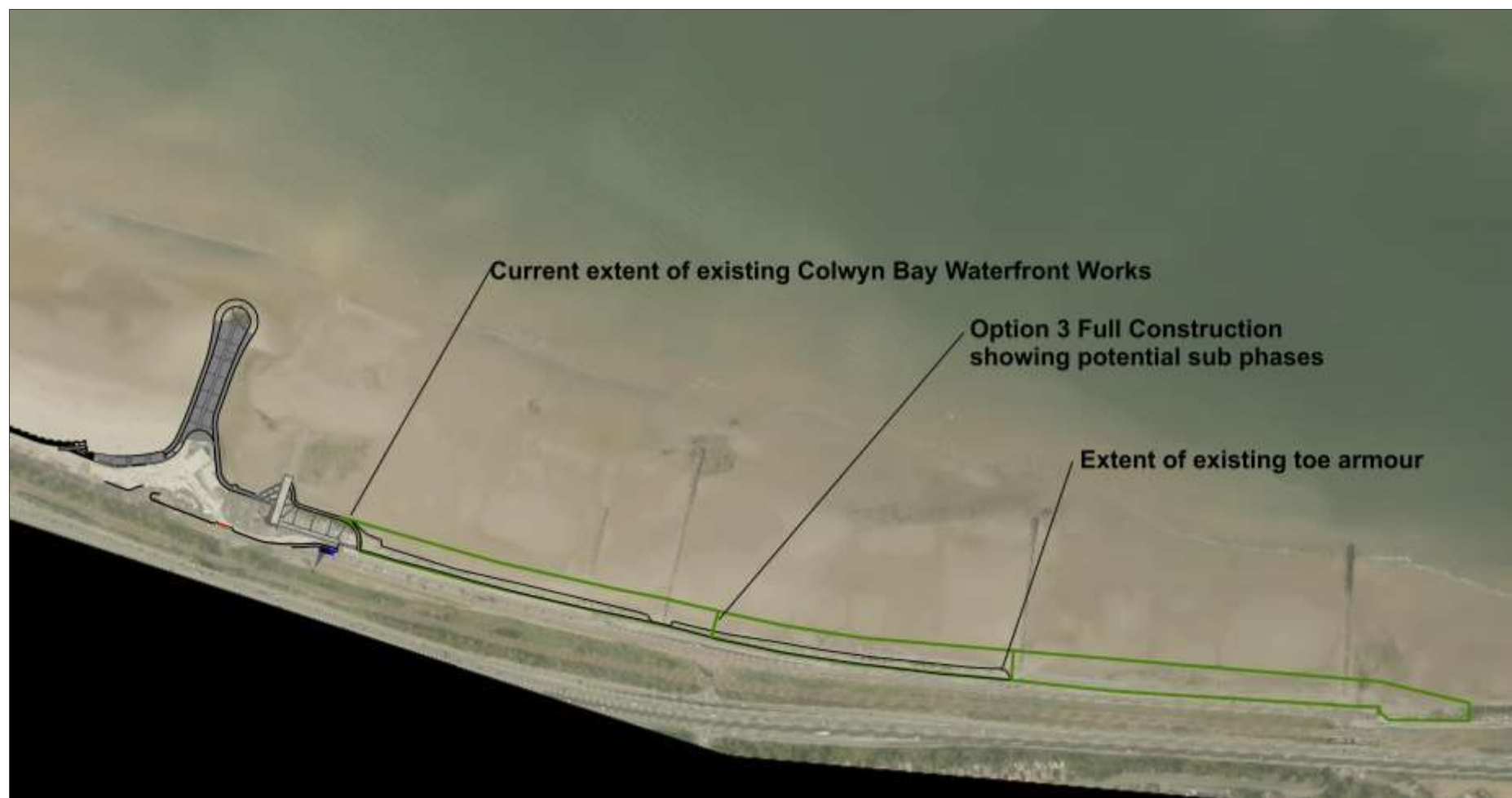


Figure 14: Proposed Works Extents – Option 3

4. PUBLIC SERVICE IMPACT REVIEW

4.1 INTRODUCTION

As identified in section 3.3.4 above an assessment of the direct economic damages, if no further coastal defence management works were to be undertaken by Conwy CBC, was undertaken as part of the development of the business case for Welsh Government Grant Aid for the Colwyn Bay Waterfront project.

The damages calculated assume that as well as there being no future investment works in coastal defence measures by the Coastal Erosion Risk Management Authority (Conwy CBC) the damages would be limited to the like for like replacement cost of the services in respect of Utilities and the cost of providing an alternative service with regard to the road and rail infrastructure that would be affected. Specifically, this did not include construction of new infrastructure in an alternative position or the cost of carrying out works to protect the asset.

In reality, this may not be the case so as part of the review and in order to gauge to what degree of economic benefit is gained by the various infrastructure providers affected, a review of what actions would be taken has been carried out as part of this study.

In order to inform this review and assessment, contact was made with those bodies whose assets are affected or who have responsibility for emergency service provision, in order to identify what they would do in order to ensure on-going operation of the asset/public safety, both temporarily and in the longer term.

The following stakeholders were contacted:

- CCBC Highways;
- CCBC Harbourmaster;
- CCBC Street Lighting;
- Dŵr Cymru Welsh Water;
- Emergency Services - Police, Fire, Ambulance;
- Network Rail;
- North and Mid Wales Trunk Road Agency (NMWTRA);
- North Wales Councils Regional Emergency Planning Service;
- Scottish Power;
- Welsh Government Network Management Division (Transport)

requesting details of the actions that would be taken by the organisation and an estimate of the associated costs of implementing those actions in the event that the existing coastal defences between Porth Eirias and Beach Rd/Cliff Gardens failed and were not replaced, specifically:

- if the asset had to be relocated where would that be;
- if the asset were to remain in place what measures would be taken to protect it; or if not
- what diversion arrangements, if any, would be put in place;
- what arrangements would be required to ensure public safety; and
- what other impacts would there be e.g. impacts on the local community etc.

Contact details for stakeholders are provided in Appendix III .

4.2 RESPONSES

Of the organisations contacted responses were received from:

- CCBC Highways
- CCBC Harbourmaster;
- CCBC Street Lighting;
- Dŵr Cymru Welsh Water;
- Network Rail;
- North Wales Councils Regional Emergency Planning Service

- Scottish Power;
- Welsh Government Network Management Division (Transport)

The following sections summarises the key points identified by the stakeholders.

4.2.1 CCBC Highways

- Loss of highway access would mean that traffic travelling along the A547 (Abergele Rd) towards the promenade is directed by current signage towards the seafront down Wynnstay Rd and onto the promenade at Cliff Gardens. In the event that the promenade highway was closed, which would also include closure of access from the A55 at Rotary Way, traffic would have to continue along the A547 into the centre of Colwyn Bay and thence onto the promenade at Marine Drive, between Porth Eirias and Rhos-on-Sea. This would lead to significant congestion, particularly during the summer months; and
- There would be a loss of parking on the promenade

4.2.2 CCBC Harbourmaster

- Loss of the promenade would mean loss of the promenade amenity and access to the beach at locations east of Porth Eirias;
- This would have a negative impact on public use of the beach at Old Colwyn and reduced numbers of visitors would impact negatively on the local economy
- In the event that the sea wall/promenade were structurally weakened public access would be prohibited;
- The cost of monitoring and managing the area – increased inspections, erecting and maintaining fencing is estimated to cost £30,000 per annum.

4.2.3 CCBC Street Lighting

- In 2015, the Street Lighting was located to the landward side of the highway between Rotary Way and Beach Road due to deterioration of the cable network. If the sea wall/promenade collapsed this would cause damage to the underground cable network with the risk of possible fatal or severe injury to the public;
- In general, if no Street Lighting was utilised in this area then there would be a possible increase in crime & anti-social behaviour which would have a negative effect on road & public safety & pedestrians; and
- With regeneration of the promenade (Option 3 only) street lighting would be upgraded to LED lighting with a 65% saving in energy and carbon footprint. This would also boost tourism.

4.2.4 Dŵr Cymru Welsh Water

- DCWW operate two lengths of sewer within the Phase 3 section of promenade
 - a combined trunk sewer; and
 - a parallel storage pipe

These are located below the promenade immediately behind the sea wall, so in the event of it being breached they could suffer structural damage, with a potential risk of loss of function and pollution.

- DCWW are committed to working with CCBC in relation to arrangements along the Phase 3 frontage;
- DCWW have contributed to emergency repairs carried out to the promenade in the past 12 months and are prepared to work collaboratively with key agencies, to consider the most sustainable long-term options for the protection of the coastal assets in Old Colwyn;
- DCWW have considered the risks associated with the failure of the existing coastal defences between Porth Eirias and Beach Road including dealing with local failures and an assessment of risk in the event of total loss of the affected 1.2km length of promenade, compromising the associated trunk and storage sewers in their entirety;

- In the event of localized repairs being required, it would require flows from Beach Road pumping station (and possibly Tan Lan sewage pumping station) to be tankered for the duration of the work. Repairs downstream of Rotary Way and the Civic Centre could require temporary slipway closure on and off the A55 to enable tankering of flows. Estimated repair costs (include tankering costs) could be in the region of £350,000 per annum average. *CEUK note it is assumed this would be per occurrence.*
- In the event that failure of the defences required the re-routing of services, DCWW have considered three options have been considered
 - A rising main below the seabed;
 - A rising main from Beach Road PS to Eirias Park and gravity sewer combination; and
 - A tunnel option, between Eirias Park Access Road and rear of Beach Road Pumping Station

DCWW have produced a high level estimate of the cost of these options of £4.3 million.

4.2.5 Network Rail

Network Rail responded that they had already been involved in discussions regarding this project and potential funding opportunities. They see CCBC, as the primary coastal protection authority, being responsible for providing coastal protection to third parties and that the risks should be addressed at a more strategic level by Welsh Government.

Network Rail confirmed that relocation or diversion of railway infrastructure would not be a viable option in the event of a failure of the current coastal defences. Under these circumstances the railway would be shut to protect public safety and not re-opened until the risk had been addressed. In the interim bus replacement services would be used.

Network Rail are the key stakeholder with regard to impact on infrastructure protected. It is, considered to be inconceivable, based on their response, that in the event that the sea wall was breached/failed, that they would countenance long term severance of their network. In this respect it is considered likely that they would put in place emergency measures in the short term to protect the toe of their embankment and would then carry out measures to provide long term protection. This was the approach taken by British Rail in 1990 following failure of the railway defences at Towyn in February 1990, which resulted in extensive disruption to the railway and widespread flooding of the hinterland (Coastal Flooding in Towyn 1990, n.d.).

Network Rail did not provide any values for their assets or the estimated cost of protecting them in the absence of investment in the current coastal defences. For the purposes of this study, the high level cost of implementing such works is estimated to be of the order of £5-10 million for temporary works and a further £15-20 million in the long term.

4.2.6 North Wales Councils Regional Emergency Planning Service

The NWCREPS responded that "they have no emergency planning/response impacts of an unplanned, long term closure of the Old Colwyn promenade".

4.2.7 Scottish Power

- There is a 400V low voltage cable running along the length of the promenade, approximately 450mm deep, which SP believe feeds a number of street lights and two small kiosks;
- In the event of a flood SP would isolate the cable at adjacent substations or link boxes. On the assumption that supplies would not be required on the promenade, this cable would be left isolated until a future plan was agreed. This emergency work / action would take approximately 2 hours;
- To permanently abandon the low voltage cable jointing work would be carried out at the boundary of the area affected. This would be estimated to cost in the region of £5000. Usually the abandoned cable would be left in the ground;
- The low voltage cable can also be used to maintain customer supplies when adjacent substations are switched out for planned maintenance. Diverting and retaining this low voltage cable would provide this security and flexibility, however it would not necessarily be an absolute requirement and SP could consider running the network without it;

- SP also operate 11,000V / 400V substations at Port Eirias and the Civic Centre, outside the Phase 3 frontage, which are not considered to be affected in the event of sea wall failure;
- Overall the scenario identified does not pose SP Energy networks significant network issues and they would be able to deal with the situation in an emergency, as it presents itself, with minimal impact on the local community.

4.2.8 Welsh Government Network Management Division (Transport)

- The Welsh Government Network Management Division are not aware of any assets that would require re-locating or diverting; and
- From a public safety perspective, they did not envisage any immediate arrangements that would be necessary to the A55 Dual Carriageway should the sea defences fail due to the fact that the rail track provided a buffer⁸.

The Welsh Government Network Management Division (Transport) did not provide any values for their assets. Current costs for construction of a two lane dual carriageway are estimated to be of the order of £10-12 million per kilometre (average 2005 costs updated to 2019 using Construction Tender Indices). However, given that any replacement road would have to be constructed in an elevated position, either supported on piles or through a bridge arrangement, on the same alignment it is likely that actual costs would be much higher, perhaps double.

4.2.9 Emergency Services

Of the Emergency Services only the North Wales Fire and Rescue Service responded and identified that they would need more time to carry out detailed analysis of impacts but commented that they “would consider that this would a major event requiring significant contingency arrangements to minimise the impact on business continuity”.

4.2.10 Organisations that didn't respond

No responses were received from North Wales Police, the Welsh Ambulance Service or NMWTRA. The emergency services do not have a responsibility for assets so their primary issues would be about managing public safety, access and traffic movements in the area, presumably in line with concerns raised by CCBC Highways and CCBC Harbour Master.

The North Wales Police, Fire and Ambulance services would presumably have a concern over any impact closure of the highway would have on response times. In addition, the RNLI would still be able to gain access to the sea at Porth Eirias (ref , left), if required, the access at Beach Rd/Cliff Gardens (ref , right) not being suitable anyway.

Figure 15: Beach Access Locations



Foreshore Access at Porth Eirias



Foreshore Access at Beach Rd/Cliff Gardens

⁸ Although this is strictly the case, damage to or loss of the embankment and bridge adjacent to the Promenade/Cliff Gardens junction would potentially threaten the integrity of the supports to the A55 at this location (ref Figure 10 – right)

4.3 **FUTURE ACTIONS**

Based on the responses, in practical terms, the likely impacts actions and associated costs that would ensue in the event that CCBC were unable to undertake future management of their defences are:

- Permanent closure of the promenade and highway to pedestrian and vehicular traffic at an estimated cost of about £30,000 per annum to the Local Authority;
- Modification to highway signage and implementation of a permanent vehicular diversion route through Colwyn Bay, cost unknown but estimated to be of the order of £20-30,000 per annum;
- Construction of terminal works at the interface with already completed sections of the Colwyn Bay Waterfront to safeguard the investment made here. Estimated to cost £3-5 million. Funded by CCBC with potential FCERM grant aid from WG;
- Diversion of part of the National Cycle Route 5 through the centre of Colwyn Bay with the associated risks and costs (new signage, routing etc.) this would entail;
- Permanent diversion of Dŵr Cymru Welsh Water services at a high level estimated cost of £4-5 million;
- Abandonment of low voltage electricity supply at a cost of £5000 to Scottish Power; and
- Provision of temporary and subsequently permanent protection to the railway embankment at an estimated cost to Network Rail of £20-30 million, assuming Network Rail would not allow their asset to be compromised in the long term. This approach would, it is expected, lead to some short term disruption to services e.g. the provision of rail replacement buses, whilst such measures were put in place.

At face value, the response from the Welsh Government Network Management Division suggests that they do not see there being any requirement on them to invest in protection works to their infrastructure, however that would only be the case if Network Rail carried out works to protect their asset, which they have said they would do. If they didn't then ultimately there would be a risk to the Trunk Road network, which could potentially cost conservatively up to £30 million to manage.

5. **FUTURE COLLABORATION**

Welsh Government have identified that as this phase of the project does not meet their criteria for funding, it is ineligible for funding under their current Coastal Risk Management Programme (CRMP) and that a collaborative approach needs to be developed to deliver the scheme and the benefits it provides to public and private organisations.

On the basis that no funds would be made available under Flood and Coastal Defence Grant Aid by the Welsh Government Environment Directorate, the key stakeholders that could reasonably be expected to participate, collaborate and potentially contribute to the cost of refurbishing the defences across the Phase 3 frontage are:

- Conwy County Borough Council as Lead Flood and Coastal Erosion Risk Management Authority under the Coast Protection Act 1949 and the Land Drainage Act, 1991 as amended by the Flood and Water Management Act, 2010;
- Network Rail whose assets currently protected represent the most economic value of the infrastructure protected at immediate risk;
- Dŵr Cymru Welsh Water whose local assets would need to be re-routed in the absence of works to improve the current defences;
- Welsh Government Network Management Division, whose National Trunk Road assets, managed by NMWTRA, would be at risk in the longer term if other stakeholders, i.e. Network Rail, did not carry out works.

In addition, the National Cycle Route runs along the promenade and Sustrans could also be approached with a view to potentially contributing to the scheme.

The starting basis for examining potential contributions arises from the costs to the various stakeholders, if improvement works are not carried out. At present day values the approximate costs that could be incurred by the key stakeholders, assuming the future actions, as defined in section 1.1, are carried out would be:

- | | |
|---------------------------------|-------------------------------|
| • Conwy County Borough Council: | £ 8-10 million ⁹ ; |
| • Network Rail: | £ 20-30 million; and |
| • Dŵr Cymru Welsh Water: | £ 4-5 million; |
| • Sustrans: | £ 1-2 million. |

If Network Rail were not to carry out works to protect their asset then NMWTRA would incur costs of an estimated similar magnitude as Network Rail to protect their assets.

As identified in section 2.4.4 any disruption to the railway would also have a loss in terms of impact on rail users, causing increases in journey times and requiring alternative transport to be laid on whilst protection measures were put in place. Based on accepted methodologies for quantifying the cost of delay and provision of a rail replacement bus service (Middlesex University Flood Hazard Research Centre, 2016), the economic cost to the nation has been estimated to be approximately £15 million per annum. In addition, there would be further indirect losses to the local and regional economies of Conwy and North Wales in terms of the impact on the numbers of tourists and the disruption to freight carried on the network between Abergele and Llandudno Junction.

It should also be recognised that without the proposed works there would be an indirect loss to the local economy of Colwyn Bay associated with the loss of a popular and well used section of promenade and the potential knock on impact this could have in terms of public perception on the remainder of the already completed waterfront.

Based on the above the estimated direct and indirect economic cost of allowing the existing defence line to fail and alternative measures be put in place by individual stakeholders clearly outweighs the costs of

⁹ Based on Annual expenditure of £50-60,000 per annum over 100 years and the cost of terminal works to protect the current waterfront investment.

developing a collaborative approach, where individual stakeholders contribute to the costs in line with the level of economic risk and disruption to their infrastructure/operations there would be.

In practice, it is appropriate that contributions made by individual stakeholders would not exceed the estimated costs that the stakeholder would incur if no works were promoted here. Such an approach is currently being explored with United Utilities (UU) in relation to proposed coastal defence works at Crosby on Merseyside, where the Local Authority (Sefton Council) are looking to promote an erosion protection scheme and UU's rising main and pumping station (part of the Mersey Estuary Pollution Alleviation Scheme) represent the primary infrastructure at risk in the short term. In this case, it is understood that UU are potentially looking to contribute up to the value of the cost to re-align their services outside the predicted limits of erosion. This is similar to the position that DCWW have at Colwyn Bay.

Without funding support from Welsh Government promotion of the scheme would require the remaining individual public and private bodies to contribute the full costs of the works, currently estimated to be approximately £35 million.

If the scheme were eligible under CRMP then Conwy County Borough Council would have to fund 25% of the cost. This would equate to £7-8 million, which roughly equates to the estimated direct costs they would incur in the event that the existing defences were allowed to deteriorate and fail. Based on the estimates provided a DCWW contribution would be of the order of £5 million, leaving a shortfall of £22-23 million to be found from other sources, primarily Network Rail and potentially Welsh Government Network Management Division.

It is understood that Network Rail have identified £1.2 million of investment, during their current CP6 funding period (2019-24)¹⁰, on their current defences to the east of the promenade/Cliff Gardens junction. However, the potential contribution to this scheme is significantly greater and would, it would be expected, require funds identified for other NR proposed schemes to be diverted to Colwyn Bay, based on urgency of need.

DCWW have already intimated that they would be willing to contribute to the costs of a scheme that preserves their current infrastructure, however further dialogue with Network Rail and the Welsh Government Network Management Division in particular is clearly essential if a collaborative way forward is to be achieved.

¹⁰ Letter from RT Hon Chris Grayling MP, Secretary of State for Transport to Rt Hon David Jones MP for Clwyd West – 25 Feb 2019.

6. **WAY FORWARD**

The report presented has defined the current conditions applying across the Colwyn Bay Waterfront Phase 3 frontage, provided an updated assessment of the risk to infrastructure if works are not carried out, identified the costs for a range of options for implementing the preferred scheme and provided a basis for developing funding arrangements for the scheme.

The current estimated cost for implementing the defence improvements that accord with the Council's overall Colwyn Bay Waterfront regeneration objectives is approximately £35 million, which includes a 30% contingency allowance to cover present uncertainties and unknowns.

However, Welsh Government Environment Directorate have identified that as the scheme does not provide protection to residential or commercial properties it is ineligible for funding under the Coastal Risk Management Programme. Accordingly, the scheme will have to be funded by key stakeholders whose assets/infrastructure receives protection from the proposals i.e.

- Conwy County Borough Council;
- Dŵr Cymru Welsh Water;
- Network Rail;
- The Welsh Government Network Management Division; and potentially
- Sustrans.

It is clear, from the budget costs identified, that the level of investment required cannot be met solely from the County Council's budgets alone and significant contributions are required from the other private and public stakeholders, primarily Network Rail, Dŵr Cymru Welsh Water and potentially the Welsh Government Network Management Division.

Welsh Government have to date been involved in promoting dialogue between interested parties and the AM for Clwyd West has proposed that a summit of interested parties be convened to move things forward. Dŵr Cymru Welsh Water have co-operated with Conwy CBC in carrying out maintenance due to storm damage and have indicated a willingness to co-operate in developing proposals further, however the value of their infrastructure alone combined with potential Council contributions would only provide a third of the expenditure required and a significant financial burden potentially falls on Network Rail and the Welsh Government Network Management Division.

At the present time there appears to be a lack of willingness by both these parties to engage on this matter and this needs to be the focus in the short term. In Network Rail's case the consequences of inaction or willingness to co-operate could lead to costs and/or damage on potentially a similar scale to that which occurred at Towyn 30 years ago.

The longer it takes to develop a way forward the greater the risk of catastrophic failure of the current defences. The frontage is at risk of overtopping and therefore promenade closure and potential damage on every spring tide period, particularly if onshore west to north west winds occur concurrently. Accordingly, there is only a finite time (probably less than 5 years based on condition assessments of the existing defences and likely storm frequency) that the Council are going to be able to continue their current policy of "make do and amend" and decide that this approach is no longer sustainable financially. In such a case the decision would have to be made to close the promenade permanently and nature would take its course requiring the other stakeholders to adopt their own action plans to protect their infrastructure.

The immediate risk of damage could be reduced by construction of a rock toe along that section of frontage where one doesn't exist, over approximately 40% of the length, at an estimated cost of approximately £2.0 million, which would contribute to safeguarding the integrity of the existing defences, where they are currently weakest and would also reduce the overtopping taking place across this part of the frontage. This would buy some time to develop arrangements for permanent improvements.

However, it is important to recognise that this only represents a short-term solution, that does not address the longer-term risk to infrastructure across the frontage, although the rock imported would be available to be re-used in the proposed works when they are implemented.

Notwithstanding the benefits that implementing Option 2 in the short term would have, it is important that adopting this approach is not allowed to lead to complacency amongst potential partners/collaborators, assuming that the proposed Option 3 works would not then need to be implemented. This would have a perceived negative affect on Colwyn Bay, by not delivering fully on the objectives for the Waterfront Project, that were set out at the outset, and therefore not fully delivering the wider benefits identified for the overall Colwyn Bay frontage.

Accordingly it is suggested that development of a collaborative approach between Conwy CBC, Welsh Government, Network Rail, the Welsh Government Network Management Division and Dŵr Cymru Welsh Water to a point where there is a binding agreement to contribute to the Option 3 works is made, albeit at a date in the future that is mutually acceptable to all parties, before there is a commitment by Conwy CBC to implement the stop gap works, should those funds be available.

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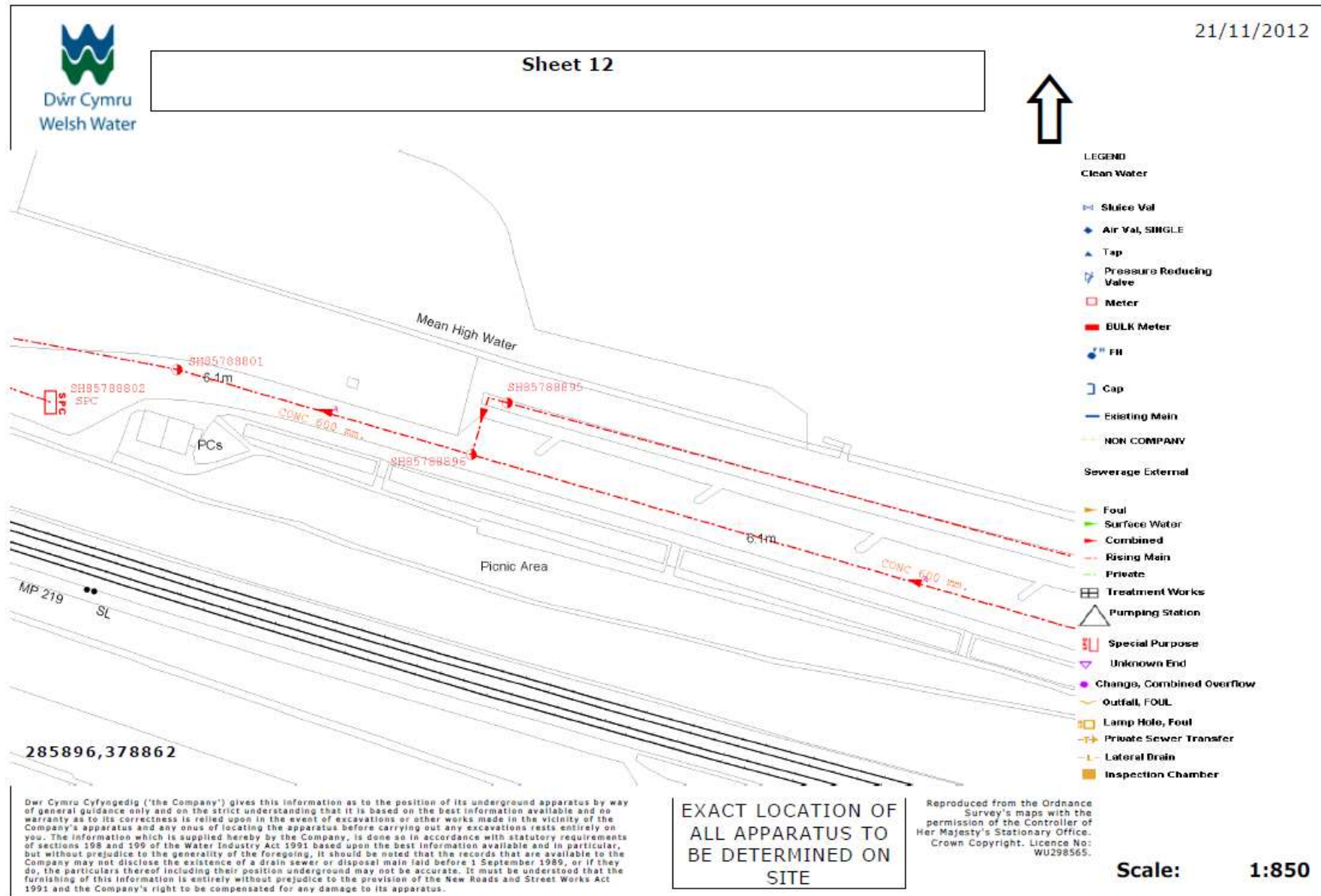
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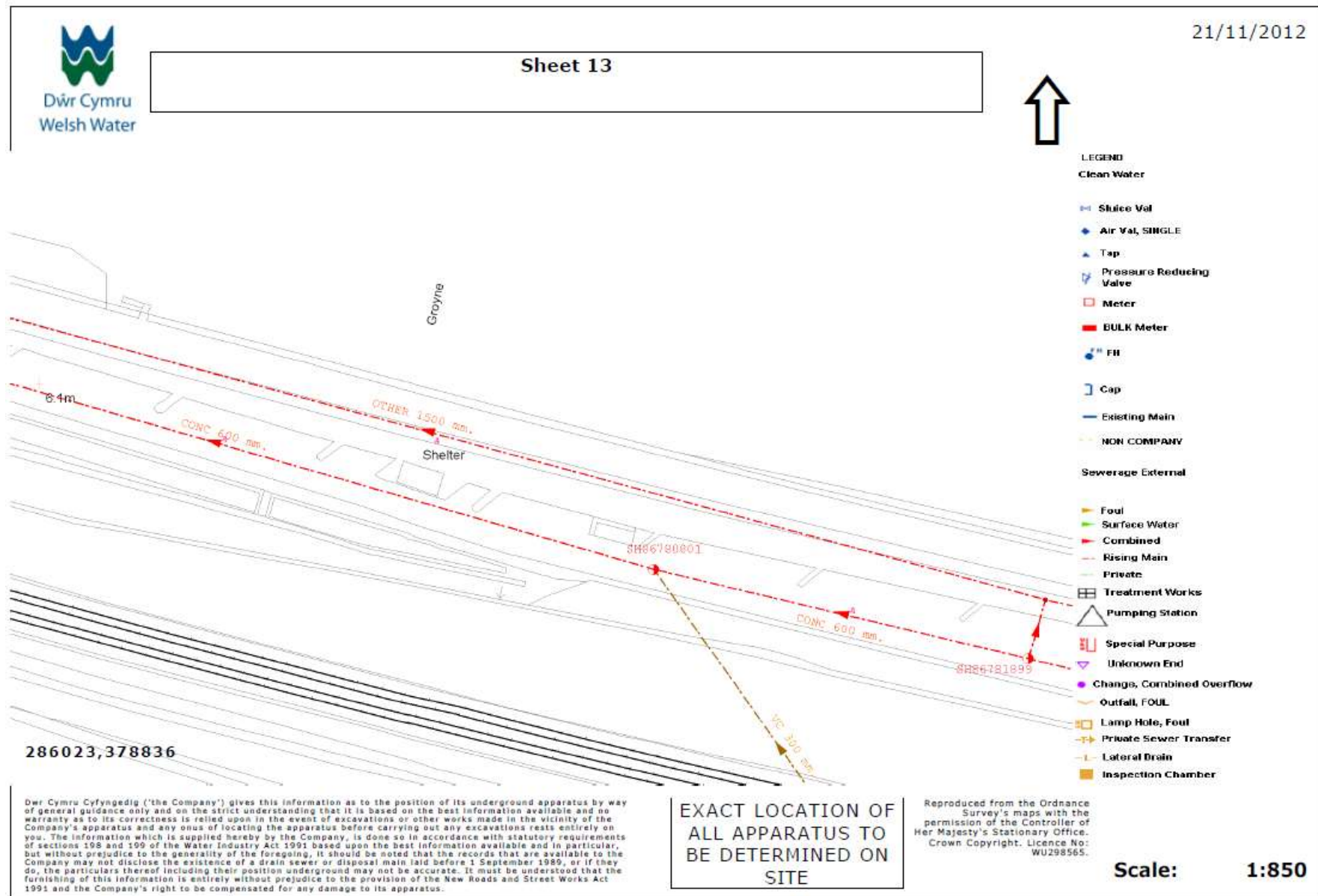
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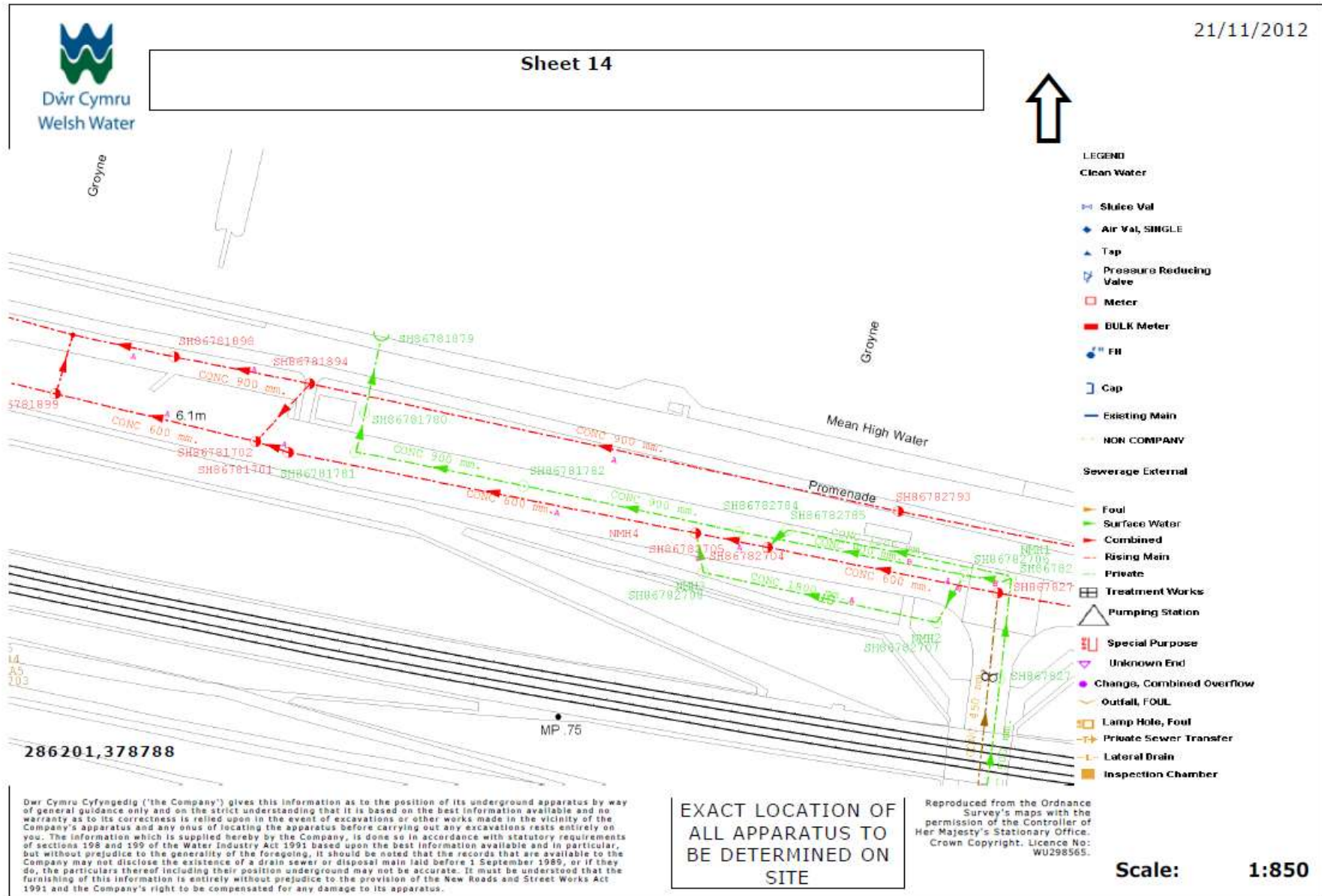
APPENDICES

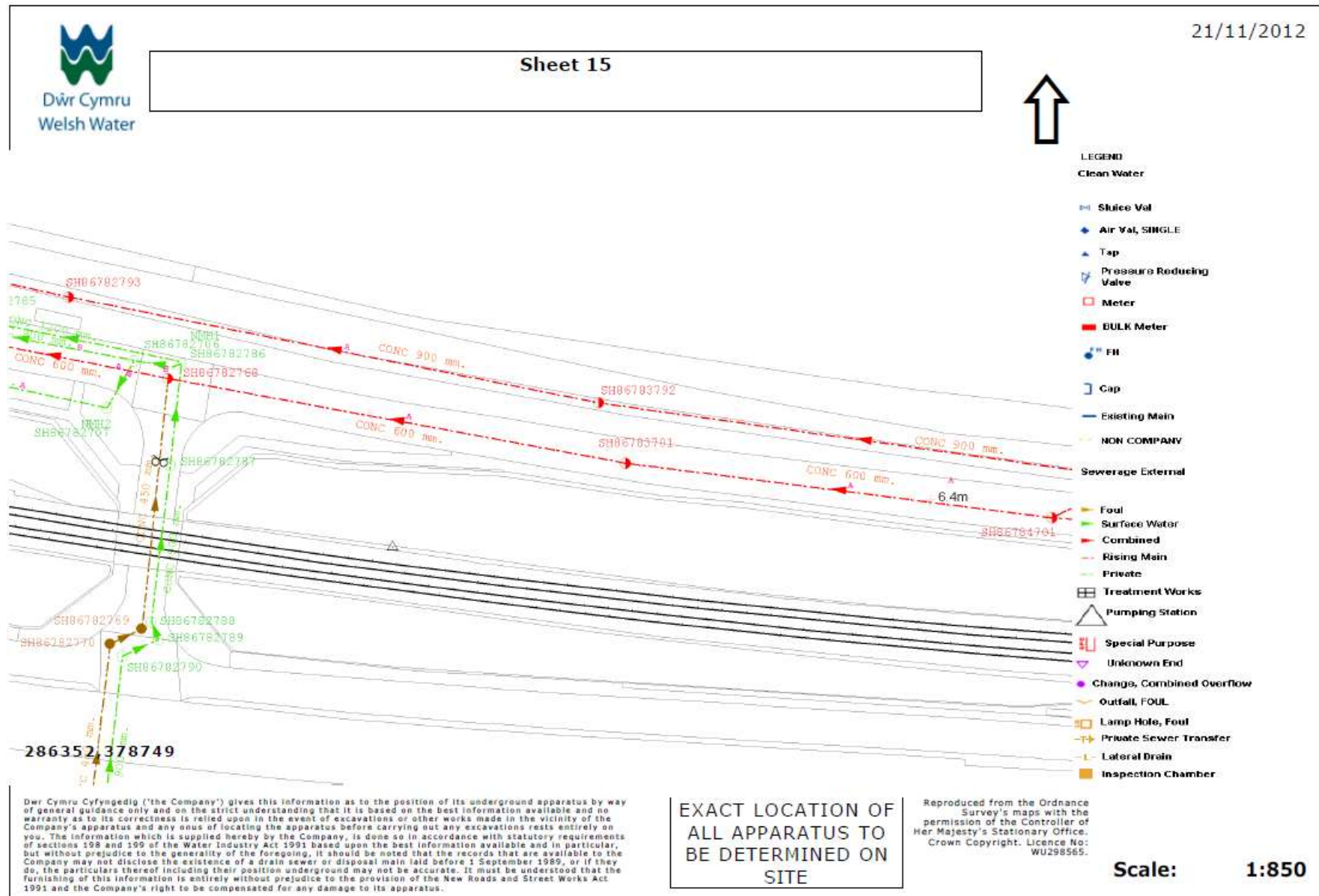
Appendix I: Utility Service Plans

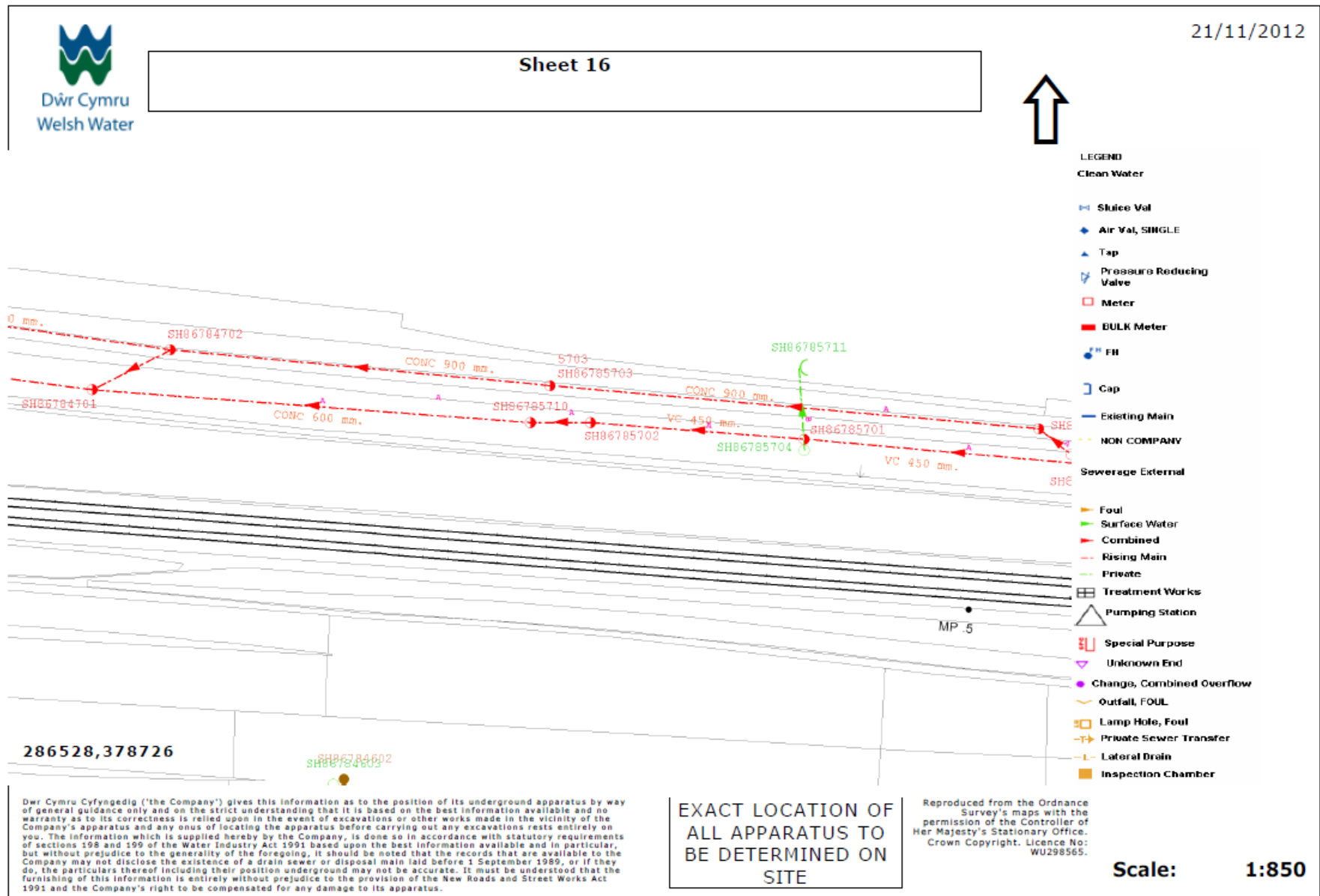
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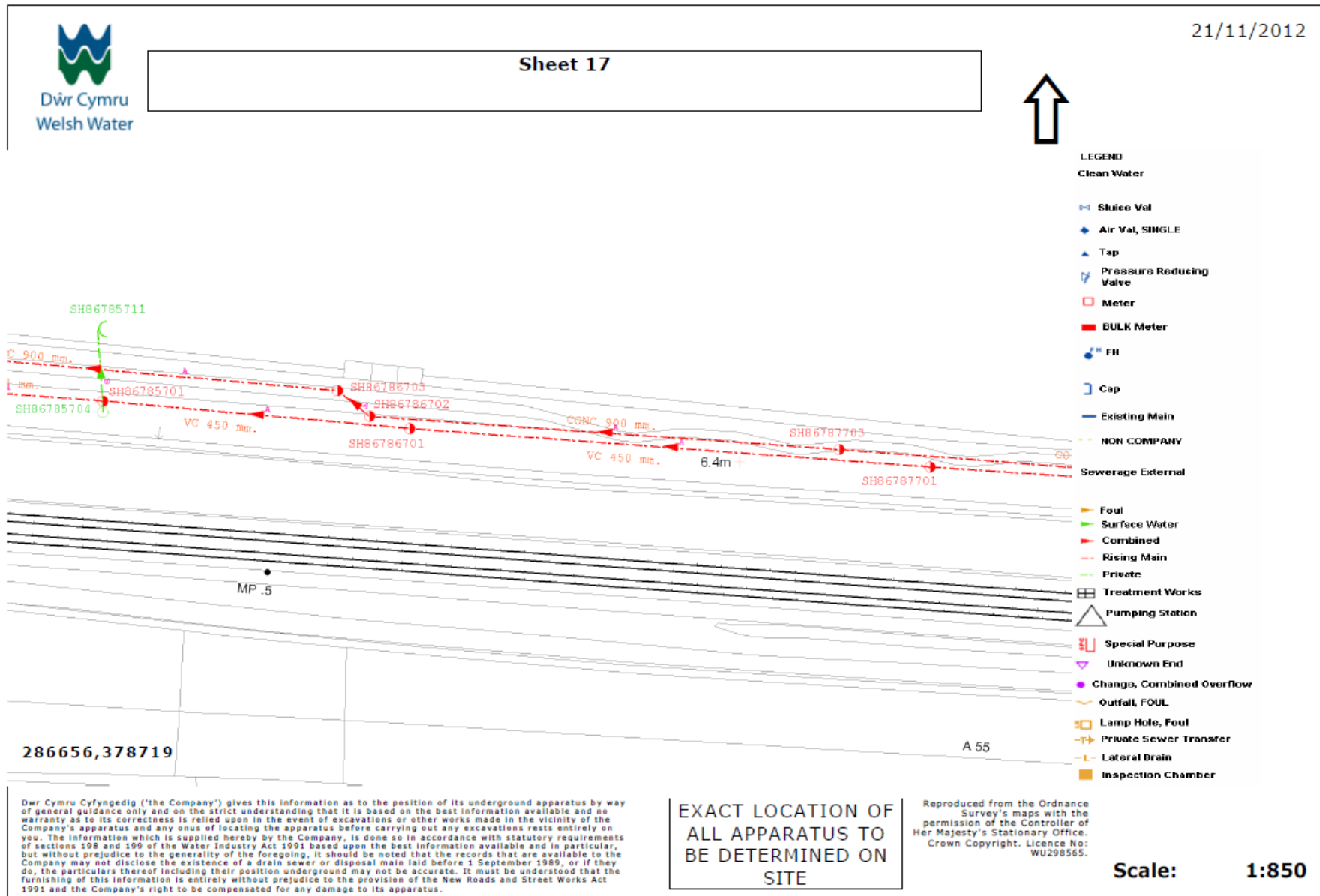














Appendix II: Letter from Welsh Government – March 2019

Water and Flood Division
Is-adran Dŵr a Llifogydd

Owen Conry
Conwy County Borough Council,
Mochdre Offices,
Conway Road,
Mochdre
LL28 5AB
owen.conry@conwy.gov.uk



Llywodraeth Cymru
Welsh Government

12 March 2019

Dear Owen,

I write following recent emails from Dyfed Rowlands, Conwy County Borough Council, regarding the Old Colwyn Coastal Defence works and the requests for Welsh Government funding through the Coastal Risk Management Programme (CRMP).

It is important that the best possible use is made of the resources available to support flood and coastal risk management across Wales, and in that regard the primary objective of the CRMP, and the Welsh Government's core programme, is to reduce risk to properties, primarily homes. It is on this basis that coastal defence schemes in the Colwyn Bay area have benefitted from significant Welsh Government funding to date.

Whilst the proposed scheme at Old Colwyn would reduce risk to infrastructure, this would be considered as a wider benefit within the CRMP. The proposed scheme at Old Colwyn does not meet the primary objective of the Programme – to reduce risk to homes and businesses. This is the measure by which all potential schemes have been assessed, and it is for this reason that I am writing to confirm that the proposed scheme is ineligible for CRMP funding.

Yours sincerely

Huw Owen
Deputy Director, Water and Flood Division, Welsh Government



BUDDSODDWYR | INVESTORS
MEWN POBL | IN PEOPLE

Phone • Ffôn: Tel 0300 061 5962
Email • epost: Huw.owen@gov.wales
Gwefan • website: www.wales.gov.uk

Appendix III: Key Stakeholders Contact and Response Details

Stakeholder	Contact	Response Received
Dŵr Cymru Welsh Water	Sharon Ellwood sewerage.services@Dŵrcymru.com	Yes 29/03/19
WG Highways	Carol Willgoose Carol.Willgoose@gov.wales	Yes 01/04/19
SP Energy Network	Terry Jones Terry.Jones@spenergynetworks.co.uk	Yes 02/04/19
CCBC Harbourmaster	Matt Forbes matthew.forbes@conwy.gov.uk	Yes 04/04/19
CCBC Highways	Stephen Daly Stephen.Daly@conwy.gov.uk	Yes 08/04/19
CCBC Street Lighting	Len Jackson Len.Jackson@conwy.gov.uk	Yes 09/04/19
North Wales Councils Regional Emergency Planning Service	Neil Culff neil.culff@nwc-reps.org.uk	Yes 28/05/19
North Wales Fire & Rescue Service	helen.macarthur@nwales-fireservice.org.uk	Yes 31/05/19
Network Rail	Andy Cross Andy.cross@networkrail.co.uk Dan Hughes Dan.Hughes@networkrail.com	Yes 19/7/19
North Wales Police	force.control@nthwales.pnn.police.uk	No Further chased on 03/04/19
North Wales Ambulance Service	amb_northshiftmanagers@wales.nhs.uk	No Further chased on 03/04/19

Appendix 2.2 – Colwyn Bay Phase 1 Engineering Works Environmental Statement: Volume 1

COLWYN BAY WATERFRONT PROJECT

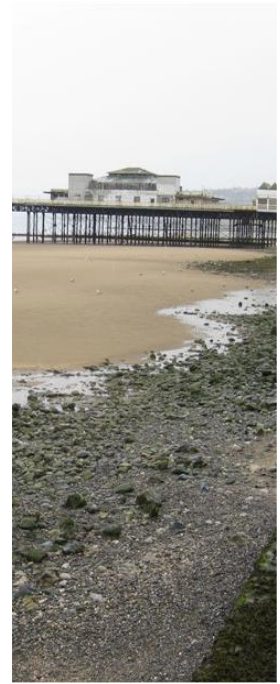
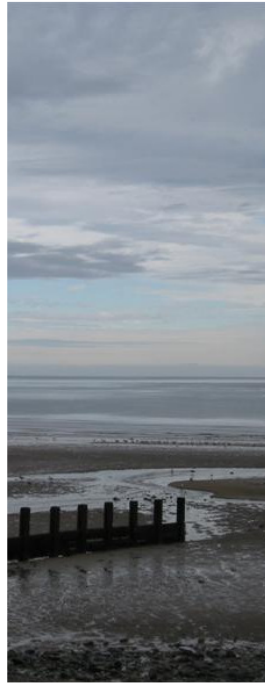
Phase 1 Engineering Works

Environmental Statement: Volume 1 Main Text



October 2010





Colwyn Bay Waterfront Project Phase 1 Engineering Works

Environmental Statement Volume 1: Main Text

October 2010
Conwy County Borough Council

Colwyn Bay Waterfront Project Phase 1 Engineering Works

Environmental Statement Volume 1: Main Text

October 2010

Conwy County Borough Council

Mochdre Offices, Conwy Road, Mochdre, Colwyn Bay, LL28 5AB

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	October 2010	Various	N. Berry P. Bointon	A. Lawrance	First Issue

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Abbreviations

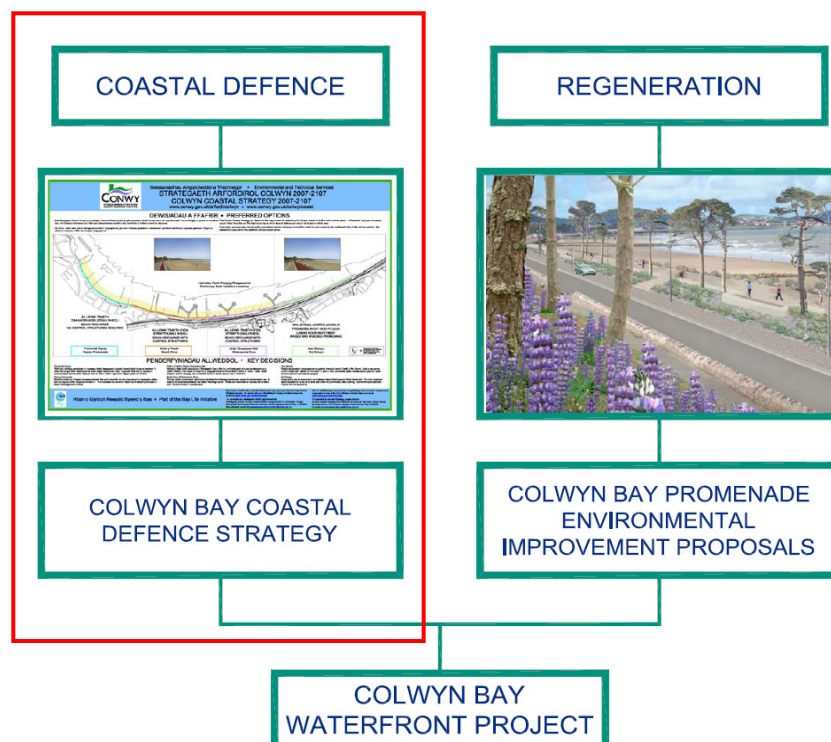
mAOD	m Above Ordnance Datum
AQMA	Air Quality Management Area
BGS	British Geological Survey
CCBC	Conwy County Borough Council
CCW	Countryside Council for Wales
CEMP	Construction Environmental Management Plan
CEUK	Coastal Engineering UK
CPA	Coast Protection Act
DCLG	Department of Communities and Local Government
EA Wales	Environment Agency Wales
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESA	Environmentally Sensitive Area
FEPA	Food and Environment Protection Act
GV	Government View
ICZM	Integrated Coastal Zone Management
IEMA	Institute for Environmental Management and Assessment
LDP	Local Development Plan
LSAO	Lower Super Output Areas
LSP	Local Strategic Partnership
MAGIC	Multi Agency geographic Information for the Countryside
MCS	Marine Conservation Society
MTAN	Mineral Technical Advice Note
NTS	Non-Technical Summary
PAG	Project Appraisal Guidance
PAR	Project Appraisal Report
PPS	Planning Policy Statement
SAC	Special Area of Conservation
SMP	Shoreline Management Plan
SPA	Spatial Plan Area
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
T&C EIA Regulations	Town and Country (Environmental Impact Assessment) Regulations
TAN	Technical Advice Note
WAG	Welsh Assembly Government
WSP	Wales Spatial Plan

1. Introduction

1.1 Overview

- 1.1.1.1 Mott MacDonald Ltd has been commissioned by Conwy County Borough Council (CCBC) to undertake an Environmental Impact Assessment (EIA) for coastal defence elements of the proposed Colwyn Bay Waterfront Project. This Environmental Statement (ES) has been produced following the EIA process to accompany a full planning application to be submitted to CCBC for Phase 1 engineering works and outline planning permission for Phase 2 and 3 improvements to the coastal defences along a 3.5km stretch of the Colwyn Bay waterfront.
- 1.1.1.2 The scheme is to work in conjunction with a regeneration package of environmental improvements for Colwyn Bay forming the other half of the Colwyn Bay Waterfront Project (see Figure 1.1). **However, the regeneration package has separate funding from the coastal defence improvements and hence will be covered by a separate planning application and supporting EIA. Therefore, the potential impacts stemming from the regeneration and environmental improvements are not assessed in this ES, which focuses on the physical aspects of the engineering works only. Potential combined effects of the regeneration and environmental proposals are discussed in the cumulative impacts section (Chapter 10).**

Figure 1.1: Colwyn Bay Waterfront Project Aspects



1.1.2 Colwyn Bay

Location and Description

- 1.1.2.1 Colwyn Bay (Bae Colwyn) is a town and seaside resort in Conwy County Borough on the North Wales Coast. Principal settlements comprise Rhos-on-Sea to the west, the town of Colwyn Bay in the centre and Old Colwyn to the east. The A55 trunk road passes through the town, running parallel to the North Wales mainline railway, both of which separate Old Colwyn and Colwyn Bay town from the waterfront. A site location plan is provided in ES Volume 2, Technical Appendix 1.
- 1.1.2.2 The long Promenade and associated cycle track follows the waterfront from Rhos-on-Sea past the Victorian pier in the centre of the bay and round to Old Colwyn. Kiosks are situated along the promenade and there are slipways located at regular intervals for beach access.

History

- 1.1.2.3 The town of Colwyn Bay was first developed in 1865, around the railway which predates the town by approximately 20 years. By 1878, Colwyn Bay was a premier seaside resort and development of the town continued during the early part of the twentieth century with the opening of Victoria Pier in around 1900, construction of the promenade along the seafront between 1898 and 1911, continued residential development and the extension of the railway. The A55 highway was constructed in the 1980s.
- 1.1.2.4 Like many other seaside towns, the growth of the foreign holiday market led to a decrease in visitors and subsequent decline in tourist infrastructure. The construction of the A55 expressway through the town in the 1980s accelerated decline by reinforcing the physical barrier between the town centre and waterfront, and removing through traffic from the town centre.

Coastal Defences

- 1.1.2.5 Vertical masonry sea walls were initially constructed between Rhos-on-Sea and Old Colwyn in the later part of the nineteenth century. Historical records indicate that the beach level has fallen considerably over the last century, with a historical loss of beach level across the foreshore, resulting in increased exposure and in some areas undermining of the sea defences. To prevent beach erosion, wooden groynes were initially constructed in the early part of the twentieth century. However, these are now in poor condition and are effectively redundant. Further low level boulder groynes and rock toes were subsequently constructed and maintained in the late twentieth-early twenty-first centuries.
- 1.1.2.6 The present coastal defence provision across the Colwyn Bay Frontage has several key issues. Regular coastal defence overtopping is having negative impacts on the existing defences, adjacent infrastructure and also on the local community through the regular closure of the coast road following storm damage. The regular overtopping has also resulted in a lack of investment in the waterfront area. The railway line, railway station and the A55 are particularly at risk given their location running parallel to the waterfront for a significant distance. In addition, the ageing and deteriorating defences have an imminent risk of failure in the immediate term (0-5 years) and the lowering of the beach through littoral drift (particularly severe following storms) requires on-going intervention which has associated cost implications.

1.1.3 Proposed Development

Options

1.1.3.1 The proposed development is for coastal defence improvement works along approximately 3.5km of the Colwyn Bay coastline and is currently divided into three phases. There were two principal options identified for the scheme:

- **Option 1** which is for the construction of a rock revetment against and over the existing sea wall, a wave return wall and substantial raising of the promenade around the entirety of the bay; and
- **Option 2** which includes variations on the following along the length of the waterfront: the raising of the promenade, the construction of a wave return wall, rock revetment construction, implementation of beach control groynes, and beach recharge, with different areas having different works undertaken depending on the technical feasibility of providing a controlled beach in each particular area along the frontage. The form of the Option 2 coastal defences will facilitate later development of a “watersports hot-spot square”, to be located over a large beach control groyne in the central section of the bay.

1.1.3.2 Development of the project has identified Option 2 as the preferred option at this stage in terms of both coastal defence and in the facilitation of the regeneration and environmental improvement aspects of the Colwyn bay Waterfront Project. This is therefore the option that is assessed primarily within this ES, although in the individual technical chapters, comparisons are made with Option 1. Schematic drawings in ES Volume 2, Technical Appendix 1 pictorially represent the two different options.

Option 2

1.1.3.3 The coastal defence works are proposed to be undertaken in three phases:

- Phase 1 – Cayley Promenade to Eirias Park: Recharging of beach with sand, improvements to the promenade and crest of existing defences. Provision of beach control structure (groyne) on the foreshore and rock armour revetment to the east. The coastal defence works will be supplemented with engineering works to create a hotspot square on the landward side of the groyne and will include an extension of the promenade out over the groyne to form a platform which it is anticipated could be used as a water-based activity launching zone. The design of associated buildings, street furniture, parking and operational facilities will be part of the environmental improvements element of the Colwyn Bay Waterfront Project and hence outside the scope of this ES;
- Phase 2 – West of Cayley promenade to Rhos Jetty: Recharging of beach with sand, improvements to the promenade and crest of existing defences; and
- Phase 3 – East of Eirias Park to Old Colwyn: Construction of rock armour revetment, improvements to the promenade and crest of existing defences.

- 1.1.3.4 The scheme is to work in conjunction with a separate regeneration package of environmental improvements for Colwyn Bay promenade, which includes the hotspot works described above. The project proposals also accord with the Colwyn Bay Masterplan (currently in development) which outlines the aspiration for regeneration in the town over the next ten years and aims to improve the connectivity between the waterfront and the town.

1.1.4 Scheme Objectives

- 1.1.4.1 The principal objectives of the Scheme are as follows:

- To safeguard the integrity of the existing defences while providing improved coastal defence measures within Colwyn Bay;
- To allow the construction of improved defences that are proportional to the risk of flooding and erosion to:
 - the local population;
 - residential properties;
 - local and national infrastructure including the A55 trunk road, Chester-Holyhead mainline railway, railway station and coast road;
- To maintain the availability of the waterfront area as an amenity area for both residents and visitors;
- To allow the progression of other regeneration and environmental improvement initiatives associated with the waterfront and town centre; and
- To accord with the wider Baylife initiative that will benefit the whole of Colwyn Bay.

- 1.1.4.2 The scheme receives funding from the European Regional Development Fund with match funding provided by the Welsh Assembly Government.

1.1.5 Consultation

- 1.1.5.1 Public consultation played a major part of the Waterfront Project Plan in 2006 and 2007. Further to the initial public consultation exercise, technical development of options, economic analysis and environmental appraisal was carried out, in order to complete the strategy and the Draft Strategy Option was presented for further public examination in November 2007.
- 1.1.5.2 As part of the EIA process, during the scoping stage, consultation has been undertaken with statutory and non-statutory consultees as discussed in more detail in Section 1.2.6.

1.2 Environmental Assessment Procedure

1.2.1 Legislative Requirement

- 1.2.1.1 The EIA Directive (97/11/EC) requires an EIA to be carried out in support of an application for development consent for categories of project listed in the Directive at Annexes I and II. For schemes included within Annex I, an EIA is mandatory, while within Annex II, an EIA is required if the development is likely to have significant effects on the environment. Harbour works, marinas, land reclamation and certain coastal defence works fall within Annex II.
- 1.2.1.2 The Marine Works EIA Regulations apply the EIA Directive so that suitable EIAs are carried out prior to granting permission for the deposit of substances or articles within UK waters or UK controlled waters, either in the sea or under the sea bed, from various structures, vessels, containers or structures on land, or anywhere in the sea. The Marine Works EIA Regulations provide for the necessary steps to be taken in addition to those required under existing legislation, namely Part II of the Food and Environment Protection Act 1985 and Part II of the Coast Protection Act 1949:
- Part II of the Food and Environment Protection Act (FEPA) 1985 provides one of the principal mechanisms for controlling the potential environmental impact of marine works. Section 8 of the Act requires the licensing authority, in determining any application to undertake proposed works, to have regard to the need to protect the marine environment and the living resources which it supports.
 - Part II of the Coast Protection Act (CPA) 1949 (as amended) obliges those intending to undertake works involving the placement or movement of articles and materials in the sea, including on or under the seabed or their removal from the seabed, to seek consent of the Secretary of State or appropriate Minister where those works may be detrimental to the safety of navigation.
- 1.2.1.3 As the proposed Phase 1 Coastal Defences at Colwyn Bay will include a landward element that also requires consent under the Town and Country Planning Act, the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 (hereafter referred to as the T&C EIA Regulations) also have to be considered. This results in the requirement for EIA under both the Marine Works EIA Regulations and the T&C EIA Regulations.
- 1.2.1.4 The proposed scheme does not fall within Annex 1 of the EIA Directive (Schedule 1 of the T&C EIA Regulations), within which EIA would be mandatory. However, it does fall within Annex 2 (Schedule 2):
- *Schedule 2 - 10. Infrastructure Projects*
 - *“Coastal work to combat erosion and maritime works capable of altering the coast through the construction, for example, of dykes, moles, jetties and other sea defence works, excluding the maintenance and reconstruction of such works”.*
- 1.2.1.5 As the proposed works are not considered to represent “*maintenance*” and are not limited to “*reconstruction*”, the proposed coastal protection works (regardless of area) fall under Annex 2 of

the EIA Directive (Schedule 2 of the T&C EIA Regulations). Therefore, the need for EIA and an ES had to be considered.

- 1.2.1.6 The Liverpool Bay Special Protection Area (SPA) for the protection of certain bird species abuts the wider Colwyn Bay Waterfront Project Area up to the Mean Low Water Mark and the scheme is also located within the North Wales Coast Important Bird Area. The need for EIA at this site is therefore based on the significance of the potential effects of the coastal defences development on the surrounding environment.
- 1.2.1.7 The FEPA and Section 34 CPA approvals in Wales are dealt with by the Marine Consents Unit at WAG.

1.2.2 Purpose of EIA

- 1.2.2.1 In accordance with current legislation and guidance, the EIA assesses potential environmental impacts, both positive and negative, on the surrounding area during periods of construction and operation of the scheme. Where possible, indirect effects and the effects from other developments in the area have been included in the assessment. The short-term effects from construction and medium to long term effects from operation have been addressed. For most effects, impacts have been assessed on a local to regional scale as the major impacts are likely to be of a local nature.
- 1.2.2.2 The baseline conditions for each of the environmental topic areas are established within this report. Each baseline reviews a range of information sources and includes both desk-based and survey information, as appropriate. Any consultation responses and relevant policy and planning guidance are referred to. The impacts of the proposed development have been assessed and the significance of these impacts identified. Where relevant, mitigation measures (and any potential enhancement measures that may be provided) are established to minimise the significance of any negative impacts identified. The existence of any residual impacts, following the implementation of the proposed mitigation measures and their significance, are also assessed.
- 1.2.2.3 The overall EIA process has involved the following key stages, with statutory and non-statutory consultation throughout the process:
- Screening;
 - Scoping of the EIA;
 - Collection of Baseline Data;
 - Impact Assessment; and
 - Preparation of Environmental Statement.

1.2.3 Environmental Screening and Scoping

1.2.3.1 As the first stage in the EIA process, and in accordance with the T&C EIA Regulations 1999 and the Marine Works EIA Regulations, screening and scoping opinions with regard to the proposals were sought, via production of an Environmental Screening Letter and an Environmental Scoping Document. These were issued to the Planning Authority in August 2010, and had the following purposes:

- Provide an outline description of the proposed developments;
- Ascertain the requirement for EIA;
- Initiate consultation with key stakeholders;
- Describe the EIA process;
- Identify potential environmental and community impacts (both positive and negative) which may arise; and
- Set out a framework for wider consultation.

1.2.3.2 The Environmental Scoping Document provides an initial assessment opinion of the potentially significant issues which require detailed examination and those topics that do not require further consideration. Environmental topics which will clearly have no adverse impacts as a result of the scheme (without the need for detailed studies) are deemed to be “scoped out” and do not require investigation as part of the future assessments. The Environmental Screening Letter and Environmental Scoping Document are included in Technical Appendix 1. A formal response to the screening letter is expected following a Planning Committee meeting on 13th October, whilst responses from various consultees regarding scoping opinions were received throughout August and September 2010. All responses are included in Technical Appendix 1.

1.2.3.3 Despite not receiving formal responses from all those consulted through the scoping process, views were sought from relevant bodies directly by the appropriate technical specialists during the EIA process to ensure that their comments could be considered in the design and assessment.

1.2.3.4 The considerations of all responses to the scoping request and other EIA consultation have been taken account in the technical chapters of the ES and during the full scheme design.

1.2.4 Scope and Structure of the Environmental Statement

Scope

1.2.4.1 Environmental assessments are required to evaluate the effects of schemes at key stages of construction and operation. An environmental baseline study is essential in order to provide reference conditions, which may be compared with predicted impacts in the future. Therefore, the EIA process will differentiate between construction and operational impacts of the scheme.

- 1.2.4.2 The spatial scope of further environmental assessment varies with the topic under consideration. For instance, certain environmental factors can be relevant significant distances from individual scheme areas, whereas other impacts tend to be confined to the construction footprint.
- 1.2.4.3 The entire package of waterfront works are designed to be delivered following a phased approach to allow the different phases to be completed as and when funding allows - funding has been allocated to commence Phase 1 works only at the current time. **Therefore, the ES has been developed as far as practicable on a frontage-wide basis, with specific regard for the initial engineering works within the Phase 1 area.**

Structure

- 1.2.4.4 In line with standard practice the Environmental Statement will comprise three documents, namely:
- Environmental Statement: Volume 1;
 - Environmental Statement: Volume 2 – Technical Appendices; and
 - Environmental Statement: Non-Technical Summary (NTS).
- 1.2.4.5 Chapters 1-4 of the ES will deal with the purpose of the ES, a description of the site, a detailed description of the development to which all subsequent technical topics should refer, consideration of alternatives, scope and content of the ES and the planning policy framework. Chapters 5 onwards will deal with the technical topics.
- Chapter 1: Introduction and background to EIA;
 - Chapter 2: Scheme description;
 - Chapter 3: Assessment of Alternatives;
 - Chapter 4: Planning Policy Framework;
 - Chapter 5: Coastal processes;
 - Chapter 6: Ecology (Terrestrial, ornithology and marine);
 - Chapter 7: Landscape and visual;
 - Chapter 8: Socio-economic;
 - Chapter 9: Other Environmental Topics;
 - Chapter 10: Cumulative Impacts; and
 - Chapter 11: Summary.

1.2.5 Methodology

Baseline Data

- 1.2.5.1 Baseline data has been obtained from a variety of sources from prior to commencement of the EIA, and throughout the EIA process.
- 1.2.5.2 Baseline data is included in each specialist chapter and within the technical appendices. The baseline data gathered to date is considered to be sufficient to allow design development to proceed to the planning application stage and to allow production of a robust and comprehensive ES. Baseline and assessment years are defined within each chapter as relevant to each specialist topic.

Assessment of Impacts

- 1.2.5.3 The EIA is based on the proposals as described in Chapter 3. Direct and indirect effects, any secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects have been identified as resulting from the following categories:
- The existence of the development;
 - The use of natural resources; and/or
 - The emission of pollutants.
- 1.2.5.4 The assessment of whether the proposed scheme is likely to have significant impacts on the environment is undertaken through a variety of methods:
- Assessment based on professional judgement and published guidance criteria;
 - Assessment of both temporary and permanent effects;
 - Assessment of cumulative effects;
 - Assessment of reversibility of effects;
 - Assessment against local, regional and national planning policy; and
 - Consultation with statutory and non-statutory consultees.
- 1.2.5.5 Assessment of Impacts – This should include direct and indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the project. Including:
- Effects on human beings, buildings and man-made features;
 - Visual effects on the surrounding area and landscape;
 - Levels and effects of noise and emissions;

- Effects of the development on buildings, the architectural and historic heritage, archaeological features, and other human artefacts;
- Effects on flora, fauna and geology;
- Effects on land and waters;
- Effects on air and climate; and
- Other indirect and secondary effects associated with the project.

Significance Criteria

- 1.2.5.6 Significance criteria are based on the type of potential consequence, the probability of the consequence occurring, and the magnitude of the consequence. The actual criteria used are set out in each individual technical chapter, and are dependent on the guidance, legislation and best practice applicable to each topic. The nature of significance criteria are set as ranging from major adverse through to negligible, to major beneficial.
- 1.2.5.7 Where possible, the following significance categories are used to ensure overall consistency in assessment:
- Major adverse;
 - Moderate adverse;
 - Minor adverse;
 - Not significant / insignificant;
 - Minor beneficial;
 - Moderate beneficial and
 - Major beneficial.

Mitigative Measures

- 1.2.5.8 Where negative impacts are identified, the assessment identifies those measures which could be employed to mitigate the impact and the practical means of achieving this and also where mitigation measures will not deal with the relevant impact. Consideration is given to any residual impacts which identify the extent and significance of impacts that would remain after the mitigation measures are taken into account. Compensation and enhancement should also be addressed where applicable.
- 1.2.5.9 The mitigation process can be defined as working to lessen a risk by lowering its chances of occurring or by reducing its impact if it does occur. Throughout the EIA process, potential risks have been identified and mitigation measures either included in the designs, or proposed for the construction and operation processes. Mitigation measures can include:

- Avoiding the impact by not taking an action or modifying an action;
- Reducing impacts by limiting the magnitude of the action;
- Rectifying the impact by repairing/rehabilitating/restoring the impacted environment;
- Reducing/eliminating the impact over time through preservation and maintenance operations; and
- Compensating for the impact by replacing or substituting for environments.

1.2.5.10 A summary table showing the main mitigation and recommendations recommended for the Colwyn bay Waterfront Project is included as Chapter 11 in the ES.

1.2.6 Consultation

Public Consultation

1.2.6.1 Public consultation undertaken by CCBC played a key role in the development of the Waterfront Project Plan in 2006 and 2007. As part of the strategy development a range of options for maintaining or improving the coastal defences within Colwyn Bay were identified and examined, which formed the basis for initial public consultation. Further to the initial public consultation exercise, further technical development of options, economic analysis and environmental appraisal was carried out. The Draft Strategy Option was presented for further public examination in November 2007. Results of the public consultation exercise can be found in Appendix 1.

Statutory and Non-Statutory Consultation

1.2.6.2 As part of the EIA process, consultation has been undertaken with a wide range of both statutory (required by law) and non-statutory bodies, with the aim of collating all comments and concerns regarding the proposed Project. Responses from statutory and non-statutory consultees can be found in Appendix 1. This included (but was not limited to) the following organisations:

- CCBC (various departments);
- EA (Wales);
- CCW, and;
- CADW.

1.2.6.3 In addition to the request for a scoping opinion, a number of consultees have been contacted to inform the design process. Where appropriate the views have been incorporated into the design process.

1.2.7 Consideration of Alternatives

1.2.7.1 A requirement of the T&C EIA Regulations and the Marine Works EIA Regulations is to provide an outline of the main alternatives studied and the main reasons for the choice of the proposal,

taking into account the environmental effects. The consideration of alternatives is a key part of the EIA process. Adverse effects can often be avoided by considering different technologies, different sites or different ways of achieving the requirements. The full assessment of alternative options and the decision making process for selecting the preferred option can be found in Chapter 2.

1.2.8 Cumulative Impacts

1.2.8.1 The EIA Directive and its associated interpretations express the need for EIA to consider any potential cumulative effects which a scheme may have on the environment. Considering cumulative impacts ensures that the development is assessed in conjunction with other developments of a similar nature that either are in existence, are approved but uncompleted, are under consideration or of which the planning authority are aware.

1.2.8.2 Cumulative impacts are dealt within individual chapters (where relevant), and the information is summarised in Chapter 10.

1.2.9 Supporting Documentation

1.2.9.1 This scoping report has been generally informed by the following:

- Desk top studies and site visits;
- Work undertaken to date;
- Review of relevant websites;
- Scoping and further consultation key statutory and non-statutory consultees who will later be responsible for commenting on the EIA as part of the planning application process;
- Review of documents including planning policy and EIA assessment guidance, and;
- Experience of other large coastal defence projects.

1.2.9.2 The following documents will also form part of the planning application submission and should be read in conjunction with this ES when available:

- Archaeological Assessment; and
- Construction Transport Assessment

1.2.9.3 A formal response has not yet been received from CCW regarding whether further assessment will be required for the initial phase engineering works of the Colwyn Bay Waterfront Project under the Habitats Regulations (as amended), due to the proximity of the Liverpool Bay SPA.

2. Assessment of Alternatives

2.1 *Introduction*

- 2.1.1.1 As a regulatory requirement of the EIA process, a range of alternative options have been considered for the coastal defences at Colwyn Bay. This chapter outlines the comparative impacts on the natural and built environments of a number of coastal defence options. The Colwyn Bay Waterfront Project forms part of wider regeneration proposals for Colwyn Bay as a whole and consequently the cumulative impacts associated with each option have also been considered. Suggested changes to take account of elements of the promenade improvements are now being incorporated into the initial works. Based on the comparison, a preferred option has been identified.

2.2 *Need for the Scheme*

- 2.2.1.1 Although there are existing coastal defences along the Colwyn Bay frontage, the present coastal defence provision has several key problems which are increasing in severity with time.
- 2.2.1.2 The lowering of the beach requires on-going intervention. Beach volumes across the Colwyn Bay frontage have dropped since the defences were originally constructed over 100 years ago. This is considered to be as a result of the reduction in the natural feed of material from the shoreline within the bay, exacerbated by the form and profile of the defences. Despite attempts to control beach movements in the past, this trend is continuing and increasing the exposure of the present defences. Elevation changes of up to one metre can occur year on year in addition to during single coastal storm events.
- 2.2.1.3 The ageing and deteriorating defences have an imminent risk of failure in the immediate term (0-5 years). Many of the defences are over a century old and many sections include life expired elements that have failed and been repaired in the past. The residual life of the existing defences depends on the magnitude and frequency of future storm events and the location, age and type of structure.
- 2.2.1.4 Regular coastal defence overtopping is having negative impacts on the defences themselves, adjacent infrastructure (including a railway and the A55 expressway) and also on the local community. The coastal defence crest levels vary across the frontage, with the lowest levels being less than 0.5 metres above predicted Highest Astronomical tide at Old Colwyn and in the vicinity of the pier, where overtopping occurs regularly. This causes damage to the promenade and road infrastructure which results in the closure of the public highway and more severe events have caused damage to the embankment of the Chester to Holyhead railway. The defences are subject to an on-going regime of repair and management to maintain their functionality with associated costs. Storm damage occurs on a regular basis with the undermining of sections of the sea walls and damage to promenade, copings and railings.

2.3 *Coastal Defence Objectives for Colwyn Bay*

- 2.3.1.1 Conwy County Borough Council (CCBC) has been considering options for the improvement of coastal defences for several years, initially through the production of a Strategy Plan to consider coastal defence options, and subsequently through the broader scope of the Colwyn Bay

Waterfront Project and the developing town centre Masterplan, integrating coastal defence improvements with wider regeneration proposals for Colwyn Bay as a whole.

- 2.3.1.2 The principal CCBC objective of the coastal defence scheme is *“to provide improved coastal defence measures within Colwyn Bay that are commensurate with the risk of flooding and erosion to the local population, local property and local and national infrastructure.”*

2.4 Options considered

- 2.4.1.1 A number of coastal defence options have been considered for this scheme as listed below.

- **Option A:** *“Do nothing”*
- **Option B:** *“Maintenance but no improvement of the existing defence assets”*. Maintenance and remedial works to existing masonry and concrete defence structures but with no improvement
- **Option C:** *“Sustain the existing defence assets”* via maintenance and remedial works to maintain the flood risk level constant. Works would include re-profiling of rock toe defences and raising of backshore defences. Additionally, this option may also include improvements to the National Rail embankment.
- **Option D:** *“Improve and maintain linear defences”* by instating new linear rock revetment and raising the promenade. Undertake ongoing maintenance of the new structures.
- **Option E:** *“Improve defences by artificially supplementing and managing beach volumes and profiles”*. Construct beach control structures, new linear defences and crest works and undertake beach recharge operations. Carry out ongoing maintenance of the new defences in addition to beach management.

- 2.4.1.2 These options have undergone assessment as part of a draft Project Appraisal Report (PAR) undertaken by Coastal Engineering UK Ltd on behalf of Conwy County Borough Council (CEUK, 2008) which is currently being updated following completion of the coastal modelling study and initial detailed design development. This report sought consultation opinions and exhibited various coastal defence options to the public. It also assessed the defence options using the Flood and Coastal Defence Project Appraisal Guidance (PAG) and the 2005 Multi-coloured Manual (Defra, 2005). Both the draft and revised PARs are included in ES Volume 2, Technical Appendix 2.

2.5 Options Evaluation

2.5.1 Comparison of Options with Baseline

- 2.5.1.1 The comparative impacts of each option have been compared against the baseline “Do Nothing” option in
- 2.5.1.2 Table 2.2 below. Impacts for the scheme on the natural and built environment have been detailed in addition to cumulative socio-economic impacts associated with the combined effect of the coastal defence scheme option and environmental improvements along the promenade and

waterfront at Colwyn Bay. The significance of impacts has been allocated using the methodology as summarised in Table 2.1 below and short and long term impact significance have been considered separately.

Table 2.1: Impact Significance

Impact Significance	Description
Adverse major impact	Future conditions of the natural and built environments are considered overall to be significantly worse than the existing. Option entirely prevents regeneration of the waterfront area
Adverse moderate impact	Future conditions of the natural and built environments are considered overall to be worse than the existing. Option significantly hinders regeneration proposals for the waterfront area
Adverse minor impact	Future conditions of the natural and built environments are considered overall to be slightly worse than the existing. Option has a slightly negative impact or limits regeneration proposals for the waterfront area
Neutral impact	Future conditions of the natural and/or built environments are considered overall to be similar to existing. Option has no impact on regeneration proposals for the waterfront area
Beneficial minor impact	Future conditions of the natural and/or built environments are considered overall to be a marginal improvement on the existing. Option facilitates limited regeneration proposals for the waterfront area
Beneficial moderate impact	Future conditions of the natural and/or built environments are considered overall to be an improvement on the existing. Option facilitates regeneration proposals for the waterfront area
Beneficial major impact	Future conditions of the natural and/or built environments are considered overall to be a significant improvement on the existing. Option actively contributes to regeneration proposals for the waterfront area

Table 2.2: Comparison of options in terms of impacts on natural and built environment, and cumulative impacts with regeneration.

Option	Impacts on Natural Environment and Landscape	Impacts on Built Environment	Cumulative Impacts with Environmental Improvements and Regeneration
OPTION A: Do nothing	- Changed sediment patterns and loss of beach sediments and associated habitats. - Change to intertidal character and loss and change of associated habitats - Eventual creation of equilibrium sedimentary shore habitat as marine algae etc. encrust collapsed hard structures which fall into the sea. - Recession of shoreline and erosion of coastline landscapes.	- Loss of cycle track and promenade - Closure of coast road - Closure of promenade businesses - Eventual loss of railway and railway infrastructure due to destabilised embankment - Eventual closure of A55 road - Eventual loss of commercial and residential property along coastline	- Regeneration proposals for the waterfront would not be possible – planning permission would be refused for any proposed improvements due to increasing flood risk and unsafe promenade (which eventually would be lost) - Closure of coast road and eventually railway and A55 would seriously restrict access to and cause further economic decline. - Loss of major transport links would also impact on towns and communities to west of Colwyn Bay. - Anthropogenic migration out of area due to loss of economic and social bases. - Eventual abandonment and loss of large stretches of seafront.
Short term impact significance	<i>Adverse Moderate Impact</i>	<i>Adverse Major Impact</i>	<i>Adverse Major Impact</i>
Long term impact significance	<i>Adverse Moderate Impact</i>	<i>Adverse Major Impact</i>	<i>Adverse Major Impact</i>
OPTION B: Maintenance but no improvement of the existing defence assets	- Impacts as for Option A over a longer timescale. - Impacts on ecological habitats and associated species due to maintenance of defence structures. Initially localised impacts which would become more widespread as maintenance operations became more frequent.	- Impacts as for Option A over a longer timescale	- Increasingly high defence maintenance costs would eventually become economically unsustainable. - Impacts as for Option A over a longer timescale.
Short term impact significance	<i>Adverse Moderate Impact</i>	<i>Adverse Moderate Impact</i>	<i>Adverse Major Impact</i>
Long term impact significance	<i>Adverse Moderate Impact</i>	<i>Adverse Major Impact</i>	<i>Adverse Major Impact</i>
OPTION C: Sustain existing defence assets.	- A rock toe would initially cover existing habitat although would create new habitat in longer term. - Short and medium term minimisation of beach level fluctuations although long term storm events would result in eventual beach erosion.	- Sustained partial protection to existing infrastructure in short to medium term. - Deterioration of existing defences would result in long term (i.e. beyond 2060) threat to transport	- Full regeneration of promenade unlikely to be permitted due to existing level of flood risk although in short and medium terms sustained defences would facilitate some regeneration and hence begin to provide limited economic growth.

Table 2.2: Comparison of options in terms of impacts on natural and built environment, and cumulative impacts with regeneration.

Option	Impacts on Natural Environment and Landscape	Impacts on Built Environment	Cumulative Impacts with Environmental Improvements and Regeneration
	- Modifications to defence walls may impact on seascape panorama. - Eventual coastal recession as existing defences deteriorate over long term.	infrastructure and restrictions to promenade access.	- Increasingly high defence maintenance costs would eventually mean existing defences would become economically unsustainable. - Long term disruptions to promenade access and eventual beach erosion would prevent investment in tourism and result in longer term economic decline. - Eventual failure of defences over long term would ultimately result in the same impacts as for Options A and B.
Short term impact significance	<i>Adverse Minor Impact</i>	<i>Neutral impact</i>	<i>Neutral impact</i>
Long term impact significance	<i>Adverse Moderate Impact</i>	<i>Adverse Major Impact</i>	<i>Adverse Major Impact</i>
OPTION D: Improve and maintain linear defences	- Longshore sediment movement regime maintained, thus beach levels would be maintained with little erosion. - Movement of intertidal habitat seaward due to instatement of linear rock defences. - Loss of habitat due to rock armour revetment construction in immediate term. Countered by creation of new habitat for fish and hard substratum favouring species. - Alterations to promenade elevation and construction of rock revetment defences would have a significantly adverse effect on the open nature of the waterfront. <i>Current planning policy discussions may result in the establishment of a new planning policy prohibiting the construction of a rock revetment where a beach solution is technically viable.</i>	- Improved level of protection and long term security for commercial and residential property - Reduces risk to A55 road and maintains integrity of railway embankment and railway infrastructure. - Protection of promenade and businesses along promenade. - Raised nature of linear defence will prevent easy access between the promenade and beach area.	- Condition of beach would not significantly be improved. Increased segregation between beach and town due to construction of new linear defences would conflict with short and medium term regeneration proposals to improve beach as an amenity resource. - Improved defences will facilitate some regeneration of the promenade although development of waterfront as an amenity resource will be limited due to severance between promenade and beach by defences and lack of improvement in beach condition. - Improved town centre and promenade will attract tourism into area and thus improve identity and reputation of Colwyn Bay. - Improved town identity will encourage business relocation into area resulting in improvement in economic and social bases in medium and long terms.
Short term impact significance	<i>Beneficial minor impact</i>	<i>Beneficial minor impact</i>	<i>Beneficial Minor impact</i>
Long term impact significance	<i>Beneficial minor impact</i>	<i>Beneficial moderate impact</i>	<i>Beneficial Moderate impact</i>

Table 2.2: Comparison of options in terms of impacts on natural and built environment, and cumulative impacts with regeneration.

Option	Impacts on Natural Environment and Landscape	Impacts on Built Environment	Cumulative Impacts with Environmental Improvements and Regeneration
OPTION E: Improve defences by artificially supplementing and managing beach volumes and profiles	- In immediate term, beach recharge would smother benthic and intertidal fauna and may also impact on bird species by affecting their infaunal prey items. Increased suspended sediment in marine waters may also have a slightly adverse impact on species. - In immediate term, control structures would remove spawning, foraging and nursery habitats for benthic and fish species - However, the above affects would be mitigated by creation of "reef" like habitat in short term utilised by fish and commercial species - Creation of new intertidal habitat and larger area of beach habitat due to recharge operations. - Slightly negative impact on seascape panorama and beach views from new linear defences - However, negative visual impact of defences offset by positive visual impact of beach recharge operations (seen as enhancement of natural habitat).	- Some areas may experience a slightly lessened improvement in the level of flood protection where storms occur in rapid succession between beach management exercises. This risk can be mitigated by undertaking beach management exercises immediately after storm events. - However, beach recharge will reduce severity of impacts such as wave reflections on existing and new defences as are currently undertaken by the Local Authority as part of their shoreline management regime. - Other impacts on the built environment are similar to those for Option D.	- Creation of beach could be utilised as an amenity resource which will greatly improve the appearance of the waterfront and will significantly contribute to regeneration proposals. - Improved defences, improvements to promenade and new beach area will facilitate comprehensive regeneration of Colwyn Bay in line with CCBC objectives. - Revival of tourist industry in area will create economic growth and improve the identity and reputation of Colwyn Bay. - Improved town identity will encourage business relocation into area resulting in improvement in economic and social bases in medium and long terms.
Short term impact significance	<i>Neutral impact</i>	<i>Beneficial moderate impact</i>	<i>Beneficial major impact</i>
Long term impact significance	<i>Beneficial moderate impact</i>	<i>Beneficial moderate impact</i>	<i>Beneficial major impact</i>

2.6 Justification for preferred Option

- 2.6.1.1 Both Options A and B are considered to have an unacceptable impact on the built environment in the short and long terms and would prevent any regeneration of the Colwyn Bay waterfront from being undertaken due to planning constraints, including lack of flood protection and safety issues. Adverse impacts on local and national transport infrastructure such as the coast road, A55 road and railway embankments would eventually have a knock-on effect on the economic sustainability of both Colwyn Bay and areas to the west. The impacts on the natural environment are also considered to be severe for both options, due to significant changes to coastal habitats and recession and erosion of the coastline. Neither of these options fulfils the key CCBC objective to provide improved coastal defence measures. **Consequently Options A and B are not considered as viable.**
- 2.6.1.2 While Option C would ensure continued partial protection to infrastructure and facilitate some regeneration in the short and medium terms, disruptions to promenade access, ultimate failure of the defences and coastal recess would have significantly adverse impacts on transport infrastructure and a negative impact on the built environment as a whole. Some retention of existing environmental conditions would result in a delayed and slow alteration to the natural environment, eventually resulting in erosion of the coastline. This option does not improve the level of coastal defences and consequently does not align with the CCBC objective. **Option C is therefore not considered to be viable.**
- 2.6.1.3 Option D would provide and maintain an improved level of flood protection for the built environment and in general; environmental conditions and ecological habitats of Colwyn Bay waterfront would remain similar to the existing. The Option would also facilitate some environmental improvements along the waterfront, although the development of the promenade to improve local amenity and encourage tourism would be limited due to a) the new linear defences creating a barrier between the promenade and the beach and b) the lack of improvement to the beach condition. It should be noted that the lack of beach improvement and increased severance between the promenade and beach may prevent funding for the waterfront regeneration proposals. Overall, the Option would satisfactorily comply with the CCBC objective to improve coastal defences but may hinder wider regeneration proposals for the town.
- 2.6.1.4 Option E would achieve a similar level of flood protection to the built environment as Option D and would comply with the CCBC objective to improve coastal defences. The immediate term ecological impacts may be slightly more significant than for Option D due to smothering of species and covering of habitats during the beach recharge option. However, new habitats created within the new beach control structures and improved beach area, along with the perceived improvement in natural environment of the beach would counter any short term negative environmental impacts and would overall improve the natural environment. Option E would actively contribute to regeneration proposals via the creation of an improved amenity resource and hence would enhance the waterfront area. The raised beach level would improve linkage between the beach and promenade.
- 2.6.1.5 Based on the above reasoning, only Options D and E are considered to be viable alternatives which would provide an improved level of coastal defence. Although the immediate ecological impacts of Option E could be considered to be slightly worse than those for Option D, the long term environmental impact is considered to be slightly better. Additionally, Option E will actively

contribute to wider regeneration proposals for Colwyn Bay waterfront and consequently, **Option E is seen as the preferred option in terms of environmental impacts.**

- 2.6.1.6 Throughout the remainder of this ES Options D and E are referred to as Options 1 and 2 respectively.

3. Scheme Description

3.1 Site Location and Description

- 3.1.1.1 The Colwyn Bay frontage in question is an approximately 3500m stretch of shoreline located between Rhos Point to the west and Tan Penmaen Head to the east.
- 3.1.1.2 Local defences are provided at Rhos Harbour and also between Old Colwyn and Tan Penmaen Head, although the latter section is under the jurisdiction of Network Rail and the Highways Directorate of the Welsh Assembly Government. The intervening stretch of shoreline is defended primarily by a series of vertical masonry and/or concrete walls dating from the early 1900s. Falling beach levels over time have also led to significant repairs and remedial works to the existing defences.
- 3.1.1.3 The original groynes constructed along the frontage are in a general state of disrepair. In the 1990s, the Council constructed a 650m rock toe along the most at risk stretch of wall. Further revetment improvements along with the construction of a number of low rock groynes have encouraged some beach recovery.
- 3.1.1.4 The majority of the foreshore is sand overlying boulder clay, however significant loss of sand has occurred over the years and the clay can now be exposed following significant beach movements. The net littoral drift trend direction is from west to east along the North Wales Coast. Shingle and cobbles are present towards the landward edge of the beach.
- 3.1.1.5 The section from Rhos-on-Sea to the Victoria Pier comprises masonry walls with concrete and rock toe additions, while the section to the immediate east of the pier comprises an integral wave recurve along the crest of the masonry wall and a low rock toe has been constructed along the majority of its length. Further to the east in the vicinity of Old Colwyn, there is no wave recurve along the crest and remedial works are routinely carried out as beach levels fluctuate. The eastern section of the sea front is the least sheltered from westerly directions by Rhos Point and the shoreline becomes more exposed to wind generated waves (the majority of which are west of north).
- 3.1.1.6 The existing coastal defence management policy along this frontage is to 'hold the line', involving monitoring, maintenance and repair of the present defences. However, on-going monitoring has revealed that beach levels are continuing to fall and that the coastal defence condition is deteriorating.
- 3.1.1.7 Photographs of the Colwyn Bay Area can be found in ES Volume 2, Technical Appendix 3.

3.2 Scheme Description

- 3.2.1.1 The proposed Colwyn Bay Waterfront Project works in their entirety will provide renewed coastal defences along the frontage of Colwyn Bay between Rhos-on-Sea and Old Colwyn. The principal objective of the scheme is to provide improved coastal defence measures within Colwyn Bay that are commensurate with the risk of flooding and erosion to local property, the local population and local and national infrastructure. The scheme aims to protect the following assets:

- Commercial properties;
- Residential properties;
- The Chester to Holyhead Railway line and associated track and station infrastructure;
- The A55 Trunk road;
- The trunk sewer located in the promenade; and
- A National cycle route which runs along the promenade.

3.2.1.2 The Project will seek to integrate the defences with environmental improvements to the promenade in order to maximise the regeneration potential of the scheme and provide environmental improvements to offer a modern, robust, sustainable and attractive public realm. It will also link in with other regeneration initiatives which will benefit the whole of Colwyn Bay in addition to the seafront.

3.2.1.3 The works are designed to be delivered following a phased approach of discrete packages of work as and when funding allows - funding has been allocated for Phase 1 works only at the current time. Therefore the environmental topics 'scoped in' will have to be developed as far as practicable on a frontage wide basis, with specific regard for the Phase 1 works in isolation. The proposed coastal defences have been developed following substantial background work from CCBC including extensive public consultation to determine the preferred option for each Zone of the frontage as part of an overall development plan for Colwyn Bay.

- Phase 1 – Cayley Promenade to Eirias Park: Recharging of beach with sand, improvements to the promenade and crest of existing defences. Provision of beach control structure (groyne) on the foreshore with a "hotspot" on its landward side and a rock armour revetment to the east. The hotspot will include an extension of the promenade out over the groyne to form a platform which it is anticipated will be used to support water based activity along the promenade. The design and development of any associated buildings, street furniture, parking and operational aspects will be a later part of the environmental improvements element of the Colwyn Bay Waterfront Project. Consequently this falls outside the scope of this ES, which includes engineering works to form the boundary of the hotspot along the Phase 1 coastal defence works only;
- Phase 2 – West of Cayley promenade to Rhos Jetty: Recharging of beach with sand, improvements to the promenade and crest of existing defences. Some further coastal structures may also be required; and
- Phase 3 – East of Eirias Park to Old Colwyn: Construction of rock armour revetment, improvements to the promenade and crest of existing defences.

3.2.1.4 The locations of the three development phases are pictorially represented on Figure 3.5 in ES Volume 2, Technical Appendix 3.

- 3.2.1.5 Phase 1, in its entirety covers up to 35 hectares within the central section of the frontage either side of the Victoria Pier from the section of seafront in the vicinity of Marine Road to the west, to the section of seafront parallel to the J22 eastbound slip road of the A55 to the east. The Phase 1 area includes the prioritised engineering works.
- 3.2.1.6 In the Phase 1 area, the proposals include a new rock groyne control structure (approximately 200m long) and a new linear rock armour revetment with rear wave return wall east of the control structure. It is proposed to carry out beach recharge to the west of these new structures, to bring beach levels up to the level of the existing promenade (approx 5.5mAOD) but below the existing sea wall crest (at approx 6.15mAOD). A new wave return wall is proposed on the promenade behind the recharged beach. Further groyne structures may be constructed to the west of the new groyne to maintain these raised beach levels. The proposals also include engineering works for the construction of a large concrete platform located at the landward end of the new rock groyne control structure. Future proposals for this platform, to be contained within the scope of the environment improvement proposals, include development of a 'hotspot'. A number of general arrangement Phase 1 drawings, in addition to a drawing of the proposed 'hotspot' are included in ES Volume 2, Technical Appendix 3 for more information.
- 3.2.1.7 The scheme also includes future management and maintenance actions comprising:
- Maintenance and repair of rock structures, promenade and crest works;
 - Beach material management;
 - Clearance of wind blown sand from the promenade;
 - Topping up of beach levels as required; and
 - Reworking of structures to maintain standard of service in line with sea level rise.
- 3.2.1.8 The proposed scheme will safeguard the integrity of the present coastal defence and protect the land, property and infrastructure at risk, improving the amenity of the area and linked to other regeneration initiatives (associated with waterfront and town centre), which will form part of a wider regeneration package that will benefit the whole of Colwyn Bay.

3.3 Construction Strategy

3.3.1 Construction Materials

- 3.3.1.1 The primary materials to be used in the works comprise:
- Graded primary rock armour (~3-6 tonne mass) and secondary underlayers. Suitable existing boulders within the footprint of any structures will be selected for re-use where feasible. Local suppliers will be used preferentially, however volume issues may preclude the use of solely local quarries;
 - In-situ and pre-cast concrete designed to BS8500;

- Geotextile membranes obtained from approved suppliers with a record of use in coastal defence;
- Sheet piles and fill material for hotspot area; and
- Sand beach recharge obtained from either existing licensed offshore dredging sites containing appropriate beach material or from maintenance dredging exercises (if available and suitable). It is understood that the sand that is to be transported to the site by sea can be applied by a direct damp spraying method from vessels moored off the beach. Smaller volume recharges as proposed for the initial phase works are to be transported to site via road and deposited onto the seafront before profiling.

3.3.1.2 There are currently several outfalls which discharge to Colwyn Bay along the seafront, which will be accommodated through the proposed defences.

3.3.2 Construction Workforce

3.3.2.1 For the Phase 1 coastal defences (the only phase of the works progressing at this stage), a peak workforce of 50 site staff would be anticipated, with an average of 35–40 for the 3.5 month duration of the works.

3.3.2.2 A tender process is currently underway to appoint a Contractor for the initial Phase 1 engineering works. Due to the value of the works an OJEU procurement procedure has to be followed – tenders can therefore be received from any firm in Europe interested in undertaking the work. All tenders received must be appraised using a fair and transparent system in accordance with European Directives, which cannot show preference in terms of location; however, as part of the selection procedure, Contractors are required to answer the following question:

“Please detail any measures the company would propose to adopt to ensure that the workforce local to the Contract area receive both short term and long term benefits from the works.”

3.3.2.3 Responses to the above question will be used as part of the selection process to appoint a Contractor to undertake the works, who will then be required to adopt the proposal they have put forward to benefit the local workforce.

3.3.2.4 The works, once complete, will require regular maintenance to ensure the infrastructure remains at a high standard. It is unlikely that a dedicated resource would be employed by CCBC for the sole purpose of maintaining the new Colwyn Bay infrastructure; rather the work would be divided as additional tasks for existing Council Services. Those Services however may require a small number of additional employees to accommodate the increased workload, or may make greater use of local Contractors to undertake the additional work.

3.3.3 Construction Practicalities

3.3.3.1 The contractor will be allowed the use of an area of hardstanding on the existing promenade as a compound area and for the storage of plant and materials. Access will be required along the promenade to carry out crest works and appropriate fencing and signing will be erected to demarcate this area – temporary diversion routes and/or closures of the promenade and public

highway in places are likely to be required during the construction period. Access to the foreshore will be gained using existing slipways and across the foreshore, the contractor will be allowed to gain access within the footprint of the new works plus a working corridor outside the limits generally not exceeding 5m in width but incorporating areas for vehicle turning. Improvements to wall face drainage arrangements will be carried out concurrently with revetment construction.

- 3.3.3.2 The primary linear revetment facing works will generally commence from one end and commence in a single working face. Crest and promenade works are likely to be carried out on completion of the facing works in any area. Drainage works and accommodation works on the promenade will be carried out concurrently with crest works. Beach control structures will be constructed during suitable low water periods, working from landward to seaward with bulk fill and rock underlayers and shoreward with the primary rock facing and crest works. Beach recharge proposals in Phase 2 will only be carried out following completion of control structures – material will generally be pumped ashore from dredgers and placed to its final location by land based plant.

3.3.4 Timings

- 3.3.4.1 The initial Phase 1 engineering works will commence in January 2011 and be completed by the end of March 2011. Finishing works to the new hotspot are being scheduled to follow on from the initial engineering works in April 2011 and are intended to be completed by early summer 2011. Phase 2 and Phase 3 works currently cannot be programmed due to uncertainty over the availability of funding.

4. Planning Policy Framework

4.1 Introduction

4.1.1 Scope and Structure of Chapter

- 4.1.1.1 This chapter details a review of international, national, regional and local planning policies relevant to Colwyn Bay Waterfront Project.
- 4.1.1.2 The proposed development comprises three distinct phases of work along the central, western and eastern sections of Colwyn Bay respectively. The scheme will include the installation of beach control structures, raising of the promenade and existing defences, installation of rock armour revetment and beach recharge. The first phase of the works, (for which a full planning application will be submitted), is located along the central section of the bay, and will comprise a sea defence groyne, areas of beach recharge, raising of the promenade, construction of a wave return wall, and engineering works to form a hotspot area on the promenade and over the base of the new sea defence groyne.
- 4.1.1.3 The scheme may have social, economic and environmental impacts which could hinder or assist planning policy objectives on the national, regional and local levels. This chapter therefore considers the significance of potential impacts in relation to relevant planning objectives. This chapter considers the Waterfront Project in its entirety, although works associated with Phase 1 of the scheme are taken as the predominant factor when assessing impacts.
- 4.1.1.4 Section 4.1 summarises key policy at national, regional and local level and sets out the assessment methodology for this scheme. Sections 4.2 to 4.5 assess the compliance of the proposed scheme with relevant planning policies and Section 4.6 summarises the findings of the study.

4.1.2 Methodology

- 4.1.2.1 Assessment has been achieved by considering whether the scheme is anticipated to benefit, hinder or have no effect on specific planning policy objectives. Where an impact is considered to be beneficial or adverse, the degree to which this is true is emphasised by subcategorising impacts as outlined below.
- **Major Beneficial impact:** A scheme aspect considered to be significantly beneficial to planning policy objectives.
 - **Moderate Beneficial impact:** A scheme aspect considered to be moderately beneficial to planning policy objectives.
 - **Minor Beneficial impact:** A scheme aspect considered to slightly contribute to successful implementation of planning policy objectives.
 - **Insignificant impact:** A scheme aspect considered to have little or no impact on planning policy objectives.

- **Minor Adverse impact:** A scheme aspect considered to slightly hinder or prevent achievement of planning policy objectives
- **Moderate Adverse impact:** A scheme aspect considered to moderately impede planning policy objectives.
- **Major Adverse impact:** A scheme aspect considered to significantly impede or explicitly contradict planning policy objectives.

4.1.2.2 Impacts associated with construction and operation have been considered separately, due to the transient nature of construction compared with the long period of time over which the scheme will be operational.

4.1.3 Key legislation

4.1.3.1 The key approvals and permissions required for this scheme are as follows:

- The requirement for the production of an Environmental Impact Assessment (EIA) under both the Marine Works EIA Regulations and the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999;
- The requirement for a Section 34 Coastal Protection Act (CPA) Approval under the Coastal Protection Act 1949 (as amended by section 36 of the Merchant Shipping Act 1988 and the Energy Act 2004); and
- The requirement for a licence 'for deposit of substances and articles in the sea etc' under Section 8 of the Food and Environment Protection Act 1985.

Further guidance on legislative requirements for this scheme is provided in Section 1.2.

4.1.4 Policy overview

4.1.4.1 The UK planning systems regulates land use and comprises a three tier hierarchy of national, regional and local levels. National Planning Policy provides the overarching planning framework for the UK from which all planning policy at lower levels stems. For this scheme, national policy must be considered at two levels; that specific to Wales in addition to UK wide policy, due to the substantial responsibility for planning transferred from central government to the Welsh Assembly Government (WAG) through the Government of Wales Act 2006.

4.1.4.2 National planning policy informs the development of regional policy which in turn contributes to the production of country and district level development plans.

National (Wales)

4.1.4.3 Under the Government of Wales Act 2006, The Welsh Assembly Government has powers to pass legislation, or "Assembly Measures", on a number of issues, such as water and flood defence, tourism and town and country planning.

4.1.4.4 Overall planning policy in Wales is set out within Planning Policy Wales (PPW) (2002) which provides the policy framework for the effective preparation of local planning authorities' development plans. PPW is supplemented by a number of Technical Advice Notes (TAN) which describe Welsh national planning policy for specific topics. TANs provide guidance to local authorities and to the Welsh Ministers when making planning decisions. The following TANs are of most relevance to the Colwyn Bay Waterfront Project:

- **TAN4** (Retailing and Town Centres) provides background on key planning matters which affect the vitality and viability of town centres such as population change and retail provision. The TAN recommends that impact assessments, including effects beyond the local authority boundaries, are produced for major retail development applications. Changes of use, car parking standards and management are listed as important considerations, as is the environmental assessment of large retail projects.
- **TAN5** (Nature Conservation and Planning) outlines Welsh Assembly Government policy on development control issues for designated sites such as Special Protection Areas (SPAs), Special Areas of Conservation (SACs), and Sites of Special Scientific Interest (SSSIs). The TAN also covers non-statutory nature conservation site selection and designation and discusses the protection of species, commons and greens.
- **TAN11** (Noise) outlines some of the major considerations a planning authority should account for when preparing development plans and making planning application decisions where noise may be an issue. It emphasises the necessity of environmental health considerations when assessing noise generating developments and provides guidance on noise related development control issues in addition to measures to mitigate noise impact.
- **TAN13** (Tourism) identifies the issues raised by tourism that should be addressed in development plans and in development control decisions. It addresses problems associated with provision, maintenance and enhancement of tourist accommodation. The TAN also discusses the imposition and enforcement of seasonal and holiday occupation conditions attached to planning permissions.
- **TAN14** (Coastal Planning) seeks to protect the coastal zone from inappropriate development by considering aspects such as potential impacts on visual amenity, physical processes and ground conditions; sensitivity and conservation of designated marine and coastal sites; the requirement for remedial works and defence works; and recreational development. It also describes the role of local planning authorities and the range of regulatory controls over coastal and marine development.
- **TAN15** (Development and Flood Risk) highlights the responsibility of local authorities to discourage development in areas of flood risk, or developments which would increase flood risk elsewhere or interfere with flood control works. The TAN identifies the Environment Agency as the supervisory body for flood defence matters and stipulates the requirement to consider flood risk in development plans and determination of planning applications. Guidance is provided for coastal protection and flood defence works, in addition to considerations regarding runoff and flood risk increase.

- **TAN16** (Sport, Recreation and Open Space) provides advice to local authorities and communities on the provision of recreational space and allotments and considers topics related to water-based recreation. The note also discusses development management, noise and accessibility issues for the design and operation of facilities and spaces.
- **TAN18** (Transport) highlights the requirement for an efficient and sustainable transport system in Wales. It provides guidance on a number of transport issues, including the integration between land use planning and transport, development location and design, modes of transport and the importance of planning for transport infrastructure.

National (UK)

- 4.1.4.5 Within Wales, TANs provide the main guidance for local authorities with regards to planning as detailed previously. However, due to the limitations of WAG independent planning jurisdiction over central government, TANs do not comprehensively cover all topics relevant to planning. Where a TAN is not available for a particular topic, Planning Policy Statements (PPSs) have been reviewed for the purposes of the Colwyn Bay Waterfront Project.
- 4.1.4.6 PSSs set out Central Government planning policy and provide guidance on the planning system operation. They also explain the relationship between planning policies and other policies relevant to land use and development issues. Local authorities must take these policies into account during the planning process and when making decisions with regards to planning applications. The following PPSs are of most relevance to the scheme at Colwyn Bay:
- **PPS5** (Planning for the Historic Environment) sets out government policy on the conservation of the historic environment. The PPS highlights the importance of the planning system for conservation of heritage assets, defined as “parts of the historic environment that have significance because of their historic, archaeological, architectural or artistic interest.” The PPS then outlines policies for the identification and protection of heritage assets.
 - **PPS23** (Planning and Pollution Control) stipulates that consideration is given to the quality of land, air or water and potential pollution associated impacts arising from development during planning decisions. The PPS also outlines government policy on pollution control and waste management.

Regional

- 4.1.4.7 **People, Places, Futures – The Wales Spatial Plan:** Section 16 (North East Wales, Border and Coast). The Wales Spatial Plan provides an overarching planning framework for national and regional sustainable development in Wales. The Spatial Plan is less prescriptive than RRSs used in England and encompasses the elements required to deliver sustainable land use, services and investment.
- 4.1.4.8 Key aims of the **Wales Spatial Plan for North East Wales** relevant to the Colwyn Bay Waterfront Project are: i) an improved integrated transport system, ii) identification and development of suitable responses for areas prone to flooding and iii) adaption of coastal resorts to changing tourism patterns.

- 4.1.4.9 The **North West England and North Wales Shoreline Management Plan (SMP2)** is currently under development by Halcrow. This document is due for completion in December 2010. The key objectives of this plan for Colwyn Bay have been outlined in a draft issues document published in August 2008 and are predominantly concerned with the protection of property, important cultural heritage sites, community amenity facilities and economic assets from damage or loss due to coastal erosion and/or flooding events.

Local

- 4.1.4.10 The **Conwy Local Development Plan** (draft) is currently under development by the planning authority, Conwy County Borough Council, and is due for adoption in March 2012. The plan will cover the entire area of Conwy which lies outside Snowdonia National Park. The relevant adopted plans which are to be used until the adoption of the Conwy LDP are 'The Colwyn Borough Local Plan' and 'Clwyd Structure Plan Second Alteration (Conwy Version)', both adopted on 31st March 1999.

- 4.1.4.11 Until 2004, a **Conwy Unitary Development Plan** was developed with the intention that this plan would supersede the local plans described above. However, this plan has never been adopted and so does not carry the same weight as the two adopted local plans. Nonetheless, it is still utilised in some circumstances for the purposes of planning application decisions.

- 4.1.4.12 Policies with specific relevance to the scheme from **The Colwyn Borough Local Plan** are listed below:

- **Policy CN6:** This policy states that “developments in areas of undeveloped coastline outside settlement limits, that will adversely affect the open character, nature conservation value or coastal processes of the coastal zone, will not normally be permitted.” Exceptions to the policy include proposals to improve access to the shoreline.
- **Policy CN7:** This policy specifies that permission of development within the settlement limits of the coastal zone shall be dependant on whether the development is for a tourism and/or recreation use requiring a coastal location.
- **Policy CN9:** According to this policy, coastal protection works will be permitted providing that full consideration is given to the open character and nature conservation value of the coastal zone.
- **Policy CN10:** This policy states that any development that requires an increase in the level of coastal protection, or enhancement of protection and mitigation works, will only be permitted where the developer funds any necessary improvements.

- 4.1.4.13 Key policies from the **Clwyd Structure Plan Second Alteration (Conwy Version)** relevant to the scheme are listed below:

- **Policy Cons 5:** According to this policy, “the natural ecology and landscape of the aquatic environment will be protected and enhanced throughout the county.” The policy also states that development along the undeveloped coast “will not be permitted unless it is essential for... suitable outdoor sport, recreation or other uses”.

- **Policy TLR 7:** This policy states that large scale tourist, recreation and leisure facilities will be located within the main coastal holiday resorts, in areas convenient for the visitor and resident population. The policy also emphasises the importance of development sensitive to the scale, character and environment of the local area.

4.1.4.14 While not adopted, the Conwy Unitary Development Plan also contains some relevant planning information which should be taken into account for the Colwyn Bay Waterfront Project.

4.1.5 Planning Permissions

4.1.5.1 Colwyn Bay Waterfront Project forms part of wider development proposals to regenerate Colwyn Bay. The project shall ultimately include environmental improvements along Colwyn Bay Promenade, in coordination with proposals outlined in the Bay Line regeneration plan for the area. A separate planning application will be developed and submitted for the Environmental Improvements at a later date and consequently the cumulative impacts of the two schemes should be considered. This study assesses the impacts of the coastal defence and initial hotspot engineering works only but makes references to regeneration proposals where the impacts of the two project elements cannot clearly be distinguished.

4.1.5.2 The Waterfront Project comprises three Phases. At this stage, the initial Phase 1 engineering works, located within the central section of the bay in the vicinity of the access into Eirias Park is to be developed for a full planning application, while Phases 2 and 3 at either end of the Bay will be submitted for outline planning only.

4.1.5.3 A search of planning applications for the surrounding area was undertaken. No other significant extant planning applications were identified.

4.2 National Policy Table of Effects

4.2.1.1 Assessment has been achieved by considering whether the scheme is anticipated to benefit, hinder or have no effect on national planning policy objectives as summarised in Table 4.1.

Table 4.1: National Policy Effects Table

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
DEPARTMENT OF COMMUNITIES AND LOCAL GOVERNMENT (DCLG)			
PPS5 (Planning for the Historic Environment)	The policy emphasises the need to assess the potential impact of a scheme on the setting and preservation of the historic environment and heritage assets. Where a scheme is proposed to mitigate the effects of climate change, the policy notes the importance of weighing potential benefits with potentially adverse effects on heritage assets and the historic environment to develop feasible solutions which do not significantly harm a heritage asset or its setting.	Construction: Adverse minor impact Operation: Beneficial moderate impact	There are a number of listed buildings in the vicinity of the site, including Victoria Pier. There is likely to be slightly negative impact during construction on the setting of heritage assets in the site vicinity. Excavation during construction may also disturb archaeologically important assets and intertidal marine archaeological deposits. However, beach recharge proposals during Phases 1 and 2 will have a long term beneficial impact on the setting and protection of heritage assets such as the Victoria Pier and buried forest. Additionally, the new coastal defences will provide protection against flooding to heritage assets along the Waterfront. Design of groyne and flood defences should be sensitive to the historic setting of Colwyn Bay, which contains assets dating from the nineteenth century to modern day.
PPS23 (Planning and Pollution Control)	This policy details guidance for the prevention of pollution and control of potentially polluting development. Key aims of the policy are to prevent pollution at source and to minimise risks to human health and the environment. The policy also details guidance for land which may be affected by contamination (Annex 2).	Construction: Adverse minor impact Operation: Neutral impact	There is potential for temporary adverse impacts on marine and coastal habitats and species to occur during construction due to: accidental spillage of contaminated materials stored and used on site, temporary reduction in air quality due to dust generation and construction traffic, and an increase in silt levels due to ground disturbance. Providing all work is carried out in accordance with guidelines and requirements of the Environment Agency and CEFAS, and all mitigation measures are fully implemented, the overall impact of the scheme on water and air quality is considered to be negligible. Berry's Garage lies within 30m of the site and listed as contaminated under Part IIA of the Environmental Protection Act. However, the Colwyn Bay Waterfront scheme is highly unlikely to impinge on or otherwise disturb this site. Although operational impacts can largely be considered to be negligible, slightly adverse impacts on local air quality may result indirectly from the scheme due to increased traffic movements to the Waterfront as more visitors are attracted to the area.

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
WELSH ASSEMBLY GOVERNMENT (WAG)			
TAN4 (Retailing and Town Centres)	This policy is predominantly concerned with the viability and vitality of town centres, providing guidance on the provision and distribution of retail facilities and study of population changes. The policy provides guidance on suitable car parking levels and requirements for town centres, emphasising the importance of assessing a 'maximum' parking level to avoid excessive use of private cars.	Construction: Adverse minor impact Operation: Beneficial moderate impact	Construction impacts of the scheme may include temporary disruption to local businesses along the waterfront although the site and associated traffic access routes are located away from the town centre and consequently overall business in the local area will be largely unaffected by the scheme. An indirect impact of the scheme will be facilitation of regeneration of the Waterfront area, attraction of tourists to the area and development of links to the town centre. This will then likely benefit the town centre by ensuring the retention of existing business and attracting new businesses to the area. Additionally, the new sea defences will create additional space along the Promenade which can then be utilised for the development of parking facilities and transport links as part of other regeneration proposals.
TAN5 (Nature Conservation and Planning)	This policy provides guidance on the protection and enhancement opportunities of the natural environment and specifies that schemes should aim to maintain, enhance and restore the biodiversity and geology of an area.	Construction: Adverse minor impact Operation: Beneficial minor impact	There are internationally and nationally designated sites within the zone of influence of the site, although it is not considered that the scheme will have a significant impact on these sites due to the relatively insignificant area of the scheme in relation to the size of the designations (approximately 0.8%). Construction impacts are likely to be small and limited to temporary noise disturbance and land take, and disturbance of sediments. New linear defences will cause a temporary loss of coastal habitat for benthic and bird species due to loss of the foreshore. However, the long term impact of the scheme is considered to be beneficial to nesting birds and substratum marine species due to the creation of new habitat. 'Reef like' habitat created by the scheme would also provide increased habitat availability for commercial marine species.
TAN11 (Noise)	This guidance emphasises the necessity of environmental health considerations when assessing noise and noise generating developments and provides guidance on noise related development control issues in addition to measures to mitigate noise impact.	Construction: Adverse minor impact Operation: Adverse minor impact	Potential noise impacts include temporary noise generated from construction operations and associated traffic. The most significant noise impact during construction is likely to be due to driving sheet piles for the engineering works associated with the hotspot area. These works should be scheduled to minimise disruption to sensitive receptors such as local residents. The main operational phase noise impacts of the project are expected to relate to changes in traffic due to increased vehicle movements from both the increased leisure usage of the recharged beach areas. Traffic due to an increased number of visitors to the town centre may subsequently arise indirectly from the scheme in conjunction with other regeneration proposals.

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
TAN13 (Tourism)	This policy identifies tourism as “a range of different, but interdependent activities and operations which overlap with sport, entertainment, the arts and other recreation and leisure activities.” This policy provides guidance for problems associated with provision, maintenance and enhancement of tourist accommodation, in addition to the imposition and enforcement of seasonal and holiday occupation conditions attached to planning permissions.	Construction: Adverse minor impact Operation: Beneficial major impact	Construction impacts may include temporary removal of beach access and visual impact which may affect the number of visitors to the waterfront. However, the long term impact of the scheme is likely to be significantly beneficial, as the recharged beach areas and subsequent regeneration of the Waterfront will provide an important tourist attraction for the town. Increased tourism industry resulting from regeneration proposals, although indirectly from the Waterfront Project, will provide new employment opportunities.
TAN14 (Coastal Planning)	This policy provides guidance on protection of the coastal zone from inappropriate development. Consideration is given to visual amenity, physical processes and ground conditions; sensitivity and conservation of designated marine and coastal sites; the requirement for remedial works and defence works; and recreational resource development.	Construction: Adverse minor impact Operation: Beneficial major impact	There is potential for local marine water quality to be adversely affected during construction due to the disturbance of sediment during excavations. The scheme will support the development of recreational resources in the form of the recharged beach areas. The scheme strongly complies with policy objectives to improve sea defences as it will prevent frequent tidal flooding, beach erosion and storm damage to property and assets along the waterfront. The scheme is not anticipated to have any significant long term impacts on visual amenity, designated sites or ground conditions at the site. In the longer term, there is potential for coastal processes such as long shore drift to be impacted, although providing full consideration is given to coastal processes during design and all mitigation methods are adhered to, the long term impacts on the natural environment of the bay should be minimal. Comparatively, Option 1 (linear rock revetment as discussed in Section 2.5) would be inappropriate in the context of this planning objective, as it would not support development of an amenity beach resource and would have a significantly adverse affect on the open nature and visual amenity of the seascape at Colwyn Bay.
TAN15 (Development and Flood Risk)	The policy aims to prevent new development in areas of high flood risk and provides guidance on policy objectives for the management and reduction of flood risks.	Construction: Neutral Impact Operation: Beneficial Major Impact	Construction impacts of the scheme are considered to be mostly negligible. The scheme is not anticipated to have any impacts with regards to fluvial flooding, and the installation of the new coastal defences strongly complies with policy objectives. Overall, the impact of the scheme is considered to be significantly beneficial as it will provide additional tidal flood protection for Colwyn Bay.

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
TAN16 (Sport, Recreation and Open Space)	This policy is concerned with development management issues for the design of facilities and spaces, and noise and accessibility. An aim of the policy is to improve water-based recreation.	Construction: Adverse minor impact Operation: Beneficial moderate impact	Construction impacts are likely to include temporary loss of car parking facilities along the waterfront, and access restrictions to areas of the Promenade and beach. Noise from HGV movements etc. may be another slightly adverse impact during the construction phase. Long term impacts of the scheme are likely to be largely beneficial, due to the improved open space of recharged beach and widening of the Promenade due to the construction of the new sea defences.
TAN18 (Transport)	This policy emphasises the need for an efficient and sustainable transport system in Wales. It provides guidance on a number of transport issues, including the integration between land use planning and transport, development location and design, modes of transport and the importance of planning for transport infrastructure.	Construction: Adverse minor impact Operation: Beneficial moderate impact	Short term impacts on the local road network may arise from the construction phase of the scheme due to construction traffic. However, the larger volume of beach recharge proposed in later phases is to be delivered by boat and so will minimise the disruption to local traffic from transport of materials. The long term impact of the scheme will have a significant beneficial impact as the A55 and railway will be protected from erosion and storm damage. However, there may be local minor adverse impacts once the scheme is operational due to altered traffic flows due increased usage of the waterfront area.

4.3 Regional Policy Table of Effects

- 4.3.1.1 Assessment has been achieved by considering whether the scheme is anticipated to benefit, hinder or have no effect on regional planning policy objectives as summarised in Table 4.2.

Table 4.2: Regional Policy Effects Table

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
WALES SPATIAL PLAN (WSP)			
16.4 Conwy	States that broadening the economic base and raising the profile of the county's environmental assets will be an important focus to provide high quality employment opportunities.	Construction: Beneficial minor impact Operation: Beneficial major impact	Temporary employment will be generated during the construction phase of the scheme. The long term, indirect, impact will be largely beneficial due to employment generation in tourist industry and improvements to environmental assets of beach.
16.9 Sustainable travel links	Highlights the necessity for sustainable transport links between towns.	Construction: Neutral impact Operation: Beneficial moderate impact	There are likely to be minimal impacts during construction, although temporarily reduced access along the Waterfront and Promenade may occur. During operation, the scheme will provide greatly improved protection for important transport links through Colwyn Bay, including the A55 road and railway thus facilitating achievement of policy objectives.

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
16.11 & 16.36 Regeneration and tourism	Identifies Colwyn Bay as a key settlement for regeneration. Improvement of quality of tourism facilities and services in the town.	Construction: Neutral impact Operation: Beneficial major impact	There are unlikely to be any significant impacts during construction. Evidence from other recent schemes in Wales suggests that the construction of the defences would have a positive impact on the number of visitors to the area as people come to watch the works taking place. Overall, the scheme will (indirectly) have a significantly beneficial impact as the coastal defences and recharged beach areas will facilitate improvement of tourist facilities of the town and make Colwyn Bay a more attractive holiday destination.
NORTH WEST ENGLAND AND NORTH WALES SHORELINE MANAGEMENT PLAN 2			
1.3 Colwyn Bay	Key objectives for the area are: i) to avoid loss of property due to erosion and/or manage risk of flooding to people and property, ii) to avoid loss of scheduled and other nationally important cultural heritage sites, iii) to avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities, and iv) to avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities.	Construction: Neutral impact Operation: Beneficial major impact	The scheme complies with policy objectives to avoid loss due to erosion and prevention of flooding of residential, commercial and economic assets and will ensure the protection of important infrastructure such as the A55 and railway.

4.4 Local Policy Table of Effects

- 4.4.1.1 Assessment has been achieved by considering whether the scheme is anticipated to benefit, hinder or have no effect on regional planning policy objectives as summarised in Table 4.3.

Table 4.3: Local Policy Effects Table

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
COLWYN BOROUGH LOCAL PLAN			
Policy CN6 (Development within coastal zone)	This policy states that <i>"developments in areas of undeveloped coastline outside settlement limits, that will adversely affect the open character, nature conservation value or coastal processes of the coastal zone, will not normally be permitted."</i>	Construction: Adverse minor impact Operation: Neutral impact	Construction of the groyne may have a slightly adverse impact on the open character of the coastal zone although this will be largely mitigated by the beach recharge operation. Coastal defence works have been carefully designed to be in keeping with the surroundings and sensitive to existing development and so adverse operational impacts are considered to be negligible. The operational impacts may in fact be slightly positive, as the beach recharge operation will return the frontage to a state similar to that present when the defences were first installed.

Planning Policy	Details of policy relevant to Colwyn Bay Waterfront Project	Assessment of Impact	Comments
Policy CN7 (Development within coastal zone and settlement limits)	This policy specifies that development within the settlement limits of the coastal zone shall only be permitted where it is for a tourism and/or recreation use requiring a coastal location.	Construction: Neutral impact Operation: Beneficial moderate impact	A slightly adverse impact may result from construction activities, which may temporarily reduce access to the beach and waterfront area. However, as the waterfront is located away from the town centre, the majority of businesses will be unaffected by the construction works and will benefit in the longer term due to increased visitor numbers to the area as an indirect result of the scheme. The scheme complies with the policy stipulation that development is for tourist and recreation purposes as the scheme forms part of regeneration proposals for Colwyn Bay to encourage a revival of the tourist sector.
Policy CN9 (Coastal Protection works)	Coastal protection works will be permitted providing that full consideration is given to the open character and nature conservation value of the coastal zone.	Construction: Adverse minor impact Operation: Beneficial major impact	Construction impacts of the scheme are considered to be negligible although a slightly adverse impact may result from construction activities due to temporary visual impacts due to construction of coastal defences along the waterfront and beach. The operational impacts are considered to be largely beneficial as the improvements to the beach will support objectives to maintain the open character of the coast. Conversely, Option 1 (comprising linear rock revetment defences), is considered to conflict with this planning objective as it would adversely affect the open character of the coastal zone. The scheme complies with the policy objectives as a full EIA is being undertaken.
Policy CN10 (Development and coastal protection)	This policy states that any development that requires an increase in the level of coastal protection, or require enhancement and mitigation works, will only be permitted where any necessary improvements are undertaken at the expense of the developer.	Construction: Neutral impact Operation: Beneficial moderate impact	The scheme will have a largely positive impact with regards to this policy as it will provide an increase in coastal protection for the whole town of Colwyn Bay.
CLWYD STRUCTURE PLAN SECOND ALTERATION (CONWY VERSION)			
Policy Cons 5: Development on coast	This policy aims to protect the natural ecology and landscape of the county through considerate and limited development along the coast, particularly in undeveloped areas.	Construction: Adverse minor impact Operation: Beneficial minor impact	Slightly adverse impacts to local ecosystems during construction may arise during the beach recharge operation. The scheme is predominantly located along an area of already developed coastline in the vicinity of Colwyn Bay consequently its impact on undeveloped coastline can be considered to be minimal. The scheme will create new habitat within the groyne structure and coastal defences thus preserving the natural ecology of the area. The overall impact is considered to be largely beneficial.
Policy TLR 7: Tourist facilities	<i>"large scale tourist, recreation and leisure facilities will be located within the main coastal holiday resorts"</i>	Construction: Neutral impact Operation: Beneficial major impact	Construction impacts can be considered to be negligible. This scheme is a fundamental part of regeneration proposals for Colwyn Bay and will generate significant tourism for the area. The scheme aligns with policy objectives in that it is located within a main coastal holiday resort for North Wales.

4.5 Other national, regional and policies of relevance

4.5.1 National Guidance

Minerals Technical Advice Note (Wales) 1: Aggregates

- 4.5.1.1 The Coastal Defence scheme proposes to utilise locally quarried material from existing operational quarries for the purposes of the construction of rock armour revetments along the Colwyn Bay. As material will be sourced from independently operational sites, the key impacts associated with use of quarried material are associated with transport of materials to site.
- 4.5.1.2 The Welsh Assembly Government has produced the '**Mineral Planning Policy for Wales**' which is supported by a number of Mineral Technical Advice Notes (MTAN). MTAN 1 provides advice for the extraction of aggregates by mineral planning authorities and the aggregates industry. The MTAN details guidance on environmental impacts of quarried materials, including those associated with material transport.

Marine Mineral Guidance (MMG) 1 (Extraction By Dredging From the English Sea Bed)

- 4.5.1.3 The beach recharge aspects at Colwyn Bay are likely to utilise dredging material from existing licenced offshore dredging sites in the local area wherever possible. Limitations with the supply of local rock may result in materials being sourced from further a field. The sites from which dredging material is to be sourced are already licenced and so planning approval is not required for dredging operations and consequently the review of the below policy is included in this study for information only.
- 4.5.1.4 A Minerals Technical Advice Note (MTAN) specific to dredging materials has not yet been produced. This scheme could utilise dredged material from Liverpool Sound which is under English planning jurisdiction. The English MMG 1 has consequently been reviewed.
- 4.5.1.5 MMG 1 outlines Government policy on extraction of marine gravel, sands and other minerals from the English seabed. The policy is relevant for dredging licence applications submitted under the Government View (GV) procedure in addition to any Dredging Permissions made under the new statutory system when it is implemented.

4.5.2 Local Guidance

Conwy Unitary Development Plan

- 4.5.2.1 While the Conwy Unitary Development Plan was never adopted and does not carry as much weight as the adopted Local Development Plans, specific policies relevant to the scheme have been noted below **for information only**:
- **Policy ST10:** *"Developments which maintain and enhance.....the role of Colwyn Bay as a main shopping centre, will be encouraged."* The Colwyn Bay Waterfront Project complies with this policy as it will encourage visitors to the area and as a result retail investment in the town centre is likely to increase. The scheme can therefore be considered to have a beneficial minor impact on this policy.

- Policy CF8L** *“Development associated with sport and leisure activities in the countryside will only be permitted in locations where 1) the amenity of local residents and other users of the countryside are not unacceptably affected, 2) there is no unacceptable visual impact on the landscape, 3) there is no unacceptable affect on conservation interests, and 4) the site is close to a main ‘A’ or ‘B’ road to which there is an adequate and safe access point to serve the development.”* The Colwyn Bay Waterfront Project can be considered to largely align with this policy objective as the recharged beach will create a new open space and public amenity resource. Additionally, the site of the proposed scheme has good existing links to the A55 road and the scheme is considered to have a positive impact on the landscape during operation although some minor adverse impacts may occur due to visual intrusion during construction.
- Policy TR4:** *“Developments will be required to comply with appropriate parking standards or through contributions to related public transport initiatives”* Although the coastal defence and engineering works will not directly provide parking or improve public transport facilities, the construction of new defences along the Promenade will provide additional space to facilitate installation of parking facilities and transport links as part of the environmental improvements element of the project to follow at a later date.

The Bay Life Regeneration Strategy

- 4.5.2.2 **The Bay Life Regeneration Strategy** will be coordinated with closely during environmental improvement strategy proposals for Colwyn Bay Waterfront. Consequently, it has been briefly reviewed for the purposes of this study to identify objectives which may also be of relevance to the coastal defences and initial engineering works.
- 4.5.2.3 One priority of the plan is *“the creation of an accessible and visually attractive waterfront that will provide leisure opportunities for both residents and visitors to the area whilst at the same time offering sustainable solutions to protection against the threats caused by climate change and coastal erosion.”* The Coastal Defence Scheme strongly supports this objective in that it will provide significantly improved protection against coastal erosion and flooding events. The scheme will also facilitate the development of leisure facilities through the improved beach resource and improvements to the Promenade following provision of the new sea defences.
- 4.5.2.4 The Strategy also notes the intention to *“support the growth of watersports and other leisure activities within the town.”* Recharge of the beach and improvement of sea defences and later environmental improvement works will in general create an ideal resource to act as a base for watersports. The scheme can therefore be considered to align with this strategy objective.

4.6 Summary of effects

- 4.6.1.1 The scheme can be considered to align with policy objectives on the national, regional and local level, particularly with regards to climate resilience and ultimately through the facilitation of the tourist industry. Temporary adverse impacts which may be experienced during construction are not anticipated to last beyond the initial phase of the scheme and residual impacts during operation are generally considered to be beneficial.
- 4.6.1.2 Tourism and regeneration are key policy objectives at all levels of planning, and the scheme supports these (specifically TAN4, TAN13, WSP 16.11 and TLR7) in several ways. Firstly, the

scheme will provide flood and coastal erosion protection to local transport, residences and businesses, thus encouraging economic growth in the area. Secondly, the recreation of a sandy beach resource through beach recharge proposals will restore the town's status as a desirable coastal holiday destination and consequently tourism in the area can be expected to significantly increase as an indirect result of the coastal defence works. Increased investment and a greater number of visitors to the area will raise the profile of the town, promoting long term economic growth and benefits to the local community. Due to the above reasons, the scheme is also considered to comply with policies relating to recreation and open space (specifically TAN 16).

- 4.6.1.3 The construction of new coastal defences along the Bay supports national, regional and local policy objectives to enhance sea defences in accordance with TAN 14, TAN 15, the Shoreline Management Plan for the area (SMP2) and CN10. The scheme will help to prevent damage and eventual closure of critical transport infrastructure in addition to providing improved protection to residential and commercial property and recreational facilities. Local policies associated with the protection of the 'open character' of the North Wales coastline (CN6, CN7 and CN9) will not be significantly affected as the scheme falls within an area of already developed coastline and proposals to recharge the beach will add to the coastal resource.
- 4.6.1.4 Transport policies (TAN18, WSP 16.9) are supported by the scheme as it will ensure the continued operation of both the A55 and the railway line, which would otherwise be seriously affected by continued coastal erosion. Improved access to the Waterfront will also improve local transport links between the town centre and coast. It should be noted that the local road network, particularly along the Promenade, may be temporarily impacted during construction due to construction traffic movements (e.g. HGVs) and works at the Waterfront. There is a direct link from the A55 to the Waterfront and so the impact on town centre traffic is likely to be minimal during construction. Additionally, it is proposed to import the larger volumes of sand for the beach recharge to site by sea and once the construction phase is complete the impact of the scheme on local transport is considered to be minimal. Increased vehicular movements to and from the Waterfront during operation can be expected due to an increased number of visitors to the area.
- 4.6.1.5 While the Coastal Defence scheme will not directly address the issues of traffic flow, the new sea defences will facilitate the development of parking provision along the Waterfront, new transport links between the Waterfront and town centre, and improved transport links along the Waterfront area in general. The slightly adverse impact of increased vehicular movements can therefore be considered to be indirectly mitigated by improvements to the transport network in subsequent regeneration proposals. Additionally, increased traffic flows will only occur due to an increase in the number of visitors and users of the Waterfront area, which will benefit Colwyn Bay in other ways, specifically; economically, through a revival of the tourist industry, and socially, through the provision of a public open space resource.
- 4.6.1.6 Land take and noise during construction have the potential to temporarily impact on local ecological features and the local community and consequently there may be some slightly negative impacts on policy objectives for environmental management (such as TAN 11 and PPS23). However, construction impacts are transient in nature and there are not anticipated to be significant residual impacts on these objectives. The new linear defences will result in some loss of foreshore habitats important for some marine species. However, in compensation, new control structures will create reef habitat suitable for fish, and commercial species such as lobster and crab. Adverse disturbance impacts on bird species during construction will largely be mitigated by the provision of new roosting habitat for shoreline species within the coastal defences. In general,

the scheme falls in line with national and local planning policy (specifically TAN 5, Cons 5) for nature conservation as the operation of the scheme is considered highly unlikely to impact on significant nature conservation designations or ecological features.

- 4.6.1.7 The scheme is considered to be beneficial to and compliant with planning policy objectives relating to the historic environment (such as PPS5) as the new coastal defences will provide improved flooding and storm protection to listed buildings and archaeologically important structures along the waterfront. Additionally, the beach recharge operations will provide additional protection to the ancient buried forest in the vicinity of Rhos-on-Sea. Should any archaeologically valuable finds be encountered during construction of the new sea defences, the relevant archaeologists in Conwy County Borough Council and Cadw will be informed.
- 4.6.1.8 Providing that work is undertaken in accordance with TAN5, TAN14, TAN15 and PPS23 and Environment Agency (Wales) and CEFAS guidelines, in addition to requirements of regional and local planning policy, the long term impact of the scheme is considered to facilitate improvements to the social and economic stability of Colwyn Bay, with no residual major negative impacts on water or air quality, historic coastal setting, or the surrounding environment.

4.7 References

- Planning Policy Statement 5 (Planning for the Historic Environment)
- Planning Policy Statement 23 (Planning and Pollution Control)
- Technical Advice Note 4 (Retailing and Town Centres)
- Technical Advice Note 5 (Nature Conservation and Planning)
- Technical Advice Note 11 (Noise)
- Technical Advice Note 13 (Tourism)
- Technical Advice Note 14 (Coastal Planning)
- Technical Advice Note 15 (Development and Flood Risk)
- Technical Advice Note 16 (Sport, Recreation and Open Space)
- Technical Advice Note 18 (Transport)
- People, Places, Futures - The Wales Spatial Plan
- North West England and North Wales Shoreline Management Plan: Draft Issues (August 2008)
- The Colwyn Borough Local Plan
- Clwyd Structure Plan Second Alteration (Conwy Version)

- The Bay Life Initiative Development Plan 2007 – 2014, Conwy Country Borough Council
- Draft Issues and Objectives Tables, Cell 11 Shoreline Management Plan SMP2 North West England and North Wales, North West and North Wales Coastal Group

5. Coastal Processes

5.1 Introduction

5.1.1.1 This chapter presents an assessment of the impacts of the coastal defence improvement works within the Colwyn Bay Waterfront Project on the coastal processes, including hydrodynamics, geomorphology and water quality. It provides an overview of the baseline hydrodynamic conditions, the local geomorphological setting and water quality conditions and an assessment of the potential impacts that the coastal defence improvement works may have on these issues. Appropriate mitigation measures to avoid or reduce significant impacts are also presented as well as a discussion of residual and cumulative impacts.

5.2 Methodology

5.2.1 Methodology

5.2.1.1 The methodology carried out to assess the impacts of the proposed coastal defence improvement works is as follows:

- Review of the relevant legislation and policies pertinent to the scheme;
- Identification of the baseline conditions, including coastal processes, hydrodynamic conditions and geomorphology through desktop surveys, site reconnaissance and preliminary ground investigation;
- Prediction of the impacts on the baseline conditions as a result of the proposed coastal defence improvement works;
- Identification of the mitigation measures that may be required to address any potential significant impacts on coastal processes;
- Assessment of residual impacts on coastal processes in the context of the proposed mitigation measures; and
- Assessment of cumulative impacts in relation to adjacent schemes and proposals.

5.2.2 Sources of data

5.2.2.1 The following general information sources have been used to establish the baseline conditions:

- Published geological maps and hydrogeological maps including:
 - Geological Survey of Great Britain (England and Wales), Sheet 95, Rhyl, 1:50,000, Solid & Drift Edition, Reprinted 1999
 - Institute of Geological Sciences, Hydrogeological Map of the UK
- Multi Agency Geographic Information for the Countryside (MAGIC);

- These data have been supplemented by the use of specific studies of this frontage a number of which have been undertaken for the purpose of the proposed coastal defence improvement works:
 - North West England and North Wales Shoreline Management Plan (SMP2), Consultation Draft (Halcrow, 2009);
 - Colwyn Bay Waterfront Project Plan, Draft for Consultation (Coastal Engineering UK, 2006);
 - Colwyn Bay Preliminary Project Appraisal Report (PAR) (Coastal Engineering UK, 2008);
 - Detailed Modelling Studies For Colwyn Bay Coastal Defence Scheme Physical Model Tests of New Linear Defences (Royal Haskoning, 2010);
 - Colwyn Bay Detailed Modelling Study for Coast Defence Scheme. Phase 1 Interim Modelling Technical Note (Royal Haskoning, 2010);
 - Colwyn Bay Waterfront Project Plan, Natural Processes and Coastal Defence Baseline Report (Coastal Engineering UK, 2006);
- Colwyn Bay Waterfront Project – Phase 1 Coastal Defence – Ground Investigation Works (Allied Exploration and Geotechnics Limited, 2010);
- Site walkovers and inspections carried out by experienced coastal managers and engineers on 20th – 21st July 2010; and
- Beach Profile Data from 1997 to 2009 obtained from Conwy County Borough Council.

5.3 Policy Context

5.3.1.1 This section provides the main legislation and policies relevant to the assessment of potential impacts of the proposed coastal defence improvement works on coastal processes.

5.3.2 Legislation

The main legislative framework regarding coastal processes is set by the following Acts and Regulations:

- Agriculture Act 1986;
- Coast Protection Act 1949;
- Construction (Design and Management Regulations) 2007;
- Contaminated Land (Wales) Regulations 2001;
- Control of Substances Hazardous to Human Health 2002 (as amended);

- Environmental Damage and Liability (Prevention and Remediation) Regulations 2009;
- Environmental Permitting Regulations 2007;
- Environmental Protection Act 1990 (as amended by the Environment Act 1995);
- Environmental Protection (Duty of Care) Regulations 1991 (as amended 2003);
- EC Landfill Directive 1999/31/EC 1999;
- Groundwater Regulations 2009;
- Hazardous Waste (England and Wales) Regulations 2005;
- Land Drainage Act 1991;
- Landfill Tax (Contaminated Land) Order 1996;
- Landfill (England and Wales) Regulations 2002;
- Town and Country Planning Act 1990;
- Water Act 2003;
- Water Resources Act 1991 (WRA 1991); and
- Wildlife and Countryside Act 1981 and (Amendment) Act 1985 (as amended by the Countryside and Rights of Way Act 2000).

5.3.2.1 The Wildlife and Countryside Act 1981 (as amended) provides statutory protection of Sites of Special Scientific Interest (SSSIs) in England and Wales, some of which are of geological importance. Special Protection Areas (SPAs) and Ramsar Sites, as well as Limestone pavements, are also protected under this act. Environmentally Sensitive Areas (ESAs) are agricultural areas benefiting from special protection. The importance of nature conservation, including areas with geological features, is also emphasised in the Environmental Protection Act 1990 (as amended).

5.3.3 Planning Policy

5.3.3.1 The planning policies which are of direct relevance to coastal processes are described in the following section. These include:

- Current national policies (including, for example, Planning Policy Wales, Technical Advice Notes and Local Development Plans Wales 2005);
- The Wales Spatial Plan;
- The Community Strategy; and

- Local transport plans and policies.

National planning policy

5.3.3.2 The specific Technical Advice Notes that relate to the proposed coastal protection works are:

- TAN 5 – Nature Conservation and Planning (1996) gives advice on development control issues for environmental designated areas;
- TAN 12 - Design (2009) provides all those involved in the design of development with advice on:
 - How 'promoting sustainability through good design' may be facilitated through the planning system
 - The preparation and validation of mandatory design and access statements
- TAN 13 – Tourism (1997) recognises that although tourism cannot be regarded as a single or distinct land-use category, the issues it raises should be addressed in preparing or revising development plans and in development control decisions;
- TAN 14 - Coastal Planning (1998) describes the coastal zone as a complex and dynamic area of mutually interdependent land and adjacent sea defined by the local authority in consultation with neighbouring authorities. The guidance details a number of issues which must be taken into account because of their potential effects on physical processes and ground conditions, as well as the overall balance, sensitivity and conservation of the area; and
- TAN 15 - Development and Flood Risk (2004) provides guidance on flooding as a material consideration in development control decisions, runoff and increasing the risk of flooding on or off site, coastal protection works and flood defence works.

Regional Planning Policy - North Wales Regional Planning Guidance

5.3.3.3 The North Wales Regional Planning Guidance specifies the following policies that are related to the proposed coastal protection works:

5.3.3.4 Environment – Unitary Development Plan proposals should acknowledge important environmental features and establish policies to protect or enhance areas of environmental designations. Within the Plan is a section relating to the coast which presents the following guidance:

- Guidance on coastal issues seeks to encourage Local Authorities to act together to deliver a sustainable, integrated and environmentally sensitive land use planning strategy for the region's coast;
- Policies and proposals in Unitary Development Plans should aim to enhance the economic prospects of the coastal area whilst protecting and enhancing its biodiversity,

natural character and quality of the landscape and built environment. In this way the true value of the coast to the people who live, work and enjoy it can be realised;

- In preparing Unitary Development Plans neighbouring coastal authorities should liaise closely in identifying the extent and characteristics of coastal areas of influence; and
- As a guiding principle only development which requires a coastal location should be so located. Development on the coast should be considered in the context of the capacity of the coast and maritime waters to absorb change and any risks which may arise from erosion, flooding or pollution.

Local Planning Policy – Conwy Deposit Local Development Plan 2007-2022

5.3.3.5 The existing local plan covering the site contains policies relating Spatial Objectives, Sustainable Development, Tourism and the Natural Environment which have relevance to the proposed coastal protection works, including:

Spatial Objectives

- SO1. To promote development levels that contribute to protecting the natural and built environment and meets the needs of the community by locating development where practicable on previously used land, primarily in the urban coastal locations, along existing and proposed infrastructure networks, and by ensuring an efficient density of development compatible with local amenity;
- SO8. Assist tourism through the protection and enhancement of coastal and rural based tourism attractions and accommodation; and
- SO12. Safeguard and enhance the character and appearance of the undeveloped coast and countryside, sites of landscape/conservation importance and features of historic or architectural interest whilst ensuring the conservation of biodiversity and protected species.

Sustainable Development

5.3.3.6 The following are relevant to coastal processes:

1. Development will only be permitted where it is demonstrated that it is consistent with the principles of sustainable development.

- Conserve or enhance the quality of biodiversity and wildlife habitats, and safeguard protected species in line with policy NTE/1 'The Natural Environment';
- Conserve or enhance the quality of buildings, sites and places of historic, archaeological or architectural importance in line with policy CTH/1 'Historic Environment'; and

- Take account of and address the risk of flooding and pollution in the form of noise, lighting, vibration, odour, emissions or dust in line with DP/2 'Overarching Strategic Approach' and DP/3 'Promoting Design Quality and Reduction of Crime'.

2. Development proposals should also where appropriate.

- be designed to a high standard, being attractive, adaptable, accessible, safe and secure as set out in DP/3 'Promoting Design Quality and Reduction of Crime';
- conserve or enhance the quality of valued open spaces, the character and quality of local landscapes and the wider countryside in line with policy NTE/1 'The Natural Environment' and CFS/1 'Community Facilities and Services';
- take account and address the potential impact of climate change in line with policy NTE/1, 'The Natural Environment'; and
- protect the quality of natural resources including water, air and soil in line with NTE/1 'The Natural Environment'.

Tourism

5.3.3.7 To contribute to economic development through the promotion of year-round tourism whilst ensuring the protection of the natural and built environment:

- Supporting, in principle, proposals for tourism related development that diversify the tourism economy in off-peak seasons whilst sustaining environmental and heritage qualities; and
- Seeking to improve cross-boundary links and benefits with neighbouring authorities, in line with Policy EMP/7 'Location of New Tourism Development'.

Natural Environment Strategy Statement

5.3.3.8 4.168 The Plan Area benefits from attractive rural and coastal attributes which support a thriving tourism industry and providing a valuable leisure and recreation resource for residents. Policies in this section aim to protect and enhance the character of the countryside, landscape, built environment, and the rich biodiversity and geological assets.

5.4 Baseline Conditions

5.4.1.1 A thorough understanding of the baseline conditions of the frontage has been developed through previous work commissioned by Conwy County Borough Council. The work has included the development of both a Coastal Strategy (Draft for Consultation) (CEUK, 2006) and a Project Appraisal Report (Draft) (CEUK, 2008). The coastal strategy is included in ES Volume 2, Technical Appendix 5 for reference, while the draft PAR can be found in ES Volume 2, Technical Appendix 3. These baseline conditions have then been used to develop both numerical and physical models of the area (Royal Haskoning, 2010 – provided in ES Volume 2, Technical Appendix 5) in order to gain a thorough understanding of the hydrodynamics and the potential effects of any reconfiguration of beach control and coastal protection structures. Information from

these previous studies has been used to develop concept designs for the improvement works and the subsequent detailed design of a preferred option.

5.4.2 Geology and Geomorphology

- 5.4.2.1 The Colwyn Bay frontage that is included within these proposed coastal defence improvement works is fixed at its extremities by Rhos jetty in the west and Beach Road, Old Colwyn in the east. The backshore of the bay is defined by cliffs comprising glacial sands and gravels. The superficial geology of the study area comprises glacial sands and gravels and boulder clay. These glacial deposits overlay the Elwy Formation. The Elwy Formation comprises coastal and fluvial alluvium which is formed of mainly silty clays with subordinate sand, gravel and peat in valleys, estuaries and sheltered coastal environments. Sands and gravels in these deposits may provide limited supplies of uncertain quality, with the risk of saline contamination in coastal areas. The lower boundary of the formation is the ribbon banded mudstones of the Nantglyn Flags Formation. The upper boundary is unconformably overlain by Carboniferous Limestone and Basel Conglomerate which is formed of massive well fissured karstic limestones.

5.4.3 Sediment Processes

- 5.4.3.1 The net littoral drift along the frontage is in a west to east direction. The sediment transport around Rhos Point, from Penrhyn Bay to the adjacent Colwyn Bay is limited to fine sand and silt-sized material offshore. Inshore the beaches in Penrhyn Bay have largely been denuded of fine material and the protrusion of Rhos Point limits the transport of material around the headland. Studies show that prior to the construction of the breakwater at Rhos-on-Sea beach material was readily transferred from Penrhyn Bay to Colwyn Bay (Halcrow, 2009).
- 5.4.3.2 The potential rate of transport (not considering actual sediment availability) is estimated to be 10,000m³/year (HR Wallingford, 1988). A study by HR Wallingford indicated that the majority of alongshore sediment transport within Colwyn Bay takes place on the lower foreshore, between low water and the -4.0maOD contour, reducing both landward and seaward of this zone. Observations and monitoring suggests that material between low and high water is moved on/offshore, by wave activity and interaction with the present defences, with material overall being gradually lost from the intertidal zone (Halcrow, 2009).
- 5.4.3.3 There is evidence that beach volumes have reduced since 2001 although there is some cyclic behaviour. Overall beach volumes are reducing between Rhos and Old Colwyn and foreshore levels have lowered in the past 150 years. An assessment of beach profiles by HR Wallingford (1988, as reported in Conwy County Borough Council, 2006) showed, however, that between 1956 and 1988, the volume of the beach in Colwyn Bay has not changed significantly in the previous 30 years. HR Wallingford (1991) does, however, report that the upper beach has displayed considerable variation from 1870. There has been a general movement of sediments seawards, with a drop in beach levels in front of the seawall. This lowering of the upper beach is matched by a general increase in sediment quantities on the lower beach. Halcrow (2000), as reported in Conwy County Borough Council (2006) consider that this is due in part to scour of the upper beach by waves reflected from the seawall.
- 5.4.3.4 The current beach material is predominantly gravelly fine to medium sands. Replenishment of the beach is proposed as one phase of the options for coastal defence improvement works. Alternative sand sources have been examined using existing offshore sand supply areas. Four

licensed sites have been considered, with the most appropriate sources being at Liverpool Bay Area 457. The grading of the current beach material and potential sources for recharge are presented in Table 5.1.

Table 5.1: Sediment grading for the current and proposed beach material.

	D90(mm)	D50(mm)	D10(mm)	Size Spreading	General Description	Comments
Current beach grading	16.63	2.13	0.28	7.71	Slightly gravelly fine to medium Sand	Predominately fine to medium sand
Liverpool Bay Area 457	1.34	0.41	0.23	2.41	Medium SAND	Very little gravel and fines.
Hibre Swash Area 392	4.43	0.53	0.16	5.26	Gravelly fine to medium SAND	
Morecombe Bay	0.64	0.29	0.16	2.00	Fine to Medium SAND	
Liverpool Bay (Gardline Report)	0.18	0.17	0.07	1.60	Fine SAND	Frequent pockets and bands of organics, and organic silt

Source: Colwyn Coastal Strategy, Site Investigation (Celtest, 2007)

5.4.3.5 Sediment modelling along the frontage has identified that with no coastal defences there will be an estimated sediment loss of 575,000m³ for d₅₀ = 0.25mm and 400,000m³ for d₅₀ = 0.45mm 10 years after recharge occurred (Royal Haskoning, 2010).

5.4.4 Hydrodynamics

Tides and Tidal Currents

5.4.4.1 The tidal range along this section of the frontage has an important influence on coastal processes. The spring tidal range is up to 7.14mAOD with the neap tide range over 3.81mOD as presented in Table 5.2.

Table 5.2: Tide Levels for Colwyn Bay

Tide	Level (mAOD)
HAT	+4.68
MHWS	+3.70
MHWN	+2.00
MSL	+0.11
MLWN	-1.81
MLWS	-3.44
LAT	-4.34

5.4.4.2 The tidal currents in Liverpool Bay are generally in an easterly direction on the flood tide and westerly on the ebb tide with a residual net current from west to east. The maximum flood currents are greater than the maximum ebb currents because the tidal rise time on the flood is shorter than the time of fall on the ebb. Offshore the mean speed on both flood and ebb is of the order of 1.0m/s. The inshore tidal streams are roughly parallel to the North Wales coast changing to south-easterly on the flood and north-westerly on the ebb across the strategy frontage. Magnitudes also decrease to typically 40-75% of the values offshore.

- 5.4.4.3 At Colwyn Bay the tidal streams are generally in a west to east direction. HR Wallingford (1991) identified that the Rhos-on-Sea breakwater may be causing a reversal of currents at Colwyn Bay. This reversal results in the formation of a localised net drift reversal to the south of Rhos Point during storms (Halcrow, 2009).
- 5.4.4.4 The tidal currents, together with the agitation of wave action are sufficiently high to induce shear stresses which exceed the critical shear stress for initiating the movement of sand on the seabed (CEUK, 2006).

Wave Climate

- 5.4.4.5 The wave conditions at Colwyn Bay are generally generated by local wind or as a result of longer period swell waves that have propagated into the Irish Sea from the Atlantic Ocean via the St Georges Channel and Cardigan Bay to the south or the north channel between Scotland and Northern Ireland, to the north. Generally approximately 50% of the waves are generated from directions 250°-330° whole circle bearing (WCB) with over 30% from the directions of largest fetch.
- 5.4.4.6 The Colwyn Borough Sea Defence Review (HR Wallingford, 1991) provides both wave height versus direction distributions and predicted marginal extreme wave heights and periods for an offshore location and two locations inshore across the frontage:
- Point D Victoria Pier 285256E, 379747N
 - Point E Rhos on Sea 283715E, 381887N
- 5.4.4.7 The locations of these points and the relative proportions of waves from different direction sectors are shown in Figure 5.1.

Figure 5.1: Location of Inshore Wave Prediction Points (Conwy County Borough Council, 2006)



5.4.5 Flood Risk and Erosion

Coastal Protection Structures

- 5.4.5.1 Along the frontage the foreshore is backed by masonry and concrete vertical walls. These walls are reported to date back to the 19th Century. Timber groynes were also previously constructed along the frontage to retain beach material but have since fallen into disrepair and are no longer effective. Beach levels were observed to drop following the construction of the hard defences and the failure of the timber groynes leading to undermining and instability of the sea walls.
- 5.4.5.2 The coastal defences along the frontage are maintained by Conwy County Borough Council and Network Rail. An assessment of the condition of the existing defences in 2008 reported the residual life of the existing defences to be less than 5 years.
- 5.4.5.3 Between Rhos-on-Sea and Victoria Pier concrete and rock armour toe constructions have been added to ensure the integrity of the walls which range in crest height between 7.0-8.0mAOD falling to 5.0mAOD in the vicinity of Victoria Pier. In 1987 Conwy County Borough Council constructed a 650m rock berm along the most severely affected stretch of wall. The rock berm has resulted in the accumulation of sand on the beach. Subsequently, in 1990 long low rock groynes were constructed along with additional revetment improvements to encourage further beach recovery. These can be seen to have been effective with sand accumulations adjacent to the groyne reaching to near the top of the groyne design height however this level is still considerably lower than before the construction of hard defences along the frontage and the subsequent lowering of the beach.
- 5.4.5.4 To the south of Victoria Pier is an integral wave recurve wall along the crest of the masonry wall which is support by an 800m line of steel sheet piles. A rock revetment with a crest level of 6.2mAOD has been constructed in front of the wall along the majority of the section.
- 5.4.5.5 Along the eastern wall of the frontage, towards Old Colwyn, no wave recurve wall is present along the crest of the masonry wall (crest level 5.5mAOD). Along this section of the frontage routine remedial works are undertaken to provide additional toe protection as the beach levels fluctuate. In February 2005 following a storm, which resulted in the beach levels dropping by 1m, the wall required further apron construction comprising steel sheet piles and concrete infill. A further storm in March 2010 required construction of a further 160m of temporary revetment along the toe of an undermined section of the wall.

Overtopping and Run-up

- 5.4.5.6 The varying forms and crest level of the existing coastal defence structures along the frontage, and the changing relationship between the orientation of the shoreline and the wave conditions results in variable level of defence to overtopping and flood prevention along the Colwyn Bay frontage.
- 5.4.5.7 The crest level of defences varies significantly along the frontage by up to 3.0 metres, with the lowest levels being less than 0.5 metres above predicted Highest Astronomical tide. At the lowest defence sections, at Old Colwyn and adjacent to the Pier, overtopping occurs on a regular basis,

resulting in damage to the promenade and road infrastructure and closure of the public highway to traffic.

5.4.6 Water Quality and Contamination

5.4.6.1 The Environment Agency is responsible for monitoring the bathing water quality at Colwyn Bay. The monitoring point is located to the east of Victoria Pier as shown in Figure 5.2 where Nant y Groes Stream discharges to the beach. Monitoring of the water occurs weekly. The summary of the results of the bathing water quality sampling are presented in Table 5.3.

Figure 5.2: Location of the monitoring station for Bathing Water (source: Environment Agency, 2010)

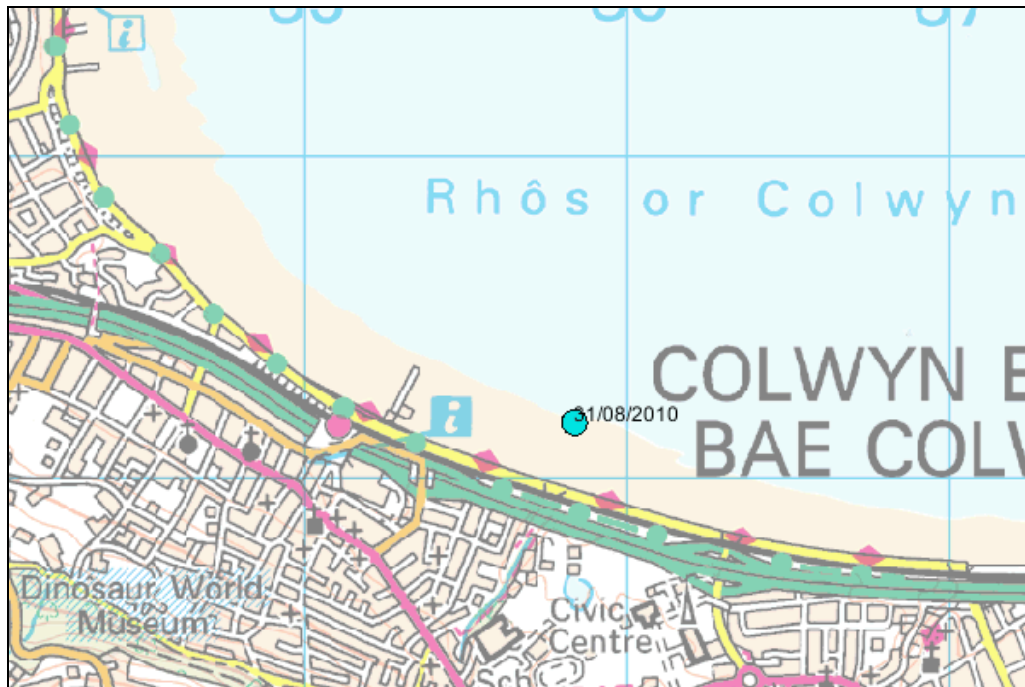


Table 5.3: Bathing Water Quality at Colwyn Bay (Environment Agency, 2010).

Year	Water Quality
2008 -2010	Good
2007	Excellent
2005 – 2006	Good
2004	Excellent
2003	Good
2002	Excellent
1994 – 2001	Good
1993	Poor
188 - 1992	Good

5.4.6.2 Water quality is assessed based on the number of certain types of bacteria which may indicate the presence of pollution, mainly from sewage or livestock waste. A quality rating of excellent

means the bathing water meets the criteria for the stricter UK guideline standards of the Directive (includes lower levels of concentrations and a third parameter (FS)); limits used are TC: ≤ 500 ; FC: ≤ 100 ; FS: ≤ 100 . Good means that at least 95% of the samples meet the mandatory standards of the Directive; limits used are TC: ≤ 10000 ; FC: ≤ 2000 ; FS: N/A. Poor means that fewer than 95% of the samples meet the required mandatory standards of the Directive; limits used are TC: > 10000 ; FC: > 2000 ; FS: N/A.

- 5.4.6.3 There are three culverted watercourses which discharge into the study area, and an additional outfall at NGR SH85877 78886, though inspections show that this outfall is currently blocked. The culverts currently drain from under the road and promenade, through the sea wall and onto the beach. The quality of the water from these culverts is currently unknown though the consistently Good-Excellent ratings achieved in Bathing Water Quality for the area indicate that these are unlikely to be contaminated although anecdotal evidence suggests that contamination incidents have previously occurred relating to this urban stream in the past. The ownership of these culverts and type of drainage they provide is currently unknown and must be determined prior to construction.

5.5 Assessment of Impacts

- 5.5.1.1 In this section, the predicted impacts on coastal processes as a result of the construction and operation of the proposed options for the improvement of coastal protection are considered and assessed in terms of their significance. Two potential options for coastal protection have been assessed:
- 5.5.1.2 Option 1 comprises improvements to the existing seawall and promenade and a rock revetment along the entire Colwyn Bay frontage, a length of some 3560m.
- 5.5.1.3 Option 2 comprises improvements to the existing seawall and promenade together with beach recharge. To control the beach recharge, a single 200m long groyne, perpendicular to the existing seawall is to be constructed. Sheet piling at the landward end of the control groyne, around the boundary of the hotspot area is to be installed. To the east of the groyne, the existing seawall is to be improved through the addition of rock revetment along its existing line linking up to an existing rock revetment along the coast.

5.5.2 Construction Impacts

- 5.5.2.1 The construction of both potential coastal protection improvement works may have an impact on a number of elements of the physical coastal environment including hydrodynamics, geomorphology and the water quality.

Geology and Geomorphology

- 5.5.2.2 For both options, there are likely to be local impacts on geology and geomorphology from the construction of the revetment. Similar impacts on geology and geomorphology are anticipated from the construction of the 200m rock groyne proposed in Option 2, though the impact from the revetment construction will be considerably less covering a reduced length than the 3650m in Option 1. Effects will derive from:

- the excavation of materials down to glacial till level within the footprint of the new revetment to provide it with a solid foundation;
- the tracking of machinery along the foreshore to excavate and dispose of existing material and to place new materials.

5.5.2.3 The method of recharge may affect the degree of impact. If material can be placed on the foreshore direct from vessels moored inshore this will require less machinery on the beach than if material is brought in by land. If the recharge is delivered by road, this method will require significant vehicle movements onto the beach to deliver materials, as well as the use of machinery to profile the beach to the necessary specification.

Sediment Transport

5.5.2.4 The construction phase for both options may lead to both a short term negative impact on the sediment, through placement of rock used for groyne or revetment construction in the intertidal zone which may affect current sediment transport patterns, leading to settling out of materials in the vicinity of the stockpiled materials and the reduction in sediment transported along the frontage. This will be a short-term effect that will cease as soon as the materials are moved and used in the construction, enabling the sediment settlement areas to be reactivated and transported alongshore. Under Option 2 there will be an introduction of a significant volume of new sediment into the construction zone which, where it is placed in the intertidal zone may lead to significant supply of material into the existing sediment transport system.

Hydrodynamics

5.5.2.5 Impacts on the hydrodynamics during the construction of either of the proposed coastal defence improvement works will be limited to small scale temporary disruption in the vicinity of any materials stored below Mean High Water.

Flood Risk and Erosion

5.5.2.6 Local reconfiguration of the existing defences prior to the construction of the proposed coastal defence improvement works may result in the increased risk of flooding and increased erosion rates along the frontage.

Water Quality and Contamination

5.5.2.7 Excavated materials, if released into the water column, may result in a decrease of water quality in the short term through an increase in turbidity and/or release of contaminants if present within the excavated matter. The previous ground investigation for the site does not detail whether there is likely to be contaminated sediments exposed during construction.

5.5.2.8 From conversations with the Environment Agency's Environmental Management Team it is understood that the culverting of watercourses is generally opposed because of the adverse ecological, flood risk, human safety and aesthetic impacts. In the case of the outfalls to the beach, all are currently culverted and fitted with tidal flap valves to prevent the ingress of seawater on a high tide and temporary extension to the outfalls to divert flows away from active working areas may be necessary during construction. The existing culverted watercourses and

outfalls onto the beach may be affected by construction works to the revetment (Options 1 and 2) and by the proposed beach recharge in Option 2 in the form of temporary works.

- 5.5.2.9 Pollution from machinery operating on site may, if not managed, result in a negative impact on the water quality of the beach through spillage of fuels, oils and lubricants.

5.5.3 Operational Impacts

- 5.5.3.1 The operational impacts of the coastal protection works on the coastal processes will occur throughout the planned life of the defence structures. The purpose of the structures is to provide a flood defence and erosion protection function and therefore will have an impact of physical aspects of the coastal environment, although they are essentially inert structures. There will also be ongoing maintenance activities throughout the life of the proposed coastal defence improvement works which may have an impact on physical elements of the coastal environment.

Geology and Geomorphology

- 5.5.3.2 Construction of hard defences can have an impact on the existing geology of an area. Beach lowering has occurred in front of the current seawall. The Option 1, new linear revetment along the existing seawall will reduce the effect of scour at the toe. Under Option 2, the proposed beach recharge will cover the foreshore up to the seawall to the west of the groyne, thus protecting the toe and reducing scour.
- 5.5.3.3 Beach recharge material introduced under Option 2 will mix with the existing beach material and, if incompatible, can change the overall characteristic of the beach. A change of sediment size may result in a change to the designed beach profile. This change may result in reduced efficiency of the groyne. If beach material used within the recharge has a smaller D50 than the existing beach material, sediment transport in the area may be increased. This may result in evolution of the beach into a profile inconsistent with its current or designed profile. It is critical that the correct sediment is used to avoid significant changes in the character of the beach.

Sediment Transport

- 5.5.3.4 Under Option 1 it is likely that there will be some accumulation of sediment material in front of the new revetment, as has been recorded at the recently constructed revetment along the Colwyn Bay frontage. In the absence of any control structures further along the beach this sediment is unlikely to remain on the beach and generally the existing longshore sediment movement regime will be maintained (CEUK, 2007). This scenario has not been modelled, however, it can be assumed that the beach will continue to erode in the longer term as described within the baseline conditions presented in Section 1.3.2.
- 5.5.3.5 Numerical and physical modelling has been carried out for the Option 2 scenario (Royal Haskoning, 2010) which considered a fishtail groyne of 250m length, whilst the current Option 2 design is for a 200m straight groyne. The aim of the proposed rock groyne is to trap material and hence maintain and improve the beach along the Colwyn Bay frontage. The results of the modelling indicate that the construction of a single groyne will provide an effective barrier to drift and hold a beach to the west. However, it was concluded that a 250m groyne is shorter than the active width of the beach profile, covering just 40% of the active zone of the beach and as such,

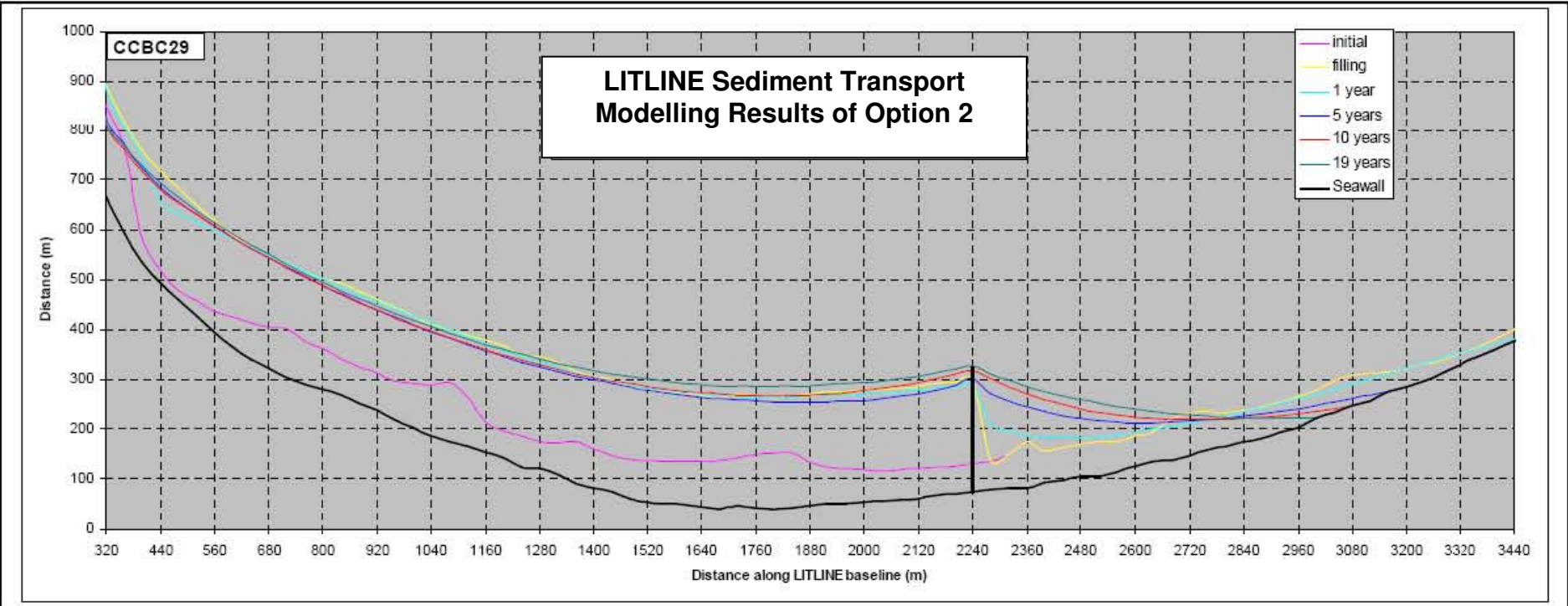
whilst it is likely to have an impact on sediment transport patterns along the frontage, it will allow by-passing of >50% of the total drift rate across the section.

- 5.5.3.6 Across the frontage the modelling suggests that there will be a retreat in the beach to the west of the groyne for the first five years following construction, reducing in magnitude moving away from the groyne, followed by recovery thereafter as presented in Figure 5.3. To the east of the groyne there is likely to be accretion occurring immediately downdrift of the groyne (up to 400m from the groyne) and erosion occurring further east of this point. The 'zone of influence' of a groyne is dependent upon its length and this can therefore be expected to be shorter with the proposed 200m groyne length.
- 5.5.3.7 The Option 2 beach recharge to the west of the groyne may also assist in maintaining the supply of sediment to the beaches downdrift of the works area. The introduction of a new supply of sediment will provide more material for potential movement but increased beach elevations may reduce movement as wave reflection is reduced from the existing sea wall. It is not possible to state how long the re-nourishment material will remain on the beach as it will be distributed along the shore by drift processes and offshore during storm events. The length of time it remains effective will depend on the frequency and magnitude of storm events. Modelling estimates losses ten years after recharge of 450,000m³ (Royal Haskoning, 2010). The current groyne design is for a shorter (200m) straight groyne located slightly to the West of this modelled groyne and as such by-pass volumes can be expected to be similar or greater than those modelled.
- 5.5.3.8 The addition of beach recharge material under Option 2 that is not consistent with the material presently found on the beach may have a negative impact on the beach. A change of the sediment size may result in a change in the existing beach profile. This change may result in the reduced efficiency of the groyne. If the beach material used within the recharge is smaller compared to the existing beach material it is possible that sediment transport will increase as wave and tidal action removes the material.

Hydrodynamics

- 5.5.3.9 Coastal processes can be anticipated to change over time even under a do nothing scenario. There will be changes in the interaction with the existing sea defences as beach levels continue to lower and sea levels rise due to the effects of climate change. Eventual deterioration of the existing defences will lead to sediments being released and a more natural evolution of the coastline, although it should be noted that given the constructed nature of much of the shoreline, materials released are likely to be man-made in origin (concrete/fill material) and coastal evolution will be inconsistent as a result of failure of specific parts of the defences over time.
- 5.5.3.10 Option 1 may result in the alteration of the waves incident at the seawall. The revetment in front of the existing seawall will provide a less reflective surface and as such would be expected to reduce scour and thus further erosion and lowering of the beach along the frontage.
- 5.5.3.11 The construction of the rock groyne and beach recharge included in Option 2 may result in the alteration of incident waves at the seawall reducing erosion at the toe of the seawall but enabling the new beach recharge material to be mobilised and potentially supplied to downdrift areas. To the east of the groyne, where revetment is proposed, the impacts would be as expected for Option 1.

Figure 5.3: Sediment Transport Modelling for Option 2



Flood Risk and Erosion

- 5.5.3.12 The proposed coastal defence improvement works will both increase the height of the defences along the frontage from 5.0-8.0m AOD to a consistent 8.0m AOD reducing the flood risk potential to the frontage. Option 2 will provide the greatest level of protection from overtopping and flood risk as the beach recharge reduces the overtopping of the seawall more effectively than the proposed revetment under Option 1 provided the beach is maintained at its design profile for which ongoing recharge will be necessary. The future increase in sea level rise and storminess will mean that both options will provide less protection to the shoreline through time.

Water Quality and Contamination

- 5.5.3.13 The proposed beach included within Option 2 may result in a negative impact on the water quality of the bay. If the material is finer than the beach sediment then wave and tidal action may result in more sediment being carried along or offshore. The additional movement of sediment, particularly if there is a large amount of fines, may have an impact on the water quality through increased turbidity. In addition, there is potential for pollutants to be introduced in the new beach material being placed at the site. If mobilised, this material may release contamination into the water column.
- 5.5.3.14 Option 2 will require regular topping-up of beach recharge and re-profiling activity requiring operation of machinery on the beach which may lead to localised pollution incidents from fuel or lubricant spillage. Additional sources of pollution on the beach and in the water may result from the increased use of vehicles and boats on the access ramps. The access steps and ramps will also require cleaning which may result in the use of chemicals. These chemicals may result in localised pollution of the water column and beach material.
- 5.5.3.15 The existing culverted watercourses and outfalls onto the beach may be affected by construction works to the revetment (Options 1 and 2) and by the proposed beach recharge in Option 2. From conversations with the Environment Agency's Environmental Management Team it is understood that the culverting of watercourses is generally opposed however in the case of the outfalls to the beach, all are currently culverted and fitted with tidal flap valves to prevent the ingress of seawater on a high tide.

5.6 Mitigation of Impacts

5.6.1 Construction Impacts

- 5.6.1.1 The import of rock for Options 1 and 2 can be by sea or road. Sea transport will have the benefit of reduced land-side vehicle movements, but will require increased vehicle movements on the foreshore. Import by road, will enable rock to be lowered direct from the promenade onto the beach, reducing the requirement for vehicle movements directly on the foreshore.
- 5.6.1.2 Large volumes of beach recharge for Option 2 can be brought in by ship rather than by road and wet sprayed directly onto the shore, thus reducing the need for lorry movements along the shore. Smaller vehicles will then be required to move the material into the required design profile, but this will involve tracking across the new sediment rather than the existing geology. Impacts from

the use of machinery on the foreshore can be reduced through the specification process and through production of a Construction Environmental Management Plan (CEMP).

- 5.6.1.3 Excavation of waste materials for both Options 1 and 2 should be kept to the minimum required in order to allow a solid founding for the new structures without the removal and disturbance of excess materials. This will reduce construction material requirements and hence costs and will minimise displacement of removed sediments onto the foreshore that might be dispersed leading to water quality issues. Sediment sampling within the construction area to determine whether contaminants are likely to be released during construction may be appropriate.
- 5.6.1.4 During construction the methodology proposed to be used will need to ensure that methods are used that minimise the suspension of sediments. To reduce short term negative impact on hydrodynamics and the sediment transport regime materials, such as the rock used for groyne or revetment construction and excavated spoil, should be stored above Mean High Water. It is unlikely that there will be any tidal working within the proposed coastal defence improvement works therefore reducing the likelihood of suspended sediments. Beach recharge material should be profiled from the back of the beach towards the seaward edge to reduce the remobilisation of materials before the final designed beach profile is achieved. If required monitoring of the suspended sediments can be undertaken during the construction period. To ensure that the construction for Option 2 has as low an impact on the sediment and water quality the works should be undertaken during the months where there is least storm activity.
- 5.6.1.5 The beach recharge material proposed for Option 2 must be suitable for the design profile. Sources of re-nourishment material for Option 2 have been assessed for their suitability. Material will be sourced from a licensed site and specified so that particle size and characteristics are similar to the existing beach to avoid changing the physical characteristics of the beach and to minimise the mobilisation of sediments. The material selected will be tested to ensure that there is no contamination of the site.
- 5.6.1.6 To reduce the potential of increases to flood risk and increased erosion during the temporary removal of defences, works should be scheduled as far as is practicable for lower tides and reduced storm periods. Alternatively, enforced temporary closures of the promenade may be required during the works.
- 5.6.1.7 Improvement works to the existing outfalls are proposed as part of the coastal protection works to ensure that they remain free flowing. The design of the coastal protection works will consider their effective drainage and ongoing maintenance during the lifetime of the works as it is recognised that these outfalls may potentially have a negative impact on the water quality if they become blocked.
- 5.6.1.8 To prevent blockage or interference with the drainage capacity of the existing outfalls onto the beach, it is recommended that within the active work areas, the culverts should be temporarily extended to divert flows away from the works. This will reduce the risk of any localised pollution incidents during construction being spread further than their source. From conversations with the Environmental Management Team we understand that they are generally opposed to the culverting of watercourses because of the adverse ecological, flood risk, human safety and aesthetic impacts. Further discussions will be had with the team as well as the owners of the outfalls, to determine the suitability of any proposed temporary works.

- 5.6.1.9 A detailed CEMP should be set up prior to commencement of construction works to minimise the likelihood of a pollution incident occurring during construction and to ensure that in the event of a pollution incident it is dealt with effectively.

5.6.2 Operational Impacts

- 5.6.2.1 The rock structures proposed for Options 1 and 2 will require minimal maintenance. Inspection should be carried out annually to recognise any movement or potential failure of the structures. Maintenance and repair of the rock structures will be possible using small tracked machinery on the beach. The construction of the revetment and the groyne will allow for repair and reconfiguration of the structures if required in response to changes in physical environmental conditions.
- 5.6.2.2 Regular beach monitoring is currently carried out by Conwy County Borough Council with information provided to the Environment Agency. A beach-monitoring regime will need to continue throughout the life of the proposed coastal defence improvement works. For Option 1, this will show how the beach is evolving in front of the new hard defences enabling remedial action to be planned if necessary. For Option 2, this will enable measurement of the loss of beach material to enable a suitable programme of maintenance beach recharge or by-passing programme to be set up and implemented to maintain the beach to the west of the groyne at its design levels and ensure that the beaches to the east are not negatively impacted by the proposed coastal defence improvement works.
- 5.6.2.3 The Environment Agency is currently looking to relocate the existing water quality sampling point. Information should be provided to the Environment Agency to assist them in determining the best location for the sampling point, given possible works to the existing outfalls and the location of new structures. Following the construction of the proposed coastal defence improvement works there is unlikely to be a significant impact on the bathing water quality of the beach due to the inert nature of the structures however there may be some variation in quality due to the change in sampling location.
- 5.6.2.4 Existing outfalls to the beach will need to be accessed and maintained by their owners/operators.
- 5.6.2.5 Chemicals used for cleaning of the beach access points (stairs and slipways) must be specified to be non-hazardous to ensure that there is no adverse impact on the sediment and water quality.

5.6.3 Residual Impacts

- 5.6.3.1 Table 5.4 and Table 5.5 present a summary of the potential impacts during the construction and operation of the proposed coastal protection works as part of the waterfront project. It shows the significance of residual impacts if the mitigation measures described in Section 5.6 are implemented.
- 5.6.3.2 The two options currently proposed for the Colwyn Bay frontage may both have effects on coastal processes. During the construction phase it is unlikely that there will be any major adverse effects on the coastal processes for either option if mitigation measures are implemented. Option 1 may have a Minor Adverse impact on sediment transport, whilst the residual impacts of Option 2 may offer Beneficial impacts to both the construction area and downdrift coastal areas from the introduction of new sediment to the area.

5.6.3.3 During the operation of the proposed coastal defence improvement works, Option 2 is likely to have a greater impact on the sediment transport and hydrodynamics of the frontage as a result of the proposed beach recharge. These impacts are seen to be Beneficial both to the construction area and to the downdrift beaches. The residual impacts of Option 1 on sediment transport may have an adverse impact on downdrift areas whilst benefiting the construction area as there is no new sediment supply introduced in this option.

Table 5.4: Summary table of significance of impacts during construction

Significance (Minor, Medium, Major); Adverse/Beneficial Impact					
Effect		Option 1	Option 2	Option 1	Option 2
		Impact (Without mitigation)		Residual Impact (With Mitigation)	
Geology and Geomorphology	Damage to geology	Minor Adverse	Minor Adverse	None	None
Sediment transport	Change to current littoral drift processes	Minor Beneficial to Phase 1-3 areas	Major Beneficial to Phase 1-3 areas.	Minor Beneficial to Phase 1-3 areas	Major Beneficial to Phase 1-3 areas.
		Minor Adverse to downdrift areas.	Major Beneficial to downdrift areas.	Minor Adverse to downdrift areas.	Minor Beneficial to downdrift areas.
Hydrodynamics	Change to tidal currents and wave conditions	Neutral	Minor Adverse	None	Minor Adverse
Flood Risk and Erosion	Removal of Defences	Minor Adverse	Minor Adverse	None	None
Water Quality and Contamination	Increased turbidity	Medium Adverse	Minor Adverse	None	None
	Release of contaminants	Medium Adverse	Medium Adverse	None	None
	Diversion/blockage of outfalls	Minor Adverse	Minor Adverse	None	None
	Pollution Incidents	Major Adverse	Major Adverse	None	None

Table 5.5: Summary table of potential impacts, timing of impacts and significance of impacts during operation

	Effect	Significance (Minor, Medium, Major); Adverse/Beneficial Impact			
		Option 1	Option 2	Option 1	Option 2
		Impact (Without mitigation)		Residual Impact (With Mitigation)	
Geology and Geomorphology	Change in beach profile	Neutral	Major Beneficial to Phase 1-3 areas	None	Major Beneficial to Phase 1-3 areas
	Scour	Minor Adverse	Neutral	None	None
Sediment transport	Interruption of littoral drift	Minor Adverse to downdrift areas	Major Beneficial to downdrift areas	Minor Adverse to downdrift areas.	Major Beneficial to downdrift areas
	Accumulation of sediment	Minor Beneficial to Phase 1-3 areas Minor Adverse to downdrift areas	Major Beneficial to Phase 1-3 areas Major Beneficial to downdrift areas	Minor Beneficial to Phase 1-3 areas Minor Adverse to downdrift areas	Major Beneficial to Phase 1-3 areas Major Beneficial to downdrift areas
Hydrodynamics	Change to tidal currents	Neutral	Neutral	None	None
	Change to inshore wave conditions	Neutral	Medium Beneficial to Phase 1-3 areas	None	Medium Beneficial to Phase 1-3 areas
Water Quality and Contamination	Increased turbidity	Neutral	Neutral	None	None
	Blockage of culverts	Neutral	Medium Adverse	None	None

5.7 Cumulative Impacts

5.7.1.1 The main developments in the immediate vicinity of the proposed coastal defence improvement works are:

- Gwynt y Mor offshore wind farm, located 13km offshore from Colwyn Bay. The impact of this scheme on the proposed coastal defence works is neutral.
- Burbo Bank wind farm, located approximately 30km from Colwyn Bay. The impact of this scheme on the proposed coastal defence works is neutral.
- The Regeneration of the Colwyn Bay promenade and the town. This scheme is proposed within the existing urban area and therefore is not proposed to have any impact on the coastal processes.

There are no cumulative impacts on coastal processes as a result of the main developments in the vicinity.

5.8 Summary and Conclusions

- 5.8.1.1 The two options currently proposed for the Colwyn Bay frontage may both have effects on coastal processes. The mitigation proposed reduces the Adverse impacts during both construction and operation of both scheme options. Both options are seen to have Beneficial impacts during both the construction and operation. The residual beneficial impacts of Option 2 are considered to be greater.

5.9 References

- Conwy County Borough Council (2006) Colwyn Bay Waterfront Project Plan, Natural Processes and Coastal Defence, Baseline Report
- HR Wallingford (1991) Colwyn Borough Sea Defence Review – Report EX 2367, H R Wallingford, October 1991
- HR Wallingford (2008). Coastal process study: Rhyl to Prestatyn. Report EC 5690, June 2008. Report produced for Martin Wright Associates, as part of the Denbighshire County Council Report on the Development of a Waterfront Project
- Environment Agency (2010) www.environment-agency.gov.uk
- SMP (2009) North West England and North Wales Shoreline Management Plan (SMP2), Consultation Draft
- Coastal Engineering UK (2006) Colwyn Bay Waterfront Project Plan, Draft for Consultation
- Coastal Engineering UK (2008) Colwyn Bay Preliminary Project Appraisal Report, Draft
- Royal Haskoning (2010) Detailed Modelling Studies For Colwyn Bay Coastal Defence Scheme Physical Model Tests of New Linear Defences
- Royal Haskoning (2010) Colwyn Bay Detailed Modelling Study for Coast Defence Scheme. Phase 1 Interim Modelling Technical Note
- Conwy County Borough Council (2006) Colwyn Bay Waterfront Project Plan, Natural Processes and Coastal Defence Baseline Report (prepared by Coastal Engineering UK, 2006)
- Allied Exploration and Geotechnics Limited, (2010) Colwyn Bay Waterfront Project – Phase 1 Coastal Defence – Ground Investigation Works (AM 26714)

5.10 Appendices

5.10.1.1 The following can be found in the ES Volume 2, Technical Appendix 5:

- Coastal Engineering UK Ltd, Colwyn Bay Waterfront Project plan, 2006
- Royal Haskoning, Colwyn Bay Detailed Modelling Study for Coast Defence Scheme – Phase 1 Interim Modelling Technical Note, 2010

6. Marine Ecology

6.1 **Background**

6.1.1 **Purpose of Assessment**

6.1.1.1 This chapter outlines the potential impacts associated with the construction and operational phases of the proposed coastal defence works on marine ecology. This chapter summarises the relevant legislative and policy context applicable to the scheme, presents the methodology used in undertaking the ecological assessment, assesses the effects and discusses the requirements for mitigation and any subsequent monitoring measures required. Cumulative impacts of the Colwyn Bay Waterfront Project in conjunction with other projects in the site vicinity have also been considered.

6.1.2 **Location**

6.1.2.1 The proposed coastal defence works would be undertaken in Colwyn Bay in Conwy County in North Wales. The scheme would extend along the Colwyn Bay frontage from Rhos Jetty in the west to Beach Road, Old Colwyn in the east and would involve two proposed options, these include:

- Option 1 - Instate new linear rock revetment and raising the promenade along the length of Colwyn Bay and undertake ongoing maintenance of the new structures.
- Option 2 - Construct beach control structures, new linear defences and crest works and undertake beach recharge operations. Carry out ongoing maintenance of the new defences in addition to implementing a beach management and monitoring programme.

6.1.2.2 Figure 3.5 of ES Volume 2, Technical Appendix 3 shows the layout of the scheme along with the three different phases and their corresponding locations.

6.1.3 **Scoping and Consultation**

6.1.3.1 A scoping report was submitted to CCW (Countryside Council for Wales) in August 2010. Subsequent informal discussions have confirmed that CCW require the ES to consider impacts on the intertidal zone and birds. Informal discussions have also taken place with the Welsh Assembly Government Inshore Fisheries Department regarding fishing activities and the probability of some protected fish species being present in Colwyn Bay.

6.2 **Legislative Framework and Policy**

6.2.1.1 The main legislative framework for the assessment is set by the following Acts of Parliament and Regulations:

- Wildlife and Countryside Act 1981 (as amended);
- Environmental Protection Act 1990;
- Countryside and Rights of Way Act 2000 (CRoW Act 2000);

- Conservation (Habitats etc) Regulations 1994 as amended 2009 (Habitats Regulations);
 - Environment Act 1995; and
 - Wild Mammals (Protection) Act 1996.
- 6.2.1.2 Non-statutory supplementary guidance in the form of the UK Biodiversity Action Plan and the Conwy Local Biodiversity Action Plan (LBAP) will also be used in the assessment process.
- 6.2.1.3 The following EC Directives and international conventions are also relevant, as applied in the above UK Acts and Regulations:
- Convention on Biological Diversity (CBD) 1992;
 - Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1975;
 - The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar) 1971;
 - EC Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna (Habitats Directive 1982) as amended (92/43/EEC);
 - OSPAR. The Convention for the Protection of the Marine Environment of the North-East Atlantic (1992);
 - EC Directive on the Conservation of Wild Birds (Birds Directive 1979) as amended (79/409/EEC);
 - Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979) as amended; and
 - Bonn Convention on the Conservation of Migratory Species of Wild Animals (1979) as amended.
- 6.2.1.4 Further ecological planning guidance is set out in the Department for Communities and Local Government Planning Policy Statement 9 Biodiversity and Geological Conservation. In accordance with PPS9 Biodiversity and Planning guidance any development, as part of the planning process, needs to take into consideration the following:
- Assess any potential impacts of the development on the ecology and nature conservation interests within the area of the development;
 - Undertake any necessary ecological surveys, including protected species surveys, which are needed to inform the impact assessment and the subsequent planning decision; and
 - Aim to ensure that the development, after appropriate mitigations, compensations and enhancements, results in a beneficial outcome for biodiversity.

6.3 Assessment Methodology

6.3.1 General Approach

6.3.1.1 The assessment of ecology and nature conservation was undertaken using the methodology based on Institute of Ecology and Environmental Management (IEEM) guidance and a modified version of the WebTAG ecological impacts assessment criteria (DfT, 2004). The overall approach and methodology has been to:

- Define the baseline through consultations, desk study and field surveys;
- Identify receptors (designated sites, habitats and species) and assess their conservation value;
- Identify potential impacts on receptors taking into account the incorporated mitigation and best practice;
- Assess the magnitude of impacts, the timescale and reversibility of the impacts;
- Provide an overall appraisal for each impact, assess the confidence of the likelihood of the impact occurring and state the significance of the impact;
- Recommend supplementary mitigation measures to reduce significant impacts; and
- Evaluate any residual impacts with compensation and enhancement measures.

6.3.2 Zone of Influence

6.3.2.1 Operation and construction of the proposed development can have impacts on ecological features beyond the confines of the site itself. Following IEEM guidance, all ecological features should be investigated which occur within the zone of influence (Zol) which arises during the whole lifespan of the proposed development. The potential zone of influence is defined as:

- Areas directly within the footprint of the proposed scheme; and
- Areas where there is a risk from loss and alteration of habitat, burial, increase in suspended solids, noise, pollution and light during construction and/or operation.

6.3.2.2 The study area of disturbance for the development is likely to encompass a 500m radius around the boundary of the onshore working area for Phase 1, 2 and 3. However, the desk study extends to a 1km radius around the boundary for protected coastal flora and fauna and 2km for designated sites. The desk study further extends out to 10km for one marine designated site (i.e. Y Fennai a Bae Conwy / Menai Conwy Bay Special Area of Conservation) as some of the qualifying features (i.e. marine mammals) could be present within Colwyn Bay.

6.3.3 Desk Based Review

6.3.3.1 Baseline ecological data was obtained from North Wales Environmental Information Service (COFNOD) and Clwyd Bird Recording Group for a radius of 2 km around the Colwyn Bay

frontage as well as local fishing records (Wirral Sea Fishing, 2010). A search was also undertaken of the following online databases:

- Countryside Council for Wales;
- National Biodiversity Gateway;
- UK Biodiversity Action Plan (UKBAP);
- Multi-Agency Geographic Information for the Countryside (MAGIC); and
- Joint Nature Conservation Committee (JNCC).

6.3.3.2 A search was also conducted for available publications and reports relevant to the area, these included the following:

- A Phase 1 Habitat Survey (CCW, 2003);
- Liverpool Bay SPA Standard Data Form;
- Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC Standard Data Form;
- Departmental Brief: Liverpool Bay / Bae Lerpwl Special Protection Area (Natural England & Countryside Council for Wales, 2010);
- Recommendations for the selection of, and boundary options for, an SPA in Liverpool Bay (Webb et al., 2006); and
- ESS Ecology FEPA Monitoring Reports (e.g. Driessen et al., 2009).

6.3.4 Field Surveys

6.3.4.1 A site walkover was undertaken on 25th and 26th August 2010. The main marine habitats were noted along with any species observed. Figure 6.1 in the ES Volume 2 Technical Appendix 6 shows the main biotopes recorded during the 2010 site walkover survey.

6.3.5 Evaluation and Significance Criteria

6.3.5.1 The IEEM guidance (IEEM 2006) for ecological impacts and assessment was followed using a modified version of the WebTAG ecological impact assessment criteria to evaluate potential impacts and assign impact significance. The IEEM Guidance states that 'professional judgement' should be used when assessing the value of ecological features (IEEM, 2006).

6.3.5.2 Ecological features within the zone of influence were identified using the methodologies described above. The conservation value of these features was then assessed using the criteria described in Table 6.1.

Table 6.1: Criteria for determining Conservation Value

Conservation value	Criteria	Examples
Very high	High importance and rarity, international scale and limited potential for substitution	Internationally designated sites
High	High importance and rarity, national scale, or regional scale with limited potential for substitution	Internationally important species and habitats Nationally designated sites Regionally important sites with limited potential for substitution
Medium	High or medium importance and rarity, local or regional scale, and limited potential for substitution	Regionally important sites with potential for substitution Locally designated sites BAP priority species of conservation concern
Low	Low or medium importance and rarity, local scale	Undesignated sites of some local biodiversity and earth heritage interest
Negligible	Very low importance and rarity, local scale	Other sites with little or no local biodiversity and earth heritage interest

6.3.5.3 Once the conservation value of each resource was identified, the magnitude (major, moderate, minor negative or positive, Table 6.2) and the characterisation (Table 6.3) of the impact on the resource were evaluated.

Table 6.2: Criteria for determining the Magnitude of Impacts

Magnitude	Criteria
Major negative/positive	The proposal would affect the integrity of the site, habitat or species population, in terms of the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, the complex of habitats and/or the population levels of species of interest.
Moderate negative/positive	The proposal would not affect the integrity of the site, habitat or species, but would affect the ecological objectives for the site or species. However if, in the light of full information, it cannot be clearly demonstrated that the proposal will not have an effect on integrity, then the impact should be assessed as major.
Minor negative/positive	Some minor impact is evident with changes in the habitat or species population. However, ecological objectives for the site or species not be affected.
Negligible	The habitats or species on the site are being affected or changed, but there is no observable impact in either direction.
No impact (neutral)	The site, habitat or species is either outside the zone of influence, or if inside the zone of influence is not in any way altered by the works.

Table 6.3: Characterisation of Impacts

Characterisation	Description
Time scale	Short-term: 12 months to 5 years Medium-term: 5 to 10 years Long-term: 10 years+
Scale and Persistence	Localised: Damage or loss of a habitat or species which may be reversible or irreversible and having an impact on less than 5% of the local species population or 5% habitat. Reversible: Temporary damage or loss of a habitat or species in the short, medium or long-term. Irreversible: Permanent damage or loss of a habitat or species

6.3.5.4 The conservation value and the magnitude of the impacts were then used to provide an overall appraisal, a confidence level was then given for the overall appraisal and the significance of the impacts was assessed as shown in Table 6.4 and Table 6.5.

Table 6.4: Appraisal Category

Magnitude of impacts	Conservation Value				
	Very High	High	Medium	Low	Negligible
Major negative	Very large adverse	Large adverse	Moderate adverse	Moderate/Slight adverse	Negligible
Moderate negative	Large adverse	Large/moderate adverse	Moderate adverse	Slight adverse	Negligible
Minor negative	Moderate/Slight adverse	Slight adverse	Slight adverse	Slight adverse	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Neutral	Neutral	Neutral	Neutral	Neutral	Neutral

Table 6.5: Significance Criteria

Magnitude of impacts	Conservation Value				
	Very High	High	Medium	Low	Negligible
Major negative	Significant	Significant	Significant	Significant	Not significant
Moderate negative	Significant	Significant	Significant	Not significant	Not significant
Minor negative	Significant	Not significant	Not significant	Not significant	Not significant
Negligible	Not significant	Not significant	Not significant	Not significant	Not significant
Neutral	Not significant	Not significant	Not significant	Not significant	Not significant

6.4 Baseline

6.4.1 Designated Sites

6.4.1.1 The following designated sites were identified near to Colwyn Bay.

Liverpool Bay potential Special Protection Area (SPA)

6.4.1.2 The inshore area of Colwyn Bay lies within the boundary of Liverpool Bay potential SPA. The SPA regularly supports more than 1% of the British populations of red-throated diver *Gavia stellata*, 1% of the biogeographical population of common scoter *Melanitta nigra* and more than 20,000 waterfowl during the non-breeding season.

6.4.1.3 These species are discussed in more detail in section 6.4.5.7.

Y Fenai a Bae Conwy/Menai Strait and Conwy Bay Special Area of Conservation (SAC)

6.4.1.4 The Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC is located 10km from Colwyn Bay and therefore beyond the two kilometre radius usually required for inclusion in EIA assessments. However, as two mobile qualifying features, that is, the grey seal *Halichoerus grypus* and Bottlenose dolphin *Tursiops truncatus* have been observed within Colwyn Bay, there is a possibility that these species form part of the same marine assemblage present within this SAC. Consequently potential impacts on these qualifying features of the SAC will be assessed. Further qualifying features that could be present in the vicinity of Colwyn Bay include:

- Sea lamprey *Petromyzon marinus*;
- River lamprey *Lampetra fluviatilis*;
- Allis shad *Alosa alosa*;
- Twaite shad *Alosa fallax*; and
- Common skate *Dipturus Batis*

6.4.1.5 Where information is available the occurrence and frequency of these species observed along Colwyn Bay is described in more detail in 6.4.5.15.

6.4.2 Habitats and Associated Benthos

6.4.2.1 In both the 2003 Phase 1 Biotope Survey (CCW, 2003) and 2010 walk over survey, similar biotopes were recorded in the same approximate locations. The only exception was the absence in 2010 of a previously recorded MLR.MF.MyPid (Eulittoral form clay with piddocks) biotope which is a UK BAP Priority Habitat. Both surveys indicate that the Phase 2 location contains a greater density and coverage of blue mussel *Mytilus edulis* aggregations. The mussel aggregations in each phase were in approximately the same locations during both surveys, however the 2010 survey recorded a greater extent, particular in the Phase 2 location. This could be due to the continued erosion of the sandy substrate leading to the exposure of a more firm underlying substrate which is subsequently colonised by *M.edulis*. Furthermore, a muddy substrate behind Rhos jetty is likely to contain a more diverse infaunal assemblage than some of the sandy areas within the Bay. The following sections describe the habitats and the associated sessile species recorded during both surveys with any distinct differences in the habitats discussed.

6.4.3 Intertidal Zone

Phase 1- Cayley Promenade to Eirias Park

- 6.4.3.1 Along the seawalls, sparse yellow and grey lichens along with sparse black tar lichen *Verrucaria maura*, gut weed *Enteromorpha sp* and the spiral wrack *Fucus spiralis* were recorded (CCW, 2003). At the base of the seawalls on a mixed rock/gravel substrate, sparse blue mussel *Mytilus edulis* aggregations along with barnacles and brown seaweeds belonging to the fucoid family were found attached to the substrate (see Figure 6.1). There were also some small areas comprising barren coarse sand which usually contains some sparse fauna with a low abundance of burrowing amphipods, otherwise known as LGS.BarSnd biotope.
- 6.4.3.2 In the mid and lower intertidal zones, the substrate varied, but the main substrate type consisted of a LGS. AP.P (Mid shore clean coarse sand with burrowing amphipods) biotope. In both surveys, some small discrete areas consisting of sparse mussel aggregations with many broken shells on a mixed rock and gravel substrate were also recorded. This is categorised as a SLR.MytX biotope (Eulittoral mixed substrata with *Mytilus edulis* beds) of low conservation value. Acorn barnacles *Elminius modestus* were frequently recorded along with *Chthamalus spp*, *semibalanus balanoides* and some limpets *Patella vulgata* were also recorded within cobbled areas (CCW, 2003).

Figure 6.1: Sparse Blue Mussel Aggregations



6.4.3.3 In both surveys, the gastropods the rough winkle *Littorina saxatilis* and edible winkle *Littorina littorea* were recorded in the lee of the groynes as well as adhering to the rock and wooden groynes. Across the shore, sand tubes, built by the sand mason polychaete *Lanice conchilega*, were observed with very dense aggregations towards the lower shore where it remained wet. This provides an important food source for birds. Figure 6.2 shows a photograph of the dense aggregations of *Lanice conchilega* in the Phase 1 location.

Figure 6.2: Sand Mason *Lanice conchilega* Aggregations



Phase 2 Cayley promenade to Rhos Jetty

- 6.4.3.4 Within the Phase 2 footprint, the main habitats and associated sessile species were similar to that described in the upper and mid intertidal zones (i.e. on the seawalls, groynes and rock/gravel substrates) within the Phase 1 location. There is also a small area comprising of upper/ mid intertidal rock with enteromorpha (MLR.Ent biotope) which has some freshwater influence.
- 6.4.3.5 Within the upper intertidal zone towards the western end, small areas containing sparse *M.edulis* aggregations were recorded near to the seawalls. During the 2010 survey, dense rather than sparse blue mussel aggregations were recorded at the end of the groynes and are categorised as SLR.MytX (Eulittoral mixed substrata with *Mytilus edulis* beds) biotopes which are a UK BAP Priority Habitat and therefore regarded to be of medium conservation value (see section 1.4.3.1 below). These aggregations may extend into the subtidal zone. These dense blue mussel areas are clearly distinct from the sparse aggregations recorded in the Phase 1 location.
- 6.4.3.6 Further west and just inside of the Phase 2 boundary in the shelter of the Rhos breakwater, a LMU.HedMac.Are (*Hediste diversicola*, *Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores). In both surveys a very dense large mussel bed also categorised as a SLR.MytX biotope of medium conservation value was also recorded (see Figure 6.3).

Figure 6.3: Dense Blue Mussel Aggregation / Bed at Rhos Breakwater



Phase 3- east of Eirias Park to Old Colwyn

- 6.4.3.7 Moving eastwards from Colwyn Bay Pier, a rock revetment continues to extend along the upper intertidal zone from Eirias Park to Old Colwyn. Similar species were recorded as described previously in the Phase 1 location. The substrate within upper and mid intertidal zones consisted predominantly of a sand substrate with some silt. Some areas containing sparse blue mussel aggregations in the upper and mid intertidal zone were again recorded.
- 6.4.3.8 To the east, just beyond the Phase 3 boundary a dense mussel aggregation was recorded which is regarded as a potential UK BAP Priority Habitat of medium conservation value. In the 2003 survey a MLR.MF.MytPid (Eulittoral form clay with piddocks and *Mytilus edulis*) biotope was recorded, which is a UK BAP Priority habitat, but this was not recorded in the subsequent 2010 survey and instead in 2010, a mixed rocky/boulder/shell/gravel substrate was recorded. Notes provided for the 2003 survey describe this MLR.MF.MytPid biotope as suffering from erosion due to the rip-rap at the eastern end of the site. Consequently, this biotope is likely to have experienced erosion and subsequently replaced with another biotope.

Assessment of Blue Mussel Aggregations

- 6.4.3.9 *Mytilus edulis* beds on sediment are listed as a new priority habitat in the UK Biodiversity Action Plan. However, *Mytilus edulis* is widespread around the UK coastline with dense mussel beds forming on the upper faces of tide-swept sediment dominated substrates, sometimes to almost the exclusion of other species. This species will settle and attach to areas comprising a variety of

substrates (e.g. mixed boulders, cobbles and pebbles on muddy sediment). In sheltered areas infaunal beds may occur on gravel or even quite sandy areas, although it is likely that some harder substratum embedded within the more sandy areas is required (UK Marine SAC Project, undated). These mussel beds play an important part of a healthy functioning marine ecosystem, having a role in coastal sediment dynamics, acting as a food source for over-wintering waders, and providing an enhanced area of biodiversity in an otherwise sediment-dominated environment. The spaces between the mussels can provide refuges for a diverse community of organisms as described previously in sections 6.4.3.1 to 6.4.3.2. There are numerous threats to this habitat, some of these include coastal developments which can result in physical damage and displacement of beds and bait digging activities which lead to the removal of mussels as fishing bait and physical damage from associated trampling.

6.4.3.10 There appear to be no national UK BAP targets for this habitat (BARS, downloaded on 22 August 2010), however, there are targets within local biodiversity action plans for other areas around Wales coastline, some of these include:

- To identify and record priority areas of marine and coastal habitats and associated species;
- To maintain extent of these marine habitats;
- To achieve favourable conservation status of these marine;
- To restore currently degraded marine habitats;
- To maintain and expand the range and/or population of species associated with these habitat types; and
- To raise awareness of marine/coastal species and the key issues pertaining to them.

6.4.3.11 Within the footprint of the works, there are a few areas containing sparse blue mussel aggregations which are not regarded as mussel beds due to their low mussel density which form part of the UK BAP Priority Habitat. However, these areas are still considered in this assessment as they are still ecologically important (e.g. in providing a food source for many protected coastal bird species) but they have been assigned a conservation value of low rather than medium. For the larger and /or denser mussel aggregations which are regarded as beds and a UK BAP Priority Habitat, these are categorised as having medium conservation value and can be found beyond the groyne within the Phase 2 location and just behind Rhos Jetty which is just outside of the Phase 2 boundary to the east and outside of the Phase 3 boundary.

6.4.4 Protected and Invasive Plant Species

6.4.4.1 There are no records indicating that protected and invasive plant species are present within the Zol of the Colwyn Bay Waterfront Project.

6.4.5 Fauna

Marine Mammals

- 6.4.5.1 Two marine mammal species have been sighted off Colwyn Bay; the grey seal *Halichoerus grypus* and the bottlenose dolphin *Tursiops truncatus*. A general description of these species and their assigned conservation value is described below.

Grey seal

- 6.4.5.2 Seals (unspecified species) have been regularly sighted off Colwyn Bay between June and September 2009 (Wales Directory, 2010). As seals are known to cover large distances it is possible that the species observed off Colwyn Bay could belong to the grey seals *Halichoerus grypus* population present in the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC (2007) which is located 10km away.
- 6.4.5.3 The grey seal is among the rarest seals in the world. The UK population represents about 40% of the world population and 95% of the EU population. Globally, there are three reproductively-isolated stocks of grey seal with the East Atlantic stock extending from Iceland and northern Norway southwards to northern France, with the majority breeding around Great Britain and Ireland.
- 6.4.5.4 The grey seal spends most of the year at sea, and may range widely in search of prey. They come ashore in autumn to form breeding colonies on rocky shores, beaches, in caves, occasionally on sandbanks, and on small largely uninhabited islands. In such locations they may spread some distance from the shore and ascend to considerable heights.
- 6.4.5.5 The grey seal is listed in Appendix III of the Bern Convention and is protected by the EC Habitats Directive (Annex II), Wildlife and Countryside Act 1981 and Conservation of Seals Act (1970). It is not a UK BAP priority species. Consequently this species is categorised as being of high conservation value.

Bottlenose dolphin

- 6.4.5.6 There have been numerous sightings of bottlenose dolphins, *Tursiops truncatus*, near to Colwyn Bay Pier, especially in the summer of 2009 (Wales Directory, 2010). This species is listed in Appendix II of the Bern Convention, Annex IIa of the EC Habitats Directive, Wildlife and Countryside Act 1981 and as a priority species on the UK Biodiversity Action Plan. The conservation value of this species is categorised as high.

Birds

- 6.4.5.7 The inshore area of Colwyn Bay lies within the boundary of Liverpool Bay Special Protection Area (SPA). The SPA regularly supports more than 1% of the British populations of red-throated diver *Gavia stellata*, 1% of the biogeographical population of common scoter *Melanitta nigra* and supports an assemblage of more than 55,597 waterfowl during the non-breeding season.
- 6.4.5.8 Red-throated diver is predominantly a coastal species outside of the breeding season, commonly frequenting shallow inshore waters between 0-20m deep (NE and CCW, 2010). They feed

predominantly on fish; principally cod *Gadus morhua*, herrings *Clupea harengus*, and sprats *Sprattus sprattus* (Cramp and Simmons, 2004). Red-throated diver occur in loose aggregations over extensive areas within Liverpool Bay SPA with the highest densities recorded off the Ribble Estuary, North Wales and the North Wirral foreshore (Webb et al., 2006). However, the Clwyd Bird Recording Group holds just one record of one red-throated diver within the Zol of the proposed development (equivalent to 0.1% of the SPA population).

- 6.4.5.9 The conservation status of red-throated diver is primarily threatened outside of the breeding season by human disturbance, water pollution and entanglement with fishing gear (Birdlife International, 2010), although dredging and dumping impacts of prey species requires more research (NE and CCW, 2010). Developments most likely to cause concern within Liverpool Bay are those with the potential to result in increased pollution as well as the removal and disturbance of substrate resulting in an increased turbidity and subsequent difficulties in locating and catching prey. Red-throated diver is considered to be highly vulnerable to disturbance by ship traffic and usually avoid boats (Garthe and Huppopp, 2004).
- 6.4.5.10 Common scoter are predominantly a marine species commonly frequenting waters 500 m to two kilometres from land where the water depth is not more than 10–20 m (Cramp and Simmons, 2004). They feed predominantly on molluscs, especially the blue mussel *Mytilus edulis* and other bivalves (Cramp and Simmons, 2004) stocks of which Liverpool Bay has in abundance (Natural England (NE) and Countryside Council for Wales (CCW, 2010). As a result of the abundance of accessible prey, Liverpool Bay is an important over-wintering site for common scoter (54,675 individuals, 3.4% of the north west European population). The highest concentrations of birds occur in three broad areas including Great Orme's Head to the North Wirral Foreshore (NE and CCW, 2010) within which Colwyn Bay is located. Large numbers of common scoter (3700-8000 birds) were recorded on the Rhyl Flats and Colwyn Bay in November 2005, February and March 2006 and February 2007 (Driessen et al., 2009). However, there are no records of common scoter within the Zol of the proposed development held by Clwyd Bird Recording Group.
- 6.4.5.11 The conservation status of common scoter is primarily threatened outside of the breeding season by human disturbance, water pollution and the degradation of food resources (Birdlife International, 2010), although dredging and dumping impacts of prey species requires more research (NE and CCW, 2010). Those developments most likely to cause concern within Liverpool Bay are those with the potential to result in increased pollution and removal and disturbance of substrate. Common scoter is considered to be highly vulnerable to disturbance by ship traffic (Garthe and Huppopp, 2004).
- 6.4.5.12 The ornithological records for the Zol are rather limited perhaps due to the under recording of common species. Except for small numbers of birds (<10), primarily gull species, Clwyd Bird Recording Group hold no significant records of notable waterfowl within the Zol of the proposed development apart from a record of 117 cormorant *Phalacrocorax carbo* east of the promenade in September 2006.
- 6.4.5.13 From the biological records a total of 21 protected or notable bird species, including those list as birds of conservation concern (Johnstone et al., 2010), are known to occur within 500 m of the proposed scheme (Table 6.6). The species most likely to be impacted by the proposed scheme are those utilising the area between mean low water and existing sea defences. Of particular note are large aggregations of turnstone *Arenaria interpres* (54-200 birds) and oystercatcher *Haematopus ostralegus* (341-420 birds) recorded at Rhôs-on-Sea. There is also a single record

of 100 redshank *Tringa totanus* at Rhôs-on-Sea in autumn 2004. Whilst, low numbers of both turnstone and oystercatcher were recorded to the east of Rhôs-on-Sea their distribution appears clumped around the more diverse intertidal mud habitats within the Zol at Rhôs-on-Sea.

- 6.4.5.14 Furthermore, there are records of large numbers of starling (1400-4792 birds) within the Zol in winter 2008/9 and 2009/10. For at least the last couple of years, possibly longer, many thousands of starlings have been roosting on the pier during the winter (Ian Spence, Clwyd Bird Recording Group pers.comm. 28 August 2010).

Fish

- 6.4.5.15 A wide range of fish have been recorded within Colwyn Bay and the surrounding waters, which include sea bass, *Dicentrarchus labrax*, whiting, *Merlangius merlangus*, herring, *Clupea harengus*, mackerel, *Scomber scombrus*, and plaice, *Pleuronectes platessa* (Wirral Sea Fishing, 2010). The nearby shallow bays of Conwy and Red Dwarf support dab *Limanda limanda*, sand goby *Pomatoschistus minutes*, solenette *Buglossidium luteum* and dragonet *Callionymus lyra*. The sandbanks within these bays support skates and rays including the common skate, *Dipturus batis*, the blonde ray, *Raja brachyuran*, and the thornback ray, *Raja clavata* (Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC, 2007).

- 6.4.5.16 There was some initial concern that some protected fish species of medium to high conservation value belonging to the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC could be present in Colwyn Bay, these are described below.

Sea lamprey

- 6.4.5.17 The sea lamprey is a qualifying feature of the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC (2007).
- 6.4.5.18 The sea lamprey occurs over much of the Atlantic coastal area of western and northern Europe, from northern Norway to the western Mediterranean, and eastern North America (Lelek, 1973). There are several landlocked populations in North America (Maitland et al, 1994). In the British Isles it is absent from many northern rivers and has become extinct in a number of southern rivers due to pollution and man-made barriers (Maitland, 1980a).
- 6.4.5.19 *P. marinus* is anadromous and in British rivers they usually spawn from April to July, although mostly in late May and early June usually in strong-current habitats of rivers and streams, when the water temperature reaches at least 15°C (Freyhof and Kottelat, 2008). All lampreys die after spawning. After hatching the larvae leave the nest and drift downstream distributing themselves among suitable silt beds. On average, the duration of larval life is five years.
- 6.4.5.20 Metamorphosis to the adult stage occurs between July and September; the process takes a few weeks. The timing of the main downstream migration seems to vary from river to river (Maitland, 2003). Relatively little is known about the sea lamprey once they reach the sea, where they have been found in both shallow coastal and deep offshore waters. Adult lampreys are very sensitive to pollution, either alone or in combination with other factors (Morman et al., 1980), and have disappeared from polluted rivers.

- 6.4.5.21 The sea lamprey, *Petromyzon marinus*, is protected under the Berne Convention (Appendix III), EC Habitats Directive (Annex IIa and Va), OSPAR and is listed as a priority species on the UK Biodiversity Action Plan. This species is considered to be of least concern on the IUCN Red List (IUCN, 2010). Consequently this species is regarded as being of high conservation value.

River lamprey

- 6.4.5.22 The river lamprey is a qualifying feature of the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC (2007).
- 6.4.5.23 The river lamprey is a demersal species which is found mainly in the temperate zones of the world. In Western Europe, it has a wide distribution from southern Norway to the Western Mediterranean (JNCC, undated). The river lamprey is definitely rare but distinctly scattered in the UK (Maitland, 1980). According to Henderson (2003), however, this species is not rare and is probably present in all rivers and their estuaries where weirs and dams do not block access to spawning grounds.
- 6.4.5.24 The river lamprey is a primitive fish which is normally an anadromous species; however there are a few isolated non-migratory populations in Finland, Russia and Loch Lomond in Scotland (JNCC, undated; Bond, 2003).
- 6.4.5.25 In the UK, the river lamprey is intermediate in size ranging from 0.2 to 0.4 m in length (Reitti, undated; Central Fisheries Board, undated; Igoe et al, (2004). The majority of populations reach maturity in estuaries, spending approximately one to two years usually feeding parasitically on various species of marine and anadromous fish such as sprat, flounder and haddock (SNH, undated; Kelly and King, 2001; Henderson, 2003). The adults live in coastal waters in the UK and Ireland, migrating upstream around August in order to spawn in strong-current habitats of rivers and streams (Freyhof and Kottelat, 2008). The spawning season starts when water temperature usually rises above 9°C, which depends on latitude, starting in late March in France and mid-June in Finland (Morven Barnes, 2008). Adults die after spawning. Most juveniles overwinter in freshwater and migrate to the sea in the spring (Freyhof and Kottelat, 2008).
- 6.4.5.26 This species requires clean well oxygenated river gravels for spawning with suitable nearby hiding places. Good water quality and slower flowing water for nursery areas of sandy silt for juveniles. As the adult stage migrates to, and feeds in, estuaries suitable estuarine conditions are needed at the mouth of the 'home' rivers, free from pollution and with suitable prey fish species. They also require a clear migration route from the estuary to the spawning grounds with suitable flows and no barriers.
- 6.4.5.27 The river lamprey, *Lampetra fluviatilis*, is protected under Annex IIa and Va of the EC Habitats Directive (92/43/EC), Berne Convention (Appendix III) and is listed as a priority species in the UK Biodiversity Action Plan. *L. fluviatilis* is considered to be of least concern on the IUCN Red List (IUCN, 2010). Therefore this species is regarded as being of high conservation value.

Allis shad

- 6.4.5.28 The allis shad is a qualifying feature of the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC (2007).

- 6.4.5.29 The allis shad is found along the coasts of Western Europe, from southern Norway to Spain, and in the Mediterranean eastwards to northern Italy. Adults are predominantly pelagic returning upriver in May to spawn and spawning commences at a temperature of 15°C. Juveniles remain in estuaries or close to shore feeding on insect larvae until the autumn when they migrate to sea (English nature, 2003). Allis shad require a clear migration route through estuaries from March to June (Maitland and Hatton-Ellis, 2003). The population of this fish has declined significantly throughout Europe. In the UK adult fish occur in small numbers around the coast in most years. The main threats are from fishing, pollution, construction reducing access to spawning sites and gravel extraction (IUCN, 2008). It is thought that allis shad can tolerate conditions meeting Environment Agency Water Class B or better (Maitland and Hatton-Ellis, 2003).
- 6.4.5.30 The allis shad is protected under Annex IIa and Va of the EC Habitats Directive (92/43/EC), Berne Convention (Appendix III), OSPAR and is listed as a priority species in the UK Biodiversity Action Plan. This species is therefore categorised as being of high conservation value.

Twaite shad

- 6.4.5.31 The twaite shad is a qualifying feature of the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC (2007). This species has been a victim of pollution and impoundment of large rivers throughout Europe. The current status of the species is good with numbers increasing in the North and Baltic Seas (Freyhof and Kottelat, 2008).
- 6.4.5.32 This species is anadromous. At sea they are pelagic with the juveniles remaining close to the shore and estuaries. The adults congregate near estuaries in April and enter rivers when temperatures reach 10-12°C, mainly in May-June. The spawning sites usually occur in the main river often only a few kilometres above limit of brackish water, however, it has also been reported from small rivers over gravel bottom. Spawning starts when temperature reaches about 15°C or more, in May-June. Spent fish migrate back to sea. Most juveniles migrate back to the river mouth during first summer and move to sea at end of second year, where most shads remain until they mature, however, a few do live permanently in freshwaters. Individual fish are thought to return to their natal spawning site (Freyhof and Kottelat, 2008).
- 6.4.5.33 They require a clear migration route to the spawning grounds from March to June with suitable river flows and no barriers. There is also a preference for the lower reaches of large unpolluted rivers (Maitland and Hatton-Ellis, 2003). This species has been recorded from depths of 10-110m with a preference for water 10-20m deep (Taverny, 1991 cited in Maitland and Hatton-Ellis, 2003). In Britain, spawning populations of twaite shad are still found in the rivers Severn, Wye, Usk and Tywi and appear to be relatively stable (Aprahamian *et al* 1998). There may however be remnant populations present in other rivers (Maitland and Lyle, 1995).
- 6.4.5.34 The twaite shad, *Alosa fallax* (Lacepede) is protected under the Berne Convention (Appendix III), EC Habitats Directive (Annexes IIa and Va), Wildlife and Countryside Act (1981) (Schedule 5) and is listed as a priority species in the UK Biodiversity Action Plan. They are of least concern on the IUCN Red List (IUCN, 2010). Consequently this species is regarded as being of high conservation value.

Common skate

- 6.4.5.35 Common skate, *Dipturus Batis*, are known within the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC (2007). The common skate is listed on OSPAR and under the Conwy Local Biodiversity Action Plan (LBAP). They have a wide range in the north-east Atlantic but tagging records show that most fish stay within a relatively small coastal area (UKBAP, 2010). This species is categorised as being of medium conservation value.
- 6.4.5.36 Subsequent communications with the Welsh Assembly Government Inshore Fisheries Department (Phil Capper *pers. comm* 17 September 2010) have confirmed that protected fish species are not present within Colwyn Bay and therefore these are excluded from further assessment. However, other fish assigned a low conservation value have been included in the assessment as they are ecologically important in providing a source of food for other bird and sea mammal species. Table 6.6 provides a summary table of the features present in Colwyn Bay and their conservation importance.

Table 6.6: Summary Table of Features Present and their Conservation Importance

Ecological Feature	Conservation value	Designation/Protection Status
Designated Sites		
Liverpool Bay	Very High	SPA EC Habitats Directive
Y Fenai a Bae Conwy/Menai Strait and Conwy Bay	Very High	SAC EC Habitats Directive
Habitats		
Blue Mussel <i>Mytilus edulis</i> Beds	Medium	OSPAR UK BAP Priority Habitat
Protected Faunal Species		
Grey Seal	High	EC Habitats Directive (Annex IIa) Berne Convention (Appendix III) Conservation of Seals Act (1970) Wildlife and Countryside Act (1981)
Bottlenose Dolphin	High	EC Habitats Directive (Annex IIa) Berne Convention (Appendix II) Wildlife and Countryside Act (1981) UK BAP
Other fish	Low	-
Black-headed Gull <i>Chroicocephalus ridibundus</i>	Medium	Wildlife and Countryside Act (1981) UK/Local BAP Red List
Common Gull <i>Larus canus</i>	Medium	Wildlife and Countryside Act (1981) Red List
Common Scoter <i>Melanitta nigra</i>	High	EC Birds Directive (Annex 2) Wildlife and Countryside Act (1981) UK/Local BAP Amber List
Cormorant <i>Phalacrocorax carbo</i>	Medium	Wildlife and Countryside Act (1981) Amber List

Ecological Feature	Conservation value	Designation/Protection Status
Great Black-backed Gull <i>Larus marinus</i>	Medium	Wildlife and Countryside Act (1981) Red List
Guillemot <i>Uria aalge</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Herring Gull <i>Larus argentatus</i>	Medium	Wildlife and Countryside Act (1981) UK BAP Red List
House Martin <i>Delichon urbicum</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Leach's Petrel <i>Oceanodroma leucorhoa</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Mediterranean Gull <i>Larus melanocephalus</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Mute Swan <i>Cygnus olor</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Oystercatcher <i>Haematopus ostralegus</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Redshank <i>Tringa totanus</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Red- throated Diver <i>Gavia stellata</i>	High	EC Birds Directive (Annex 1) Wildlife and Countryside Act (1981) Amber List
Song Thrush <i>Turdus philomelos</i>	Medium	Wildlife and Countryside Act (1981) UK/Local BAP Amber List
Starling <i>Sturnus vulgaris</i>	Medium	Wildlife and Countryside Act (1981) UK BAP Red List
Swift <i>Apus apus</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Turnstone <i>Arenaria interpres</i>	Medium	Wildlife and Countryside Act (1981) Amber List
Twite <i>Carduelis flavirostris</i>	Medium	Wildlife and Countryside Act (1981) UK BAP Red List
White-fronted Goose <i>Anser albinfrons</i>	Medium	Wildlife and Countryside Act (1981) Red List
Wood Warbler <i>Phylloscopus sibilatrix</i>	Medium	Wildlife and Countryside Act (1981) UK BAP Red List

6.5 Prediction of Impacts and Effects

6.5.1 Impact Identification and Assessment

Overview

- 6.5.1.1 Within this section, potential impacts generated during the construction and operational phases of the scheme on the valued ecological resources (VER's) are assessed. The VER's are only those features which are considered to be of importance and could experience potential significant and/or adverse impacts. Those of negligible or low conservation value and unlikely to be adversely impacted by the proposals are not considered further.
- 6.5.1.2 The key potential impacts resulting from the scheme on the valued ecological resources are summarised below.

Construction Effects

- Beach recharge would involve jetting a large volume of sand above the high water mark on the beach which would result in the subsequent blanketing and burial of some habitats and associated sessile species; including foraging areas and prey species of notable bird species;
- Beach recharge could result in an increase of fine sand particles into suspension especially in the swash zone and a subsequent increase in turbidity reducing the light available for photosynthesis as well as clogging the breathing apparatus in shellfish and gills in fish (including prey species for notable bird species);
- Construction of the rock revetments would involve the emplacement of large rock boulders on to the upper intertidal zone resulting in the loss of a predominantly sand substrate and some sparse blue mussel aggregations (foraging habitat and prey species for notable bird species) and their replacement with a rock substrate; and
- Construction of the new groyne would also result in the replacement of a predominantly a sandy habitat with a rocky substrate.
- Construction of the hotspot would result in a small amount of a predominantly sandy habitat loss around the groyne; and
- Construction of the rock revetments, beach recharge and construction of the hotspot would result in temporary disturbance to foraging, roosting and/or loafing birds.

Operational Effects

- As periodic topping-up of the beach recharge would be required, it is envisaged that the impact on the flora and fauna would be the same as that described during construction;
- Following construction of the groyne and hotspot there is likely to be an alteration of sediment transport across the Phase 1 and 3 locations and potentially result in further

erosion to the east of the scheme and potentially loss of some coastal biotopes and a dense blue mussel bed (foraging habitat and prey species for notable bird species); and

- Following construction of the rock revetment within the Phase 3 location, it is possible that scouring could occur in the vicinity of the revetment toe and enhance erosion of the dense mussel bed (foraging habitat and prey species for notable bird species).

6.5.2 Construction (Option 2)

6.5.2.1 During construction the following impacts and subsequent effects could occur on the marine ecology, these include:

Intertidal Habitats and Associated Sessile Species

Habitat Loss

6.5.2.2 Beach recharge would involve jetting importing a large volume of uncontaminated sand from a barge on to the upper intertidal zones above the high water mark within the Phase 1 and 2 locations (i.e. Cayley Promenade to Rhos Jetty). Heavy plant vehicles would subsequently move this recharged sand across the shore so as to achieve the required beach profile (i.e. a 5m elevation, above existing beach levels, at the back of the shore, sloping down steeply to a 3m elevation towards the lower shore). This would result in the blanketing and subsequent burial of some areas containing sparse aggregations of blue mussels on mixed substrate in the upper intertidal zone. Some studies have shown that infaunal species can migrate up through large overburdens of sediments in the range of 0.6m to 1m (Nelson, 1985) and young mussels have been shown to move up a bed to avoid smothering (Dare, 1976; Holt et al., 1988). However, due to the large volume of sand to be distributed across the beach, these mussels would suffocate and starve as they would be unable to re-surface, especially higher up the shore. Furthermore, it is likely that the moving plant vehicles would also damage existing biotopes. Consequently, beach recharge would result in a major negative impact resulting in the following:

- Phase 1 Location- Loss of approximately 36 504m² (3.5 hectares) of sparse blue mussel aggregations of low conservation value; and
- Phase 2 Location- Loss of approximately 72 039m² (7.5 hectares) of sparse blue mussel aggregations of low conservation value.

6.5.2.3 For other ecologically important areas, such as the dense blue mussel beds present to the west of Rhos breakwater and outside of the Phase 2 location, it is envisaged that beach recharge operations would have a negligible impact. The Rhos breakwater and other elevated beach features would shield this biotope from a potential impact from suspended sand particles which would also be transported in an easterly direction away from this biotope and as sand jetting would not occur on the Phase 2 boundary. Furthermore, beach recharge would have a negligible impact on the dense mussel beds present towards the end of the groynes which cover an area of approximately 14 812m² (1hectare) within the Phase 2 location.

Alteration of Habitat

- 6.5.2.4 Construction of the rock revetments and groynes would require heavy plant vehicles to transport, lift and position large rock boulders across the intertidal zone within the Phase 1 and 3 locations. Consequently, in the lower intertidal zone, construction of the rock revetments would result in the replacement of approximately 19,940m² (20 hectares) of shore habitat with a new rock boulder substrate. Approximately 7 555m² (0.75 hectares) of sparse blue mussel aggregations of low conservation value could be replaced in the Phase 3 location.
- 6.5.2.5 Similarly, construction of the new rock groyne and hotspot within the Phase 1 location would also result in the replacement of approximately 8000m² (0.8 hectares) of existing biotopes of mainly negligible conservation value and replacement with a new rock boulder substrate and a small amount of concrete substrate for the hotspot.
- 6.5.2.6 This new rock boulder substrate would provide numerous crevices and niches for various rocky shore species to colonise which could eventually include the blue mussel, especially as recruitment is likely to come from larvae located elsewhere and outside of the existing biotopes. It is possible that a single good recruitment event could result in the colonisation of this substrate within a year, although it could take longer, however, they are known to regenerate quickly (UK Marine SAC, 2001).
- 6.5.2.7 Consequently, beach recharge would result in a major negative impact on the small areas containing sparse blue mussel aggregations of low conservation value, resulting in an overall appraisal of moderate/slight adverse which is significant.
- 6.5.2.8 For other ecologically important areas, such as the dense blue mussel beds present on the mixed rocky substrate located to the west of Rhos breakwater and outside of the Phase 2 location, and overall appraisal of negligible which is not significant is envisaged

Subtidal Habitats and Associated Sessile Species***Increase in Suspended Sediments***

- 6.5.2.9 During the beach recharge and for a short period afterwards there is likely to be an increase of fine sand particles into suspension, especially in the swash zone, which could result in a number of adverse effects on the subtidal biotopes, including:
- An increase in turbidity levels which could under certain conditions reduce the light available in the water column and subsequently adversely affect photosynthesis in submerged seaweeds and plants (Par et al. 1998); and
 - An increase in suspended sediments which could have adverse effects on filter feeding organisms, such as shellfish as sediments could become lodged in their breathing apparatus thus reducing their breathing ability (Brehmer 1965; Parr et al 1998).
- 6.5.2.10 It is envisaged, however, that beach recharge would only result in a minor negative impact, as all of the sand would be jetted above the High Water Mark and occur over a couple of days. Therefore there would only be a large initial increase of finer sand particles into suspension for a few days which would be either transported eastwards and therefore any subsequent adverse

effects would be short term. Furthermore, as the subtidal biotopes already experience elevated levels of sand in suspension, during various storm events, which has resulted in the erosion of the Colwyn Bay beach area, the species present should be suitably adapted to survive.

- 6.5.2.11 Consequently for the dense mussel beds of medium conservation value observed off the groynes which could extend into the subtidal zone within the Phase 2 location an overall appraisal of slight adverse is envisaged which is not significant.

Marine Mammals

- 6.5.2.12 It is extremely unlikely that the coastal defence scheme would result in adverse impacts on marine mammals for the following reasons:

- There would be no percussive works from the construction of the rock groyne or rock revetment which is known to cause adverse effects in marine mammals (e.g. behavioural changes and impairment to their auditory system);
- Collision impacts between the barge and marine mammals is highly unlikely as marine mammals are not regularly sighted or residing permanently in the bay and if they were to be present at the same time they are likely to move away from the vessel; and
- The increase in suspended solids from the beach recharge is unlikely to have an adverse impact on marine mammals as they are capable of moving away from areas with elevated levels of suspended sediment.

- 6.5.2.13 Consequently, for the grey seal and bottlenose dolphin of high conservation value, a negligible magnitude of impact is envisaged resulting in an overall appraisal of negligible which is not significant.

Birds

- 6.5.2.14 It is likely that the construction activities of the proposed scheme would result in negative impacts on bird species of medium conservation value from:

- Disturbance and displacement especially in the Phase 2 area;
- Increased suspended sediments in the water column resulting in changes in prey species abundance and accessibility for fish-eating bird species such as cormorant and red-throated diver;
- Increased suspended sediments in the water column resulting in changes in biotopes, and;
- Loss of biotopes, and therefore loss of prey species, within the scheme footprint especially in the Phase 2 area.

Disturbance

- 6.5.2.15 Disturbance (e.g. noise and visual presence of people) has been found to have a fundamental influence on the behaviour of birds (e.g. Fitzpatrick and Bouchez, 1998; Goss-Custard and Verboven 1993; Riddington et al., 1996). This not only has consequences for individual species but also impacts on the composition of bird communities. A study of wintering oystercatchers by Goss-Custard et al., (2006) showed that birds could be disturbed 1.0–1.5 times per hour before their energy budgets were adversely affected, such that they were more likely to die of starvation. In severe winters this disturbance rate reduced to 0.2–0.5 times per hour. The impact of disturbance varies between species and the time of year, and the adverse effects are not universal. The zones within which the effects of noise disturbance can be measured have been calculated to cover large areas. Furthermore, the visual presence of humans can displace birds and result in the deterioration of the conservation value of a site (e.g. Hockin et al., 1992; Smit & Visser, 1993). Any increase in visual disturbance resulting from construction activities has the potential to exasperate any existing levels of disturbance and limit the functionality of the area.
- 6.5.2.16 Whilst disturbance of birds from construction activities on the proposed scheme is likely to occur across all phases, it is disturbance in the Phase 2 area that is likely to be most adverse given the potential for large number of oystercatcher, redshank and turnstone in this area especially in winter. Assuming that construction activities are undertaken between November and February and that birds do not habituate to construction related disturbance, i.e. noise and the visual presence of people, before mitigation it is likely that disturbance will probably result in a significant short-term, localised, moderate adverse impact.

Increase in Suspended Sediments

- 6.5.2.17 Impacts from increases in suspended sediment on fish (assessed in Section 6.5.2.22) are not considered to be significant but could be adverse or potentially beneficial to fish-eating birds. An increase in water turbidity resulting from suspended sediments could decrease the detection of prey by pursuit-diving bird species such as cormorant (Strod et al., 2008) and red-throated diver; both species recorded within the Zol of the proposed scheme. Cormorant, according to White et al. (2007) have limited visual capabilities and given that cormorant and red-throated diver have the same colour vision type and chromatic ocular disposition (Ödeen and Håstad, 2003) it could be assumed that red-throated diver have similar visual capabilities. Therefore it could be considered that both cormorant and red-throated diver would be visually affected by increased water turbidity in a similar way.
- 6.5.2.18 However, changes in hunting behaviour in cormorants at one freshwater lake location in the Netherlands resulted in the exploitation of turbid waters (Van Eerden and Voslamber, 1995). Should birds in a marine context show similar behavioural changes in response to increased water turbidity there is a possibility that an increase in suspended solids could result in a beneficial impact by providing new, although temporary, foraging opportunities.
- 6.5.2.19 Increased suspended sediments in the water column resulting from construction activities are likely to occur across all phases. Before mitigation it is likely that increased water turbidity will probably result in a short-term, localised, slight adverse impact which is not considered to be significant.

6.5.2.20 Impacts from increases in suspended sediment on biotopes, especially the subtidal biotopes (assessed in Section 6.5.2.9) are considered to be minor negative. The distribution of large numbers of wading birds i.e. oystercatcher, redshank and turnstone are approximately concomitant with the Phase 2 area and the larger, denser beds of blue mussel. A reduction in the density and abundance in the blue mussel beds are likely to result in increased competition for food resources within and between species. However, given that the potential impacts on the blue mussel beds are minor negative it is considered that the increased suspended sediments in the water column will result in a short-term, localised, slight adverse impact on birds which is considered not to be significant.

Habitat Loss/Alteration

6.5.2.21 Habitat loss resulting from the burial of biotopes is considered to be a major negative impact and habitat alteration (assessed in Section 6.5.2.4) resulting from the construction of revetments and groynes is considered to be minor adverse impact. The impact from burial is considered to be significant and the impacts on foraging birds, before mitigation is also considered to be major negative and significant.

Fish

6.5.2.22 Beach recharge resulting in an initial increase of fine sand particles into suspension and subsequent increase in turbidity could result in a number of subsequent adverse effects in fish. For example various studies have shown that fatalities can occur in young fish as particles become trapped in their gills as a result of very high levels of suspended sediments following dredging and disposal works (UK Marine SAC's Project, undated). Whereas adult fish have been shown to move away from or avoid areas of high suspended solids, unless food supplies are increased as a result of an increase in organic material (ABP Research R701, 1997).

6.5.2.23 As the recharge of sand onto the beach would be above the high water mark and it would be undertaken over a couple of days, it is unlikely that a subsequent initial increase of clean fine sand into suspension would have an adverse effect on fish populations and especially as no nursery grounds have been identified in the area. Furthermore, as the new groyne should trap the recharged sand, this should reduce the amount of suspended sand into suspension downstream and subsequent adverse affects.

6.5.2.24 Consequently, for fish species of low conservation value, it is possible that they could experience a minor negative impact resulting in an overall appraisal of slight adverse which is not significant.

Designated Sites

Liverpool Bay SPA

6.5.2.25 Due to the very low number of qualifying features found within the ZOI and the localised nature of the impacts it is not considered that the integrity of Liverpool Bay SPA would be adversely affected by the Colwyn Bay Waterfront Project.

Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC

6.5.2.26 Potential impacts and subsequent effects on the marine mammals and fish species associated with the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC were described previously in sections 6.5.2.13 and 6.5.2.23, respectively. To summarise there would be no adverse impacts and subsequent negative effects on the grey seal and bottlenose dolphin of high conservation value resulting in an overall appraisal of negligible which is not significant.

6.5.3 Construction (Option 1)

6.5.3.1 During construction, the potential impacts and subsequent effects on the marine ecology are described below.

Upper Intertidal Habitats and Associated Sessile Species***Alteration of Habitat***

6.5.3.2 The main impact would be derived from the construction of the rock armour revetment across the entire Colwyn Bay frontage, that is, from Rhos Jetty to Beach Road. The subsequent effects on the upper intertidal biotopes were described previously in section 1.5.2.1. For Option 1, however, there would be a greater loss of upper intertidal habitat as the rock revetment would extend into the Phase 2 location.

6.5.3.3 Consequently for sparse blue mussel aggregations of low conservation value a moderate negative impact is envisaged on the biotopes of low conservation value resulting in an overall appraisal of slight adverse which is not significant.

Birds

6.5.3.4 It is likely that the construction activities of the proposed scheme would result in negative impacts on bird species of medium conservation value from:

- Disturbance and displacement especially in the Rhôs-on-Sea area; and
- Loss of biotopes, and therefore loss of prey species, within the scheme footprint especially in the Rhôs-on-Sea area.

6.5.3.5 The impacts from Option 1 construction activities are as assessed in section 6.5.3, with beach recharge omitted for this option. However, the impact on biotopes for Option 1 construction activities is considered to be moderate negative (section 6.5.3.2). The knock-on impact on bird species through the loss of good foraging habitat is likely to be moderate negative and therefore significant.

Designated Sites***Liverpool Bay SPA***

6.5.3.6 Due to the very low number of qualifying features found within the ZOI and the localised nature of the impacts it is not considered that the integrity of Liverpool Bay SPA will be adversely affected.

Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC

- 6.5.3.7 As the majority of the works would be undertaken within the upper intertidal zone, no impact is envisaged on the subtidal qualifying features (i.e. marine mammals) of the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC and an appraisal of neutral impact is assigned.

6.5.4 Operation (Option 2)

- 6.5.4.1 During the operation of the scheme the potential impacts and subsequent effects are described below.

Intertidal Habitats and Associated Sessile Species***Habitat Loss***

- 6.5.4.2 It is likely periodic topping-up of beach recharge would be required, depending on the rate of losses. The volume of sand required for on-going beach recharge would equate to the volume lost and necessary to maintain the required beach profile. Consequently, it is envisaged that the subsequent blanketing and burial effects would be the same as those described previously in section 6.5.2.2. However, many of the biotopes currently present in the upper intertidal zone would have altered due to the creation of the rock revetment and new groyne.
- 6.5.4.3 It is difficult to determine what the overall assessment would be in several years; nevertheless, the magnitude of impact would be the same but with potentially different biotopes. Consequently, it is envisaged that subsequent beach recharge would result in a moderate negative impact on potentially new biotopes of similar conservation value i.e. negligible to low conservation value within the upper and mid intertidal zones within the Phase 1 and 2 locations, resulting in an overall appraisal of slight adverse which would not be significant.

Subtidal Habitats and Associated Species

- 6.5.4.4 For the dense mussel beds currently recorded in the subtidal zone, beyond the groynes in the Phase 2 location, these aggregations would experience a similar negligible impact for the reasons outlined in section 6.5.2.9, resulting in an overall appraisal of negligible which is not significant.

Alteration of Sediment Transport

- 6.5.4.5 Following construction of the new groyne and hotspot there would be an alteration in the volume of sand transported to the east. A modelling study for the transport of sediment following construction of a similar shaped groyne has been undertaken. The model predicted an initial eastwards accretion of sand for a distance of 500m with erosion occurring beyond this point (see section 5.5.3.6 for further details). Consequently, this may result in some erosion of the small dense mussel bed located immediately east of the Phase 3 boundary. However, as the previous biotope MLR.MF.MyPid recorded in 2003 (see section 6.4.2.1) has naturally eroded it is possible that this dense mussel bed would erode regardless of whether the new groyne is constructed.

Scouring

- 6.5.4.6 A modelling study of the proposed rock revetment has been undertaken and the design profile has been detailed to ensure that no scouring or undermining of the structure will occur.
- 6.5.4.7 Consequently for this dense mussel bed of medium conservation value, a minor adverse impact is envisaged resulting in an appraisal of slight adverse which would not be significant.

Marine Mammals

- 6.5.4.8 Repeated beach recharge is highly unlikely to have a significant impact on marine mammals as described previously in section 6.5.2.12. As a result, an overall appraisal of negligible which is not significant has been assigned for grey seal and bottlenose dolphin populations in the vicinity of the site.

Birds

- 6.5.4.9 It is likely that the operation of the proposed scheme would result in negative impacts on bird species of medium conservation value from:
- Disturbance and displacement especially in the Phase 2 area;
 - Increased suspended sediments in the water column resulting in changes in prey species abundance and accessibility for fish-eating bird species such as cormorant and red-throated diver; and
 - Loss of biotopes, and therefore loss of prey species, within the scheme footprint especially in the Phase 2 area.

Disturbance

- 6.5.4.10 The impacts of disturbance are discussed above in Section 6.5.2.15

Increase in Suspended Sediments

- 6.5.4.11 The impacts of suspended solids are discussed above in Section 6.5.2.17.

Habitat Loss/Alteration

- 6.5.4.12 Subsequent beach recharge is considered to result in a major negative impact on biotopes within the Phase 1 and 2 locations (assessed in section 6.5.2.2) resulting in an overall appraisal of moderate/slight adverse which would not be significant. Therefore the potential impact on birds, especially those species of medium conservation value in the Phase 2 area is likely, before mitigation, to be moderate negative and significant. The predicted loss of a dense blue mussel bed in the Phase 3 area is likely to result in a minor negative impact on birds which is considered not to be significant.

Habitat Creation

- 6.5.4.13 The creation of new rock substrate and artificial structures could provide new foraging opportunities for species such as turnstone, and possibly oystercatcher and redshank if the new substrate and structures are colonised by suitable prey species. Therefore the creation of new rock substrate and artificial structures could have a minor positive impact.

Fish

- 6.5.4.14 Repeated beach recharge could result in a number of subsequent effects in fish as described previously in section 6.5.2.22. In congruence with section 6.5.2.24, fish of low conservation value could experience a minor negative magnitude of impact resulting in an overall appraisal of slight adverse which is not significant.

Designated Sites

Liverpool Bay SPA

- 6.5.4.15 Due to the very low number of qualifying features of the SPA found within the Zol and the localised nature of the impacts the integrity of Liverpool Bay SPA will be not be affected.

Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC

- 6.5.4.16 Potential impacts from beach recharge and the subsequent effects on the marine species associated with the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC were described previously in sections 6.5.2.13, 6.5.2.23 and 6.5.2.26. To summarise it was envisaged that there would be no adverse effects from an increase in suspended sediments or potential collision impacts with the barge on marine mammals resulting in an overall appraisal of negligible which is not significant.

6.5.5 Operation (Option 1)

Intertidal Habitats and Associated Sessile Species

- 6.5.5.1 The impact of constructing the rock revetment and subsequent scouring effects on the dense mussel bed east of the Phase 3 boundary are likely to be minimal, as described previously in section 6.5.4.6. Consequently for this dense mussel bed of medium conservation value, a slight adverse impact is envisaged resulting in an appraisal of slight adverse which would not be significant.

Birds

- 6.5.5.2 It is likely that the operation of the proposed Option 1 would result in negative impacts on bird species of medium conservation value from:
- Loss of biotopes, and therefore loss of prey species, within the scheme footprint.

Habitat Loss/Alteration

- 6.5.5.3 The erosion and loss of the dense mussel bed in the eastern section of the scheme footprint is likely to result in a minor negative impact on birds of medium conservation value.

Habitat Creation

- 6.5.5.4 The creation of new rock substrate and artificial structures could provide new foraging opportunities for species such as turnstone, and possibly oystercatcher and redshank if the new substrate and structures are colonised by suitable prey species. Therefore the creation of new rock substrate and artificial structures could have a minor positive impact.

Designated Sites

Liverpool Bay SPA

- 6.5.5.5 Due to the very low number of qualifying features found within the ZOI and the localised nature of the impacts the integrity of Liverpool Bay SPA will not be affected.

Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC

- 6.5.5.6 No impact is envisaged on the marine mammals of high conservation value and therefore an overall appraisal of neutral is derived.

6.5.6 Impact summary

The potential impacts resulting from the construction and operation of the scheme are summarised in Table 6.7 to

Table 6.10 below.

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Table 6.7: Summary Table for Overall Appraisal for Construction (Option 2)

Ecological Feature	Conservation value	Potential Impacts	Magnitude of Impacts	Overall Impact Appraisal (before mitigation)	Mitigation and Compensation	Overall Impact Appraisal (after mitigation)
Designated Sites						
Liverpool Bay SPA (including common scoter <i>Melanitta nigra</i> and red-throated diver <i>Gavia stellata</i>)	Very High	Increase in suspended solids in the water column from beach recharge.	Neutral	Neutral	None	Neutral
Y Fenia a Bae Conwy/Menai Strait and Conwy Bay SAC	Very High	Beach recharge resulting in potential collision impacts between marine mammals and seaborne vessel and an increase in suspended solids.	Negligible	Negligible	Ensure slow barge approach Reduce the percentage of fine particles in the recharged beach material.	Negligible
Intertidal Habitats and Associated Sessile Species						
Sparse aggregations of the blue mussels <i>Mytilus edulis</i>	Low	Beach recharge resulting in the burial of biotopes in both the Phase 1 and 2 locations. Installation of the rock revetments and groyne in the Phase 1 and 3 locations resulting in the loss and replacement of upper intertidal biotopes.	Major adverse	Slight/Moderate adverse which is locally significant.	Reduce the percentage of fine particles in the recharged beach	Slight/Moderate adverse of local significance.
Dense aggregations of blue mussel beds <i>Mytilus edulis</i> beds located outside of the main footprint and at the end of the groynes within the Phase 2 location.	Medium	Beach recharge resulting in the burial of intertidal biotopes. Increase in suspended solids and some smothering effects as a result of beach recharge in Phase 2 location	Negligible	Negligible which is not significant	Reduce the percentage of fine particles in the recharged beach material. Ensure no jetting of sand near to the western end of the Phase 2 boundary.	Negligible
Subtidal Habitats and Associated Sessile Species						
Dense aggregations of blue mussel beds <i>Mytilus edulis</i> beds	Medium	Beach recharge resulting in an increase in suspended sand.	Minor adverse	Slight adverse which is not significant	Reduce the percentage of fine particles in the recharged beach material.	Negligible

Ecological Feature	Conservation value	Potential Impacts	Magnitude of Impacts	Overall Impact Appraisal (before mitigation)	Mitigation and Compensation	Overall Impact Appraisal (after mitigation)
Protected Faunal Species						
Marine mammals Grey seal <i>Halichoerus grypus</i> Bottlenose dolphin <i>Tursiops truncatus</i>	High	Beach recharge resulting in potential collision impacts with seaborne vessel and an increase in suspended solids.	Negligible	Negligible	Ensure slow barge approach Reduce the percentage of fine particles in the recharged beach material.	Negligible
Fish	Low	Beach recharge resulting in a potential increase in suspended solids.	Minor adverse	Slight adverse which is not significant	Reduce the percentage of fine particles in the recharged beach material.	Negligible
Birds Oystercatcher <i>Haematopus ostralegus</i> Redshank <i>Tringa totanus</i> Turnstone <i>Arenaria interpres</i> Gull sp. <i>Laridae</i>	Medium	Disturbance. Increase in suspended solids from beach recharge. Habitat loss and alteration.	Moderate Negative	Moderate Adverse	Avoid construction related disturbance in Phase 2 area between November and February inclusive. Reduce the percentage of fine particles in the recharged beach material	Slight Adverse

Table 6.8: Summary Table for Overall Appraisal for Construction (Option 1)

Ecological Feature	Conservation value	Potential Impacts	Magnitude of Impacts	Overall Impact Appraisal (before mitigation)	Mitigation and Compensation	Overall Impact Appraisal (after mitigation)
Designated Sites						
Liverpool Bay SPA (including common scoter <i>Melanitta nigra</i> and red-throated diver <i>Gavia stellata</i>)	Very High	No impact	Neutral	Neutral	None	Neutral
Y Fenia a Bae Conwy/Menai Strait and Conwy Bay SAC	Very High	No Impacts	Neutral	Neutral	-	Neutral
Upper Intertidal Habitats and Associated Sessile Species						
Sparse aggregations of the blue mussels <i>Mytilus edulis</i>	Low	Installation of the rock revetments in the Phase 1 and 3 locations resulting in the loss and replacement of upper intertidal biotopes.	Moderate adverse (as a result of construction of the new revetments and groyne)	Slight adverse which is not significant	-	Slight adverse
Protected Faunal Species						
Birds Oystercatcher <i>Haematopus ostralegus</i> Redshank <i>Tringa totanus</i> Turnstone <i>Arenaria interpres</i> Gull <i>sp. Laridae</i>	Medium	Disturbance from construction noise Increase in suspended solids from beach recharge. Habitat loss and alteration.	Moderate Negative	Moderate Adverse	Avoid construction related disturbance in Rhôs-on-Sea area between November and February inclusive. Reduce the percentage of fine particles in the recharged beach material	Slight Adverse

Table 6.9: Summary Table for Overall Appraisal for Operational Impacts (Option 2)

Ecological Feature	Conservation value	Potential Impacts	Magnitude of Impacts	Overall Impact Appraisal (before mitigation)	Mitigation and Compensation	Overall Impact Appraisal (after mitigation)
Designated Sites						
Liverpool Bay SPA (including common scoter <i>Melanitta nigra</i> and red-throated diver <i>Gavia stellata</i>)	Very High	Increase in suspended solids in the water column from beach recharge.	Neutral	Neutral	None	Neutral
Y Fenia a Bae Conwy/Menai Strait and Conwy Bay SAC	Very High	Collision impacts between marine mammals and barge. Increase in suspended sand.	Negligible	Negligible	Ensure slow barge approach Reduce the percentage of fine particles in the recharged beach material.	Negligible
Intertidal Habitats and Associated Sessile Species						
New biotopes colonising new sand substrate and rock revetments/ groynes.	Negligible to low	On-going beach recharge resulting in the burial of new biotopes within the Phase 1 and 2 locations.	Moderate negative	Slight adverse which is not significant	Reduce the percentage of fine particles in the recharged beach material.	Slight adverse
Dense blue mussel beds <i>Mytilus edulis</i> beds.	Medium	On-going beach recharge impacting on those at the western end of the Phase 2 boundary. Following construction of the groyne there would be an alteration of the eastwards transport of sediment resulting in initial accretion then erosion impacting those present on the eastern end of the Phase 3 boundary.	Negligible (for the mussel beds located at the western end of the Phase 2 boundary) Slight adverse (for those located near to the eastern end of the Phase 3 boundary)	Negligible	Reduce the percentage of fine particles in the recharged beach. Undertake further modelling studies to assess erosion and scouring effects.	Negligible
				Slight adverse which is locally significant		Slight adverse
Subtidal Habitats and Associated Sessile Species						

Ecological Feature	Conservation value	Potential Impacts	Magnitude of Impacts	Overall Impact Appraisal (before mitigation)	Mitigation and Compensation	Overall Impact Appraisal (after mitigation)
Dense aggregations of blue mussel beds <i>Mytilus edulis</i> beds	Medium	Beach recharge resulting in an increase in suspended sand.	Minor adverse	Slight adverse (not significant)	Reduce the percentage of fine particles in the recharged beach material.	Negligible
Marine Mammals	High	Beach recharge resulting in potential collision impacts with seaborne vessel and an increase in suspended solids.	Negligible	Negligible	Ensure slow barge approach Reduce the percentage of fine particles in the recharged beach material.	Negligible
Birds Oystercatcher <i>Haematopus ostralegus</i> Redshank <i>Tringa totanus</i> Turnstone <i>Arenaria interpres</i> Gull <i>sp. Laridae</i>	Medium	Disturbance. Increase in suspended solids from beach recharge. Habitat loss and alteration. Habitat creation	Minor Negative	Slight Adverse	Avoid beach recharge in Phase 2 area between November and February inclusive. Reduce the percentage of fine particles in the recharged beach material	Negligible
Fish	Low	Beach recharge resulting in a potential increase in suspended solids	Minor adverse	Slight adverse which is not significant	Reduce the percentage of fine particles in the recharged beach material.	Negligible

Table 6.10: Summary Table for Overall Appraisal for Operation (Option 1)

Ecological Feature	Conservation value	Potential Impacts	Magnitude of Impacts	Overall Impact Appraisal (before mitigation)	Mitigation and Compensation	Overall Impact Appraisal (after mitigation)
Designated Sites						
Liverpool Bay SPA (including common scoter <i>Melanitta nigra</i> and red-throated diver <i>Gavia stellata</i>)	Very High	None	Neutral	Neutral	-	Neutral
Y Fenia a Bae Conwy/Menai Strait and Conwy Bay SAC	Very High	None	Neutral	Neutral	-	Neutral
Intertidal Habitats and Associated Sessile Species						
Dense aggregations of blue mussel beds <i>Mytilus edulis</i> beds located immediately adjacent to the easternmost boundary of the Phase 3 location.	Medium	Following installation of the revetments there could be subsequent scouring effects.	Minor adverse	Slight adverse which is not significant		Slight adverse
Birds Oystercatcher <i>Haematopus ostralegus</i> Redshank <i>Tringa totanus</i> Turnstone <i>Arenaria interpres</i> Gull <i>sp. Laridae</i>	Medium	Habitat loss and alteration. Habitat creation	Minor Negative	Slight Adverse	None	Slight Adverse

6.6 Mitigation Measures

6.6.1.1 The Coastal Processes chapter provides a list of the mitigation measures required to reduce the impacts in the water column (see section 5.6). Additional mitigation measures are outlined in section 9.6.5. The essential general mitigation measures to reduce the impacts on the ecology are described below.

6.6.2 Construction

Habitats and Associated Sessile Benthos

- Beach recharge would comprise similar sized sand particles as those already present in the intertidal zone;
- The percentage of high fines in the recharged sand would be minimised to reduce turbidity;
- The recharged sand would be uncontaminated;
- Impacts on water quality would be minimised through use of good construction practices and following available guidance (for example the Environment Agency Pollution Prevention Guidelines as well as any guidance provided by OSPAR, MARPOL and DEFRA);
- The refuelling of machinery used to spread the recharged sand on the beach would be undertaken away from the beach;
- Beach recharge would be undertaken within the Phase 2 footprint and not extend westwards on to the large adjacent mussel beds;
- Piling during construction of the hotspot will take place a low tide to avoid noise impacts on marine mammals and fish;
- Sediment dispersion would be limited by ensuring that the sand is sprayed above the high water mark and away from the western end of the Phase 2 boundary; and
- Works to be undertaken within the Phase 2 location would be confined to the Phase 2 footprint and not extend into the adjacent dense blue mussel beds, to the west of this location near to Rhos breakwater.

Birds

- Measures to minimise noise from construction activities during the over-wintering period (November to February inclusive) will be implemented. This will include:
 - Timing of works to avoid disturbing high tide roosts;
 - Avoidance of unnecessary revving of engines and switch off equipment when not required;

- Plant and vehicles would be properly maintained to meet the manufacturers' noise rating levels. Any silencers or bearings which become defective would be replaced as soon as possible;
 - Using reverse warning systems incorporating broadband noise;
 - Vehicles would reverse in a direction towards Old Colwyn and wherever possible manoeuvre in a circular manner to minimise the use of reversing alarms;
 - Location of internal haul routes away from the Rhôs-on-Sea;
 - Keeping all haul routes well maintained to avoid unwanted rattle and "body slap" from vehicles;
 - Using enclosures for noisy plant such as pumps or generators;
 - Minimising drop height of materials;
 - Limiting the use of particularly noisy plant or vehicles;
 - Plant and vehicles would be operated with noise control hoods closed; and
 - Lorry tailgates would be kept closed where possible.
- Limiting personnel, contractors, sub-contractors and other site visitors on the top of the seawall and within the Phase 2 (Rhôs-on-Sea) area. Increased presence of people in this area would create additional visual disturbance to wintering birds especially at high tide.

6.6.3 Operation

Habitats and Associated Sessile Benthos

- Ongoing beach recharge would require the same mitigation measures as those described previously; and
- Modelling of the new revetment has been undertaken and the design profile has been detailed to ensure that no scouring or undermining of the structure will occur. Consequently, there is not considered to be a significant impact on the nearby mussel bed biotope of medium conservation value.

6.7 Monitoring Measures

- 6.7.1.1 If construction takes place between November and February, then prior to construction bird surveys will be undertaken to locate high tide roosts of over-wintering bird species within the ZOI. The results of these surveys will be used to formulate a detailed mitigation strategy to time works in order to minimise disturbance at high tide roosts. Monitoring during construction would be undertaken to ensure that mitigation measures for over-wintering birds are effective and the strategy amended if necessary. Following construction of the groyne in the Phase 1 location and

adjacent rock revetment, surveillance monitoring should be undertaken to test the modelling predictions.

6.8 Residual Effects

6.8.1.1 It is apparent from Table 6.7 to

6.8.1.2 Table 6.10 that after the implementation of the proposed mitigation measures the main residual effects have been identified as:

- During Construction:
 - The initial beach recharge would result in the loss of existing biotopes of low conservation value i.e. sparse aggregations of blue mussels above the high water mark;
 - Construction of the rock revetments and new groyne would also result in the loss of existing biotopes of predominantly low conservation value. However, it is likely that the new rock substrate would eventually be recolonised by biotopes of a similar conservation value;
 - Temporary disturbance to birds, especially at Rhôs-on-Sea; and
 - Temporary loss and alteration of bird foraging habitat, especially at Rhôs-on-Sea.
- During Operation:
 - On-going beach recharge would not be considered to have a significant effect as the newly formed biotopes present on the shore should be capable of reforming following further recharge; and
 - Following construction of the rock revetments and new groyne there could be some scouring/erosion effects on biotopes (foraging habitats for birds) to the east of the new groyne such as the dense mussel bed of medium conservation value. However, modelling indicates that scouring effects will be negligible and sediment erosion limited to the very far end of the Bay, beyond the Phase 3 boundary.

6.9 Cumulative Impacts

6.9.1.1 An initial screening exercise identified potential developments and some socio-economic activities which could have a potential impact when assessed in parallel to the Colwyn Bay Waterfront Project and these are discussed below.

6.9.2 Regeneration of Colwyn Bay

6.9.2.1 The regeneration of Colwyn Bay promenade and the town is currently at the design stage and therefore subject to future planning approval. As the works would be undertaken within an existing urban hard standing area, there would generally be no impact on the marine ecology

during construction. However, there is likely to be an impact on birds utilising the habitats above mean low water and for example on the large aggregation of starlings (UKBAP, Red List Bird of Conservation Concern) roosting on the pier in winter. During operation, however, there could be some adverse impact from leisure activities (e.g. Watersports) operating in the Bay on the Liverpool Bay SPA and marine species.

6.9.3 Wind farms

6.9.3.1 Two main wind farm developments have been identified and the main cumulative effects would be derived from a combined alteration of the sediment transport regime in the area which could result in adverse affects elsewhere, these are discussed below.

- Gwynt y Mor Offshore Wind farm (awaiting planning approval): As this wind farm would be located 13km off the North Wales coastline it is highly unlikely that there would be any in-combination effects, as the Colwyn Bay scheme would only result in a short term very localised alteration of the sediment regime along the coastline and would not extend out to a distance of 13km offshore; and
- The Burbo Bank Offshore Wind farm (operational with an extension planned): As this wind farm would be located approximately 30km from Colwyn Bay it is highly unlikely that there would be any in-combination effects, as the Colwyn Bay scheme would only result in a short term very localised alteration of the sediment regime along the coastline and would not extend out to a distance of 30km offshore.

6.9.4 Fisheries

- The scheme could result in some cumulative impacts with local fishery activities which take place from the beach at Colwyn Bay (Martyn Boyce, Welsh Assembly Government Inshore Fisheries Department, *pers. comm.*, 26 August 2010);
- Netting occurs from the beach at Rhos on Sea and is mostly undertaken in the summer. There is also a shrimp fishery with shrimp push nets operating mostly in the winter, but it does occur all year;
- Small fishing boats operate from Colwyn Bay, which trawl for mixed species and this takes place all year. Mussel collection occurs throughout the year and tends to be at the western end within the Phase 2 location. Bait digging also takes place throughout the year and winkle picking also occurs. There is also some peeler crab collection which takes place in spring;
- Consequently, the main impact on these fisheries activities would be from beach recharge which could have a long term adverse impact on shore based fishing activities. For example, beach recharge could prevent the collection of some shore species as they could be buried beneath the recharged sand and/or the rock revetments and groyne. Furthermore an increase in suspended sediments could have adverse effects on the shrimp fishery should the level of suspended sediments could cause mortality in shrimps; and

- Consequently, this could have a moderate adverse impact resulting in an overall appraisal of moderate which could be significant and this would need to be further addressed. It is possible that adverse effects could be minimised following consultation with the appropriate fishery bodies.

6.10 Summary

6.10.1.1 The purpose of this chapter was to undertake an ecological impact assessment of the proposed options. The desk based study showed that the site of the proposed scheme was located within Liverpool Bay SPA and 10km from Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. Liverpool SPA is important because it holds internationally important numbers of common scoter *Melanitta nigra* and nationally important numbers of red-throated diver *Gavia stellata*. In Colwyn Bay there have been a number of sightings of protected marine mammals such as seals which could be the grey seal *Halichoerus grypus* and the bottlenose dolphin *Tursiops truncatus* which could form part of the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. A total of 21 protected or notable bird species, including those listed as birds of conservation concern (Johnstone et al., 2010), are known to occur within 500 m of the proposed scheme. Of particular note are large aggregations of turnstone *Arenaria interpres* (54-200 birds) and oystercatcher *Haematopus ostralegus* (341-420 birds) recorded at Rhôs-on-Sea. There is also a single record of 100 redshank *Tringa totanus* at Rhôs-on-Sea in autumn 2004. Whilst, low numbers of both turnstone and oystercatcher were recorded to the east of Rhôs-on-Sea their distribution appears clumped around the more diverse intertidal mud habitats within the ZOI at Rhôs-on-Sea.

6.10.1.2 Impacts due to the construction and operation of the scheme were shown to have a number of effects on the valued ecological resources (VERs). However, following the implementation of mitigation measures it was apparent that in general, the scheme has minimal long term impacts on marine ecology; although some locally significant residual impacts may arise in the shorter term as listed below:

- Option 2:
 - During construction, , beach recharge combined with construction of the rock revetment could result in an overall appraisal of slight / moderate adverse on sparse aggregations of the blue mussel *Mytilus edulis* present in the intertidal zone;
 - During construction, foreshore based fisheries activities (e.g. bait digging, winkle picking, mussel collection, shrimp push nets and peeler crab collection) beach recharge could result in some adverse impacts and subsequent effects resulting in an overall appraisal of moderate adverse;
 - During operation, For dense blue mussel *Mytilus edulis* beds present to the east and outside of the scheme footprint, on-going erosion effects could occur following construction of the rock revetments and new groyne resulting in an overall appraisal of slight adverse; and
 - During operation, foreshore based fisheries activities, beach recharge could result in some adverse impacts and subsequent effects resulting in an overall appraisal of moderate adverse.

- Option 1:
 - For dense blue mussel *Mytilus edulis* beds present to the east and outside of the scheme footprint, on-going erosion effects could occur following construction of the rock revetments resulting in an overall appraisal of slight adverse; and
 - Loss of biotopes and therefore bird foraging habitat results in an overall appraisal of moderate adverse.

6.10.1.3 As a result of this ecological assessment further investigation/surveys are required to inform the mitigation plans to define the important foraging and roosting areas for birds within and adjacent to the Phase 2/Rhôs-on-Sea area in order to effectively implement relevant mitigations. However, the current planning application is only comprehensive for the Phase 1 area, to the east of Victoria Pier. Consequently, surveys required for the Phase 2 area can be instructed without affecting the granting of permission for the initial works.

6.10.1.4 Overall both options have the potential to have an adverse affect on some of the valued ecological resources. During construction, Option 2 would have a greater adverse impact on the shore due to beach recharge. During operation, Option 2 would continue to have a greater adverse impact due to on-going beach recharge and the new groyne could result in potential erosion of further biotopes to the east of the scheme as well as scouring effects from the construction of the rock revetment in the Phase 3 location. However, erosion is already occurring so it may be that the groyne does not in fact exacerbate the current condition.

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6.12 Appendices

6.12.1.1 The following can be found in the ES Volume 2, Technical Appendix 6:

- Figure 6.1 – Colwyn Bay Biotope Map

7. Landscape and visual

7.1 *Introduction*

7.1.1.1 This Landscape and Visual Impact Assessment has been prepared on behalf of Conwy County Borough Council. This chapter describes the assessment of the landscape and visual impacts arising from the construction and completion of the proposed Colwyn Bay Waterfront Project and suggests mitigation measures to offset these impacts.

7.1.1.2 This landscape and visual assessment addresses the impact of the proposed development on the landscape resource and visual amenity. These are separate but related items. Impacts upon the landscape resource are derived from the physical properties and landscape character of the site and study area. Visual impact occurs to views of the proposed development from locations within the site and from its surroundings. Landscape character forms an element in both landscape and visual assessment.

7.2 *Methodology*

7.2.1 *Guidance*

7.2.1.1 The landscape and visual impact assessment for this project has been undertaken in accordance with the 'Guidelines for Landscape and Visual Impact Assessment, second edition (2005) published by the Landscape Institute and the Institute of Environmental Management and Assessment. The landscape character assessment has also drawn on the guidance provided in the Countryside Agency's Landscape Character Assessment: Guidance for England and Scotland (2002). Both landscape and visual studies have used additional best practice guidance on seascape assessment by the Countryside Council for Wales (CCW) (2001).

7.2.2 *Impact Significance*

7.2.2.1 The two principle criteria determining the significance of a landscape impact are the magnitude of impact and the sensitivity of the receptor. A higher level of significance is often attached to a greater level of impact magnitude, and to the impacts on more sensitive receptors. Other relevant factors, which inform impact significance, include issues such as:

- The number of activities and the people affected;
- The frequency or duration of the impact and its distance from the receptor; and
- If the impact is permanent or reversible through mitigation.

7.2.3 *Determining Significance of Effects*

7.2.3.1 The determination of the significance of the landscape and visual effects is formulated as a combination of the receptor sensitivity value and the magnitude of the scheme impacts. The sensitivity value is assigned within the Baseline Assessment (chapter 7.4), the magnitude of impact is assigned within the Potential Landscape and Visual Impacts Assessment (chapter 7.5) and the significance of effects are then assigned within the Conclusions (chapter 7.8).

7.2.3.2 The following significance categories are used (LI, 2005 and IEMA, 2002):

- Major adverse;
- Moderate adverse;
- Minor adverse;
- Not significant / insignificant;
- Minor beneficial;
- Moderate beneficial; and
- Major beneficial.

7.2.4 Resources and Methods

- 7.2.4.1 The Landscape and Visual Impact Assessment process involved desk study and a field survey to establish the existing baseline condition, landscape character, classification and quality assessments, and any potential landscape mitigation measures that should be incorporated in to the project and to summarise the overall landscape and visual impact.
- 7.2.4.2 The study area for the assessment has, in accordance with good practice, been limited to the extent of the Visual Envelope (refer to Figure 7.1 ES Volume 2 Technical Appendix 7).
- 7.2.4.3 Desk based reviews were carried out of available publications, including LANDMAP information from CCW and the Conwy County Borough Council Local Development Plan (Deposit 2009).
- 7.2.4.4 A field study was undertaken by a Chartered Member of the Landscape Institute on the 24th August 2010. All studies were undertaken from ground level within the site and from publicly accessible areas. An assessment was made of the site and the surrounding landscape to include landscape character descriptions and types, identification of aesthetic or perceptual qualities and visual characteristics. Photographs were taken using a digital SLR camera fitted with a standard fixed 50mm lens (which accords closely with the human perception of views). For each viewpoint, the photographs have been stitched together to provide panoramic images (refer to Figures 7.2.1 – 7.2.4 ES Volume 2 Technical Appendix 7).

7.2.5 Scope of Assessment

- 7.2.5.1 Assessment of effects on the landscape resource considers three different aspects:
- Elements;
 - Characteristics; and
 - Character

- 7.2.5.2 Visual effects relate to the changes that arise in the composition of available views, to people's responses to the changes and to the overall effects on visual amenity. They include the visual amenity of residents and members of the public passing through the area. These are usually recorded as views from roads and other Rights of Way, but in this case this includes views from the coast and sea as well.
- 7.2.5.3 In addition to the effects on views, the visual effects on the settings of conservation areas and listed buildings and structures are also considered.
- 7.2.5.4 It is standard practice to assess the landscape and visual impacts by comparing, at two stages, the predicted effects of the scheme with the situation if the scheme were not constructed:
- During construction; and
 - During the operational stage immediately following completion of the works.

7.3 Policy Context

7.3.1 Designations, Legislation and Policy

- 7.3.1.1 There are no landscape designations within the site area. The nearest landscape designated site being a National Park which is approximately 7 km to the west and south of Colwyn Bay.
- 7.3.1.2 There are however, other designated areas in the vicinity of the site and this includes the Creuddyn peninsula of which much of this headland is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) and as a Heritage Coast. This important coast line begins approximately 2 km to the west of Rhos Point and covers the coast from Little Ormes head to the Great Orme.
- 7.3.1.3 Within the towns of Colwyn Bay and Rhos-on-Sea are designated Conservation Areas and Listed Buildings. The conservation area of Colwyn Bay was designated in 1998 and covers the central area of the town. The Rhos-on-Sea conservation area was designated in 1991 and includes much of the frontage of Rhos-on-Sea and the village centre.
- 7.3.1.4 The Colwyn Bay Conservation Area was designated because of the quality of design and use of materials of late 19th and early 20th century developments that give it a unique 'sense of place'. Despite a gradual deterioration in the quality of appearance and general well being of the town, the urban townscape has retained some of its character.
- 7.3.1.5 The conservation area of Rhos-on-Sea includes the frontage that faces out onto the promenade and contains several important views. These include views over the promenade and sea front, encompassing the whole of the bay.
- 7.3.1.6 The listed buildings include the Victorian pier and pavilion at Colwyn Bay which were constructed in 1899.
- 7.3.1.7 Within the Conwy Local Development Plan (2009) the site area is classified as Coastal and Serviced Accommodation zones.

7.4 Baseline

7.4.1 Existing Landscape Character

7.4.1.1 Landscape character describes what makes an area distinctive, what gives it a sense of place and what makes it different from another landscape. The study area for the baseline landscape character classification and evaluation has concentrated on three separate components:

- Landscape character – description of the seafront landscape;
- Seascape character – the seascape within the Visual Envelope; and
- Townscape character - the townscapes of Colwyn Bay and Rhos-on-Sea.

National and Regional Landscape Character

7.4.1.2 The site is covered at national level by the Countryside Council for Wales (CCW) landscape character mapping initiative (LANDMAP). This evaluates the landscape in terms of its visual and sensory aspect and also its cultural landscape. The visual and sensory character region of Colwyn Bay study area is described as *'a settlement that consists of a series towns joined in conurbation including Colwyn Bay, Old Colwyn and Rhos-on-Sea. It is a major coastal resort on the north Wales coast with a promenade and some elegant Victorian built form in its core. The settlement is orientated towards the bay with its beach, promenade and pier, but for much of its frontage to the core and east, the town is separated from the beach by the major A55 road and railway line. This disrupts the relationship and reduces tranquillity'*.

7.4.1.3 The value of the landscape is classified as being of 'Moderate' value in terms of its visual and sensory evaluation. The promenade is described as allowing positive views of the bay and the built form of the core is pleasing in its composition. The promenade and core has the strong integrity with coherent form. The core has the strong character of a Victorian seaside resort with fine buildings.

Local Landscape Character

7.4.1.4 The landscape character of Colwyn Bay can be described as unique with its sweeping open promenade and elevated backdrop with seascape views. This seaside character has gradually however, been undermined by the declining tourist infrastructure and subsequent commercial viability. Structural disrepair is visually evident along the promenade as ad hoc repairs to the concrete defence walling have taken place since the early 1900's adding to the dilapidated and chaotic character of the urban structure.

7.4.1.5 The shoreline comprises a slightly sloping sandy beach controlled by numerous vertical timber groynes. However, the existing timber groynes are in poor condition and no longer provide control over beach movement. The existing level of beach in comparison to the promenade greatly limits any physical or visual connection for the pedestrians with the foreshore.

7.4.1.6 The frontages of Colwyn Bay and Rhos-on-Sea overlooking the bay consist predominately of residential and commercial properties. These are a diverse range of properties with many architectural styles.

- 7.4.1.7 Along the promenade are structures and furniture that retains a traditional style of seaside architecture. These include food outlets, seating shelters and benches. However, there are no areas of vegetation within the site extents, serving to reinforce the hard urban character of the promenade with no features to break up the vast areas of hard landscaping.
- 7.4.1.8 The main transport corridors closely follow the sea front for much of Colwyn Bay, which with the recent construction of the A55 expressway reinforces the physical barrier between the town centre and the waterfront. This currently detracts from the sense of place of an otherwise traditional sea front character with its long promenade, pier and retail units. The A55 also creates light spill impacts on the current site due to the roadside lighting.
- 7.4.1.9 The length of the promenade and relatively unobstructed views seawards provide Colwyn Bay's unique character however, it is now widely recognised that the area is in need of regeneration both socially and physically. Urban regeneration, if undertaken sensitively, could revitalise and improve the character of the area. This could be achieved with the introduction of landscape elements to integrate the seascape with the townscape and therefore improve the overall seaside character.

Seascape Character

- 7.4.1.10 The North Wales coastal area is rich in landscape, cultural and heritage features, with a natural and wild coastline interspersed with seaside resorts.
- 7.4.1.11 This study has drawn upon guidance of the CCW Guide to Best Practice in Seascape Assessment (March 2001) and also the Guidance for Coastal Defence in relation to their Landscape and Visual Impacts (2003), to assist with the identification of elements that contribute to the local character and quality of the coast.
- 7.4.1.12 The seascape is defined as including views from sea to land and views along the coastline. Seascape assessment is an extension of landscape character assessment and assesses the integration of the sea, coastline and land components together.
- 7.4.1.13 Important amenity resources relevant to seascape assessment include: promenades, coastal footpaths, beaches and water sports access points. To complement the land based amenity uses, there are also water-based leisure activities that may depend on the character and quality of the seascape for their user's enjoyment, and which also affect the appearance of the coast.
- 7.4.1.14 The coastline is open to the north, with a number of off shore features which can be seen from Colwyn Bay. These includes the production platform of the Douglas and Hamilton oil and gas field located approximately 11 miles off shore and the wind turbines of the Rhyl Flats and North Hoyle wind farms which can also be seen closer on the horizon.
- 7.4.1.15 The foreshore consists of a large, gently shelving, predominately sandy beach with some rock armour and many groynes present.

Townscape Character

- 7.4.1.16 The towns of Colwyn Bay and Rhos-on-Sea are relatively recent towns, dating back to Victorian times of the latter part of the 19th century and the early part of the twentieth century. These have now largely reached their limits due to the proximity of the hills which have constrained development. Until the middle of the century, the area was an important holiday destination that was easily accessed by the main Holyhead to London railway line, but recent changes in the holiday market have a marked effect and impact on the town.
- 7.4.1.17 The architecture and urban fabric still retains much of its quality in its design and use of materials of the period. This provides a diversity of architectural styles that contributes to the towns' sense of place and distinctiveness. Buildings along the front and within the towns typically range from 2 - 4 storeys and their mass is skilfully broken down by the introduction of several design features and elements such as the use of bay windows, plain and decorative fenestration, gabled and dormer roofs and dutch gables. The visual appearance of the street scene is further varied by use of different materials and textures such as red and yellow brick, stone render, black and white mock Tudor work.
- 7.4.1.18 Eirias Park situated on the east of the town centre comprises 40 acres of rolling open park land and formal gardens close to the sea front.
- 7.4.1.19 The original settlement of Old Colwyn was a small fishing and farming community that grew up around the river Colwyn and rises dramatically up the surrounding hills.
- 7.4.1.20 Rhos-on-Sea is a more prosperous sea side town lying on the western side of Colwyn Bay and has a small harbour providing moorings for small boats. There is a broad sweeping promenade part of which is backed by a grassy embankment known as Cayley Promenade.
- 7.4.1.21 The pier stands between Rhos-on-Sea and Old Colwyn and was constructed in 1900. Over the years it has been damaged and re-built with its present structure in neglect.
- 7.4.1.22 The transport corridors and topography of the area have influenced the development of the town of Colwyn Bay, as it has expanded outwards in easterly and westerly directions. The railway line pre-dates the town having been built in 1847.

Landscape Quality and Sensitivity

- 7.4.1.23 The quality of the landscape incorporating the local landscape, townscape and seascape elements can be described as 'good' in the overall context. Even though individual elements of the landscape have suffered decline and are in a poor state of repair, the landscape in the wider context still retains its scenic quality and sense of place. There is also still potential for enhancement and scope for restoring the typical seaside character of the area. The landscape susceptibility to change and sensitivity to development can be classified as '*medium*'.

7.4.2 Visual Baseline Analysis

- 7.4.2.1 Due to the location and landform of the area around the site, there are a large number of potential viewpoints of the site. During site visits, principal representative viewpoints were identified. A location and visual analysis plan which shows these key public viewpoints and a Visual Envelope is given in Figure 7.1 ES Volume 2 Technical Appendix 7. Photographs of these views are provided in Figures 7.2.1 – 7.2.4 ES Volume 2 Technical Appendix 7.
- 7.4.2.2 The Visual Envelope is restricted to the south by the landform and built environment. There are open and unobstructed views to the north however, the visual envelope is displayed as a maximum distance of 1 km to the seaward side as views further than this distance are not considered significant.
- 7.4.2.3 Public Rights of Way in the vicinity of the site are also shown on Figure 7.1 ES Volume 2 Technical Appendix 7. These include the Long Distance Footpath 'North Wales Path' which follows the coastline before heading inland at Beach Road, Old Colwyn.
- 7.4.2.4 The nature of the topography and also the location and spread of the built environment and transport corridors limits views other than those in close proximity of the seafront. The locations where public views will be most significantly affected are:
- Views from the shore immediately north of the site;
 - Views from inshore waters north of the site;
 - Views from the promenade for all recreational and commercial users;
 - Views from the adjacent A55 and railway; and
 - Views from the frontage properties including residential and commercial.
- 7.4.2.5 The site is partially visible from some more distant views from within the built environment where the nature of the rising topography allows views over the bay. Due to the urban scale and massing however, these views are generally obstructed by intervening buildings.
- 7.4.2.6 The listed Victorian pier and pavilion occupies a prominent position along the eastern section of the site however, this is currently closed to the public due to its unsafe condition.
- 7.4.2.7 Views from the shoreline and water to the north of the site will cover all recreational and commercial users of the beach and water. These range from day-trippers, dog walkers and water activity based recreational users to commercial fishing and sailing activities.
- 7.4.2.8 Views from properties are mostly restricted to frontage properties. These frontage properties are predominately residential or commercial properties of hotels and bed and breakfast establishments. Shop premises and public houses are more evident near the town of Rhos-on-Sea and are within the Conservation Area designation.
- 7.4.2.9 Views from the widely used promenade include recreational users of walkers and cyclists as well as patrons of the many refreshment kiosks situated along the promenade. At Rhos-on-Sea there

are small retail units serving the typical recreational activities of the area such as fishing equipment and kayaking and fishing charter operations. These units are located at Rhos Point and Rhos Jetty. At Rhos Jetty there is also a restaurant and tea shop within a prominent position overlooking the bay.

- 7.4.2.10 Views from the A55 and railway include key elevated views over the bay. For travellers on the A55 westbound, the Colwyn Bay section is the first where the road reaches the open sea coastline. This allows viewers to appreciate the large scale and dramatic nature of the coast.

7.4.3 Topography

- 7.4.3.1 The topography rises from the beach gradually increasing in gradient to the southern fringes of Colwyn Bay. This then rises steeply up a series of hills bordering the south of the town towards the extensive woodlands to the south. These woods occupy steeply rising ground and form a pleasing and attractive backcloth to the town as well as providing an important valuable amenity.
- 7.4.3.2 The sloping and undulating nature of the terrain and its changing levels contribute to the character of the town and provides potential for a variety of enclosed and open views.

7.5 Assessment of Effects

7.5.1 Landscape, Townscape and Seascape Effects

- 7.5.1.1 This section identifies and assesses the potential landscape, townscape and seascape character effects of the scheme and its potential visual impact during its phases of construction (temporary effects) and operation (longer term effects). The visual impact of the scheme is that as would be experienced by visual receptors within the indicative Visual Envelope to the existing bay (Figure 7.1 in ES Volume 2 Technical Appendix 7).

Construction

- 7.5.1.2 Temporary adverse landscape, townscape and seascape impacts during the construction periods would result during removal operations of the existing rock groynes and the construction of the new sea wall, groynes and promenade. This will result in impacts on the natural environment of the foreshore during this construction period.
- 7.5.1.3 Large scale construction equipment would be required to remove the existing rock groynes and install the new sections of walling. The construction management plan is to be provided by the contractor and is not available at this stage. However, the delivery of materials and construction traffic would have temporary impacts on the area.
- 7.5.1.4 The construction works would have the following impacts and effects upon this area of 'medium' landscape quality:
- Magnitude of Impact: Moderate
 - Landscape sensitivity: Medium
 - Significance of effect: Moderate adverse

Operation

- 7.5.1.5 When the development is completed, current levels of tranquillity may be reduced by increased pedestrian activity on the promenade. This will be increased further if cumulative urban regeneration works take place. However, this would be viewed as a positive improvement and any additional activity is not considered a significant adverse effect.
- 7.5.1.6 There would be some positive change in experiential characteristics, because the foreshore would be changed by the removal of damaged existing sea defence structures and the introduction of sand to raise the levels of the beach. These proposals for recharging the beach would serve to provide a positive experience for users due to the beach being raised to a level that would provide an improved visual as well as physical connection to the promenade.
- 7.5.1.7 The introduction of rock armour and control structures at the eastern and central ends of the sea wall are not expected to change the seascape character at these locations. The proposed hotspot located on the central control structure will alter the character of this section of the promenade due to the increased activity and movement in this area. However, this will be in character with other sections of the promenade which contain hub areas of water based activity launching zones.
- 7.5.1.8 The ongoing management of the proposed sea defence structures, promenade and foreshore levels will have an effect on the tranquillity of the area but, this is not expected to cause significant impacts. Any further regeneration activities linked to this scheme will have a beneficial effect on the urban character.
- 7.5.1.9 The operation works and 15 years after completion of the scheme would have the following impacts and effects upon this area of 'medium' landscape quality:
- Magnitude of Impact: Slight;
 - Landscape sensitivity: Medium; and
 - Significance of effect: Minor beneficial.

7.5.2 Visual Impact Assessment

- 7.5.2.1 Due to the nature of the site and its location there will be potential for a high number of impacts to sensitive receptors particularly along the waterfront. These sensitive receptors will include predominately members of the public using public rights of way and undertaking other outdoor recreational activities.
- 7.5.2.2 Other sensitive receptors will be occupiers of residential and commercial properties within prominent positions overlooking the bay. To the western section of the scheme, the commercial property lined frontages such as cafes and pubs overlook the waterfront providing potential for visual impacts.
- 7.5.2.3 The railway line also includes a high number of potential sensitive receptors along its elevated position to the eastern section. The A55 provides a visual barrier to the majority of Colwyn Bay to

the eastern and central sections of the scheme. These receptors would have a lower sensitivity than residential or recreational receptors.

- 7.5.2.4 A number of key viewpoints were identified during the base line assessment (Figures 7.2.1 to 7.2.4 in ES Volume 2 Technical Appendix 7). The potential changes to these existing views and the potential magnitude of impact upon each is described in Table 7.1.

Table 7.1: Change in View at Principal Receptors

Viewpoint	Sensitivity of Viewpoint	Change of View	Magnitude of Visual Impact
1. Cycleway and footpath on Promenade, Rhos-on-Sea. (Western section).	High	The raised beach levels will result in a more attractive beach and enhance views for recreational users.	Slight beneficial in the long term
2. Cayley Promenade overlooking the bay. (Western section)	High	Elevated view over most of the bay. The promenade and rear defence improvements will be visible.	Slight beneficial in the long term
3. Cycleway and footpath on Promenade, Colwyn Bay. (Western section)	High	The raised beach levels may result in a more attractive beach and enhance views for recreational users.	Slight beneficial in the long term
4. A55, Colwyn Bay. (Western section)	High	Views over the promenade and foreshore will be slightly obscured by the raised promenade and wave return wall.	Slight beneficial in the long term
5. Foreshore, Colwyn Bay. (Central section)	High	The raised beach levels may result in a more attractive beach and enhance views for recreational users.	Slight beneficial in the long term
6. Cycleway and footpath on Promenade towards pier, Colwyn Bay. (Central section)	High	The raised beach levels may result in a more attractive beach and along with promenade improvements will enhance views for recreational users.	Slight beneficial in the long term
7. Cycleway and footpath on Promenade, Old Colwyn. (Central section).	High	Rear defences will be raised over and against the existing sea wall although beach levels in this area will remain the same.	Neutral in the long term.
8. Foreshore, Colwyn Bay. (Eastern section).	High	The raised beach levels may result in a more attractive beach and enhance views for recreational users. The rock groyne structure will also be visible.	Slight beneficial in the long term

7.5.3 Construction

- 7.5.3.1 The views predicted to be adversely affected are predominately from within close proximity to the site. These include the public footpaths and cycleway along the promenade. However sections of these might be closed to the public during the construction period and therefore there would be no views from these places.
- 7.5.3.2 Lighting for night-time working will have an adverse impact in the short term, although this will be viewed in relation with the existing light spill from the A55 and other roads in proximity to the promenade.

- 7.5.3.3 Views from residential and commercial areas will be from the frontage properties of Colwyn Bay and Rhos-on-Sea. Receptors will experience changes in their sea views during the construction period due to construction activity and are considered as high sensitive receptors.
- 7.5.3.4 Receptors travelling in vehicles on the A55 are considered the least sensitive of receptors because their attention is primarily focused on other activities.
- 7.5.3.5 It is considered that predominately sensitive public views will be moderately altered during the construction stage of the scheme. Therefore, the overall significance of the visual impact of the scheme during construction stage is considered to be '*moderate adverse*'.

Operation

- 7.5.3.6 There will generally be visual benefits arising from the scheme due to the improved appearance of the promenade and sea defence wall. This will benefit receptors to the promenade and frontage properties. The introduction of rock armour and control structures at the eastern and central ends of the sea wall will not significantly affect the viewpoints to sensitive receptors. These will be viewed in conjunction with the existing sea control structures along the foreshore and as an extension of the promenade. The proposed hotspot located on the central control structure along with the associated facilities (which will be subject to a later planning application) will visually break up and add interest to the long promenade and provide opportunities to view water-based activities.
- 7.5.3.7 When the works are completed there will be ongoing maintenance and management operations taking place. This includes topping up of beach levels and regular maintenance to the seawall structure.
- 7.5.3.8 The views from the foreshore would be generally improved due to sand recharge raising beach levels against the sea wall.
- 7.5.3.9 The effects on resident's views, from the frontage properties will be slightly improved due to the improved appearance of the promenade.
- 7.5.3.10 Visual impacts from the A55 would be moderately altered during the operational stages due to the slight obstruction of views over the foreshore. This is due to the raised level of the promenade and the introduction of the wave return wall.
- 7.5.3.11 The scheme according to the design options would not cause an appreciable change in the existing situation. The changes in elevation of the beach, promenade and wave return wall may have negative impacts on the panorama of the landscape viewed from for the road and foreshore. However, the coastal defence structure proposed is currently of a scale that would not be expected to significantly impact on views.
- 7.5.3.12 It is considered that although some views will be moderately altered the overall significance of visual impact of the scheme during operational stage is '*minor beneficial*'.

7.6 Mitigation of Impacts

7.6.1.1 Specific mitigation measures would be developed as part of the detail design. However, the following measures would potentially form part of the scheme:

- The existing stone and predominantly new locally sourced stone will be used in the construction of the proposed sea wall to integrate it with the overall scheme;
- The eventual promenade finishes will be designed to give a high quality and in-keeping finish. The finishes will be subject to a separate planning application to be completed at a later date;
- The visual impact of the rock revetment to Phase 3 of the scheme will be minimised by the use of locally sourced stone to integrate it with the overall scheme. In the longer term, the visual impact will be softened as the revetment becomes weathered and is colonised by marine habitats;
- The proposed concrete wave return wall will be constructed as low as possible while still providing the necessary level of overtopping performance and textured or clad in suitable materials that may reduce its visual impact; and
- Detailed design proposals of the scheme components, surfacing and edgings would be in keeping with the local character as far as practicable and will all be subject to a separate planning application to be completed at a later date.

7.6.1.2 While there are no opportunities for planting during the initial engineering works, the environmental improvement element of the Waterfront Project contains proposals to undertake soft landscaping on the embankment to form a backdrop to the promenade. However, selected planting should be appropriate for the hostile marine environment along the promenade. The proposals are widely viewed as providing a catalyst for further regeneration works to the area. This will provide an opportunity to soften and break up the visual dominance of the sea wall structure in elevation. Any landscape elements that could be incorporated within any regeneration works would greatly enhance the visual aspect of the area. This could include hard and soft elements such as landscaping and public art pieces. There is a separate public art project being developed alongside the Waterfront Project which will comprise four or five major pieces of commissioned public art installed along the Waterfront.

7.7 Cumulative Effects

7.7.1.1 Cumulative effects are likely to arise from future development works as part of the overall regeneration programme. These regeneration works of the promenade and town are currently at design stage and submitted separately for planning approval. The current developing design proposals will improve the appearance and integration of the waterfront with the town centre and other parts of the town.

7.7.1.2 The current concept Masterplan shows a new town centre with pedestrianised squares, a multi-sports village at Eirias Park, revamped railway station and a link bridge over the A55. The plans also show the promenade with avenue tree planting and terraces down to the foreshore, which will improve the visual links and add vertical interest to the long promenade.

- 7.7.1.3 Therefore, based on the current concept designs any cumulative effects arising from the regeneration works can be considered as a benefit to the overall area in landscape and visual terms and can also be considered to form part of positive long term mitigation measures.

7.8 Summary and Conclusions

- 7.8.1.1 The scheme as proposed will provide a positive landscape and visual benefit to the area in the long term. This will be in character with the existing situation retaining and improving upon the characteristics of the area that currently provide its 'sense of place'.
- 7.8.1.2 Existing coastal sea defence structures exist along the shoreline and consist of a series of vertical masonry and/or concrete walls and rock revetments at Rhos Harbour and between Old Colwyn and Tan Penmaen Head. Beach levels are currently reported to be continuing to fall and the coastal defence condition is deteriorating.
- 7.8.1.3 The quality of the landscape can be described as 'good' and the sensitivity of the area is assessed as being of 'medium' rating. This is based on the quality and 'sense of place' of the overall landscape in its wider context.
- 7.8.1.4 There will be a number of visual receptors to the scheme due its prominent location. These will be predominately receptors of a high sensitive nature as the scheme is viewed in close proximity by recreational users.
- 7.8.1.5 This scheme is likely have moderate adverse landscape and visual impacts on the environment during construction stages due to the nature of the works and proximity to a natural environment and highly sensitive visual receptors.
- 7.8.1.6 As the proposed sea defence structures will be generally in character with the existing structures, there will be no adverse impacts anticipated during the operation stage. The improved appearance of the promenade and sea wall and connectivity for the public to the foreshore are likely to provide beneficial impacts.
- 7.8.1.7 Providing sensitive design and material selection is carried out, the proposals and any future enhancements of the area will visually mitigate against any short term impacts expected during construction and beach management periods. The long term and cumulative impacts will be beneficial to the overall area and should improve the sea side character of waterfront. There are opportunities to incorporate improvement works to the public realm areas of the seafront and improve the connectivity for future public access.
- 7.8.1.8 This assessment has focused on coastal defence Option 2 in its assessment of impacts. Option 1 is for rock revetment constructed around the entirety of the bay. This will have fewer long term beneficial impacts due to the reduced visual as well as physical connectivity for users of the promenade to the beach. Additionally, Option 1 would reduce the open character of the frontage at Colwyn Bay.

7.9 References

- Countryside Agency, 2002 Landscape Character Assessment Guidance for England and Scotland;
- Countryside Council for Wales 2001 Guide to Best Practice in Seascape Assessment, The Marine Institute;
- Guidelines for the Assessment of Landscape and Visual Impacts, second edition (2005), The Landscape Institute;
- Conwy County Borough Council, Draft Local Development Plan 2009.

7.10 Appendices

7.10.1.1 The following figures can be found in the ES Volume 2, Technical Appendix 7:

- Figure 7.1 – Location Plan and Visual Analysis
- Figure 7.2.1 – Representative Viewpoints 1 & 2
- Figure 7.2.2 – Representative Viewpoints 3 & 4
- Figure 7.2.3 – Representative Viewpoints 5 & 6
- Figure 7.2.4 – Representative Viewpoints 1 & 2

8. Socio-Economic

8.1 Introduction

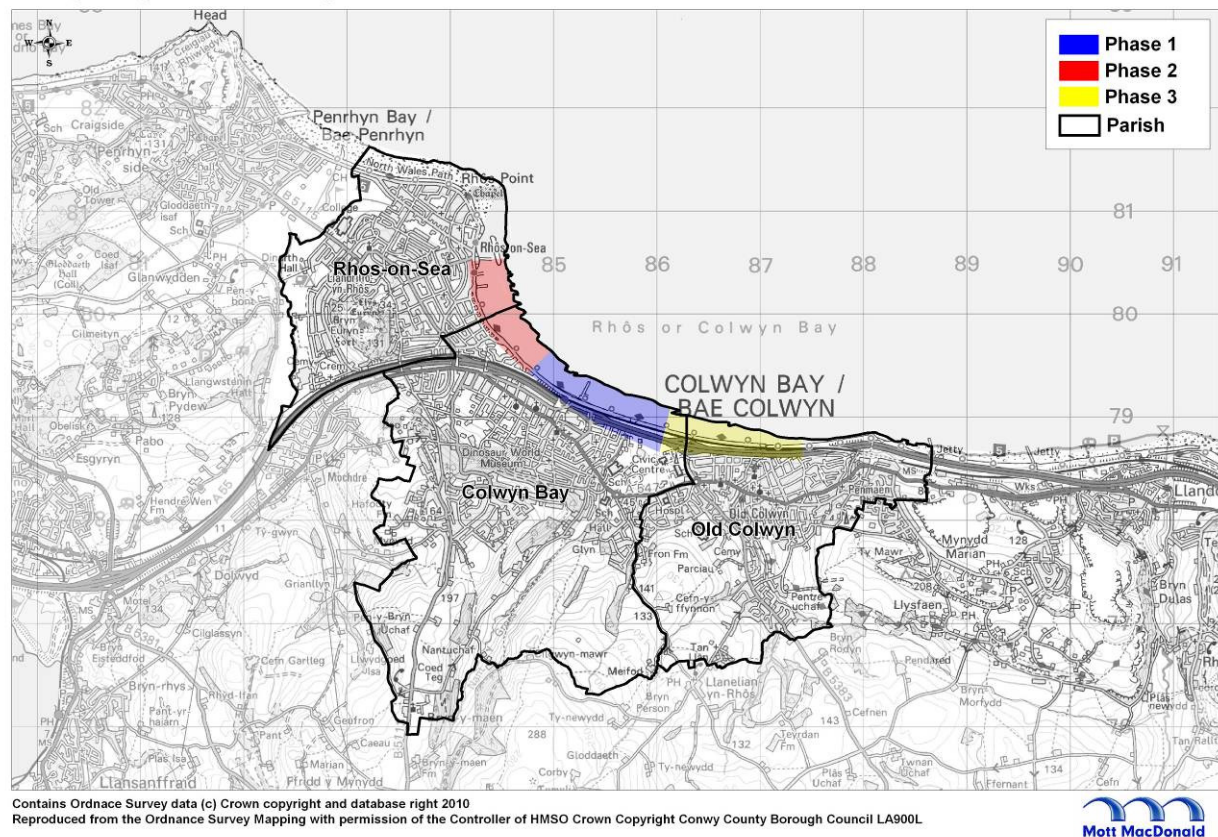
- 8.1.1.1 This Chapter presents the technical assessment of the socio-economic effects of the construction and operation of the Colwyn Bay Waterfront Project in Conwy County, north Wales. The Colwyn Bay Waterfront Project is specifically designed to address declining beach levels and the deteriorating coastal defences along the 3500m of shoreline located between Rhos jetty to the west and Beach Road, Old Colwyn to the east. The coastal defence element of the Colwyn Bay Waterfront Project is being undertaken together with environmental improvements and regeneration initiatives; together this package is intended to boost the attractiveness of the promenade to make it a more desirable destination for tourists and businesses.
- 8.1.1.2 Conwy County Borough Council has considered two principal options for coastal defence improvements, where Option 2 has been determined as the preferred Option:
- Option 1 – rock revetment around the entirety of Colwyn Bay; and
 - Option 2 (preferred Option) – areas of beach recharge; control structures, promenade raising, and wave return walls and rock revetment.
- 8.1.1.3 The core assessment considers Option 2 in support of the planning application being submitted by CCBC. A comparison of alternative options is included in Chapter 2 of this report.
- 8.1.1.4 Under Option 2 the project will be delivered in the following three phases, which are indicated on Figure 8.1 below.
- Phase 1 – Cayley Promenade to Eirias Park: Recharging of beach sands, improvements to the promenade and crest of existing defences. Provision of beach control structures on the foreshore and a hotspot are over one of the control structures. Rock armour revetment to east of control structures.
 - Phase 2 – West of Cayley Promenade to Rhos Jetty: Recharging of beach sand improvements to the promenade and crest of existing defences.
 - Phase 3 – East of Eirias Park to Old Colwyn: Construction of rock armour revetment, improvements to the promenade and crest of existing defences.
- 8.1.1.5 This assessment considers the effects of all three phases and considers the following effects (it should be noted that the EIA Regulations do not prescribe in detail the types of issues that should be considered when assessing socio-economic effects):
- Employment – temporary employment for construction works;
 - Local business – temporary disruption to local businesses during construction works;
 - Local business – protection of commercial properties;

- Local residents – protection of residential properties and improvements to local amenity; and
- Regeneration – contribution to regeneration, tourism and social inclusion objectives.

8.1.1.6 This assessment does not serve as a cost benefit analysis or a financial analysis of the proposed scheme.

Figure 8.1: Immediate Impact Area of the Colwyn Bay Waterfront Project

Colwyn Bay Immediate Impact Area



8.1.2 Structure of assessment

8.1.2.1 The assessment comprises the following sections:

- **Methodology** – explaining the assessment methodology including the spatial and temporal scope, the identification of receptors, the criteria used to assess the significance of the impacts and relevant study assumptions and limitations;
- **Legislative and policy framework** – examining how the development proposal fits into the socio-economic and planning framework;

- **Baseline** – presenting the baseline scenario and current local socio-economic conditions including data on population, employment, labour and deprivation;
- **Assessment of effects** – setting out likely direct and indirect socio-economic effects during both construction and operation;
- **Mitigation proposals** – highlighting any mitigation measures to address any adverse consequences and the predicted residual impacts following implementation of these measures;
- **Summary and conclusions** – summarising the potential impacts and associated mitigation actions; and
- **References** – containing the references relating to the socio-economic assessment.

8.2 Methodology

8.2.1.1 This section explains the methodology that has been used to produce this socio-economic impact assessment. It is broken down as follows:

- Identification of spatial scope for the assessment;
- Identification of temporal scope of the assessment;
- Identification of receptors;
- Research methods ;
- Development of assessment criteria; and
- Assumptions and limitations.

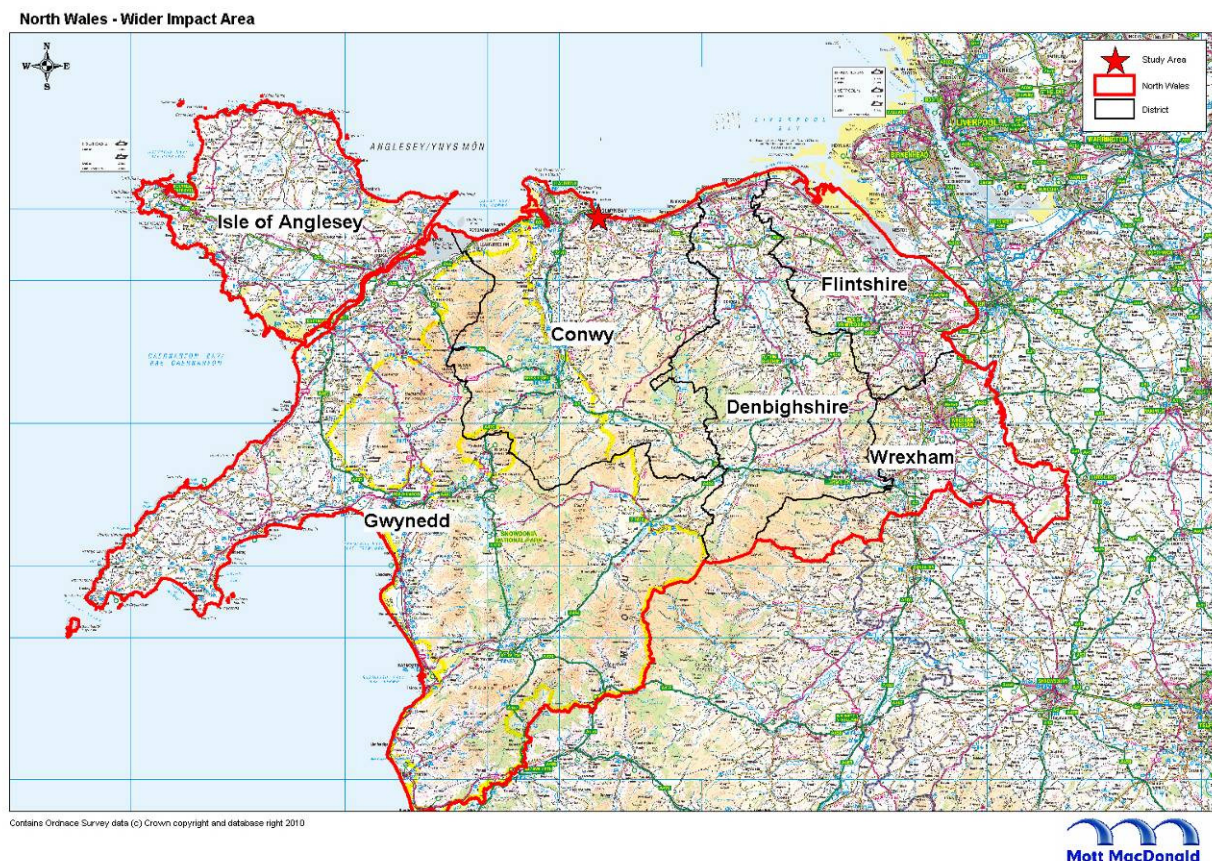
8.2.2 Spatial scope

8.2.2.1 The potential socio-economic effects will be considered at two scales:

- The immediate impact area – the three parishes of: Rhos-on Sea; Colwyn Bay; and Old Colwyn. This is the primary area of focus for the assessment and has been selected as the Colwyn Bay Waterfront Project spans these three parishes (see Figure 8.1); and
- The wider impact area – which is defined as North Wales. This is the area in which Conwy County sits and is important to consider due to area strategies of the Wales Spatial Plan (WSP) and tourism policy. North Wales comprises: Conwy; the Isle of Anglesey; Gwynedd; Denbighshire; Flintshire; and Wrexham. See Figure 8.2.

8.2.2.2 It is acknowledged that the extent of certain effects, for example the influence of tourism, may be experienced at much larger geographical scale. However, the defined impact areas are considered appropriate to capture the potential significant effects associated with the scheme.

Figure 8.2: North Wales Wider Impact Area



8.2.3 Temporal scope

8.2.3.1 The baseline for this assessment will be taken to be 2010. It is assumed that construction of the initial Phase 1 engineering works will commence in January 2011 and be completed by the end of March 2011. The construction period for Phases 2 and 3 is not yet confirmed due to future funding not yet being confirmed.

8.2.4 Receptors

8.2.4.1 Socio-economic receptors are individuals, groups or entities whose access to, and control over, socio-economic assets, resources and opportunities may be affected by the project.

8.2.4.2 In terms of the Colwyn Bay Waterfront Project these are:

- Local businesses; and

- Local residents.

8.2.4.3 Whilst this assessment considers the impacts in the context of the whole of the three parishes into which all three Phases of the scheme falls, sensitive receptors are identified as those commercial and residential properties which are located adjacent to the construction zone and those that would be protected following implementation of the scheme. From plans provided by Conwy County Borough Council this is a total of 285 properties, which includes approximately ten commercial properties (five each for both for Phases 1 and 2¹) and 275 residential properties (190 for Phase 1 and 85 for Phase 2). There are no properties benefiting from the Phase 3 works as the primary beneficiaries in this area are infrastructure assets

8.2.5 Research methods

8.2.5.1 The following research was undertaken to compile this assessment:

- Desk study – relevant national, regional and local policy documents were reviewed;
- Compilation of baseline – key socio-economic indicator data was collated for the immediate and wider impact area and Wales;
- Site survey – a site walkover was undertaken to identify the sensitive receptors within the project area; and
- Consultation – there is no statutory consultation required for the purposes of a socio-economic consultation. However, informal discussions were undertaken with residents and businesses and Conwy County Borough Council provided answers to specific socio-economic questions. Findings from previous consultations were also reviewed and are incorporated into this assessment where relevant.

8.2.6 Assessment criteria

8.2.6.1 The significance of the socio-economic impacts associated with the Colwyn Bay Waterfront Project will be assessed using the following approach.

Construction

8.2.6.2 For the construction period the impacts that will be considered are:

- Temporary employment through construction works;
- Temporary closure or disruption to local businesses; and
- Temporary closure or disruption to local community facilities.

¹ It is not yet possible to estimate the number of properties for Phase 3.

Operation

8.2.6.3 For the operation period the impacts that will be considered are:

- Permanent employment for maintenance of the coastal defences;
- Retention and attraction of businesses;
- Improvements to local amenity (for example streetscape, open spaces) and social inclusion; and
- Contribution to local and wider regeneration/tourism challenges and objectives.

Determining significance

8.2.6.4 Each impact identified will be assessed in terms of the following indicators:

- Positive or negative;
- Temporary or permanent;
- Long or short term;
- Direct or indirect; and
- Whether impacts will be felt in the immediate or wider impact area or both.

8.2.6.5 Taking these indicators into consideration, the significance of each impact (pre-mitigation) will be classified as follows:

- Major adverse;
- Moderate adverse;
- Minor adverse;
- Not significant;
- Minor beneficial;
- Moderate beneficial; and
- Major beneficial.

8.2.6.6 Residual impacts, following the application of mitigation measures, will also be identified.

8.2.7 Assumptions and limitations

8.2.7.1 The following assumptions and limitations should be considered when reading this socio-economic assessment.

Assumptions

- The construction process will not render local properties unusable and there will be no displacement of local residents;
- The construction process may cause some disruption but will not result in any temporary business closures. There are six existing kiosks along the Waterfront (owned by CCBC and leased to private tenants). At the time of completing this report, it is known that all of these will be closed during varying stages of the construction works. Consultation with the kiosk tenants has been undertaken and in general, the tenants are supportive as they anticipate improved trading following completion of the works.
- Levels of public service provision will not alter as a result of the scheme; health, education and community provision will remain unchanged; and
- The data on number of residential and commercial properties protected by the scheme has been provided by Conwy County Borough Council. Mott MacDonald has not undertaken a validation of this data.

Limitations

- No formal consultation or primary research was undertaken in the production of this report;
- Very limited information is presently available on Phases 2 and 3 of the project as these proposals are currently under development;
- It has not been possible to determine the exact number of employees in businesses identified as sensitive receptors (in the construction area); and
- Qualitative assessments of the impacts to businesses and residents (i.e. in terms of disruption, access and quality of life) have been based upon professional judgement.

8.3 Policy Context

8.3.1.1 This section discusses the key strategic documents relating to the proposed Colwyn Bay Waterfront Project.

8.3.1.2 Full references are provided in section 8.9 of this chapter.

8.3.2 National policy

One Wales: A progressive agenda for the government of Wales (2007)

- 8.3.2.1 'One Wales' is the joint agreement between the National Assembly coalition parties, Labour and Plaid Cymru and is set around several strategic themes. The most pertinent of these in terms of socio-economic issues is around creating a 'prosperous society'. Several actions are identified to deliver this including creating jobs across Wales; stimulating enterprise and business growth; promoting tourism; and enhancing skills for jobs. Tourism is seen as vital to the economic prosperity and job creation; One Wales advocates the promotion of and investment in tourism facilities and infrastructure.

People, Places, Futures: Wales Spatial Plan (2008 update)

- 8.3.2.2 'People, Places, Futures' is Wales' Spatial Plan (WSP). It acts as the central statutory planning document for Wales, bringing together a variety of key themes including regeneration, skills, economy, housing needs, and transport. It sets a broad 20 year agenda, setting the context for local and community planning policy and looks to progress on priorities which were set out in *One Wales*.

- 8.3.2.3 The Plan is based around five key themes as set out below:

- **Building sustainable communities** – creating attractive places for communities to live and work, reducing inequalities whilst retaining their character and distinctiveness. This includes the need to tackle deprivation, and particularly pockets of poverty and unemployment.
- **Promoting a sustainable economy** – establishing an innovative high value-added economy for Wales, which creates wealth, spreads prosperity throughout Wales and adds to the quality of life and the standard of the living and working environment.
- **Valuing our environment** – safeguarding and enhancing the natural and built environment to attract people to and retain them within Welsh communities. Within this theme particular reference is made to the need to implement integrated coastal management.
- **Achieving sustainable accessibility** – developing ways to encourage economic activity, widen employment opportunities, ensure quality services and balance the social, environmental and economic benefits of travel.
- **Respecting distinctiveness** – promoting a cohesive identity which sustains and celebrates what is distinctive about Wales to secure future economic competitiveness and social and environmental well-being. There is a particular mention of the importance of working with Visit Wales and the regional tourism partnerships.

- 8.3.2.4 The WSP divides Wales into six Spatial Plan Areas (SPAs) which are marked out by 'fuzzy boundaries' rather than on the basis of administrative borders, thereby encouraging partners to work together flexibly. It sets out separate priorities and issues for each of these SPAs. Conwy is

one of the only counties to fall into two areas, north east and north west Wales. The key socio-economic objectives for each of these SPAs are summarised below.

North East Wales

8.3.2.5 North East Wales makes an important contribution to the Welsh economy. Tourism has a key role to play in terms of the objectives for the north east SPA. The focus for the region is on improving the quality of tourism facilities and reducing the seasonality of tourism. It is acknowledged that investment will be required to support key tourist location, of which Colwyn Bay is identified as one. Managing tourist destinations and coastal locations; providing and improving infrastructure for activity and recreation; diversifying local economies to improve their image and leisure facilities; and providing quality beaches and opportunities for marine tourism are all priorities.

North West Wales

8.3.2.6 Economic inactivity remains a significant issue especially in some of the more deprived pockets throughout the SPA making the goals of reducing poverty, deprivation and exclusion and promoting social cohesion and social capital. The tourism sector is identified as having an important role to play in improving quality of life, reducing economic inactivity and enhancing regeneration. It is recognised that the coastal areas provide a backdrop to develop and grow the outdoor recreation sector in synergy with providing a high class tourism offer.

Planning Policy Wales (2010)

8.3.2.7 This national document presents the context and main objectives and principles for land use planning policy for Wales. It is designed to deliver the strategic spatial priorities set out in the WSP and provides a guide to the application of national policy statements in Local Development Plans (LDPs), which are the responsibility of every local planning authority to prepare.

8.3.2.8 Within Planning Policy Wales' nine themes, there two in particular, to which LDPs need to adhere, that are of relevance to the Colwyn Bay Waterfront Project.

- **Theme: Conserving and Improving Natural Heritage and the Coast.** This theme highlights the importance of protecting the Welsh coast line and promoting coastal development in already developed coastal locations. It also requires LDPs to consider landward and seaward pressures on coastal systems, which can impact on existing businesses and employment as well as on the natural and historic character of the coastline.
- **Theme: Tourism, Sport and Recreation.** The overriding objectives for this theme are to encourage sustainable tourism in Wales, promoting local prosperity and supporting community well-being and involvement; and to manage tourism in ways in which to minimise environmental impact. With a view to promoting active and healthy lifestyles the document calls for a pattern of development which creates and maintains accessible networks and facilities and open spaces

Planning Guidance (Wales): Technical Advice Note (Wales) 14 (1998)

8.3.2.9 This document provides guidance to planning authorities on coastal management. The note raises several key issues, the most relevant of which in terms of socio-economic impacts is the need to safeguard public access to the coast as a positive feature of both new developments and regeneration schemes.

Economic renewal: a new direction (2010)

8.3.2.10 This document details WAG's programme for developing a strong and dynamic economy. It sets out five guiding priorities to deliver economic renewal. These are:

1. Investing in high quality and sustainable infrastructure;
2. Making Wales a more attractive place to do business;
3. Broadening and deepening the skills base;
4. Encouraging innovation; and
5. Targeting business support.

8.3.2.11 The second of these priorities is particularly relevant to this socio-economic assessment. It highlights WAG's ambition to develop conditions which allow and actively help people and businesses to flourish sustainably, by making the most of Welsh assets and getting the right balance between environmental, social and economic objectives.

8.3.2.12 In addition, specifically in relation to tourism, the strategy highlights the importance of Wales being marketed as a visitor destination in the UK and internationally and the need for developing tourist infrastructure.

Coastal Tourism Strategy (2008)

8.3.2.13 The Coastal Tourism Strategy provides WAG's objectives for a sustainable tourism market. It aims to develop a clear way forward to maximise the economic potential of the coastline, tackle the deprivation which characterises many coastal towns and, at the same time, maintain environmental quality. It provides spatial guidance for the future allocation of funds to support coastal tourism in the regions through the WSP.

8.3.2.14 The strategy sets out four aims, with associated outcomes. The first three aims are directly relevant in terms of socio-economics. These are set out below:

- Aim 1: To ensure that sustainable tourism is making an increasing contribution to the local economy of coastal communities.

Outcomes

- The decline in coastal tourism trips and nights is halted and reversed;
- The coast attracts more higher spending visitors;
- Tourism supports more full time jobs on the coast;

- There are increased levels of entrepreneurship amongst local communities in tourism related activities; and
 - The coastal tourism season is extended.
- Aim 2: To improve the quality of the visitor experience
Outcomes
 - The Welsh coastal tourism offer appeals increasingly to the under 25 age group and AB socio-economic groups;
 - Wales is the leading UK water sports destination for the family and multi-activity holiday maker;
 - The coast offers a more diverse tourism accommodation base that is meeting visitor needs; and
 - Access to the coast is improved.
- Aim 3: To achieve an integrated approach to the development and management of coastal tourism.
Outcomes
 - Local communities are actively involved in the management of the rural coast;
 - Coastal resorts are managed and developed with the needs of visitors in mind;
 - Local communities are involved in developing tourism in their area;
 - Coastal communities / residents are not disadvantaged because they live in an area that is attractive for tourism; and
 - There is an increase in the number of Welsh residents participating in the outdoor coastal activities.

Integrated Coastal Zone Management (2007)

8.3.2.15 In response the European Union's policy for Integrated Coastal Zone Management (ICZM), WAG published its own ICZM in 2007, with the purpose of encouraging collaboration to manage coastal areas in an environmentally and economically sustainable; socially equitable; and cohesive way (particularly in light of the threats posed by climate change). This highlights three principles which highlight the importance of coastal management to:

- The conservation of the natural and historic environment;
- Urban and rural development; and
- Tourism, leisure and recreation.

8.3.3 Regional policy

Tourism Strategy North Wales 2010 – 2015 (2010)

- 8.3.3.1 This document is a comprehensive review of the previous tourism strategy published in 2003. The strategy lays out plans for the next five years within North Wales focusing on the economic importance of the tourism industry and overcoming any challenges that are faced.
- 8.3.3.2 Action plans are provided for North East and North West Wales. Conwy falls into the western area, the priorities for which are:
- Projecting North West Wales' distinctive strengths – this includes exploiting the potential of family and activity related trips and short breaks and becoming a leading destination for outdoor holidays. The coastal scenery is viewed as having a role to play in this;
 - Investing in product excellence – it is regarded that activity should be focused around watersports and the promotion of key outdoor sectors. Implementation of the coastal action plan in Conwy is called for;
 - Providing an outstanding experience – Conwy is identified, alongside other towns, as a tourism hub where activity should be concentrated. Colwyn Bay is singled out as a particular priority. The strategy calls for the coastal problems to be addressed so that the town can be repositioned in tourism terms; and
 - Working together in partnership – by harnessing the energies of the public, private and third sector in order to prioritise tourism.

8.3.4 Local policy

Community Strategy for Conwy (2004)

- 8.3.4.1 Conwy's Community Strategy establishes community priorities between 2004 and 2014 to be delivered by the Local Strategic Partnership (LSP). One of the themes of the strategy is to work towards a 'prosperous Conwy'. The relevant aims and actions under this priority theme are:
- Raised economic activity rates;
 - The creation of additional high quality, high value employment and business opportunities;
 - A vibrant and innovative economy with a net annual increase of registered businesses of 2% per annum;
 - Developing the tourism industry into a high value sector that offers long term opportunities for growth, quality job creation and economic impact;
 - The average wage being raised to an equivalent of the All-Wales average;
 - Generating wealth and employment by assisting the growth and development of businesses with a range of generic and specialist support options for all sectors;

- Securing new investment opportunities supported by key infrastructure improvements; and
- Progressively reducing barriers to inclusion by providing better access to more diverse opportunities, building capacity and improving conditions for community and social business activity.

Regeneration Strategy for Conwy (2005)

8.3.4.2 The County's Regeneration Strategy was introduced to support and develop the Community Strategy and the WSP. It sets out a regeneration vision based around four key themes with associated actions, designed to respond to the key challenges faced by the county. The four themes and the actions relevant to the Colwyn Bay Waterfront Project are outlined below:

- Theme 1: economic improvement – including improving the quality of tourism and related services; and promoting employment opportunities within the County;
- Theme 2: cohesive communities – including targeting regeneration of disadvantaged areas of Conwy through projects which address local social, economic and environmental issues; and encouraging greater numbers of younger people to live and work in the County;
- Theme 3: culture and environment – including marketing the County's coastal resorts; growing watersports and other sporting and leisure opportunities; and enhancing beach and sea quality through water quality and coastal management; and
- Theme 4: improving infrastructure – including designing better, clean and well-maintained public places; and providing more walking and cycling routes.

Conwy Deposit Local Development Plan 2007 - 2022 (2009)

8.3.4.3 Conwy's LDP concludes that the majority of new development should be along coastal locations, where accessibility and facilities are already more closely linked to employment locations. Colwyn Bay is one of the 'urban belt coastal locations' which is identified as an area to concentrate development and regeneration (see policies SO1 and SO2). It is recognised that this would be beneficial to boosting the economy in general but the tourism sector in particular, which is an important economic generator.

8.3.4.4 Policy SO8 supports the link between coastal management and boosting the tourism sector, stressing the importance of enhancing and protecting the coast due to its importance as a traditional holiday destination.

8.4 Baseline

8.4.1.1 Baseline data is presented and addressed below under a series of topic headings. The socio-economic baseline is important for assessing the effects because it provides the context for the project and details the customer base for local businesses; the residential base for employees and employers; and an infrastructure base for property and workplaces.

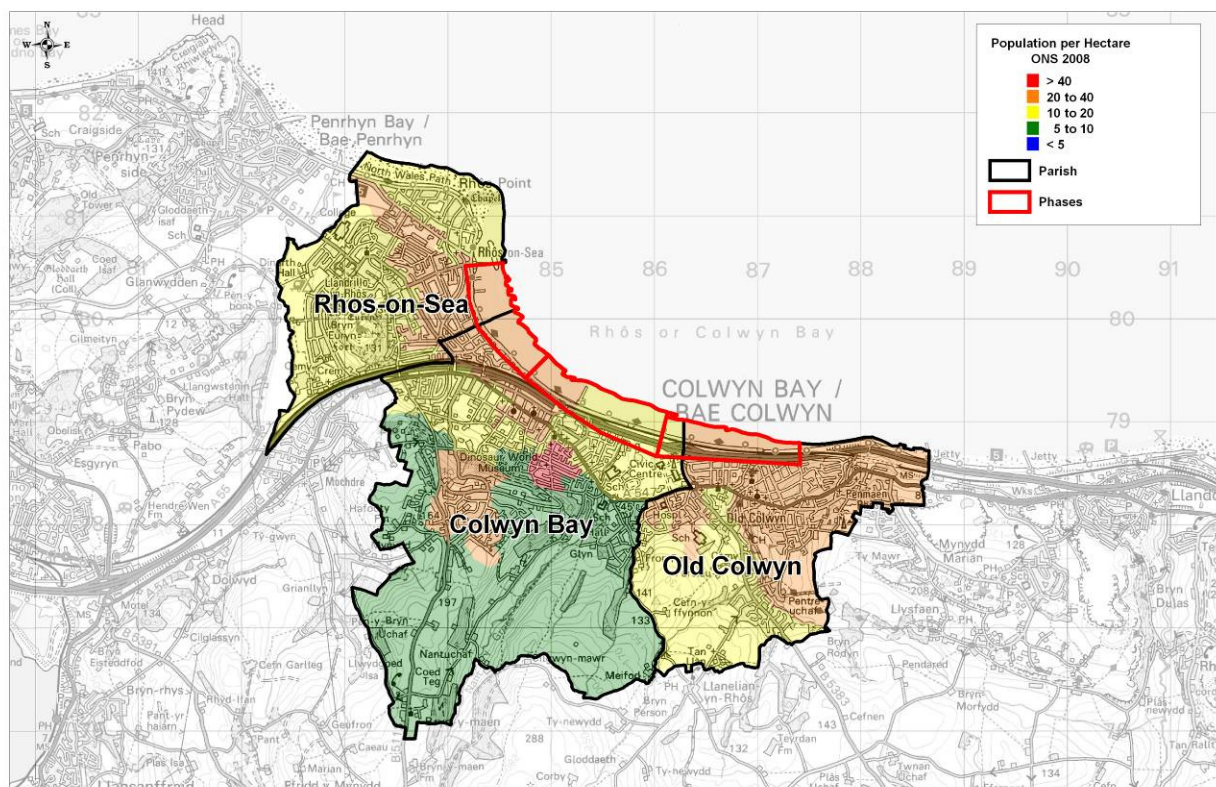
8.4.1.2 Figures presented below are for both immediate impact area (comprising the three parishes of Rhos-on-Sea; Colwyn Bay; and Old Colwyn) and the wider assessment area (Conwy; Isle of Anglesey; Gwynedd; Denbighshire; Wrexham; and Flintshire). Figures for Wales are also provided as a national comparator.

8.4.2 Population data

Population density

8.4.2.1 Figure 8.3 illustrates population density within the immediate impact area. It is evident that density is highest in Colwyn Bay town and also relatively high concentrations of residents along the coast line, particularly in the area where Phases Two and Three works will be undertaken.

Figure 8.3: Colwyn Bay Population Data



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Age profile

Table 8.1: Colwyn Bay Age Profile

Area	All Persons	Aged 0-15	Aged 16-29	Aged 30-44	Aged 45 - Pensioner	Pensioner	Working Age
Immediate Impact Area	25316	17.4%	14.9%	16.6%	22.9%	28.1%	54.4%
North Wales	680642	18.2%	16.5%	18.8%	23.5%	23.0%	58.8%
Wales	2993426	18.5%	18.3%	19.0%	22.9%	21.4%	60.2%

8.4.2.2 Table 8.1 compares the age ranges within the three spatial areas. It is evident that the immediate impact area comprises a high proportion of people who are of pensionable age when compared to north Wales and the national average. This is relevant in terms of the effect on economic activity rates.

8.4.3 Employment and labour market data

8.4.3.1 Table 8.2 to Table 8.4 highlight that the immediate impact area performs poorly in comparison to the wider impact area and Wales across all three economic indicators.

Table 8.2: Job Seeker Allowance Claimant Rate

Area	Rate (% of working population)
Immediate Impact Area	4.5
North Wales	3.6
Wales	3.8

Table 8.3: Economic Activity (2001)

Percentage	Economically Active	Economically Inactive
Immediate Impact Area	60.0%	40.0%
North Wales	63.2%	36.8%
Wales	61.0%	39.0%

Table 8.4: Employment/Unemployment (2001)

Percentage	All People 16-74	% 16-74 Unemployed	% Economically Active Unemployed
Immediate Impact Area	16,588	3.8%	6.3%
North Wales	474,769	3.6%	5.7%
Wales	2,075,347	3.5%	5.7%

Employment on the project site

8.4.3.2 It has not been possible to determine the exact number of people employed by business that are likely to be disrupted during the construction of each of the three phases.

8.4.4 Commercial baseline

8.4.4.1 Table 1.6 below displays employment by sector across North Wales and Wales as a whole. One sector with the high employment across all three geographical areas is wholesale and retail trade. Generally there is more of a reliance on public sector professions in the immediate impact area compared with the other geographies. For example, education; health and social work figures; and public administration are higher in the immediate impact area whilst manufacturing rates are much higher in North Wales and nationally. Also of note is the sector relating to tourism – hotels and catering; employing 7.6% in the immediate impact area this is higher than both North Wales (6.6%) and Wales (5.4%).

Table 8.5: Employment by Sector (2001)

Sector	Immediate Impact Area	North Wales	Wales
Agriculture Hunting and Forestry	1.3%	2.9%	2.5%
Fishing	0.1%	0.1%	0.0%
Mining	0.5%	0.4%	0.3%
Manufacturing	9.1%	17.7%	17.3%
Electricity Gas and Water Supply	0.8%	1.2%	1.0%
Construction	6.8%	7.4%	7.1%
Wholesale and Retail trade	19.1%	16.6%	16.3%
Hotels and Catering	7.6%	6.6%	5.4%
Transport, Storage and Communication	4.9%	5.1%	5.5%
Financial Intermediation	2.9%	2.7%	3.3%
Real Estate, Renting and Business Activities	8.7%	8.0%	8.5%
Public Admin and Defence	7.1%	5.5%	6.8%
Education	9.5%	7.8%	8.1%
Health and Social Work	16.8%	13.1%	13.0%
Other	4.8%	4.8%	4.8%

Social deprivation baseline

8.4.4.2 Figure 8.4 and Figure 8.5 highlight the level of social deprivation within the immediate and wider impact areas. The majority of North Wales experiences low levels of deprivation with the more deprived communities largely clustered along the coast. The immediate impact area itself is also characterised by low levels of deprivation but there is a stark contrast in Colwyn Bay. The Lower Super Output Areas (LSAOs) adjacent to the shore line experience much higher levels of deprivation than the surrounding communities.

Figure 8.4: IMD Score – Immediate Impact Area

IMD score - Immediate Impact Area

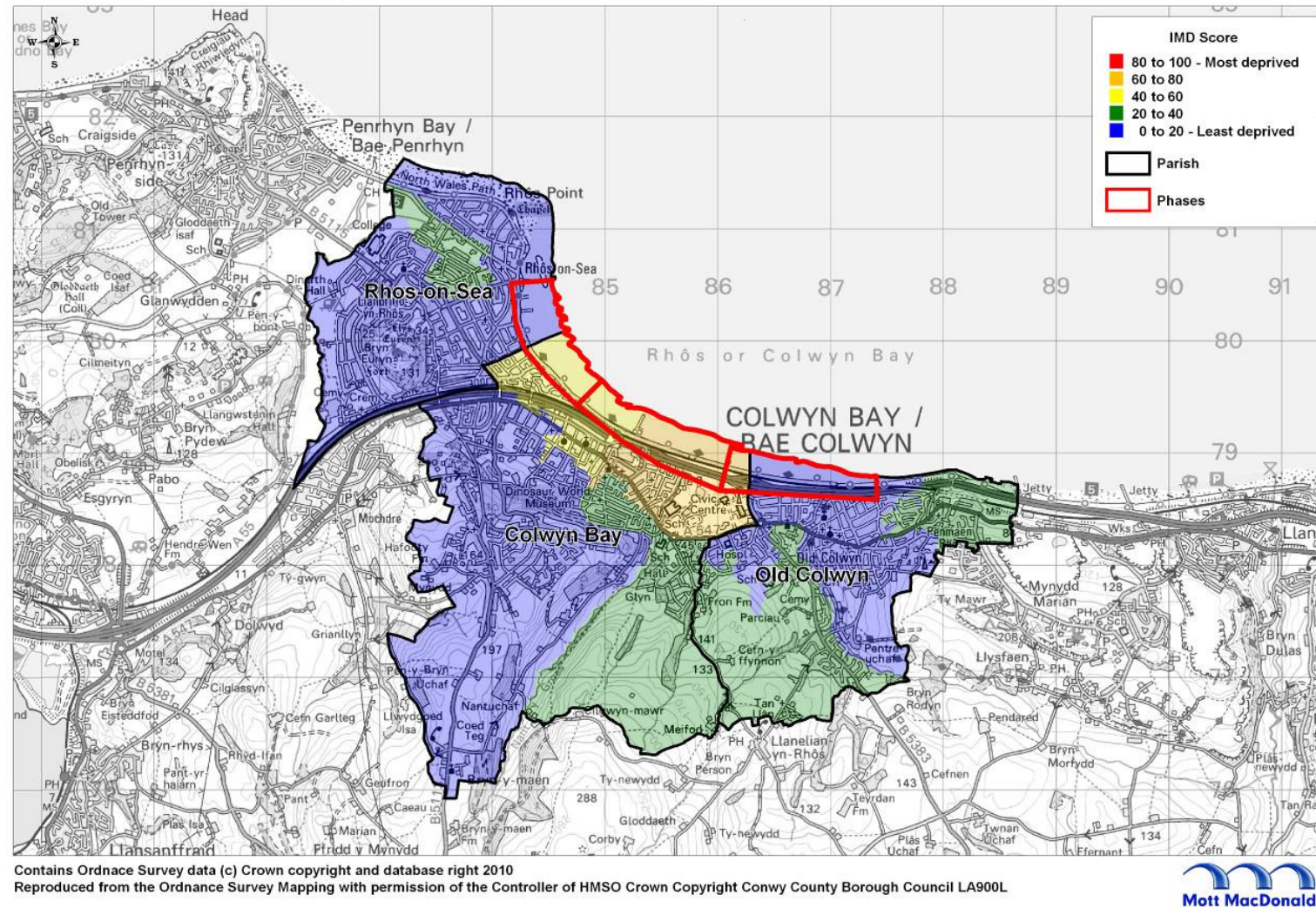
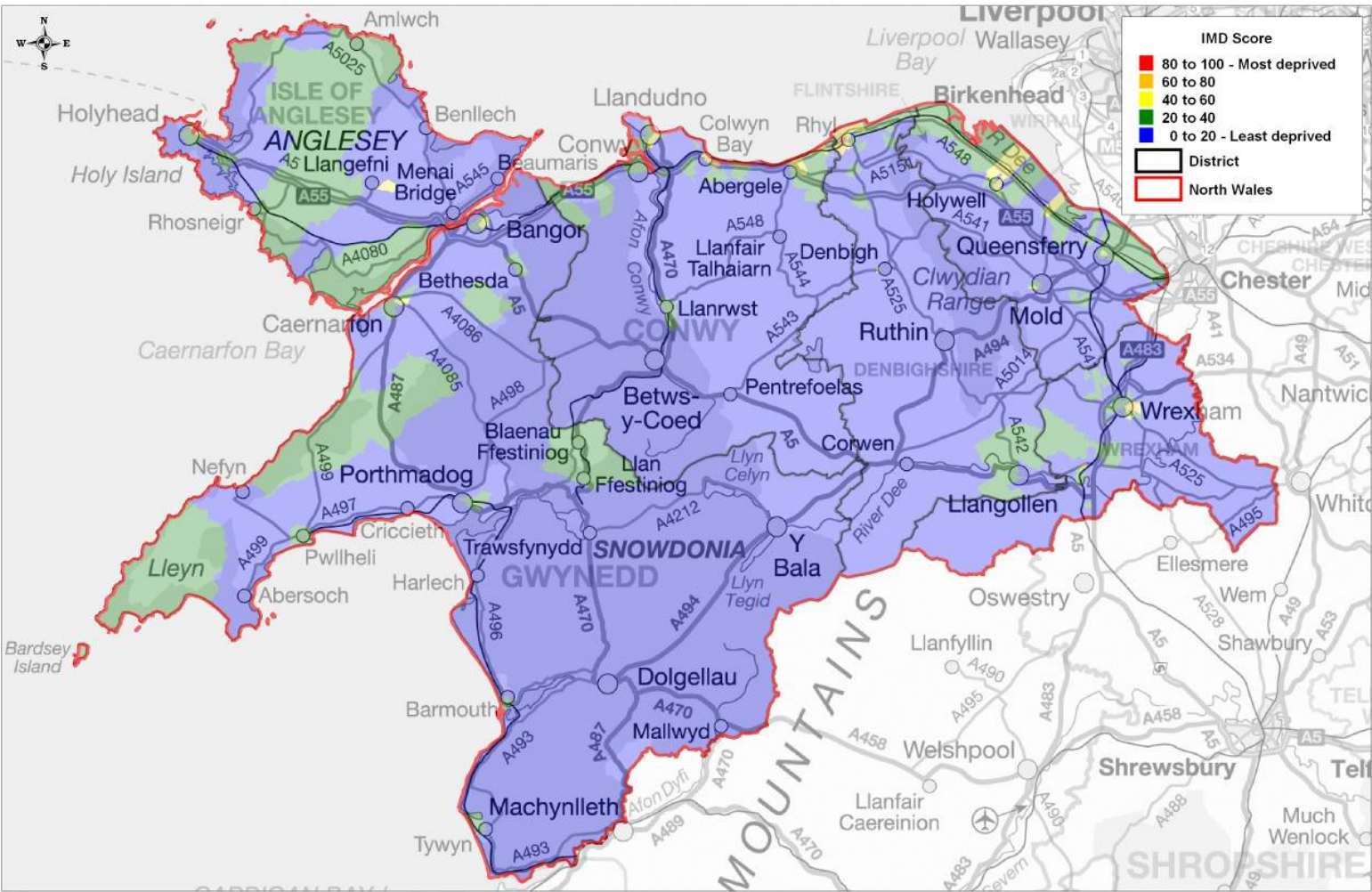


Figure 8.5: IMD Score – Wider Impact Area

IMD score - Wider Impact Area



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8.4.5 Tourism baseline

- 8.4.5.1 The Welsh coast is vital to the tourism industry in Wales. In 2006, spending associated with an overnight visit to the coast amounted to around £648 million nearly 40% of the total tourism spending in Wales; visits to the coast accounted for 41% of all overnight trips, much higher proportion than in England and Scotland (20% and 13% respectively). Over the past 15 years, however, visitors are taking fewer trips to the seaside and the seaside share of the UK holiday market in Wales has fallen.
- 8.4.5.2 North Wales itself is an important tourist region accounting for 1% of the UK population but attracting 3% of domestic tourism nights. It accounts for around a third of tourism in Wales – more than any other of the Welsh regions. In 2007, the region attracted an estimated eight million staying visitors and 17 million day visits. As such, the tourism sector is critical to the local economy.
- 8.4.5.3 No detailed figures have been obtained for the immediate study area, although figures for the County of Conwy show that tourism generates an injection of around £375 million annually to the local economy.

8.5 Assessment of effects

- 8.5.1.1 This section presents the likely direct, indirect and cumulative socio-economic effects of Option 2 of Colwyn Bay Waterfront Project.

8.5.2 Construction

Direct impacts

Employment

- 8.5.2.1 For the initial Phase 1 engineering works (which is the only stage for which worker numbers can be estimated so far) it is anticipated that the peak workforce would total 50 site staff. It is likely that the average employees on site would be between 35 and 40 for the three and half month duration of the construction period.
- 8.5.2.2 It is presently unknown where the staff to undertake the project will be drawn from. Due to the size of the works an Official Journal of the European Union (OJEU) procurement process was required; the tender process is currently underway so the contractor has yet to be appointed. Although the selection of the successful contractor cannot prejudice on the basis of location, the following question has been asked within the pre-qualification documentation:
- 8.5.2.3 “Please detail any measures the company would propose to adopt to ensure that the workforce local to the Contract area receive both short term and long term benefits from the works.”
- 8.5.2.4 The contractor will be required to deliver the works in accordance with the detail in their proposal and, therefore, some benefits to the local workforce can be expected, but it is not possible to quantify these.

Local businesses

- 8.5.2.5 There is the potential for temporary disruption during the construction period. The initial Phase 1 engineering works will begin in January 2011 and be completed by early summer 2011. During all three Phases the contractor will be using areas of hardstanding on the existing promenade as compound areas and for the storage of plant and materials. Access will be required along the promenade to carry out crest works and appropriate fencing and signing will be erected to demarcate this area. This is likely to cause closures to sections of the promenade which will cause temporary disruption to the businesses that operate there.

Local residents

- 8.5.2.6 The expected closures to the promenade will impact on the quality of life of local residents, limiting opportunities for walking and cycling along the promenade and partaking in other beach and recreational activities.

Indirect impacts

Economic activity

- 8.5.2.7 It is likely that there will be increased economic activity as a result of the construction workers utilising local goods and services in Colwyn Bay (Phase 1), Rhos (Phase 2) and Old Colwyn (Phase 3). However, as the average number of works on site is likely to be small (35 – 40) these impacts are likely to be small.
- 8.5.2.8 Indirect employment effects can be calculated by the use of a multiplier which estimates the further economic activity (for example jobs, expenditure or income) associated with development. The value of the multiplier used varies according to a number of factors, particularly the size and openness of the economy.
- 8.5.2.9 English Partnerships produced an Additionality Guide in 2008 which suggests that at a local or neighbourhood level the multiplier effect will be low, for example a figure between 1.05 and 1.1. Applied to the direct employment that will be created during the construction period (on average 40 jobs for Phase 1), it is therefore expected that an additional four jobs could be created locally.

Travel and access

- 8.5.2.10 Temporary diversion routes of the public highway are likely to be required during the construction period, resulting in access difficulties and possible congestion. This is likely to affect businesses and residents not only in the construction zone but also those in the immediate impact area. Construction traffic could also temporarily impact upon quality of life.

Tourism

- 8.5.2.11 Closure of the promenade, limited opportunities for undertaking recreational activities in Colwyn Bay and access difficulties are likely to have negative effect on a small number of tourists visiting the area during the construction period and the quality of experience of visitors if they do visit the town during this time.

8.5.3 Operation

Direct impacts

Employment

8.5.3.1 Once complete the coastal defence works they will require regular maintenance to ensure the infrastructure remains in working condition. The Council sees it unlikely that a dedicated resource would be employed for the sole purpose of maintaining the new Colwyn Bay infrastructure; rather it is more likely that the work would be divided as additional tasks for existing Council services. Those services may require a small number of additional employees to accommodate the increased workload, or may make greater use of local contractors to undertake the additional work so there could, therefore, be a small number of additional permanent jobs created. However, it is not possible to say with certainty that additional staff would be recruited or to quantify this number and any uplift in jobs is expected to be very small.

Local businesses

8.5.3.2 Information provided by the Council indicates that ten commercial properties will be removed from risk (those within and behind the construction zone) following the implementation of Phase 1 and Phase 2 works. These properties are set out below.

- Phase One:
 - Alwyn House Hotel;
 - Toad Hall Inn;
 - Dales Taxis;
 - Arriva Trains Wales; and
 - The Bell Hotel.
- Phase Two:
 - Aberhood Old Hall;
 - Cayley Arms;
 - Conwy County Borough Council;
 - Harlequin Puppet Theatre; and
 - Rothesay Hotel.

Local residents

8.5.3.3 Information provided by the Council indicates that 275 residential properties will be removed from risk (those within and behind the construction zone) following the implementation of Phase 1 and Phase 2 works. These properties are principally in the following areas.

- Phase One (190 residential properties):
 - Marine Road;
 - Upper Promenade; and
 - Pendorlan Avenue.
- Phase Two (85 residential properties):
 - Sea Bank Road;
 - West Promenade; and
 - Rhos Promenade.

Indirect and cumulative effects

8.5.3.4 As highlighted in the introduction of this chapter, the coastal defence works of the Colwyn Bay Waterfront Project will be accompanied by a package of environmental improvements along the promenade. This combination of elements within the Colwyn Bay Waterfront Project will contribute to meeting the long term regeneration aims for Colwyn Bay town centre and Eirias Park. These include creating a distinctive seafront with considerable improvements to the quality of public realm, pedestrian facilities, retail outlets, transport links and sports facilities. Recharging the declining beach will return the town to being an attractive coastal resort, whilst the promenade environmental improvements will create an attractive public realm creating an improved trading environment for business along the Waterfront.

8.5.3.5 It is important, therefore, to view the coastal defence works in the context of this wider project for Colwyn Bay and to note that, its contribution to it will realise a range of indirect / cumulative benefits. These are set out below.

Businesses, economic growth and investment

8.5.3.6 Informal consultation highlighted that businesses would welcome the coastal defence improvements as it is likely to reduce the number of road closures caused by overtopping and, potentially, lower insurance premiums.

8.5.3.7 Businesses are likely to reap advantages of the improved beach facilities and regenerated promenade facilities as it is likely to result in increased tourist and resident footfall enabling them to benefit from local and visitor spend.

- 8.5.3.8 Increased commercial opportunities will assist with the attraction and retention of businesses to the area, which is likely to encourage more inward investment and potentially induce more employment.

Local residents

- 8.5.3.9 As with local businesses, local residents are expected to benefit, in the short term, from fewer road closures and disruptions. Informal consultation undertaken during the site visit to Colwyn Bay revealed that the location population are in support of the Colwyn Bay Waterfront Project due to its potential to bring tourists and businesses back into the Bay. There are also likely to be associated quality of life improvements arising from the Waterfront Project. There will be visual and landscape improvements plus more opportunities for outdoor pursuits such as cycling, walking and water sports. Such activities will boost social inclusion and the ability to lead healthy lifestyles, and therefore contribute to objectives set out in the Community Strategy for Conwy.

- 8.5.3.10 Local residents are also likely to benefit if more businesses locate in the area due to the enhanced coastal facilities and this will improve local amenities.

Regeneration and tourism policy objectives

- 8.5.3.11 The Colwyn Bay Waterfront Project, and its associated effects contributes to several regeneration and tourism challenges faced by the immediate and wider impact areas as set out in local, regional and national policy (as set out in sections 8.3.2 to 8.3.4) as well as highlighted by baseline data. These include:

- Prioritising tourism as an industry;
- Tackling deprivation (particularly important along the relatively deprived coastal LSOAs in Colwyn Bay);
- Inducing economic inactivity and employment;
- Encouraging more outdoor pursuits and healthier lifestyles; and
- Improving the quality of life and the public realm.

- 8.5.3.12 More specifically, the Waterfront Project will contribute to regeneration and tourism planning policy objectives set out in:

- Wales Spatial Plan (see section 8.3.2.2);
- Planning Policy Wales (see section 8.3.2.7);
- Planning Guidance Wales – Technical Advisory Note 14 (see section 8.3.2.9); and
- Conwy Deposit Local Development Plan (see section 8.3.4.3).

- 8.5.3.13 In addition, the Waterfront Project contributes to regeneration and tourism objectives set out in other policy documents:

- Coastal Tourism Strategy (see section 8.3.2.13);
- Integrated Coastal Zone Management (see section 8.3.2.15);
- Tourism Strategy North Wales 2010 – 2015 (see section 8.3.3.1);
- Community Strategy for Conwy (see section 8.3.4.1); and
- Regeneration Strategy for Conwy (see section 8.3.4.2.)

8.5.4 Summary of impacts

8.5.4.1 This assessment reveals there to be several direct and indirect socio-economic impacts as a result of implementing the Colwyn Bay Waterfront Project. Table 8.6 below provides a summary of these and identifies their significance. All operational effects are likely to be beneficial, however some minor and moderate effects are predicted for the construction stage.

Table 8.6: Significance of Socio-Economic Impacts

Phase	Receptor / impact	Direct or indirect	Temporary or permanent	Long. Medium or Short Term	Immediate or Wider Impact Area	Significance of Impact
Construction	Employment - creation of jobs (average 35 – 40 on site)	Direct	Temporary	Short	Wider	Moderate beneficial
	Local businesses – Disruption to access to promenade and trade.	Direct	Temporary	Short	Immediate	Moderate adverse
	Local residents – promenade closure affecting quality of life	Direct	Temporary	Short	Immediate	Moderate adverse
	Economic activity – construction workers using local services / amenities	Indirect	Temporary	Short	Immediate	Minor beneficial
	Travel and access – diversions, access disruption and congestion for businesses, residents and tourists	Indirect	Temporary	Short	Immediate	Moderate adverse
	Tourism – possible disincentive to visit Colwyn Bay	Indirect	Temporary	Short	Immediate & wider	Minor adverse
Operation	Employment – possible recruitment to maintain new infrastructure	Direct	Permanent	Short - medium	Immediate	Not significant
	Local businesses – commercial properties removed from risk	Direct	Permanent	Long	Immediate	Major beneficial
	Local residents – residential properties removed from risk	Direct	Permanent	Long	Immediate	Major beneficial
	Businesses, economic growth and investment – reduced road closures and insurance premiums increased local and tourist spend increasing opportunities for investment and job creation	Indirect	Permanent	Medium	Immediate	Moderate beneficial
	Local residents – reduced road closures and disruption to community life, more amenities and recreational opportunities	Indirect	Permanent	Medium	Immediate	Moderate beneficial
	Regeneration and tourism policy objectives – meeting planning policy and wider policy goals	Indirect	Permanent	Medium	Immediate & wider	Moderate beneficial

8.5.5 Comparison with option 1

8.6 Option One

8.6.1.1 The impacts for Option 1 are likely to be similar in nature to Option Two, with a few main differences which show that fewer beneficial impacts are expected from this scheme.

8.6.2 Construction

8.6.2.1 It is assumed that there will be a similar level of disruption to businesses, local residents and tourism due to promenade and access closures. However, due to the reduction in works, it is likely that fewer jobs will be created during the construction period reducing the significance of this benefit.

8.6.3 Operation

8.6.3.1 The main differences in predicated effects between Options One and Two are likely to be witnessed in the operation phase.

8.6.3.2 In terms of major positive effects of Option Two (removing the commercial and residential properties from risk), it is assumed that these will also be realised by Option One. However, some of the other positive impacts are likely to be less due to the absence of beach recharging, which is likely to lessen tourist appeal and the utility of the coast to residents. It is likely that the following impacts would be reduced from moderate positive to minor positive:

- Impacts on businesses, employment and investment;
- Impacts on quality of life and recreational opportunities for local residents;
- Impacts on the tourism industry and the quality of experience for tourists; and
- Meeting the policy objectives around tourism and social inclusion.

8.6.3.3 A comparison between the Do Nothing Scenario and Option 1 is included in ES Volume 2, Technical Appendix 8. This Appendix provides a brief comparison of the Do-Nothing Option and Option One (rock revetment around the entirety of Colwyn Bay, without the beach recharging and groynes).

8.7 Mitigation Proposals

8.7.1.1 Table 8.7 highlights that some negative impacts will be experienced during implementation of the Colwyn Bay Waterfront Project. Through the implementation of selected mitigation measures it may be possible to manage some of these effects and reduce any adverse impacts on local receptors. The table below identifies possible mitigation measures and the likely residual impacts.

Table 8.7: Mitigation Summary Table

Phase	Receptor / impact	Significance of Impact	Suggested Mitigation / Improvement	Residual Impact
Construction	Employment - creation of jobs (average 35 – 40 on site)	Moderate beneficial	Ensure that Contractor commitments to benefit the local workforce are implemented and monitored.	Moderate beneficial
	Local businesses – Disruption to access to promenade and trade.	Moderate adverse	Require the Contractor to develop a construction management plan to minimise disruption to promenade access for customers, deliveries and staff	Minor adverse
	Local residents – promenade closure affecting quality of life	Moderate adverse	Require the Contractor to develop a construction management plan to minimise disruption to promenade access	Minor adverse
	Economic activity – construction workers using local services / amenities	Minor beneficial	N/A	Minor beneficial
	Travel and access – diversions, access disruption and congestion for businesses, residents and tourists	Moderate adverse	Ensure the Contractor develops a traffic and access management policy for the duration of the works and that this is well advertised throughout the immediate impact area.	Minor adverse
	Tourism – possible disincentive to visit Colwyn Bay	Minor adverse	Advertising and promotions on the length of works and the benefits to visitors and tourists once complete	Not significant
Operation	Employment – possible recruitment to maintain new infrastructure	Not significant	N/A	Not significant
	Local businesses – commercial properties removed from risk	Major beneficial	N/A	Major beneficial
	Local residents – residential properties removed from risk	Major beneficial	N/A	Major beneficial
	Businesses, economic growth and investment – reduced road closures and insurance premiums increased local and tourist spend increasing opportunities for investment and job creation	Moderate beneficial	N/A	Moderate beneficial
	Local residents – reduced road closures and disruption to community life, more amenities and recreational opportunities	Moderate beneficial	N/A	Moderate beneficial
	Regeneration and tourism policy objectives – meeting planning policy and wider policy goals	Moderate beneficial	N/A	Moderate beneficial

8.8 Summary and conclusions

8.8.1.1 The implementation of the Colwyn Bay Waterfront Project is likely to have impacts on the following receptors / issues.

- Construction:
 - Employment;
 - Local businesses;
 - Local residents;

- Economic activity;
 - Travel and access; and
 - Tourism.
 - Operation:
 - Local businesses;
 - Local residents;
 - Businesses, economic growth and investment; and
 - Regeneration and tourism planning policy objectives.
- 8.8.1.2 In terms of job creation, beneficial effects are likely only in the construction phase and these will be minor due to the small numbers of extra employment expected, the temporary nature of these jobs and the uncertainty about whether this will benefit the labour force in the immediate impact area. As maintenance is likely to be undertaken by existing Council resources, permanent new jobs are unlikely when the scheme is operational.
- 8.8.1.3 The construction phase is likely to give rise to some adverse effects, including the impacts likely to be felt by businesses, residents and the tourism industry due to temporary closures of sections of the promenade and public highway. In addition, by employing appropriate mitigating measures (for example an appropriate construction management plan and traffic and travel management plan) it would be possible to reduce these impacts to minor adverse.
- 8.8.1.4 During the operational phase all socio-economic effects are likely to be beneficial and permanent. The direct impacts of reducing the risks faced by commercial and residential properties close to the shore line (medium term) and properties further back from the coast (long term) are the most significant positive effects. Many indirect beneficial effects are also anticipated particularly through the Colwyn Bay Waterfront Project's enabling contribution to the Colwyn Bay Regeneration proposals, which is likely to realise moderate beneficial impacts for businesses, local residents and tourism.

8.9 **References**

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- English Partnerships (2008): 'Additionality Guide: A standard approach to assessing the additional impacts of interventions'
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- Welsh Assembly Government (1998) "Planning Guidance (Wales) Technical Advice Note (Wales) 13"
- Welsh Assembly Government (2007) "Making the most of the Wales coast – The Integrated Coastal Zone Management Strategy for Wales"
- Welsh Assembly Government (2008) "Coastal Tourism Strategy"
- Welsh Assembly Government (2010) "Economic Renewal"
- Welsh Assembly Government (2010) "Planning Policy Wales"

8.10 Appendices

- 8.10.1.1 A comparative assessment between the Do Nothing Scenario and Option 1 can be found in ES Volume 2, Technical Appendix 8.

9. Other Environmental Topics

- 9.1.1.1 Several environmental topics have not been included as separate Chapters in this ES. This may be because they have been scoped out of the EIA process or because the impacts relating to these topics are being covered by stand alone reports being submitted in support of the Planning Application.
- 9.1.1.2 The environmental topics not previously covered are summarised in this Chapter along with a summary of any further assessment being undertaken separately from the ES.

9.2 **Cultural Heritage**

- 9.2.1.1 Cultural heritage assets comprise buildings, areas (e.g. landscapes, archaeological complexes) and sites (e.g. ancient monuments), and may include both above ground and buried features. The significance of heritage features depends largely upon their importance (e.g. statutory designations such as Scheduled Ancient Monuments or Listed Building Status, identified archaeological sites which are not protected, and other designations such as World Heritage Sites), reasons for importance, and the inter-relationships between heritage features.

9.2.2 **Baseline**

Historical land use

- 9.2.2.1 The town of Colwyn Bay was first developed in 1865, around the railway which predates the town by approximately 20 years. By 1878, Colwyn Bay is described as a seaside resort comprising numerous residential properties and hotels. Development of the town continued during the early part of the twentieth century with the opening of Victoria Pier in around 1900, construction of the promenade along the seafront between 1898 and 1911, continued residential development and the extension of the railway. The A55 highway was constructed by 1987.
- 9.2.2.2 Vertical masonry sea walls were initially constructed between Rhos-on-Sea and Old Colwyn in the later part of the nineteenth century. Historical records indicate that the beach level has fallen considerably over the last century, with a historical loss of beach level across the foreshore of approximately 10-20mm per year, resulting in increased exposure and in some areas undermining of the sea defences. To prevent beach erosion, wooden groynes were initially constructed in the early part of the twentieth century, with further boulder groynes constructed in the 1990s. Rhos Breakwater was constructed in 1983 and has been successful in preventing overtopping of the seawall at Rhos and has encouraged the accumulation of a beach in that area.

Archaeological features

- 9.2.2.3 There are not believed to be any Scheduled Ancient Monuments directly impacted by the scheme, however, there are several marine archaeological features of note in the vicinity of the site, including:
- Medieval fish traps, located offshore to the east of Rhos on sea;
 - A number of historic shipwrecks, including the Mary Catherine Shipwreck; and

- Submerged forests along the bay.

9.2.2.4 The Victoria Pier and pavilion which bisects the central section of the beach, is a Grade II listed building. Although not a listed building, Colwyn Bay Railway Station is a historic building of archaeological importance. St Trillo's Chapel is a Grade II listed building located just above the beach near Rhos Head, just beyond the western boundary of the scheme. Additional listed buildings may be present along the promenade in the vicinity of Rhos Head.

9.2.3 Summary of Potential Effects

9.2.3.1 The Grade II listed pier and pavilion is located within the centre of the scheme and is likely to be impacted, however the majority of any significant impacts are anticipated to be positive. The recharging of the beach will act to protect the lowest part of the structure which is currently exposed. The improvements of the waterfront in general may potentially lead to greater opportunities for the pier in years to come. Under the 'Do Nothing' scenario the pier would eventually become detached from the shoreline and its condition would deteriorate significantly.

9.2.3.2 The submerged forest is currently exposed at low tide following storm events. The recharge of the beach would provide additional protection of the tree stumps, rootlets and other features found in the area.

9.2.3.3 The proposed coastal defences will protect the railway embankment and the historic railway station, along with the railway bridges and listed buildings within the town. The sea walls are not understood to be archaeologically protected structures, however they currently suffer annual storm damage and overtopping. The scheme in general will act to protect the historic walls which were first constructed over a century ago, and ensure they remain for the generations to come.

9.2.3.4 In general, the scheme will have significant beneficial impacts on cultural heritage, bringing the waterfront area back into its intended initial use as a seaside resort, with the attraction of visitors and protection of historic features.

9.2.4 Scoping Opinion

9.2.4.1 Cadw have been consulted regarding this scheme. In their opinion, an assessment needs to be made of the impacts arising from the scheme on cultural heritage and archaeological resources.

9.2.4.2 They stated: "*The scoping study already identifies several marine archaeological features, as well as the listed pier. Clearly it would be helpful for the ES to consider how these sites and features will be affected by the proposed works. The scoping study also includes more general reference to historical land use and settlement in Colwyn Bay and Rhos on Sea, and the covering email describes this scheme as working in conjunction with a separate regeneration package for Colwyn Bay which will address the question of connectivity between the waterfront and the town centre. We think it would be useful for the ES to give brief, proportional, consideration to the potential impact of the proposed scheme on the townscape to enable its contribution to the connectivity question to be assessed*".

9.2.5 Recommendations

9.2.5.1 As previously discussed within the ES, the full environmental improvement works proposed along the promenade will be covered by a separate planning application and supporting EIA. Therefore, the potential impacts stemming from the regeneration and environmental improvements are not assessed in this ES, which focuses on the physical aspects of the initial Phase 1 engineering works only.

9.2.5.2 However, it is agreed that following the recommendation from Cadw, a cultural heritage archaeological impact assessment should be undertaken to accompany the planning application. A specialist archaeological contractor could not be commissioned in time for inclusion within this ES and so it is to be provided as a stand alone document in support of the Planning Application.

9.2.5.3 The scope of the assessment is to comprise:

- A review of cultural heritage related planning and legislative issues;
- A search of online archaeological resources;
- A search of the Historic Environment Record database for cultural heritage sites within 500m of the proposed development;
- A map regression exercise, looking at OS historic maps;
- A review of aerial photographs held and the National Monuments Record;
- A review of existing impacts at the proposed development site;
- A site walk-over;
- An assessment of the potential for archaeological remains to be present in the area of development;
- A review of the proposed scheme to identify potential impacts on archaeological deposits; and
- Recommendations for further surveys or mitigation measures ahead of implementation of the scheme.

The following outputs will be provided:

- Final Archaeological Impact Assessment

9.3 Air Quality

- 9.3.1.1 The purpose of air quality assessments are to identify any potential changes or impacts to air quality with reference to current legislation and guidance. Ambient air quality in the UK is regulated through the National Air Quality Strategy and the Air Quality Regulations. These Regulations include health-based standards for seven pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide particulate matter as PM10 and sulphur dioxide).
- 9.3.1.2 Since 1997 local authorities in the UK have been carrying out a review and assessment of air quality in their areas. The aim of the review is to ensure that national air quality objectives will be achieved. If a local authority finds any places where the objectives are not likely to be achieved, it must declare an Air Quality Management Area (AQMA).

9.3.2 Baseline

Local Air Quality

- 9.3.2.1 The site is not located within an AQMA, however air quality impacts in the local area are likely to be dominated by the A55 'North Wales Expressway' – a major transport route across North Wales which runs immediately adjacent and parallel to the beach at Colwyn Bay. The North Wales Coastal railway line also runs parallel to the A55 on the seaward side.
- 9.3.2.2 The nearest Environment Agency registered emitter of air pollutants including carbon dioxide and nitrogen oxides is located 3 km to the east of Victoria Pier, at Llandulas Quarry.

Potential Receptors

- 9.3.2.3 Residential areas in the eastern and central areas of Colwyn Bay are generally separated from the beach by the A55. However, there are a number of properties in the western section of the Bay which are within 30m of the beach, at Penrhos Road and along Rhos Promenade.
- 9.3.2.4 There are several sensitive receptors in the vicinity of the site, including schools, nurseries, residential care homes and a hospital. The closest of these is Pendorlan Junior School, located approximately 250m southeast of the beach at Victoria Pier.

9.3.3 Summary of Potential Effects

- 9.3.3.1 Construction phase impacts will include emissions from plant and vehicles and particularly dust impacts from construction activities – specific impacts depend on the type and duration of each construction activity. Dust impacts are generally no longer significant beyond 200m.
- 9.3.3.2 The main operational phase impacts of the project are expected to relate to changes in traffic due to increased vehicle movements from both the increased usage of the waterfront area for business and leisure usage, and the increased number of business and leisure visitors to the town centre. However impacts are likely to be restricted by the limited area available for parking along the waterfront.

- 9.3.3.3 Wind blown sand is an inevitable consequence of providing elevated beach levels with dry sand from the crest of the beach being transported landward by aeolian forces. Material will settle out on hard defences and the promenade.

9.3.4 Scoping Opinion

- 9.3.4.1 The Environmental Health team were consulted at CCBC however no response was received.

9.3.5 Recommendations

- 9.3.5.1 The operation of the initial Phase 1 engineering works in themselves are unlikely to result in a significant change in air quality from the current situation, however the subsequent regeneration and environmental improvements may, with the promotion of visitors and associated vehicles to the waterfront area, impact on air quality. It is therefore recommended that further consideration be given to any air quality impact during future planning applications for the environmental improvement works.
- 9.3.5.2 The preliminary air quality impacts for the initial Phase 1 engineering works are considered to relate to the construction phase. Therefore it is recommended that a Construction Environmental Management Plan is implemented during the construction phase to minimise any adverse impacts. See Section 9.8 for more details.

9.4 Noise and Vibration

- 9.4.1.1 Broad guidance on the assessment of noise from various sources is given in the guidelines produced jointly by the Institute of Environmental Management and Assessment and the Institute of Acoustics. More Guidance on the prediction and assessment of noise and vibration from construction operations is given in BS 5228 Part 4 and BS 6472. Detailed guidance on the prediction and assessment of noise and vibration from road traffic is given in the Design Manual for Roads and Bridges Volume 11.

9.4.2 Baseline

Existing Noise Sources

- 9.4.2.1 Local background noise conditions are likely to be dominated by the adjacent A55 expressway – a busy dual carriageway in close proximity to the residential areas of Colwyn Bay. Speed limits along the section of the A55 passing through Colwyn Bay are restricted to 50mph.
- 9.4.2.2 The adjacent North Wales Coast Railway which runs through Colwyn Bay is the main link between Holyhead and Chester which will also contribute to background noise levels.

Potential receptors

- 9.4.2.3 There are several sensitive receptors in the vicinity of the site, including schools, nurseries, residential care homes and a hospital. The closest of these is Pendorlan Junior School, located approximately 250m southeast of the beach at Victoria Pier.

- 9.4.2.4 Residential areas in the eastern and central areas of Colwyn Bay are generally separated from the beach by the A55. However, there are a number of properties in the western section of the Bay which are within 30m of the beach, at Penrhos Road and along Rhos Promenade.

9.4.3 Summary of Potential Effects

- 9.4.3.1 The assessment of the potential impacts of vibration from construction operations is generally limited to occupied properties at which perceptible vibration is predicted and any building where vibration may affect its structural integrity. However construction vibration impacts are not anticipated to be significant and operational impacts are expected to be negligible.
- 9.4.3.2 Potential noise impacts include temporary noise generated from construction operations and associated traffic. The most significant noise impacts arising during construction are likely to relate to driving of the sheet piles for the hotspot. The main operational phase noise impacts of the project are expected to relate to changes in traffic due to increased vehicle movements from both the increased usage of the waterfront area for business and leisure usage, and the increased number of business and leisure visitors to the town centre.

9.4.4 Scoping Opinion

- 9.4.4.1 The Environmental Health team were consulted at CCBC however no response was received.

9.4.5 Recommendations

- 9.4.5.1 The operation of the initial Phase 1 engineering works in themselves are unlikely to result in a significant change in noise levels from the current situation, however the subsequent regeneration and environmental improvements may, with the promotion of visitors and associated vehicles to the waterfront area, impact on noise levels. It is therefore recommended that further consideration be given to any noise and vibration impacts during future planning applications for the environmental improvement works.
- 9.4.5.2 The preliminary noise impacts for the initial Phase 1 engineering works are considered to relate to the construction phase. Therefore it is recommended that a Construction Environmental Management Plan is implemented during the construction phase to minimise any adverse impacts. See Section 9.8 for more details.

9.5 Geology and Soils

- 9.5.1.1 Former activities on the site and the existing ground conditions (both geological and chemical) may impose constraints on the developments requiring positive measures to be taken to mitigate design risks. Ground conditions may also present health and safety risks that will require management.

9.5.2 Baseline

Underlying strata

- 9.5.2.1 A ground investigation undertaken by Grontmij Ltd in the vicinity of the proposed initial Phase 1 works identified localised areas of made ground, predominantly comprising tarmacadam and granular backfill on the landward side of the existing seawall, and a thin layer of concrete from a former structure at the northern extent of the proposed groyne.
- 9.5.2.2 Information from British Geological Survey (BGS) mapping and draft logs from the Grontmij Ltd ground investigation indicate that in areas where tidal influence is not apparent, superficial deposits underlying the site comprise glacial sands and gravels, present in a discontinuous layer overlying glacial till. In areas subject to tidal influence, beach sands with localised pockets of shingle overlie glacial till. In the northwest area of the bay (towards Rhos-on-sea), an area of alluvium overlies the glacial till.
- 9.5.2.3 A desk study also undertaken by Grontmij Ltd notes the presence of a shallow submerged forest on the seaward side of the sea wall, manifested as occasional tree stumps, grey clay with peat and rootlets.
- 9.5.2.4 The Elwy Group of the Ludlow Series forms the solid geology at the site, comprising mudstone with subordinate sandstone beds. The extreme north western section of the site comprises strata of the Dyserth Limestone Group.

Contaminated land

- 9.5.2.5 Due to the construction of the Promenade, Victoria Pier, historical groynes and sea defences, there is potential for contaminated made ground to exist across the site.
- 9.5.2.6 A site designated as 'Contaminated Land' under Part IIA of the Environmental Protection Act is located approximately 30m west of the site and upslope of the promenade. The site is known as Berry's Garage and the underground petrol storage tanks are known to have leaked.

Mining

- 9.5.2.7 The site is not in an area affected by current coal mining or mineral extraction, although a historic sand and gravel quarry was operational in the early part of the twentieth century, immediately south of Colwyn Bay railway station.

9.5.3 Summary of Potential Effects

- 9.5.3.1 Impacts on geology and soils are anticipated to be minor given the proposals are predominantly concerned with raising levels rather than excavating both on the shore and on the promenade. Some localised excavation may be required which will result in the generation of waste materials.
- 9.5.3.2 Contaminated land is not anticipated to be encountered from the examination of previous investigation logs and consultation with CCBC. However, the chemical qualities of the imported sand will have to be suitable for use with a similar composition to the existing sand at the site.

9.5.4 Scoping Opinion

- 9.5.4.1 The EA Wales and the contaminated land representative from CCBC were consulted regarding geology and soils. The EA Wales stated '*Our Groundwater and Contaminated Land team have assessed the report but have no comment to make at this stage of the development, as there appears little potential for land contamination, and the site is not considered sensitive from a groundwater perspective*'. The full EA response is included in ES Volume 2, Technical Appendix 1.
- 9.5.4.2 The contaminated land representative from CCBC agreed with the EA Wales view and stated that the principal geology issues are geotechnical, which fall outside the scope of EIA.

9.5.5 Recommendations

- 9.5.5.1 Geology and Soils has been scoped out of the EIA and no further assessment is required.

9.6 Hydrology, Hydrogeology, Drainage

- 9.6.1.1 The main regulatory provisions aimed at protecting the quality of water are provided under the Water Resources Act 1991 and the Groundwater Regulations 1998. It is an offence to cause or knowingly permit any poisonous, noxious or polluting matter or any solid waste to enter controlled waters. Controlled water includes surface waters (rivers and still water bodies) and groundwater.

9.6.2 Baseline

Hydrogeology

- 9.6.2.1 The Elwy Group bedrock is designated as a Secondary B Aquifer. These are "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers." The site does not lie within an Environment Agency designated groundwater source protection zone.
- 9.6.2.2 Due to the low topography of the site (between 1 and 2 m AOD), groundwater is expected to be encountered across the site, both within the beach sands and within the granular fill of the promenade.

Hydrology and Drainage

- 9.6.2.3 The tidal range at Colwyn Bay is between 6m and 9m. At high tide the sea is typically located immediately adjacent to the sea wall. On a low tide the sea can be up to 250m from the sea wall.
- 9.6.2.4 The promenade lies within an Environment Agency designated Zone 2 and Zone 3 floodplain. For this determination, the annual probability of flooding is greater than 0.5% from tidal flooding and greater than 1% from fluvial flooding.
- 9.6.2.5 Several surface water courses are located in close proximity to the site; the majority of which are culverted under the promenade before discharging to the sea.

- 9.6.2.6 The River Nant y Groes flows from south to north, discharging into the sea at National Grid Reference (NGR) SH 8574 7893. Nant y Groes is classed as a 'primary river' and flows along a valley that separates Colwyn Bay and Old Colwyn. The EA has designated the Nant y Groes river as having 'moderate' ecological quality.
- 9.6.2.7 A second river discharges into the sea from a culvert that passes beneath the promenade. The river, classed as a 'primary river', is currently undefined. Prior to flowing into the sea the river runs parallel to Beach Road and discharges to the beach at approximate NGR SH 8701, 7872.
- 9.6.2.8 An extended culvert runs from south to north and discharges into the sea at approximate NGR SH 8582, 7890. The culvert flows beneath a sports centre and recreational ground before running beneath the promenade.
- 9.6.2.9 In general, surface water runoff from the promenade and highway area outfalls directly to the foreshore and into the sea.

Seawater/Bathing water Quality

- 9.6.2.10 The water quality along most sections of the beach has not been tested or has been graded by the Marine Conservation Society (MCS) as "Basic pass - European minimum standard for water quality. Waterborne pathogens present in quantities known to cause illness. All available data from summer 2009 used." However, the beach at Old Colwyn is MCS recommended – "Highest UK standard for bathing water quality. Only sites with properly treated continuous sewage discharge (if any) considered. All available data from summer 2009 used".
- 9.6.2.11 An Environment Agency Wales bathing water quality point is located to the east of the Victoria Pier in the vicinity of the Nant y Groes stream which discharges to the beach. It was last monitored in July 2010 and was rated as 'good' (meets mandatory standards). However, contamination issues are understood to have occurred in the past.
- 9.6.2.12 It is known that there are three local monitoring points where regular monitoring is undertaken by CCBC.

9.6.3 Summary of Potential Effects

- 9.6.3.1 There may be temporary adverse impacts on water quality during the construction phase with the disturbance of sediment (and potential release of contaminants to seawaters) and due to general construction processes, however this can be mitigated through the use of best practice construction methods and by having a Site Environmental Management Plan (SEMP) in place to minimise the risk of accidental spillage.
- 9.6.3.2 A temporary adverse impact may also be experienced on bathing water quality from sediment disturbance leading to the release of bacteria into the water column. This would be at its most significant for any works undertaken in May through to September (peak months for sea bathing).
- 9.6.3.3 In general, the operational impacts of the scheme are anticipated to be largely beneficial. Several sections of the waterfront are in high flood risk zones and the improved coastal defences will act to decrease the risk of flooding. The streams discharging to the beach will have to be

appropriately managed to ensure there is no increase in the contamination risk to either beach users or the environment.

- 9.6.3.4 Increased traffic flows on the coast road may also have an adverse effect on the quality of drainage water, however these impacts are anticipated to be negligible.

9.6.4 Scoping Opinion

- 9.6.4.1 The EA Wales were consulted regarding hydrology and drainage and provided the following response, as included in ES Volume 2, Technical Appendix 1:

9.6.4.2 *'The report has identified 3 watercourses which discharge into the study area (as per Section 7.10.2), however we would advise that there is an additional outfall at NGR SH85877 78886.*

9.6.4.3 *By raising the beach profile levels, this will inevitably affect the flow in the watercourse outfalls and it is noted that the preliminary proposal is to 'accommodate existing outfall'. We would advise that we operate a Policy Regarding culverts and we are generally opposed to the culverting of watercourses because of adverse ecological, flood risk, human safety and aesthetic impacts. We will consider each application to culvert a watercourse on its own merits and in accordance with our risk-based approach to permitting. We will only approve a culvert if there is no reasonably practicable alternative, or if we think the detrimental effects would be so minor that a more costly alternative would not be justified. Should there be no other option available, then we would advise that the outfalls should extend beyond the extent of the proposed beach profile to prevent future blockages at the outlet.*

9.6.4.4 *Outfalls from watercourses affected by these works may need to be passable to migratory fish (e.g. eels and sea trout). We would advise that the EA should be consulted on the design of these outfalls.*

9.6.4.5 *Our Environment Management Team are in the process of gathering data in order to put a case forward for moving the designated bathing water EC point. With this in mind it is of most importance that close liaison with the Council is maintained before, during and after the project.*

9.6.4.6 *The main issues that need further discussion are the impacts the Waterfront project will have on:*

- *Existing EC sample point*
- *Proposed new sample point*
- *Bathing Water Season (May-Sept).*

Agreements need to be made in relation to when the work will be carried out and what provisions we will put in place to prevent any deterioration in the water quality'.

- 9.6.4.7 In addition, the EA Wales initially also recommended a Flood Consequence Assessment be undertaken, however following further meetings between the EA Wales and CCBC have agreed that as the purpose of the coastal defence improvements are to reduce the risks of flooding it would be more prudent to undertake the FCA for assets to be constructed later as part of the

regeneration and environmental improvement design process following construction of the initial engineering works.

9.6.5 Recommendations

- 9.6.5.1 As a Chapter, Hydrology, Hydrogeology and Drainage has been scoped out, however, water quality is considered in the coastal processes chapter, see section 5.4.6.
- 9.6.5.2 Continued consultation and close liaison is recommended with EA Wales regarding timings of works, culverting of watercourses and bathing water quality.
- 9.6.5.3 In terms of construction impacts, a Construction Environmental Management Plan is recommended for the scheme to set out the reasonable and precautionary steps to be taken in order to minimise the risks to surface waters within Colwyn Bay. See Section 9.8 for more details.

9.7 Traffic, Transport and Access

- 9.7.1.1 Transport Assessments are required should significant changes to traffic flows be anticipated, or if alterations to road layouts or networks are required, including major departures from local plans or policies.

9.7.2 Baseline

Existing infrastructure and access

- 9.7.2.1 The promenade is split into two sections along its length; a single carriageway road and a pedestrianised section, including a national cycle route. Existing vehicular access to the promenade is via three main underpasses, which cross to the promenade from the town to the south, under the A55 Expressway and railway line and along the coast road from the west. Spaced along the bay there are several slipways and steps which lead from parking areas to the beach itself.

Public Transport

- 9.7.2.2 The railway station is located immediately to the south of the beach in the vicinity of the Victoria Pier and the railway embankment runs along the landward side of the coast road. The station is served by both local and national train services. Colwyn Bay town is served by 27 local bus services and 4 coach services to local and national destinations.

Beach usage

- 9.7.2.3 During the summer months, the beach and promenade can become very busy. A usage survey undertaken in May 2010 monitored the beach and promenade usage in the areas to the east and west of Victoria Pier. The survey recorded a peak of 390 people on the beach, 735 people on the promenade and around 1000 cars parked along the promenade. These numbers were recorded on a hot Sunday afternoon.

9.7.3 Summary of Potential Effects

- 9.7.3.1 Under the 'Do-Nothing' scenario there would be a negative impact on transport, traffic and access due to the loss of promenade and cycle track, temporary and eventually permanent closure of the highway running along the waterfront. Further more severe negative impacts for transport in the wider area would also occur from loss of integrity of the railway embankment and loss of the A55.
- 9.7.3.2 During the construction phase, the transport of materials to the site will have an environmental impact from the numbers of lorries using the road network. Locally the impact will be relatively low with direct access from the A55 (junction 24) to the area of the waterfront where initial works are planned with the minimum of disruption to the surrounding area i.e. avoiding travel through the town centre and/or residential areas. Large volumes of recharge sand are anticipated to be delivered by boat and damp sprayed directly onto the beach.
- 9.7.3.3 The main operational phase impacts of the project are expected to relate to changes in traffic flows due to increased vehicle movements from both the increased usage of the waterfront area for business and leisure usage, and the increased number of business and leisure visitors to the town centre.

9.7.4 Scoping Opinion

- 9.7.4.1 The Highways Department of CCBC were consulted regarding the proposals and were of the opinion that while they *'would not consider that a full TA (Transport Assessment) would be required (or even possible at this stage due to lack of concrete (i.e. signed up for) proposals for the area'*, they *'would consider that the effect of the construction phase in highway terms needs to be considered within the EIA.'* The full Highways Department response is included in ES Volume 2, Technical Appendix 1.

9.7.5 Recommendations

- 9.7.5.1 Given that CCBC Highways Department have recommended a Construction Phase TA, only it was not considered to be suitable for inclusion within the ES and it is to be provided as a stand alone document in support of the Planning Application.
- 9.7.5.2 The scope of the Construction Phase TA is to comprise (for each Phase):
- the sourcing of materials and the transport routes to site including potential problem areas;
 - the effect on the surrounding highway network due to construction works resulting from diverted traffic;
 - the properties potentially affected by increased noise from construction traffic; and
 - alternative scenarios considered to enable comparison.

9.8 Construction Environmental Management Plan

9.8.1 Purpose

- 9.8.1.1 It is recommended that general construction impacts are managed through the implementation of a Construction Environmental Management Plan (CEMP). The purpose of a CEMP is to set out the precautionary and reasonable steps that the contractor will take to prevent adverse environmental impacts occurring.
- 9.8.1.2 The Contractor shall provide his CEMP for the acceptance of the Supervising Authority prior to the commencement of Works on Site.
- 9.8.1.3 The CEMP shall be project-specific and provide:
- details of the Contractor's organisational framework, in particular the designation of a senior manager to take overall responsibility and an engineer, nominated as the Environmental Monitor to manage environmental control facilities on a day-to-day basis and liaise with the Supervising Authority.
 - details of the principal pollution control facilities proposed, including procedures for the mitigation, collection and disposal of wastes, and of contingency plans in the event of failure of these facilities, including emergency procedures where appropriate;
 - details of the Contractor's proposed environmental monitoring procedures, to ensure the construction sites are operating satisfactorily and that problems are being dealt with promptly;
 - format of a monthly report to the Supervising Authority, comprising a checklist of environmental issues at each work site, and covering the specific problems of the Works;
 - forms that will be used by the Contractor to demonstrate compliance with the environmental requirements of the Contract and to identify any problems;
 - details of any other records to be kept to allow the Contractor to demonstrate compliance with the CEMP;
 - details of the Contractor's environmental awareness training programme proposed for the workforce;
 - a requirement that all method statements include a section on environmental impacts and mitigation; and
 - a formalised mechanism to audit the effectiveness of the CEMP.

9.8.2 Scope

9.8.2.1 The CEMP shall, as a minimum, address the following issues:

- noise and vibration;
- water pollution;
- waste management;
- impacts on flora/fauna;
- visual impact;
- air pollution, including odour, dust and fumes;
- storage and handling of hazardous materials;
- good housekeeping/vermin control;
- contaminated land;
- archaeology and heritage issues;
- impacts on the local community; and
- impacts of any temporary works including location of Contractors facilities, workers camps, gravel pits, haul roads etc.

9.8.3 Compliance with the CEMP

9.8.3.1 The Supervising Authority shall have the right to audit the Contractor's management of the CEMP. Such audits will include a review of the Contractor's internal audit records including identified non-conformities and the effectiveness of the corrective action. The Contractor shall be provided with ten working days' notice prior to an audit being carried out.

9.8.3.2 On a day-to-day basis, the Contractor shall afford reasonable availability of staff and documentation for the Supervising Authority to assess implementation of the SEMP.

10. Cumulative Impacts

10.1 Introduction

- 10.1.1.1 The coastal defences and initial engineering works forms the first element of the Colwyn Bay Waterfront Project. The other aspect of this scheme comprises environmental improvements of the promenade area. The aim of the Waterfront Project is to *“integrate the renewed sea defences with environmental improvements along the promenade to provide a coordinated approach to the delivery of the project which maximises the regeneration potential of the scheme while also providing the necessary level of coastal protection”*.
- 10.1.1.2 This chapter summarises the key proposals Colwyn Bay Waterfront Project as a whole and subsequently considers their cumulative environmental and socio-economic impacts in combination with other significant schemes in the vicinity of the waterfront, such as the proposed promenade environmental improvements and the concept Colwyn Bay Masterplan and town centre improvements.

10.2 Cumulative Schemes for Consideration

10.2.1 Colwyn Bay Waterfront - Coastal Defence Scheme

- 10.2.1.1 Aim: *“Provide renewed coastal defences along the waterfront to protect the residents and businesses of the town from the threat of the sea”*
- 10.2.1.2 The Coastal Defence Scheme will be undertaken in three phases along the length of Colwyn Bay waterfront. Principal components of the scheme comprise raising of the promenade, the construction of a wave return wall, rock revetment construction, implementation of beach control groynes, engineering works to form a hotspot over part of the groyne, and beach recharge. The principal proposals for the Coastal Defence Scheme are described in detail in Section 3.

10.2.2 Colwyn Bay Waterfront – Environmental Improvement Works to the public realm areas of the seafront

- 10.2.2.1 Aim: *“Provide environmental improvements to the promenade to offer a modern, robust, sustainable and attractive public realm to draw new visitors to the area and coordinate with the Bay Life regeneration plan”*.
- 10.2.2.2 Environmental improvements to the promenade will generally include construction of new kiosks, and new footways and cycle routes along the improved promenade. Transport links will also be created to improve connectivity between the promenade and the town centre, and improved access to the foreshore will maximise the newly created amenity resource of the recharged beach. The visual appearance of the promenade will be achieved through the installation of new street furniture, landscaping and planting schemes along the waterfront.
- 10.2.2.3 The Waterfront Project divides the waterfront area into ‘Zones’ with Zone-specific improvements to be made dependent on the proposed end-use of that particular section of the waterfront, including Zones for watersports, traditional beach use and improved nature conservation

- 10.2.2.4 The environmental improvements aim to promote a number of particular amenity activities to encourage increased beach user numbers. Key activities identified for the scheme include cycling, walking, watersports, fishing, parking and traditional family beach 'bucket and spade' outings.

10.2.3 Colwyn Bay Town Centre Improvements

- 10.2.3.1 This scheme currently comprises an initial Masterplan concept which aims to stimulate rehabilitation of the town centre and encourage economic growth in the area. Key objectives of the Masterplan include: renovations to the railway station; construction of pedestrian links between the town and Eirias Park, which is to be developed to include a sports complex; bridges over the A55 linking the town and beach and creation of a large central square.

10.3 Cumulative Impacts of the Waterfront Project

- 10.3.1.1 The coastal defence element of the scheme aims to recreate the security to properties along the Waterfront by increasing the level of protection. By recharging the declining beach, the scheme also aims to return the town to a position of being an attractive coastal resort. The Environmental Improvements will then create an attractive public realm behind the defences creating a substantially improved trading environment for the tourist industry along the Waterfront.
- 10.3.1.2 The Environmental Improvements element of the Waterfront scheme is focussed around benefits to the tourism industry in Colwyn Bay. Despite the beach and Waterfront being the town's principal asset (and the reason Colwyn Bay developed as a popular tourist resort during Victorian times) the existing condition of the promenade does not create an attractive trading environment for businesses. This is principally due to the threat to infrastructure from the poor level of coastal defence along the frontage caused by declining beach levels, and the worsening of the infrastructure along the promenade which detracts from the town's ability to attract visitors.
- 10.3.1.3 The coastal defence works are a key component in the delivery of the Colwyn Bay Waterfront Project, where coastal defences are the key facilitator for the package of regeneration initiatives and waterfront environmental improvements. This combination of projects will contribute to meeting the long term regeneration aims for Colwyn Bay town centre and Eirias Park. These include creating a distinctive seafront with considerable improvements to the quality of public realm, pedestrian facilities, retail outlets, transport links and sports facilities. Recharging the declining beach will return the town to being an attractive coastal resort, whilst the promenade environmental improvements will create an attractive public realm creating an improved trading environment for business along the Waterfront.
- 10.3.1.4 Cumulative impacts of the Colwyn Bay Waterfront Project and other significant schemes are summarised in Table 10.1 below.

Table 10.1: Cumulative Impacts Table

Topic	Colwyn Bay Waterfront Project		Impacts of any other significant schemes	Cumulative impact significance
	Coastal Defence Scheme Impacts	Environmental Improvements Impacts		
Planning Policy	The scheme can be considered to align with policy objectives on the national, regional and local level, particularly with regards to climate resilience and indirectly through the facilitation of the tourist industry. Planning policy objectives to protect property and transport infrastructure from coastal erosion and flooding will also be achieved through the scheme. Temporary adverse impacts which may be experienced during construction are not anticipated to last beyond the initial phase of the scheme and residual impacts during operation are generally considered to be beneficial.	Improvements to the waterfront area will encourage a revival of the tourist industry, stimulate economic growth and generally improve the identity of Colwyn Bay as a town. Consequently, the overall impact of the scheme is considered to be significantly beneficial and compliant with national, regional and local planning policies which target Colwyn Bay as an area requiring improvement in order to promote tourism and economic growth and social welfare. Slightly adverse impacts may occur during construction due to restricted access to the promenade although these are considered to be of short duration.	<i>Town Centre Regeneration</i> As for the impacts associated with Environmental Improvements of the Waterfront, impacts of regeneration and improvement of the town centre align with planning policy objectives to promote tourism, generate economic growth and encourage relocation of businesses into the area. The impacts of this scheme are therefore considered to be significantly beneficial in the long term.	There are anticipated to be significantly beneficial impacts due to the combination of the three schemes in terms of planning policy, as national, regional and local planning policy objectives are actively supported by proposals to regenerate Colwyn Bay and provide improved coastal defences. The coastal defence and regeneration proposals specifically align with objectives set out in the Wales Spatial Plan, Planning Policy Wales, Planning Guidance Wales – Technical Advisory Note 14, and Conwy Deposit Local Development Plan. The overall cumulative impact in terms of planning policy is therefore considered to be Major Beneficial.
Coastal Processes	With mitigation measures, construction impacts will be minimal and limited to those associated with hydrodynamics and sediment transport. Operational impacts are largely positive and are again associated with hydrodynamics and sediment transport.	No coastal process impacts are considered to be associated with environmental improvements as they scheme is proposed within the existing urban area and will not affect the beach and coastal environment.	<i>Gwynt y Mor offshore wind farm, located 13km offshore from Colwyn Bay.</i> The impact of this scheme on coastal processes in the vicinity of the proposed coastal defence works is not anticipated to be significant. <i>Burbo Bank wind farm, located approximately 30km from Colwyn Bay.</i> The impact of this scheme on coastal processes in the vicinity of the proposed coastal defence works is not anticipated to be significant.	No cumulative coastal process impacts are considered to exist as the only impacts are related to the coastal defence scheme which generally is considered to have a Major Beneficial impact significance.

Topic	Colwyn Bay Waterfront Project		Impacts of any other significant schemes	Cumulative impact significance
	Coastal Defence Scheme Impacts	Environmental Improvements Impacts		
Ecology	Impacts of the scheme are generally only slightly adverse or neutral once mitigation measures have been implemented. Long term impacts of the scheme are unlikely to be significant as new habitats are created and the ecological environment adapts to the altered sediment transport patterns and coastal regime.	Regeneration proposals for the waterfront are to be undertaken on areas of hardstanding away from the waterfront consequently there is not considered to be an impact on the marine ecology. However, there may be an impact on bird species utilising the habitat above the Mean High Water mark during construction. Increased anthropogenic activity during operation of the scheme may have slightly adverse impacts on marine species.	<i>Town Centre Regeneration</i> Regeneration proposals are to be undertaken on hardstanding away from the waterfront consequently and are not considered to impact on marine ecology. <i>Gwynt y Mor offshore wind farm, located 13km offshore from Colwyn Bay.</i> The impact of this scheme on the marine ecology in the vicinity of the coastal defence scheme is not considered to be significant. <i>Burbo Bank wind farm, located approximately 30km from Colwyn Bay.</i> The impact of this scheme on the marine ecology in the vicinity of the coastal defence scheme is not considered to be significant. <i>Local Fisheries activities</i> <i>Beach recharge operations from the coastal defence scheme may have a moderately adverse impact on shore species and shrimp.</i>	In general, the main ecological impacts arise from the coastal defence scheme as other schemes are outside the zone of influence for the coastal defence scheme, or are located on areas of hardstanding away from the marine environment. Slightly adverse cumulative impacts may result from beach recharge operations and consultation with appropriate fishery bodies should be undertaken to establish suitable mitigation strategies.
Landscape and Visual	Construction impacts are in general considered to be moderately adverse due to visual intrusion of construction plant and activities in an area exposed to a large number of important receptors. Overall, the long term operational impacts are considered to be minor beneficial due to improved seaward views from the promenade and the improved visual appearance of the beach area.	Construction impacts may be moderately adverse due to visual impact of construction plant on a large number of sensitive receptors. The proposals will improve the appearance and integration of the waterfront with the town centre and other parts of the town. The plans also show the promenade with avenue tree planting and terraces down to the foreshore, which will improve the visual links and add vertical interest to the long promenade. The overall operation impact is considered to be major beneficial for the waterfront area.	<i>Town Centre Regeneration.</i> The Masterplan concept shows a new town centre with pedestrianised squares, a multi-sports village at Eirias Park, revamped railway station and a link bridge over the A55. The operational impact of this scheme is considered to have a minor beneficial impact on the waterfront area.	Cumulative impacts of the three schemes are generally considered to be moderate adverse during construction due to the large number and sensitive nature of visual receptors Overall cumulative impacts of the three schemes are generally considered to have Moderate Beneficial impact significance due to the significant visual improvements made to the waterfront, beach, and Colwyn Bay as a whole.

Topic	Colwyn Bay Waterfront Project		Impacts of any other significant schemes	Cumulative impact significance
	Coastal Defence Scheme Impacts	Environmental Improvements Impacts		
Socio-Economic	Improvements to the coastal defences and a reduced risk of flooding will have a significantly beneficial impact on homes and businesses along the waterfront. Insurance premiums are likely to reduce, as are the number of coastal road closures due to storm damage/floods which disrupt local businesses and residents. The beach recharge operation will create a new public amenity resource and facilitate environmental improvements of the waterfront area. There may be a slightly adverse impact during construction due to disruption to businesses and noise intrusion to residents although these impacts will be temporary in nature.	Improvements to the waterfront are considered to have a significantly beneficial impact to the local community and economy as the scheme will improve links between the waterfront and town centre, and increase availability of leisure activities and amenity along the waterfront, thus encouraging visitors to the area. Local businesses will then benefit from visitor and local expenditure, and the area will become more attractive for business relocation. Increased opportunities for activities such as cycling, walking and watersports will boost social inclusion and local residents ability to lead healthy lifestyles. As for the coastal defence scheme, there may be a slightly adverse construction impact due to restricted access to promenade and disruption to businesses.	<i>Town Centre Regeneration</i> Regeneration proposals for the town centre will encourage economic growth to the area, and will assist in a number of council objectives, including reducing crime and unemployment rates, increasing social inclusion and improving the quality of the retail sector within the town centre. During regeneration construction activities there may be a slightly adverse impact due to disruption to local businesses and communities	The general cumulative impact of the three schemes is considered to be Major Beneficial as all three will significantly contribute to economic growth of the area and make Colwyn Bay as a whole a more attractive and pleasant place to live. Slightly adverse impacts experienced during construction of the three schemes will be temporary in nature and residual impacts are generally anticipated to be positive.
Cultural Heritage*	In general, the scheme will provide reduced flood risk and greater protection to archaeologically valuable buildings and remains along the waterfront. Archaeologically valuable marine deposits and buried articles may be disturbed during construction although once in operation, the recharged beach will provide additional protection to these heritage assets.	Improvements to the waterfront are likely to improve the setting of listed buildings and archaeologically important sites along the waterfront. Slightly adverse impacts are likely during construction due to a temporary impact on the setting of heritage assets	New development in the town centre should be sensitive to existing heritage assets although rehabilitation of the surrounding environment is generally considered to have a positive impact on heritage assets.	Improved protection from flooding and coastal erosion, in addition to improving the setting of archaeologically important buildings and articles are generally to have a Moderately Beneficial impact.

NOTES: * Impacts detailed here are an overview only; full cumulative impacts will be discussed in the Cultural Heritage Impact Assessment, to be submitted as a separate document

10.4 Cumulative Impact Summary

- 10.4.1.1 The overall impact of the two aspects of the Colwyn Bay Waterfront Project is considered to be positive, as new coastal defences will provide additional flood protection for the bay and will facilitate regeneration of the waterfront area, and subsequently rehabilitation of the town centre, which is considered as another significant scheme. Other significant schemes in the area are few in number, and comprise two offshore wind farms which are not anticipated to contribute to any cumulative impacts on Colwyn Bay.
- 10.4.1.2 The Waterfront Project in addition to town centre regeneration proposals are considered to strongly support national, regional and local planning policy objectives and will greatly improve the socio-economic environment of the town. Cumulative impacts on the natural environment are generally considered to be beneficial in the long term, due to prevention of coastal erosion, creation and preservation of ecological habitats and improvements to the visual landscape. However, some slightly adverse cumulative impacts are anticipated during construction on the natural environment, cultural heritage and socio-economic aspects due to disruption of local businesses, visual intrusion and temporary disturbance of heritage assets.
- 10.4.1.3 In general however, the Waterfront Project and town centre regeneration will work together to improve both the natural and built environments of Colwyn Bay and will raise the town's profile as a desirable place to live and work.

11. Impact Summary

Table 11.1: Colwyn Bay Waterfront Project: Summary of Mitigation and Residual Effects

Environmental Topic	Principal Impacts Identified for Option 2	Impact Significance Prior to Mitigation	Mitigation and compensation integrated into design and recommendations/enhancement	Impact Significance after mitigation	Differing impacts for Option 1 (linear defences)
PLANNING POLICY					
Construction	Impact on national policy objectives to preserve setting of heritage assets and historic environment due to disturbance of assets and visual impact of construction works.	Minor Adverse	Ensure design of defences is sensitive to heritage assets in vicinity of site. Maintain construction site in a clean and tidy condition	Neutral	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Impact on national and local policy objectives to protect and enhance natural environment due to habitat loss and disturbance to species through noise and sediment movement.	Minor Adverse	Construction materials and spoil should be stored above Mean High Water mark to minimise level of suspended sediment in waters. Creation of new habitats in beach control structures, new defences and recharged beach will compensate for initial loss of habitat during construction.	Neutral	Sediment movement for Option1 is likely to be more significant than for Option 2 due to the longer length of rock revetment defence installation. Consequently this impact might be slightly more adverse for Option 1.
	Impact on national and local planning objectives to protect 'open character' and visual character of coast due to construction works	Minor Adverse	Maintain construction site in a clean and tidy condition.	Minor Adverse	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Impact on regional policy objectives to improve economic base due to employment generated during construction workers	Minor Beneficial	Ensure that Contractor commitments to benefit the local workforce are implemented and monitored.	Minor Beneficial	Impacts for Option 1 are considered to be comparable to those for Option 2.
Operation	Impact on national, regional and local policy objectives to improve coastal defences and reduce flood risk due to improved level of flood protection along length of bay.	Major Beneficial	N/A	Major Beneficial	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Impact on national, regional and local policy objectives to improve tourism and public amenity in the area through creation of beach and regeneration of waterfront	Major Beneficial	N/A	Major Beneficial	Option 1 would not have such a significant affect on the policy objective as the proposals would not facilitate creation of a new public amenity resource (the beach condition would not be improved)
	Impact on regional and local policy objectives to protect and enhance the coastal environment and maintain its 'open character'.	Moderate Beneficial	Implement beach monitoring scheme and implement programme of maintenance beach recharge	Moderate Beneficial	Option 1 is not considered to have such a beneficial impact due as the existing beach condition would not be improved and the new linear defences would increase severance between the promenade and beach, thus reducing the 'open character' of the coastline.
	Impact on national and regional policy objectives to provide sustainable transport links across area due to improved protection to transport infrastructure assets and regeneration proposals for promenade	Moderate Beneficial	N/A	Moderate Beneficial	Impacts during construction are considered to be comparable for the two Options.
COASTAL PROCESSES					
Construction	Damage to geology from excavations and vehicle tracking on the foreshore	Minor adverse	Import of rock transported to site by road and lowered directly from promenade to minimise tracking of vehicles on the foreshore. Large volumes of beach recharge material transported to site by sea and sprayed directly onto beach to minimise tracking on the foreshore. Minimise excavation of waste materials	None	Slightly greater adverse impact on geology due to larger excavation requirements for installation of linear defences.
	Change to current sediment transport processes	Major Beneficial	Critical to ensure correct sediment is utilised for beach recharge to match existing beach material to prevent changes to the character of the beach.	Major Beneficial	Slightly reduced beneficial impact as no supply of material for beach recharge to beaches to east of scheme.
	Change to tidal currents and wave conditions	Minor Adverse	Localised temporary disruption in material storage areas below Mean High Water mark.	Minor Adverse	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Removal of defences resulting in flood risk and erosion	Minor Adverse	Schedule works as far as possible during low tides and reduced storm periods. Enforce closures of promenade as an alternative.	None	Impacts for Option 1 are considered to be comparable to those for Option 2.

Table 11.1: Colwyn Bay Waterfront Project: Summary of Mitigation and Residual Effects

Environmental Topic	Principal Impacts Identified for Option 2	Impact Significance Prior to Mitigation	Mitigation and compensation integrated into design and recommendations/enhancement	Impact Significance after mitigation	Differing impacts for Option 1 (linear defences)
	Impacts to water quality (release of contaminants, diversion, blockage of outfalls, pollution Incidents)	Moderate – Major Adverse	Construction materials and spoil should be stored above Mean High Water mark. Detailed CEMP should be developed prior to commencement of construction to minimise likelihood of pollution and to implement effective management procedures if a pollution incident occurs.	Neutral	Reduced adverse impact on outfalls as no beach recharge operation proposed for Option 1. Other impacts as for Option 2.
Operational	Changes to geology/geomorphology (alteration in beach profile)	Major Beneficial	N/A	Major Beneficial	Effect of scour reduced although lack of beach recharge for Option 1 would slightly reduce significance of beneficial impact to beach profile.
	Sediment transport (changes to littoral drift, sediment accumulation)	Major Beneficial	Implement beach monitoring scheme and implement programme of maintenance beach recharge	Major Beneficial	Accumulation of sediment would be slightly adversely impacted due to lack of beach recharge for Option 1.
	Change to tidal currents and inshore wave conditions	Moderate Beneficial	N/A	Moderate Beneficial	Impacts as for Option 2 although added benefit that revetment would reduce wave power at seawall and hence reduce scour and beach lowering.
	Impacts to water quality (blockage of culverts)	Moderate Adverse	Specify chemicals for beach access point cleaning to minimise impacts on water quality. Improvement works to existing outfalls to be undertaken prior to operation phase to ensure they remain free flowing. Existing outfalls are to be accessed and maintained by their owners/operators. Supply information to Environment Agency to enable relocation of water sampling point for bay.	Neutral	Impacts for Option 1 are in general considered to be slightly less adverse prior to mitigation as lack of beach recharge operation will remove the issue of suspended sediments. Impacts relating to blockage of culverts are considered to be comparable for the two Options.
ECOLOGY					
Construction	Beach recharge resulting in the burial of biotopes	Major Adverse	Reduce the percentage of fine particles in the recharged beach	Minor Adverse	Although Option 1 does not include beach recharge, installation of the rock revetments for would result in the loss and replacement of upper intertidal biotopes. However, this is considered to be slightly less adverse than for Option 2.
	Disturbance to bird species, habitat loss and alteration. Increase in suspended solids from beach recharge may impact on prey articles.	Moderate Adverse	Avoid construction related disturbance in Phase 2 area between November and February inclusive. Reduce the percentage of fine particles in the recharged beach material	Minor Adverse	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Beach recharge resulting in a potential increase in suspended solids. This may impact on fish and sessile species	Minor Adverse	Reduce the percentage of fine particles in the recharged beach material.	Neutral	Impacts for Option 1 are considered to be comparable to those for Option 2 as although no beach recharge is proposed for Option 1, the larger area of excavations required for rock revetment defences would also increase suspended solids within marine waters.
Operation	On-going beach recharge resulting in the burial of new biotopes.	Moderate Adverse	Reduce the percentage of fine particles in the recharged beach material.	Minor Adverse	Although no beach recharge is proposed for Option 1, following installation of the revetments there could be subsequent scouring effects which would result in a moderate adverse impact on biotopes.
	Following construction of the groyne there would be an alteration of the eastwards transport of sediment resulting in initial accretion then erosion. This may impact on sessile species such as blue mussels.	Moderate Adverse	Undertake further modelling studies to assess erosion and scouring effects	Moderate Adverse	Following installation of the revetments there could be subsequent scouring effects which would result in a moderate adverse impact on sessile species.
	Disturbance to bird species, habitat loss and alteration. Increase in suspended solids from beach recharge may impact on prey articles. Partially mitigated by the creation of new habitat in new coastal defences.	Minor Adverse	Avoid beach recharge in Phase 2 area between November and February inclusive. Reduce the percentage of fine particles in the recharged beach material	Neutral	Impacts associated with Option 1 are considered to be considerably less adverse than for Option 2 due to low maintenance requirements and lack of beach recharge operations.

Table 11.1: Colwyn Bay Waterfront Project: Summary of Mitigation and Residual Effects

Environmental Topic	Principal Impacts Identified for Option 2	Impact Significance Prior to Mitigation	Mitigation and compensation integrated into design and recommendations/enhancement	Impact Significance after mitigation	Differing impacts for Option 1 (linear defences)
	Maintenance beach recharge resulting in a potential increase in suspended solids. This may impact on fish and sessile species	Minor Adverse	Reduce the percentage of fine particles in the recharged beach material.	Neutral	Sediment disturbance impacts are likely to be less adverse for Option 1 than for Option 2.
LANDSCAPE AND VISUAL					
Construction	Townscape, seascape and landscape impacts will include the effect of demolition of existing defence structures and construction of new defences and groynes, and promenade improvements.	Moderate Adverse	Immediately following completion of construction works, environmental improvements of the promenade are to be undertaken, a part of which will be to clad the structures and promenade in suitable finishing material.	Minor Adverse	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Delivery of construction materials to site and construction traffic will have temporary visual impacts due to number of sensitive visual receptors	Moderate Adverse	Delivery of some construction materials to site by sea will reduce visual impact of construction traffic. Keep the public well informed of construction work timings and activities and maintain construction site in a clean and tidy condition.	Minor Adverse	Option 1 would require significantly more rock import to site and consequently may have a slightly more adverse visual impact during construction than Option 2.
Operational	Visual impact due to changes to beach level and improvements to promenade	Minor Beneficial	Design of new defences should be sensitive to the surrounding environment and cladding and finishing materials should be selected to match the surrounding townscape. Regeneration of the waterfront will improve and break up the visual dominance of the new coastal defences.	Minor Beneficial	Increased severance between promenade and beach without improvements to the beach condition in Option 1 would have a slightly adverse impact compared to Option 2.
	Activity zones will change the townscape and seascape characters and lead to increased activity and footfall in localised area	Minor Beneficial	-	Minor Beneficial	Option 1 will not create an amenity space on the beach and severance between the promenade and beach will restrict the potential to develop activity 'zones'. Consequently, the increase in level of activity for Option 1 may be slightly lower than for Option 2.
SOCIO ECONOMIC					
Construction	Employment generation (35 – 40 No. jobs) for construction works	Moderate Beneficial	Ensure that Contractor commitments to benefit the local workforce are implemented and monitored.	Moderate Beneficial	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Impact to local businesses –through disruption to access to promenade and trade.	Moderate Adverse	Require the Contractor to develop a construction management plan to minimise disruption to promenade access for customers, deliveries and staff	Minor Adverse	
	Impact to local residents through promenade closure affecting quality of life	Moderate Adverse	Require the Contractor to develop a construction management plan to minimise disruption to promenade access	Minor Adverse	
	Economic activity generation as construction workers use local services / amenities	Minor Beneficial	N/A	Minor Beneficial	
	Travel and access issues due to diversions, access disruption and congestion for businesses, residents and tourists	Moderate Adverse	Ensure the Contractor develops a traffic and access management policy for the duration of the works and that this is well advertised throughout the immediate impact area.	Minor Adverse	
	Temporary impact on tourism as construction may cause a possible disincentive to visit Colwyn Bay	Minor Adverse	Advertising and promotions on the length of works and the benefits to visitors and tourists once complete	Neutral	
Operation	Impact on local businesses as commercial properties removed from flood risk	Major Beneficial	N/A	Major Beneficial	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Impact on local residents –as residential properties removed from flood risk	Major Beneficial	N/A	Major Beneficial	

Table 11.1: Colwyn Bay Waterfront Project: Summary of Mitigation and Residual Effects

Environmental Topic	Principal Impacts Identified for Option 2	Impact Significance Prior to Mitigation	Mitigation and compensation integrated into design and recommendations/enhancement	Impact Significance after mitigation	Differing impacts for Option 1 (linear defences)
	Indirect impact on businesses, economic growth and investment – reduced road closures and insurance premiums increased local and tourist spend increasing opportunities for investment and job creation	Moderate Beneficial	N/A	Moderate Beneficial	Option 1 is not considered to create as many opportunities for tourism generation as Option 2 as it will not create an amenity resource on the beach and will limit the effectiveness of regeneration of the promenade. Option 1 will have a positive impact regarding reduced road closures and insurance premiums.
	Indirect impact on local residents – reduced road closures and disruption to community life, more amenities and recreational opportunities	Moderate Beneficial	N/A	Moderate Beneficial	Option 1 will also have a positive impact on local residents due to reduced disruption to community life but will not generate the same amenity resource as Option 2.
	Regeneration and tourism policy objectives – meeting planning policy and wider policy goals	Moderate Beneficial	N/A	Moderate Beneficial	Option 1 is not considered to contribute to wider tourism attraction as significantly as Option 2.
CULTURAL HERITAGE*					
Construction	Construction activities may have a detrimental impact on the visual setting of heritage assets	Minor Adverse	Ensure design of defences is sensitive to heritage assets in vicinity of site. Maintain construction site in a clean and tidy condition	Not significant	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Excavations during construction may expose archaeologically valuable buried assets	Minor Adverse	Minimise excavation of waste materials and avoid tracking of vehicles on the foreshore	Minor Adverse	Slightly greater adverse impact may occur for Option 1 due to larger excavation requirements for installation of linear defences.
Operational	Beach recharge operation will provide additional protection to Victoria Pier, the lower structure of which is currently partially exposed. Beach recharge will also improve the setting of this heritage asset	Major Beneficial	N/A	Major Beneficial	Protection of Victoria Pier via beach recharge will not occur in Option 1 although the Pier will benefit from a lesser degree of additional protection due to installation of rock revetment structures.
	Coastal defences will protect historic railway infrastructure and existing masonry defence structures	Moderate Beneficial	N/A	Moderate Beneficial	Impacts for Option 1 are considered to be comparable to those for Option 2.
	Submerged forest and archaeologically important marine deposits will be covered and thus better protected by the beach recharge operation	Moderate Beneficial	N/A	Moderate Beneficial	Option 1 would not provide any additional protection to buried heritage assets as the proposals do not include beach recharge. Option 1 would however reduce scour of the upper levels of the beach and so would provide some degree of additional protection to buried assets.

Appendix 2.3 – Colwyn Bay Waterfront Project, Coastal Defence Improvements: Project Appraisal Report Update



Colwyn Bay Waterfront Project

Coastal Defence Improvements - Project Appraisal Report (PAR)
Update

September 2010
Conwy County Borough Council

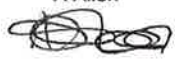
Colwyn Bay Waterfront Project

Coastal Defence Improvements - Project Appraisal Report (PAR)
Update

September 2010

Conwy County Borough Council

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	September 2010	V Tonks 	A Allen 	P Phipps 	For Issue

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1. Executive Summary

1.1 Introduction and Background

This Project Appraisal Report (PAR) covers the Colwyn Bay frontage from Rhos Jetty to Beach Road, Old Colwyn. Local defences are provided at Rhos Harbour at the western end and also between Old Colwyn and Tan Penmaen Head at the eastern end, the latter being under the jurisdiction of Network Rail and the WAG Highways Directorate. The shoreline in between is defended by vertical masonry and/or concrete walls that date back to the early 1900s.

The shoreline has been subject to a number of studies including the North West England and North Wales Shoreline Management Plan SMP2 (Halcrow, 2009), the Colwyn Bay Coastal Defence Strategy Plan (CEUK, 2006) and a Draft Project Appraisal Report (PAR) (CEUK, 2008). This PAR supersedes the 2008 Draft PAR.

1.2 Problem

The defences along the frontage are frequently overtopped leading to significant damage to the promenade and frequent closures of the road behind it. In April 2010, a severe storm resulted in approximately £1 million of damage to the promenade and damage to the railway embankment behind it. In addition, the defences are recorded to be in a poor condition with a residual life of less than 5 years. The defences along the frontage are subject to ongoing maintenance and repair by the Council to ensure that they function as a coastal defence but urgent action is required to ensure the continued sustainable protection of the frontage.

1.3 Options Considered

Options previously considered in the Draft PAR were developed from the work carried out for the SMP and Strategy Plan. The four options considered in the Draft PAR (in addition to the Do Nothing scenario) were:

- Option 1 – Do Nothing
- Option 2 – Maintenance but no improvement of the existing defence assets – reducing standard of service
- Option 3 – Sustaining existing defence assets – maintaining existing minimum standard of service
- Option 4 – Improve and maintain linear defences – improved standard of service
- Option 5 – Improve defences by artificially supplementing and managing beach volumes and profiles – improved standard of service

The two Options that have been taken forward for consideration by this PAR are:

- Option 4 – Improvement of the current standard of defence through the construction of a linear rock revetment along the frontage
- Option 5 – Improvement of the current standard of defence through beach recharge works and construction of associated beach control structures and a short stretch of revetment.

1.4 Preferred Option

The whole life costs of each of the options has been calculated based on detailed unit costs of each element of the scheme together with the necessary description.

The preferred Option (Option 5) proposed for the Colwyn Bay frontage includes the three phases of work.

- Phase 1 of the works will include a 200m rock groyne, a 260m rock revetment and the raising of 260m Promenade by approximately 2m
- Phase 2 of the works will include 1.56 million cubic metres of beach recharge and the raising of the Promenade
- Phase 3 of the works includes an extension of 1122m to the rock revetment to the east of the proposed rock groyne and the raising of the Promenade.

Environmental Considerations

Environmental Impact Assessment that reviews the impacts of both Options 4 and 5 across the entire frontage has been prepared for submission to Conwy County Borough Council.

The site lies within the boundary of Liverpool Bay potential Special Protection Area (SPA). The SPA regularly supports more than 1% of the British populations of red-throated diver *Gavia stellata*, 1% of the biogeographical population of common scoter *Melanitta nigra* and more than 20,000 waterfowl during the non-breeding season.

The site is also located 10km from the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. Within the EIA this designated site has been included owing to some of marine mammals which are listed in this SAC being observed within Colwyn Bay.

Benefits

The proposed scheme will safeguard the integrity of the present coastal defence and safeguard the land, property and infrastructure at risk including the A55, commercial and residential properties and the main Chester to Holyhead railway line for 100 years.

The scheme will improve the amenity of the area and linked to other regeneration initiatives, associated with waterfront and town centre, will form part of a wider regeneration package that will benefit the whole of Colwyn Bay, not just the seafront.

The benefits identified in the PAR update have been updated from the Draft PAR. In comparison with the Draft PAR the benefits identified are greater. The main difference in benefits is derived from an assessment of the value of tourism for each option. The PAR included a survey of tourists in Colwyn Bay to determine the value of enjoyment that they would place on the present day conditions and also the proposed Options along the frontage. This provided a PV tourism benefit of approximately £28 million compared with the £20 million in the Draft PAR.

The erosion scenario and the timing when assets were considered lost was also reassessed based on the 2009 SMP. This provided a PV benefit of £9.4 million compared to £4.1 million in the Draft PAR.

Costs

The construction costs for the preferred Option are based upon a rock groyne design including a 3.6m wide crest and a varying side slope to a total height of +5.5mOD at the landwards end of the structure and +2.5mOD at the seawards end. The groyne is to be constructed of 3-6 tonne rock armour layer, 0.3-1.0 tonne rock under layer and a fill layer. The cost outline for the rock groyne is £12,776.50 per metre run. The total cost of the rock groyne is £2,555,300.

The revetment structure proposed to the east of the rock groyne has an overall length of 1382m and a footprint of 29.7m. The armour layer is comprised 3-6 tonne rock, 0.3-1.0 tonne under layer and fill material. The cost based on this design per metre run is £10,777 giving a total cost of £14,894,112. Along the frontage the Promenade will also require raising at a cost of £4,447 per metre run giving a total cost of £16,234,798.

The initial beach recharge proposed will be 1.56 million cubic metres of sand. The total cost of this beach recharge based on this volume, a cost of £10/m³ and mobilisation and demobilisation costs is £16,192,500. For the maintenance of the preferred Option is based upon a loss of 475,000m³ every 10 years as derived from the sediment modelling undertaken by Royal Haskoning (Royal Haskoning, 2010).

Economic Summary and Outcome Measures

The economic analysis is based upon benefits associated with property and infrastructure losses to coastal erosion, and tourism losses and benefits to the Town. Annual average damages have been calculated for flood losses. The discount rate used in the analysis is based on the Defra FCDPAG 2003 Treasury Green Book Guidance. An Optimism Bias of 30% has been used in this PAR based the understanding of the frontage, detailed design and Early Contractor Involvement.

The Outcome Measure for the preferred option is presented in Table 1.1.

Table 1.1: Benefit cost ratio and Outcome measures

Contributions to Outcome Measures	Scores
OM1 – Economic Benefit	
PV Benefits (£k)	204,308.44
PV Costs (£k)	62,269.78
Benefit/Cost ratio	3.28
OM2 – Households at risk (Nr)	158
OM2b – Households moving risk bands (Nr)	
OM3 – OM2b households in deprived areas (Nr)	
OM4 – Improvement of condition of SSSIs (Ha)	
OM5 - Biodiversity Action Plan habitats (Ha)	
OM Prioritisation Score	0.91

Funding and Contributions

The preferred option has been planned for delivery in three phases. For the Phase 1 works, Conwy County Borough Council is being supported by grant funding from the European Convergence Funding Programme with match funding provided by the Welsh Assembly Government. The grant funding expenditure profile agreed between Conwy County Borough Council and its funding partners identifies that works to commence Phase 1 of the coastal defence must be delivered during the 2010/11 financial year. Circa £4.5 million of grant funding is to be utilised by Conwy County Borough Council during the 2010/11 financial year to commence Phase 1 coastal defence works.

Key Delivery Risks (economic, social and environmental)

Five key risks are highlighted in Table 1.2.

Table 1.2: Risks and mitigation

Risk	Key Mitigation
Potential for further coastal erosion/damage to the beach levels and seawall/promenade before the works begin	The risk can be mitigated against by ensuring that the works are procured and constructed as soon as possible.
Potential for further coastal erosion/damage to the beach levels and seawall/promenade during the works	This risk can be mitigated by working practices and onsite sequencing. If the works can be completed by late summer/early autumn then the likelihood of erosion is reduced compared to the work being undertaken in autumn/winter
Combination of individual threats to project extension leading to extension of capital works, cost and potential remobilisation costs	This risk will be mitigated through ongoing project risk management, project planning and through robustness in initial programme. Suitable contract terms will implemented to manage potential financial risk exposure. Programme to sensitive aspects like beach recharge early in programme
Summer working impacts on tourism income to the town	Through stakeholder engagement, careful scheme phasing to minimise impact on the beach etc. this risk has been significantly reduced. Ongoing communication with local businesses and general population throughout design and delivery phases is vital in mitigating this risk.
Potentially volatile exchange rates alter the material costs of the scheme	A contingency allowance has been given in the cost, but Contractors have advised that this remains a live and difficult to mitigate risk.

1.5 Recommendation

Conwy County Borough Council proposes that along the Colwyn Bay frontage construction of the preferred option comprising a rock groyne, rock revetment and beach recharge is undertaken. The rock groyne is 200m in length with a crest width that varies along the length. A revetment of 1382m is to be constructed to the east of the rock groyne and 1.56 million cubic metres of beach recharge placed to the west of the rock groyne. The Promenade will be raised along the entire frontage. Maintenance recharge is proposed during the 100 year life of the scheme at 10 year intervals.

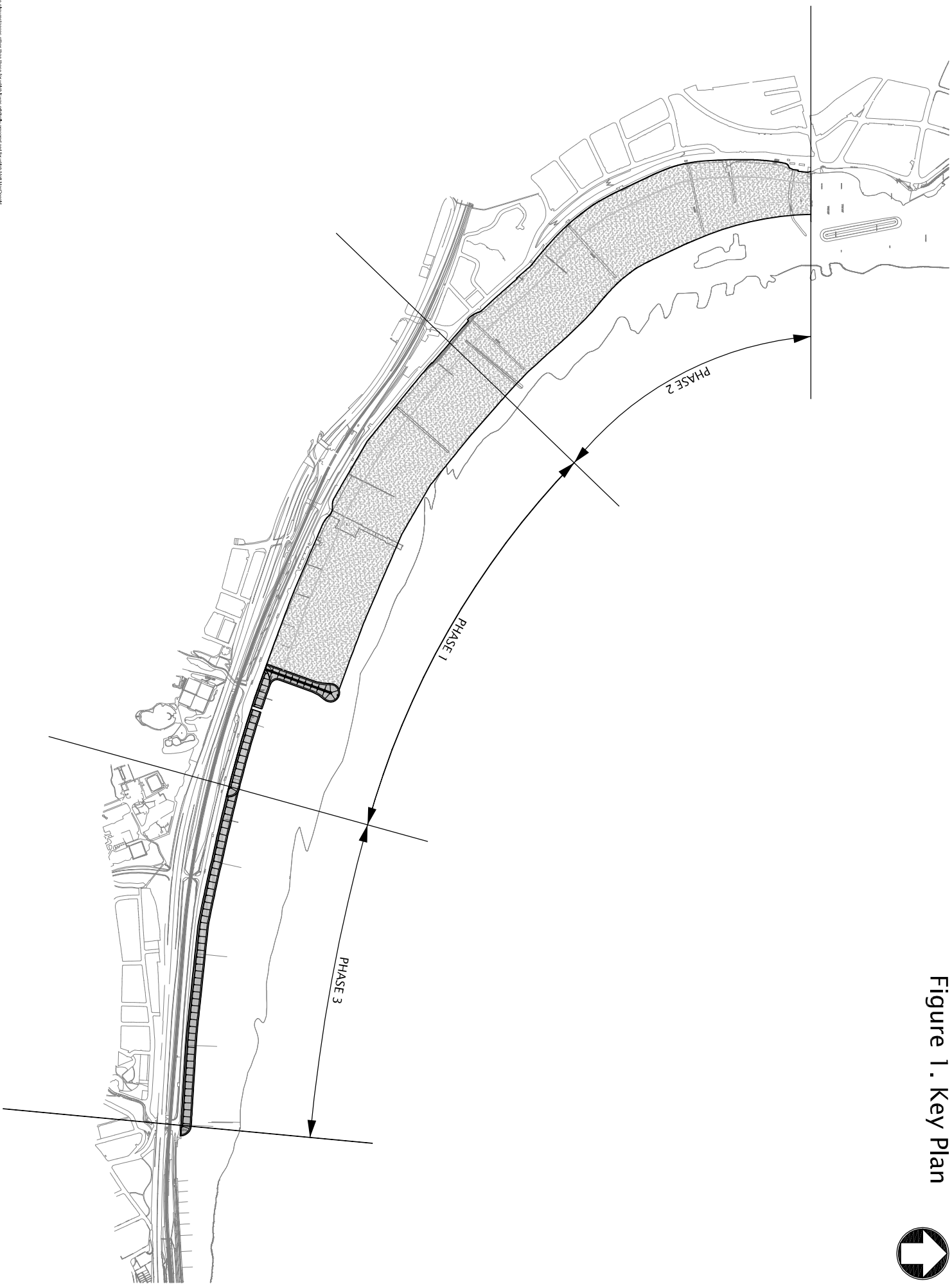
The total PV cost of the preferred scheme is £62,269.78k

1.6 Key Plan

Figure 1 overleaf presents the key plan for the frontage including the phasing of the construction works.



Figure 1. Key Plan



2. Introduction and Background

2.1 Purpose of this Report

This report has been commissioned by Conwy County Borough Council (CCBC) for submission to the Welsh Assembly Government (WAG) in support of an application for grant aid for coastal protection elements of the proposed Colwyn Bay Waterfront Project (CBWP). This report presents the results of an assessment of alternative solutions for the provision of coastal protection along the Colwyn Bay frontage and provides recommendations of a preferred option and proposals for the implementation of that preferred option. It builds on the work undertaken to develop the Draft PAR (August 2008) previously submitted to WAG by CCBC. The findings of this current PAR supersede those of the Draft 2008 PAR.

2.2 Background

CCBC is seeking to provide improved coastal protection to the area between Rhos-on-Sea and Old Colwyn to protect properties, businesses and vital infrastructure present along the frontage. The coastal protection improvement works are to be delivered in parallel to regeneration works to the promenade, which are being developed as part of efforts to drive the economic redevelopment of the town of Colwyn Bay through the Colwyn Bay Waterfront Project.

The existing defences were constructed over 100 years ago and are beyond their effective design life. The level of protection afforded by the defences is inadequate under present conditions and will become more so under future climate change scenarios putting important infrastructure and assets at greater risk.

2.3 Current Approach to Flood and Erosion Risk Management

The Colwyn Bay coastline between Rhos Point and Tan Penmaen Head is approximately 3650m in length. Defences were constructed for much of the coastline in the late nineteenth century and in general now comprise vertical seawalls in either masonry or concrete. The current approach to defence along the frontage is in response to the legacy of these Victorian and Edwardian defences.

Since the construction of the defences, beach levels have been noted to have dropped, requiring ongoing maintenance and repairs to the toe of the defences to ensure their integrity and stability. Groynes that were constructed in response to retain the wide sand beach have failed and are now absent due to a lack of ongoing maintenance. As a result, the present foreshore is typically a low gradient variably thin sandy beach overlaying fluvio-glacial sands, gravel and glacial tills. To the rear of the foreshore adjacent to the seawalls, there is some sand, shingle and cobbles that form the upper beach.

Since 1987 there has been specific, localised works carried out to extend the life of the existing sea walls and to reintroduce a beach. This has included a 650m rock revetment along the worst affected stretch of seawall constructed in 1987, and a series of long rock groynes in 1990. These structures have led to improvements in beach levels, with sand accretion within the groyne bays and in front of the rock revetment.

Since the 1990's routine maintenance of the existing structures has been carried out in order to extend their residual life. This has included patch repair of the concrete and masonry walls as well as the addition of protective rock toes and revetment facings in some areas. Emergency works have also been required in a number of locations along the seawalls, such as at Old Colwyn, in response to the rapid lowering of beach levels following severe storms. These emergency works have included the addition of rock

revetment toe protection or concrete apron construction and an 800m section of steel sheet piling to the East of the Victoria Pier as well as repairs to the copings and safety railings along the crest of the seawall and the frequent damage to the promenade and road to the rear of the defences.

3. Problem Definition and Objectives

3.1 *Outline of the Problem*

The existing defences were constructed over 100 years ago and have exceeded their design life, are no longer performing to the required defence standards, and their structural integrity is in some areas already compromised. The seawalls along the frontage range in crest height between +5.0mAOD at the Victoria Pier and +8.2mAOD. This variability in height provides an inconsistent standard of protection along the frontage that can allow flooding of better protected sections via flows from less well-protected areas.

The level of protection afforded by the defences is inadequate, allowing frequent overtopping of defences under present conditions. The effect of sea level rise and increased storminess due to climate change will increase the incidence of overtopping of the seawalls.

The area immediately to the rear of the defences includes assets of both local and regional importance and therefore requires continued coastal protection of an adequate standard. There is therefore a need to improve the standard of coastal protection along the entire frontage.

3.2 *Consequences of Doing Nothing*

In a Do Nothing scenario, the programme of ongoing maintenance and repairs to the existing defences will stop allowing the defences to rapidly deteriorate over time. The conditions for which the defences were originally designed in the early 1900s have changed to the present day. Sea level has risen and storms of increasing frequency and scale are being seen.

An inspection in October 2009 found the current defences to be in generally Poor-Fair condition (Mott MacDonald, 2010). Given the current condition of the defences, the timeline for failure is likely to occur within 0-5 years of the maintenance of the defences being stopped. The stability of the structures has been a key concern with undermining of the structures considered likely to lead to sudden failure of the defences (Mott MacDonald, 2010). The Draft PAR (CEUK, 2008) estimated the residual life of the structures to be five years indicating that their failure is potentially imminent and urgent action is required to ensure their continued performance.

The defences are also more frequently being overtopped causing significant damage to the infrastructure to their rear. Predicted climate change scenarios show increasing sea levels that will lead to increased heights of wave impacting the seawalls. This, coupled with an increase in the frequency and scale of storms, will lead to more frequent and more damaging flood events.

Under a Do Nothing scenario, it is considered that the Promenade and the local road along the Promenade will be subject to increasing overtopping of the coastal defences until these defences fail. Once the defences fail, there will be a loss of commercial and residential properties, in addition to the promenade, and the road behind it. The loss of these assets is a result of coastal erosion and increased flood frequency. Over the 100 years the Do Nothing scenario predicts that owing to the erosion rate along the frontage the Chester to Holyhead railway and the A55 will be lost to coastal erosion.

The loss of the A55, railway, Promenade and commercial and residential properties will have a significant impact on the value of tourism and amenity in Colwyn Bay.

3.3 Strategic Issues

A number of plans and studies exist for the Colwyn Bay frontage, these include:

- North West England and North Wales Shoreline Management Plan (SMP2)
- Colwyn Bay Coastal Defence Strategy Plan
- Colwyn Bay Regeneration Plan

The SMP2 (Halcrow, 2009) indicates the following policies for the Colwyn Bay frontage (Management Unit 11a):

Table 3.1: SMP2 policies for the management of the Colwyn Bay frontage (Halcrow, 2009)

Epoch	Policy	Mechanism for Delivery
0 – 20 years	Hold the Line	By maintaining and improving / raising the existing defences. A strategy study needs to be undertaken to confirm the long-term economic viability.
20 – 50 years	Hold the Line	By maintaining and improving / raising the existing defences, subject to confirmation through the strategy study
50 – 100 years	Hold the Line	By maintaining and improving / raising the existing defences, subject to confirmation through the strategy study

In the SMP2, these policies have been reviewed under social, environmental and economic criteria, the results of which are summarised in Table 3.2 below:

Table 3.2: SMP2 justification for the Hold the Line policy for the Colwyn Bay frontage (Halcrow, 2009)

Social	Environmental	Economic
Manages risk to the railway and other infrastructure as well as other assets in the erosion risk zone. Manages risk to the cycleway and coastal path.	No conservation designations present. Local opportunities for environmental improvements and the layout and size of the groynes should be considered in a more detailed local study.	The recommended policy is potentially economically viable depending on estimated costs for relocating the railway and road which would be at long term risk. (Needs further investigation and more detailed strategy studies to confirm the policy).

The Colwyn Bay Coastal Defence Strategy Plan (CEUK, 2006) also recommends a Hold the Line policy for the Colwyn Bay frontage. It advises that the policy be implemented through an upgrade of the coastal defences along the frontage using a combination of beach recharge, linear rock revetment and control structures.

Conwy County Borough Council is developing a regeneration strategy for the town of Colwyn Bay. This sets out environmental improvements to the public realm along the Colwyn Bay promenade, and aims to create a more usable and attractive amenity space to attract increased visitor numbers to the town, improve the visitor experience and strengthen links with the town centre. It is essential that the coastal protection options for the frontage take into consideration the needs of the wider regeneration proposals for the area.

3.4 Objectives

The principle objective of the original Draft PAR (CEUK, 2008) was to develop a scheme that provides:

- Improved coastal defence measures within Colwyn Bay that are commensurate with the risk of flooding and erosion to the local population, local property and local and national infrastructure.

CCBC have developed new objectives since the Draft PAR was prepared and the Colwyn Bay Waterfront Project has evolved to encompass objectives for coastal protection of the town. In summary, the overarching objectives for the Colwyn Bay frontage are to:

- Provide renewed coastal defences along the waterfront to protect the residents and businesses of the town from the threat of the sea.
- Integrate the renewed sea defences with environmental improvements along the promenade to provide a coordinated approach to delivery of the project which maximises the regeneration potential of the scheme while also providing the necessary level of coastal protection.
- Provide environmental improvements to the promenade to offer a modern, robust, sustainable and attractive public realm to draw new visitors to the area and coordinate with the Bay Life Initiative's development plan.

4. Options for Managing Flood Risk and Erosion

4.1 *Potential FCRM Measures*

The Colwyn Bay Coastal Defence Strategy Plan (CEUK, 2006) considered a number of options for managing the risk of flooding and coastal erosion of the frontage under a Hold the Line policy option:

Maintain Defences - the minimum “do-something” option in terms of intervening with the present defences. Implies routine maintenance only to preserve an existing defence function and prolong its usual life and/or delay failure.

Sustain Standard of Defences – this option aims to sustain the present standard of defence for the intended strategy life of 100 years (e.g. by keeping pace with, or pre-empting, sea level rise). This generic option can include maintenance and the construction of new defences, as appropriate.

Improve Standard of Defences - this option aims to improve the present standard of defence for the intended strategy life of 100 years.

These were compared to the **Do Nothing (No Active Intervention)** scenario, where natural processes are allowed to act without interference.

4.2 *Long List of Options*

A range of options for providing improved coastal defence for this section of frontage were considered and assessed as part of the Strategy Plan development. These options were subsequently consulted on as part of the Strategy Plan consultation process. CCBC held a public exhibition in December 2006 to determine public perception to a number of potential schemes, which they had developed to deliver the Hold the Line policy option recommended by both the SMP2 and the Strategy Plan.

The five potential schemes, which formed the basis for the Stage 1 public exhibition, were:

- Maintain the existing defences
- Sustain the existing defences by provision of a rock toe in front of the existing walls (as already exists on some sections of frontage)
- Improve the defences with a linear (stepped or sloping) concrete revetment
- Improve the defences with a linear rock revetment
- Improve the defences by artificially recharging the beach (with or without control structures)

From the Strategy Consultation period the following comments were made:

SU 2/2/2 - Cayley Promenade

A clear majority (43%) favoured Beach Recharge, with significant support also for the Concrete Step Revetment (31%). The Rock Revetment (14%) and Rock Toe (8%) options received little support.

SU 2/3/1 (West) - Beach Zone

A clear majority (55%) favoured Beach Recharge, with support also for the Concrete Step Revetment (25%). The Rock Revetment (12%) and Rock Toe (4%) options received very little support.

SU 2/3/1 (West) - Watersports Zone

The public consultation favoured Beach Recharge (39%) with support also for the Concrete Step Revetment (22%).

SU 2/3/2 - Old Colwyn

- Beach Recharge was still supported (28%) as was Concrete Step Revetment (20%), but the most popular option was the Rock Revetment (29%), an option not favoured for other zones.

4.3 Options Rejected at Preliminary Stage

The Draft PAR (CEUK, 2008) assessed a number of options derived from the Strategy Plan using the PAG guidance and the 2005 Multi-coloured Manual (Flood Hazard Research Centre, 2010). It demonstrated that there is clearly an economic case for providing improved coastal defence to Colwyn Bay. Table 4.1 summarises the results of the Draft PAR assessment.

Table 4.1: Summary of options considered and Benefit:Cost results from the Draft PAR (CEUK, 2008)

	Option 1	Option 2	Option 3	Option 4	Option 5
Option Description	Do nothing	Maintenance but no improvement of the existing defence assets	Sustaining existing defence assets	Improve and maintain linear defences	Improve defences by artificially supplementing and managing beach volumes and profiles.
Method of delivery		Maintenance and remedial works to existing masonry and concrete structures	Maintenance and remedial works. Rock toe re-profiling. Raising of backshore defences. Improvements to National Rail embankment.	New linear rock revetment and raised promenade. Ongoing maintenance of these new structures.	Construction of control structures, linear defences and crest works followed by beach recharge. Ongoing maintenance of new structures including beach management.
Impact on Standard of Service	Reduced	Reduced	Maintained	Improved	Improved
Benefit Cost Ratio		18.34	9.40	5.04	3.21

The Draft PAR considered that Options 1 and 2 did not meet the policy recommendations of either the SMP2 or the Strategy Plan, leading to a reduced standard of defences and significant losses of assets and infrastructure over time. Neither option supported the principle objective of the original Draft PAR which was to develop a scheme that provides improved coastal defence measures within Colwyn Bay commensurate with the risk of flooding and erosion to the local population, local property and local and national infrastructure. The objectives of the Colwyn Bay Waterfront Project, which incorporates objectives for coastal protection, are also not met by either option. Options 1 and 2 of the Draft PAR have therefore been dismissed from further consideration in this updated PAR.

Option 3 of the Draft PAR maintained the integrity of the defence line throughout the next 50 years and adjusted the structure crest level to maintain the level of risk of overtopping due to rising sea levels at its present level. However it was identified that in the longer-term maintaining the integrity of the existing structures is not considered to be viable and there is associated risk to infrastructure associated with the maintain option. In the longer-term promenade access and the railway would be under threat with

associated risk of damage and eventual loss beyond 50 years. The works will enhance the life of the defences and reduce but not eliminate the risk of shoreline recession. Overtopping will continue to take place at the present rate. For this reason, Option 3 was not considered to meet the policy recommendations of either the SMP2 and the Strategy Plan or the objectives of either the Draft PAR or the Colwyn Bay Waterfront Project and for this reason has not been considered further in this updated PAR.

Option 4 comprises a new linear rock armour revetment built directly in front of the existing sea wall along the whole frontage similar to that which exists between Rhos-on-Sea and Penrhyn Bay. It also includes for a new promenade and improved crest levels that would limit overtopping. It is considered that this option would not significantly improve the beach condition or provide any significant amenity benefit and therefore that it fails to meet the objectives of the Colwyn Bay Waterfront Project, although it does deliver the objectives of both the SMP2 and the Strategy Plan. For this reason, Option 4 has not been immediately rejected and has been considered in this updated PAR.

4.4 Options Short-listed for Appraisal

CCBC has short-listed options for the coastal management of the Colwyn Bay frontage in response to the recommendations of the SMP2 and the Strategy Plan and in response to the findings of extensive public consultation as part of both the Strategy Plan and the Colwyn Bay Waterfront Project.

Options 4 and 5 were the favoured alternatives arising from the draft PAR and have been developed and refined in the light of subsequent technical evaluation and modelling carried out by Royal Haskoning (2010). Both alternatives provide an improved level of flood and coastal protection that achieves the best balance between the costs of providing and maintaining the defences and the potential damages that would occur for different levels of service, which would be determined during detailed design and appraisal. They also include for amending crest levels and/or profiles in 50 years time in response to increased sea levels and climate change.

Option 4 comprises a new linear rock armour revetment built directly in front of the existing sea wall along the whole frontage, a new promenade and improved crest levels. This option will safeguard the integrity of the defences, protect local and national infrastructure and improve the level of service provided to one that is commensurate with the level of risk applying.

Option 5 is a combined approach developed from the technical appraisal carried out and the Stage 1 Strategy Plan consultation, consisting of beach recharge and revised beach control structures combined with new linear revetments and promenade improvements in places with the following proposed arrangements applying for the individual lengths of frontage:

- Western Section - Rhos Jetty to Penrhos College: Beach Recharge
- Central Section - Penrhos College to Eirias Park: Beach Recharge, Control Structures and new Crest Works in places
- Eastern Section - Eirias Park to Old Colwyn: New Linear Rock Revetment and new Crest Works.

Option 5 requires ongoing beach management and periodic “topping up” of beach levels to maintain the necessary design level of protection. The beach management is required as there will be movement of the beach under the action of waves and tide and potentially wind resulting in potential losses from time to time. Beaches are dynamic landforms and such temporal and spatial changes are a natural part of their successful function. Option 5 also provides not only improved defence function but also opportunities for improved amenity and development to meet the aspirations of the local community for the economic regeneration of Colwyn Bay. The approach is in line with the recommendations of the SMP2 and Strategy

Plan, responds to public feedback and fully supports the objectives of the Colwyn Bay Waterfront Development.

For Option 5, several configurations of beach control structures have been considered and developed using the outputs of the modelling work carried out (Royal Haskoning, 2010). These have included a single Y-shaped groyne, a single straight groyne and several shorter Y-shaped and straight groynes.

An optioneering workshop was carried out to select the preferred configuration for Option 5. Options for Y-shaped/T-head groynes are shown by the modelling (Royal Haskoning, 2010) to result in less longshore transport of beach recharge material and therefore reduced beach management costs, but have a significantly higher initial construction cost leading to little variance in whole-life costs and no variation in benefits achieved. For this reason a single, straight groyne was selected as the preferred layout for Option 5.

5. Options Appraisal and Comparison

Conwy County Borough Council has undertaken substantial background work to develop proposals for the coastal defences along Colwyn Bay's frontage. This Project Appraisal Report (PAR) builds on this previous work, in particular the Draft PAR (CEUK, 2008), and provides an up to date appraisal of the options brought forward.

5.1 *Technical Issues*

5.1.1 *Assessment Criteria*

The appraisal and comparison of options has been carried out using FCDPAG and reviewed against the Environment Agency's FCERM-AG, which was published earlier this year, with figures updated to reflect those in the latest version of the Multi-Coloured Manual (Flood Hazard Research Centre, 2010).

5.1.2 *Draft PAR*

In developing this PAR, the findings of the Draft PAR (CEUK, 2008) have been reviewed and used where appropriate, having first been updated using current guidance and values. The method is described in Section 5.4 and 5.5. Reference is made throughout this report to information in the Draft PAR, which is provided in Appendix A of this report.

5.1.3 *Numerical and Physical Modelling*

Following completion of the Strategy Plan, CCBC commissioned a detailed numerical and physical coastal modelling study (Royal Haskoning, 2010) to examine the feasibility of their preferred option from the Stage 1 consultation process and to optimise arrangements of the defences based on the results obtained.

The numerical modelling study provided an assessment of a number of configurations of defences along the frontage. There is consideration within the model report of a single straight groyne (as in Option 5), in a similar location to the current proposed straight rock groyne. The following key points have been identified:

- The single groyne is effective in providing a barrier to drift and holding a beach to the west
- Across the frontage immediately west of the groyne the frontage, the model predicts retreat in the first 5 years west of the groyne, reducing in magnitude moving away from the groyne, followed by recovery thereafter
- The groyne clearly interferes with drift across the upper part of the active zone, causing downdrift beach erosion to the east of the groynes location
- At the western end the recession identified in the unrestrained beach scenario is replicated. Despite significant retreat in the west end, the beach width would however still be wider than its current situation after 19 years of simulated conditions.

The numerical modelling report provides estimated losses of between 425,000m³ to 450,000m³ for multiple straight groynes and a single 'Y' shaped groyne respectively. Therefore based on these estimates a recharge value of 475,000m³ for a single straight rock groyne has been assumed.

The numerical modelling report also considered the frontage if no control structures were constructed and only beach recharge was undertaken. The following key points were identified:

- Gradual beach retreat would occur at the western end of the frontage
- There would be a relatively stable beach in the middle section between chainage 700m and 1700m

- Significant retreat of the eastern end of the recharged frontage would occur
- Beach advancement to the east of the recharged section, reducing in magnitude towards the east
- The modelling estimated losses over the first ten years after recharge of 575,000m³ for $d_{50} = 0.25\text{mm}$ and 400,000m³ for $d_{50} = 0.45\text{mm}$

The physical model study (Royal Haskoning, 2010) focused on the Phase 1 area of the frontage. A report summarising the results of the study and a rationale behind recommendation of the proposed defence arrangement for the Phase 1 area was been produced (Royal Haskoning, 2010). The study modelled eight alternative designs for the revetment along the Phase 1 frontage. The results indicated that to keep the crest levels to a minimum whilst reducing overtopping the revetment required a slope of 1V:3H, a recurve crest wall and a permeable crest.

5.1.4 Ground Investigations

Conwy County Borough Council commissioned a ground investigation for the entire Colwyn Bay Waterfront Project area (Allied Exploration and Geotechnics Limited, 2010). The ground investigation was carried out both landward and seaward of the existing sea wall to inform the regeneration and coastal defence elements of the project respectively.

5.1.5 Asset Condition Surveys

Conwy County Borough Council commissioned a detailed condition survey of the existing sea wall in support of the development of options for the frontage (Mott MacDonald, 2010). The October 2009 inspection found the current defences to be in generally Poor-Fair condition. Defects included:

- Cracking
- Distortion, misalignment and tilting
- Bulging
- Loss of mortar
- Loss of facing
- Spalled or eroded surface
- Erosion, undermining
- Exposed steel reinforcing bars
- Localised water seepage
- Externally corroding steel elements

The stability of the structures has been a key concern with undermining of the structures considered likely to lead to sudden failure of the defences (Mott MacDonald, 2010). The improvement of the levels of beach material is important for the protection and stability of the existing seawalls. The existing groynes at their present height are insufficient to raise beach levels to an effective level to provide this protection to the rear of the foreshore. The Draft PAR (CEUK, 2008) estimated the residual life of the structures to be five years. Given the current condition of the defences, the timeline for failure may reasonably occur within 0-5 years of the cessation of maintenance of the defences.

5.1.6 Preliminary Design

CCBC has developed preliminary designs for Option 5, which has been split into a three-phase approach to work. Phase 1, which comprises a 200m long groyne and 260m revetment, has been developed to detailed design stage.

5.2 Environmental Assessment

Conwy County Borough Council views a strong environmental performance as a vital element in the success of this scheme. An Environmental Impact Assessment which reviews the impacts of both Options 4 and 5 across the entire frontage has been prepared.

The site lies within the boundary of Liverpool Bay potential Special Protection Area (SPA). The SPA regularly supports more than 1% of the British populations of red-throated diver *Gavia stellata*, 1% of the biogeographical population of common scoter *Melanitta nigra* and more than 20,000 waterfowl during the non-breeding season.

The site is also located 10km from the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. Within the EIA this designated site has been included owing to some of marine mammals which are listed in this SAC being observed within Colwyn Bay.

5.3 Social and Community Impacts

Conwy County Borough Council recognises the importance of community acceptance of the proposed coastal protection works. They have carried out significant consultation throughout the development of the Strategy Plan and Waterfront Development Project to develop an understanding of the concerns and priorities of local residents and visitors to the Colwyn Bay waterfront. CCBC has carried out additional survey work during the summer of 2010 to determine visitor numbers and to develop contingent valuation data for the waterfront.

5.4 Option Costs

The Detailed Design of Phase 1 of the coastal defence improvements has enabled unit costs for each element of works to be established. This has enabled robust and sensible costs for the design, construction and whole-life maintenance of Options 4 and 5 to be developed. These supersede the costs originally developed in the Draft PAR. The costs for the revetment in Option 4 include half the rock being sourced from overseas to ensure that the required volume of rock can be obtained within the short construction period.

An optimism bias of 30% has been applied to the whole scheme costs based on an understanding of the frontage, detailed design and Early Contractor Involvement. The price date for the costs is July 2010.

The cost basis for the options is based on a 100 year design including:

- Option 4 – 3650m rock revetment and the raising of the Promenade.
- Option 5 – 200m rock groyne, 1382m revetment to the east, 1.56 million cubic metres of sand recharge to the west and the raising of the Promenade

Table 5.1 provides a summary of the whole life and present value (PV) costs of each option considered.

Table 5.1: Summary of Options 4 and 5 whole life and PV costs

		Option 4 - Improve - Linear Defences	Option 5 - Improve – Combined Approach
	Initial Capital Costs including fees (£k)	64,708	49,877
Cash costs (not discounted)	Maintenance/Management Costs over 100 years (£k)	48,473	64,949
	Total cost (no OB) (£k)	113181	114826
Discounted costs	Total PV costs (£k)	68,839	62,270
	Total cost including Optimism Bias (£k)	89,490	80,951

5.5 Options Benefits (Damages Avoided)

The assessment of benefits of each option, or damages avoided, is derived from the Draft PAR and new data collected and updated as appropriate under the FCDPAG/FCERM guidance and in accordance with indexed values from the Multi-Coloured Manual (Flood Hazard Research Centre, 2010), the latest retail price index (RPI) and housing price index. This section describes the approach adopted for the review and update of the benefits.

The price date for all calculations is July 2010.

The discount rates used for the benefit cost analysis are taken from the Treasury Green Book (March 2003) to allow for the uncertainties of future to be taken into account. The discount rates from year 0-30 is 3.5%, year 30-75 is 3% and year 75-100 is 2.5%.

5.5.1 Assessment of damages

Under a Do Nothing scenario it is considered, over 100 years, that there will be a loss of commercial and residential properties and infrastructure including the A55, Chester to Holyhead railway line and the Promenade and promenade road as a result of coastal erosion and flooding.

The damages related to the proposed schemes arise from two principal areas:

- Overtopping of defences causing closure of the promenade and traffic diversion
- Failure of defences leading to permanent traffic diversions, loss of commercial and residential properties and loss of railway and highway infrastructure

The recession lines from the Draft PAR have been updated using the latest erosion guidance in the 2009 SMP. The SMP erosion rate along the frontage is indicated to be 15m over the first 50 years increasing to a total of 50m over 100 years. However, this is based on the coastal defences failing in year 20. From the condition survey undertaken by Mott MacDonald (2010) it was identified that the residual life of the defences was less than 5 years. The erosion rates used to determine the loss of assets has therefore been updated to reflect this change. The recession line for the Colwyn Bay frontage is 54.5m in 100 years. The additional increase in the recession line from the 2009 SMP is to reflect the failure of the defences in year 5 rather than year 20. Within the first 50 years, the recession rate is 0.3m per year therefore giving an

additional 4.5m. The predicted erosion rate for Colwyn Bay is similar to other North Wales frontages comprising made ground, fluvio-glacial sands and glacial tills.

Commercial and Residential losses

An assessment of the losses to commercial and residential properties was undertaken in the Draft PAR. The values for commercial and residential properties have been updated from the 2008 Draft PAR using known house price selling values and the latest mid-point council tax bands from Conwy County Borough Council. To ensure that the values are up to date the house price index from the Land Registry has been applied.

The timing of the losses for commercial and residential properties has been based on the predicted erosion rate along the frontage. The assets are considered lost when the erosion line reaches within 5.0m of the property boundary based on the Multi-Coloured Manual (Flood Hazard Research Centre, 2010). Within the benefit cost analysis the sensitivity of the assets being lost has been considered based on including the probability of when the asset would be lost and in which year. Along the main frontage the erosion scenarios indicated that the majority assets would be lost by year 10 as a result of the loss of the promenade road. The sensitivity of this loss included determining the loss of the property in year 5 and year 15.

The total PV damage of the properties from erosion over the 100 year life of the scheme is £9,416k.

A55 road losses

The loss of the A55 trunk road has been considered to occur in year 80 based on the erosion rate along the frontage. Once the road was considered lost the cost of diverting traffic permanently was calculated. The cost of diverting the traffic is based on the methodology provided in the Multi-Coloured Manual (Flood Hazard Research Centre, 2010) which identifies that there are additional costs associated with each vehicle using the road network. These costs relate to the additional distance travelled or the additional time taken. The number of vehicles that are expected to be affected by the loss of the A55 was identified in the Draft PAR as 961 vehicles per hour. The costs associated with the diversion are presented in Table 5.2. The cost of travelling along the A55 assumes a speed of 60mph compared to the local diversion which assumes a speed of 25mph.

Table 5.2: Diversion costs

	A55 route	Local diversion route	A55 route	Local diversion route
	Travel Cost (£/km)	Travel Cost (£/km)	Cost per hour (£/km)	Cost per hour (£/km)
Car	0.15	0.31	545	1206
LGV	0.20	0.37	242	480
OGV1	0.27	0.44	163	285
OGV2	0.37	0.57	202	333
PSV	1.06	2.16	64	140
Total			1216	2445

The difference in the cost of travelling on the A55 route and the local diversion is £1229/hour giving an annual diversion cost of £10,766k.

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The PV loss of the A55 over the 100 years is estimated to be £14,865.25K.

Local traffic losses

The loss of the Promenade road along the frontage has been assessed using the information provided in the Draft PAR.

The numbers in the Draft PAR were calculated based on local traffic count data and information relating to historic promenade closures between 1996 and 2010. The two areas where overtopping would cause flooding and diversion of traffic are as follows:

- Central Promenade: Toad Hall to A55 Junction 22, Old Colwyn
- East Promenade: A55 Junction 22, Old Colwyn to Beach Road.

For each of the routes alternative diversion routes were identified and the additional travel costs for different types of vehicles have been calculated per event based on average closure lengths from historical flood event data.

During the first 9 years of the scheme design life the Promenade is assumed to be affected by flooding owing to the presence of the coastal defences. The cost of the damage caused as a result of a flooding event has been calculated using information provided by Conwy County Borough Council and the Multi-Coloured Manual (Flood Hazard Research Centre, 2010). The Eastern end of the Promenade has been recorded to be closed from flooding events, on average, 6 times a year compared with once for the Central Promenade section. The cost of diverting the traffic was calculated using information from the Multi-Coloured Manual (Flood Hazard Research Centre, 2010). The cost per disruption was based on the average number of hours each section has been closed for based on historical data. The information indicates that along the Eastern Promenade the cost per disruption was £4,663 and for the Central Section £2,445. The total cost of the diversion annually is estimated to be £30.4k.

Following the loss of the road in Year 10 from coastal erosion the annual diversion cost is estimated to be £2,594.42k based on the cost of diversion for the Eastern and Central Promenade.

The PV loss of the Promenade road over 100 years is estimated to be £55,408.02k.

Railway Losses

The loss of the railway is considered to occur in Year 45 owing to the failure of defences in a number of locations. Loss of the asset would require provision of a bus diversion service to be implemented between the two stations to either side – Abergele and Pensarn and Llandudno Junction. The loss would be valued as the delay cost to passengers arising from having to change from train to bus and vice versa at each end and the cost of provision of the bus service. The compensation payment costs and alternative bus costs developed in the Draft PAR have been updated using July 2010 RPI figures. A summary of the costs is included in Table 5.3.

Table 5.3: Cost associated with the loss of the railway based on the Multi-Coloured Manual (Flood Hazard Research Centre, 2010)

Percentage of Rail services delayed	40%
Total Passengers travelling across the area per hour	170
Compensation payments per hour delay for regional trains	£18.00
Compensation payments per hour delay for intercity trains	£17.20
Cost of delay per day	£29,018
Provision of replacement Bus service	£3929
Total cost per year of diversion	£12025.67k

The annual cost of the diversion of the railway from Year 45 onwards is estimated to be £12,025.67k.

Therefore, over the 100 year scheme life the PV cost is £77,526.72k.

Loss of Services under the Promenade

Within the Promenade it has been identified that there are a number of services that would be lost at the same time that the Promenade is lost in Year 5, including:

- Two BT Cables
- Low Voltage Cable
- Combined Water Pipe
- Street Light Cables
- Water supply Pipe
- Foul Water Pipe
- Gas Pipe

The PV cost associated with losing these services is £5,792.55k based on estimates provided by service companies for replacement and re-routing.

5.5.2 Contingent Valuation

Under a Do Nothing scenario, it is considered that there will be a loss of visitors to the frontage as a result of the loss of promenade and amenity value. To establish the potential impact of this loss, a contingent valuation (CV) survey was carried out (as part of a wider survey of visitors to the Colwyn Bay Waterfront area) during the weekend of 21st June 2010. This is in accordance with the method described in the Multicoloured Manual (Flood Hazard Research Centre, 2010). The extract of CV questions from the questionnaire together with the responses given is provided in Appendix B. Responses to the CV questions enabled a Value of Enjoyment to be derived for the Colwyn Bay Waterfront under the following scenarios:

- Do nothing
- Option 4 – Revetment along the frontage
- Option 5 – Beach Recharge, Rock Groyne and Revetment

Table 5.4 presents the Value of Enjoyment figures derived from the survey.

Table 5.4: Value of Enjoyment for the various proposed schemes

	Do Nothing	Option 4 - Revetment along the whole frontage	Option 5 - Beach Recharge, Rock Groyne and Revetment
Value of Enjoyment	£8.97	£7.84	£17.74

Surveys carried out between May and June 2010 have enabled visitor numbers to be assessed. Figures have been indexed, as per the Multicoloured Manual (Flood Hazard Research Centre, 2007) to provide annual visitor numbers. From these numbers it has been possible to derive the impacts, either positive or negative of each of the options. Table 5.5 presents the losses/gains as a result of the implementation of each of the scheme options. The gain of tourism associated with the construction of Option 4 or 5 is indicated by a negative number.

Table 5.5: The tourism losses/gains associated with each scheme

	Do Nothing	Option 4 - Revetment along the whole frontage	Option 5 - Beach Recharge, Rock Groyne and Revetment
Potential loss / gain (£k)	14,221.72	-12,430.13	-28,126.34

5.5.3 Summary table of the PV losses for each option

Table 5.6: The PV losses and benefits associated with each scheme

	Do Nothing	Option 4 - Revetment along the whole frontage	Option 5 - Beach Recharge, Rock Groyne and Revetment
Assets (£k)	9,416	-9,416	-9,416
Damage (£k)	152,547	2.74	2.74
Tourism (£k)	14,222	-12,430	-28,126
Total PV losses (£k)		188,612	204,308

5.6 *Benefit Cost Appraisal*

	Option 1 (do nothing)	Option 4	Option 5
PV costs PVc		68,838.66	62,269.78
Optimism bias adjustment		20,651.60	18,680.94
Total PV Costs for appraisal PVc		89,490.26	80,950.72
PV damage PVd	152,547.13	2.74	2.74
CV damages	14,221.72	-12,430.13	-28,126.34
PV damage avoided		179,196.24	194,892.45
PV assets Pva	9,415.99		
PV asset protection benefits		9,415.99	9,415.99
Total PV benefits PVb		188,612.23	204,308.44
Net Present Value NPV		99,121.97	123,357.72
Average benefit/cost ratio		2.74	3.28
Incremental benefit/cost ratio		2.11	-1.84

6. Selection and Details of the Preferred Option

6.1 *Selecting the Preferred Option*

The preferred option has been developed using the Draft PAR as a baseline. Additional information to update the Draft PAR has been used to select the preferred option including the latest erosion rates from the 2009 SMP2, the modelling results from Royal Haskoning (2010) and other additional sources of information.

The tourism benefits that were considered for the preferred option were developed through a survey to determine the value of enjoyment that visitors would put on their trip to Colwyn Bay. The process indicated that people would pay more for the preferred Option 5 owing to the beach recharge providing a wider and improved beach.

The preferred option is consistent with the outcome of the Draft PAR and the Strategy. The Strategy and the Draft PAR identified that the preferred option for the frontage was Option 5. However, this recommendation was based on the availability of funding.

The preferred option will provide Colwyn Bay not only with an improvement in the standard of coastal defence but also opportunities to improve amenity and leisure interests across the frontage and in combination with other proposals aid regeneration of the town.

Table 6.1: Benefit cost assessment

	PV Costs (no Optimism Bias)	PV Costs (including Optimism Bias)	PV Benefits	Av. Benefit/Cost Ratio
Option 4 - Revetment along the whole frontage	68,839	89,490	188,612	2.74
Option 5 - Beach Recharge, Rock Groyne and Revetment	62,270	80,951	204,308	3.28

The two options considered have been designed to have the same function and level of protection and therefore are directly comparable. The benefit cost analysis has demonstrated that Option 5 offers the highest benefit cost ratio at 3.28, demonstrating that Option 5 offers the best long-term value.

6.2 *Sensitivity Testing*

The erosion rate used to assess potential losses as a result of the Do Nothing scenario and potential benefits of Options 4 and 5 is considered to be conservative. It has been based on erosion rates provided in the SMP2, 2009 which equates to an average of 0.3m/yr for the first 50 years and 0.7m/yr for the second 50 years i.e. 50m over 100 years. This has been updated assuming failure of defences in Year 5 not year 20 giving a total erosion of 55m. At Penrhyn Bay to the north west, historic erosion rates of 0.55m/yr have been recorded (SMP2, 2009). If the Bruun rule is provided to this erosion rate, then in a 100 year period, the recession could be anticipated to reach 110m rather than the 55m assessed in this updated PAR. This would lead to higher benefit cost ratios for both Options 4 and 5.

It has been assumed in the benefit cost analysis that the initial recharge phase will take place during one summer season. This will minimise losses of recharge material which could be vulnerable to removal during storms etc. Additionally, a one season construction period will minimise disturbance to the tourism industry of the Town.

6.3 Details of the Preferred Option

Technical Aspects

The preferred option is for a 200m long rock groyne with a crest height of +5.5mOD at the landwards end of the structure and +2.5mOD at the seaward end. To the east of the groyne a 1382m rock revetment is proposed with a 29.7m footprint. To allow construction of the revetment it is considered necessary to raise the Promenade level by approximately 2m.

The preferred option includes beach recharge from the west of the rock groyne to Rhos Jetty. The recharge is proposed to be similar to the existing beach material and a volume of 1.56 million cubic metres is required. Maintenance recharge of 450,000 cubic metres is proposed for every 10 years, based on the sediment transport modelling undertaken by Royal Haskoning (2010).

The design life of the preferred option is 100 years.

Costs for the Preferred Option

Details of the cost basis for the preferred Option are summarised in Section 5.4, with a cost date of July 2010. The spreadsheets are presented in Appendix C.

Table 6.2: Capital costs for construction

	Option 4 – revetment only	Option 5 – Rock groyne, revetment and beach recharge
Promenade Construction (£k)	16,235	16,235
Revetment (£k)	48,473	14,894
Rock Groyne (£k)		2,555
Beach Recharge including mobilisation and demobilisation (£k)		16,193
Total PV Costs (£k)	62,520	48,190
Total Costs including Optimism Bias of 30%	81,276	62,647

Outcome Measures

A detailed breakdown of the calculations for the Outcome Measures for the preferred option is presented in Table 6.3.

Table 6.3: Outcome measures

Outcome Measure	Total
OM1 Economic Benefit PV Benefits (£k)	204,308
OM2 Households at risk (nr) OM2b Households moving Risk Bands (Nr)	158
OM3 Households at risk in Deprived Areas (Nr)	
OM4 Improved condition of SSSI (ha)	
OM5 BAP Habitat (ha) Costs (£k)	62,270
Outcome Measure Prioritisation Score	0.91

7. Implementation

7.1 Project Planning

The preferred option has been planned for delivery in three phases. For the Phase 1 works, Conwy County Borough Council is being supported by grant funding from the European Convergence Funding Programme with match funding provided by the Welsh Assembly Government. The grant funding expenditure profile agreed between Conwy County Borough Council and its funding partners identifies that works to commence Phase 1 of the coastal defence must be delivered during the 2010/11 financial year. Circa £4.5 million of grant funding is to be utilised by Conwy County Borough Council during the 2010/11 financial year to commence Phase 1 coastal defence works.

Phase 1 construction works comprise the rock groyne and approximately 260m of revetment to the east. Phase 2 comprises the beach recharge to the west of the new rock groyne. Phase 3 extends the revetment to the east of the proposed rock groyne to its full design length.

Beach recharge is recommended every 10 years to supplement the beach levels.

Maintenance of the rock groyne and revetment is recommended every 25 years. The cost of this is proposed to increase by 10% every 25 years starting from 10% of the overall cost in Year 25.

7.2 Delivery Risks

The key risks are presented in Table 7.1

Table 7.1: Key Risks of the preferred Option

Key Project Risk	Adopted Mitigation Measure
Potential for further coastal erosion/damage to the beach levels and seawall/promenade before the works begin	The funding will need to be made available as soon as possible to prevent any losses
Potential for further coastal erosion/damage to the beach levels and seawall/promenade during the works	Depending on the construction method adopted and the timing of construction then sections of the currently protected coastline may be exposed to storm events. If the works can be completed by late summer/early autumn then the likelihood of erosion is reduced compared to the work being undertaken in autumn/winter
Potential for further coastal erosion/damage to the beach levels and seawall/promenade following the works	The Preferred Option does not prevent dynamic response of beaches to storm events and that seasonal changes in beach profile and beach level are an inherent part of the Preferred Option.

8. References

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Appendix A. Draft 2006 PAR

Draft



Colwyn Bay

Proposed Coastal Defence Improvements



Preliminary Project Appraisal Report

August 2008

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Conwy County Borough Council
Colwyn Bay – Proposed Coastal Defence Improvements
Project Appraisal Report
August 2008

Document History Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date
1	0	Draft for Comment	31/08/08

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APPENDICES

- I. Summary of Public Consultation
- II. Photographic Plates
- III. Optimism Bias Derivation

1 INTRODUCTION

1.1 KEY OBJECTIVES

1.1.1 The PAR presented here relates to the provision of improved coastal defence measures along the coastal frontage of Colwyn Bay between Rhos-on-Sea and Old Colwyn, as shown on figure 1.1.

1.1.2 The principle objective of the scheme is:

- To provide improved coastal defence measures within Colwyn Bay that are commensurate with the risk of flooding and erosion to the local population, local property and local and national infrastructure.

1.2 APPRAISAL DETAILS

1.2.1 The appraisal has been carried out in accordance with Flood and Coastal Defence Project Appraisal Guidance (MAFF, 2000) as amended by the supplementary note to Operating Authorities (DEFRA, March 2003). Data used in the appraisal has been obtained from a variety of sources, including:

- Site visits and historic/contemporary surveys (including Authority Beach Monitoring Records)
- Assessment of historical reports and records (Ordnance Survey maps, photographs (aerial/ground) etc)
- Review of effects of historic events, the causes and impacts on property and land
- Middlesex University "Multi-coloured Manual" - 2005

1.2.2 The scope of the work for the current study involved:

- Site visits to confirm status of current position of site features and to obtain relevant information from land/property owners
- Consultation with Countryside Council for Wales with regard to potential impacts on nature conservation interests.
- Establishing the boundaries of land ownership at the site
- Discussions with local estate agents to establish current property values
- Identification of potential future behaviour of the cliff frontage without further intervention
- Economic, environmental and technical evaluation of a range of coastal defence options
- Identification of a preferred scheme of improvements

1.3 PREVIOUS REPORTS AND STUDIES

1.3.1 The appraisal is based on the work carried out in development and production of the Colwyn Bay Coastal Defence Strategy Plan, which was produced by and on behalf of the Council in 2006/07 (Conwy CBC/Coastal Engineering UK Ltd, November 2007). The Colwyn Bay frontage was part of a wider strategy area from the Little Orme to Tan Penmaen Head, as shown on figure 1.2.

1.3.2 The Coastal defence strategy plan provided technical, economic and environmental appraisal of a range of options to maintain or improve coastal defences across the frontage.

1.4 APPROVALS & CONSENTS

1.4.1 The proposed scheme of work will require approval from different local and central government departments before any works can proceed. The specific approvals required may include, but will not necessarily be limited to, all or some of the following:

- Planning Approval under Town and Country Planning Legislation.
- A licence to deposit materials on the foreshore below mean high water spring tide (MHWST) level in accordance with the Food and Environmental Protection Act (1985) - FEPA Licence;
- Approval under the Coast Protection Act 1949, Section 34.
- Coast Protection Act Approval by the Coast Protection Authority (Conwy County BC).
- Approval for Grant Aid Assistance from Welsh Assembly Government (WAG).

The FEPA and section 34 Coast Protection Act approvals in Wales are currently dealt with under a single application to

Marine and Fisheries Agency in London. It is understood that this role will be transferred to Welsh Assembly Government sometime in 2008.

1.5 CONSULTATIONS

- 1.5.1 Public consultation played a key role in the development of the Coastal Defence Strategy Plan in 2006 and 2007.
- 1.5.2 As part of the strategy development a range of options for maintaining or improving the coastal defences within Colwyn Bay were identified and examined, which formed the basis for initial public consultation, which included a public exhibition held in December 2006.
- 1.5.3 The results of the initial consultation are provided in a report produced by the Authority (Conwy County Borough Council, February 2007), a summary of which is provided in Appendix I.
- 1.5.4 The Authority has consulted the Countryside Council for Wales with regard to the effects changes to the coastal defences would have on nature conservation interests and a Strategic Environmental Assessment was carried out as part of the strategy development (CMACS Ltd, October 2007).
- 1.5.5 Further to the initial public consultation exercise, further technical development of options, economic analysis and environmental appraisal was carried out, in order to complete the strategy and the Draft Strategy Option was presented for further public examination in November 2007.
- 1.5.6 Results of draft strategy plan consultation to be inserted here.

1.6 ASSETS PROTECTED

- 1.6.1 The assets protected comprise the following:
 - The Chester to Holyhead Railway line and associated track and station infrastructure
 - The A55 Trunk road
 - 12 Commercial properties
 - 180 Residential properties

1.7 BENEFITS OF THE PROPOSED SCHEME

- 1.7.1 The proposed scheme will safeguard the integrity of the present coastal defence and safeguard the land, property and infrastructure at risk that is identified in section 1.6.1.
- 1.7.2 The scheme will improve the amenity of the area and linked to other regeneration initiatives, associated with waterfront and town centre, will form part of a wider regeneration package that will benefit the whole of Colwyn Bay, not just the seafront.

1.8 SUMMARY OF CONCLUSIONS

- 1.8.1 The present minimum standard of protection against erosion is estimated to be between 1 and 5 years and protection against flooding at < 1 years, both of which are below the indicative standard of protection of 1 in 100-300 years (Land Use Band A) as stated in current Flood and Coastal Defence Project Appraisal Guidance (MAFF, 2000).
- 1.8.2 Project Appraisal has confirmed that there is technical, environmental and economic justification for carrying out a scheme of coast protection improvements to provide an improved uniform level of defence across Colwyn Bay
- 1.8.3 The preferred scheme comprises initial capital works as follows:
 - Eastern Section between Eirias Park and Old Colwyn: Construction of a new rock armour revetment, promenade and crest wall
 - Central and Western Sections between Rhos Jetty and Eirias Park: Recharging of the beach with sand and improvements to the promenade and crest of existing defences
 - Central Section between Penrhos College site (Toad Hall) and Eirias Park: Provision of beach control structures (breakwaters, groynes etc) on the foreshore

1.8.4 The scheme also includes future management and maintenance actions comprising:

- Maintenance and repair of rock structures
- Maintenance and repair of promenade and crest works
- Beach management – movement of material on the beach
- Clearance of wind blown sand from promenades
- Topping up of beach levels as necessary
- Reworking of rock structures to maintain standard of service in line with sea level rise

1.8.5 The Environmental Impact of the proposed measures has been evaluated within the SEA carried out as part of the strategy development (CMACS Ltd, October 2007).

1.8.6 The estimated capital cost of the scheme over a 100 year timescale is approximately £39,750,000 (PV=£28,750,000).

1.8.7 The estimated costs of the works required immediately are approximately £27,000,000 including an allowance for fees. On-going capital works and structure maintenance and beach management, as identified in 1.8.5 above is estimated to cost on average approximately £100,000 per annum.

1.8.8 With appropriate maintenance and management the proposed works will provide an estimated design life of 40-70 years and potentially more, with material able to be re-used in any re-working to upgrade defence levels in the future.

1.8.9 The preferred scheme provides a benefit to cost ratio of about 1:3 and under a range of sensitivities tested between 1:2.5 and 1:4.

1.8.10 The improvements proposed will reduce the risk of flooding to events with an estimated annual probability of exceedance of $\leq 1-2\%$ (1 in 50-100 year return period event or greater). The risk of erosion will be reduced by implementation and subject to suitable maintenance and beach management will provide protection for at least the design life expectancy of the materials elements of the structure. Over the lifetime of the scheme changes to the level of risk will be mitigated by a combination of increasing beach levels and/or modifications to structure crest levels.

2 PROBLEM DEFINITION

2.1 SITE DESCRIPTION

2.1.1 The Colwyn Bay frontage is situated between the fixed shoreline locations of Rhos Point and Tan Penmaen Head. Local defences are provided at Rhos harbour at the western end and also between Old Colwyn and Tan Penmaen Head at the eastern end, the latter being under the jurisdiction of Network Rail and the WAG Highways Directorate. The shoreline in between, a distance of some 3500 metres, is defended by primarily a series of vertical masonry and/or concrete walls that date back to the early 1900s. For the purposes of evaluation and to accord with linked amenity regeneration initiatives the frontage is split into three discrete units, described below.

- SU 2/2/2 – CAYLEY PROMENADE - From Rhos Jetty around to the site of the former Penrhos College (Toad Hall)
- SU 2/3/1 – CENTRAL PIER FRONTAGE - From the site of the former Penrhos College (Toad Hall) to Eirias Park
- SU 2/3/2 – OLD COLWYN - From Eirias Park to Beach Road, Old Colwyn

The location of the key points that identify the start and finish locations of these units are shown on figure 1.1

2.1.2 Plates illustrating the current conditions applying and referred to in the text are provided in Appendix II.

2.1.3 The foreshore across the frontage is largely sand overlying boulder clay. In places the sand forms only a thin veneer and the clay can be exposed when significant beach movement occurs. At the top of the beach the sand is mixed with larger shingle and cobbles which are the remnants of the natural shoreline that existed prior to the erection of the first defences.

2.1.4 Across this frontage the foreshore is backed by a series of masonry and concrete vertical walls, the western parts of which date back to the 19th century. These walls have been subject to a great deal of repair and reconstruction almost from the date of construction, as beach levels have fallen. The situation has not been helped by the fact that groynes along parts of this frontage were allowed to fall into disrepair allowing beach levels to deteriorate. In 1987 the Council constructed a 650m rock berm along the most severely affected stretch of wall, and this has encouraged some sand accretion thus further assisting seawall stability. Further revetment improvements and construction of a number of long, low rock groynes (1990) encouraged beach recovery, with sand now covering large parts of the formerly exposed intertidal cobbles.

2.1.5 The section from Rhos-on-Sea to the Victoria Pier (SU 2/2/2 and the western half of SU2/3/1) comprises a mixture of masonry wall constructions which have been added to with various concrete and rock toe constructions (Plates 1-6). The crest level of these structures varies across this section of frontage between 8 and 5 metres AOD being typically 7-8 metres AOD across unit SU 2/2/2 before falling to 5m AOD adjacent to the Pier.

2.1.6 The section immediately east of the Victoria Pier (the eastern half of SU2/2/2) includes an integral wave recurved along the crest of the masonry wall, which is supported on a line of steel sheet piles over a length of about 800 metres. A rock revetment has been constructed in front of the wall along the majority of its length (plate 7). The crest level along this section is 6.2m AOD

2.1.7 Further to the east approaching Old Colwyn the crest level drops to 5.5 metres AOD and there is no wave recurve along the crest (plates 8-9). Routine remedial works are carried out across this frontage, generally to provide additional toe protection as beach levels fluctuate. The most recent storm event in February 2005 caused a beach level drop of about a metre over a 200 metre length of frontage, which undermined the wall and necessitated a further apron construction, comprising steel sheet piles and concrete infill (plate 10). Damage also occurs to the copings along the crest of the wall.

2.2 CURRENT CONDITIONS

2.2.1 Exposure conditions within Colwyn Bay vary across the frontage as a result of the natural features that bound the wider bay area and the orientation of adjacent shoreline lengths. The western end is sheltered from directions west of north but as the shoreline moves eastwards direct exposure to more westerly directions increases as the shoreline moves out of the shelter of Rhos Point. As a result the shoreline becomes more exposed to waves that approach the shoreline from oblique directions.

2.2.2 About 70% of wind generated waves occur from directions west of north (<360° WCB) and inshore these are generally

less than 3.0 metres in height with a significant wave height (Hs) of approximately 1.2 metres [HR Wallingford, 1991]

- 2.2.3 Predicted tide levels have a range of 7.0 metres on spring tides and 3.80 metres on neap tides. Mean High Water Spring Tide is 3.65 metres above Ordnance Datum (OD) and Highest Astronomical Tide is 4.60 metres above Ordnance Datum.
- 2.2.4 Current estimates of extreme tidal levels suggest a figure of 5.19 metres above Ordnance Datum for a tide level with a 10% annual probability of exceedance (1 in 10 year return period) and a figure of 5.64 metres above Ordnance Datum for a tide level with a 1% annual probability of exceedance (1 in 100 year return period).
- 2.2.5 Current allowances for future sea level rise (WAG, July 2007) show a rising trend as shown in table 2.1 below.

TABLE 2.1: REGIONAL NET SEA LEVEL RISE ALLOWANCES					
	Assumed vertical land movement (mm/yr)	Net Sea Level Rise (mm/year) relative to 1990			
		1990-2025	2025-2055	2055-2085	2085-2115
Wales	-0.5	3.5	8.0	11.5	14.5

- 2.2.6 The overall trend of littoral drift is from west to east along the North Wales coast. The magnitude of drift varies with wave exposure and the pattern is segmented into sub-units by estuaries and bays where tidal currents and local wave patterns dominate sediment transport.
- 2.2.7 Changes in beach volume across the frontage are available from the Authorities' KeyShore beach monitoring database and reported in their annual monitoring reports (Coastal Engineering, June 2006).
- 2.2.8 Beach levels have fallen and volumes reduced historically across this frontage and although there is cyclical behaviour, volumes recorded in 2007 were nearly 40,000m³ lower than in 2001 although across the SU 2/2/2 frontage in isolation volumes were approximately the same in 2007 as 10 years ago. Observations from inspections identify changes in beach level of up to a metre over a twelve month period can occur.
- 2.2.9 Beach response modelling carried out as part of the Strategy development confirms that, based on the last twenty years of wave conditions, the beach across SU2/2/2 is in reasonable equilibrium. However as the shoreline curves easterly the propensity to longshore movement increases, before slowing towards the old Colwyn end where shoreline orientation is more normal to the predominant wave directions.

2.3 PROBLEM DESCRIPTION

- 2.3.1 There are three key issues associated with the present coastal defence provision across the Colwyn Bay frontage:
- Beach lowering requiring on-going intervention
 - Ageing and decaying defences with an imminent risk of failure in the immediate term (0-5 years)
 - Regular overtopping and its effects on defences and adjacent infrastructure
- 2.3.2 Beach volumes across the Colwyn Bay frontage have historically dropped since the defences were originally constructed, primarily as a result of reduction in the natural feed of material from the shoreline within the bay, due to a reduction in littoral drift from the west exacerbated by the hardening of the shoreline here and by the vertical nature of the defences which induced wave reflections and scour necessitating extensions of the toe in many places to mitigate the risk of undermining. Despite attempts to control the movement of the beach in the past, this trend is continuing and increasing the exposure of the present defences.
- 2.3.3 Many of the defences are over 100 years old and despite the addition of newer toe works many sections include life expired elements that have failed and been patched up in the past, most recently in February 2005.
- 2.3.4 The crest level of defences varies significantly across the frontage by up to 3 metres, with the lowest levels being less than 0.5 metres above predicted Highest Astronomical tide. Overtopping of these lowest defences (at Old Colwyn and adjacent to the Pier) occurs on a regular basis, causing damage to the promenade and road infrastructure and necessitating closure of the public highway to traffic (plate 11). Severe events have caused damage to the embankment on the landward side of the road that supports the Chester to Holyhead railway (plate 12).

2.4 HISTORY OF EROSION AND SYSTEM FAILURES

- 2.4.1 The defences are subject to an on-going regime of repair and management to maintain their functionality.

- 2.4.2 Storm damage occurs regularly. The most significant recent event was in February 2005, when sections of walls were undermined requiring addition of further sections of sheet piled and concrete toe (plate 9) and damage was caused to promenade surfacing and along the crest of the sea wall to copings and railings (plate 11).
- 2.4.3 Pre 2005 damage to the defences has occurred on a regular basis with the following specific events
- 2.4.4 Surveys of the beach identify that beach elevation changes of up to one metre can occur year on year.

2.5 FREQUENCY OF EVENTS

- 2.5.1 With beach volumes and therefore elevations falling, overtopping of defences and the potential for damage occurs with a > 100% annual probability of occurrence (< 1 in 1 year return period).
- 2.5.2 Over the past thirty years the following major storm events have occurred in Liverpool Bay
- November 1977
 - January 1983
 - February 1990 Estimated Annual Probability of occurrence < 1%
 - February 1997 Estimated Annual probability of occurrence 12.5%
 - February 2002 Estimated Annual probability of occurrence 16.6%
 - February 2005 Estimated Annual probability of occurrence > 100%

2.6 LINKS WITH STRATEGY PLANS AND DETAILS OF INTERDEPENDENCIES

- 2.6.1 The Shoreline Management Plan (SMP) for sub-cell 11a [Liverpool Bay (Great Orme, Llandudno to Formby Point)] was produced over the period 1997-1999 [Shoreline Management Partnership, 1999].
- 2.6.2 The SMP identified the shoreline from Rhos Point Tan Penmaen Head as two management units.
- Rhos Point to Penrhos College (MU 2/2) – where the principal coastal defence risk was flooding
 - Penrhos College to Tan Penmaen Head (MU 2/3) – where the principal coastal defence risk was erosion
- 2.6.3 The preferred future coastal defence policies identified, and subsequently adopted, for both the management units were as follows:
- Short Term (< 10 years) **Hold the Line**
 - Anticipated Long Term (> 10 years) **Hold the Line**
- 2.6.4 The Shoreline Management Plan however only identifies what the appropriate policy should be, not the ways in which the policy is to be achieved.
- 2.6.5 Further to recommendations in the Shoreline Management Plan, Conwy County Borough Council produced a Coastal Defence Strategy for Colwyn Bay covering the shoreline from the Little Orme to Tan Penmaen Head (Coastal Engineering UK Ltd, November 2007). This document is currently open to public consultation.
- 2.6.6 The Strategy split the Colwyn bay frontage into three separate strategy units, as detailed in section 2.1.1 above. However due to the inter connection and dependency between the units, appraisal was carried out as a single frontage. The strategy considered a range of options for implementing the Shoreline Management Policy - MAINTAIN, SUSTAIN and IMPROVE
- 2.6.7 Strategic assessment of a range of options identified that - “Only the IMPROVE management approaches proposed accord with the shoreline management policy of Hold the Line in this strategy unit, due to the general poor condition and low residual life expectancy of the existing defences. The DO-NOTHING, MAINTAIN and SUSTAIN options do not accord with the policy and are therefore inappropriate and not considered further”
- 2.6.8 The strategy recommended that - “The proposed management approach for this strategy unit is IMPROVE with the preferred option, subject to availability of funding, being the combined approach that not only provides an improvement in the standard of coastal defence but provides opportunities to improve amenity and leisure interests across the frontage and in combination with other proposals aid regeneration of the town”.

2.7 REVIEW OF EXISTING POLICY OPTIONS

- 2.7.1 The existing policy along this frontage is one of HOLD THE LINE by monitoring the foreshore and condition and maintaining the present defences.
- 2.7.2 The results of the on-going monitoring have confirmed that the beach levels are continuing to fall and that the condition of the defences is worsening.

2.8 RESIDUAL LIFE OF EXISTING STRUCTURES

- 2.8.1 The residual life of the existing defences depends on the magnitude and frequency of future storm events and the ability of the defences to resist the imposed loadings. Accordingly this will vary with location, age and type of structure.
- 2.8.2 The condition of the existing defences varies across the frontage, with fluctuating beach levels in front of the defences causing undermining and wave impacts and overtopping causing structural damage to the wall and promenade fabric.
- 2.8.3 Certain elements of the defences can be considered as nearly life expired. Without further attention the minimum residual life of sections of the defences is estimated to be < 5 years.

2.9 PROBABILITY OF OVERTOPPING

- 2.9.1 Due to the varying forms and crest level of the structures, and the changing relationship between the orientation of the shoreline and the wave conditions applying, the existing structures provide a variable level of defence to overtopping and flood prevention.
- 2.9.2 Examination of the overtopping criteria for a range of defence profiles however suggests that due to the general low beach levels applying across the frontage (toe level typically at or below mean high water level) all lengths are vulnerable to overtopping for conditions that are predicted to occur on at least an annual basis. In the case of the highest level of defences this may just be in the form of spray, but for the lower defended sections this will provide for “green water” overtopping the defences, which causes disruption to hinterland infrastructure. At its lowest sections overtopping can occur typically on a monthly frequency and sometimes on every spring tide, if wave conditions occur at the same time as high waters.

2.10 DO-NOTHING EVALUATION

- 2.10.1 The Do-nothing (or No Active Intervention) scenario provides the basis for establishing whether it is economically viable to artificially intervene in management of the shoreline, or whether the shoreline should be left to its own devices.
- 2.10.2 In accordance with the latest guidance on Flood and Coastal Defence Project Appraisal (FCDPAG3), the basis of evaluation of future shoreline management strategies or individual schemes is the economic viability of incurring expenditure against the option of doing nothing (the ‘do-nothing’ scenario). The technical robustness and environmental effects of adoption of such a policy also require consideration.
- 2.10.3 The do-nothing scenario varies dependant on the specific existing circumstances applying:
- Where existing defences are in place, walk-away, cease all maintenance, repairs and similar activities. Any expenditure for health and safety reasons to abandoned works should be counted as a scheme cost.
 - Where there are no existing defences in place do not intervene in natural process behaviour.
- 2.10.4 The starting point for evaluation of the do-nothing scenario can be defined by the following criteria:
- The current condition and residual life of the existing coastal defences.
 - The current and likely future position of the shoreline.
 - The effects on the assets being protected of erosion of the natural shoreline;
 - The effects on the natural environment

2.10.5 Under a No Active Intervention scenario, overtopping of the defences will continue to occur on a regular basis, in the immediate term (0-5 years) necessitating closure of the promenade from “Toad Hall” to the A55 junction 22 and/or from the A55 junction 22 to Beach Road during particularly severe occasions.

2.10.6 With major damage to the existing defence structures occurring on typically a five year frequency in the recent past, it is anticipated that failure of the defences is unlikely to occur in the immediate term but is likely to occur in the short term. The most likely sections for initial failure are the Old Colwyn end or the section west of the Pier.

2.10.7 The principal future effects would be:

- Loss of promenade highway access and closure of promenade businesses
- Erosion of the embankment supporting the railway and closure of the railway
- Detachment of the pier from the shoreline
- Loss of the A55
- Gradual spread of recession inland and longshore until the beach reaches an equilibrium, leading to loss of a number of properties in the centre of Colwyn Bay and along the front between the Pier and Cayley Promenade in the medium to long term

2.10.8 The predicted timeline of effects under the Do-Nothing scenario for this unit are provided in table 2.1 below:

TABLE 2.1: TIMELINE OF PREDICTED DO-NOTHING IMPACTS		
Term	Years	Predicted Behaviour
Immediate	2007-2012	• Overtopping of defences causing damage to structures and temporary closure of the promenade to traffic
Short	2013-2027	• Overtopping of defences causing damage to structures and temporary closure of the promenade to traffic • Initial failure of the defences leading to immediate closure of the promenade to traffic from Toad Hall to Beach Road, Old Colwyn (years 10-20)
Medium	2028-2057	• Continued overtopping of intact defences • Erosion of embankment supporting the railway and closure of the railway (year 30-40) • Gradual longshore and inshore spread of recession leading to failure of more lengths of defences • Potential loss of a number of properties along the front between the Pier and Cayley Promenade (year 40-50) • Probable detachment of the pier from the shoreline (year 50)
Long	2058-2107	• Continued overtopping of intact defences • Loss of the A55 (year 50-60) • Further longshore and inshore spread of recession leading to failure of more lengths of defences • Loss of a number of properties in the centre of Colwyn Bay and along the front between the Pier and Cayley Promenade (year 50-100)

2.10.9 The predicted limits for recession under the DO-Nothing scenario are shown in figure 2.1

2.11 DESIGNATED AREAS AND SITES AFFECTED

2.11.1 There are no designated areas of environmental importance within this frontage.

2.11.2 A proposed SPA covering the Liverpool Bay area (Liverpool Bay pSPA), a Natura 2000 site, will potentially abut the Colwyn Bay frontage and would therefore be an important site of nature conservation interest.

2.11.3 There are no scheduled ancient monuments or listed buildings located within this section of frontage.

2.12 IMPACT ASSESSMENT

- 2.12.1 A Strategic Environmental Assessment was produced as part of the Colwyn Bay Coastal Defence Strategy Plan. (CMACS Ltd, November 2007). This considered the impacts of adopting different strategic management options.
- 2.12.2 Under the Do-Nothing scenario eventual failure of the defences would release sediments and gradual alteration to shoreline alignment would provide for different conditions applying – changed sediment transport patterns etc, providing eventually for a more equilibrium process/shoreline interaction. The loss of sediment trapping groynes on beaches could result in loss of current beach sediments and, potentially, a change in intertidal character. Hard structures such as sea walls, cycle track etc would be colonised by marine algae and encrusting fauna as they collapsed into the sea and the area would eventually be expected to equilibrate to a sedimentary shore habitat. There would be a **Negative** impact on the built environment due to the loss of promenade and cycle track, highway access and closure of promenade businesses which would all have a detrimental impact upon the local economy and the regions tourism. Further infrastructure and economic impacts would also occur from loss of the A55, loss of integrity of the railway embankment and a number of commercial/residential properties in the medium to long term. Failure of sea wall and recession of shoreline is considered to have a **Negative** landscape impact
- 2.12.3 The impacts of maintaining defences would be as for the Do-Nothing scenario but over a longer timescale. Maintenance of structures may impact habitats and associated species from construction plant. Such impacts would be highly localised and temporary but would increase in frequency as higher levels of maintenance would be required over time.
- 2.12.4 Sustaining the present defences would have similar impacts to the maintain option but at a different frequency. Provision of a rock toe would provide for improved shoreline/defence interaction mitigating against beach lowering and fluctuations in beach levels in front of the defences. It would also initially cover up existing habitat although it would then provide a small area for colonisation. There would be a short to medium positive impact regarding the protection of the existing land infrastructure; however modifications to the crest may have a negative impact on the panorama of the seascape from the road/promenade. Eventual failure of the defences in the long term would have the same ultimate **Negative** impacts as the Do Nothing and Maintain options.
- 2.12.5 Linear defence improvements will move the high water mark to seaward but would provide for improved shoreline/defence interaction mitigating against beach lowering and fluctuations in beach levels along the toe. Generally the existing longshore sediment movement regime would be maintained. New structures would cause a loss of habitat due to coverage of foreshore, however this impact would be ameliorated by subsequent colonisation by marine algae and encrusting species. Subsequent habitat could be altered in places from a predominantly soft-substratum environment to one dominated by hard-substratum favouring species. In places these structures would also attract fish for feeding opportunities during high water periods. Built environment impacts are considered to be positive regarding the protection of the existing land infrastructure; however changes in elevation of the promenade may have a **Negative** impact on the panorama of the seascape from the road and foreshore
- 2.12.6 Beach recharge would provide more material for potential movement but increased elevations would reduce impacts with existing defences e.g. wave reflections. Control structures will modify wave, tide and sediment patterns but longshore drift offshore of groynes will persist. Losses of material at eastern end will continue to provide feed to down drift areas albeit at a reduced rate. It would smother existing benthic and intertidal infauna and may also cause elevated suspended sediments impacting upon water quality and subsequently benthic and fish species. Additional impacts to coastal bird species may occur due to smothering of infaunal prey items. Control structures would remove habitat previously available for benthic and fish species foraging, spawning and nursery areas. Such structures may have the benefit of providing additional complex “reef” like habitat which would provide increased habitat availability for commercial species such as crabs and lobster. Such structures may also act to aggregate fish species utilising it for food, shelter from currents and predators. Impacts on the built environment are generally as for linear defences. In addition greater visual impacts would be incurred from control structures with connected groynes impacting the beach panorama or offshore breakwaters affecting the seaward views. The artificial beach recharge would also cause a visual impact, due to the elevation of levels. However, as this is seen as enhancement of a natural habitat and because the levels would not be above the current sea defences this visual impact is considered to be low.

2.13 OPPORTUNITIES AND CONSTRAINTS

- 2.13.1 The principal opportunity associated with coastal defence improvements is in providing a uniform level of coastal defence to the entire frontage, thereby safeguarding the integrity of the present defence line and providing long term security to local residents and commercial business operators.

2.13.2 By linking the provision of improved coastal defences to a comprehensive plan for physical regeneration of the whole of Colwyn Bay, the proposals also provide opportunities for:

- Improved amenity and tourism
- Improved town identity
- Increased social inclusion
- Greater attraction for business relocation
- Improved employment opportunities

2.13.3 The principal constraint on provision of improved coastal defences is funding for the works, specifically:

- Obtaining EU Convergence Funding
- WAG approval for Coastal Defence Expenditure and associated Grant Aid

3 APPRAISAL OF OPTIONS

3.1 ALTERNATIVES CONSIDERED

3.1.1 Options considered have been developed from the strategic assessment carried out for the Strategy Plan.

3.1.2 Intervention Options considered comprise the following options:

- Maintenance but no improvement of the existing defence assets – reducing standard of service
- Sustaining existing defence assets – maintaining existing minimum standard of service
- Improve and maintain linear defences – improved standard of service
- Improve defences by artificially supplementing and managing beach volumes and profiles – improved standard of service

Specific arrangements associated with each of these alternatives are discussed below.

Maintain Existing Defence Assets

3.1.3 For the maintain option, maintenance works comprising repair of damage and maintenance of the existing concrete/masonry walls, promenade and rock toe structures will be carried out.

3.1.4 Maintenance of the beach and defence structures is estimated to be sufficient to prolong the integrity of the defence line by up to 20 years with overtopping continuing during that period. Failure of the defences will occur eventually however and the impacts of the Do-Nothing scenario will take place but delayed, as this option does not include for major capital works to be carried out.

3.1.5 This option provides a slight reduction in risk compared to the Do-Nothing case but would not improve conditions along the frontage and the standard of service would reduce over time.

Sustain Existing Defence Assets

3.1.6 The sustain option provides for the on-going maintenance of structures and the promenade together with the provision of a uniform rock toe along the whole frontage, to assist in stabilising beach levels. It also includes for topping up and re-profiling of the rock toe structure and increasing the crest level of the defences through provision and upgrading of additional crest walls.

3.1.7 This would initially improve the level of defence but due to the variable elevation of the defences across the frontage a uniform level of defence and hence standard of service would not be achieved.

3.1.8 This option would maintain the integrity of the defence line throughout the next 50 years and adjusts the structure crest level to maintain the level of risk of overtopping due to rising sea levels at its present level. However in the longer term maintaining the integrity of the existing structures is not considered to be viable and there is associated risk to infrastructure concomitant with the maintain option. In the longer term promenade access and the railway would be under threat with associated risk of damage and eventual loss beyond 50 years.

3.1.9 These works will enhance the life of the defences and reduce but not eliminate entirely the risk of shoreline recession. Overtopping will continue to take place at the present rate.

3.1.10 This form of construction already exists in sections across this frontage, as shown in figure 3.1

Improve Existing Defences

3.1.11 The indicative standard of protection for the Colwyn Bay frontage is 1 in 100-300 years (Land Use Band A), or an annual probability of exceedance of $\frac{1}{3}$ - 1% (MAFF, 2000).

3.1.12 A range of options for providing improved coastal defence for this section of frontage have been considered and assessed as part of strategy development. These options were subsequently consulted on as part of the strategy consultation

process (Ref. section 1.5) and two favoured alternatives were developed and refined in the light of subsequent technical evaluation and modelling carried out.

- 3.1.13 Both the alternatives will provide an improved level of flood and coastal protection that achieves the best balance between the costs of providing and maintaining the defences and the potential damages that would occur for different levels of service, which would be determined during detailed design and appraisal. They also include for amending crest levels and/or profiles in 50 years time in response to increased sea levels and climate change.
- 3.1.14 The first alternative would comprise a new linear rock armour revetment built directly in front of the existing sea wall along the, whole frontage, similar to that which exists between Rhos-on-Sea and Penrhyn Bay. It would also include for a new promenade and improved crest defences that would limit overtopping. This option would not significantly improve the beach condition or provide any significant amenity benefit. This represents the least cost option to safeguard the integrity of the defences, protect local and national infrastructure and improve the level of service provided to that which is commensurate with the level of risk applying.
- 3.1.15 An artists impression of how this might look, viewed from the Pier westerly is provided in figure 3.2
- 3.1.16 The second alternative represents a combined approach developed from the technical appraisal carried out and the Stage 1 strategy consultation, consisting of beach recharge and revised beach control structures combined with new linear revetments and promenade in places with the following proposed arrangements applying for the individual lengths of frontage:
- Western Section - Rhos Jetty to Penrhos College: Beach Recharge.
 - Central Section - Penrhos College to Eirias Park: Beach Recharge, Control Structures and New Crest Works in Places.
 - Eastern Section - Eirias Park to Old Colwyn: New Linear Rock Revetment, Crest Works and Promenade.
- 3.1.17 An artists impression of how the beach recharge with control structures might look, viewed from the Pier westerly, is provided in figure 3.3.
- 3.1.18 This alternative requires regular beach management and periodic “topping up” of beach levels to maintain the necessary design level of protection, as there will be movement of the beach under the action of the wind, waves and tide and losses will occur from time to time.
- 3.1.19 This alternative also provides not only improved defence function but opportunities for improved amenity and development to meet the aspirations of the local community for economic regeneration of the Colwyn Bay frontage.

Summary

- 3.1.20 Table 3.1 below provides a summary of the timing of actions required under each of the options within four epochs:
- Immediate Term: Years 0-5;
 - Short Term: Years 6-20;
 - Medium Term: Years 21-50 and,
 - Long Term: Years 51-100.

TABLE 3.1: SUMMARY OF INTERVENTION OPTION ACTIONS

OPTIONS				
Term	Option 2 Maintain Existing	Option 3 Sustain Existing	Option 4 Improve - Linear Defences	Option 5 Improve – Combined Approach
Immediate	Maintenance of existing masonry/concrete structures and promenade (Annually) and rock armour structures (5 yearly)	- Maintenance of existing masonry/concrete structures (Annually) and rock armour structures (5 yearly) - Major remedial work to masonry/concrete structures and promenade (year 60, 70, 80 & 90) - Rock toe reprofiling (year 75) - Raise crest level of backshore defences (year 75) - Possible remedial repairs to NR embankment (dependant on storm frequency and magnitude)	Construct new linear rock revetment and promenade	Recharge beach & construct control structures, linear defences and crest works
Short	- Maintenance of existing masonry/concrete structures and promenade (Annually) and rock armour structures (5 yearly) - Major remedial work to masonry/concrete structures and promenade (year 10, 20)	- Maintenance of existing masonry/concrete structures (Annually) and rock armour structures (5 yearly) - Major remedial work to masonry/concrete structures and promenade (year 60, 70, 80 & 90) - Rock toe reprofiling (year 75) - Raise crest level of backshore defences (year 75) - Possible remedial repairs to NR embankment (dependant on storm frequency and magnitude)	- Maintain new rock armour structures (5 yearly) - Regular maintenance of crest works and promenade (5 yearly)	- Beach Management (1/2 yearly) - Maintain new rock armour structures (5 yearly) - Regular maintenance of crest works and promenade (5 yearly)
Medium	- Maintenance of existing masonry/concrete structures and promenade (Annually) and rock armour structures (5 yearly to year 40) - Major remedial work to masonry/concrete structures and promenade (year 30)	- Maintenance of existing masonry/concrete structures (Annually) and rock armour structures (5 yearly) - Major remedial work to masonry/concrete structures and promenade (year 60, 70, 80 & 90) - Rock toe reprofiling (year 75) - Raise crest level of backshore defences (year 75) - Possible remedial repairs to NR embankment (dependant on storm frequency and magnitude)	- Maintain new rock armour structures (5 yearly) - Regular maintenance of crest works and promenade (5 yearly) - Review crest level and profile of sustain level of protection (year 50)	- Beach Management (1/2 yearly) - Maintain new rock armour structures (5 yearly) - Regular maintenance of crest works and promenade (5 yearly) - Review crest level and profile of defences to sustain level of protection (year 50)

TABLE 3.1: SUMMARY OF INTERVENTION OPTION ACTIONS

OPTIONS				
Term	Option 2 Maintain Existing	Option 3 Sustain Existing	Option 4 Improve - Linear Defences	Option 5 Improve – Combined Approach
Long	No works – Do Nothing applies	- Maintenance of existing masonry/concrete structures (Annually) and rock armour structures (5 yearly) - Major remedial work to masonry/concrete structures and promenade (year 60, 70, 80 & 90) - Rock toe reprofiling (year 75) - Raise crest level of backshore defences (year 75) - Possible remedial repairs to NR embankment (dependant on storm frequency and magnitude)	- Maintain new rock armour structures (5 yearly) - Major maintenance of crest and promenade works (year 60) - Regular maintenance of crest works and promenade (5 yearly)	- Beach Management (1/2 yearly) - Maintain new rock armour structures (5 yearly) - Regular maintenance of crest works and promenade (5 yearly) - Major maintenance of crest and promenade works (year 60)
Notes * Frequency to be confirmed, subject to on-going monitoring and beach management plan				

3.2 COSTS

3.2.1 Table 3.2 below provides a summary of the estimated costs applying in relation to each of the options.

TABLE 3.2: SUMMARY OF OPTION COSTS					
Cost Element¹	OPTIONS				
	Option 1	Option 2	Option 3	Option 4	Option 5
	Do-Nothing	Maintain Existing	Sustain Existing	Improve - Linear Defences	Improve – Combined Approach
Initial Capital Costs (1st five years)	0	165,000	2,990,000	15,420,000	26,320,000
Design & Construction Fees (Initial)	0	30,000	260,000	1,055	1,625,000
Maintenance/Management Costs (Year 5 on)	0	3,695,000 ²	79,000	265,000	190,000
Future Capital Costs (Year 5 on)	0	0	17,438,000	2,408	10,340,000
Future Fees (Year 5 on)	0	503	1,940,000	330,000	1,270,000
Notes ¹ All costs are £k ² Costs to year 50 only					

3.2.2 Cost estimates used are based on recent figures provided in competitive tenders to the Authority and/or historical rates uplifted to the present day.

3.2.3 In accordance with the supplementary note to Operating Authorities (DEFRA, March 2003) - “Revisions to Economic Appraisal Procedures Arising from the New HM treasury Green Book” - the risk associated with the above costs has been accounted for by inclusion of an optimism bias within the economic appraisal carried out.

3.2.4 For the economic analysis of the proposals examined an optimism bias of 60% has been used, which has been derived, as shown in Appendix III.

3.2.5 Economic Assessment of each of the options has been carried out over a 100 year timeframe, in accordance with the revised FCDPAG3 guidance (DEFRA, March 2003). On-going maintenance and management costs are included over the full 100 year time frame.

3.3 ASSESSMENT OF DAMAGES

3.3.1 Damages in relation to the proposed scheme arise from two principal areas:

- Overtopping of defences causing closure of the promenade and traffic diversion and flooding to residential and commercial property
- Failure of defences leading to permanent traffic diversions, loss of commercial and residential properties and loss of railway and highway infrastructure.

3.3.2 Residential and commercial property flood damages have been obtained from the database contained on the “Multi-Coloured CD version 2.1 that accompanies the most recent version of the Multi-Coloured manual (Middlesex University Flood Hazard Research Centre, 2005/06).

3.3.3 Where properties would be lost due to erosion, average values for residential properties in Conwy have been obtained from the Land Registry website (<http://www.landreg.gov.uk/houseprices/>), supplemented by specific local valuations, where available. Generalised local valuations have been made for commercial properties.

3.3.4 The numbers of properties at risk of erosion were obtained by overlaying the predicted recession limits for each area, onto the OS survey data and the timescales to losses of property and infrastructure obtained from technical evaluation, detailed modelling and estimated average rates of recession.

3.3.5 Traffic and rail diversion losses are calculated using methodologies and data from the Multi-Coloured manual,

specifically:

- **Chester to Holyhead railway line:** This asset could be lost due to failure of defences in a number of locations. Loss of the asset would require provision of a bus diversion service to be implemented between the two stations to either side – Abergele and Pensarn and Llandudno Junction. The loss would be valued as the delay cost to passengers due to having to change from train to bus and vice versa at each end and the cost of provision of the bus service. The annual damage associated with loss of the railway is estimated at approximately £10 million.
- **A55 Trunk Road:** As with the railway, this asset could be lost due to failure of defences in a number of locations and its effect would be considered as for the railway. Valuation of the loss would be the lower of the following:
 - Cost of maintaining a permanent diversion for traffic from junction 23 at Llandulas to the east to junction 20 for Rhos-on-Sea to the west. The estimated annual cost of maintaining this diversion and additional travel time, due to a longer diversion distance and slower travel time is estimated at approximately £2,000 million.
 - Provision of a permanent alternative route. In 1976 when alternative routes for the A55 were being considered the estimated cost for an alternative route was £6.63 million (Proceedings of the ICE, 1988). Updating this to the present day using price adjustment indices for construction work provides an estimated cost for provision of a replacement route of £40-50 million
- **Local traffic losses:** These have been calculated based on local traffic count data and information relating to historic promenade closures. There are two areas where overtopping would cause flooding and diversion of traffic:
 - Central Promenade: Toad Hall to A55 Junction 22, Old Colwyn
 - East Promenade: A55 Junction 22, Old Colwyn to Beach Road

For each of the routes alternative diversion routes have been identified and the additional travel costs for different types of vehicles have been calculated per event based on average closure lengths from historical data. Where roads are lost under a recession scenario an annual diversion cost has been calculated and used in perpetuity until the end of the strategy timescale. Where the PV of this cost exceeds the PV cost of re-building a new route prior to the route being lost the lesser value has been used.

3.3.6 For the purposes of evaluation of the damages, a probabilistic approach in accordance with the methodology identified in Appendix A3.2 of FCDPAG3 – “Changing Probabilities of Failure” – has been used.

3.4 **BENEFITS AND IMPACTS**

- 3.4.1 The Do-Nothing option provides no benefits above the existing situation. Present risk levels remain locally in the short term with risks increasing with time with sea level rise and falling beach levels which will allow increased wave energy to impact the shoreline and which will lead to inevitable breaching of the defences.
- 3.4.2 The MAINTAIN option manages in the short term the risks by repairing the structures for a limited time until such time that they are no longer fit for purpose. Risk levels will similarly increase as under the Do-Nothing but the inevitable consequences will be the same. The only benefit provided by this option is in the delay of collapse of defence infrastructure and of erosion of the shoreline, which extends the residual life of property and infrastructure within the predicted zone of recession.
- 3.4.3 The SUSTAIN option manages the risk better by maintaining the present minimum level of defence, and upgrading the defences over time to keep the risk level constant. However there is a residual risk of erosion due to the lower standard of service provided. The deteriorating fabric of the present defences, which still form an integral part of this option, means that collapse of the defences and erosion of the shoreline will still take place but only in the longer term (50-100 years). The benefits of this option are the further delay of collapse of defence infrastructure and of erosion of the shoreline, which further extends the residual life of property and infrastructure within the predicted zone of recession. Under this option there is little residual risk to properties and the A55 would not be lost.
- 3.4.4 The provision of IMPROVED linear defences across the frontage will reduce the risk of wave and tidal waters causing disruption to traffic, property and infrastructure by providing defences that will, with appropriate maintenance and management, provide an appropriate level of service to the frontage. Over time sea level rise will nominally increase that risk but modifying the crest level of defences over time mitigates against that risk. The benefits of this option are the prevention of erosion of the shoreline and protection of those assets at risk.
- 3.4.5 The combined approach of IMPROVED linear defences and beach recharge and management will provide an equivalent level of protection to the linear defence option although it will be need to be maintained through regular beach management and topping up of levels. There may be localised (spatial and/or temporal) increased risk of flooding

damage if successive storms occur between beach management exercises e.g. over a single winter period. This risk can be mitigated against by carrying out beach management immediately following storms. As with the linear defence options, sea level rise will nominally increase the overall level of risk across the frontage but management of the beach and modifying crest levels of the linear defence sections over time mitigates against that risk. This option provides the same benefit as the linear defence only option in terms of providing protection to assets at risk. It also however provides a more flexible and innovative approach to the provision of coastal defence, whilst offering potential additional benefits and improvements in terms of amenity and regeneration.

- 3.4.6 An assessment of the likely benefit this would produce has been carried out using available visitor enjoyment data from published sources (Middlesex University, 2005). Annual values of this benefit are estimated to be of the order of £0.5 million per annum. The PV of this benefit over 100 years is estimated to be approximately £20 million.
- 3.4.7 Both the linear defence only and the combined alternatives have roughly equivalent Net Present Values (NPV) – the difference between the PV benefits of the scheme and the PV costs – of approximately £100 million

3.5 BENEFIT COST APPRAISAL

- 3.5.1 The results of the benefit cost appraisal exercise are shown in table 3.3 below:

TABLE 3.3: BENEFIT COST SUMMARY

TABLE 3.3: BENEFIT-COST SUMMARY

Client/Authority		Prepared (date)		August 2007	
Conwy County Borough Council		Printed		31/08/2007	
Project name		Prepared by		CEUK	
Colwyn Bay Coastal Strategy		Checked by		AJW	
Project reference		Checked date		September 2007	
Base date for estimates (year 0)		Jan-2007			
Scaling factor (e.g. £m, £k, £)		£k		(used for all costs, losses and benefits)	
Principle land use band		B		(A to E)	
Initial discount rate		3.5%			
Optimism bias factor		60%			
Costs and benefits of options		Original Assessment			
PV costs from estimates Optimism bias adjustment Total PV Costs for appraisal PVc PV damage PVd PV damage avoided PV assets Pva PV asset protection benefits Total PV benefits PVb Net Present Value NPV Average benefit/cost ratio Incremental benefit/cost ratio (1) Incremental benefit/cost ratio (2)	Costs and benefits £k				
	No Project	Option 2	Option 3	Option 4	Option 5
	0.00	2,336.16	7,830.55	15,761.17	28,738.28
		1,401.69	4,698.33	9,456.70	17,242.97
		3,737.85	12,528.89	25,217.88	45,981.25
	126,987.69	58,416.94	9,218.61	0.85	0.85
		68,570.75	117,769.08	126,986.83	126,986.83
					20,600.19
		0.00	0.00	0.00	20,600.19
		68,570.75	117,769.08	126,986.83	147,587.02
		64,832.90	105,240.19	101,768.96	101,605.77
	18.34	9.40	5.04	3.21	
		5.60	0.73	0.99	
			0.73	0.89	
Highest b/c - - -					
Original notes:					
1) Incremental benefit/cost ratio (1) is relative to previous lower cost option					
2) Incremental benefit/cost ratio (2) is relative to Option 3.					
Brief description of options:					
Option 1	Do nothing				
Option 2	Maintain Defences				
Option 3	Sustain Defences				
Option 4	Improve Defences - Rock Revetment Only				
Option 5	Improve Defences - Combined Defence Solution				
Relative Damages	No Project	Option 2	Option 3	Option 4	Option 5
Promenade Disruption and Loss	21,336.97	11,030.96	3,633.44	0.85	0.85
Property	5,567.11	3,113.86	3.84	0.00	0.00
A55	32,485.06	12,346.70	0.95	0.00	0.00
Rail	67,598.55	31,925.42	5,580.39	0.00	0.00

- 3.5.2 It can be seen from the summary that each of the options has a benefit to cost ratio in excess of unity but that as expected the ratio decreases with increase in overall scheme cost.

3.5.3 The whole life PV costs of the combined approach (Option 5) represent an 80% increase compared to the linear defence only option (Option 4), however due to the additional amenity benefit provided by this option (as identified in sections 3.4.5-3.4.7 above and as PV assets in table 3.3), both the IMPROVED schemes may be considered as roughly equivalent in economic terms.

3.5.4 Option 3 is marginally the most economically attractive scheme with the highest NPV. The additional costs associated with Options 4 and 5 compared to Option 3 are roughly the same in monetary terms as the additional benefits that each option provides, however as can be seen from the Relative Damages only the Improve options safeguard local and national infrastructure in the longer term.

3.6 UNCERTAINTY CONSIDERATIONS

3.6.1 Option Appraisal Uncertainties within this unit relate primarily to the following criteria:

- Relative flood damages associated with each option
- Residual Life expectancy of the existing defences
- Rate of deterioration and recession of shoreline and hence timing of losses
- Volume(s) of Beach Nourishment required and frequency of topping up losses and beach management (Improve 2)

3.6.2 The overall cost sensitivity is adequately addressed within the optimism bias allowance (Appendix III) included in the original assessment presented in section 3.5 above

3.6.3 Predominant damages in this unit result from overtopping and/or breaching of the defences causing flooding and or loss of hinterland and assets. Overtopping damages are primarily associated with road closure so can be readily identified for each option although identification of frequencies of overtopping less than one year is more subjective.

3.6.4 The existing defences are known to be at imminent risk of failure. A conservative estimate has been used in determining the damages but modifying the timescale provides an assessment of the robustness of the appraisal.

3.6.5 The timing of losses is to a significant degree subjective although a probabilistic assessment has been used to determine the PV of initial loss assuming a low probability of initial failure. Again amending the timescales provides a handle on how robust the economic case is for intervention. Modifying the timescale of the major property and infrastructure losses by ± 10 years results in approximately a 35% increase or reduction in the valuation of the damages associated with the Do-Nothing scenario.

3.6.6 The effects on the individual courses of action of amending the timescale at which losses occur provides the following:

- The benefit to cost ratios for all options remain comfortably in excess of unity, with the highest to lowest order remaining the same, only the magnitude changing
- Under the decreased residual life expectancy both Options 4 and 5 become more economically attractive compared to Option 3 and conversely under the increased residual life expectancy they become less attractive, as defined by the changes in Incremental Benefit Cost Ratio (2).
- In all cases the

3.6.7 The volumes of nourishment have been defined from examination of existing sediment sizes on the foreshore, available grading sizes available from viable sources and consideration of placed gradients for recharge schemes locally using similar material. A conservative approach has been adopted in this respect with the design of the beach profile subject to further analysis and review during subsequent detailed design and appraisal. Further detailed modelling will be carried out to determine recharge volumes, topping up rates and re-cycling arrangements.

3.6.8 Table 3.3.4 and 3.3.5 below provides summary results of the effects of decreasing and increasing the timing of losses by 10 years, respectively.

TABLE 3.5: BENEFIT COST SUMMARY (DECREASED EROSION LOSS TIMING SENSITIVITY)

Client/Authority		Prepared (date)		August 2007	
Conwy County Borough Council		Printed		31/08/2007	
Project name		Prepared by		CEUK	
Colwyn Bay Coastal Strategy		Checked by		AJW	
Project reference		Checked date		September 2007	
Base date for estimates (year 0)		Jan-2007			
Scaling factor (e.g. £m, £k, £)		£k		(used for all costs, losses and benefits)	
Principle land use band		B		(A to E)	
Initial discount rate		3.5%			
Optimism bias factor		60%			
Costs and benefits of options		Decreased Residual Life Assessment (-10 years)			
	Costs and benefits £k				
	No Project	Option 2	Option 3	Option 4	Option 5
	0.00	2,336.16	7,830.55	15,761.17	28,738.28
		1,401.69	4,698.33	9,456.70	17,242.97
		3,737.85	12,528.89	25,217.88	45,981.25
	171,838.13	81,539.01	15,609.93	0.85	0.85
		90,299.12	156,228.20	171,837.28	171,837.28
					20,600.19
		0.00	0.00	0.00	20,600.19
		90,299.12	156,228.20	171,837.28	192,437.47
		86,561.27	143,699.31	146,619.40	146,456.22
		24.16	12.47	6.81	4.19
		7.50	1.23	0.99	
			1.23	1.08	
Highest b/c - - -					
Original notes:					
1) Incremental benefit/cost ratio (1) is relative to previous lower cost option					
2) Incremental benefit/cost ratio (2) is relative to Option 3.					
Relative Damages	No Project	Option 2	Option 3	Option 4	Option 5
Promenade Disruption and Loss	21,336.97	11,030.96	3,633.44	0.85	0.85
Property	7,451.40	3,113.86	3.84	0.00	0.00
A55	47,958.41	20,712.07	0.95	0.00	0.00
Rail	95,091.34	46,682.12	11,971.71	0.00	0.00

TABLE 3.6: BENEFIT COST SUMMARY (INCREASED EROSION LOSS TIMING SENSITIVITY)

Client/Authority		Prepared (date)		August 2007		
Conwy County Borough Council		Printed		31/08/2007		
Project name		Prepared by		CEUK		
Colwyn Bay Coastal Strategy		Checked by		AJW		
Project reference		Checked date		September 2007		
Base date for estimates (year 0)		Jan-2007				
Scaling factor (e.g. £m, £k, £)		£k		(used for all costs, losses and benefits)		
Principle land use band		B		(A to E)		
Initial discount rate		3.5%				
Optimism bias factor		60%				
Costs and benefits of options		Increased Residual Life Assessment (+10 years)				
	Costs and benefits £k					
	No Project	Option 2	Option 3	Option 4	Option 5	
	PV costs from estimates	0.00	2,336.16	7,830.55	15,761.17	28,738.28
	Optimism bias adjustment		1,401.69	4,698.33	9,456.70	17,242.97
	Total PV Costs for appraisal PVc		3,737.85	12,528.89	25,217.88	45,981.25
	PV damage PVd	93,622.64	16,248.89	4,225.72	0.85	0.85
	PV damage avoided		77,373.76	89,396.92	93,621.79	93,621.79
	PV assets Pva					20,600.19
	PV asset protection benefits		0.00	0.00	0.00	20,600.19
	Total PV benefits PVb		77,373.76	89,396.92	93,621.79	114,221.98
Net Present Value NPV		73,635.91	76,868.03	68,403.91	68,240.73	
Average benefit/cost ratio		20.70	7.14	3.71	2.48	
Incremental benefit/cost ratio (1)			1.37	0.33	0.99	
Incremental benefit/cost ratio (2)				0.33	0.74	
Highest b/c - - -						
Original notes:						
1) Incremental benefit/cost ratio (1) is relative to previous lower cost option						
2) Incremental benefit/cost ratio (2) is relative to Option 3.						
Relative Damages	No Project	Option 2	Option 3	Option 4	Option 5	
Promenade Disruption and Loss	21,336.97	11,030.96	3,633.44	0.85	0.85	
Property	4,161.20	3,113.86	3.84	0.00	0.00	
A55	20,970.48	768.28	0.95	0.00	0.00	
Rail	47,153.99	1,335.78	587.50	0.00	0.00	

3.7 CHOICE OF SCHEME

- 3.7.1 The economic assessment carried out shows that there is a case for providing improved coastal defence to Colwyn Bay.
- 3.7.2 Using a probabilistic examination of the likely timescales of defence failure and hence land, property and infrastructure loss, the sensitivity of scheme choice to different timescales has been examined.
- 3.7.3 Whilst the timing of recession losses affects the overall value of assets at risk and hence the overall benefit to cost ratios of the different courses of action, it does not suggest that any of the cases do not represent value for money with the case for increased investment (Options 3,4 and 5) above the current regime of maintenance (Option 2), clearly established.
- 3.7.4 Overall the choice of scheme lies between sustaining the present level of defences with some minor amendments initially in the future to maintain the level of risk at its present level (Option 3) or providing improvements to the defences to provide an improved standard of service in the first instance and with appropriate management and maintenance' maintaining this improvement in the future.
- 3.7.5 Under the SUSTAIN option promenade road closures as a result of overtopping will continue to be necessary in the future and in the longer term the defences would become unsustainable due to deterioration in the material fabric of the present defences, which form an integral part of this option. The consequences of this are that ultimately the shoreline will have to recess and under this scenario local road and national rail transport routes would be disrupted/lost.
- 3.7.6 Under the IMPROVE options the fabric of the existing structures will be incorporated within the future defences with the new elements providing significant protection to the existing elements thereby extending their residual life as long as both the existing and new elements are adequately maintained. Under these options the risk of breaching of the defences is mitigated against and the assets identified at risk are protected.
- 3.7.7 In consideration of the relative merits of the IMPROVE options there are a number of key differences, which are summarised below:
- The linear defence only option provides for greater overall security with lesser future costs by virtue of its fixed nature, however it is unlikely to provide any significant amenity benefit to the frontage as beach levels will remain as they are with the potential for reduction in the future. Movement of the beach directly in front of the defences should be reduced by the improved beach/structure interface reducing scour. The linear defence option may also be considered as providing more of a barrier between the promenade and the beach, notwithstanding that stepped and slipway accesses can be incorporated within the defences.
 - There is a greater degree of inherent risk in the combined approach, specifically in sections of the frontage where the defence is reliant on improved beach levels to provide improved protection. Appropriate beach management action plans are necessary to reinstate levels and maintain protection. Conversely the use of such approach has the potential for significantly improved amenity benefits that, with appropriate funding, form an integral part of meeting the overall regeneration objectives for Colwyn Bay.
- 3.7.8 In consideration of the overall conclusions from the assessment and associated sensitivities carried out, the choice of scheme rests between the following:
- Maintaining the status quo until such time that this becomes unsustainable and in the meantime seeing the continued degeneration of the Colwyn Bay frontage
 - Providing a defence strategy that is functional in providing coastal defence but provides little stimulus to regeneration of Colwyn Bay
 - Adopting an innovative but flexible approach to the provision of coastal defence, whilst offering potential additional benefits and improvements in terms of amenity and regeneration.
- 3.7.9 In conclusion either of the above approaches may be considered as economically viable, however the Local Authority is committed to its goal of regenerating Colwyn Bay as a resort for the 21st Century and not to let it continue to decline, as it has during the latter part of the 20th century. With appropriate investment and enlightened leadership this goal can be achieved, however it needs investment in coastal defences that accord with these aspirations.
- 3.7.10 The preferred future coastal defence management approach for Colwyn Bay is, subject to availability of funding, the combined approach of improved linear defences, promenade changes and beach recharge, that not only provides an improvement in the standard of coastal defence but provides opportunities to improve amenity and leisure interests across the frontage and in combination with other proposals aid regeneration of the town.

4 DESCRIPTION OF PROPOSED SCHEME

4.1 SCHEME DESCRIPTION

4.1.1 The proposed scheme comprises initially the following key elements:

- Eastern Section between Eirias Park and Old Colwyn: Construction of a new rock armour revetment, promenade and crest wall
- Central and Western Sections between Rhos Jetty and Eirias Park: Recharging of the beach with sand and improvements to the promenade and crest of existing defences
- Central Section between Penrhos College site (Toad Hall) and Eirias Park: Provision of beach control structures (breakwaters, groynes etc) on the foreshore

4.1.2 The improvements will provide an increase in the crest level of defences to a minimum of at least 6.5m AOD. Gradients of structures will be designed to a gradient compatible with hydraulic and structural criteria requirements, with the aim of minimising the footprint of the structures on the beach.

4.1.3 The scheme also includes for improvement and dissipation of surface water run-off within the defences and access arrangements between the promenade and the beach.

4.1.4 The different arrangements applying to the lengths of frontage identified are shown in figure 4.1

4.1.5 A preliminary layout plan of arrangements in the central section, to be confirmed by detailed design and modelling, is provided in figure 4.2.

4.1.6 Future management and maintenance actions associated with the scheme will include:

- Maintenance and repair of rock structures
- Maintenance and repair of promenade and crest works
- Beach management – movement of material on the beach
- Clearance of wind blown sand from promenades
- Topping up of beach levels as necessary
- Reworking of rock structures to maintain standard of service in line with sea level rise

4.2 DEFENCE STANDARDS & CRITERIA

4.2.1 The indicative standard of protection for the Colwyn Bay frontage is 1 in 100-300 years (Land Use Band A), or an annual probability of exceedance of 0.33-1% (MAFF, 2000).

4.2.2 With appropriate maintenance and management the proposed works will provide an estimated design life of 40-70 years and potentially more, with material able to be re-used in any re-working to upgrade defence levels in the future.

4.2.3 For the proposed works at Colwyn Bay the appropriate criteria for performance evaluation are threefold:

- Structural safety relating to the revetment structure and the potential damage and risk to structure stability caused by overtopping waters.
- Safety of pedestrians
- Safety of vehicles

4.2.4 Appropriate limiting mean overtopping discharges for these criteria are provided in table 4.1 below. This shows a significant range of allowable overtopping in relation to the risks applying across the frontage.

4.2.5 Further detailed design and modelling will be carried out to establish appropriate crest levels to minimise the overtopping risks and provide an appropriate level of protection.

TABLE 4.1: SUGGESTED ALLOWABLE MEAN OVERTOPPING LIMITS FOR PERFORMANCE CRITERIA AT COLWYN BAY (EurOtop, 2007)

Hazard type and reason	Mean discharge q (l/s/m)
Structure Damage	
Damage to paved or armoured promenade behind seawall	200
Overtopping limits for Pedestrians	
Trained staff, well shod and protected, expecting to get wet, overtopping flows at lower levels only, no falling jet, low danger of fall from walkway	1-10
Aware pedestrian, clear view of the sea, not easily upset or frightened, able to tolerate getting wet, wider walkway	0.1
Overtopping limits for Vehicles	
Driving at low speed, overtopping by pulsating flows at low flow depths, no falling jets, vehicle not immersed	10-50
Driving at moderate or high speed, impulsive overtopping giving falling or high velocity jets	0.01-0.05

4.3 MATERIALS TO BE USED

- 4.3.1 The primary materials to be used in the works comprise works will require the importation and placing of the following materials:
- Graded primary rock armour and secondary underlayers. Typically primary rock armour will have a mean mass of between 2 and 4 tonnes.
 - In-situ and precast concrete designed to BS8500.
 - Geotextile membranes.
 - Sand beach recharge.
- 4.3.2 Suitable rocks from the existing boulders presently utilised on site, that are located within the footprint of the proposed structure and which meet the required grading requirements, will be selected for re-use in the new structure.
- 4.3.3 Imported graded rocks will be supplied from approved local quarry sources with material matching the indigenous material available and the surrounding landscape of rock outcrops in the area e.g. Little Orme, Tan Penmaen Head.
- 4.3.4 The geotextile will be obtained from approved suppliers whose materials have a proven track record of use in coastal defence works and which match the required permeability and strength requirements for use in the structure.
- 4.3.5 Beach recharge material will either be obtained from existing licensed offshore dredging sites in Liverpool Bay or, if available and suitable, from maintenance dredging exercises such as that which takes place at Mostyn Docks in the River Dee.

4.4 OUTLINE METHOD OF CONSTRUCTION

- 4.4.1 Construction of the works will be carried out in accordance with the following broad requirements.
- 4.4.2 The Contractor will be allowed the use of an area of hardstanding on the existing promenade as a compound area and for the storage of plant and materials.
- 4.4.3 Access will be required along the promenade to carry out crest works and appropriate fencing and signing will be erected to demarcate this area. Temporary diversion routes and/or closures of the promenade and public highway in places are likely to be required during the construction period.
- 4.4.4 Access to the foreshore will be gained using existing slipways. Across the foreshore the Contractor will be allowed to gain access within the footprint of the new works plus a working corridor outside the limits, generally not exceeding 5 metres in width but incorporating areas for vehicle turning.

- 4.4.5 Improvements to drainage arrangements to the cliff face will be carried concurrently with revetment construction.
- 4.4.6 The primary linear revetment facing works will generally commence from one end and proceed in a single working face to completion. Crest and promenade works are likely to be carried out following completion of the facing works in any area. Drainage works and accommodation works on the promenade will be carried out concurrently with crest works
- 4.4.7 Beach control structures will be constructed during suitable low water periods generally working from landward to seaward with bulk fill and rock underlayers and shoreward with the primary rock facing and crest works.
- 4.4.8 Beach recharge will only be carried out following completion of control structures. Material will be generally pumped ashore from the dredgers and placed to its final location by land based dozers and excavators.

4.5 ENVIRONMENTAL IMPACT OF SCHEME

- 4.5.1 The proposed linear revetment cross section will have a construction width of between 15 and 30 metres covering approximately 1.5-3 ha of foreshore.
- 4.5.2 Beach control structures will cover of the order 5-10,000 m² of foreshore per structure
- 4.5.3 Beach recharge will increase foreshore levels over approximately 15-20 ha of existing beach
- 4.5.4 The type of imported rock to be used within the works will be carefully chosen to blend in with the existing surrounding landscape.
- 4.5.5 Linear defence improvements will move the high water mark to seaward but would provide for improved shoreline/defence interaction mitigating against beach lowering and fluctuations in beach levels along the toe. Generally the existing longshore sediment movement regime would be maintained.
- 4.5.6 Beach recharge would provide more material for potential movement but increased elevations would reduce impacts with existing defences e.g. wave reflections. Control structures will modify wave, tide and sediment patterns but longshore drift offshore of groynes will persist. Losses of material at eastern end will continue to provide feed to down drift areas albeit at a reduced rate.
- 4.5.7 Wind blown sand is an inevitable consequence of providing elevated beach levels with dry sand from the crest of the beach being transported landward by aeolian forces. Material will settle out on hard defences and the promenade requiring regular clearance.
- 4.5.8 New linear defences would cause a loss of habitat due to coverage of foreshore, however this impact would be ameliorated by subsequent colonisation by marine algae and encrusting species. Subsequent habitat could be altered in places from a predominantly soft-substratum environment to one dominated by hard-substratum favouring species. In places these structures would also attract fish for feeding opportunities during high water periods.
- 4.5.9 Recharge the beach will smother existing benthic and intertidal infauna and may also cause elevated suspended sediments impacting upon water quality and subsequently benthic and fish species. Additional impacts to coastal bird species may occur due to smothering of infaunal prey items. Control structures would remove habitat previously available for benthic and fish species foraging, spawning and nursery areas. Such structures may have the benefit of providing additional complex "reef" like habitat which would provide increased habitat availability for commercial species such as crabs and lobster. Such structures may also act to aggregate fish species utilising it for food, shelter from currents and predators
- 4.5.10 Built environment impacts of linear defences are considered to be positive regarding the protection of the existing land infrastructure; however changes in elevation of the promenade may have a negative impact on the panorama of the seascape from the road and foreshore.
- 4.5.11 Greater visual impacts would be incurred from control structures with connected groynes impacting the beach panorama or offshore breakwaters affecting the seaward views. The artificial beach recharge would also cause a visual impact, due to the elevation of levels. However, as this is seen as enhancement of a natural habitat and because the levels would not be above the current sea defences this visual impact is considered to be low.
- 4.5.12 Transporting of materials to the site will have an environmental impact from the numbers of lorries using the road network. Locally the impact will be relatively low with direct access from the A55 (junction 24) to the promenade

effected with the minimum of disruption to the surrounding area i.e. avoiding travel through the town centre and/or residential areas

4.6 TIMING/PHASING OF WORKS

- 4.6.1 The proposed works will take an estimated 18-24 months to complete if carried out within a single working timeframe, or longer if the scheme is split into a number of smaller work packages.
- 4.6.2 The scheme potentially lends itself to being split into a number of work packages in accordance with temporal, spatial or funding constraints and specific construction requirements, although this has the potential to increase overall costs with higher contract administration costs and multiple mobilisation and de-mobilisation costs.
- 4.6.3 The principal constraints on the timing of the works, relate to working through the summer months and its potential affect on the holiday trade. An embargo on summer working in some areas may be considered.
- 4.6.4 Alternatively to avoid disruption along the whole of the frontage at once the scheme could be split into three geographic phase and one construction related phase as below:
- Eirias Park to Old Colwyn Linear Defences and Promenade Works
 - Toad Hall to Eirias Park Beach Control Structures and Promenade Works
 - Rhos Jetty to Toad Hall Promenade and Sea Wall Works
 - Beach Recharge
- 4.6.5 The favoured approach would be to let the works as a single contract incorporating requiring completions of works in specific areas before commencement on others, timing constraints relating to specific activities or areas etc.
- 4.6.6 To mitigate against the risk of further damage to existing defences the works would most appropriately be carried out working from east to west across the frontage.

4.7 FUTURE MONITORING & MANAGEMENT

- 4.7.1 The proposed linear defences and beach control structures will be designed to be hydraulically and structurally stable for the design conditions identified.
- 4.7.2 Maintenance of rock structures will be generally carried out in accordance with maintenance schedules developed as part of CDM scheme requirements. Typically a maximum frequency of once every five years will be required, or less if there is damage arising from severe storms, which might dislodge or move boulders within the face. Maintenance will require mobilisation of heavy excavators with grab attachments to move and replace affected rocks.
- 4.7.3 The recharged beach between Rhos Jetty and Eirias Park will be subject to movement due to the action of the wind, waves and tide with the following maintenance and management requirements:
- Beach Management - Artificial movement of the beach to maintain beach design profiles.
 - Future Recharge - Topping up of beach levels with additional material to mitigate against beach losses and sea level rise.
 - Wind Blown Sand recycling – Movement of sand from the sea wall structures and promenade back onto the beach
- 4.7.4 The likely frequency for beach management is 1-2x per year.
- 4.7.5 Future recharge requirements will be determined from further detailed technical evaluation and modelling but is likely to be required on typically a 10-20 year frequency.
- 4.7.6 Regular clearance of wind blown sand will be required throughout the year, although detailed scheme design will include examination of measures for controlling and reducing the impact of wind blown sand.
- 4.7.7 The Council presently operates a policy of monitoring and beach management at other locations along its frontage and is currently preparing a beach management plan. The Colwyn Bay frontage will be incorporated into the Authority wide beach management plan. Initial requirements will be derived from the detailed modelling work to be carried out as part of

the detailed design of the scheme with modifications, as necessary, informed by analysis of post construction performance monitoring.

- 4.7.8 Crest and promenade structures will be maintained in accordance with maintenance schedules developed as part of CDM scheme requirements.

4.8 EFFECTS OF PROPOSALS ON COASTAL CELL

- 4.8.1 The frontage between the Little Orme and Tan Penmaen Head is controlled by the natural rock outcrops, the intermediate hard point at Rhos and the shoreline orientation defined by the location of the artificial defence structures that have been built along the shoreline. Littoral drift of material occurs in a net easterly direction across the frontage.
- 4.8.2 The proposed works will stabilise upper beach behaviour across the section where the cross shore structures are to be constructed although longshore drift will continue to seaward and there will be a need for some recharge on the immediate downdrift side of the most easterly control structure, where the beach is in shadow.
- 4.8.3 Overall though lower beach drift to the east will be maintained once the frontage moves away from the influence of this last structure, with no changes to behaviour expected along the adjacent Network Rail and WAG Highways frontage
- 4.8.4 Drift impacts will therefore be local to Colwyn Bay with the works having no effect on areas outside the frontage between Rhos and Tan Penmaen Head.
- 4.8.5 The works will have no impact on general behaviour within the wider sediment cell (Great Orme to Ribble).

5 CONCLUSIONS & RECOMMENDATIONS

5.1 CONCLUSIONS

- 5.1.1 Detailed examination of the technical, environmental and economic factors associated with the provision of improved coastal defence measures at Colwyn Bay and the risk to people, property and infrastructure located to landward of the shoreline has been carried out based on the results of previous strategic assessments, detailed investigations and analysis of available monitoring data.
- 5.1.2 Economic analysis of the likely damages that would accrue as a result has been determined in accordance with current guidance and a preferred approach has been identified.
- 5.1.3 The assessment has confirmed that there is justification for the provision of a scheme of coast protection improvements to be carried out that:
- Provides an improved standard of coastal defence commensurate with the value of assets at risk
 - Is overall environmentally neutral in its affects on habitats
 - Is not considered to be unacceptably visually intrusive.
 - In association with wider plans for regeneration of Colwyn Bay provides opportunities to improve amenity and leisure interests across the frontage that will assist in meeting objectives to provide real improvements to the town and to the lives of the people who inhabit and visit it.
- 5.1.4 The preferred scheme comprises:
- Construction of a new rock armour revetment, promenade and crest wall between Eirias Park and Old Colwyn at the eastern end of the frontage
 - Recharging of the beach with sand and improvements to the promenade and crest of existing defences between Rhos Jetty and Eirias Park
 - Provision of beach control structures (breakwaters, groynes etc) on the foreshore between Penrhos College site (toad Hall) and Eirias Park
 - Future beach management and maintenance of structures in accordance with management and maintenance schedules
 - Future re-working and upgrading of existing structures from time to time to accommodate increasing exposure conditions e.g. sea level rise

5.2 RECOMMENDATIONS

- 5.2.1 That this report be accepted in support of applications for EU convergence funding and for grant aid assistance from the Welsh Assembly Government, under the Coast Protection Act, 1949.

6 **REFERENCES**

- **CMACS Ltd, October 2007.** Colwyn Bay Strategy Plan – Strategic Environmental Assessment.
- **Coastal Engineering UK Ltd, October 2007.** Colwyn Bay Coastal Defence Strategy Plan – Stage 2: Strategic Assessment and Proposals
- **Conwy County Borough Council, February 2007.** Colwyn Bay Coastal Strategy – Stage 1 Consultation Report
- **DEFRA, March 2003.** Flood and Coastal Defence Project Appraisal Guidance, FCDPAG3 Economic Appraisal – Supplementary Note to Operating Authorities March 2003
- **DEFRA, October 2006.** Flood and Coastal Defence Project Appraisal Guidance, FCDPAG3 Economic Appraisal – Supplementary Note to Operating Authorities - Climate Change Impacts.
- **EA/ENW/KRKL, August 2007.** EurOtop - Wave Overtopping of Sea Defences and Related Structures: Assessment Manual.
- **HR Wallingford, May 2004.** Conwy Tidal Flood Risk Assessment - Stage 1 Report. Report EX 4667
- **Ministry of Agriculture, Fisheries & Food, 2000.** Flood and Coastal Defence Project Appraisal Guidance – Economic Appraisal (FCDPAG3).
- **Shoreline Management Partnership, 1999.** Shoreline Management Plan – Sub Cell 11a: Great Ormes Head to Formby Point.
- **Survey Operations Ltd, October 97 – July 2007.** Little Orme to Colwyn Bay – Bi-annual Topographic Beach Surveys

FIGURES

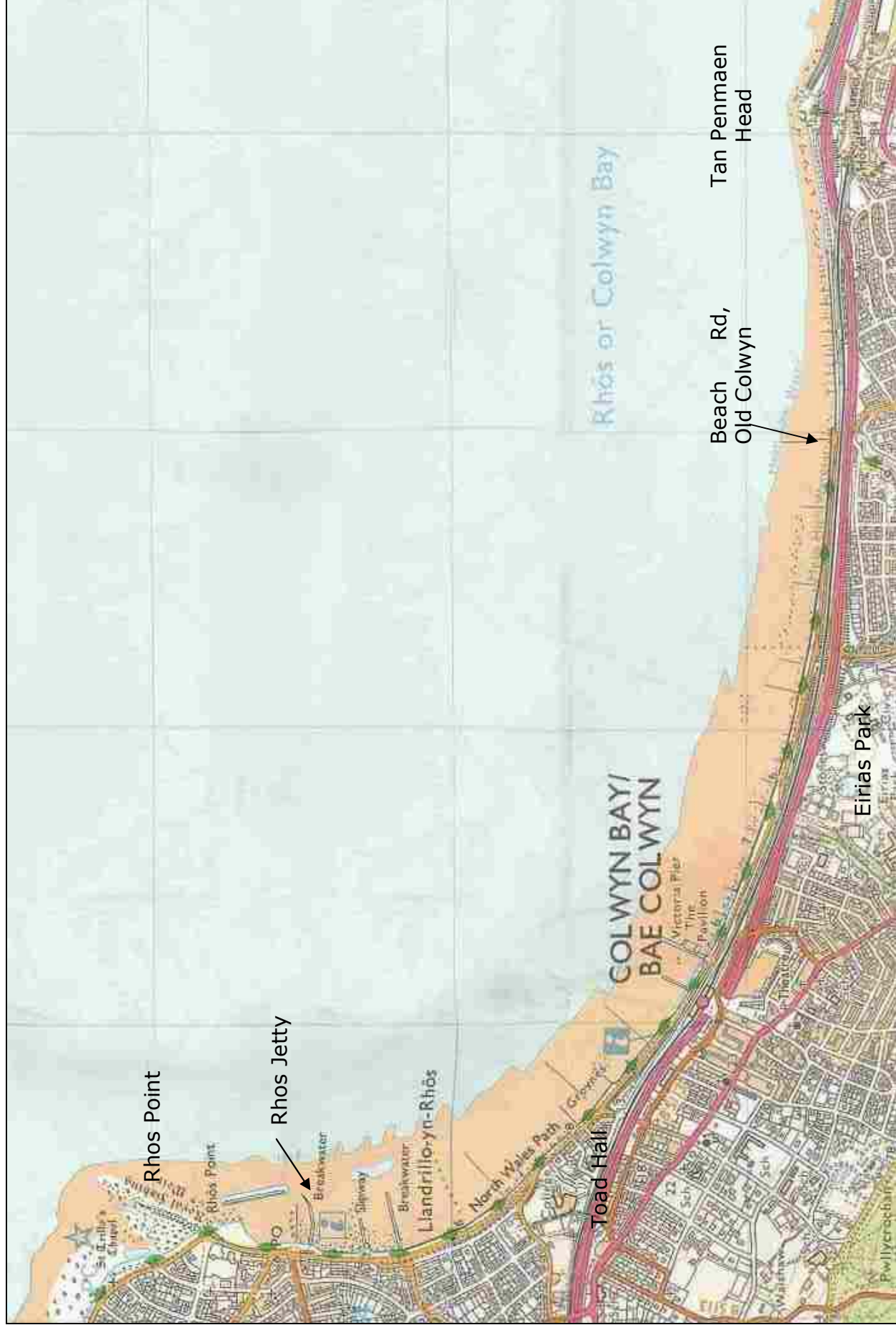


Figure 1.1 – General Location Plan

(Reproduced from OS 1:25,000 Explorer Series Plan – Sheet 17, Snowdonia ©Crown Copyright)

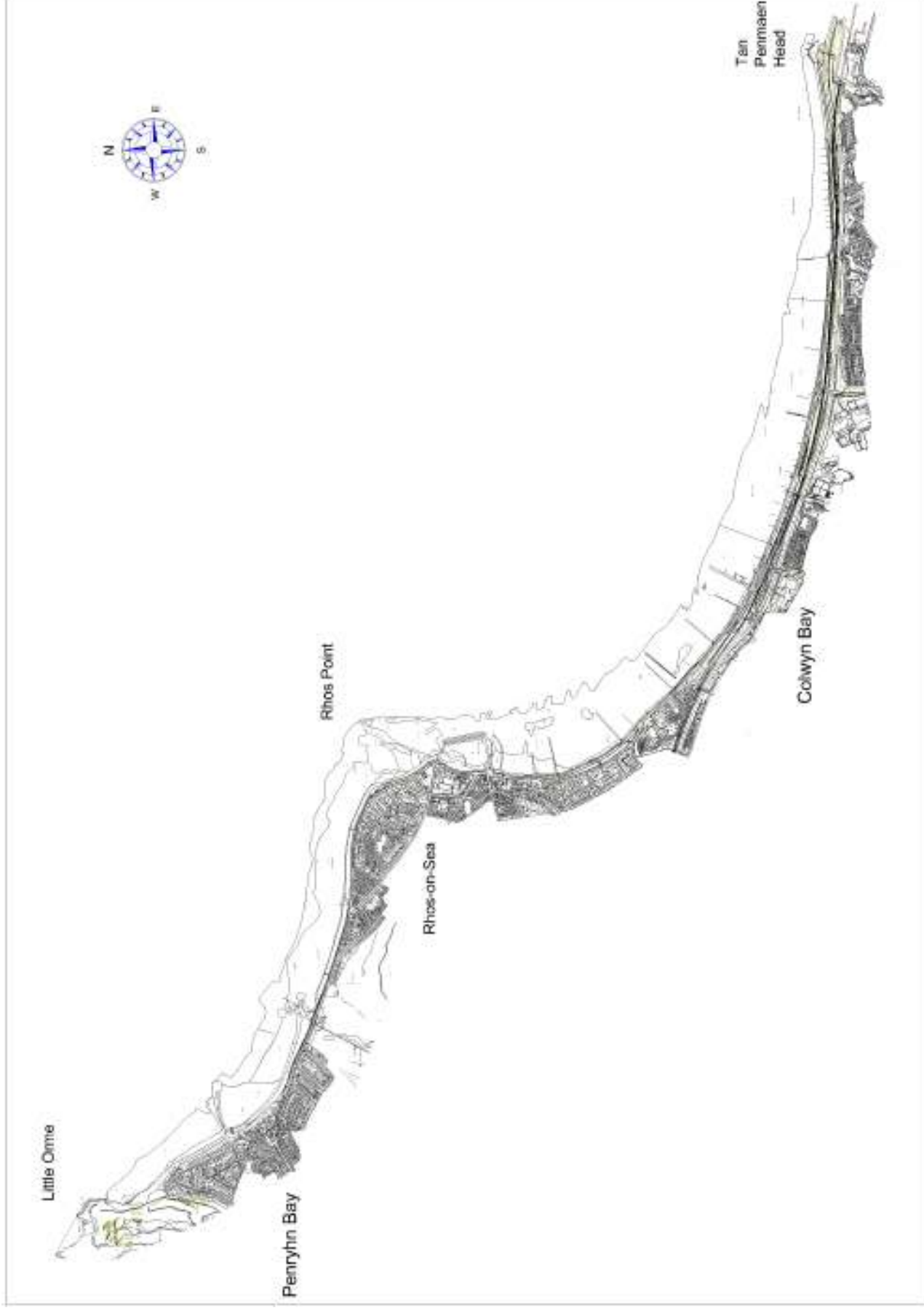


Figure 1.2 – Colwyn Bay Strategy Area Plan



Figure 2.1 – Predicted Do-Nothing Recession Limits



Figure 3.1 – SUSTAIN (Rock Toe) Option (as existing in places)



Figure 3.2 – IMPROVE (Linear Rock Armour Revetment) Option (Artists Impression)



Figure 3.3 – IMPROVE (Beach Recharge) Option (Artists Impression)

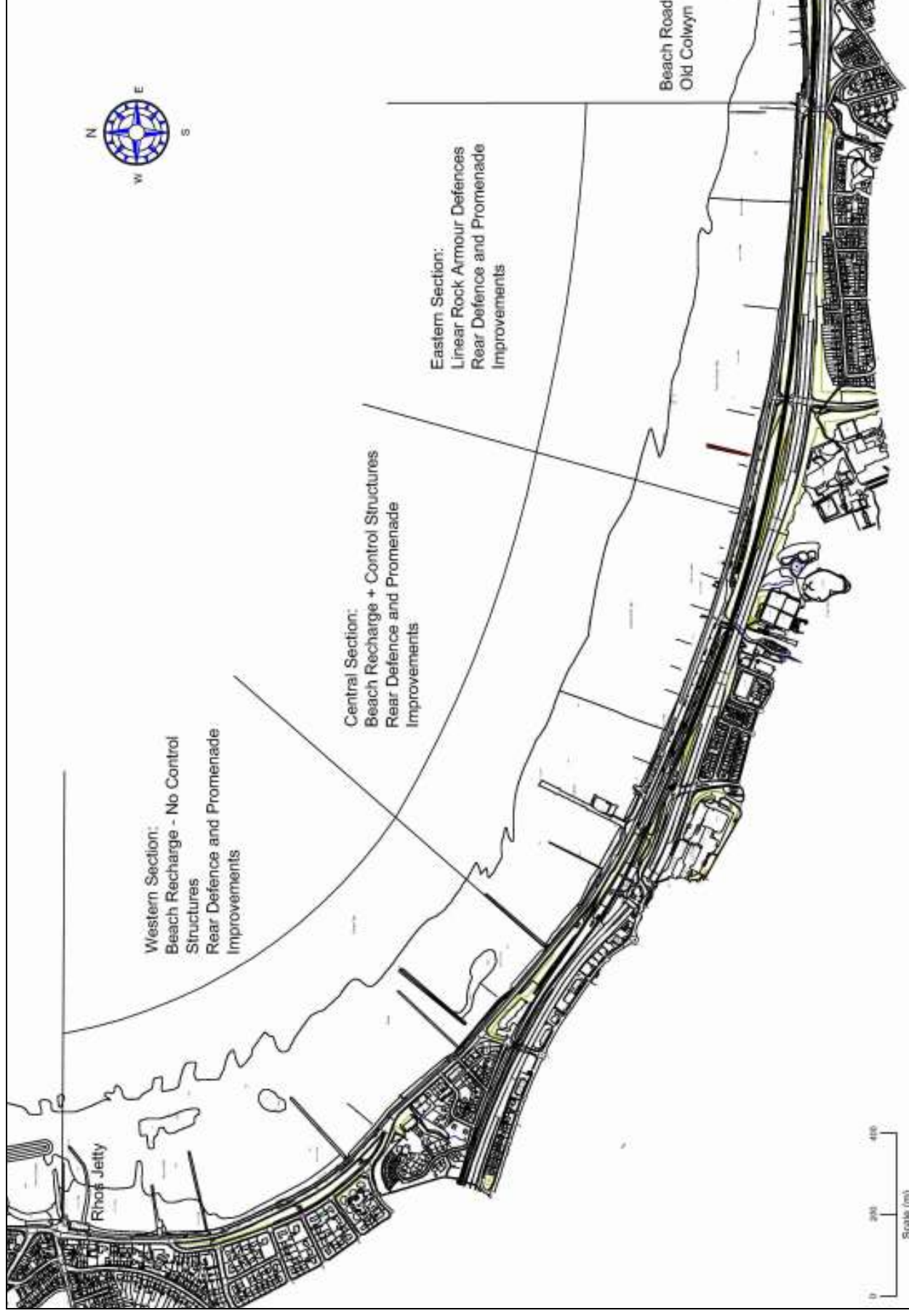


Figure 4.1 – Plan of Preferred Arrangements



Figure 4.2 – Central Section: Preliminary Plan and Control Structure Cross Section

APPENDICES

APPENDIX I – SUMMARY OF PUBLIC CONSULTATION

Consultation Responses

There was a positive reaction to development of the strategy and the opportunity to comment on the preliminary proposals. Individuals and bodies who responded had widely differing views on the various options, but most were supportive of improving the coastal defences. The level of understanding of and interest in coastal defence issues was very high, confirming the value of the results. A total of 248 completed feedback questionnaires were received by the closing date of January 31st 2007.

In order to gauge the interests and biases of respondents, a section of the questionnaire asked “*which of the following do you use the coast for?*” More than one box could be ticked. This question was designed to avoid weighting of the results by one particular interest group. No suspicious skews were identified in the data, and the results were considered to give a representative sample of user interests.

During Stage 1 of Strategy development and prior to the public consultation, steering group representatives from Regeneration, Leisure and the Harbourmaster’s office had expressed particular support for defence measures that enhanced amenity arrangements in Colwyn Bay.

The following is a summary of the results obtained from the public consultation exercise:

SU 2/2/2 - Cayley Promenade

A clear majority (43%) favoured Beach Recharge, with significant support also for the Concrete Step Revetment (31%). This indicates that respondents see this area as an amenity beach, selecting options that improve beach levels and increase beach access. Support for the Concrete Step Revetment may also reflect concerns with the existing promenade width and associated parking and pedestrian/cyclist conflict issues. This zone was removed from the Waterfront Strategy due to public and political pressure. Therefore there is no mandate for landside development or promenade improvements and no clear strategic reason for a particular defence option. Results for this zone are thus particularly important. The Rock Revetment (14%) and Rock Toe (8%) options received little support.

SU 2/3/1 (West) - Beach Zone

A clear majority (55%) favoured Beach Recharge, with support also for the Concrete Step Revetment (25%). Respondents supported the principle that an enhanced beach with improved access was necessary for the Beach Zone, which was identified by the Waterfront Strategy as the focus of traditional (bucket and spade) amenity use. The Rock Revetment (12%) and Rock Toe (4%) options received very little support.

SU 2/3/1 (East) - Watersports Zone

The Watersports Zone, from the Pier east to Eirias Park was identified by the Waterfront Strategy as an area for the use of Powered Water Craft (PWC’s) in particular. A new slipway was constructed at the Dingle in 2006 with European Funding as part of this initiative. Assessment of public consultation results for this zone should take into account that PWC’s are not popular with all sections of the Public but that the promotion of this sport is an important part of the area’s Tourism Strategy. More weight should maybe be given to the technical requirements of PWC users and responses from relevant user groups. The public consultation favoured Beach Recharge (39%) with support also for the Concrete Step Revetment (22%).

SU 2/3/2 - Old Colwyn

The results for Old Colwyn reflect the different amenity use of the beach in this area and also the problems with the existing promenade and coastal highway. Beach Recharge was still supported (28%) as was Concrete Step Revetment (20%), but the most popular option was the Rock Revetment (29%), an option not favoured for other zones. There may be several reasons for this:

- Amenity use is more dog walking, fishing and cycling, less bucket-and-spade.
- The existing promenade width is inadequate for all current uses. The rock revetment option provides opportunities for increasing the width.
- The coastal highway is frequently closed due to overtopping. Perception may be that this is the most vulnerable area and requires the most robust defence.
- An appreciation that less expensive solutions may be more appropriate for this section of frontage. Of course, it may be that users/residents of the Beach and Cayley Zones voted for a cheaper option for ‘the other end’, in the hope that it would allow higher expenditure on other sections.

In addition to the scored results, respondents were also invited to give specific comments. Most comments simply explained and gave background to the choice of option. However a significant number raised new issues and opportunities, which are summarised below:

1. Offshore Breakwaters were suggested frequently as an option in the responses, and were also the subject of questions from the public to officers at the Public Exhibition. Shore-connected breakwaters were presented as the favoured control structure for the Beach Recharge option due to their lower cost. Given the interest in offshore structures, their design has been included in the Stage 2 modelling brief such that more accurate costs can be calculated.
2. Inadequate width of the promenade at Rhos and lack of parking. A more detailed consultation for the Rhos Breakwater Zone would have given more responses of this type. The promenade width here is a known issue, with an opportunity for improvement if the secondary sea wall is re-built.
3. A Marina at the Old Colwyn end. There is a history of aspiration for this. It has been discussed at Steering Group – there appears to be little political or strategic support for it.
4. Creation of marine habitats within revetments.
5. Visual impact of rock or concrete revetments and effect on visitor numbers.
6. Improved disabled access to beach required.
7. Beach Recharge and Concrete Steps together should be used. There were also questions about this at the Exhibition, where the Public was informed that this would not be cost effective.
8. Upgraded and maintained timber groynes are all that is required.
9. Swimming not included or considered as a user activity. Blue Flag status very important to promote tourism.
10. Width of promenade generally inadequate – parking/cyclist/pedestrian conflict a problem.
11. Importance of sea view from parking spaces - a unique feature of Colwyn Bay.
12. Walkways on breakwaters.

APPENDIX II– PHOTOGRAPHIC PLATES



Plate 1



Plate 2



Plate 3



Plate 4



Plate 5



Plate 6



Plate 7



Plate 8



Plate 9



Plate 10



Plate 11



Plate 12

APPENDIX III – OPTIMISM BIAS DERIVATION**Optimism Bias data for flood and coastal defence strategy and scheme costs****Risk components contributing to optimism bias**

		Average % for FCD Projects	Proposed Project
Procurement	Late contractor involvement in design	1	1
	Dispute and claims occurred	11	11
	Other	1	1
Project Specific	Design Complexity	4	4
	Degree of innovation	4	4
	Environmental Impact	13	13
	Other	9	9
Client Specific	Inadequacy of the business case	23	23
	Funding availability	2	2
	Project Management Team	1	1
	Poor project intelligence	8	8
Environment	Public relations	5	5
	Site characteristics	4	4
External Influences	Economic	5	5
	Legislation/regulations	4	4
	Technology	4	4
	Other	1	1
		100	100
	Proposed Coastal Defence Project		60%

Appendix B. Example Questionnaire

Colwyn Bay Waterfront Project – Water-Sports Zone

Questionnaire.

We want to hear your opinions about the future of Colwyn Bay Waterfront and would be grateful if you could spend a few minutes of your time answering a few questions:

- 1. Are you aware of the plans to regenerate Colwyn Bay's promenade?**

Yes ☐

No ☐

- 2. Do you agree that the Colwyn Bay prom area is currently in poor condition and improving the look will the benefit of the town and residents?**

Yes ☐

No ☐

- 3. If yes, please specify which areas you think need particular improvements?**

- 4. Do you feel that access to the prom from the town centre needs improving?**

Yes ☐

No ☐

Don't know ☐

- 5. Which area(s) would you use on the new prom?**

Water-sports Zone ☐

Family Zone ☐

Nature Zone ☐

6. There are plans to build a water-sports centre in the 'water-sports area'. What would you like to see in this building?

- | | |
|---|--------------------------|
| Café/refreshments Kiosk | ☐ |
| Indoor rock climbing | ☐ |
| Cycle hire facilities | ☐ |
| Classrooms/training room | ☐ |
| Retail outlet – water-sports clothing/gifts | ☐ |
| Showers/changing facilities | ☐ |
| Toilets | ☐ |
| Other | ☐ |

7. If other, please state below.

8. What other facilities would you like to see in the water-sports hotspot area?

- | | |
|---|--------------------------|
| Slipways | ☐ |
| Cast-off Dock/Slipway | ☐ |
| Outdoor Sports Facilities | ☐ |
| Seating/viewing platform to view sports | ☐ |
| Outdoor gym | ☐ |
| Water feature/Interactive fountain | ☐ |
| Water spray play area | ☐ |
| Children's play area | ☐ |
| Seating | ☐ |
| Other | ☐ |

9. If other, please state below.

10. How would you like the new water-sports centre to look?

- | | |
|--|--------------------------|
| Modern Stand-out Design | ☐ |
| Traditional Design | ☐ |
| No opinion as long as the building is eco friendly | ☐ |
| No opinion as long as the building is functional | ☐ |

11. What would make you want to use the prom more often?

Easier access

☐

Events area

☐

More seating

☐

Cycle hire facilities

☐

Better water-sports facilities

☐

Children's activities

☐

Nicer surroundings

☐

Heritage Trails/walks

☐

Interactive Art – e.g. interactive fountain

☐

Other

☐

12. If other, please state below.

13. Do you think there should be dedicated car parking spaces suitable for water-sports users?

Yes ☐

No ☐

14. Any other comments about the new Water-sports area?

15. How important do you think it is to have a clean, healthy sand beach in Colwyn Bay?

Very Important ☐

Quite Important ☐

Not Important ☐

No Opinion ☐

16. How important do you think it is for there to be easy access from the promenade to the beach?

- | | |
|-----------------|--------------------------|
| Very Important | ☐ |
| Quite Important | ☐ |
| Not Important | ☐ |
| No Opinion | ☐ |

17. We are trying to find out how much value you, as an individual, put on your enjoyment of this visit to this seafront today, in £ and pence.

Think of a visit or activity you have done in the past which gave you the same amount of enjoyment as your visit to this seafront today. Now, try to estimate how much that visit (or other activities) cost you. Remember that the cost of a visit may include petrol and parking costs or bus or train fares as well as admission charges and any other costs. You can use the costs of that visit (or other activities) as a guide to the value of your enjoyment of today's visit to this seafront.

A) CURRENT SEAFRONT

What value do you put on your individual enjoyment of this visit to this seafront?

Value of today's visit £.....:.....pence

Cannot value these things in money terms ☐

Don't know ☐

I am now going to describe to you various options being considered for this seafront and ask you to value your likely individual enjoyment of them.

B) ERODED/DETERIORATED SEAFRONT

If the seafront changed to look like this would you get more, less or the same amount of enjoyment from a visit compared to your enjoyment of today's visit?

- | | |
|------------------------------|--------------------------|
| Much less enjoyment | ☐ |
| The same amount of enjoyment | ☐ |
| Much more enjoyment | ☐ |
| DON'T KNOW | ☐ |

IF DON'T KNOW, GO TO (C)

So, how much enjoyment would you get from your visit to the seafront in the image in terms of pounds and pence?

Value of today's visit £.....:.....pence

Cannot value these things in money terms ☐

Don't know ☐

The exact form of the proposed works to protect the seafront has not yet been finally determined. This decision will be taken after further investigation and consultation.

C) OPTION 1 (REVETMENT OPTION)

At present one scheme being considered will involve construction of a rock revetment along the full length of the beach to protect the promenade:

If you were making a visit (similar to today's visit) to the seafront in this image, would you get more, less or the same amount of enjoyment from a visit compared to your enjoyment of today's visit?

Much less enjoyment ☐

The same amount of enjoyment ☐

Much more enjoyment ☐

DON'T KNOW ☐

IF DON'T KNOW, GO TO (C)

So, how much enjoyment would you get from your visit to the seafront in the image in terms of pounds and pence?

Value of today's visit £.....:.....pence

Cannot value these things in money terms ☐

Don't know ☐

C) OPTION 2 (BEACH RECHARGE OPTION)

At present one scheme being considered will involve covering the current beach with a raised layer of sand in front of the existing promenade.

If you were making a visit (similar to today's visit) to the seafront in this

image, would you get more, less or the same amount of enjoyment from a visit compared to your enjoyment of today's visit?

- Much less enjoyment ☐
- The same amount of enjoyment ☐
- Much more enjoyment ☐
- DON'T KNOW ☐

IF DON'T KNOW, GO TO (C)

So, how much enjoyment would you get from your visit to the seafront in this image in terms of pounds and pence?

Value of today's visit £.....:.....pence

Cannot value these things in money terms ☐

Don't know ☐

Finally, which of the schemes described above do you prefer?

- Promenade and Beach not developed further ☐
- Option 1 (Revetment Only) ☐
- Option 2 (Revetment and Beach Recharge) ☐
- None of them ☐

(If none of the above, please describe why)

Personal Details:

Remember this is only the first stage of the consultation process for the waterfront. Updates will be published regularly in the local papers and on Conwy County Borough Council's website.

Gender:

Male ☐

Female ☐

Age:

Under 25 ☐

25-35 ☐

36-45 ☐

46-55 ☐

56-65 ☐

Over 65 ☐

Please Tick all of the appropriate boxes that best describes what Colwyn Bay town is to you.

Colwyn Bay is where I live ☐

Colwyn Bay is where I work ☐

Colwyn Bay is a place I visit ☐

Colwyn bay is a place I shop ☐

Colwyn Bay is where I go to school ☐

Colwyn Bay is where I go for leisure ☐

Are you a member of any water-sports related groups?

Yes ☐

No ☐

If yes, which one?

How often do you use Colwyn Bay Prom for your water-sports hobby?

Less than one per month ☐

2-3 times per month ☐

4 or more times per month ☐

THANK YOU FOR YOUR FEEDBACK

Please hand in your completed questionnaire to one of our team if you are taking part in the face to face survey on the promenade.

Alternatively send it to:

**Waterfront Consultation Questionnaire
Environment
Mochdre Offices
Conwy Road
Mochdre
LL28 5AB**

Appendix C. Economic Assessment

Project Summary Sheet					
Client/Authority			Prepared (date)		
Conwy County Borough Council			01/10/2010		
Project name			Printed		
Colwyn Bay PAR update			21/09/2010		
Project reference			Prepared by		
			VT		
Base date for estimates (year 0)			Checked by		
Jul-2010			PJP		
Scaling factor (e.g. £m, £k, £)			Checked date		
£k					
Principle land use band			(used for all costs, losses and benefits)		
B			(A to E)		
Initial discount rate			3.5%		
Optimism bias factor			30.0%		
Costs and benefits of options					
	Costs and benefits £k				
	Option 1 (do nothing)	Option 4	Option 5		
PV costs PVc		68,838.66	62,269.78		
Optimism bias adjustment		20,651.60	18,680.94		
Total PV Costs for appraisal PVc		89,490.26	80,950.72		
PV damage PVd	152,547.13	2.74	2.74		
CV damages	14,221.72	-12,430.13	-28,126.34		
PV damage avoided		179,196.24	194,892.45		
PV assets PVa	9,415.99				
PV asset protection benefits		9,415.99	9,415.99		
Total PV benefits PVb		188,612.23	204,308.44		
Net Present Value NPV		99,121.97	123,357.72		
Average benefit/cost ratio		2.74	3.28		
Incremental benefit/cost ratio		2.11	-1.84		
- Highest b/c					
Brief description of options:					
Option 1 (do nothing)	Do nothing				
Option 4	Rock Revetment				
Option 5	Straight Rock Groyne, revetment and beach recharge				
Notes:					
1) Benefits will normally be expressed either in terms of damage avoided or asset values protected. Care is needed to avoid double counting					
2) PV damage avoided is calculated as PV damage (No Project) - PV damage (Option)					
PV asset protection benefits are calculated as PVa (Option) - PVa (No Project)					
PV benefits calculated as PV damage avoided + PV asset protection benefits					
3) Incremental benefit/cost ratio is calculated as:					
$(PVb(\text{current option}) - PVb(\text{previous option})) / (PVc(\text{current option}) - PVc(\text{previous option}))$					

Present Value Costs for all options																Sheet Nr.															
Client/Authority Conwy County Borough Council																Results £k								Prepared (date)				01/10/2010			
Project name Colwyn Bay PAR update																								Printed				VT			
Project reference Base date for estimates (year 0) Jul-2010																								Prepared by				PJP			
Scaling factor (e.g. £m, £k, £) £k																								Checked date							
Discount rate 3.5%																PV total costs								0							
																Option 1 (do nothing)				Option 4				Option 5				0			
																0.00				68838.66				62269.78				0.00			

Page 1

Erosion Loss Calculation Sheet with delay options										Sheet Nr.
Client/Authority Conwy County Borough Council										
Project name Colwyn Bay PAR update				Option: Do Nothing Revetment Rock Groyne, revetment		Delay (yrs) 0 100 100		Prepared (date) Printed Prepared by Checked by Checked date		01/10/2010 VT PJP
Project reference Base date for estimates (year 0) Scaling factor (e.g. £m, £k, £) Discount rate				- Jul-2010 £k 3.5%						
Ref	Asset		MV £k	Year	Prob of loss without project in year	Expected value of asset losses £k				
	Description					Without Project	Do Nothing	Revetment	Rock Groyne, revetment	
0	Westbury Flats 1-18	Flat	3,221.00	10	0.8	1,826.74	1,826.74	58.57	58.57	
1	Westbury Flats 1-18	Flat	3,221.00	5	0.1	271.20	271.20	8.69	8.69	
2	Westbury Flats 1-18	Flat	3,221.00	15	0.1	192.26	192.26	6.16	6.16	
3	Seagulls	Com	355.00	10	0.8	201.33	201.33	6.45	6.45	
4	Seagulls	Com	355.00	5	0.1	29.89	29.89	0.96	0.96	
5	Seagulls	Com	355.00	15	0.1	21.19	21.19	0.68	0.68	
6	Newstead	Com	223.00	10	0.8	126.47	126.47	4.05	4.05	
7	Newstead	Com	223.00	5	0.1	18.78	18.78	0.60	0.60	
8	Newstead	Com	223.00	15	0.1	13.31	13.31	0.43	0.43	
9	Sandside	Com	220.00	10	0.8	124.77	124.77	4.00	4.00	
10	Sandside	Com	220.00	5	0.1	18.52	18.52	0.59	0.59	
11	Sandside	Com	245.00	15	0.1	14.62	14.62	0.47	0.47	
12	Sea Crest	Com	390.00	10	0.8	221.18	221.18	7.09	7.09	
13	Sea Crest	Com	390.00	5	0.1	32.84	32.84	1.05	1.05	
14	Sea Crest	Com	390.00	15	0.1	23.28	23.28	0.75	0.75	
15	Stafford House	Com	1,150.00	10	0.8	652.21	652.21	20.91	20.91	
16	Stafford House	Com	1,150.00	5	0.1	96.83	96.83	3.10	3.10	
17	Stafford House	Com	1,150.00	15	0.1	68.64	68.64	2.20	2.20	
18	Continental	Com	223.00	10	0.8	126.47	126.47	4.05	4.05	
19	Continental	Com	223.00	5	0.1	18.78	18.78	0.60	0.60	
20	Continental	Com	223.00	15	0.1	13.31	13.31	0.43	0.43	
21	The Majestic	Com	220.00	35	0.8	52.80	52.80	1.69	1.69	
22	The Majestic	Com	220.00	30	0.1	7.84	7.84	0.25	0.25	
23	The Majestic	Com	220.00	40	0.1	5.56	5.56	0.18	0.18	
24	Balmoral	Com	350.00	5	0.8	235.75	235.75	7.56	7.56	
25	Balmoral	Com	350.00	15	0.1	20.89	20.89	0.67	0.67	
26	Balmoral	Com	350.00	10	0.1	24.81	24.81	0.80	0.80	
27	Toad Hall PH	Com	65.00	35	0.8	15.60	15.60	0.50	0.50	
28	Toad Hall PH	Com	65.00	30	0.1	2.32	2.32	0.07	0.07	
29	Toad Hall PH	Com	65.00	40	0.1	1.64	1.64	0.05	0.05	
30	8 Seabank Rd	Det	123.00	85	0.8	5.29	5.29	0.17	0.17	
31	8 Seabank Rd	Det	123.00	80	0.1	0.78	0.78	0.03	0.03	
32	8 Seabank Rd	Det	123.00	90	0.1	0.56	0.56	0.02	0.02	
33	Marine Hotel	Com	192.50	5	0.8	129.66	129.66	4.16	4.16	
34	Marine Hotel	Com	192.50	15	0.1	11.49	11.49	0.37	0.37	
35	Marine Hotel	Com	192.50	10	0.1	13.65	13.65	0.44	0.44	
36	St Enochs Hotel	Com	192.50	5	0.8	129.66	129.66	4.16	4.16	
37	St Enochs Hotel	Com	192.50	15	0.1	11.49	11.49	0.37	0.37	
38	St Enochs Hotel	Com	192.50	10	0.1	13.65	13.65	0.44	0.44	
39	Princess Court Flats 1-120	Flat	15,600.00	60	0.8	1,584.14	1,584.14	50.79	50.79	
40	Princess Court Flats 1-120	Flat	15,600.00	55	0.1	235.18	235.18	7.54	7.54	
41	Princess Court Flats 1-120	Flat	15,600.00	65	0.1	166.73	166.73	5.35	5.35	
42	The Waterfront	Flat	3,600.00	10	0.8	2,041.69	2,041.69	65.46	65.46	
43	The Waterfront	Flat	3,600.00	5	0.1	303.11	303.11	9.72	9.72	
44	The Waterfront	Flat	3,600.00	15	0.1	214.88	214.88	6.89	6.89	
45	12 Penrhos Road	Flat	300.00	90	0.8	10.85	10.85	0.35	0.35	
46	12 Penrhos Road	Flat	300.00	85	0.1	1.61	1.61	0.05	0.05	
47	12 Penrhos Road	Flat	300.00	95	0.1	1.14	1.14	0.04	0.04	
48	4 Seabank Rd	Det	123.00	85	0.8	5.29	5.29	0.17	0.17	
49	4 Seabank Rd	Det	123.00	80	0.1	0.78	0.78	0.03	0.03	
50	4 Seabank Rd	Det	123.00	90	0.1	0.56	0.56	0.02	0.02	
51	6 Seabank Rd	Det	179.00	85	0.8	7.69	7.69	0.25	0.25	
52	6 Seabank Rd	Det	179.00	80	0.1	1.14	1.14	0.04	0.04	
53	6 Seabank Rd	Det	179.00	90	0.1	0.81	0.81	0.03	0.03	
54	1 Seabank Rd	Semi	123.00	85	0.8	5.29	5.29	0.17	0.17	
55	1 Seabank Rd	Semi	123.00	80	0.1	0.78	0.78	0.03	0.03	
56	1 Seabank Rd	Semi	123.00	90	0.1	0.56	0.56	0.02	0.02	
57	1a Seabank Rd	Semi	123.00	85	0.8	5.29	5.29	0.17	0.17	
58	1a Seabank Rd	Semi	123.00	80	0.1	0.78	0.78	0.03	0.03	
59	1a Seabank Rd	Semi	123.00	90	0.1	0.56	0.56	0.02	0.02	
60	3 Seabank Rd	Det	327.00	85	0.8	14.05	14.05	0.45	0.45	
61	3 Seabank Rd	Det	327.00	80	0.1	2.09	2.09	0.07	0.07	
62	3 Seabank Rd	Det	327.00	90	0.1	1.48	1.48	0.05	0.05	
63	colburn hotel	Com	250.00	85	0.8	10.74	10.74	0.34	0.34	
64	colburn hotel	Com	250.00	80	0.1	1.59	1.59	0.05	0.05	
65	colburn hotel	Com	250.00	90	0.1	1.13	1.13	0.04	0.04	
Totals			67600.00			9415.99	9415.99	301.88	301.88	
Notes Make one entry in the description column for each property (or group of properties) as this determines subsequent calculation MV = risk free market value at base date for estimate - must be entered on each line when probaility distribution is used Equivalent annual value = MV x discount rate (assumes infinite life) Year is year in which there is the probability of loss shown, years must be entered consecutively for each property or group If no distribution is used enter year of expected year of loss and enter 1.0 in probability column Columns G to K show expected values of asset losses with each option, assuming extensions of life entered above The loss is calculated using the formula PV loss = MV * Prob of loss * (1 - (1 - 1/((1+r)^(Year of loss)))) = MV * Prob of loss / ((1+r)^(Year of loss)) Additional properties can be entered by inserting lines above line 62 and copying all formulae, including hidden calculation in column C										

3. Scheme Description Appendix

- Figure 3.1 to Figure 3.4 – Photographs along waterfront at Colwyn Bay
- Figure 3.5 – Key Plan for the Three Phases of Coastal Defence Improvements
- Detailed Drawings for Phase 1 Coastal Defence works:
 - MMD-277894-S-DR-00-GA-0100
 - MMD-277894-S-DR-00-GA-0102
 - MMD-277894-S-DR-00-GA-0103
 - MMD-277894-S-DR-00-GA-0104
 - MMD-277894-S-DR-00-GA-0105

Figure 3.1: Looking eastwards towards railway embankment and existing rock groynes at Old Colwyn



Figure 3.2: Looking east towards Old Colwyn and existing timber groynes from Victoria Pier



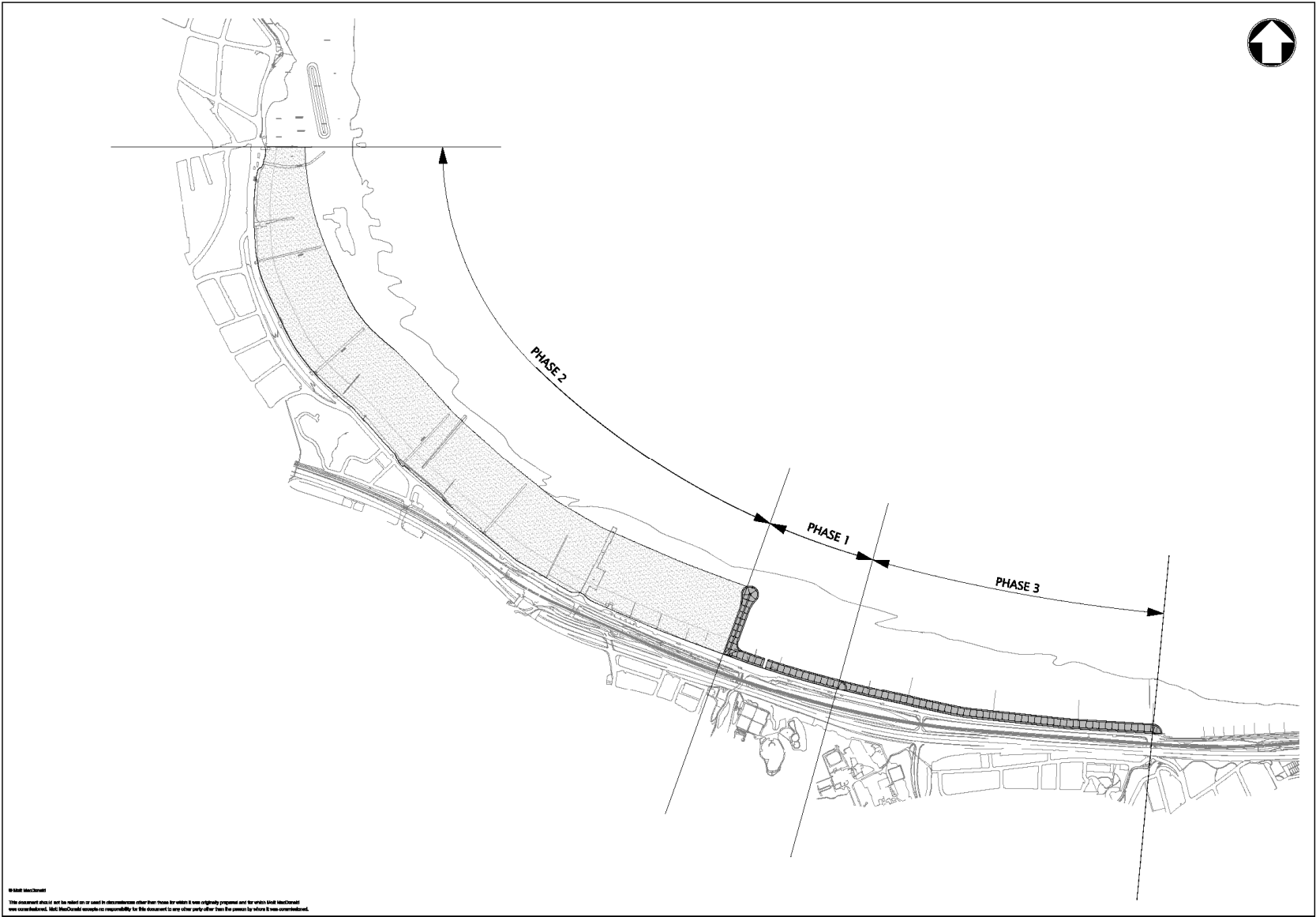
Figure 3.3: Looking eastwards towards Victoria Pier and low beach levels from Rhos-on-sea

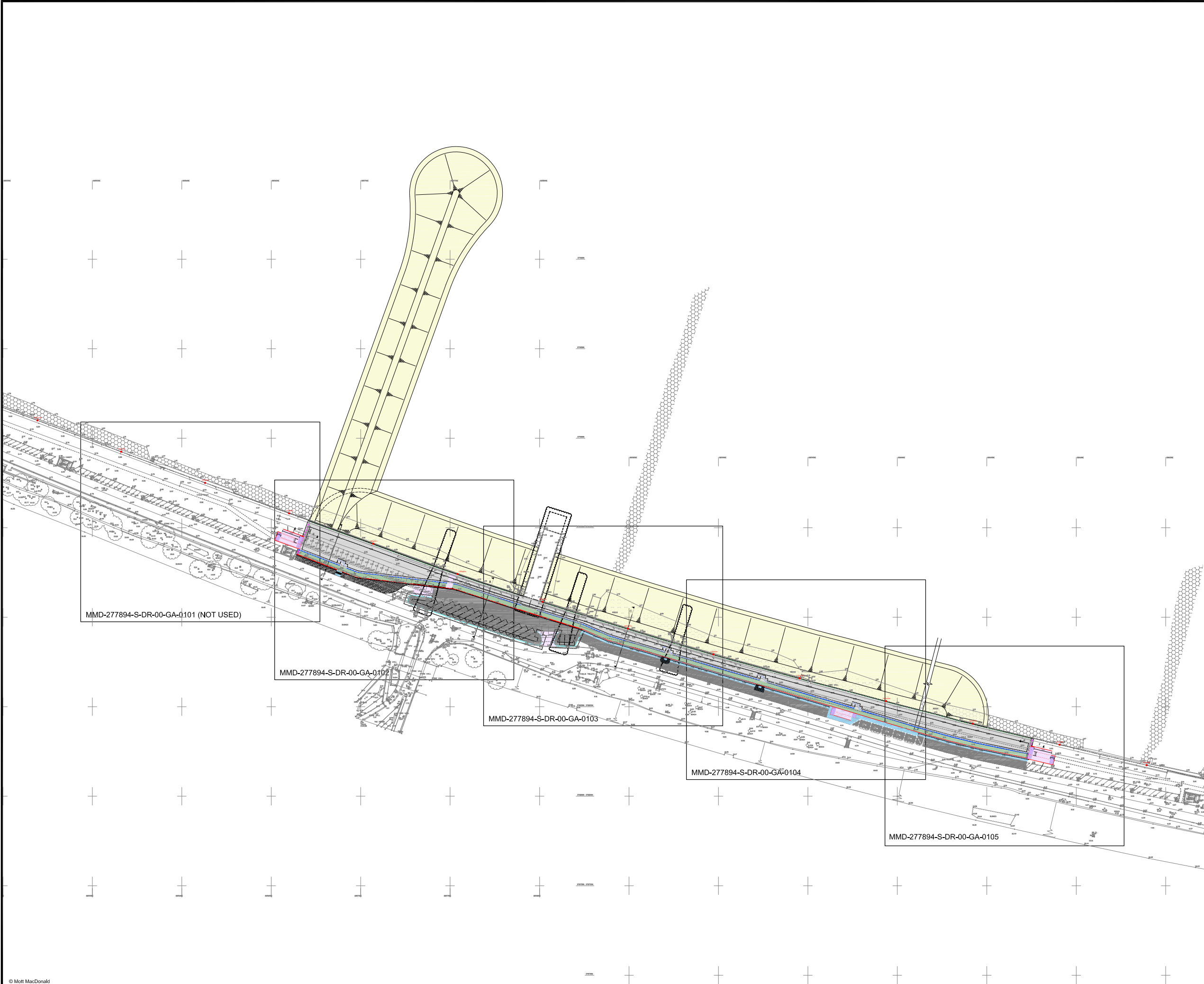


Figure 3.4: Looking west towards Rhos-on-Sea and Rhos jetty from the settlement of Colwyn Bay



Figure 3.5: Key Plan for three phases of coastal defence proposals





Notes

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7. See MMD-277894-C-DR-000-XX-2000 series drawings for details of the proposed seaside coastal defences.
8. Refer to MMD-277894-S-DR-00-XX-0010 series drawings for additional notes.

Key to symbols

- = Proposed RC recurved wall.
- = Proposed RC highway retaining wall.
- = Top of proposed mass gravity stepped concrete retaining wall.
- = Proposed retaining wall to allow phasing of works.
- = Proposed car park retaining wall.
- = Proposed pedestrian walkway.
- = Proposed cycle track.
- = Proposed footway.
- = Proposed car parking.
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- = Proposed ramp plateau.
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- = Hardware to be possibly relocated. (Consultation with statutory undertakers required.)
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- LV = Low voltage cable
- SL = Street lighting
- GAS = Gas main
- W = Water supply
- CW = Combined sewer
- FW = Foul water

Reference drawings

See cross section drawings reference MMD-277894-C-DR-00-XX-0010

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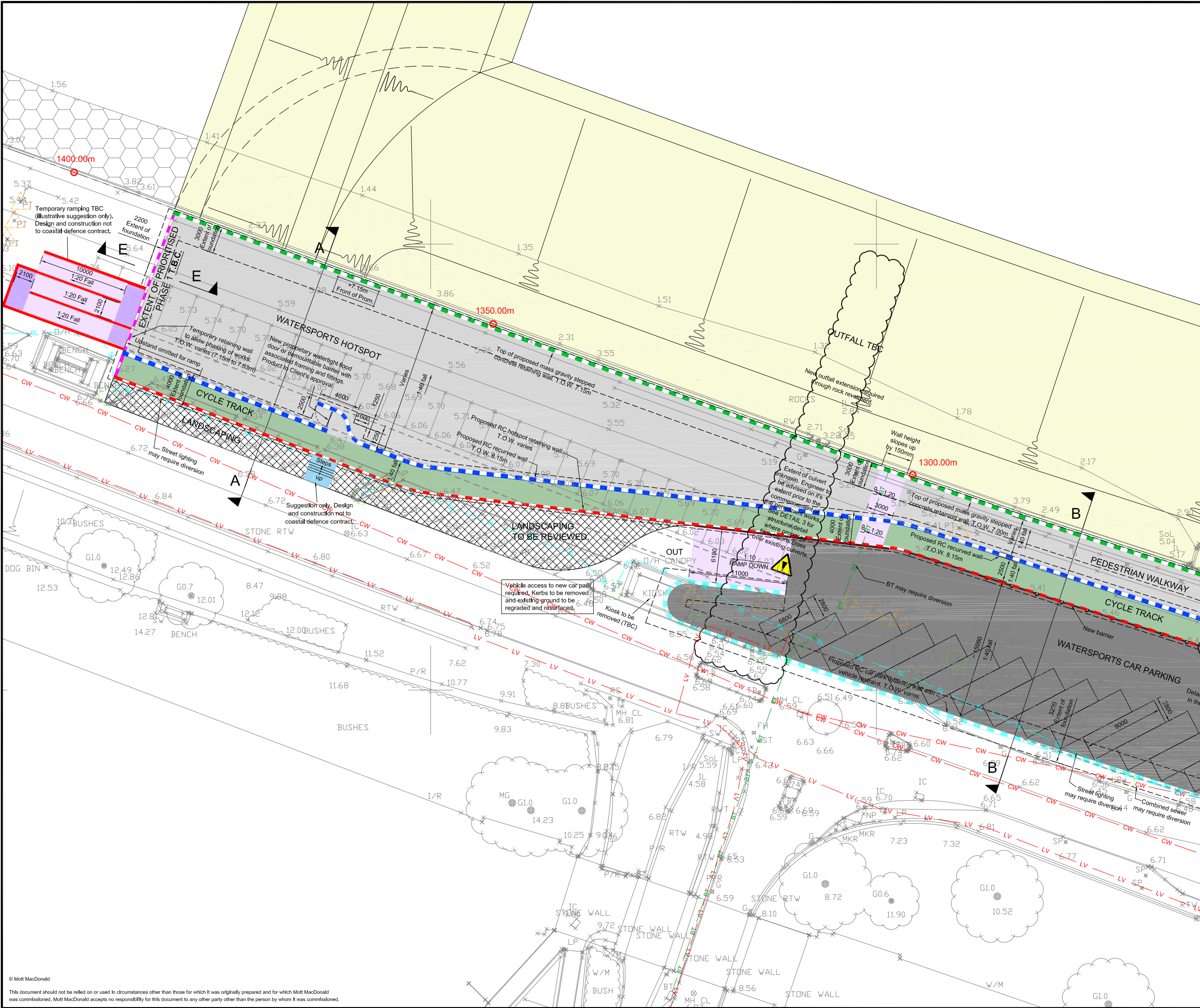
Client

CONWY
CYNGOR BWRDEISTREF SIROL
COUNTY BOROUGH COUNCIL

Title

Colwyn Bay Waterfront
Phase 1 Coastal Defences
Preliminary General Arrangement
Key Plan

Designed	A.Tarmaster	Eng check	R.Griffiths	
Drawn	H.Roberts	Coordination	G.W.Mitchell	
Dwg check	R.Griffiths	Approved	P.Phipps	
Scale at A1	1:1000	Status	PRE	Rev 0
Drawing Number MMD-277894-S-DR-00-GA-0100				



Notes

- This drawing is to be read in conjunction with all related structural, civil, maritime and subcontractor drawings, specifications and standards. All discrepancies shall be referred to the Engineer for decision before proceeding.
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- Refer to MMD-277894-S-DR-00-XX-0010 series drawings for additional notes.

Key to symbols

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- Proposed footway.
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- CW = Combined sewer
- FW = Foul water

Reference drawings

See cross section drawings reference MMD-277894-C-DR-00-XX-0010 to 0015.

TENDER ISSUE

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Rev	Date	Drawn	Description	Ch'kd	App'd

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COUNTY BOROUGH COUNCIL

Title

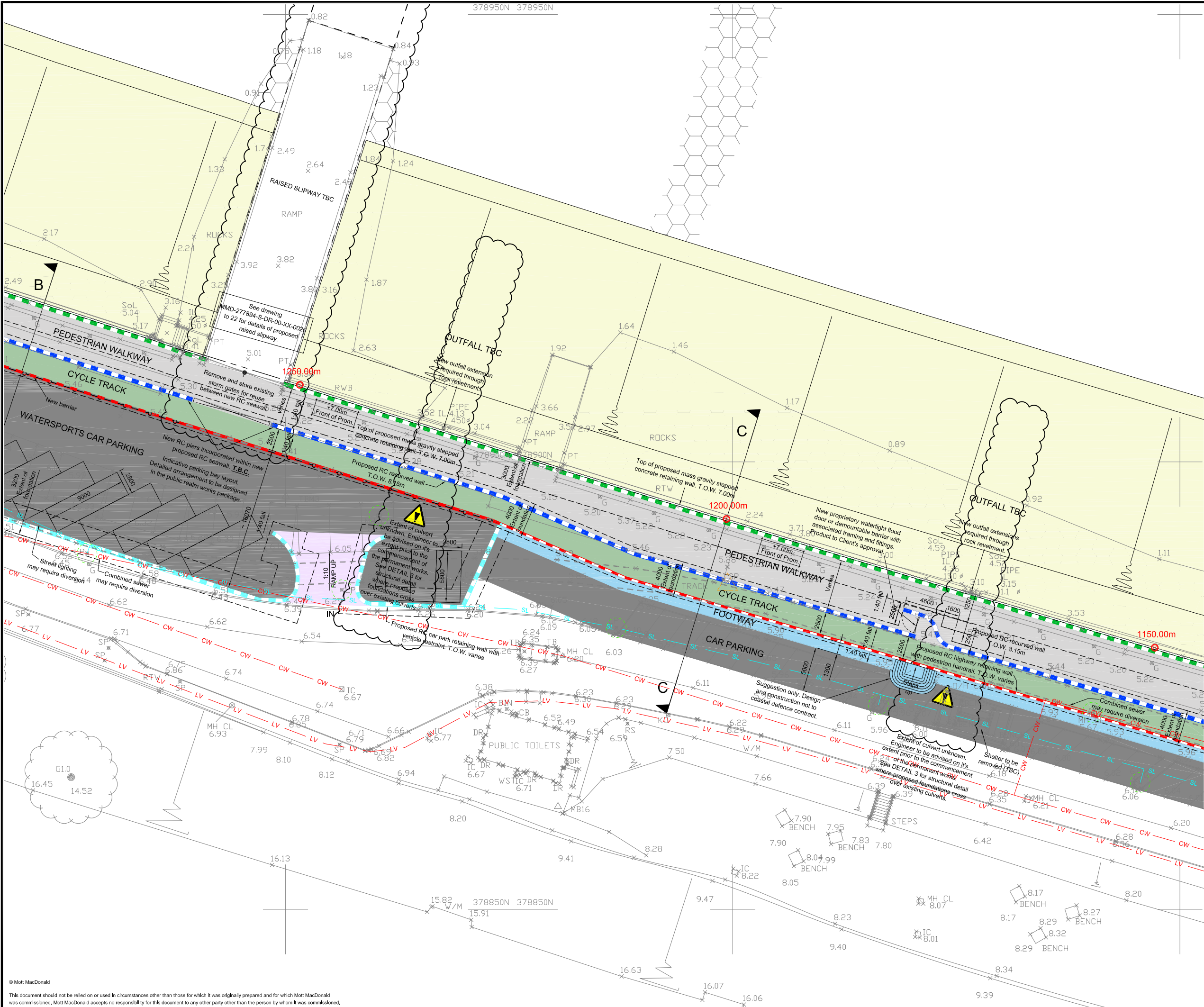
**Colwyn Bay Waterfront
Phase 1 Coastal Defences
Promenade Structures
General Arrangement (Sheet 2 of 5)**

Designed	G.Mitchell	Eng check	R.Griffiths
Drawn	H.Roberts	Coordination	G.W.Mitchell
Dwg check	R.Griffiths	Approved	P.Phipps
Scale at A1	1:200	Status	TEN
Drawing Number	MMD-277894-S-DR-00-GA-0102	Rev	0

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P:\Colwyn Bay\277894\Drawings\Internally Produced\GA Plan.dwg Sep 3, 2010 - 3:41PM mlt29405



Notes

- This drawing is to be read in conjunction with all related structural, civil, maritime and subcontractor drawings, specifications and standards. All discrepancies shall be referred to the Engineer for decision before proceeding.
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Reference drawings

See cross section drawings reference MMD-277894-C-DR-00-XX-0010 to 0015.

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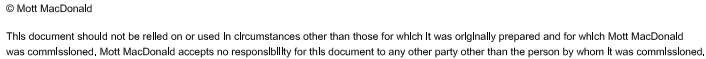
CONWY

CYNGOR BWRDEISTREF SIROL
COUNTY BOROUGH COUNCIL

Title

Colwyn Bay Waterfront
Phase 1 Coastal Defences
Promenade Structures
General Arrangement (Sheet 3 of 5)

Designed	G.Mitchell	Eng check	R.Griffiths
Drawn	H.Roberts	Coordination	G.W.Mitchell
Dwg check	R.Griffiths	Approved	P.Phipps
Scale at A1	1:200	Status	TEN
Drawing Number	MMD-277894-S-DR-00-GA-0103	Rev	0



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7. See MMD-277894-C-DR-000-XX-2000 series drawings for details of the proposed seaside coastal defences.
8. Refer to MMD-277894-S-DR-000-XX-0010 series drawings for additional notes.

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See cross section drawings reference MMD-277894-C-DR-00-XX-0010 to 0015.

Holt Rinehart & Winston

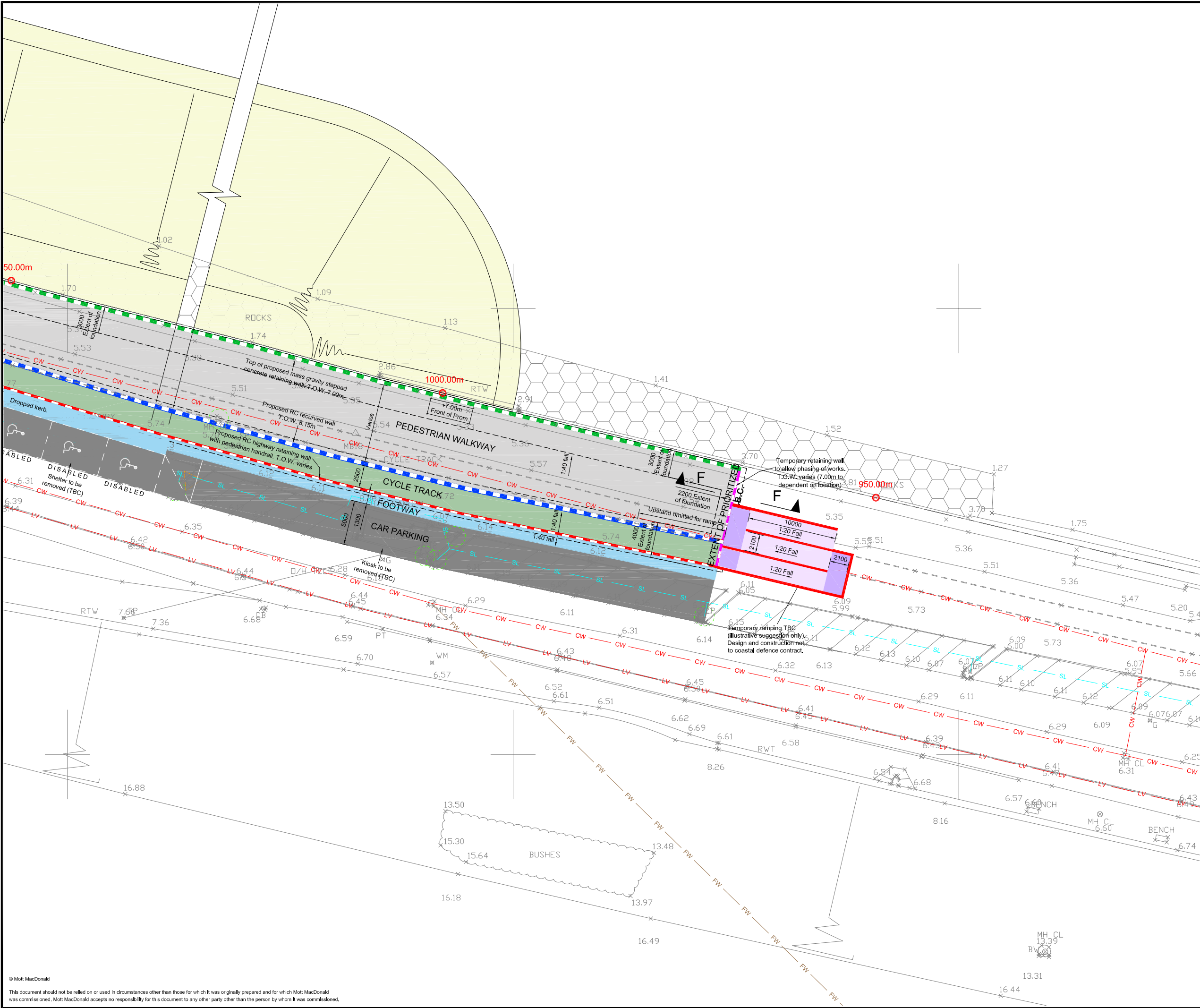
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P1	13.8.10	H,R.	Progress print for budget estimate only.	R,G.	P,P.
Rev	Date	Drawn	Description	Ch'k'd	App'd



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COUNTY BOROUGH COUNCIL

Colwyn Bay Waterfront
Phase 1 Coastal Defences
Promenade Structures
General Arrangement (Sheet 4 of 5)

Designed	G.Mitchell		Eng check	R.Griffiths	
Drawn	H.Roberts		Coordination	G.W.Mitchell	
Dwg check	R.Griffiths		Approved	P.Phipps	
Scale at A1		Status		Rev	
1:200		TEN		0	
Drawing Number					
MMD-277894-S-DR-00-GA-0104					



- Notes
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P1	13.8.10	H.R.	Progress print for budget estimate only.	R.G.	P.P.
Rev	Date	Drawn	Description	Ch'k'd	App'd

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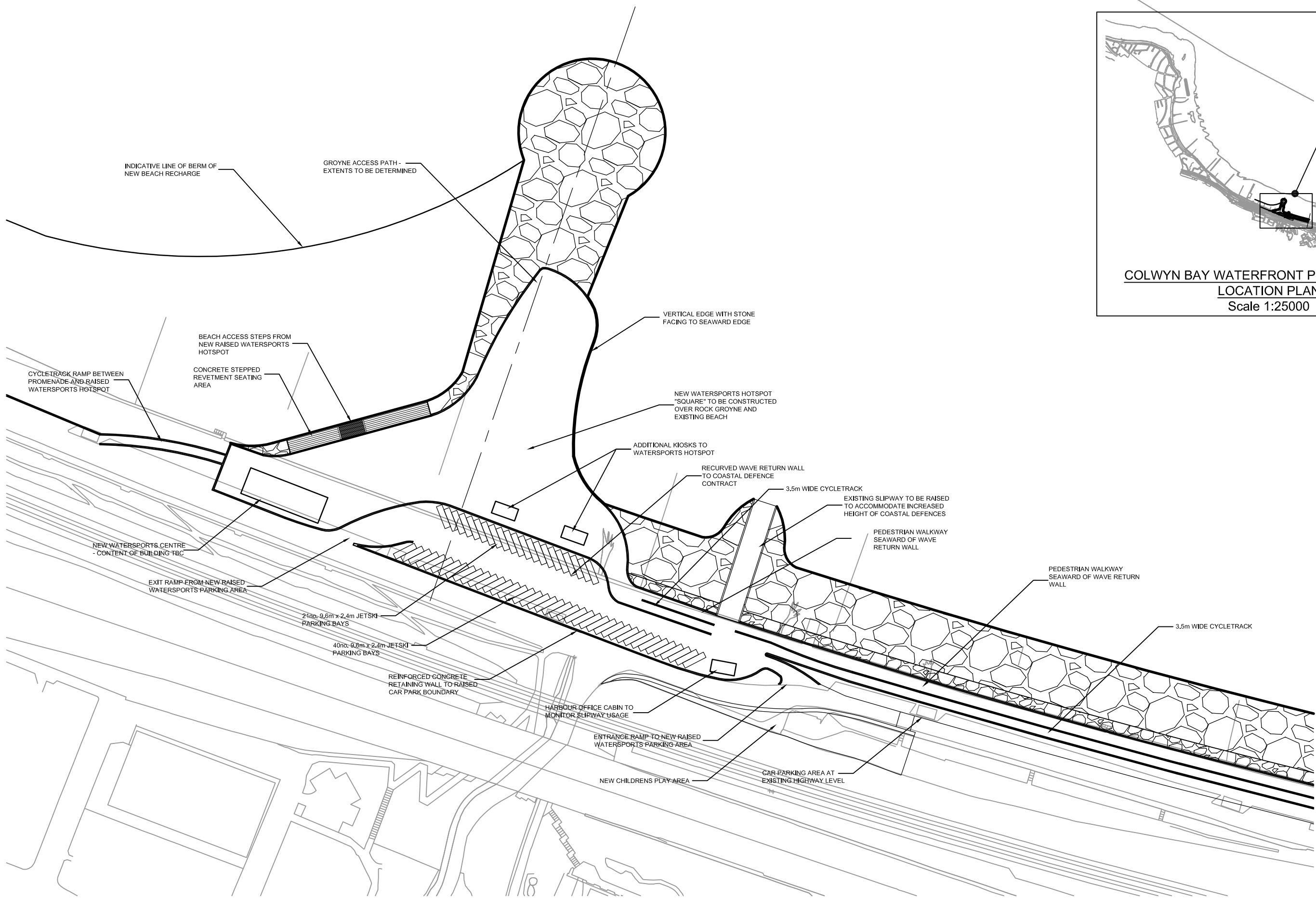
Client

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CYNGOR BWRDEISTREF SIROL
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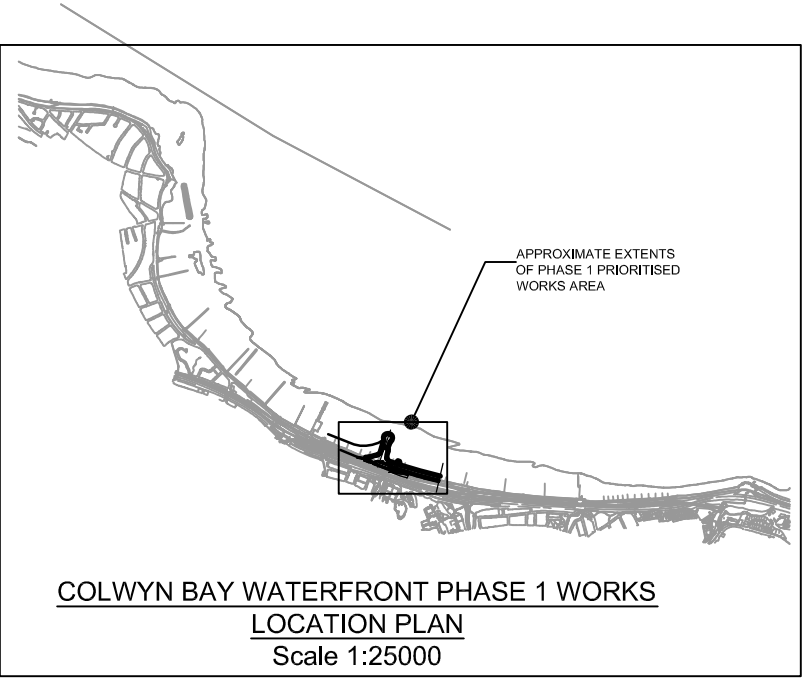
Title

Colwyn Bay Waterfront
Phase 1 Coastal Defences
Promenade Structures
General Arrangement (Sheet 5 of 5)

Designed	G.Mitchell	Eng check	R.Griffiths	
Drawn	H.Roberts	Coordination	G.W.Mitchell	
Dwg check	R.Griffiths	Approved	P.Phipps	
Scale at A1	1:200	Status	TEN	Rev 0
Drawing Number	MMD-277894-S-DR-00-GA-0105			



PRELIMINARY ARRANGEMENT OF RAISED WATERSPORTS HOTSPOT
Scale 1:750



REV	DETAIL	DRAWN	CHECKED	DATE
PROJECT				
COLWYN BAY WATERFRONT PHASE 1 ENVIRON. IMPROVEMENTS				
TITLE				
RAISED WATERSPORTS HOTSPOT ENLARGEMENT OPTION 2				
CLIENT				
DRAWN BY: CHECKED BY: APPROVED BY: APPROVAL DATE:				
SCALE @ A1: CAD File Ref:				
AS SHOWN				
G.B. Edwards, BEng (Hons) Head of Environment, Mochdre Civic Offices, Conwy Road, Mochdre, LL28 5AB				
Tel. (01492) 574000 Fax. (01492) 575199				
PROJECT Ref: EP0802		DRAWING No: EIP1002		REV

Appendix 2.4 – Basis of Design Report



Old Colwyn Promenade Coastal Defence & Active Travel Improvement

Basis of Design Report

27 April 2020

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon CR0 2EE
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Old Colwyn Promenade Coastal Defence & Active Travel Improvement

Basis of Design Report

27 April 2020

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
P01	27/04/2020	P Kacperek N Sigalas D Palanisamy N Januddin	N Clarke F Loy A Douglas	Z Hutchison	First Issue for Client comment

Document reference: 415437-MMD-00-XX-RP-C-3100

Information class: Standard

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1 Introduction

1.1 Project Background

Conwy County Borough Council (CCBC, hereinafter referred to as the Client) require a detailed design to be carried out for a new coastal defence and active travel improvements on an approximately 1,250m long section of frontage at Old Colwyn.

Coastal defence works include:

- A rock revetment protecting the seawall and improving overtopping performance;
- Extension and protection works to existing active outfalls that will be covered by the revetment;
- New pedestrian beach accesses to replace the existing ones; and,
- Raising and widening of the promenade.

Active Travel improvements include:

- New cycleway layouts;
- Improved lighting and signage; and,
- New guardrails, etc.

Mott MacDonald Limited (MML) have previously worked on nearby projects including Colwyn Bay Promenade Phase 1a & b, Colwyn Bay Promenade Phase 2 and regularly undertakes inspections along this frontage.

1.2 Project Appraisal Report Stage

The Project Appraisal Report (PAR) produced by MML in October 2010 assessed two options (Options 4 and 5), narrowed down from five, for the provision of coastal protection along the entire Colwyn Bay frontage. The PAR recommended Option 5 as the preferred option. This consists of improving the current standard of defence through beach recharge works, construction of associated beach control structures and stretches of revetment.

Option 5 divides the entire Colwyn Bay frontage into three phases. Phase 3 includes the 1,250m long frontage at Old Colwyn, the area this report is focused on, and proposed a revetment structure with a footprint of 29.7m from the existing seawall. The proposed revetment comprised of 3-6 tonne rock armour layer with 0.3-1.0 tonne rock underlayer with fill material beneath. Additionally, the option raised the promenade by approximately 2m to enable the construction of the rock revetment as the coastal defence while preserving the coastal views from the promenade. No beach recharge works were proposed in Phase 3.

1.3 Scope of Works

Based on the Design Concept produced by the Landscape Architect (BCAL [11], included in the Technical Submission), the following coastal structures have been identified:

- Rock revetment along the seawall between Porth Eirias and Splash Point;
- Beach egress steps at intervals along the frontage;
- Access build-out including access ramp (providing inclusive access) and wide beach steps;
- Extension and protection of the various outfalls/ culverts; and,
- Tidal pools and other ecological enhancements;

Based on the Procurement Document by CCBC [12], it is understood that the coastal deliverables for the Old Colwyn Promenade Defence & Active Travel Improvements Scheme comprise the following:

- Design reports defining criteria and assumptions and including relevant calculations;
- Preparation of specifications based on Specification for Highway Works;
- Production of drawings and estimate of volumes;
- Inputs to the Environmental Scoping Report; and,
- Risk assessments related to coastal works

1.4 Purpose of this Report

The existing promenade is inundated during storms, causing flooding of the promenade and road. This will be exacerbated with future climate change, increasing both the frequency and magnitude of flooding. The promenade requires raising to safeguard the area from overtopping, the raising shall include allowances for future climate change.

Provision of new coastal defences provides the opportunity for additional regeneration and amenity benefits along the frontage. This will include widening the promenade along the narrow sections to improve access for cyclists, pedestrians and vehicles and facilities for leisure pursuits such as fishing.

This report forms the Basis of Design for the Old Colwyn Promenade Coastal Defence Scheme. The objectives of this report are to:

- Summarise the project requirements;
- Describe the approach and methods adopted in the design of the works;
- Outline the available information that will inform the design; and,
- Set out any design clarifications or assumptions.

The information contained in this report is based on the data collected to date and received from the Client. Further site surveys (drainage and ground investigations) are currently planned and are required to validate the design of the coastal structures. Reasonable assumptions have been made from current data available to inform the design, however some reviews will be necessary when the data from the investigations become available.

1.5 Document Structure

This report is structured on the following basis:

Chapter 1	Introduces the project and the objectives of the report;
Chapter 2	Details the Employer's Requirements and the project objectives;
Chapter 3	Summarises the site information;
Chapter 4	Describes the ground conditions at the site and the geotechnical parameters to be adopted for the design;
Chapter 5	Details the methodology to be adopted for the design, codes and standards, design actions and construction materials;
Chapter 6	Describes the scheme alignment and the key design elements;
Chapter 7	Outlines the methodology adopted to assess wave overtopping in line with international guidance and the recommendations on crest level and promenade level;

Chapter 8 Describes the landscaping aspirations developed in collaboration with the Client and the Landscape Architect;

Chapter 9 References.

Appendices

2 Project Objectives

2.1 Client's Requirements

2.1.1 Design Requirements

The following Client requirements are reproduced from the contract scope:

- Design of large rock revetment 1,250 in length along the frontage and approximately 30m in width. The design is to be carried out in accordance with the recommendations of the Linec modelling report and the relevant design standards [1]. Rock Armour is to be designed to 'The Rock Manual: The Use of Rock in Hydraulic Engineering' [8].
- T98 condition grade to be assessed as Condition Grade 1 upon completion.
- The design life is to be 120 years for all structural elements.
- Culvert and outfall extensions to allow flows to pass through the revetment. Existing outfalls shall not be negatively structurally affected by the new revetment.
- Raising of the promenade, where necessary, to safeguard from overtopping and the effects of climate change. Where possible, the promenade is to be widened along the narrow sections.
- Design shall merge in well with the existing environment particularly with the adjacent recently constructed phases of the promenade enhancement works, and that is sympathetic with its surroundings and historic environment.
- Provision of a buildable design solution which incorporates elements that are replicable by the construction industry and are perceived by them as being viable. Incorporating into the design the use of high quality, robust and sustainable materials that will blend in with the surrounding environment.
- Provision of a quality, sustainable and economical design in accordance with the latest legislation; codes of practice and industry best practice guidance.
- Provision of a design that is inclusive to all users.

2.1.2 Design Aspirations

The following design aspirations have been identified through discussions and communications with the Client and by the Landscape Architect BCAL employed by Mott MacDonald at concept design stage:

- To achieve a high level of environmental and social performance for the scheme. Environmental, Sustainability and Social performance shall form strong focus points for the scheme. The Client is aiming to achieve a CEEQUAL 'Whole Team' score of 'Excellent' (Civil Engineering Environmental Quality Assessment and Awards Scheme).
- 'Active Travel' improvements are included through the design of access build-outs and pedestrian access steps, thus making the beach a more attractive place to visit;
- Fishing platform elevated over the rock revetment to cater for popular fishing activity;
- Continuity of finishes and landscape materials from nearby projects.

2.2 Waste Management and Material Resources

Sustainable waste management should be practiced, and all reasonable measures are to be taken to apply the waste hierarchy: prevention; preparing for re-use; recycling; other recovery (e.g. energy recovery); and disposal, as noted in the Waste (England and Wales) Regulations 2011.

The works shall aim to comply with the Waste Framework Directive target that “by 2020, the preparing for reuse, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the list of waste, shall be increased to a minimum of 70% by weight.”

The design shall aim to accommodate construction activities that minimise any adverse impacts construction waste and material resources have on the environment. This will be achieved by materials selection, identification of sustainable construction techniques and operational methods when practical, and by reducing construction methods with high waste and waste to landfill and increasing reused and recycled content.

2.3 Safe by Design

The design of the works is covered by the CDM regulations 2015. Safety will be considered in the design with reference to the construction method, lifetime maintenance and operations, and future demolition/extension of the structures. Public safety will also be considered as part of the design safety.

A risk identification exercise is carried out and the key hazards on the scheme identified. Measures to remove or mitigate the safety risks are implemented during the design.

Appendix A contains the Designers Hazard and Elimination Record (DHER) for the works. This record is a live document which will be updated as the project develops to incorporate new hazards identified or existing hazards which are mitigated through alternative means. Main forms of mitigation include ground investigations to identify the stability of the existing/ future walls and drainage survey to locate existing utilities and pipes. Where pipes/ utilities clash with the proposed works, these will be considered in the design from the offset to mitigate the risk of them having an uncontrolled impact on the design and construction.

Drawings for the works will include a ‘SHE box’ with significant Safety, Health, and Environmental hazards from the DHER listed and located on the drawing with warning symbols. Significant risks are those that are difficult to manage during construction or that a competent Contractor experienced in this type of work would not be expected to identify.

3 Site Information

3.1 Site Location

The site is in Colwyn Bay, North Wales. The project area is located between Porth Eirias carpark (by Colwyn Bay Water sports Centre) to the west and Splash Point Old Colwyn to the east. Figure 3-1 shows the location and extent of the site.

Figure 3-1: Site location



Source: Google Earth ©

The only amenities at present are the promenade and accessible beach but these are of poor quality. There are no shops and restaurants on the landward side of the promenade. At the rear of the promenade runs an embankment with the railway located on its crest. The A55 North Wales Express Way runs adjacent to the railway further landward.

3.2 Existing Beach Accesses

Access to the site can be gained from Promenade Road in the centre of the scheme, from Cliff Gardens Road and Beach Road to the east and from Marine Road to the west.

The frontage is mainly used by the public for cycling, walking, and fishing and gets narrow towards the east at Porth Eirias. There is currently no inclusive access ramp to the beach along the promenade. The slipway located by the Porth Eirias carpark is steeper than the guidance for inclusive access gradients. It is currently used to launch jet skis and small boats and will be retained for that purpose.

The beach at Old Colwyn Promenade is divided into four sections by rock groynes. It is currently possible to walk along the whole beach frontage as a gap exists between the rock groynes and the existing rock revetment. This gap/access would be closed by the new rock revetment owing to its increased footprint. The four existing access steps are shown in Figure 3-2. Some are built of steel whilst others are concrete, they are assessed to be in fair to poor condition with repairs needed. They will be removed and replaced by the new beach access steps.

Figure 3-2: Existing beach at low tide with step locations (R: Right, L: Left access)



Source: Google Earth

The existing situation is as follows:

- Slipway by Porth Eirias carpark (1 in 8 slope);
- The slipway to Steps 1 is a distance of 150m;
- Steps 1 to Steps 2 (at rock groyne) is a distance of 280m;
- Steps 2 to Steps 3 (at rock groyne) is a distance of 400m;
- Steps 3 to Steps 4 (at rock groyne by Splash Point) is a distance of 360m.

3.3 Existing Sea Defences

3.3.1 Current Storm Events

There is no formal record of road closures of the promenade from Rotary Way to Beach Road. However, the Client has advised that, the number of closures has increased in recent years. The promenade is now routinely closed when spring tides coincide with forecast strong north or northwest winds.

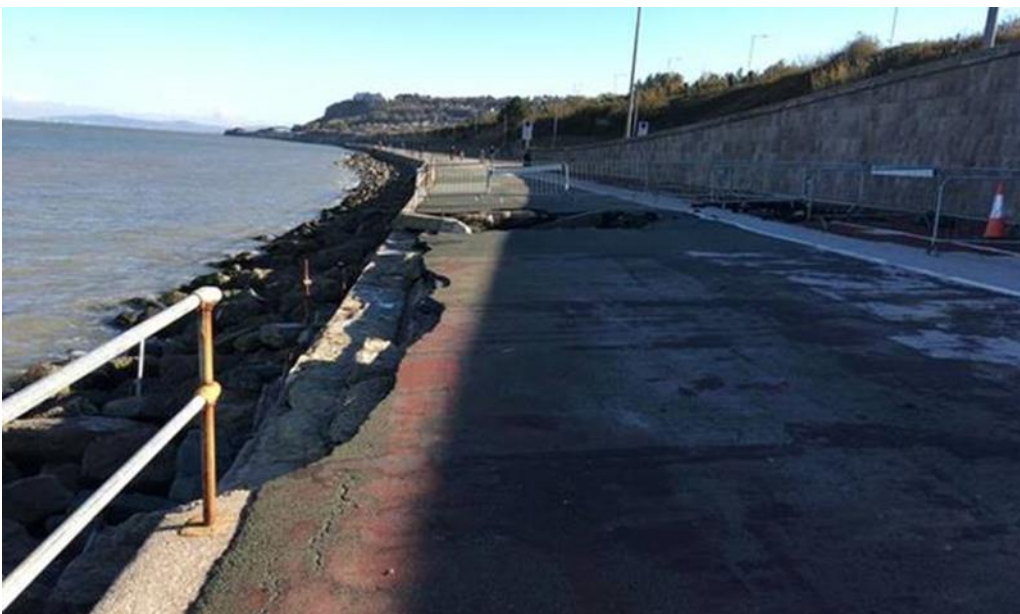
In the past, overtopping has been sufficient to break up the surfacing of the promenade, handrails have failed, sections of the seawalls have suffered from undermining / voids to rear of the promenade, and the rear wall along the toe of the railway embankment has been damaged. These defects are currently repaired by the Client on a reactionary basis each time they occur. Figure 3-3 and Figure 3-4 shows damage to the promenade and seawall after storms.

Figure 3-3: Old Colwyn's sea defence damaged during a storm



Source: <https://www.bbc.co.uk/news/uk-wales-50069665>

Figure 3-4: Damage to Old Colwyn's sea defences after storm events



Source: <https://www.bbc.co.uk/news/uk-wales-50069665>

3.4 Datum Levels and Coordinates

Existing levels are to be derived from topographical drawings supplied by the Client. The topographic survey was undertaken by Survey Operations dated April 2008. The data is in British National Grid and to Ordnance Datum.

Beach survey information is based on Penrhyn Bay – Colwyn Bay post storm survey undertaken in 2019 by Environmental & Engineering Services. The data is supplied to British National Grid and to Ordnance Datum.

All levels used in the design are in metres above ordnance datum (AOD).

Horizontal positions are relative to British National Grid (OSGB36).

3.5 Tide Levels

Table 3-1 presents the tide levels which represent typical water level conditions along the frontage.

Table 3-1: Tide levels at Colwyn Bay

Tide		Chart Datum (mCD)	Ordnance Datum (mOD)
Highest Astronomical Tide	HAT	+8.78	+4.68
Mean High Water Spring	MHWS	+7.80	+3.70
Mean High Water Neap	MHWN	+6.10	+2.00
Mean Sea Level	MSL	+4.21	+0.11
Ordnance Datum		+4.10	0.00
Mean Low Water Neap	MLWN	+2.29	-1.81
Mean Low Water Spring	MLWS	+0.66	-3.44
Lowest Astronomical Tide	LAT	-0.24	-4.34

Source: Detailed Modelling Studies for Colwyn Bay Coastal Defence Scheme, Phase 1 Interim Modelling Technical Note, 18 June 2010 [Ref. 2]

Note: MLWN and MLWS for Colwyn Bay calculation by interpolation between Llandudno and Hilbre Island.

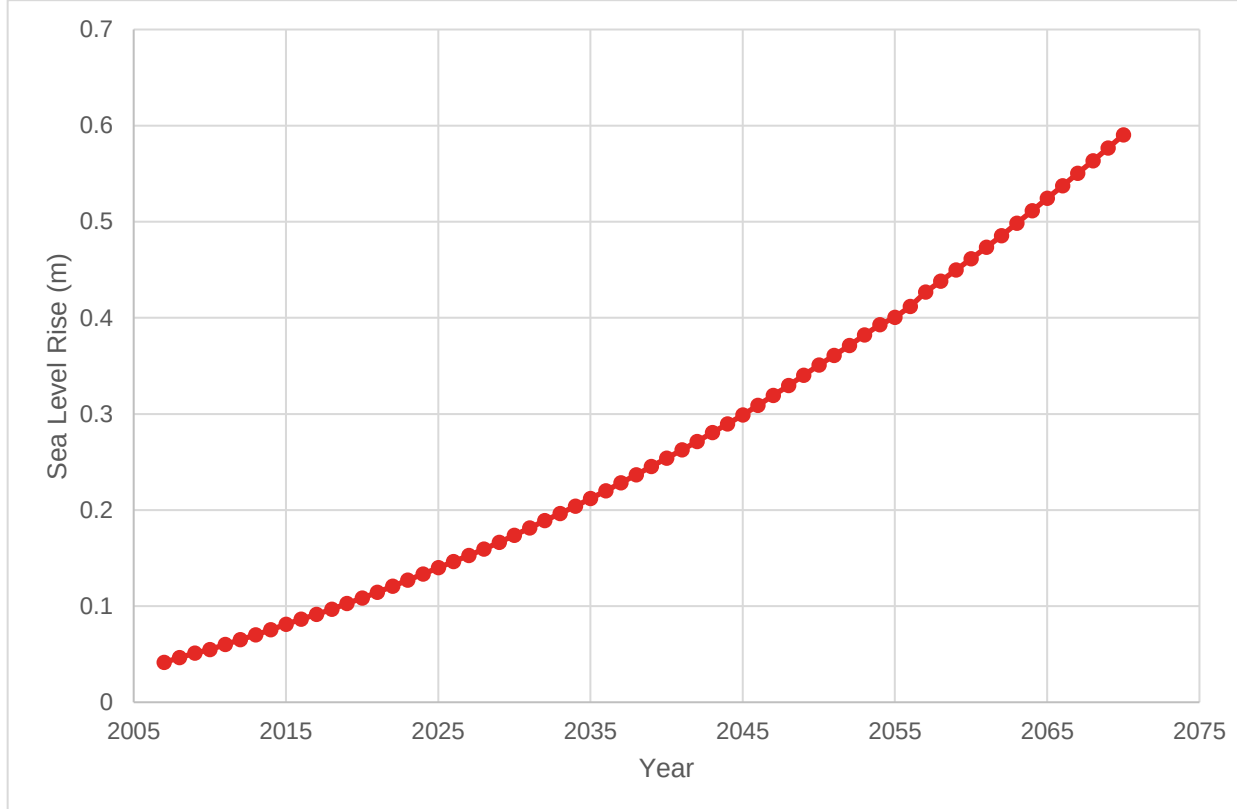
3.6 Sea Level Rise

Tide data provided in Section 3.5 was published in the 2010 report but the actual baseline date for the levels was not provided. To allow adjustment of these levels to current mean sea levels it has conservatively assumed that the data originates from 2007.

The assessment of the sea level rise allowance for coastal structures is based on UK Climate Projections 2018 (UKCP18) from the Met Office [Ref. 5]. The value used in the design has been extracted from the graph shown in Figure 3-5, this allows an adjustment from the tidal data above as well as setting 2020 as the baseline year for the beginning of the future 50 year sea level rise allowance. The 95th percentile of the RCP8.5 scenario has been considered as a conservative approach at this stage. An increase of

0.59m to water levels will be included for the mean sea level adjustment to present day and the future 50-year sea level rise allowance.

Figure 3-5: UKCP18 Projections at Colwyn Bay – RCP8.5, 95th Percentile



Source: UK Climate Projections (UKCP18) from the Met Office

3.7 Joint Probability Analysis between Waves and Water Levels

The following joint probability of extreme waves and water levels have been extracted from the Royal Haskoning Report, *Detailed Modelling Studies for Colwyn Bay Coastal Defence Scheme, Physical Model Tests of New Linear Defences*, 13th April 2010 as shown in Table 3-2.

Table 3-2: Joint probability of design waves and water levels

Return periods	WL (mOD) Sop	Tm (s)	Hs (m)
1	2.84	0.03	6.35
	3.29	0.03	6.01
	3.75	0.03	5.58
	4.21	0.03	4.95
	4.67	0.03	2.89
10	2.84	0.03	7.70
	3.29	0.03	7.70
	3.75	0.03	7.61
	4.21	0.03	7.38
	4.67	0.03	7.02
50	5.13	0.03	5.63
	3.29	0.03	8.21
	3.75	0.03	8.17
	4.21	0.03	8.03
	4.67	0.03	7.82
100	5.13	0.03	7.35
	5.58	0.03	5.58
	3.29	0.03	8.42
	3.75	0.03	8.34
	4.21	0.03	8.25
200	4.67	0.03	8.03
	5.13	0.03	7.70
	5.58	0.03	7.04
	3.29	0.03	8.68
	3.75	0.03	8.67
	4.21	0.03	8.60
	4.67	0.03	8.41
	5.13	0.03	8.04
	5.58	0.03	7.57
			3.05

Source: Detailed Modelling Studies for Colwyn Bay Coastal Defence Scheme, Physical Model Tests of New Linear Defences, 13th April 2010 [Ref. 1]

The above values have been adopted for the project area and the beach levels in front of the seawall. The results of the joint probability analysis of the design waves and water levels are shown in Table 3-3 and Table 3-4, these results will be used in the analysis of the structures.

Table 3-3: Joint probability of design waves and water levels

Return period (joint probability) (years)	Water level (mOD)	Extreme Wave Return Period (year)	Tm (s)	Hs (toe) Profile 1 (m)	Hs (toe) Profile 2 (m)	Hs (toe) Profile 3 (m)	Hs (toe) Profile 4 (m)
1	2.84	0.45	8.90	1.51	1.41	2.16	1.95
	3.29	0.38	8.50	1.72	1.64	2.33	2.17
	3.75	0.33	8.05	1.94	1.87	2.05	2.06
	4.21	0.28	7.43	1.61	1.64	1.54	1.56
	4.67	0.21	5.92	0.45	0.46	0.44	0.45
10	2.84	7.56	10.70	1.63	1.54	2.30	2.08
	3.29	7.56	10.70	1.88	1.80	2.55	2.34
	3.75	6.68	10.59	2.12	2.06	2.80	2.59
	4.21	5.21	10.32	2.34	2.29	3.03	2.83
	4.67	3.91	9.92	2.57	2.53	3.14	3.06
50	5.13	2.17	8.60	2.12	2.19	2.09	2.12
	3.29	33.30	11.34	1.94	1.86	2.61	2.40
	3.75	28.54	11.31	2.18	2.13	2.87	2.66

100	4.21	15.37	11.12	2.42	2.37	3.11	2.90
	4.67	9.30	10.85	2.64	2.61	3.34	3.14
	5.13	5.02	10.28	2.84	2.82	3.28	3.30
	5.58	2.06	8.45	2.00	2.03	1.94	1.96
	3.29	108.34	11.62	1.96	1.89	2.64	2.42
	3.75	72.22	11.52	2.20	2.15	2.89	2.68
	4.21	50.00	11.40	2.44	2.40	3.13	2.93
	4.67	15.37	11.12	2.67	2.64	3.37	3.17
	5.13	7.56	10.70	2.88	2.86	3.59	3.39
	5.58	3.91	9.92	3.07	3.06	3.16	3.18

Source: Detailed Modelling Studies for Colwyn Bay Coastal Defence Scheme, Physical Model Tests of New Linear Defences, 13th April 2010 [Ref. 1]

Table 3-4: Joint probability of design waves and water levels (in 50 years)

Return period (joint probability) (years)	Water level in 50 years (mOD)	Extreme Wave Return Period R (year)	Tm (s)	Hs (toe) Profile 1 (m)	Hs (toe) Profile 2 (m)	Hs (toe) Profile 3 (m)	Hs (toe) Profile 4 (m)
1	3.43	0.45	8.90	1.83	1.75	2.50	2.28
	3.88	0.38	8.50	2.04	1.98	2.33	2.35
	4.34	0.33	8.05	2.00	2.07	2.00	2.04
	4.80	0.28	7.43	1.56	1.59	1.51	1.53
	5.26	0.21	5.92	0.45	0.45	0.44	0.44
10	3.43	7.56	10.70	1.95	1.88	2.63	2.42
	3.88	7.56	10.70	2.20	2.14	2.88	2.67
	4.34	6.68	10.59	2.44	2.40	3.13	2.93
	4.80	5.21	10.32	2.66	2.63	3.32	3.16
	5.26	3.91	9.92	2.89	2.88	3.15	3.17
	5.72	2.17	8.60	2.12	2.16	2.07	2.09
50	3.88	33.30	11.34	2.26	2.20	2.94	2.74
	4.34	28.54	11.31	2.50	2.47	3.20	2.99
	4.80	15.37	11.12	2.74	2.71	3.44	3.24
	5.26	9.30	10.85	2.96	2.95	3.68	3.48
	5.72	5.02	10.28	3.16	3.16	3.28	3.30
	6.17	2.06	8.45	1.97	1.98	1.91	1.93
	3.88	108.34	11.62	2.28	2.23	2.97	2.76
100	4.34	72.22	11.52	2.52	2.49	3.22	3.02
	4.80	50.00	11.40	2.76	2.74	3.47	3.27
	5.26	15.37	11.12	2.99	2.98	3.70	3.50
	5.72	7.56	10.70	3.20	3.20	3.61	3.63
	6.17	3.91	9.92	3.10	3.20	3.16	3.18

Source: Detailed Modelling Studies for Colwyn Bay Coastal Defence Scheme, Physical Model Tests of New Linear Defences, 13th April 2010 [Ref. 1]

3.8 Beach Frontage

3.8.1 Description

The Old Colwyn Promenade frontage consists of a gently sloping sandy beach fronting various defences.

From previous site investigations at Porth Eirias [Ref. 9], the sand is described as “dark brown to orange brown, very silty, variable gravelly SAND with a low to medium cobble content. GRAVEL is typically fine to coarse, sub-angular to rounded of mixed lithologies such as quartz, sandstone, granite and mudstone.”

The geometry of the rock revetments varying along the project area. The eastern area does not comprise of a rock revetment in front of the seawall, instead the toe of the structure is made of sheet piles encapsulated in concrete. This toe structure is directly exposed to waves and is currently in a deteriorated condition.

The beach is accessed by four stepped accesses from the promenade and a series of outfalls and rock groynes.

3.8.2 Beach Profile

The beach slope has been estimated from the beach survey at the location of the four profiles shown in Figure 3-6.

Figure 3-6: Location of Beach Profiles



Source: Google Earth ©

The geometry of the existing seawalls at the location of the four profiles is described in Table 3-5.

Table 3-5: Existing seawall levels

Profile	Top of Seawall (mOD)	Exposed Toe Level of Seawall (mOD)	Wall Free Height (m)	Beach Slope
Profile 1	6.13	3.00	3.13	1 in 100
Profile 2	5.50	3.30	2.20	1 in 40
Profile 3	5.47	0.00	5.47	1 in 50
Profile 4	5.75	0.84	4.91	1 in 45

Photos of the structures and the beach at those profiles are shown in Figure 3-7 to Figure 3-10.

Figure 3-7: Profile 1



Source: Photo taken during site visit on 17th January 2020

Figure 3-8: Profile 2



Source: Photo taken during site visit on 17th January 2020

Figure 3-9: Profile 3



Source: Photo taken during site visit on 17th January 2020

Figure 3-10: Profile 4



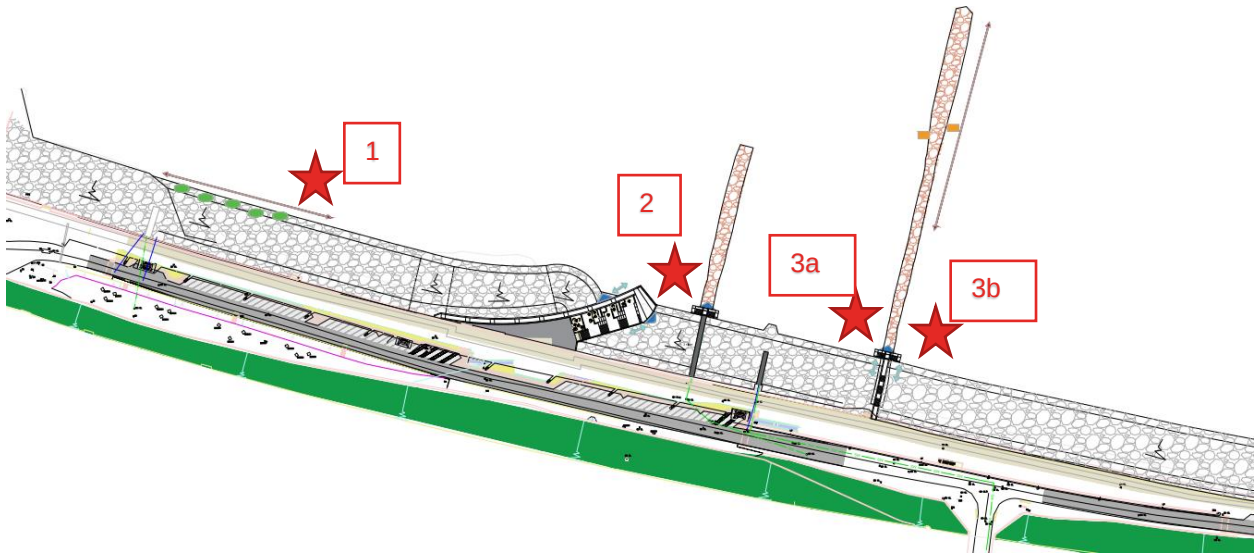
Source: Photo taken during site visit on 17th January 2020

3.8.3 Historic Beach Levels

Historic beach surveys dating back to 2005 along the Old Colwyn Frontage provided by the Client were reviewed to assess expected changes in beach levels due to beach drawdown. The levels were checked at the proposed steps locations (refer to Section 5.1) to ensure smooth access to the beach in the future.

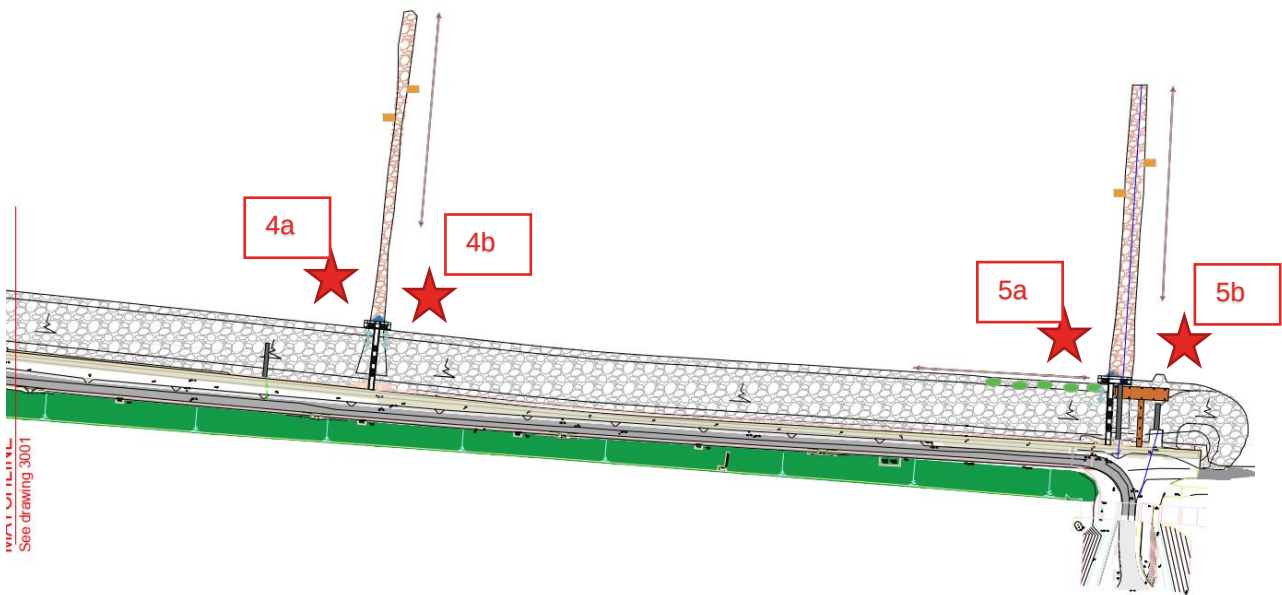
The levels were checked at the locations shown in Figure 3-11 and Figure 3-12 with the beach survey data available covering the last 15 years.

Figure 3-11: Beach level locations (Area 1)



Source: MML Drawing 415437-MMD-00-XX-DR-C-3001

Figure 3-12: Beach level locations (Area 2)



Source: MML Drawing 415437-MMD-00-XX-DR-C-3002

Table 3-6 presents the beach levels determined at the eight locations. Those values indicate that the beach is generally stable and that levels do not vary significantly with the control structures in place. The maximum variation in beach level is 0.7m at Location 4a. In light of the below results a beach drawdown value of 0.5m from the current survey data has been adopted for the design of the beach steps with possibility for the steps to be extended in the future should localised erosion occur in the future. Local beach recharge or recycling may also be implemented if required over time.

Table 3-6: Historic beach levels

Location	July 2005 (mOD)	October 2010 (mOD)	October 2015 (mOD)	January 2019 (mOD)	Max. difference in levels (m)
1	0.5	0.4	0.5	0.6	0.2
2	0.9	0.6	0.6	0.4	0.5
3a	1.1	1.0	1.2	1.3	0.4
3b	0.9	0.9	0.9	1.0	0.1
4a	0.5	0.2	0.4	0.9	0.7
4b	0.4	0.4	0.2	0.7	0.4
5a	-0.5	-0.6	-0.6	-0.5	0.1
5b	-0.4	-0.4	-0.6	-0.7	0.3

Source: MML

3.9 Existing Outfalls

A number of outfalls are located along the frontage between Porth Eirias and Splash Point. The following sources of information have been used to locate and identify the assets:

- Historic drawings from the Borough of Colwyn
- Topographic survey data available
- Welsh Water services maps
- Photographs and drawings from the Principal Inspection of Colwyn Bay Seawall [Ref. 7]
- Information and photographs from MML site visits

The identification of the existing outfalls is challenging as some of the sources above are out-of-date or incomplete. Some of the existing outfalls are hidden by the existing rock revetment, some are currently blocked while some remain in use and need to be retained.

The information gathered from the above sources have been summarised in Table 3-7 starting from Porth Eirias and finishing at Splash Point.

Table 3-7: Existing outfalls information

Approximate Location*		Dimension	Invert Level	Comments
Easting	Northing	[mm]	[mOD]	
285817.68	378903.78	450	+4.13	Historic drawings indicate 24" brick culvert. Not appearing in photos. Covered by existing revetment.
285832.18	378903.70	**	**	Historic drawings indicate two outfalls 6" C.I. gully outlet and 36"x48" brick culvert.
285875.56	378887.24	150	+4.36	Drainage pipe from promenade
285881.95	378885.48	1100 dia	+3.15	Large outfall extended through rock revetment
285890.57	378882.11	150	+4.18, 4.90	Two adjacent pipes (Vertically) – drainage pipe from promenade
286008.90	378848.25	**	+4.90	Two adjacent pipes (Horizontally) – drainage pipe from promenade
286020.72	378846.22	150	+4.35, +4.90	Two adjacent pipes (Vertically) – drainage pipe from promenade
286025.53	378844.26	150	+4.35, +4.90	Two adjacent pipes (Vertically) – drainage pipe from promenade
286098.58	378826.35	150	+4.23, +5.00	Two adjacent pipes (Vertically) – drainage pipe from promenade

Approximate Location*		Dimension	Invert Level	Comments
286141.35	378817.88	1200 wide	+1.37	Welsh Water combined rising main that runs in the rock groyne on the beach. Buried at seawall location. 1200mm wide concrete culvert boxes assembled together.
286172.72	378811.43	1100 x 600	+2.89	According to Welsh Water 900mm pipe. Photos and visit indicate a rectangular opening 1100mm wide and 600mm high with a 3000mm wide spillway.
286239.77	378797.30	**	+4.50	Historic drawings indicate 6" C.I. gully outlet. Operational status unknown.
286385.79	378765.88	**	+4.30	Historic drawings indicate 18" C.I. concrete. Partially or fully blocked.
286582.28	378740.68	600 dia	+4.00	Large circular outfall above rock revetment. According to Welsh Water 600mm dia pipe.
286712.97	378728.53	**	**	Historic drawings indicate 6" C.I. gully outlet. Only found in historic drawings. Operational status unknown.
286750.43	378724.56	500 dia	+3.00	Two adjacent pipes (Horizontally). Operational status unknown.
286989.39	378710.45	1200 wide	+1.00	Welsh Water combined rising main that runs in the rock groyne on the beach. Buried at seawall location. 1200mm wide concrete culvert boxes assembled together.
287008.60	378706.82	1800 dia	+2.50	Large culvert at Splash Point made of bricks. Water comes from Beach Road Stream. 3 foul mains overflow in the stream. 1800mm dia. Semi-circle

Source: MML

*Coordinates based on British National Grid / **: Unknown (to be verified during survey)

Five key outfalls (shaded rows in Table 3-7 above) are known to be live and shall be extended through the rock revetment. Two of those extend beyond the seawall and discharge at the end of the rock groynes.

An upcoming survey should determine the status (i.e. live or redundant) of the remaining outfalls along the existing seawall. The requirement for additional outfall extensions will be reviewed during the design.

3.10 Ecology

A desk-based assessment identified seven Statutory Designated sites within 2.0km and three non-statutory designations within 1.0km of the scheme area [Ref. 14].

The closest and most relevant is the Liverpool Bay Special Protection Area (SPA) and Important Bird Area (IBA), located 45m north of the scheme area, designated for important wading bird species. Due to the close proximity of this designation, a Habitats Regulations Assessment (HRA) screening is required for the scheme along with an application for a marine licence for the works.

The only non-statutory designation within the search area is Coed Rhos Fossil Woodland, located in the west of the scheme area. It is designated for its geological features and therefore not considered within the scope of this assessment.

The scheme area supports the priority habitats subtidal sand and gravels and blue mussel beds on sediment (two small mussel beds are present in the scheme area, both of which comprise dense and sparse areas). All other habitats are considered to be of low ecological value and do not pose a constraint to any Scheme proposals. In terms of protected and notable species, the scheme area (including the

railway embankment) has the potential to support bats, badger, other mammals, birds (nesting, foraging and overwintering), reptiles, fish and marine invertebrates.

4 Ground Conditions

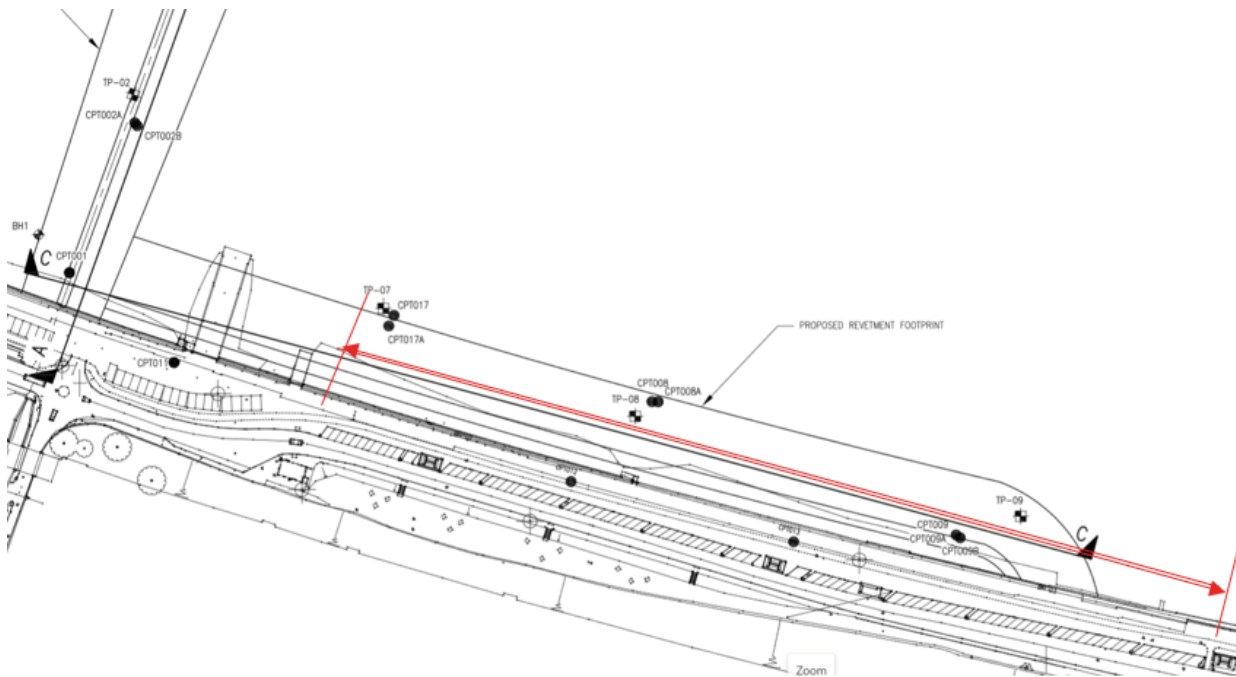
The nature of the ground strata is key to the geometry design of the sheet piles and supported structures considered in this section.

4.1 Previous Site Investigations

As part of the previous phases of the coastal defence works along the Colwyn Bay frontage, previous site investigations have been completed in areas which overlap with the Old Colwyn Promenade scheme area. Information from these site investigations are included in the following reports:

- **Grontmij, Colwyn Bay Waterfront Project Phase 1 Interpretative Report, August 2010.** As part of the Colwyn Bay Waterfront Project – Phase 1a works, Grontmij produced the detailed interpretative report on a site investigation completed by Allied Exploration and Geotechnics (AEG) in June and July 2010. The area includes the western end of the Old Colwyn Promenade Frontage near Porth Eirias.
- **AECOM Infrastructure & Environment UK Limited, Old Colwyn Promenade Improvements Geotechnical Technical Note, March 2020.** The technical note details the findings of two ground investigations undertaken by AECOM in December 2019 and February 2020 in the Splash Point area within the eastern 60m of the Old Colwyn Promenade Frontage at Splash Point.

Figure 4-1: Phase 1 site investigation area (red double arrow) near Porth Eirias



Source: Grontmij, 2010

4.2 Proposed Site Investigations

A site investigation covering the extents of the Old Colwyn Promenade scheme has been specified by MML and is currently being procured by the Client. The scope of the site investigation is included within the dedicated Ground Investigation Specification (415437-MMD-G-R-00XX-1501).

The ground parameters in Section 4.4 used for the purposes of the design at tender stage, will be updated for use in the detailed design, following receipt of information from this proposed site investigation.

4.3 Geological Profile

The ground parameters and strata levels considered in the tender design are based on the information provided in the Grontmij interpretative report and AECOM's geotechnical technical note as described above. Following receipt of the information from the proposed site investigation the parameters considered may be refined at detailed design stage.

The ground strata levels from the Grontmij (2010) report, which covers the western end of the scheme (near Porth Eirias) are presented in Table 4-1.

Table 4-1: Indicative ground model – Grontmij (2010)

Strata	Approx. Thickness (m)	Top Level (mOD)	Bottom Level (mOD)
Beach Deposits Dark brown to orange brown, very silty, variable gravelly SAND with a low to medium cobble content. GRAVEL is typically fine to coarse, sub-angular to rounded of mixed lithologies such as quartz, sandstone, granite and mudstone.	0.49 to 4.32	-2.51 to 0.81	-3.51 to 0.32 (base unproven in TP05 and TP06)
Glacial Till Comprise of stiff to very stiff, sandy, variably gravelly CLAY with a low to medium cobble and low boulder content such as quartz, sandstone, granite and mudstone.	6.7 to 10.31	-3.29 to 0.32	- 9.99 (unproven where encountered)

Source: Grontmij, 2010

AECOM Infrastructure & Environment UK Limited 2010 [Ref. 10], provides the ground model information presented in Table 4-2. This model is representative of the eastern 60m of the scheme as described previously (Splash Point).

Table 4-2: Indicative ground model – AECOM (2020)

Strata	Approx. Thickness (m)	Top Level (mOD)	Bottom Level (mOD)
Marine Beach Deposits ⁽¹⁾ Dark brown to orange brown, very silty, variable gravelly SAND with a low to medium cobble content. GRAVEL is typically fine to coarse, sub-angular to rounded of mixed lithologies such as quartz, sandstone, granite and mudstone. Loose to dense grey mottled yellowish-brown gravelly fine to coarse SAND with a low to medium cobble content and frequent shell fragments. Grey mottled yellowish-brown SAND and GRAVEL with a low to medium cobble content and frequent shell fragments.	1.0 to 2.5	Not defined	Not defined ⁽²⁾
Softened Zone of Glacial Till Soft to firm reddish-brown CLAY with occasional lenses of sand.	1.0 to 1.7	Not defined	-2.9 to -3.5
Glacial Till Firm to stiff reddish-brown CLAY with occasional lenses of sand.	1.2 to 1.8	-2.9 to -3.54	Not defined

Source: AECOM Infrastructure & Environment UK Limited (2020)

*Note:

(1) Marine Beach Deposits is proposed to be removed prior to construction of the revetment as it is not deemed suitable founding stratum due to scour and potential settlement issues.

(2) It should be noted that Trial Pit 3 excavated to 2.50m within Marine Beach Deposits but did not reach the base of the deposit.

4.4 Ground Parameters

The soil parameters considered in this tender design, for the various ground strata and fill materials are presented in Table 4-3. These values are based on the interpretive report produced by Grontmij (August 2010) and AECOM Infrastructure & Environment UK Limited (2020) for the existing ground strata.

Imported material for infilling behind the sheet pile walls shall be well graded granular material Class 6A, complying with Table 6/1 of Department of Transport 'Specification of Highway Works' Series 600, Earthworks and having the properties included in Table 4-3.

Table 4-3: Soil Parameters

Material	Assumed Youngs Modulus, E ⁽¹⁾	Dry unit weight γ (kN/m ³)	Critical Angle of shearing resistance ϕ' (°)	Undrained Shear Strength C_u (kPa)
Class 6A	16MN/m ²	19	35	-
Marine Beach Deposits	(E' assuming a loose submerged soil) 0.56 MN/m ²	20	32	-
Softened Glacial Till	(E _v assuming a soft to firm clay) 1.60 to 6.0 MN/m ²	17-18	27	47-94
Glacial Till	(E _v assuming a firm clay) 6.0 – 20.0 MN/m ²	20-21	27	94-338 135 ⁽²⁾

Source: AECOM Infrastructure & Environment UK Limited (2020)

Note:

(1) Values are not based on site specific test data but on published values for soils of a similar description

(2) Values are based on Grontmij (2010) data

5 General Design Considerations

This chapter summarises the design parameters including the relevant codes and standards for the design of the coastal structures.

5.1 Design Life

The design life of all structures is to be 120 years in accordance with the contract scope described in Section 2.1.1. This is defined as “The assumed period for which a structure or part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary”. The following exceptions have been identified:

- 1. The proposed design life of the rock revetment is 50 years.** This is due to the flexible nature of the structure and the potential need for repairs as the structure may exhibit movement and create local voids during storms. Additionally, the current design only incorporates 50 years sea level rise allowance and would require to be adapted if sea levels rise above the design allowance (refer to Sections 3.6 and 5.1.1). Note that the majority of the individual rock material will be durable to survive the 120 years where it remains undamaged.
- 2. The proposed design life of the fishing platform structures, is 50 years for the steel sub-structures and 25 years for the timber elements.** As a lightweight steel structure in the marine environment, it is at high risk of corrosion. Galvanisation will be specified as a minimum but additional coatings or finishes will be considered in the design as these can minimise maintenance and potentially extend the life. However, as the piles are located within the rock revetment there is potential that the rock could damage any applied finish and would commence the corrosion process. The design life of the timber utilised in the fishing platform is anticipated to be 25 years. Hardwood timber is suitable for the marine environment but owing to the organic nature of timber (overall durability and variability) elements will require replacement as they degrade over time. Timber elements will be designed to be easily replaceable.
- 3. Other ancillary design items such as guardrails, handrails and outfall grills are also likely to have limited design lives in accordance with manufacturers designs.** Where these items are to be specified the design will consider suitable durability for the marine environment in line with current best practice. Where practicable these items will be designed to be easily replaceable.

5.1.1 Climate Adaptability

The new promenade and rock revetment are proposed be adaptable for future sea level rise, beyond the current 50 year allowance (Refer to Section 3.6). These elements may require further works to maintain the proposed structure performance against overtopping or significant beach loss as a result of climate. However, the underlying structure design remains compliant with the required design lives outlined in Section 5.1

Providing a phased adaptable approach to climate change is more acceptable to stakeholders and cost effective for Clients. An adaptable design is more justifiable as uncertainty around the environmental responses increase non-linearly the further the prediction is into the future.

Rock revetments are able to be adapted to accommodate further sea level rise or scour in the future through the modification of the cross section by adding additional layers of rock or reconstructing the design profile. This adaptability does require additional footprint to accommodate further layers of rock.

Additional raising of the road and the promenade after 50 years is more challenging, and this area may be less adaptable. Future options may include the provision of additional setback walls to protect the road

infrastructure and utilise the promenade as stilling area for overtopped water. Further impacts on views and accesses or more restrictive management during storms may also need to be accepted.

5.2 Design Standards and Guidance

The base specification used for these works will be the Specification for Highways Works. Workmanship will be to the complementary execution specifications in accordance with the appropriate Eurocode standards.

The following codes/standards are used to develop the design:

- BS EN 1990 Basis of design
- BS EN 1991 Actions on structures
- BS EN 1992 Design of concrete structures & UK National Annex
- BS EN 1993 Design of steel structures & UK National Annex
- BS EN 1995 Design of timber structures & UK National Annex
- BS EN 1997 Geotechnical design & UK National Annex
- BS 6349 Maritime Structures
- BS 8500 - Concrete - Complementary British Standard to BS EN 206 - 1 Method of specifying and guidance for the specifier

Other Guidance and Codes of Practice:

- BS 6031 Code of Practice for Earthworks
- National Planning Policy Framework: Planning Practice Guidance: Flood Risk and Coastal Change
- DEFRA – Guidebook of Applied Fluvial Geomorphology
- Environment Agency – Fluvial Design Guide
- Environment Agency – Access for All Design Guide
- EurOtop Second Edition – 2018
- EurOtop First Edition – 2007
- CIRIA C683 The Rock Manual: The Use of Rock in Hydraulic Engineering
- CIRIA C766 Control of cracking caused by restrained deformation in concrete

Guidelines for geotechnical design:

- CIRIA C104 Design of retaining walls embedded in stiff clays
- CIRIA C580 Embedded retaining walls -guidance for economic design
- Contaminated Land: Applications in real environments: Code of practice (CL:aire)

5.3 Design Actions

The main design actions considered are summarised in Table 5-1. Characteristic values will be quantified, and the table completed following further stages of design.

Table 5-1: Design actions

Load	Characteristic	Area or point of application	Source
Pedestrian Surcharge	5kPa	Vertically applied on walkways and fishing platform	BS EN 1991-2 Table NA.2, C37
Pedestrian Point Load	3.6kN	Point load vertically applied on walkways and fishing platform	
Pedestrian Parapet Loading	1.5kN/m	Horizontally applied at seawall, steps, ramp wall crests and fishing platform	BS EN 1991-2 Table NA.8, C5, ix
Accidental Parapet Loading	1kN	Point load on any member in any direction up to 1.5m above adjacent surface level	Adapted from BS 7818
Construction Surcharge	10kPa	Vertically applied on promenade walkway	

Source: MML

5.3.1 Hydrostatic Forces

The pressure exerted by still and slow-moving water is considered to be hydrostatic. Pressures increase linearly with depth or 'head' of water above the point being considered. For structural analysis, hydrostatic forces are defined to act vertically and laterally.

Hydrostatic forces will be considered for appropriate typical and extreme water levels as defined in Section 3.5 and Section 3.7.

5.3.2 Tidal Lag

Tidal lag will be in accordance with the recommendations in BS 6349-1-3:2012. Generally undrained walls will be assumed. The variation from mean sea level will be considered to be a variable action. The tidal lag level will be factored from mean sea level but constrained by the geometry of the structure – that is the factored tidal lag cannot be above the top of the wall or below the level of the clay.

5.3.3 Wave Forces

Wave forces exerted on coastal elements of the scheme are to be calculated in accordance with the Pederson Method as described in 'The Rock Manual – The Use of Rock in Hydraulic Engineering 2nd Edition. For the exposed vertical wall at the promontory, or where the conditions for Pedersen are not met, the wave pressures according to Goda will be applied.

Wave forces will be applied to the handrails and guardrails below wave run-up level. The wave force, Pederson or Goda, will be converted to a dynamic fluid pressure and the handrails designed assuming this represents the water flowing around the handrail or guardrail with a drag factor applied.

5.3.4 Wind Loads

Wind loads will be considered on the fishing platform structures and calculated in accordance with BS EN 1991-1-4:2005 + A1:2010.

5.3.5 Settlement

Differential settlement as a result of varying ground conditions under concrete ground slabs used for the steps and ramp design will be accounted for through the provision of stainless dowel connections at in-situ concrete slab joints and 'tongue and groove' joints at precast concrete unit joints.

5.3.6 Drainage

Existing drainage outfalls through the seawall will be maintained by extending outfalls through the proposed rock revetment. Drainage of the promenade will be required through the seawall.

5.4 Load Factor and Combinations

5.4.1 Partial Factor

The load factors and combination factors to be used are generally applied in accordance with the BS 6349-1-2 and are presented in Table 5-2. Each combination will consist of permanent load with a leading unfavourable variable load and all other unfavourable variable loads being taken as accompanying loads with a combination reduction factor.

Table 5-2: Partial load factors and load combination factors

Action	Partial load factor sets (γ_F , γ_G , γ_Q , as appropriate)		Combination factors		
	STR/GEO A1	STR/GEO A2	Combination ψ_0	Frequent ψ_1	Quasi-permanent ψ_2 (see note)
Permanent loads					
Unfavourable (concrete)	1.35	1.00	-	-	-
Unfavourable (steel)	1.20	1.00	-	-	-
Favourable	0.95	1.00	-	-	-
Variable loads					
Surcharge	1.35	1.15	0.75	0.75	-
Pedestrian loads	1.35	1.15	0.40	0.40	-
Tidal lag/Hydrostatic	1.50	1.30	0.60	0.20	-

Source : BS EN 1990, BS EN 1997-1 and BS6349-2

Notes: A quasi permanent factor of zero indicates that the load is not included in the combination even if it is unfavourable.

5.4.2 Material Factor

The material factors are taken from the UK National Annex of BS EN 1997-1 and presented in Table 5-3.

Table 5-3: Partial factors for soil parameters

Soil Parameters	Partial Factors (STR / GEO)	
	M1	M2
Soil strength, $\tan \phi'$	1.0	1.25
Undrained shear strength, c_u	1.0	1.40
Effective cohesion, c'	1.0	1.25
Weight density, γ	1.0	1.00

Source: BS EN 1997-1:2004 NA

5.4.3 Vertical Equilibrium Partial Resistance Factors

Vertical Equilibrium (vertical geotechnical capacity) partial resistance factors are taken from the UK National Annex of BS EN 1997-1 and correlations reported in ICE Manual of Geotechnical Engineering (2012) and Tomlinson & Woodward (2008) will be adopted in the vertical pile geotechnical capacity.

For the piles which generate their resistance mainly from the shaft, shaft partial resistance factor $R_4 = 1.5$ (without explicit verification of SLS) and the model factor = 1.4 (without maintained load tests) are to be applied to the vertical geotechnical capacity.

The Partial resistance factors adopted in design are summarised in Table 5-4.

Table 5-4: Partial resistance factors for driven piles

Resistance	R1	R4 without explicit verification of SLS
Base	1.0	1.7
Shaft (compression)	1.0	1.5
Total/combined (compression)	1.0	1.7
Shaft in tension	1.0	2.0

Source: BS EN 1997-1:2004 NA

5.4.4 Load Combinations

The load combinations and partial factors considered for analysis are in accordance with the Eurocodes.

5.5 Reinforced Concrete Elements

Capping beams are to be designed such that they satisfy piling installation tolerances, reinforcement placement tolerances and minimum concrete cover requirements.

Reinforcement design will be determined to satisfy minimum longitudinal and shear reinforcement and early thermal cracking requirements of BS EN 1992-1-1: 2004 and CIRIA C766.

For further material properties of reinforced concrete considered in the design refer to Section 5.7.2

5.5.1 Stability Checks

The stability of concrete elements will be checked in the following scenarios;

1. Scenario 1: Assumes wave impacts through joints between precast joints and uplift water pressures are generated on the underside of the precast units and persist after the wave pressure on the outer surface has dissipated.
2. Scenario 2: Considers sliding of precast units under normal conditions (i.e. no wave or uplift forces from water). If the lateral forces are greater than resisting forces due to friction, the resultant lateral force will be applied to the end sheet pile.

The stability of in-situ concrete steps at the ends of the perpendicular steps will be checked in the considering horizontal wave pressures impacting at the top of steps causing the unit to rotate about the supporting steel sheet piles. The resultant vertical forces generated, in addition to the self-weight the steps will be impact on the sheet pile design.

5.6 Sheet Piles

For sheet pile design a representative section will be analysed in Wallap software to model the soil-structure interaction due to the actions on the wall rotational slip and global geotechnical stability. The analysis will consider SLS, DA1-1 and DA1-2 cases. The partial factors will be applied accordingly, using BS 6349-1-2:2016.

The structural capacity of sheet piles sections considered will be verified in accordance with BS EN 1993-1-3:2006 and BS EN 1993-5:2007.

5.7 Materials and Durability

The design shall consider the effects of the new defences upon any existing structures such as the existing seawall and the outfalls.

The design will seek to minimise future maintenance requirements, as far as is reasonably practicable, through the specification of materials that are suitable for the marine environment.

Where ongoing maintenance is required for the completed works to remain fully functional over their design life, all maintenance requirements will be outlined in the detailed design report and the Health and Safety File. Structural maintenance is anticipated to be required on:

- Sealants applied at concrete joints;
- Timber decking for fishing platform;
- Guardrails and handrails;
- Outfall gratings.

5.7.1 Rock

Rock material for the revetment will be specified to ensure long-term durability. The following parameters are assumed for the basis of design and rock specification:

- Rock materials will be sized to standard gradings according to BS EN 13383 standard gradings;
- Rock specification should aim to provide durability for the 120 year design life;
- Rock mass density will be a minimum of 2,600kg/m³;
- Resistance to wear, Micro Deval, less than 10%;
- Water absorption less than 4%; and,
- Compressive strength greater than 70MPa.

5.7.2 Reinforced Concrete

This section sets out the material requirements for the reinforced concrete elements included in the design.

5.7.2.1 Mix Design

The required concrete mixes will be compliant with BS 6349-1-4 and BS 8500-1:2006.

Reference is made to BS 6349-1-4, which gives recommendations for concrete used in the design and construction of maritime environment structures and includes specific provisions for use in a seawater environment.

It should be noted that the requirements for concrete types are mainly controlled by the exposure class rather than the structural requirement. Other factors such as ground aggressivity, which will be understood following the site investigation, will also influence the mix design.

5.7.2.2 Reinforcement

Reinforcement is to be designed to Eurocode recommendations typically using grade 500 Class B to BS4449:2005.

5.7.3 Structural Steel

5.7.3.1 Grade

Structural steelwork is to be designed in accordance with Eurocode recommendations and is typically manufactured and fabricated to BS EN10025. Where appropriate the steel grade adopted in design for the structural steel work is S355. The weight density adopted in the design is in accordance to EN 1991-1-1:2002 Annex A and is taken as 78.5kN/m³.

5.7.3.2 Corrosion

All structural steel should consider corrosion allowance in accordance with BS EN 1993-5: 2007. Table 5-5 summarises the corrosion rates should be considered based on zone with required working life of 50 years and uncoated.

Table 5-5: Corrosion rates

Zone	Corrosion after 50 years (mm)
Undisturbed natural soil (buried zone)	0.60
Compacted non-aggressive fill (half the value for non-compacted)	0.60
Sea water in temperate climate in zone of high attack (splash zone)	3.75
Sea water in temperate climate in zone of permanent immersion (intermediate zone)	1.75

5.7.4 Timber

All timber to be utilised in the decking and cross beams for the fishing platform design is to be a hardwood timber of minimum strength grade D45, to maximise design life.

It is assumed that due to the nature of the coastal environment the design life of the timber will be 25 years and will therefore have to be replaced periodically throughout the fishing platform design life, subject to inspection and assessment.

5.8 Constructability, Construction Risks and Mitigations

This section considers how implementation of the scheme could be carried out in an efficient manner. Constraints on construction are identified and mitigations for risks, for safety in accordance with CDM Regulations 2015, public access and use and cost and programme. Any plant and working methods are those foreseen at this stage and are based on current knowledge.

The key constructability risks currently identified are:

- Existing wall stability;
- Obstructions with existing toe of structures and culverts/ outfalls;
- Unidentified utilities;
- Environmental constraints; and,
- Health and safety hazards, including public safety.

The construction hazards in the DHER (Appendix A) were based on the following assumed methods of construction:

- Utilisation of large plant, such as piling rigs and support cranes, working predominantly from the beach, for sheet piling works;

- Lifting and placement of precast concrete units for steps construction using a crane working from the existing promenade;
- Placement of large/heavy rocks for revetment works using large plant. Delivery is assumed to be by barge off loaded onto the foreshore at low tide with rocks transported by dump truck and placed by large back actor. Placing the crest rocks may require working from the promenade;
- Outfall extensions/ protection will be constructed by crane working from the promenade with precast units delivered along the promenade. Access from the beach might be required for the headwall and the furthest precast units.

The construction sequence is assumed to follow site practicalities and is not constrained by stability requirements of the structural elements.

- Piling for the fishing platform and the promontory will need to occur before the placing of the armour rock, and possibly before placing the core depending on the grading adopted.
- The construction of the outfalls is closely integrated with the adjacent revetment.
- Construction of the stairs needs to consider tide and wave disturbance of exposed fill before the precast units are placed.

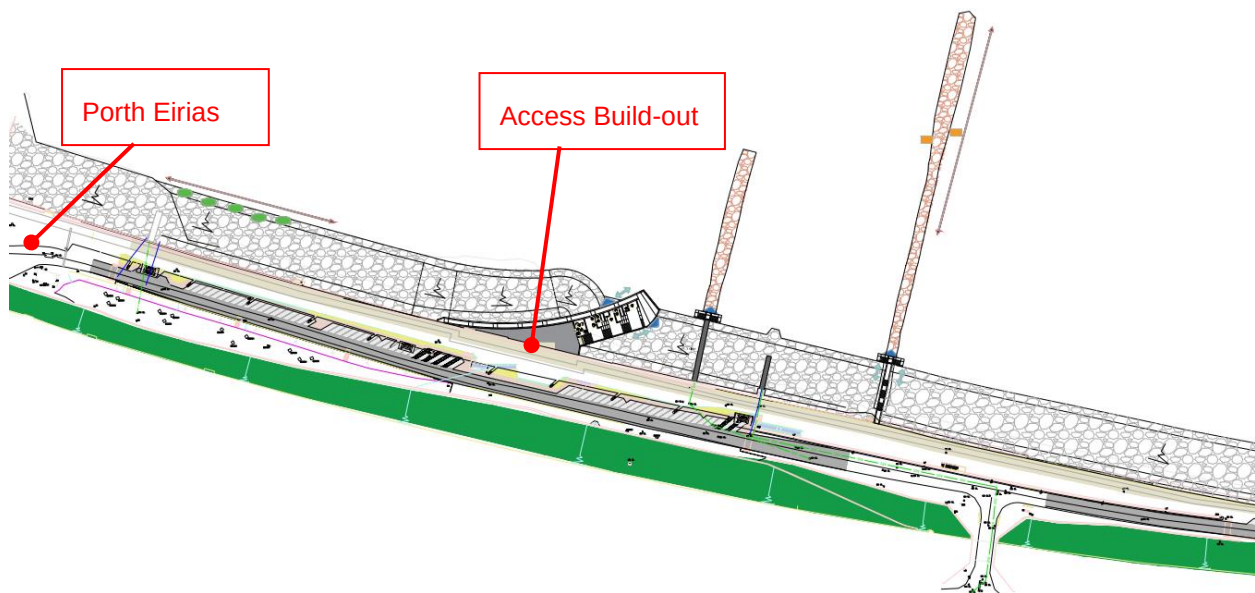
6 General Scheme Arrangement

6.1 Alignment

The scheme extends from Porth Eirias Car Park (west) to Splash Point (east) as shown in Figure 6-1 and Figure 6-2. The scheme follows the alignment of the existing seawall, with the rock revetment extending approximately 30m perpendicularly towards the beach and the promenade raising landside of the existing seawall.

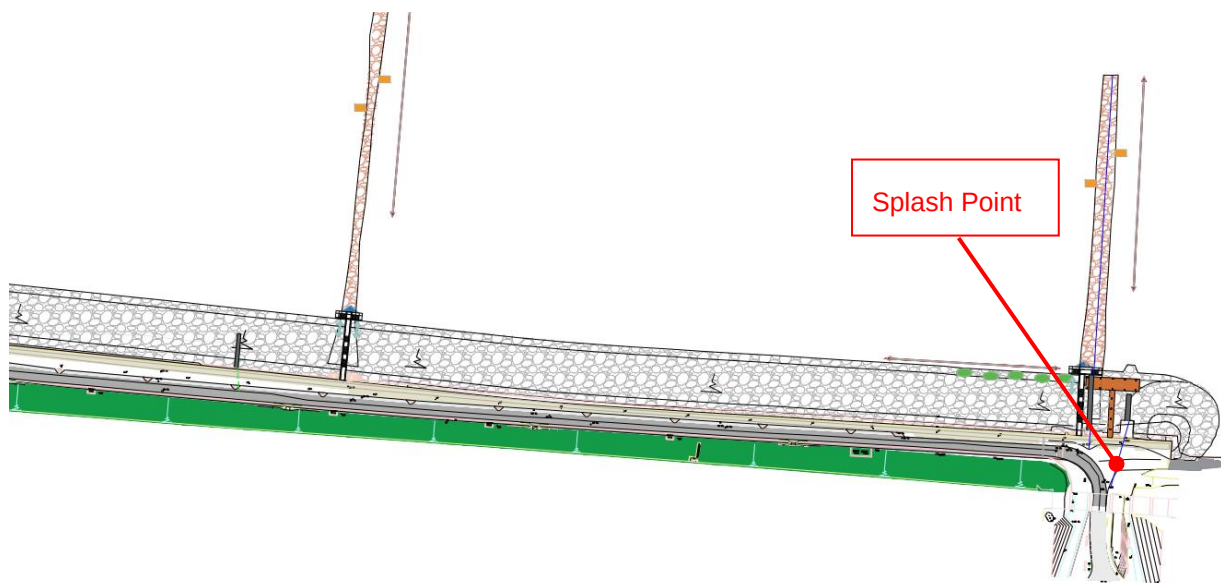
The scheme includes pedestrian access steps and a ramp connecting the promenade to the beach, an access build-out as amenity area as well as fishing platform for the angling community.

Figure 6-1: Scheme alignment (Area 1)



Source: MML Drawing 415437-MMD-00-XX-DR-C-3001

Figure 6-2: Scheme alignment (Area 2)



Source: MML Drawing 415437-MMD-00-XX-DR-C-3002

6.2 Key Design Elements

The main structural elements along the Old Colwyn Promenade consist of the following:

- Rock revetment – 1250m long and approximately 30m wide comprising rock armour;
- Promenade / seawall raising – Designed by the Colwyn Bay Team.

At specific locations along the frontage the following structural elements are also included:

- 3No. pedestrian access steps,
- 1No. 'Access build-out' with inclusive access ramp,
- 1No. timber decked fishing platform,
- 3No. seawall outfall extensions (to be confirmed by drainage survey), and protection to 2No. buried outfalls.

The design methodologies of these structural elements are outlined in this section.

6.2.1 Rock Revetment

The rock revetment geometry is to consist of a flat crest adjacent to the seawall, with a constant slope down to the beach level. Where the revetment meets the bed levels an appropriate toe detail will be provided based on the ground conditions and with an allowing for potential scour. The toe of the revetment is to be constrained to within 30m of the existing seawall.

The revetment crest width, crest level, slope angle, permeability and roughness of the rock revetment affect the amount of wave energy dissipation associated with the swash (run-up) and backwash. These parameters combine to determine the structures overtopping performance (refer to Section 7). Overtopping performance will determine the geometric design of the revetment.

The rock revetment cross section will be constructed of a primary armour layer of rock, an underlayer and a core. The core is expected to be constructed from quarry run rock or sand material. If required a geotextile filter will be used to prevent fine core material from washing out between the upper layers. For details of rock materials properties to be used in design and specification refer to Section 5.7.1.

The Rock Manual [Ref. 8] is used in the design of the rock armour revetment. As previously mentioned, the rock armour revetment would serve to provide a standard of protection against a 1 in 100-year joint probability return period event with 50 years of sea level rise allowance. Though the revetment structure is designed with a life of 50 years, this does not relate to the individual rock armour units. The rock armour design accounts for wave loadings possible within the design life of the structure, based on the most severe wave heights, periods and water levels outlined in joint probability analysis. So far as is practicable the design will specify rock units to have a durability of 120 years.

6.2.1.1 Primary Rock Armour

The general design of the rock armour is to be based on Van der Meer equations modified by Van Gent to be applicable for shallow water, as described in The Rock Manual [Ref. 8]. The key input is the ratio $H_{2\%}/H_s$ which will be estimated using a composite Weibull distribution. A damage number S_d of 3 is selected corresponding to start of damage. This allows for the potential displacement of up to 5% of the armour stones in the region of primary wave attack for the design wave conditions.

The input parameters assumed in the Van der Meer Equations (additional to the wave parameters) are:

- Local toe depth: depends on Profile location
- Beach slope: depends on Profile location
- Revetment Slope: 1:2.5 to 1:3 - may vary depending on overtopping performance and geometry constraints.
- ρ_s (Density of the rock): 2,600kg/m³
- ρ_w (Density of the water): 1,025kg/m³
- P (Permeability factor): 0.1 (due to geotextile and seawall at the back)
- Storm Duration: 6 hours
- S_d (Damage number): 3 (start of damage)

Sensitivity analysis will be undertaken to ensure the specified armour stone is stable under a variety of factors and consideration of rock source variability e.g. rock density.

The armour of the existing revetment has been identified to be approximately 3-6t which is likely to be similar to the proposed grading. Thus, the design shall look to reuse existing materials to reduce costs and make carbon savings.

6.2.1.2 Underlayer

The proposed underlayer from the PAR comprised of 0.3-1t rock in two layers with approximate D_{n50} 0.6m (1.2m nominal layer thickness). This sizing complies with the filter grading guidelines set in The Rock Manual [Ref. 8] for the proposed primary layer discussed in the previous paragraph. The sizing will be confirmed during the design.

6.2.1.3 Geotextile Fabric

To ensure that the core material does not migrate through into the rock armour a geotextile fabric has been incorporated in the design. As the core will comprise of finer material the selection of the geotextile is determined using the soil retention and permeability of the core. The proposed core material is crushed rock of grade 6A (or similar). A minimum D_{50} of 0.5mm is assumed. It is also crucial that the geotextile

does not rip or tear when placing the 0.3-1t underlayer stones and therefore is designed to satisfy a drop test requirement using the nominal upper limit armour stone size and a factor of safety of 3. Based on these criteria a geotextile of HPS8 (GEOfabrics specification) or similar is selected.

6.2.1.4 Other Considerations

It is envisaged that the revetment structure as a whole will not cause any disruption to the longshore sediment transport pathway and exacerbate erosion rates in other areas. However, due to the dynamic nature of beaches and without modelling there is still an element of uncertainty. Some conditions may induce scour at the toe whilst others may see accretion due to the dissipative nature of a rock revetment. The revetment toe depth and geometry will consider these beach fluctuations.

Beach drawdown (mentioned in Section 3.8.3) is to be accounted for in the wave overtopping assessment and in the design of the structures. The piled structures toe depth and geometry will consider these beach fluctuations.

6.2.2 Access Points

6.2.2.1 Guidance

The “Access for all design guide” provides information on access requirements and is a document produced by the UK Environment Agency for use on its public realm schemes. This guidance will be adopted to provide advice on ramp, step, handrail/guardrail geometry and features to ensure accessibility is maintained for reduced mobility and other disabilities accounting for the practicalities of the beach setting and local environment.

Within the “Access for all design guide” guidance are based on a combination of BS8300 and the A Guide to Disabled People’s Access in the Countryside (Fairfield Trust, 2005). The Fairfield Trust (2005) guidance classifies different countryside settings and provides a differing minimum guidance based on the likely use within each of the settings. This approach allows for a relaxation of standard in less urbanised settings from BS8300 which refers specifically to building access and assumes a heavy trafficked urban setting. The Old Colwyn frontage is offset from the central frontage length, and although still popular as an area, it has a lower average footfall. The frontage is slightly less managed and facilitated and has a modified natural environment, particularly towards the eastern extent. Additionally, the beach surface is not conducive for lone wheelchair or reduced mobility use. It is therefore reasonably assumed that users with reduced mobility accessing the beach would be accompanied and have assistance to ascend or descend as well as traverse the beach surface. Based on this guidance the Old Colwyn Bay area has been classified under the “urban fringe and managed landscapes” setting. Accessibility is maintained for reduced mobility users accounting for the practicalities of the beach setting and local environment.

6.2.2.2 Layout Considerations

There are no formal guidelines in the UK in terms of spacing between access points to the beach. The number and location of access points depends on the usage of the seafront, and the potential hazards on the beach. Other considerations influencing placement of access points are the likely demand, practicality and risk assessment.

The objective is to balance the provision of access to the beach for amenity and safe use of the beach by the public, but also minimise the number of access points as these often disrupt coastal defences and will attract additional capital and maintenance costs.

Spanish standards suggest 200m between access points tourist spots. The spacing between beach accesses in the highly frequented beach area of Colwyn Bay (west of Porth Eirias) is between 120m and

150m. However, the beach at Old Colwyn is less utilised and does not attract the same footfall of visitors and a wider spacing is considered to be acceptable.

Therefore, keeping 4 sets of steps (adjusting their locations as required for practicalities of construction) and adding an inclusive access ramp is the approach recommended.

Figure 6-3 shows the proposed egress steps along the promenade. In Areas 1 and 2 this will result in new steps being approximately 130m apart but further from the slipway of Porth Eirias. The distance between egress points increases towards Area's 3 and 4 with a maximum spacing of approximately of 370m. This means a person will never be more than approximately 200m from an egress point (measured parallel with the promenade). The frequency of steps provided is considered sufficient to mitigate against the risk of beach users being trapped on the beach with the tide rising.

Figure 6-3: Proposed beach accesses (R: Right access, L: Left access)



Source: Google Earth (Modified)

The proposed solution includes:

- Slipway by Porth Eirias carpark (existing);
- Between the slipway and Steps 1 at Access Build-Out, distance is 300m;
- Steps up and over rock groyne 1
- From Steps 1 to Steps 2 (at rock groyne – steps down from both sides) distance is 130m;
- From Steps 2 to Steps 3 (at rock groyne – steps down from both sides) distance is 400m;
- From Steps 3 to Steps 4 (at rock groyne by Splash Point – steps down from both sides) distance is 370m;

6.2.2.3 Pedestrian Access Steps

The new steps are proposed to be placed at the groynes and will offer access to both sides of the beach, similar to the existing set of Steps at Steps 3 (Refer to Figure 3-2).

Provision of steps over groynes ensures that:

- The whole frontage remains accessible from Area 1 to Area 4.
- Beach levels are likely to be higher/ more stable.

Steep ramps adjacent to steps have been included for beach trolleys which are becoming increasingly popular for use by beachgoers.

Pedestrian steps will be designed to be compliant with the “Access for all design guide”, a guidance produced by the Environment Agency. This provides guidance on the geometric properties of the steps and other provisions for compliance with the Equality Act. Any deviation from the guidance (e.g. on practicality basis) will be discussed and documented.

Pedestrian access steps will comprise precast concrete steps and in-situ concrete landings, supported by underlying fill material retained by steel sheet piles.

The design of the steps and ramp is influenced by varying beach levels and the surrounding proposed rock revetment levels. Additional beach drawdown of 0.5m will be considered in determining the level of the toe landings of the steps and ramps, based on the review of historic beach levels in Section 3.8.3.

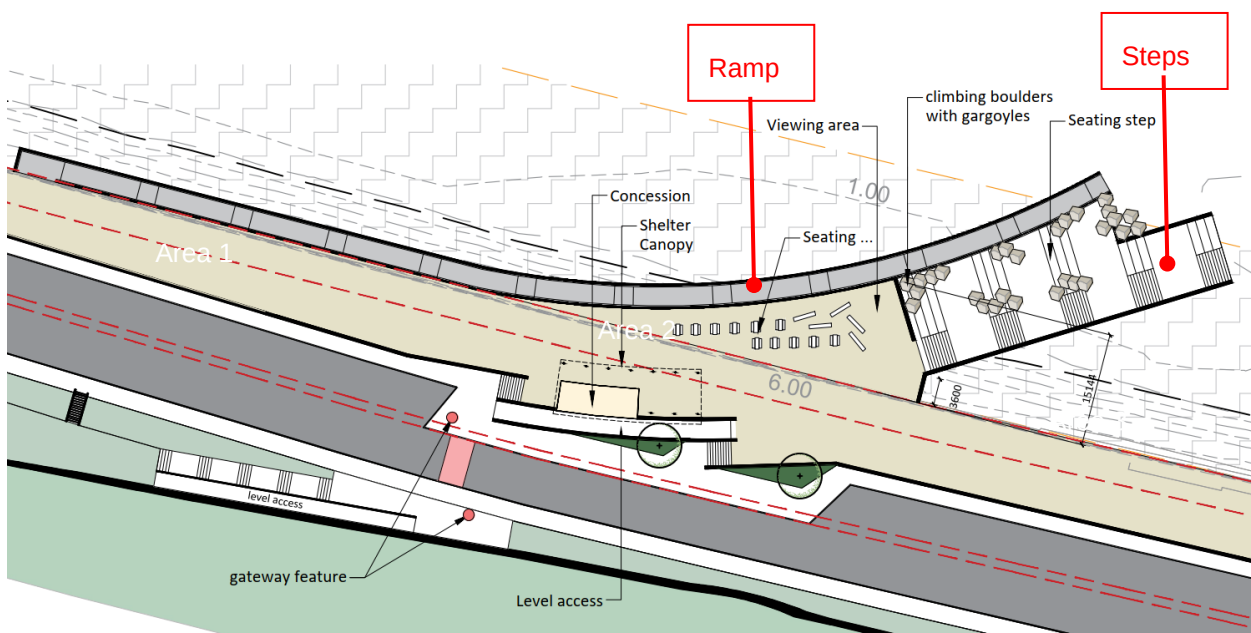
6.2.2.4 Access Build-Out with Inclusive Access Ramp

One ramp is proposed adjacent to the Steps 2 in Area 2 to the north side of the Access build-out. This new ramp is to be designed according to “Access for all design guide”, a guidance produced by the Environment Agency for compliance with the Equality Act.

Based on the ‘urban fringe and managed landscapes’ ramp gradients of 1:20 to 1:12 are recommended, incorporating level landings at intervals as resting points based on the height. To minimise ramp extents the guidance allows reduced frequency of landings with a landing every 830mm of vertical rise instead of 750mm.

An initial illustration of the Access build-out and the ramp is provided in Figure 6-4.

Figure 6-4: Proposed location of inclusive access ramp



Source: BCAL

Handrails will be provided on at least one side of the ramp. Handrails will also be provided on all steps across the site. Handrails will be between 900-1000 mm above the pitch line of steps or the level of the ground/ramp. Minimum ramp or step widths will be measured as clear widths between railings such that handrails do not interfere with passing widths.

Guardrails will be provided where the risk of falls exist. Guardrails are required to be 1000mm to 1200mm high as standard, with increases required where activities may require (e.g. if a designated cycle path is immediately adjacent a significant fall). Where possible the function of handrails and guardrails will be combined to minimise the aesthetic impact of having multiple railings at small height increments. Where guardrails have a clear gap exceeding 500mm an intermediate rail will be provided. An assessment of the risk of young children playing will be taken to determine if there is a requirement to provide mesh panel infill to the lower opening.

6.2.3 Fishing Platform

A fishing platform is to be provided over the rock revetment to provide an elevated area from which local anglers can fish safely at Splash Point. The fishing platform plan area is to be approximately 180m² and it is accessed by a 2.5m wide access to enable anglers with fishing kit to safely pass.

The platform will be a suspended deck structure and comprise timber decking supported by the timber cross beams with an underlying steel sub-structure consisting of beams and tubular piles.

Guardrails will be provided to surround the platform and access to ensure safety of the anglers. Deviation from standard guardrail heights may be required to improve the practicality of the platform for fishing. This will be assessed during the design.

Access restrictions may need to be considered to prevent access during storm periods as users are more at risk than on the promenade in this more exposed isolated area. This will need to consider the final level and position of the platform and the alignment of any access.

6.2.3.1 Timber deck design

Timber elements for the decking are to be assessed as simply supported beams and their structural capacity verified in accordance with BS EN 1995-1-1:2004+A2:2014.

Checks will be carried out on the timber deck planks and underlying cross beams to ensure the ultimate limit state (ULS) is not exceeded for bending, shear and compression stresses. The serviceability limit state (SLS) for deflection will also be checked for the design loads.

For further timber material properties refer to Section 5.7.4.

6.2.3.2 Steel sub-structure design

The steel beams are to be assessed as simply supported beams and their structural capacity will be verified in accordance with BS EN 1993-1-1:2005. Steel beams include ultimate limit state (ULS) checks for bending, shear and buckling, and serviceability limit state (SLS) check for deflection.

The steel piles will be analysed using the structural analysis software STAAD.Pro to output design forces and bending moments. The cross-section resistance and member capacity will be assessed for ULS and the deflection will be assessed for SLS.

The pile geotechnical capacity will be assessed to determine the required toe level of the pile. The parameters considered for geotechnical assessment are presented in Section 4.4.

6.2.4 Outfall Extensions

The existing outfalls that are still in operation shall be extended through the rock revetment so that their functionality is maintained (refer to section 3.9 for details). The proposed design to extend the existing outfalls through the revetment is divided into two methods based on the layer of the surrounding rock revetment they extend through, as described below:

1. Through the revetment core and underlayer:

It is proposed to use interconnected concrete rocker pipe elements to extend the outfalls through the core and underlayers of the revetment as these are less susceptible to settlements and movements and can withstand the overlying loading from the core and underlayer materials. These will vary in diameter depending on the diameter of the existing outfalls.

An in-situ concrete connection is proposed between the existing outfalls and the rocker pipe. The pipes shall be placed with 1:50 incline seawards, to ensure the flow is seaward.

The type and quantities of bedding and backfill materials to be used around the rocker pipes, shall be determined in accordance with “CD 533 – Determination of pipe and bedding combinations for drainage works” from the Design Manual for Roads and Bridges, and “Volume 3 – Highways Construction Details” from the Manual of Contract Documents for Highway Works. To prevent the bedding and backfill materials from being washed away, they shall be wrapped in geotextile.

2. Through the primary armour layer:

Outfall extensions which extend through the primary armour layer of the rock revetment, shall comprise interconnected precast concrete box culvert units instead of the rocker pipes, which are more suitable to withstand the greater loading from the surrounding rocks of the primary layer and their movements due to wave action.

The concrete box culvert units shall have a 1:50 incline seawards, and shall be reinforced and designed to withstand bending moments and shear forces generated at the ultimate and serviceability Limit States as described in Section 5.4. The dimensions of these units shall be the same for each outfall to reduce the number of different sized units manufactured. The proposed dimensions, large enough to satisfy the largest outfall, are shown in Table 6-1.

Table 6-1: Proposed box culvert unit internal dimensions

Box Culvert	Dimension
Height	1.50m
Width	1.50m
Length	2.00m

At the end of the culverts where the outfall extensions meet the outer surface of the revetment, concrete headwalls with protective sidewalls shall be included in the design. As a health and safety measure a grill is proposed to be attached to the end culvert box unit, to prevent public access into the outfall.

7 Wave Overtopping

The promenade is to be raised to safeguard the area from overtopping including allowances for future climate change. A wave overtopping assessment is required to establish the most suitable configuration for the crest of the rock revetment and the promenade level.

7.1 Methodology

Overtopping hazards are assessed by determining the volume of water that passes over the crest of the defence. The outputs of overtopping analysis undertaken utilising the EurOtop Manual 2018 [Ref 3] are:

- Mean overtopping discharge (q), defined as the average overtopping volume from all waves, it is estimated in litres per second per metre length of seawall.
- Individual maximum overtopping volume ($V_{\max}$), is defined as the maximum discharge from a single wave in litres per metre length of seawall.

These parameters (q and $V_{\max}$) are checked against defined criteria to establish the performance of differing geometric structure configurations. In the latest EurOtop $V_{\max}$ is the preferred parameter to define overtopping hazard as this represents the maximum wave overtopping based on the structure geometry, wave conditions and typical wave distributions. Definition of the criteria for $V_{\max}$ are less established and therefore the overtopping assessment will make use of both parameters, refer to Section 7.2.

The frequency of the overtopping events, assessed by the return periods set in the joint probability analysis should relate to the expectations of the users of the structures, highway and promenade and the requirements of the asset owners/ managers.

Inputs to the calculations comprise the water levels, wave heights and wave periods for each profile that resulted from the joint probability analysis, both at present day and in 50 years, the structure geometry and the beach profile for each of the profiles investigated (including beach drawdown).

The main assumptions for the calculation are as follows:

- Storm duration = 6 hours
- Roughness of revetment $\gamma_f = 0.55$ for two-layer rock armour with impermeable core (EurOtop II)
- Concrete surface of vertical walls
- Waves acting perpendicular to the structure
- No berm

Bullnose (Return Wall) width $B_r = 0.5\text{m}$ and height $h_r = 1\text{m}$ at Access build-out.

7.2 Wave Overtopping Criteria

The following criteria set out in the EurOtop Manual II – 2018 [Ref. 3] and in the EurOtop Manual I – 2007 [Ref. 4], have been reviewed to assess the level of risk associated with wave overtopping for the different scenarios. The discharge limits as shown in Table 7-1, Table 7-2 and Table 7-3 act as guidelines to assess the frequency of extreme waves exceeding the level of the proposed sea defences.

Table 7-1: Overtopping limits for people and vehicles (EurOtop II)

Hazard type and reason	Mean discharge q (l/s per m)	Max volume V_{max} (l per m)
People at structures with possible violent overtopping, mostly vertical structures	No access for any predicted overtopping	No access for any predicted overtopping
People at seawall / dike crest. Clear view of the sea.		
$H_{m0} = 3$ m	0.3	600
$H_{m0} = 2$ m	1	600
$H_{m0} = 1$ m	10-20	600
$H_{m0} < 0.5$ m	No limit	No limit
Cars on seawall / dike crest, or railway close behind crest		
$H_{m0} = 3$ m	<5	2000
$H_{m0} = 2$ m	10-20	2000
$H_{m0} = 1$ m	<75	2000
Highways and roads, fast traffic	Close before debris in spray becomes dangerous	Close before debris in spray becomes dangerous

Table 7-2: Tolerable discharge comparison between EurOtop Manual I & II

Return Period	Tolerable Discharge	Comment	Reference
1 in 1 year	$q < 1$ l/s per m $V_{max} < 600$ l/m.	For people and vehicles - People at seawall / dike crest. Clear view of the sea. $H_{m0} = 2$ m.	EurOtop (2018): Table 3.3
1 in 1 year	$q < 1-10$ l/s per $V_{max} < 500$ l/m at low level.	Trained staff, well shod and protected, expecting to get wet, overtopping flows at lower levels only, no falling jets, low danger of fall from walkway.	EurOtop (2007): Table 3.2
1 in 200 year	-	No limits given for vertical structures or promenades	EurOtop (2018)
1 in 200 year	$q < 200$ l/s per m	No damage to paved or armoured promenade behind seawall.	EurOtop (2007): Table 3.5

Table 7-3: Overtopping limits for damage to the defence crest (EurOtop Manual I – 2007)

Hazard type and reason	Mean discharge
	q (l/s/m)
Embankment seawalls/sea dikes	
No damage if crest and rear slope are well protected	50–200
No damage to crest and rear face of grass covered embankment of clay	1–10
No damage to crest and rear face of embankment if not protected	0.1
Promenade or revetment seawalls	
Damage to paved or armoured promenade behind seawall	200
Damage to grassed or lightly protected promenade or reclamation cover	50

In principle the overtopping limits are taken from the latest industry standard guidance, EurOtop Manual 2018 [Ref. 3] as shown above. However, for areas of promenade and carriageway landward of the crest no limits are given in the current version of the guidance and the limits from the previous version of the guidance have been adopted, as shown in Table 7-4. Those values are defined to ensure that the paved promenade is not damaged during extreme events behind the crest of the revetment/ seawall.

Table 7-4: Recommended discharge limits for assets

Surface	q [l/m/s]	Return period (years)
Paved	200	100
Grass	50	100

For pedestrian and vehicle access near the crest of the structure because the area does not provide essential access, but only amenity access, the overtopping limits will be assessed for the 1 in 1-year and 1 in 10-year wave and water level conditions. The risk for pedestrians and vehicles will be assessed as part of a risk assessment and mitigation measures such as promenade or road closure will be assessed. Table 7-5 presented the recommended discharge limits for pedestrian and vehicle.

Table 7-5: Recommended discharge limits for users

User	Vmax [l/m]	Return period (years)
Pedestrian	600	1 - 10
Vehicle	2,000	1 - 10

Overtopping measurements vary widely even within a single series of tests in physical modelling. It would not be unreasonable to expect the results of a physical model to be between a half and twice the predicted value for the structure. Strict adherence to the specified overtopping limits, particularly as they are upper bound predictions, is not appropriate as in many instances this may result in impractical structures. For instance, if a wave wall was designed as a standard height parapet and the predictions exceeded the limit by 20% that would be still deemed acceptable. However, when criteria are relaxed the risk consequences should be fully understood and supported through risk assessment.

7.3 Existing Defence Overtopping

The existing sea defence is comprised of vertical and stepped battered seawalls of various crest heights between +5.47mOD and +6.13mOD with some sections protected with a revetment at the toe of the wall (Profile 1 and Profile 2 in Table 3-5).

The initial overtopping results for the existing structures and geometries are presented in a Technical Note issued in February 2020 [Ref. 15]. The results consider both present day and 50-year scenarios at each profile for the existing seawall. For the 1 in 10-year return period, at present day, the maximum mean overtopping discharge q estimated is 830 l/m/s with a maximum overtopping volume $V_{\max}$ of 52,600 l/m and flooding occurring in 50 years when considering the sea level rise (Profile 3).

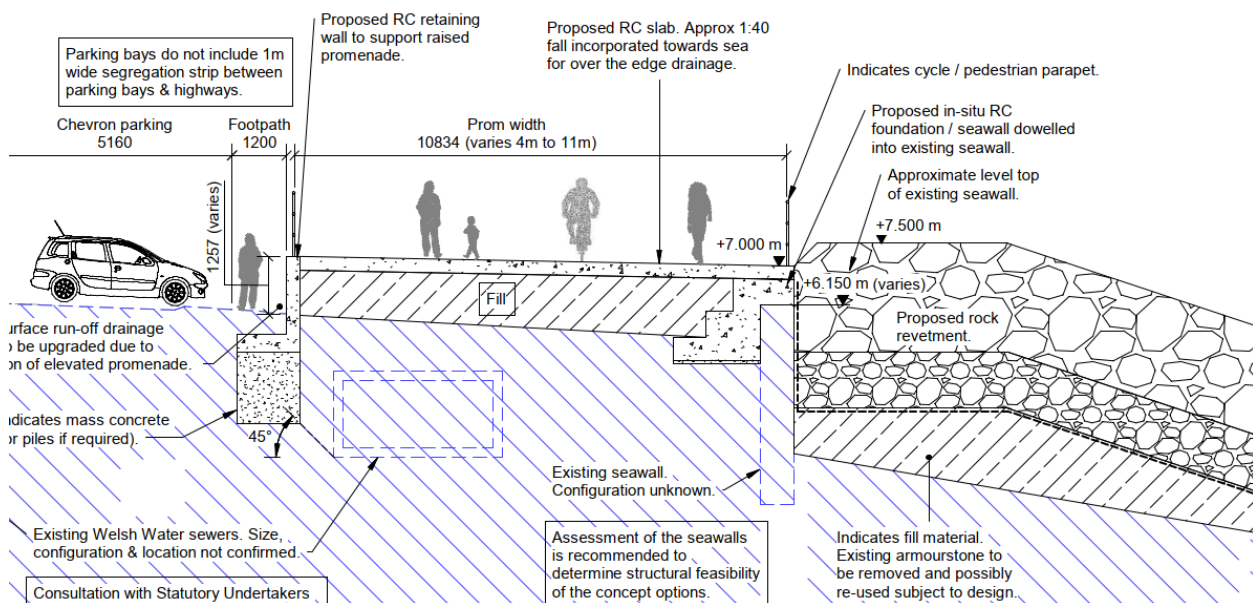
These values are significantly higher than the limits proposed by guidelines and impose risk to public health and safety, as well as risk for the protected structures, as illustrated in Section 3.3.1. Existing structures are at high risk of flooding and damage during extreme events as overtopping values significantly exceed the overtopping criteria presented in section 7.2.

7.4 Initial Proposed Defence Overtopping

An initial assessment was undertaken in a Technical Note issued in February 2020 [Ref. 15] from which an initial workable solution was chosen and approved by the Client, considering the levels of the existing structures at both ends of the scheme, the need to maintaining sea view and the impact on construction costs.

The results of this initial analysis led to a rock revetment at +7.50m OD and a promenade raised to +7.00m AOD, as illustrated in Figure 7-1.

Figure 7-1: Illustration of proposed section in Area 1 (subject to further design)



Source: MML Drawing 415437-MMD-00-XX-DR-S-0005

A sensitivity analysis will be undertaken as part of the design to confirm crest width/ level and identify an optimal solution which would reduce wave overtopping to the criteria set above.

8 Environmental and Landscape Aspirations

8.1 Environmental Enhancements

8.1.1 Rocks and Tidal Pools

Complexity is good for biodiversity, so the aim for the revetment is to provide more complex surfaces for species tolerant to the conditions (barnacles, shellfish, anemones etc). Rock surfaces can be made more complex by introducing a range of textures such as cut lines, drilled holes. Only sound rocks without defects will be used in the revetment to ensure the rock durability, any surface texturing or treatment should not be significant to reduce the rock durability.

The placement of 'enhanced' textured rock will aim to provide an improvement in habitat and biodiversity, however there are very few areas where water can be trapped naturally. Therefore, the use of pre-cast rock pool units is also to be considered (Figure 8-1) at the toe or crest of the revetment. These units come in standard sizes or can be bespoke to suit specific locations. They include intricate designs to support marine growths, such as seaweeds, algae, slimes and bacteria. These would help to support foraging birds and amphipods with food sources.

Figure 8-1: Example of precast concrete tidal pool



Source: EConcrete - EConcrete's Tide Pool Armor

8.1.2 Wall Surfacing and Vertipools

Engineered tidal pools, and enhancements to the outer walls along access steps are also recommended as they allow zonation down the intertidal area (Figure 8-2). Engineered tidal pools are artificial rock pools that offer a simple and versatile solution for creating new wildlife habitat and delivering net ecological gains across the marine environment, these may only be appropriate in more sheltered areas. Textured seawalls enhance marine biodiversity, add valuable habitat and create an aesthetic alternative to standard plain concrete walls the integrity and durability of the concrete surface will need to be assured.

Figure 8-2: Proposals for outer wall enhancements



Source: Artecology (left) and Econcrete (right) - Econcrete's Seawalls – examples of potential biodiversity enhancements

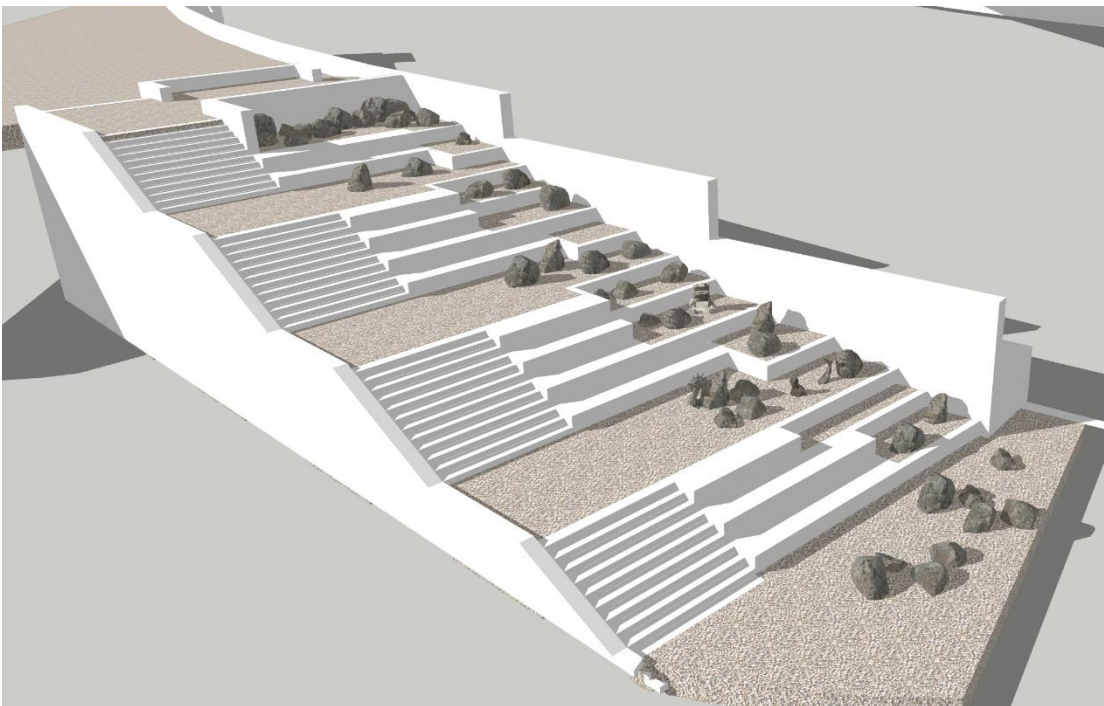
8.2 Landscape Concepts

The landscape design on the scheme is developed by BCA Landscape.

8.2.1 Access Build-out

Boulders are to be added at the Access build-out adjacent to the seating steps. The different heights and levels of the steps are good for biodiversity. The proposed landscape aspiration in terms of the arrangement of the steps and seating steps is shown in Figure 8-3. This sketch is indicative only, a number of structures have since been subject to modifications.

Figure 8-3: Indicative 3D visualisation of the Access build-out (Draft March 2020)



Source: BCAL – Note: Rock revetment and guardrails omitted from preliminary visualisation – Indicative only

8.2.2 Concrete Finishes

Patterned concrete cladding is proposed to cover the exposed sheet pile walls at the access build-out and the steps. In keeping with the nearby projects, it is recommended that a stonework patterned finish is adopted, similar in appearance to the existing seawall. The pattern will be produced by a suitable form liner.

8.2.3 Surfaces

Surfaces which alert the visually impaired to nearby hazards are included in proximity of the ramp, steps and fishing platform. Tactile paving will be used at the top and bottom of steps, level crossings and intersections of shared cycle/pedestrian routes..

The decking planks of the fishing platform will include grooves at the surface to provide more slip resistance than smooth timber planks.

9 References

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5. Met Office Hadley Centre Climate Programme funded by BEIS and Defra, UK Climate Projections (UKCP 18), 2nd Edition, March 2019.
6. Mott MacDonald Limited, Colwyn Bay Waterfront Project Coastal Defences Improvements - Project Appraisal Report, 2010.
7. Conwy County Borough Council, Colwyn Bay Waterfront Project, Principle Inspection of Colwyn Bay Seawall, 2010.
8. CIRIA C683, The Rock Manual: The Use of Rock in Hydraulic Engineering, June 2007.
9. Grontmij, Colwyn Bay Waterfront Project, Phase 1 Interpretative Report, 2010.
10. AECOM Infrastructure & Environment UK Limited, Old Colwyn Promenade Improvements Geotechnical Technical Note, March 2020.
11. BCA Landscape, 19.537 - Colwyn Bay - Phase 4 - Design Concept V2, December 2019.
12. Conwy County Borough Council, Procurement Document Design for Old Colwyn Promenade Coastal Defence and Active Travel Improvements, December 2019.
13. Environment Agency, Access for all Design Guide, September 2012.
14. Mott MacDonald, Preliminary Ecological Appraisal Report, 410895-MMD-N-R-00-XX-1701, February 2020.
15. Mott MacDonald, Colwyn Bay Old Promenade Wave Overtopping Assessment - Draft, 415437-MMD-C-R-00-XX-3000, February 2020.

Appendices

A.	Designers' Hazard and Elimination Record	49
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A. Designers' Hazard and Elimination Record

Designers' hazard elimination and management record

Complete in Conjunction with guidance in PM/106/02



Project Title		Project Number		Project Manager			
Old Colwyn Promenade Coastal Defences		415437		Geraint Mitchell			
		Division or Sub-Division		Project Safety Advisor			
		MNC		Mike Fraser			
Scope of Design		Design of promenade and new coastal defence enhancements east of Porth Eiras over approximately 1,250m long section of frontage at Old Colwyn.			Form No/ Revision MMF110-A		
(1) Haz Ref	(2) Activity/Process/ Material/Element - what is being undertaken?	(3) Hazard ¹	(4) Stage of Work	(5) Designer Risk Control Measures ² : Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken (ERIC: Eliminated, Reduced, Informed, Controlled).	(6) Is there a 'significant' residual risk to be passed on? ³ (Y/N)	(7) If answer to (6) is Yes, information flow: D/P/F ⁴	(8) Status Within MM (Active / Closed)
1	Current sea defence performance	Sea storms causing infrastructure damage and risk to humans through severe overtopping/flooding.	Use (as workplace)	Reduced: A range of coastal options have been considered to improve the overtopping performance to increase promenade safety, including seawalls and revetments. A range of revetment configurations were also tested including variants of crest height and width. The promenade is to be raised to a level of +7.0m OD and the rock revetment to be constructed to a crest level of +7.5m OD as this reduces overtopping rates to those within guidance.	No	-	Active
2	Shared use Promenade	Collision between cyclists and pedestrians resulting in injury	Use (as workplace)	Reduced: The promenade width is sufficient to accommodate both cyclists and pedestrians.	No	-	Active
3	Beach Access (ramped)	Unsafe access for mobility impaired users to beach as a consequence of exhaustion and/or excessive steepness.	Use (as workplace)	Reduced: A pedestrian access ramp has been included within the design to improve the equality of access to the beach. The ramp gradients do not exceed 1:12 and include appropriately spaced landings, in line with the Environment Agency's "Access for all design guide" guidelines and recommendations. In addition the width of the ramp is the recommended 2m to allow safe passing.	No	-	Active
4	Pedestrian usage of steps and ramp	Proposed steps and ramp become inaccessible or difficult to access from the beach as a result of beach levels dropping below bottom landing levels, resulting in injury as pedestrians try to access or egress.	Use (as workplace)	Reduced: The design has considered a maximum value for beach drawdown, based on historic beach level survey data. The steps and ramp bottom landings' levels have been determined such that they are below current beach levels minus the maximum beach drawdown level. Informed: Notes have been added to the drawings stating that beach levels should not be allowed to fall below a certain level (levels dependent on specific locations along the frontage) and be regularly monitored. Beach levels should be surveyed at regular intervals including before and after storms, and at least once a year in spring as a minimum.	Yes	D, F	Active
5	Pedestrian usage of steps and ramp	Injury through falling due to marine growth on access steps/ramp.	Use (as workplace)	Informed: The client is to be advised that that marine growth will need to be periodically removed from access steps/ramp through a maintenance regime.	Yes	D, F	Active
6	Pedestrian usage of steps and ramp	Slipping or falling on ramp/steps, resulting in injury.	Use (as workplace)	Reduced: A brushed concrete surface finish on ramp and steps surfacing has been included in the design to provide slip resistance. A fall has also been included to shed water from landing surfaces to reduce the risk of slipping on wet surfaces. Handrails have been included at a height of 950mm above ground level to provide support and stability, in line with the Environment Agency's "Access for all design guide" guidelines and recommendations.	No		Active
7	Pedestrian usage of the promenade during a storm event	Overtopping discharge onto the promenade during storm events exceeds recommended limits for safe pedestrian access resulting in injury.	Use (as workplace)	Informed: Appropriate signage and barriers is to be erected by the client during a storm event to inform public that access to promenade is not permitted.	Yes	F	Active
8	Pedestrian usage of steps	Injury through falling from height while using ramp or steps.	Use (as workplace)	Reduced: The design has included guardrails at a height of 1.1m above ground level at both sides of the steps where there is a significant drop in height. Handrails have been included in the design provide support and stability when climbing or descending the steps.	No		Active
9	Pedestrian usage of steps, ramp and beach in close proximity to the sea	Drowning in the sea	Use (as workplace)	Informed: The client is to maintain the provision of appropriate life saving appliances (e.g. lifebuoys). The items that are likely to require regular maintenance shall be located to minimise their proximity to water.	Yes	F	Active

10	Pedestrian usage of steps and ramp	Injury as a result of tripping over handrails which are buried and hidden by the sand.	Use (as workplace)	Reduced: Handrails to be fixed to walls where possible instead of central part of staircase. Handrailing below beach level have been specified not to be installed until beach levels drop. Informed: Handrails are removed when levels rise. This requirement shall be included within the health and safety file.	Yes	D, F	Active
11	Rock revetment	Limbs trapped between revetment rocks resulting in injury.	Use (as workplace)	Reduced: Guardrails have been included in design at height of 1.1m above promenade, steps and ramp levels, adding a physical barrier access to the revetment. Informed: Signs prohibiting pedestrians climbing on the rock revetment provided within the design at beach access locations.	No		Active
12	Pedestrian usage of the beach	Drowning as a result of being trapped on the beach by rising sea levels during a high tide or storm event.	Use (as workplace)	Reduced: Design has maintained the number of pedestrian access points (4No.) to the beach along the frontage providing egress routes off the beach in the event of a high tide. The design also includes pedestrian steps over all the rock groynes present along the frontage, maintaining access along the length the frontage.	No		Active
13	Pedestrian usage of the fishing platform	Sea storms causing injury to pedestrians using the platforms through overtopping. Drowning as a result of being washed over the side of the platform during a storm event.	Use (as workplace)	Controlled: The client shall install a chain with appropriate signage prohibiting access to the fishing platform during storm events, due to its exposed elevated location.	Yes	D, F	Active
14	Pedestrian usage of the fishing platforms	Slipping over on timber plank decking resulting in injury.	Use (as workplace)	Reduced: Non slip surfacing shall be included within the design to reduce the risk of slipping on wet timber.	No	-	Active
15	Replacement of concrete structures.	General construction hazards with repairing/replacing concrete structures.	Maintenance	Reduced: Concrete structures have been specified with recommended concrete cover from the marine environment to therefore reduce maintenance / replacement intervals.	Yes	F	Active
16	Concrete structures' joint sealant	Joint sealant deteriorates over design life compromising integrity of the design.	Maintenance	Informed: Client to arrange for joint sealant to be replaced when it deteriorates.	Yes	D, F	Active
17	Timber elements of scheme	Deterioration of timber decking planks and beams utilised in the fishing platform structure resulting in the platform becoming unusable.	Maintenance	informed: Timber elements to be replaced once they have deteriorated beyond the point where they can still be safely used.	Yes	D, F	Active
18	Works tying into or in close proximity to existing structures	Geometry of existing structures different to existing as-built information or topographical information, or unknown if below ground, which may affect the design and delay works on site.	Construction	Controlled: Notes have been added to the drawings specifying that the contractor shall undertake surveys of the existing seawall where proposed structures are to tie in to. Survey shall be carried out within two weeks prior to commencement of works, or ordering of materials, whichever occurs first.	Yes	D	Active
19	Sheet pile works close in close proximity to existing structures	Existing structures such as the seawall become destabilised as a result of the sheet piles or sheet piling rig damaging existing foundations.	Construction	Reduced: The design has included concrete tie-in structures adjacent to the existing seawalls, removing the need to install sheet piles immediately up to the seawalls. Informed: Notes to the drawings have been added to the drawings stating that the location and levels of the existing seawall foundations are approximate and therefore trial holes shall be undertaken by the contractor where sheet piles are to be driven to check the exact locations of the foundations. A site investigation has been arranged which will include trial holes along the toe of the existing seawall to determine depths and locations of the foundations. The information from the site investigation will be provided in the pre construction information at detailed design stage.	Yes	D, P	Active
20	Sheet pile works	Unforeseen obstructions in the ground are encountered resulting in piles not being driven to full depth and the design of the sheet pile wall becoming comprised.	Construction	Reduced: The depth of the sheet piles have been minimised through design, which has reduced the risk of unforeseen obstructions being encountered. No design measure can eliminate or further reduce the risk of encountering obstructions in the ground. Previous ground investigations have been undertaken and a further ground investigation along the frontage has been arranged, however the information from these will be specific to the individual boreholes and trial pits.	Yes	D	Active

21	Works in close proximity to existing services.	Striking live services during excavation works resulting in injury to Contractor's operatives, and/or financial penalty from the affected statutory undertaker.	Construction	Reduced: The design has considered the positions of the existing services and has avoided the requirement for excavation works to be needed near them where possible. Informed: Plans indicating the location of services from the statutory undertakers including from Welsh Water and Scottish Power have been provided in the pre construction information. Notes on the drawings have been added stating that it is unknown in some instances whether outfalls are live or disused, and that levels and positions of outfalls indicated on the drawings are approximate only. Controlled: Notes have been added to the drawings stating that the "Contractor to undertake survey to determine full extent of services present within two weeks prior to commencement of works, or ordering of materials, whichever occurs first"	Yes	D, P, F	Active
22	Working at height during construction works.	Falling from height resulting in injury.	Construction	Reduced: Design height of promenade raising, steps and ramps have been minimised through coastal and structural design.	Yes	D, P	Active
23	Construction works adjacent in close proximity to the existing seawall.	Collapse or damage to existing seawall during construction works, resulting in injury.	Construction	Reduced: Construction sequence notes shall be added to the drawings specifying that the rock revetment is to be constructed up to the existing seawall before the landside promenade raising works begin, to ensure the existing seawall remains stable during the promenade raising works. The rock revetment will provide support to the seawall from the seaside of the structure.	Yes	D, P	Active
24	Fixing of steel reinforcement.	Injury to operatives through impalement.	Construction	Reduced: Precast units have been used within the design where possible meaning reinforcement fixing is more likely to occur at a precast supplier site which will be a more controlled environment than on site.	No	-	
25	Promenade raising works.	Collapse of promenade raising structure due to possible voids under the existing promenade.	Construction	Informed: Limited information on the ground makeup is currently available however a ground investigation has been arranged to provide further information. This information will be provided in the preconstruction information at detailed design stage of the project. Over-excavation to a sound stratum and mass concrete backfilling is necessary in the event of soft ground or voids being identified, and has been included as a required measure on the drawings/specification.	Yes	D, P	Active
26	Working on lower areas of the site concurrently with works at higher levels	Falling objects hitting site operatives resulting in injury.	Construction	Reduced: Reduced: Design height of promenade raising, steps and ramps have been minimised through coastal and structural design, thus reducing the height from which any objects may fall.	Yes	D	Active
27	Working in tidal/surf zone	Plant and site operatives become trapped by incoming tide during construction works, resulting in injury or drowning.	Construction	Informed: Tide levels have been included on the drawings and within the pre construction information. No design action could have eliminated this hazard due to the location of the proposed works.	Yes	D, P	Active
28	Plant working on sloping, uneven or soft ground	Plant overturns resulting in injury to operatives and damage to plant.	Construction	Reduced: The design has minimised the size of the sheet piles and precast concrete units required, therefore minimising the size of cranes and sheet piling rig required for the works. Compaction criteria for fill to structures has been specified so that plant will work off of well compacted ground. Informed: Information regarding the condition of the existing ground has been provided in the Pre construction information in the form of previous site investigations covering some areas of the frontage. A further site investigation covering the full extent of the frontage has been arranged, and the results of which will be provided in the pre construction information at detailed design stage.	Yes	P	Active
29	Excavating works	Excavation collapse resulting in injury to operators and/or damage to plant.	Construction	Reduced: The design of the rock revetment has minimised the depth of excavation needed below beach surface level to reduce risk of collapse.	Yes	D	Active
30	Excavation works	UXOs or other buried obstructions are encountered resulting in death and injury.	Construction	Informed: A UXO hazard check has been undertaken. The Zetica UXO Online Map Viewer indicates the Site and surrounding area are in a low risk area. This information is included within the MM Geotechnical Desk Study which has been provided within the Pre construction information.	Yes	D, P	Active
31	Placement of precast concrete units	Difficult lifting operation involving heavy and large concrete units resulting in injury to operatives due to crushing.	Construction	Reduced: Precast unit lengths have been designed so that their weight is manageable and can fit on trucks/trailers typically used for large concrete unit transportation. The design for the provision of appropriate lifting fixtures in the precast units has been specified to be designed by the contractor. This is best practice as the contractor will have to design these around any lifting frames and methods of lifting that they will be using, resulting in a more controlled lifting methodology.	Yes	D	Active

32	Fishing Platform construction	Difficult construction process required in working working at height to fix connections, resulting in injury or death due to falling.	Construction	All connections to be designed at the detailed design stage to reduce the number of fixing operations that need to be carried out at height, i.e. look at making it possible to prefabricate decking and underlying beams and lifting in place, reducing number of fixings required at height.	Yes	D	Active
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Checked and approved by (see notes 5 & 6):

Name:	Signature:	Date:
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Notes

- 1 A hazard is something with the potential to cause harm, such as: working near live traffic, working at height, falling object etc.
- 2 Designer Risk Control Measures are to be based upon the Principles of Prevention - 'Eliminate, Reduce, Inform & Control'.
- 3 UK CDM ACOP defines 'significant' 'Significant risks are not necessarily those that involve the greatest risks, but those, including health risks that are: (a) not likely to be obvious to a competent contractor or other designers; (b) unusual; or (c) likely to be difficult to manage effectively.' Extract from ACOP clause 133.
- 4 Information codes: D = Information detailed on drawings (add drawing nos); P = Information for Pre-Construction Health and Safety Plan; F = information for the health and safety file. Please note that this information may also be relevant to specifications and/or reports.
- 5 Project Manager (or Design Team Leader, as appropriate) to check and approve Record unless the design work has been carried out directly by the Project Manager (or Design Team Leader) in which case the Record is to be checked and approved by the Project Director (or Sub-Project Director, as appropriate).
- 6 This Form should be reviewed and revised as design changes are made and as the stages of design progress.

Appendix 2.5 – Design Concept Drawings



Colwyn Bay

Phase 4 Promenade

Design Concept

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Concept Overview

Our Design Vision for the promenade is a scheme that seeks to continue the implementation of the Preferred Colwyn Bay Waterfront Strategy, as a key driver to the town's emergence as a visitor destination.

We will build upon our knowledge gained in previous phases to create an environment that meets the project objectives and contributes towards fulfilling the County's Citizens Outcomes, creating a Vibrant and Viable Place worthy of Conwy County.

Our initial ideas are presented in the Vision Statement. This vision picks up from Porth Eirias and continues the successful resolution of the promenade east of Porth Eirias, with the prime aim of producing an appropriate mass of consistent character and scale to unify this end of the Bay – the Back to Nature theme resonating in our proposals.

We have presented a number of options with a baseline scheme of raising levels across the promenade and replacement of the rock revetment. Against this baseline minimum scheme, there are then options for further degrees of intervention, all of which would be reviewed by all against issues such as cost, engineering, buildability, and programme to arrive at a chosen design.

Where appropriate, the detail design will contribute to the eight objectives of the Council's Corporate Plan, particularly in terms of health, personal safety, sustainability, and heritage/culture.

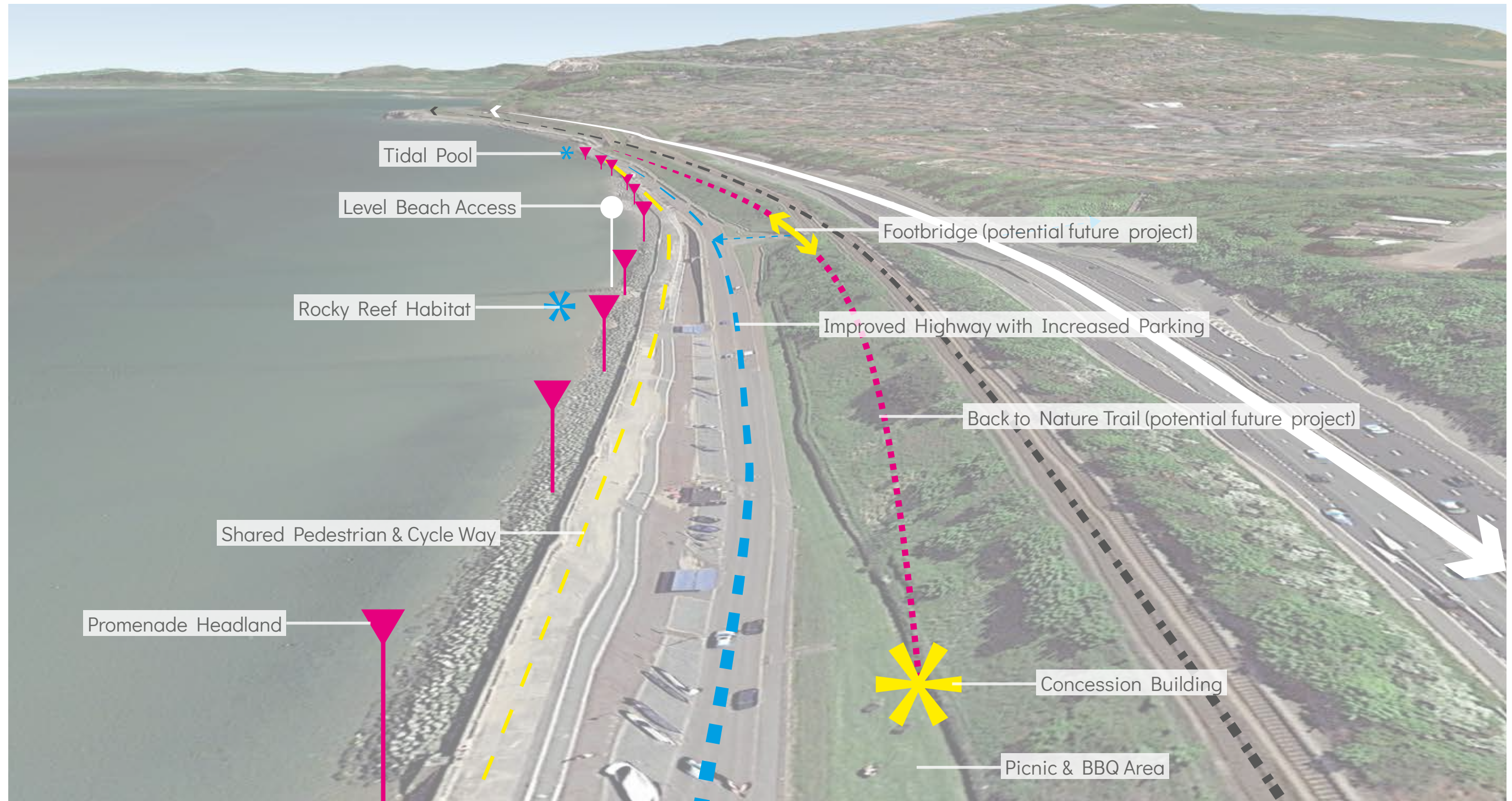
We are looking to deliver a scheme that fits with the various previous phases in terms of materiality and some repletion of successful elements from other phases, but it will also have its own identity.

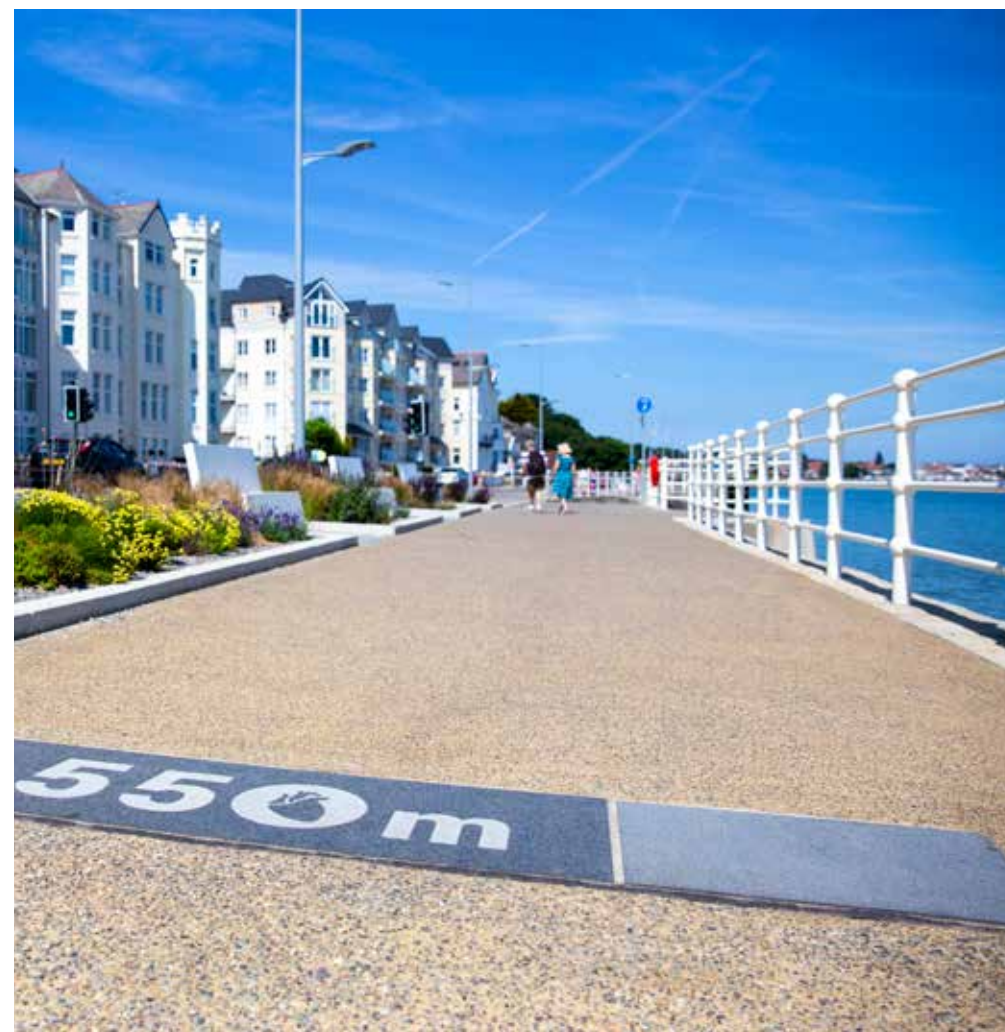
We have also examined options for increasing car parking and for a nature trail along the railway embankment, which would of course be subject to viability discussions with Railtrack.

We have focussed on the development of options that we feel are buildable and can be very easily developed into detailed design and working drawings if the project needs to be delivered quickly.

This has been possible due to the team's familiarity with the site, the lessons learned from previous phases.

Concept Overview



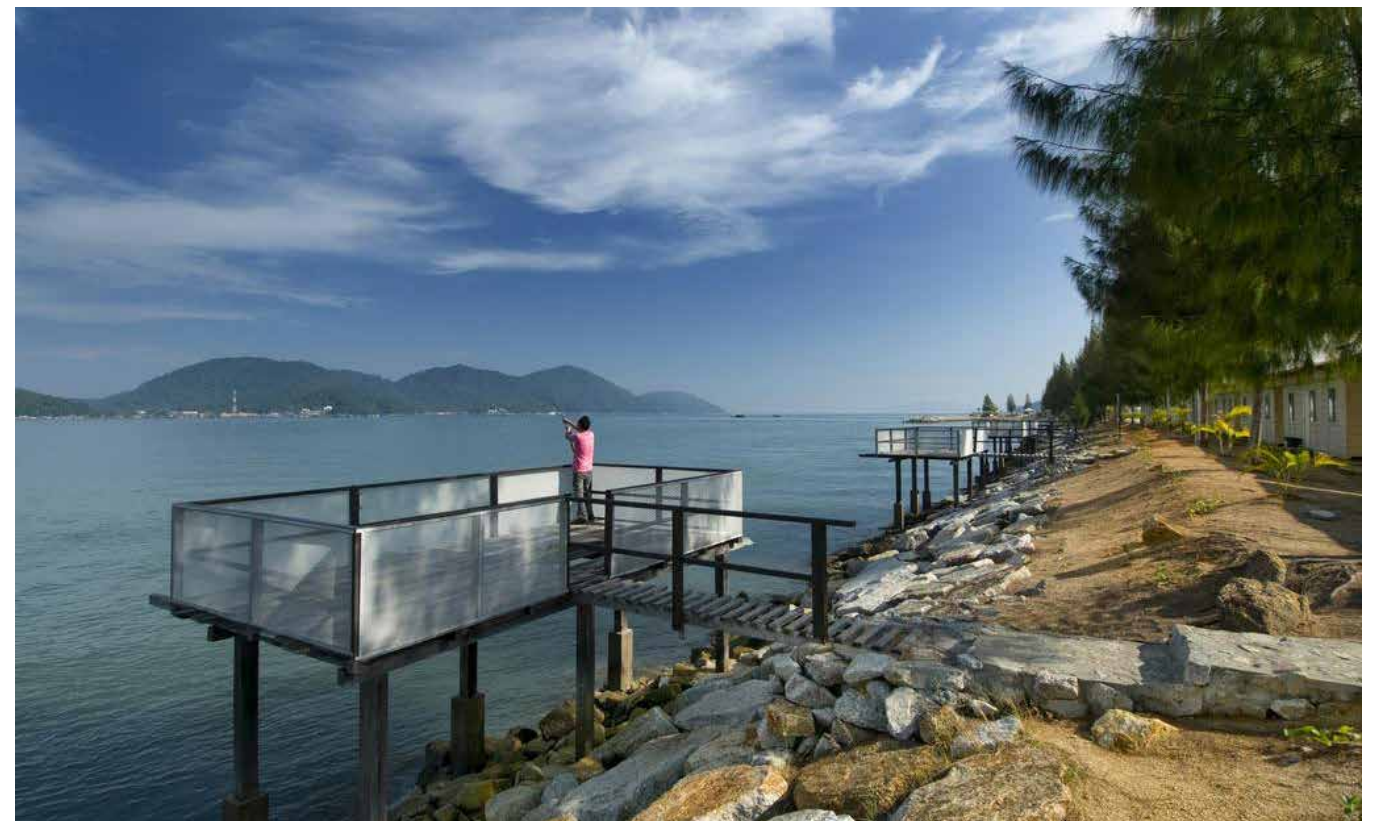


Design Concept: Promenade

Promenade: Headlands



Promenade: Fishing Platforms



Artwork & Sculptures



Picnic & BBQ Area



Back to Nature: Rock Pool



Back to Nature: Rocky Reef Habitats





Exercise: Equipment



Cost-Effective



Hard-Wearing



Low-Maintenance



Multi-Functional

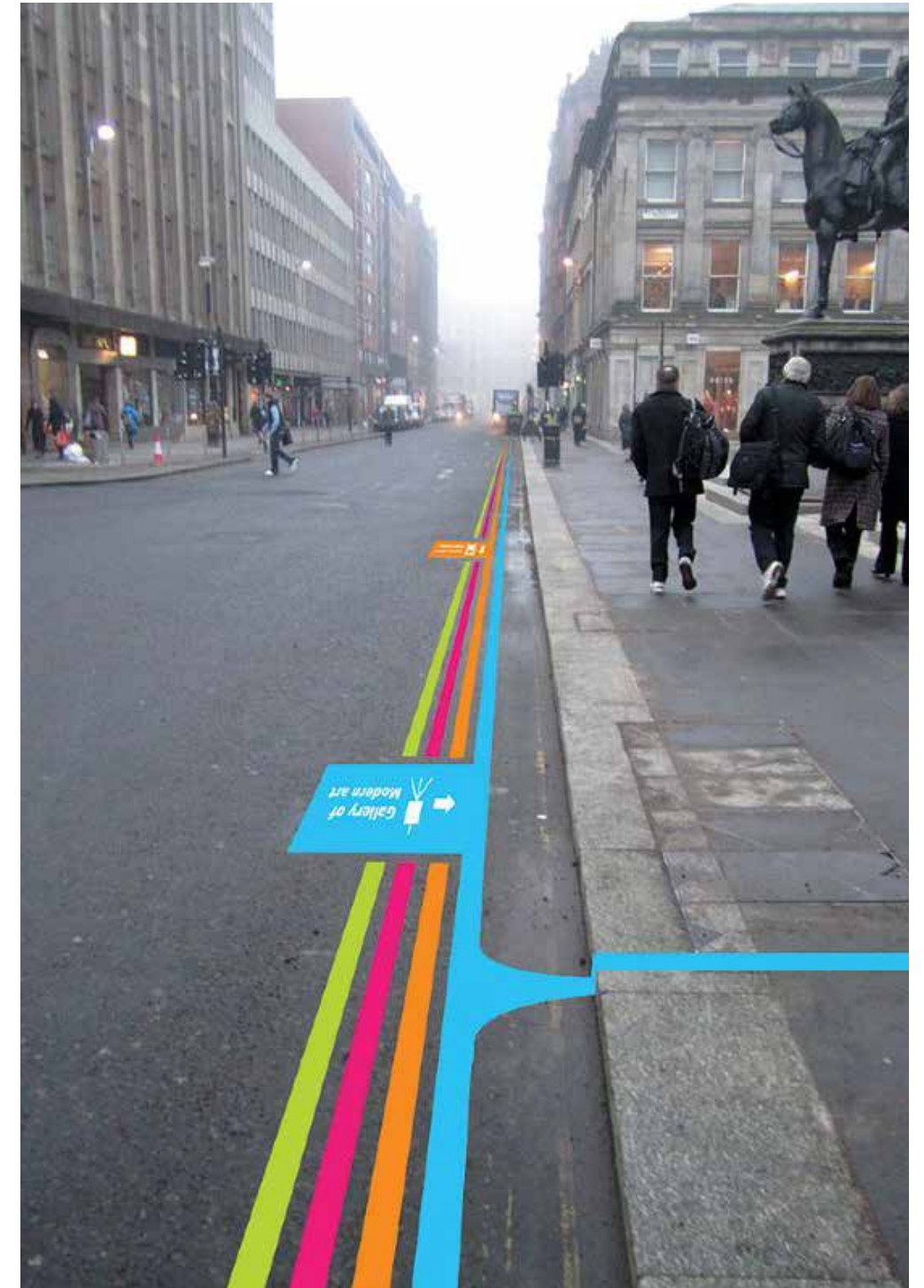
Play: Linear Elements



Surfaces: Materials & Markings



Wayfinding: Markings



Wayfinding: Structures



Structures: Concession Building



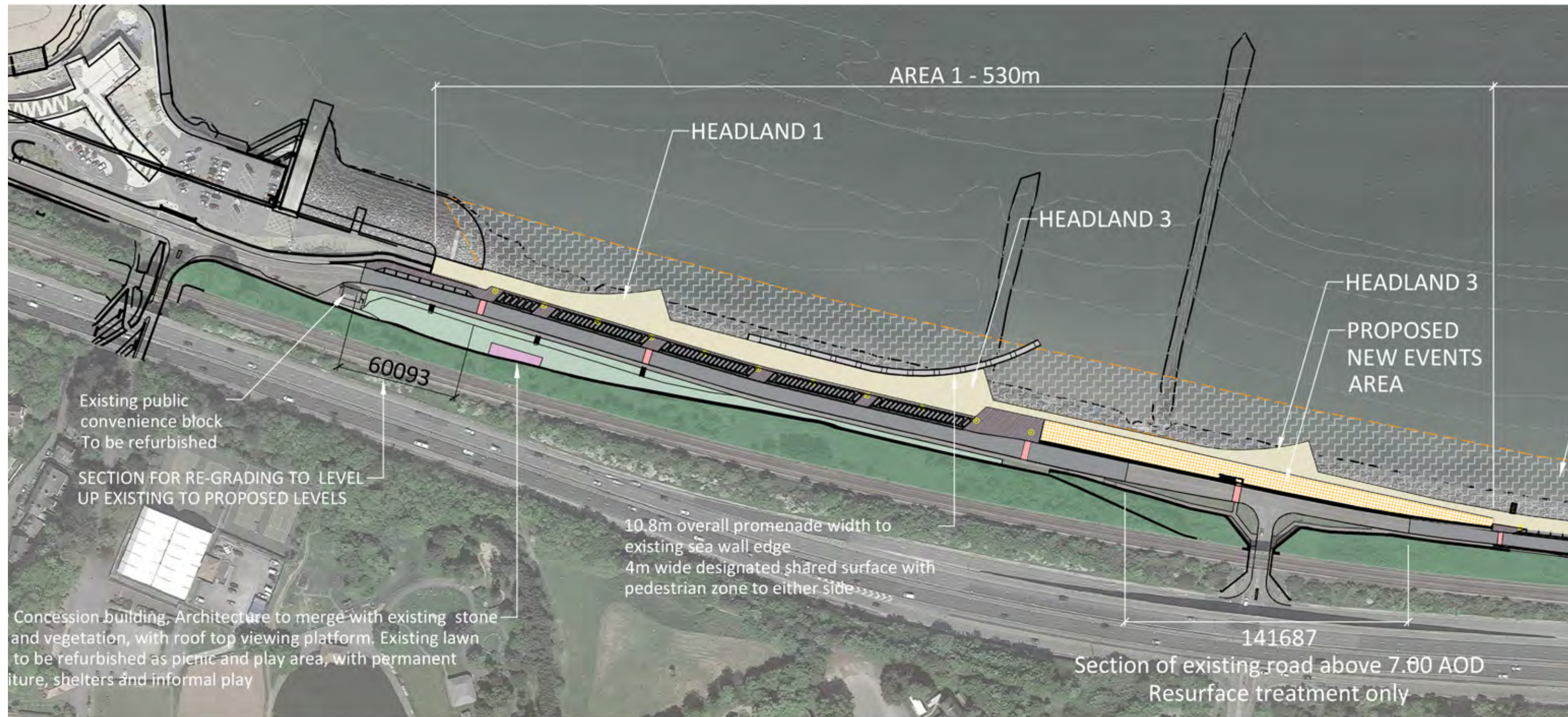
Structures: Shelters

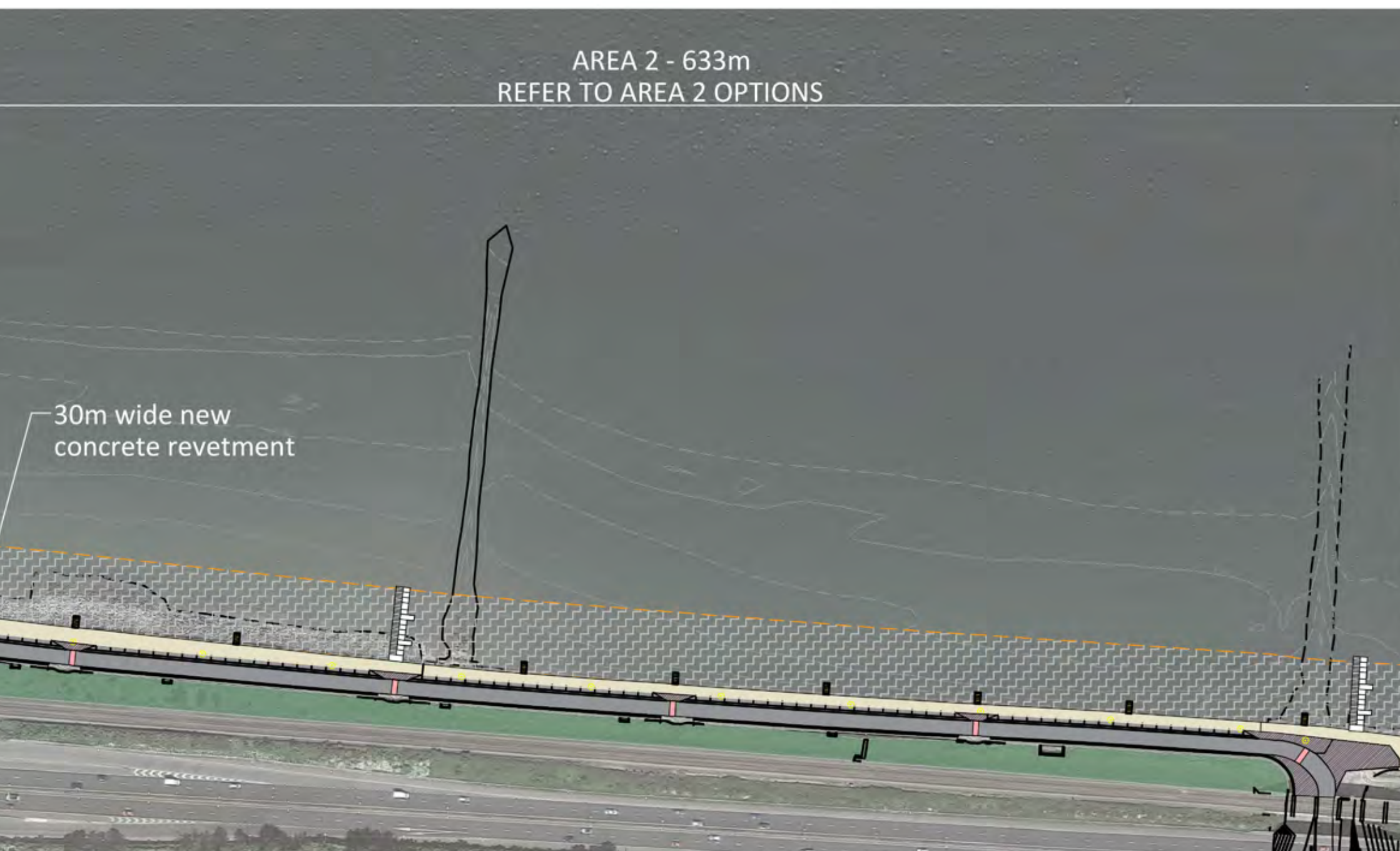




Design Development

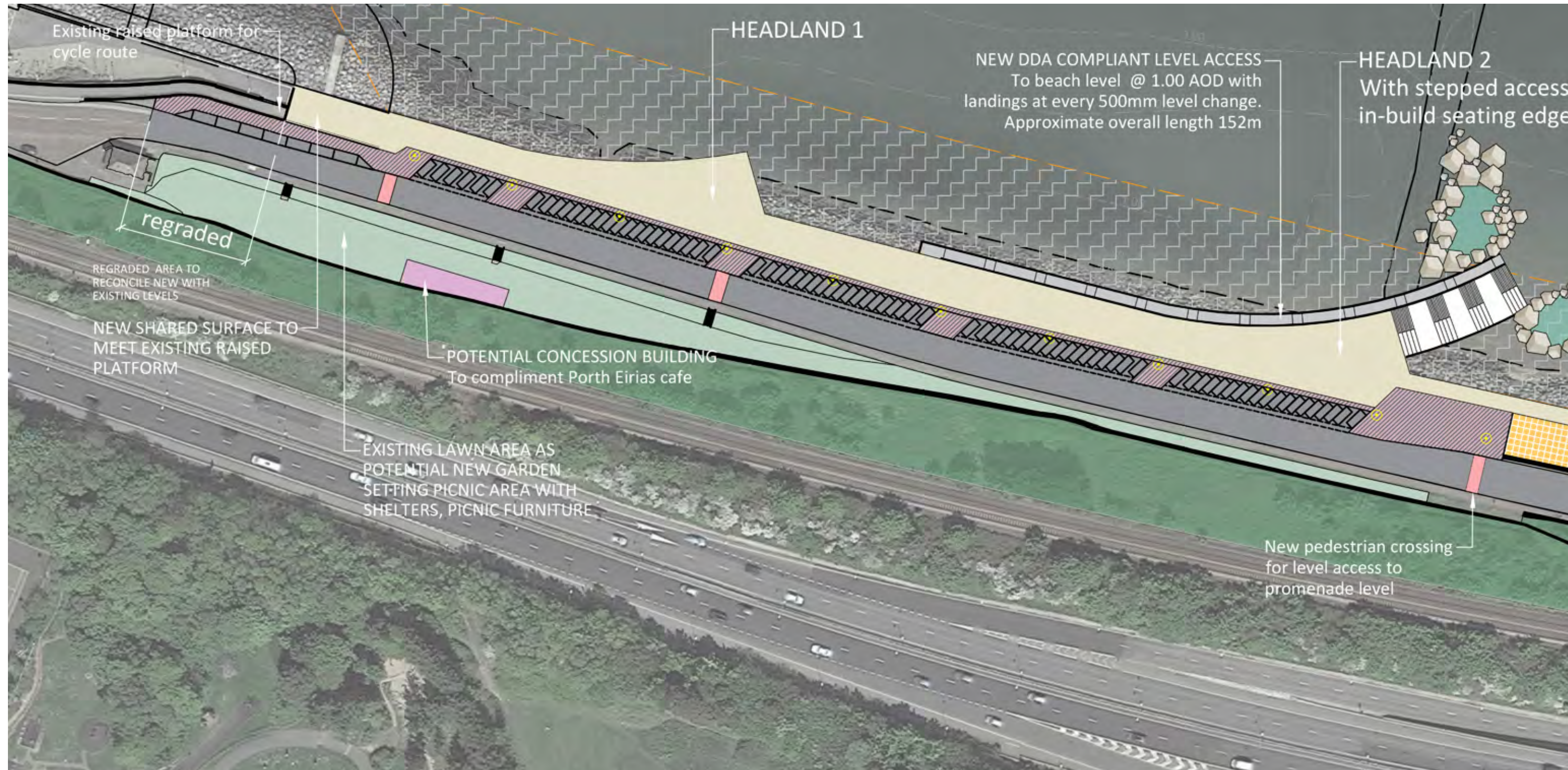
Design Development: Areas 1 & 2

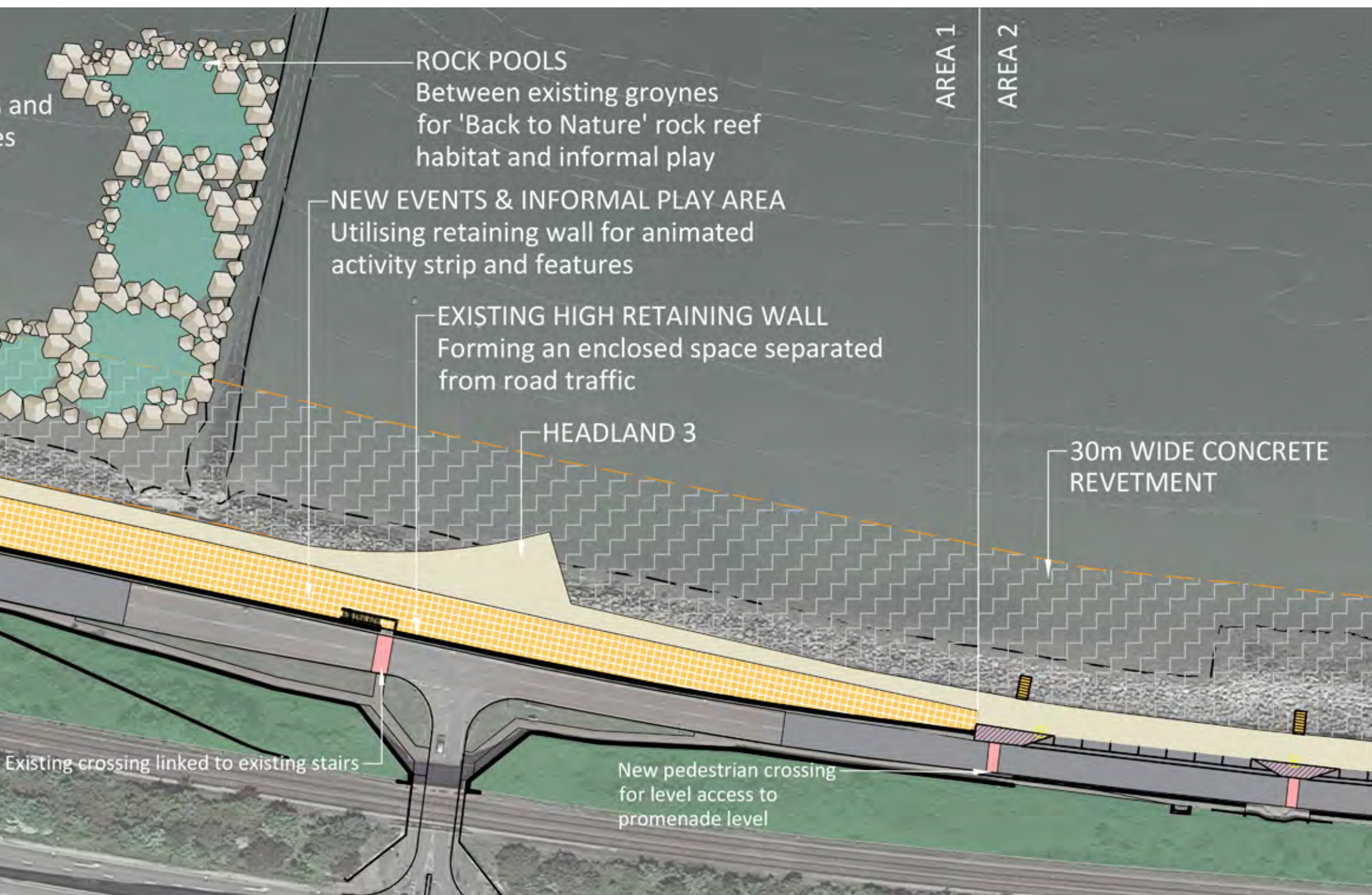




To Scale - 1::2000 @ A3

Area 1





AREA 1:

The approach taken for Area 1 is to replicate the promenade enhancement west of Porth Eirias. The dominating features being the 3 headlands which form the main activity areas with a 4m wide shared pedestrian and cycle route.

89no parking will be provided, of which 82no is chevron parking similar to existing arrangement and location. 7no new parallel parking is allocated to the area

The proposal also looks to continue with the Health and Historical themed paving art.

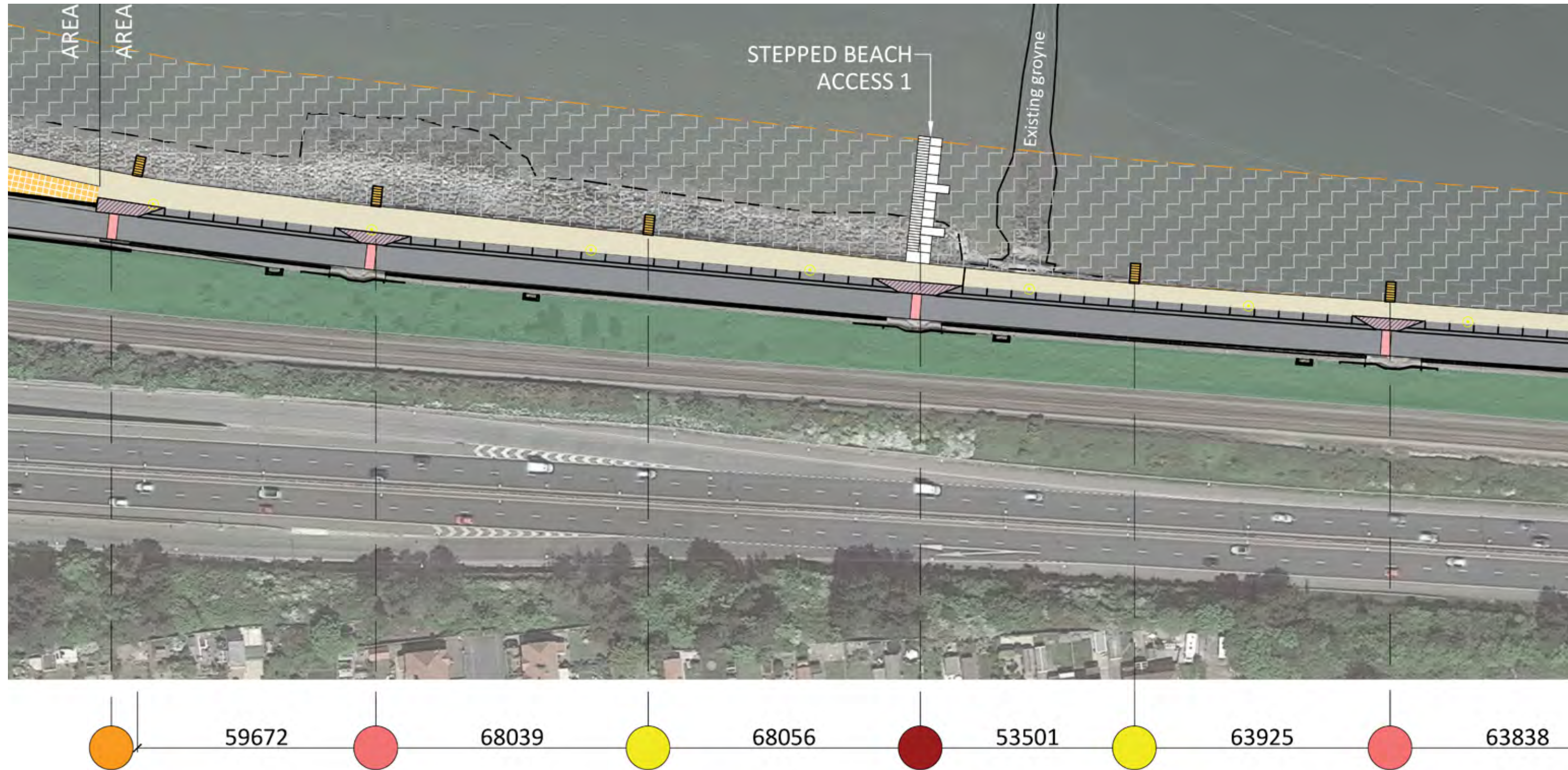
Beach access is provided adjacent to Headland 2 and includes a 152m long DDA compliant level access and steps to beach level @+1.00AOD. The steps features stepped seating blocks for every 3no steps.

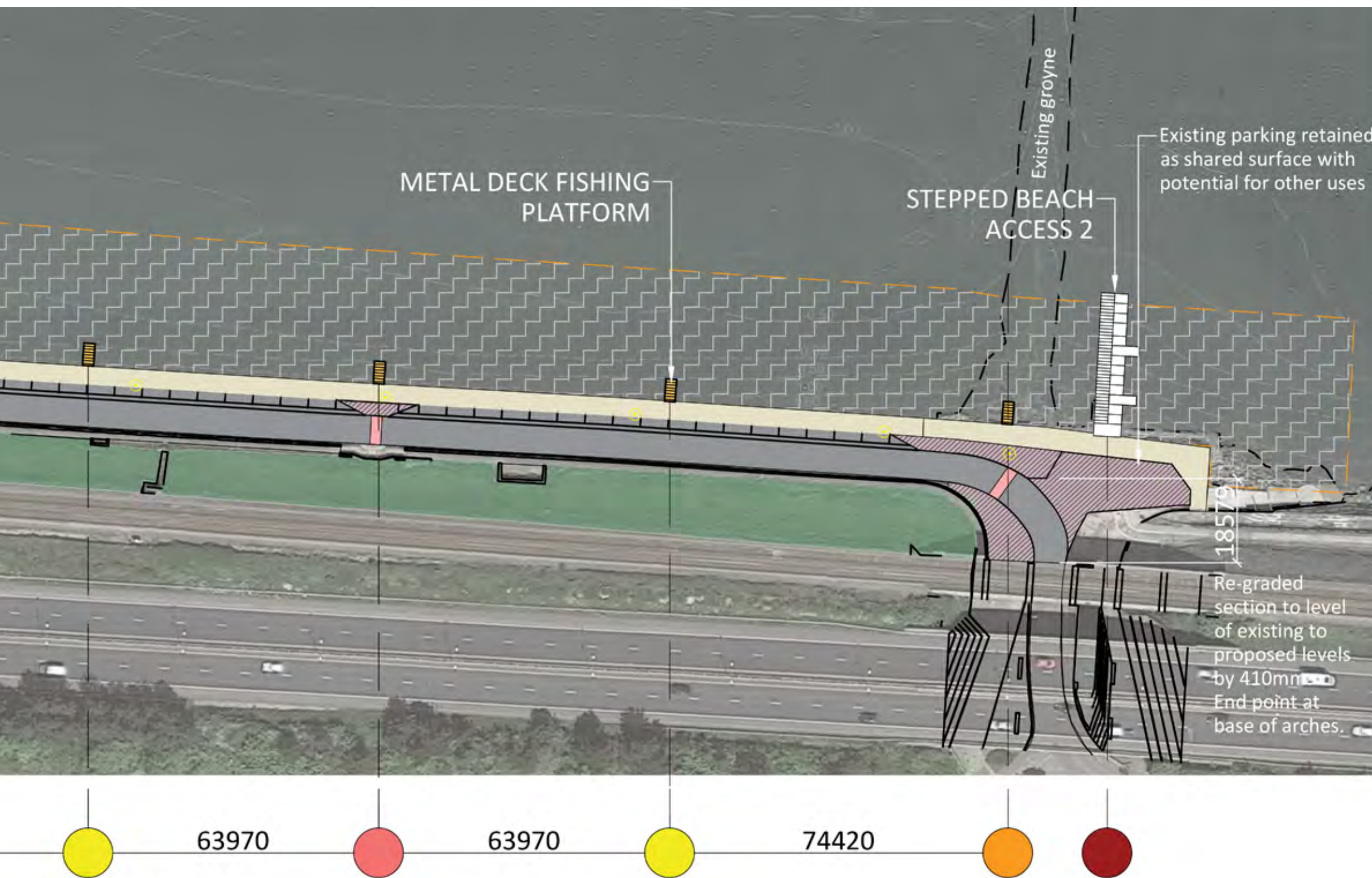
Another unique feature is the series of rock pools as informal play and as a rock reef habitat in pursuance of the 'Back to Nature' strategy. These pools will take advantage of the containment provided by the existing groynes.

An new events and informal play area adjacent to the existing high retaining wall marks the end of Area 1 and beginning of Area 2, and is linked with pedestrian access and Headland 2.

To Scale - 1::1000 @ A3

Area 2: Option A





AREA 2 - OPTION 1

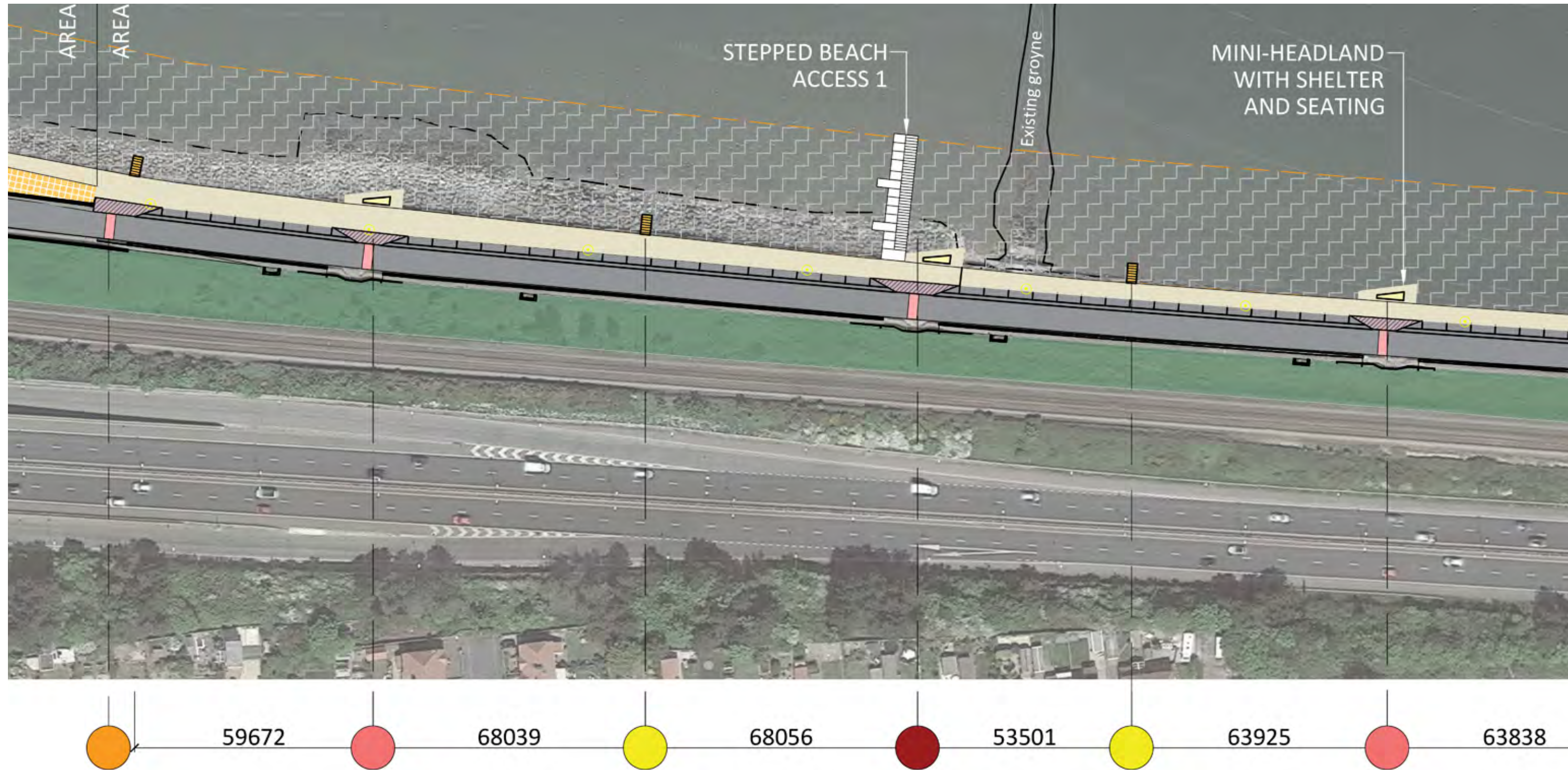
The new promenade edge is punctuated with metal decked fishing platforms to cater for the popular fishing activity.

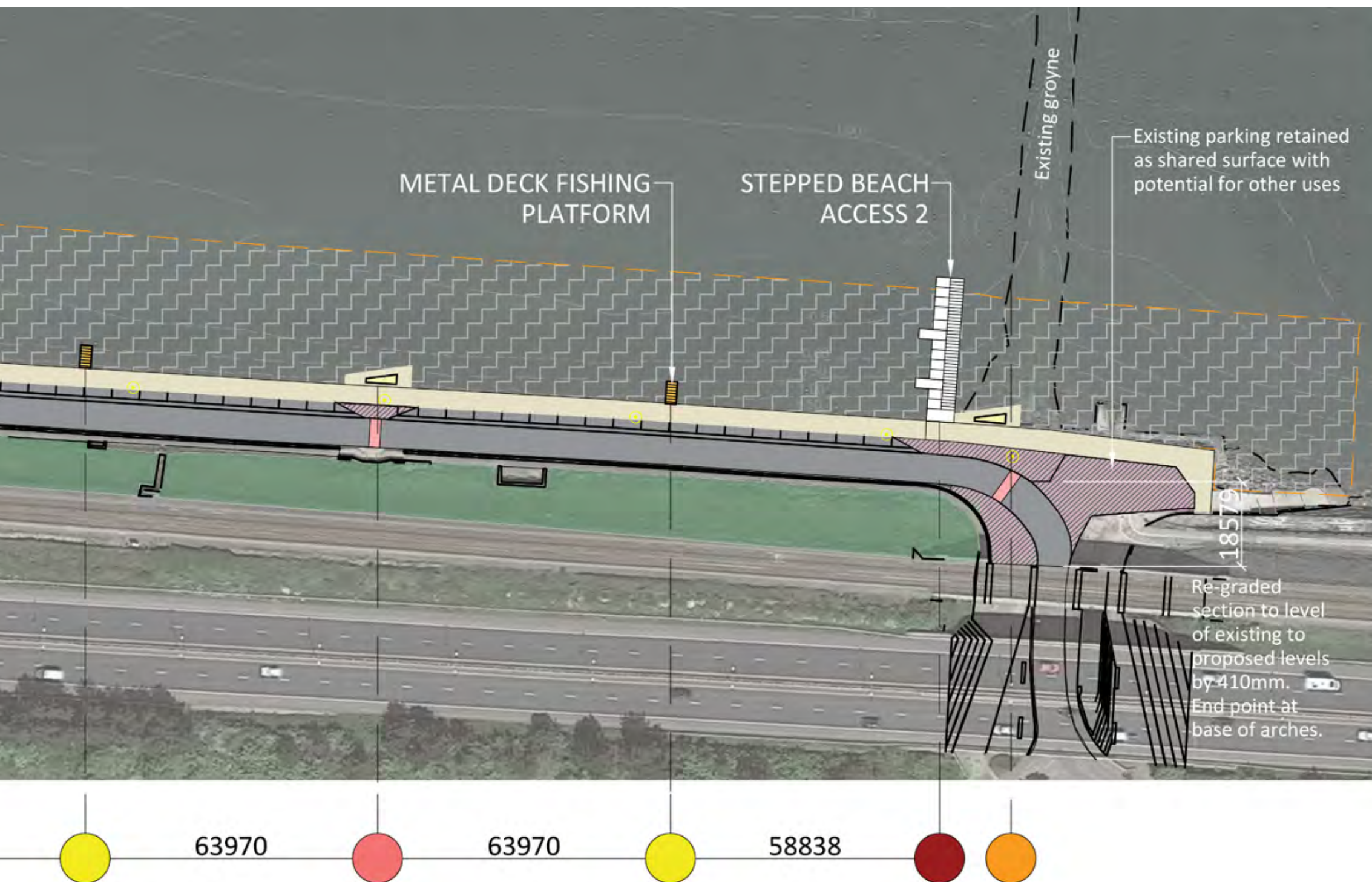
Stepped access to beach level are provided at two locations, with in-build seating and additional fishing platforms at lower levels.

- PROPOSED STEPPED BEACH ACCESS with seating edges and fishing platforms for lower tides
- PROPOSED MINI-HEADLANDS WITH SHELTERS LINKED WITH PEDESTRIAN BUILD-OUTS
To coincide with existing pedestrian crossing from footpath at the bottom of the railway embankment
- PROPOSED METAL DECKED FISHING PLATFORM
- PROPOSED NEW PEDESTRIAN CROSSINGS

To Scale - 1::1000 @ A3

Area 2: Option B



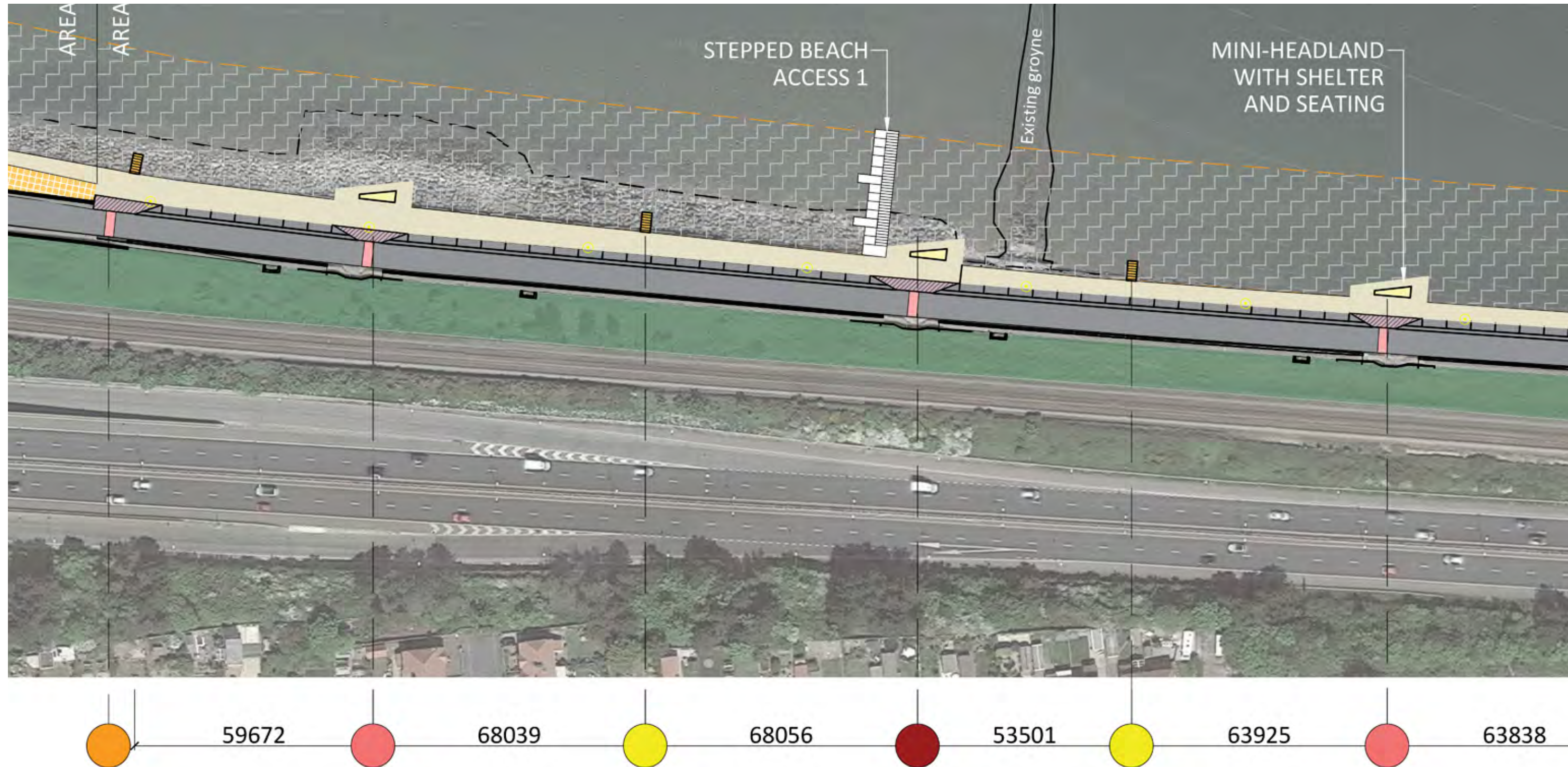


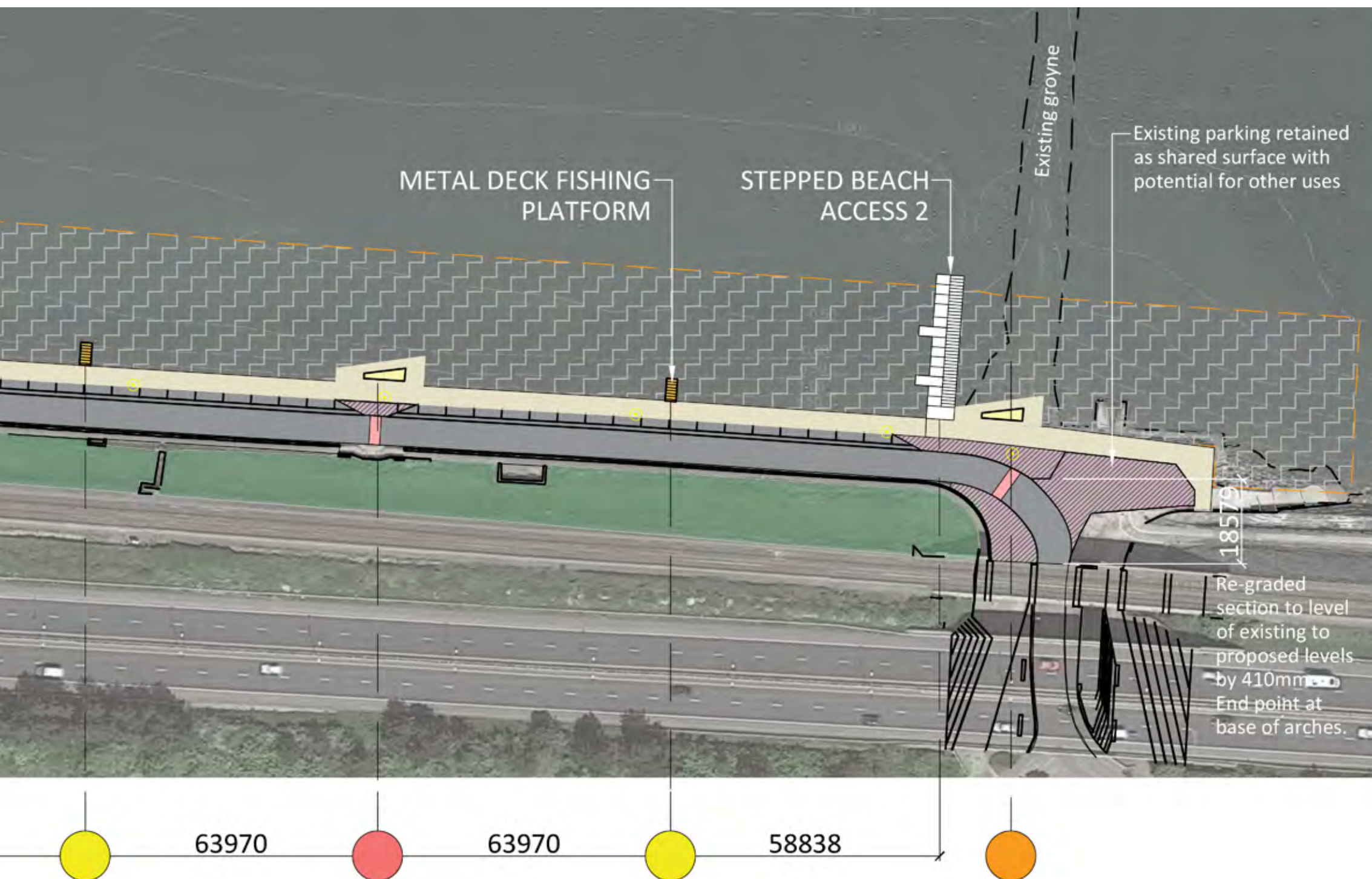
AREA 2 - OPTION 2

As per Option 1, with alternate fishing platforms substituted with mini headlands and shelter adjacent to pedestrian build-out areas linked to existing crossing points from the bottom of the railway embankment footpath. The mini-headlands and shelters are proposed as new activity hot-spots to encourage wide use of the promenade.

To Scale - 1::1000 @ A3

Area 2: Option C





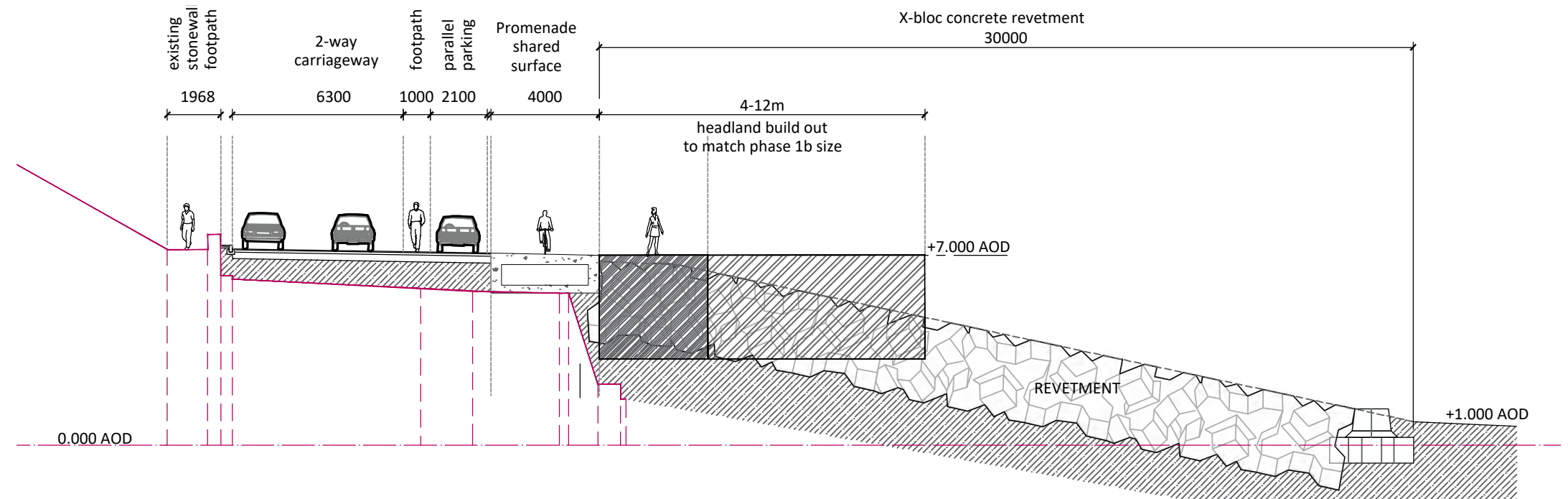
AREA 2 - OPTION 3
As per Option 2, with larger mini-headlands and shelters for greater use and capacity.

- PROPOSED STEPPED BEACH ACCESS with seating edges and fishing platforms for lower tides
- PROPOSED MINI-HEADLANDS WITH SHELTERS LINKED WITH PEDESTRIAN BUILD-OUTS
To coincide with existing pedestrian crossing from footpath at the bottom of the railway embankment
- PROPOSED METAL DECKED FISHING PLATFORM
- PROPOSED NEW PEDESTRIAN CROSSINGS

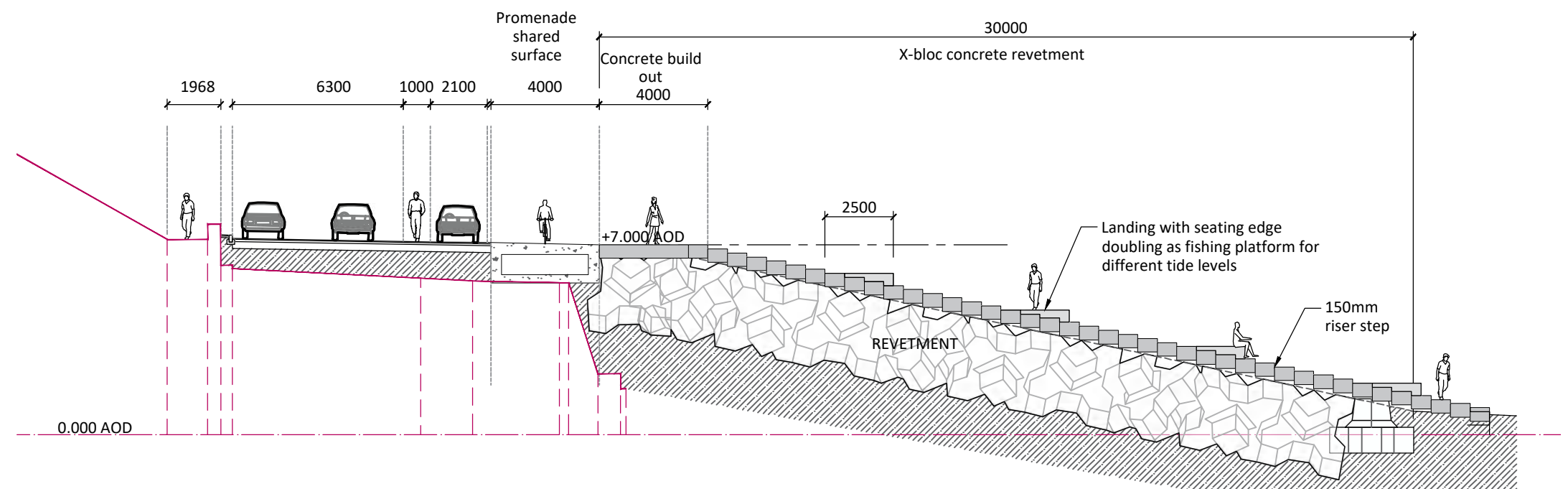
To Scale - 1::1000 @ A3

Construction Types: Build-Outs

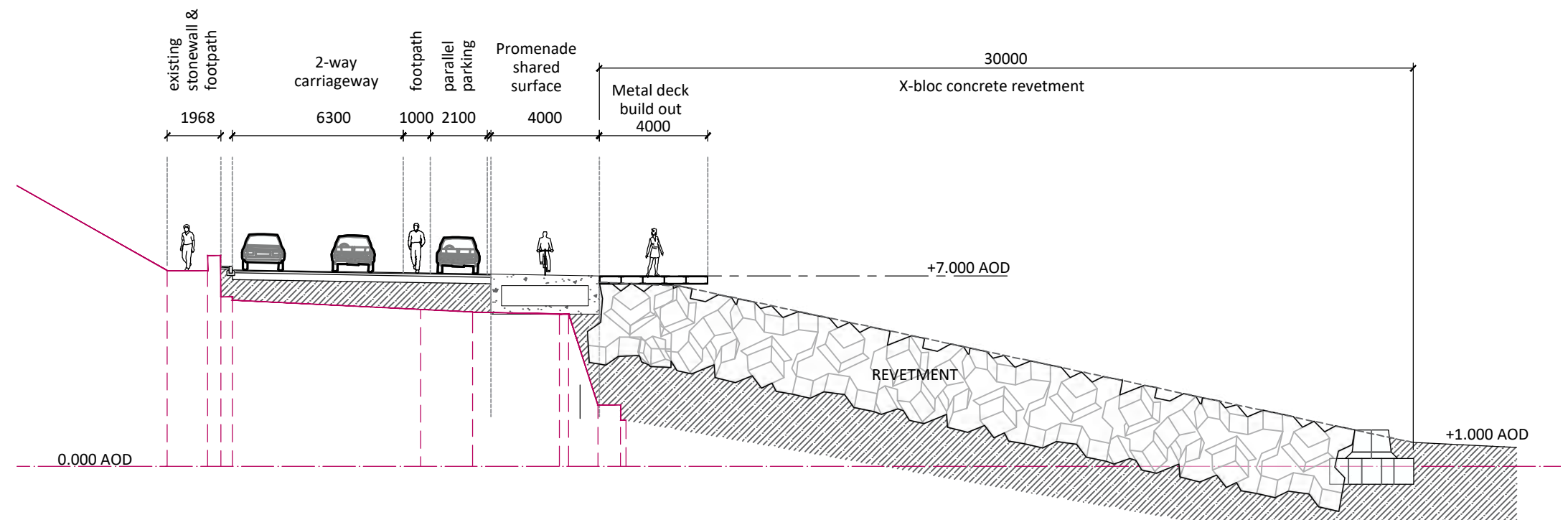
Headland Build-Out



Stepped Access



Metal Fishing Deck



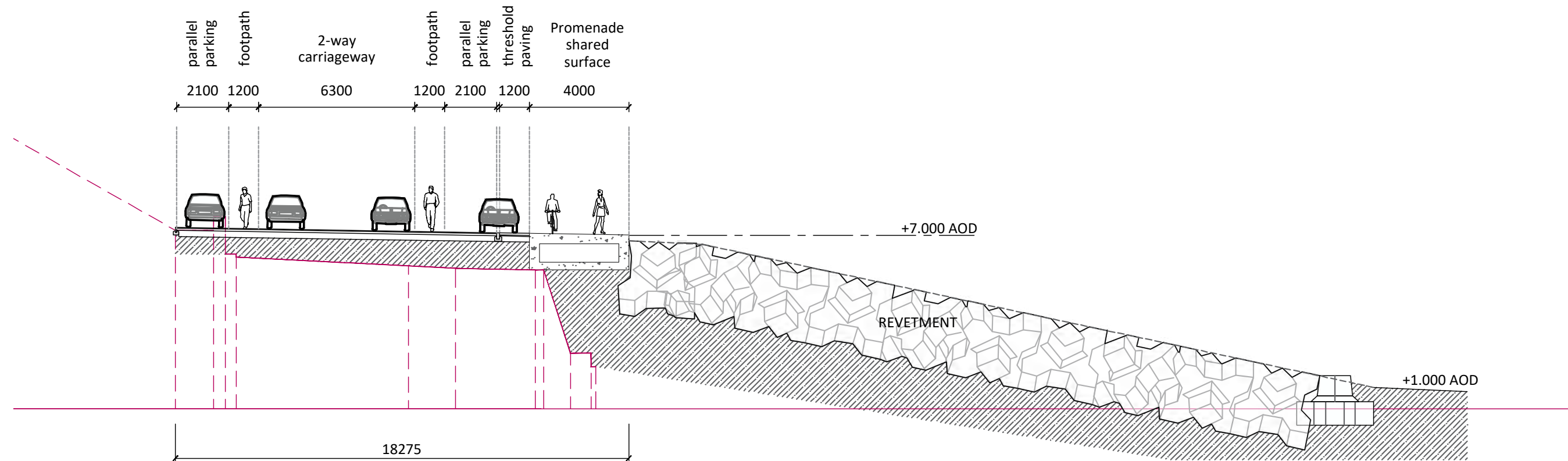
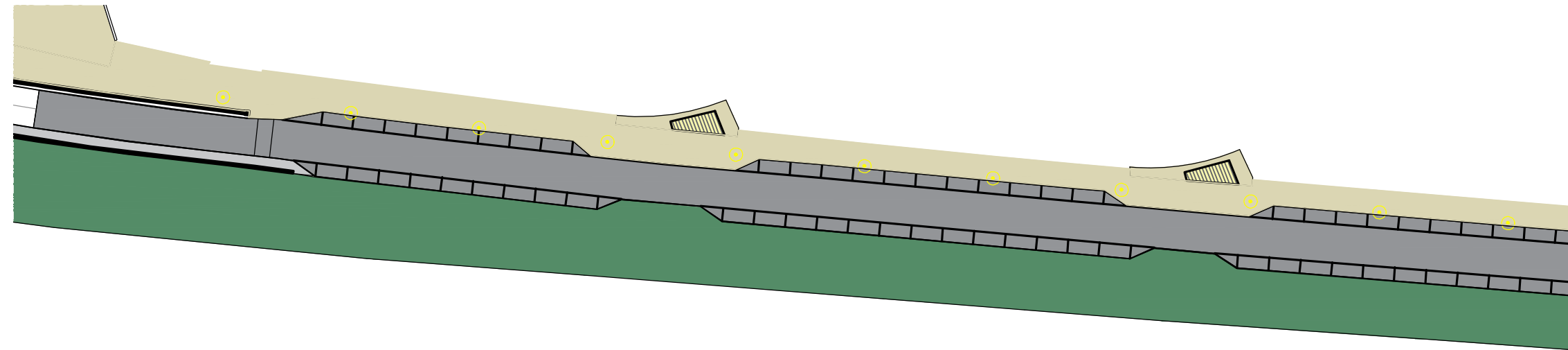
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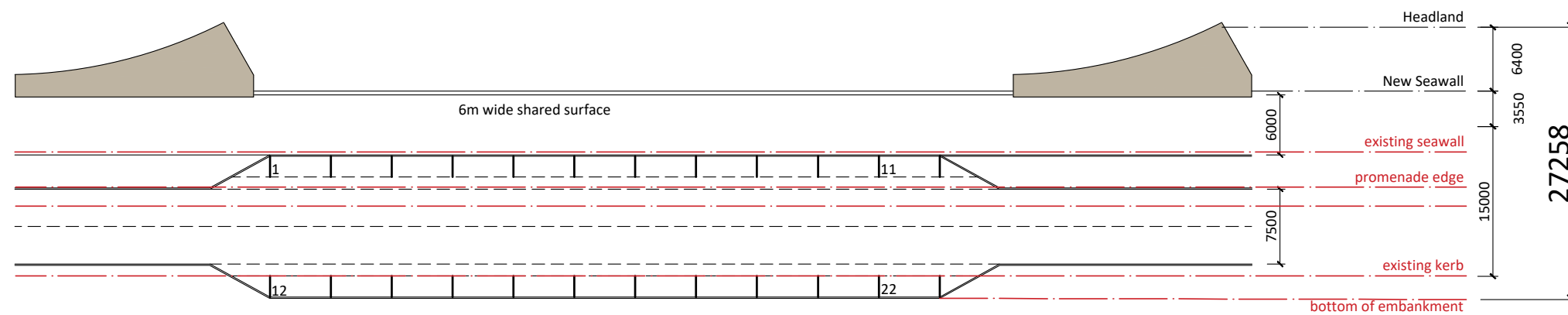
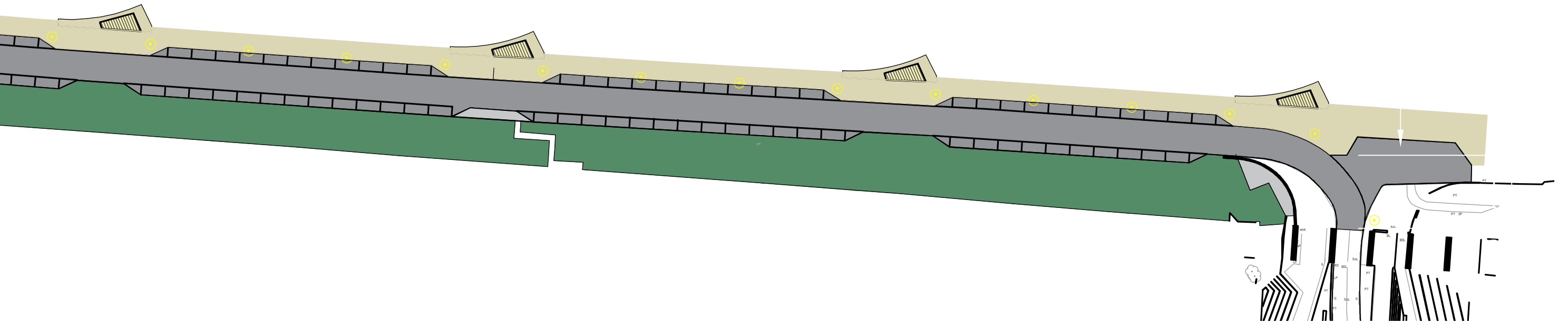
AREA 2: INCREASED PARKING OPTION 2

This option proposes using the area currently occupied by the footpath and low stone wall at the bottom of the railway embankment in order to provide additional parking.

This area would be reinstated as new parallel parking increasing the overall parking number for Area 2 to 134no compared to 77no parking as presented in Option 1 proposal (an additional 57no parking from Option 1)

TOTAL PARKING: 134



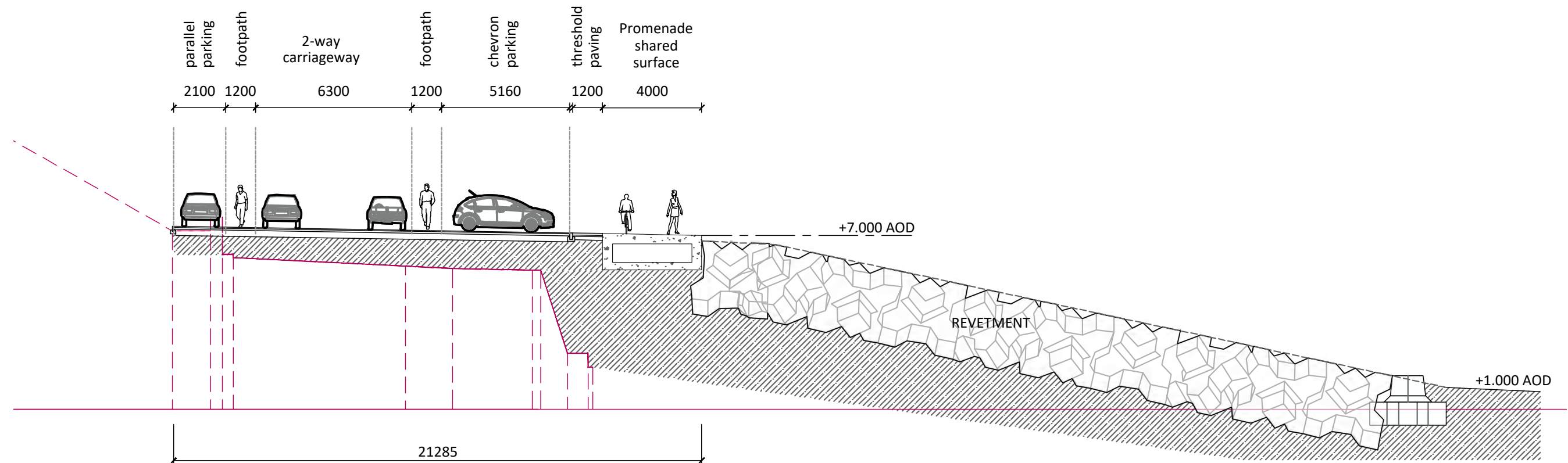
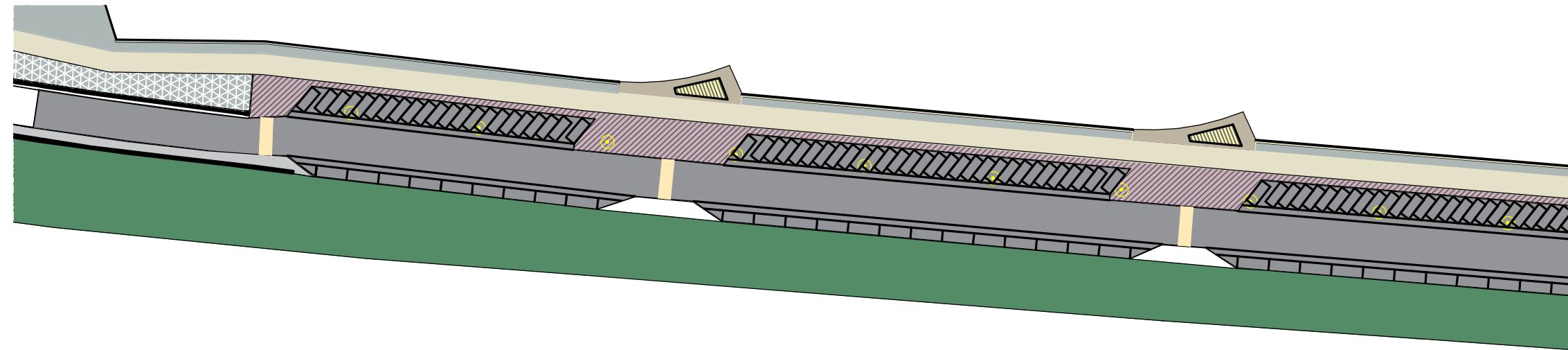


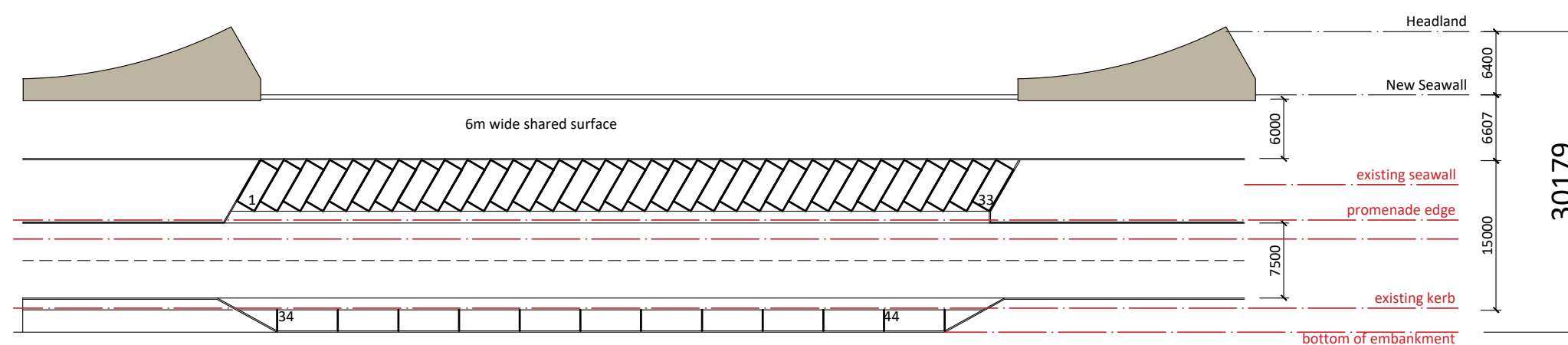
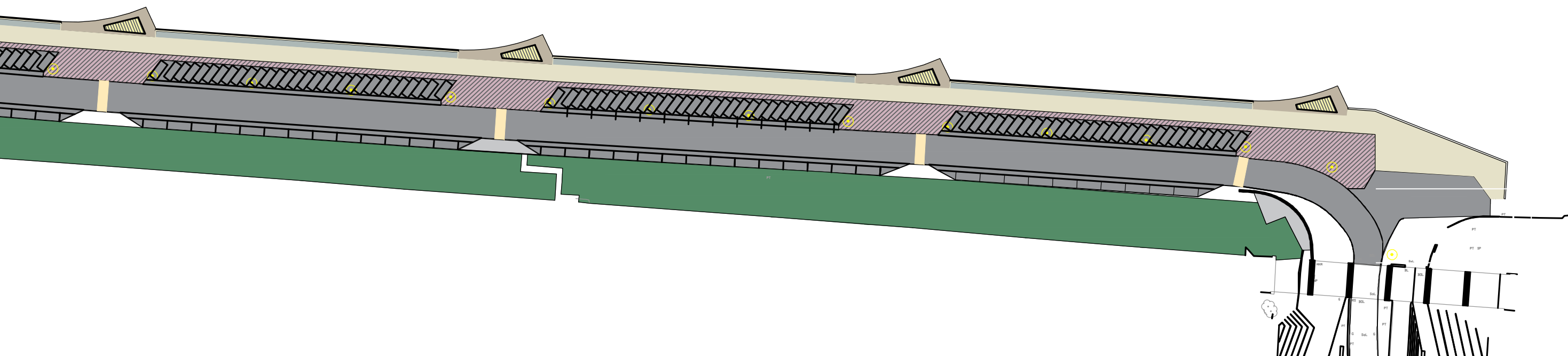
AREA 2: INCREASED PARKING OPTION 3

As per Option 2, this option utilises the existing footpath and wall, to increase overall parking numbers with new parallel parking.

Chevron parking is proposed to the promenade edge, as per Area 1 parking arrangement, increasing overall parking for Area 2 to 235no (an additional 158no parking from Option 1 with greater opportunity for disabled parking spaces).

TOTAL PARKING: 235





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