Environment, Roads & Facilities

Flood Risk & Infrastructure Group

Llandudno Beach Management Plan and Options Appraisal

CCBC Summary

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	Signature	Name	Date
Prepared by		Owen Conry	18th August 2017
Checked by		Dyfed Rowlands	
Approved by		Geraint Edwards	19th August 2017

List of Figures

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Glossary & Abbreviations

Term	Definition / Meaning
CCBC	Conwy County Borough Council
WG	Welsh Government
LCF	Llandudno Coastal Forum
OBC	Outline Business Case
CRMP	Coastal Risk Management Programme
BMP	Beach Management Plan
NRW	Natural Resources Wales
EA	Environment Agency
CTFRA	Conwy Tidal Flood Risk Analysis
MU(N,S)	Management Unit(North, South)

Foreword by CCBC

This document is a summary of the Beach Management Plan provided to Conwy County Borough Council by Aecom in July 2017 for the Llandudno beaches. It does not cover the references and should be read alongside the original document.

Large coastal projects within Conwy are normally funded by the Welsh Government (WG) and CCBC follow a well-established process to draw down available funding. This includes identifying a possible project, submitting an Outline Business Case (OBC) to the WG, getting approval from the WG for detailed design and their subsequent approval for construction.

Conwy County Borough Council (CCBC) secured funding from the WG through its Coastal Risk Management Programme (CRMP) to commission a Consultant to draft a Beach Management Plan for the beaches at Llandudno. This is the project identification stage of the process.

The Beach Management Plan (BMP) is a technical document based on defined procedures for the management of coastal assets and can be difficult to interpret for the lay person not dealing with this type of text on a regular basis.

The primary objective of this BMP in this context is to get the Llandudno scheme to the next funding stage with the WG – the Outline Business Case (OBC) stage - where detailed analysis of the options identified in BMP will be scrutinised from an Economic, Strategic, Management, Commercial and Financial point of view.

At OBC stage, the Consultant will certainly consider **all** the options identified in the BMP – including those on the Long List so even though an Option has been omitted from the Short List, that is not to say that it will not be considered at the OBC stage.

Whilst this funding stream from the WG is specifically allocated to flood and coastal protection, all WG funded projects have to consider the amenity aspect and the WG encourage schemes to have multi purposes – coastal defence and amenity value in the case of Llandudno.

The CRMP scheme is focused on enhancing the coastal defences of communities along the Welsh coastline whilst preventing erosion and improving future flood resilience taking sea level rise into account.

The WG have committed up to £50 million per year for 3 years to this scheme for all Local Authorities in Wales and CCBC are anxious to secure a portion of this funding to reduce the present day and future risk of flooding to Llandudno.

CCBC and Aecom would like to acknowledge the co-operation provided by the LCF in preparing the BMP including the documentation provided by Ships Timbers which informed the sections relation to Environmental/Heritage Assessment.

Executive Summary

Conwy County Borough Council (CCBC) secured funding from the Welsh Government (WG) through its Coastal Risk Management Programme (CRMP) to commission a Consultant to draft a Beach Management Plan (BMP) for the beaches at Llandudno.

The scope of the commission was informed by the public consultations at North and West Shore and in conjunction with the stated aims of the Llandudno Coastal Forum.

Aecom were appointed to carry out the commission and have provided a BMP which can be used to seek additional funding from the WG to formulate an Outline Business Case. Further public consultation of the options identified at BMP stage will be required at the OBC stage.

Management options were defined for both North and West Shore with subsequent short-lists defined.

1 Introduction

1.1 Terms of Reference

Insert terms of reference here

1.2 Report Objectives

Table 1 - Report Objectives

Ref	Objective
01	To provide a summary of the Aecom Beach Management Pan for the Llandudno beaches

2 Issues and Management Constraints

2.1 Introduction

The Llandudno Coastal Forum (LCF) was set up in July 2014 following public reaction to the beach management carried out specifically on the North Shore following the winter storms in 2013.

The LCF canvassed opinion through public consultation about the future flood defence requirement of the Llandudno North Shore and West Shore beaches with over 3,000 people taking part in the consultation process. The preferred options for beach maintenance were accommodated in drafting this Beach Management Plan (BMP) as well as other options identified by the Consultant.

2.2 Current Management Practice

The policy adopted for this area is known as 'Hold the Line'. CCBC achieve this by beach management and currently carry out beach management when it is required.

Beach management essentially involves the redistribution and where necessary nourishment of shingle along the beach to protect the concrete promenade. The benchmark for this work is the design profile of the beach from the late 1990s. This may be after a significant storm event or where necessary prior to the summer season.

2.3 History of Flooding

High sea levels combined with damaging wave conditions in storm events have been the cause of flooding historically in Llandudno with parts of the town flooding throughout the 20th century.

2.3.1 North Shore

The cause of flooding in the town from North Shore has, in the past, been related to low beach levels in front of the promenade revetment with significant damage caused in 1937 and 1990.

Shingle moves on the beach due to natural wave processes and CCBC has carried out regular maintenance when existing material was moved around from areas where material had accumulated to areas where shingle was depleted.

The December 2015 storm event almost breached the secondary sea wall at the paddling pool which would have resulted in flooding the immediate area.

2.3.2 West Shore

Initial flood defences were constructed at West Shore in 1905 with low beach levels contributing to overtopping (where water passes over a sea wall) in the 1950's and 1960's.

Groynes installed in the 1990's have reduced flood risk but have resulted in an accumulation of sand which may be blown inland causing nuisance to affected properties.

2.4 Sensitive Receptors

Should CCBC wish to carry out any development or coastal works in the future, it would be necessary to identify any constraints that exist relating to the environment, heritage, conservation and ecology.

The BMP report has identified and listed the constraints for both North and West Shore.

2.5 Condition Assessment

Regular - twice a year - condition surveys of the existing defences have taken place since 1996 by CCBC with additional surveys being carried out by independent coastal specialists.

It should be noted that the vertical sea wall adjacent to the Pavilion site id privately owned and not inspected by CCBC.

2.6 Existing Flood Risk

The flood risk to Llandudno has been recently updated taking on board advice from the Welsh Government in relation to projected sea level rise and climate change. This piece of work is known as the Conwy Tidal Flood Risk Analysis (CTFRA).

Using internationally accepted data on climate change, it is anticipated that sea level will be 700mm (2½ foot) higher in 100 years' time than it is today. This will result in significant flooding all around the coastline in the future and is a serious problem for Llandudno particularly in storm events.

The study had highlighted that the town is in a bowl with the defences along North Shore and West Shore acting as the rims to stop the water flowing in from the sea. The existing defences are suitable for today's conditions but will not protect the town from flooding in the future as sea levels and climate change become more apparent. Additional defences will be required as sea levels rise.

3 Environmental Constraints

3.1 Coastal Processes Appraisal

3.1.1 Site Description

The town of Llandudno lies between two large limestone outcrops – the Great Orme and the Little Orme. The town itself was originally built on sandy deposits and marshland and is protected by coastal defences supplemented by the shingle beach.

3.1.2 North Shore

The North Shore flood defence for Llandudno town consists of a stepped promenade revetment protected by a shingle beach above a flatter sand beach.

The 2013-14 storms had reduced the level of the shingle protection in front of the revetment below a pre-determined “trigger” level. A trigger level is the level where action must be taken to prevent the failure of the flood defence.

Were the shingle to be lost from the front of the revetment there would be a risk that it could fail and cause flooding to the town.

The shingle is constantly moving with the tides with significant depletion during storm events. Monitoring since the start of the 20th century has shown that there have been major losses of shingle across the bay and out to sea.

3.1.3 West Shore

West Shore is a more varied shoreline made up of a wide beach in front of a sea wall supported on sheet piles.

The 3 shore connected groynes have protected the beach but may have led to an increase in windblown sand adjacent to the neighbouring properties.

3.1.4 Climate Change

CCBC follow guidance issued by the Welsh Government in relation to climate change and its effects for the next 100 years.

Sea level rise is also predicted based on NRW/EA guidance and estimates that sea levels will rise over 700mm (2½ foot) in the next 100 years.

3.1.5 Wave and Water Level Conditions

Aecom produced the computer model simulation of the future flood risk for Llandudno from information provided by CCBC.

3.1.6 Beach Processes, wave run-up and overtopping

Beaches with sand (West Shore) and shingle (North Shore) respond differently to the same wave and water level conditions as smaller ‘particles’ move more than bigger particles.

On shingle beaches the larger material tends to be on the lower part of the beach with the smaller, more mobile material pushed up into a crest by wave action. If the crest reaches a sea wall, it will overtop if the wall is too low.

With sandy beaches, the material is more mobile and breaking waves tend to draw down the sediment down the profile. If beach levels continue to lower in front of coastal defences, there is a possibility they could be undermined and fail.

3.2 Geological Assessment

Future geological assessment will be required to inform any of the future options.

3.3 Environmental Assessment

The Preliminary Environmental Appraisal and assessment of the existing situations are located in the appendices.

4 North Shore Development and Assessment

4.1 Introduction

Llandudno North Shore has different, distinct uses along its frontage ranging from the beach zone, to the boating zone, the fishing zone and the marine zone.

4.2 Management Units

Fig1. North Shore Management Units

Aecom have sub-divided this section of coastline into 6 different Management Units for the purposes of this report and ease of referencing.

- MUN1 – This is the vertical sea wall at the pier. It is privately owned and not the responsibility of CCBC.
- MUN2 – The area known as Children's Corner is in the beach zone. This is the only part of the North Shore frontage where there is a current risk of flooding at the top of the Trevor slipway.
- MUN3 – This frontage between Trevor St. and Tudor Road is a steep shingle beach backed by a concrete revetment and was recharged in 2014 following storm events. It is exposed to severe wave energy during storm events.
- MUN4 - This frontage Tudor Road and the paddling pool is a steep shingle beach backed by a concrete revetment and was recharged in 2014 following storm events. It is exposed to severe wave energy during storm events.
- MUN5 – The Paddling Pool is very popular with visitors but in storm events water runs up the sloping sea wall to the front and shingle is discharged onto the promenade. This is a very exposed part of the beach and was recharged in 2014.
- MUN6 – The beach in this area known as the fishing zone protects the B5115 leading into Llandudno and must be maintained.

4.3 Long-list options

When drafting a Beach Management Plan (BMP), it is preferable to draw up a long list of options for managing the beach, look at advantages and disadvantages of each option and then reduce the list to a short list which would be the most likely options to be taken forward for further study.

The long list includes options that were identified by the public consultation for North Shore and those drawn up by Aecom based on their experience. These options are at a very early developmental stage and the actual extent of the works for each option has not been established.

Aecom identified seven options for North Shore along with 'Do Nothing' option which is always has to be considered in any assessment.

The options identified for North Shore include the following:

4.3.1 Do Nothing and Do Minimum

These two options have to be considered but would not be viable given the future sea level rise due to climate change.

4.3.2 Option 1 A & B: Detached Breakwaters

These would involve the construction of breakwaters made of rock armour similar to those used in Rhos on Sea. These structures would have a significant visual impact but would protect the beach. Shingle could be removed and replaced with sand.

4.3.3 Option 2 A & B: Groynes

Rock armour structures similar to those at Colwyn Bay. This option would involve the removal of the shingle and replacement with sand. The groynes would protect the sand on the beach and prevent its movement off shore but would have a significant visual impact.

4.3.4 Option 3: Traditional Timber Groynes

The installation of groynes would involve the removal of the shingle and the replenishment of the beach with sand. They are effective at preventing the movement of material along the beach but will not address the problem of sea level rise due to climate change.

4.3.5 Option 4: Beach Nourishment

This is a simple replacement of shingle with sand.

4.3.6 Option 5: Beach Nourishment Children's Corner

Localised importation of sand to this high amenity area.

4.3.7 Option 6: Wave Return Wall for Paddling Pool

This localised stub wall will increase the level of protection at the eastern end the promenade which has been identified as being vulnerable in future flood events.

4.3.8 Option 7: Wave Return Wall Along Promenade

This envisages the building of a stub wall along the promenade – at a location to be decided – to prevent against the effects of future flooding.

4.4 Assessment of Options

The capital (construction) costs for the various options have been indicated as have the ongoing annual maintenance costs.

The initial environmental impact of each option has also been highlighted.

4.5 Short-list Options

The areas that are most at risk of overtopping are Children's Corner and the paddling pool as long as the shingle levels are maintained on the beach. Options 5, 6 and 7 will provide increased protection to Llandudno from a flood protection point of view. Option 2, or any of the options in the long list, could be included in the short list should funding become available.

Criteria / Options	Amenity		Environment				Technical				Economic		
	Recreational Use	Access	Permissions, Consents and Licences	Archeological and Cultural Heritage	Landscape	Ecologial Designations	Functionality - Flood and Coastal Erosion Risk Management	Constructability	Durability	Inpact on Coastal Processes	Capital Cost (£million)	Annual Maintenance Cost	External Funding Potential
0: Do Minimum								N/A			£0	£0 to £50k	N/A
1A : Detached Breakwaters											£26m to £32m	£0 to £600k	Low
1B: Submerged Detached Breakwaters											£19m to £23m	£0 to £600k	Low
2A: Fishtail Groynes											£14m to £17m	£0 to £440k	Low
2B: Onshore Fishtale Groynes											£13.5m to £17m	£0 to £440k	Low
3: Timber Groynes											£11m to £13.5m	£600k	Medium
4A: Beach Maintenance (Capital And Maintenance)											£10.5m to £13m	£100k to £1.2m	Medium
4B: Beach Nourishment(Capital Only)											£9.5m to £12m	£100k to £1.2m	Medium
5: Beach Nourishment at Childrens Corner											£0.5m to £1m	£10k to £100k	Medium
6: Wave Return Wall Paddling Pool											£20k to £100k	£0 to £10k	Medium
7: Wave Return Wall Promenade											£0.3m to £1m	£0 to £10k	High

Assessment of Long-list of Options for North Shore

5 Options for West Shore

5.1 Introduction

The West Shore frontage is very different to North Shore both in its makeup and geographical setting and is protected by the Great Orme during certain storm events.

5.2 Management Units

5.2.1 Introduction

As with North Shore, the beach has been divided up into different Management Zones based on usage.

- MUW1 – Marine drive to Gogarth Breakwater
- MUW2 – Gogarth Breakwater to Lloyd St. Breakwater
- MUW3 – Lloyd St. Breakwater to Dale Road carpark
- MUW4 – Dale Road car park to Cerrig Duon Breakwater
- MUW5 – Immediately south of Cerrig Duon Breakwater

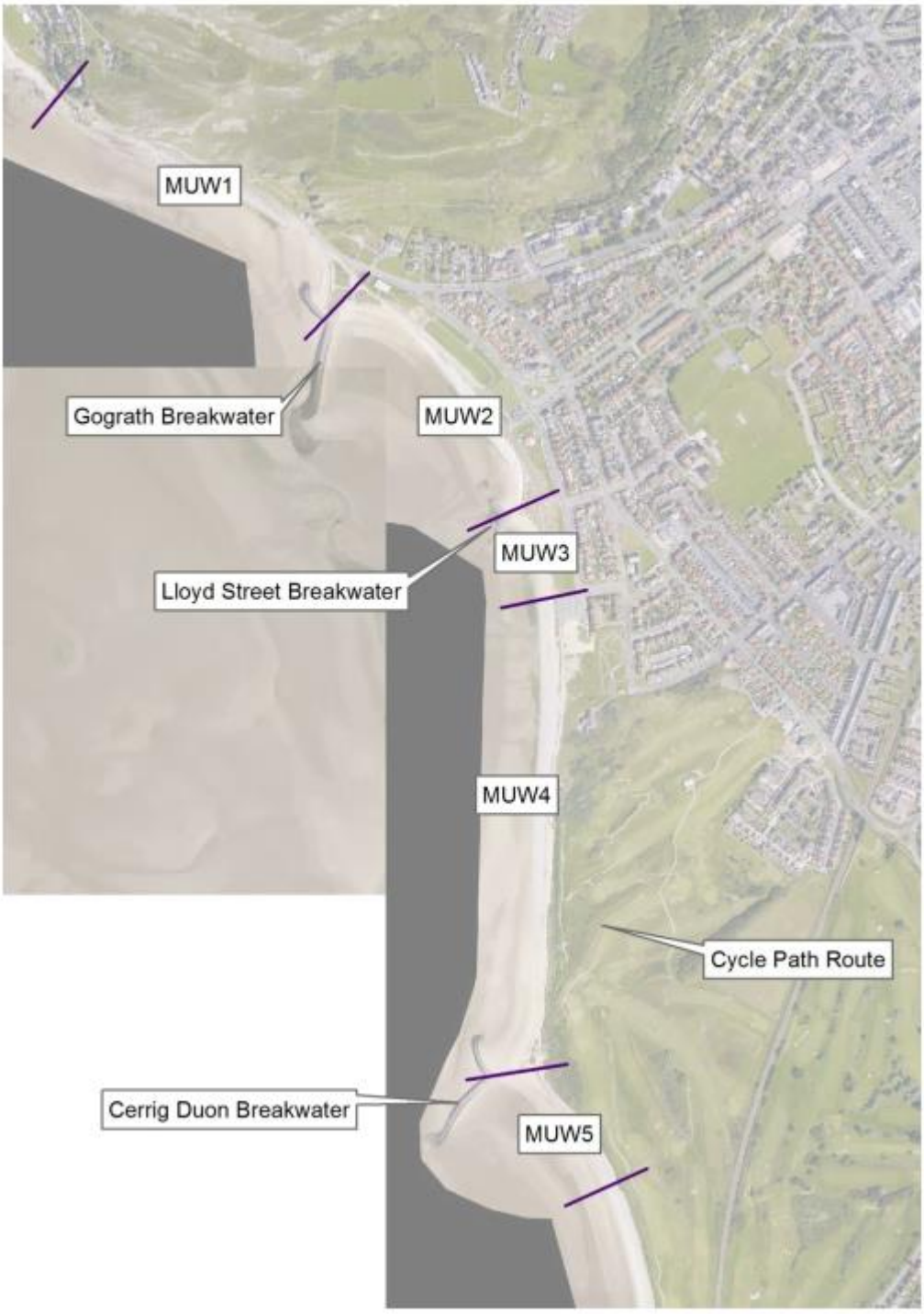

Fig2. West Shore Management Units

5.2.2 MUW1 – Marine drive to Gogarth Breakwater

This is a narrow beach consisting of sand/shingle backed by a vertical wall which protects the roadway. Beach levels to be maintained to avoid undermining/failure of wall.

5.2.3 MUW2 – Gogarth Breakwater to Lloyd St. Breakwater

The sand and cobble beach protects the stepped concrete sea wall. In future, with climate change taken into account, this area is at risk from significant overtopping. Windblown sand is a significant problem in this area.

5.2.4 MUW3 – Lloyd St. Breakwater to Dale Road carpark

There is a natural shingle and sandy beach in this area is in front of the sea wall. Windblown sand is a significant problem in this area.

5.2.5 MUW4 – Dale Road car park to Cerrig Duon Breakwater

The car park lies at the back of this portion of sandy beach with the cycle track constructed at the foot of the dunes. The area is less protected by the breakwaters and the dunes should be protected.

5.2.6 MUW5 – Immediately south of Cerrig Duon Breakwater

The sandy beach in this location is backed by the dunes with the cycle way in between. There is a significant windblown sand problem in this area which affects the coastal path and cycleway. The protection provided by the breakwater results in very fine sand accumulating in this area.

5.3 Long-list options

The long list includes options that were identified by the public consultation for West Shore and those drawn up by Aecom based on their experience with a view to providing the required standard of flood defence and addressing the problem of windblown sand.

5.3.1 Do Nothing and Do Minimum

These two options have to be considered but would not be viable given the future sea level rise due to climate change.

5.3.2 Option 1: Periodic Beach Maintenance

This option applies across the whole west Shore frontage with shingle being imported and sand being removed where necessary.

5.3.3 Option 2: Dune Regeneration

The creation of new dune system would trap windblown san though would take time to become established and would require periodic maintenance.

5.3.4 Option 3: Concrete Wall and Periodic Beach Maintenance

A wall between 1m and 1.5m in height would be constructed along the back of the beach between Dale Road carpark and Cerrig Duon breakwater combined with periodic beach maintenance. This would increase flood protection but would require regular reinvestment.

5.3.5 Option 4: Rock Cover Layer

A layer of rock would be placed at the back of the beach whilst a retaining wall would prevent material loss.

5.3.6 Option 5: Sand Traps

Low cost solution to trap windblown sand but have an ongoing maintenance requirement.

5.3.7 Option 6: Breakwater Removal

This would result in the beach being returned to its natural state but would result in increased flood and erosion risk.

5.3.8 Option 7: Raised Walkway

This involves the construction of a raised cycleway between the Dale Road carpark and past the Cerrig Duon breakwater which would take the cycleway above the influence of windblown sand and maintain this valuable amenity asset. The route of this walkway would be agreed after public consultation.

5.3.9 Option 8: Existing Wall Repairs/Raising

This would involve works being carried out to the existing sea wall structures between the breakwaters to increase their height and reduce flood risk.

5.3.10 Option 9: Combined Scheme

This scheme would be a combination of Options 5, 7 and 8 and would provide increased flood protection to West Shore whilst dealing with the issue of windblown sand and access along the cycleway.

5.4 Assessment of Options

The capital (construction) costs for the various options have been indicated as have the ongoing annual maintenance costs.

The initial environmental impact of each option has also been highlighted.

The long list assessment has been carried out bases on established criteria for coastal projects ranging from amenity, environment, technical and economic.

5.5 Short-list Options

West Shore currently faces risk from flooding from overtopping during storm events – as situation that will be exacerbated in the future due to estimated sea level rise of 700mm by 2117.

Options 7, 8 and 9 would minimise the risk of flooding in the future whilst reducing the windblown sand and enhancing the existing cycleway/footpath.

Criteria / Options	Amenity		Environment				Technical				Economic		
	Recreational Use	Access	Permissions, Consents and Licences	Archeological and Cultural Heritage	Landscape	Ecologial Designations	Functionality - Flood and Coastal Erosion Risk Management	Constructability	Durability	Impact on Coastal Processes	Capital Cost (£million)	Annual Maintenance Cost	External Funding Potential
0: Do Minimum								N/A			£0	£0 to £50k	N/A
1: Periodic Beach Maintenance											£0.5m to £1.5m	£0 to £0.5m	Low
2: Dune Regeneration											£100k to £500k	£0 to £5k	Low
3: Concrete wall and periodic beach maintenance											£400k to £600k	£300 to £400k	Medium
4: Rock cover layer											£100k to £200k	£TBD	Low
5: Sand Traps											£30k to £50k	£0 to £10k	Low
6: Breakwater Removal											£4m to £5m	£0	Low
7: Raised Walkway											£0.5m to £1.5m	£0 to £10k	Medium
8: Wall repairs/raising											£1m to £2m	£0 to £10k	Medium
9: Combined scheme											£2.4m	£0 to £20k	High

Assessment of Long-list of Options for West Shore

6 Conclusions and Recommendations

The BMP has highlighted minor present day flood risk at North Shore but increased flood risk at West Shore due to overtopping.

When projected sea level rise of 700mm is taken into account, both shores will require improvement works to their coastal defences to address this future flood risk.

The short lists have highlighted the most likely schemes that would attract funding from the WG but would be reconsidered at the next stage in the process to enhance the coastal defences of Llandudno – the Outline Business Case (OBC).

With agreed options for the management of the beach, CCBC would then hope to attract funding from the WG to carry out detailed design and ultimately construction.