

File Note

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Project title	Barmouth North Promenade - OBC	Job number	264326
cc		File reference	
Prepared by	Alba Santamaria Contreras	Date	19 May 2021
Subject	Cost comparison between OBC issued in August 2019 and updated OBC issued in May 2021		

1 Introduction

Ymgynghoriaeth Gwynedd Consultancy (YGC) of Gwynedd Council (GC) appointed Ove Arup and Partners (Arup) to review the Barmouth North Promenade Outline Business Case to reduce uncertainties associated with the preferred option for Epoch 1 works, Betterment of Existing Defences. The outline design, the construction and whole life cost and the optimism bias initially prepared in May 2019 (Rev. 1.1) have been reviewed accordingly.

The additional work (see note Appendix) included:

- Shoreline modelling to investigate the likely stability of the nourished beach to be built to protect the primary sea wall. Please refer to Appendix C of the OBC (May 2021, Rev. 2.0) for full details.
- Geophysical Surveys to investigate the current condition of the defences surface with a focus on identifying the location and characterisation of shallow voids.
- Quantified risk assessment for the project. Please refer to Appendix H of the OBC (May 2021, Rev. 2.0) for full details.
- YGC provided Early Contractor Advisor; whose input focused on buildability, construction cost and quantified risk assessment. Please refer to Appendix P of the OBC (May 2021, Rev. 2.0) for full details.

The purpose of this note is to highlight what has changed with regards to costing of the preferred option from the OBC Rev. 1.1 as a result of the exercise undertaken to reduce uncertainties.

2 Cost comparison

A non-discounted cost comparison for the **preferred solution for Epoch 1** is presented in the table below. The main differences between 2019 and updated 2021 costs are:

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- Construction cost has increased from £13,472k to £17,682k. Early Contractor Advisor in 2021 updated direct construction costs aligned with 2019 estimates (£10,110k and £9,623k respectively). However in 2019, contingency and inflation of 15% of the construction works was applied (£1,443k), whereas in 2021 a quantified risk assessment has been undertaken with the 95%ile included (£5,284k). No inflation was applied on the basis of an updated single year delivery programme recommended following Early Contractor Advisor input.
- The optimism bias has been reduced from £8,083k and £4,597k which correspond to 60% of the construction cost (2019) and 26% respectively, to reflect increased delivery confidence.
- The OBC to construction cost and the maintenance cost have been updated from 2019 to 2021 prices following CPI index in accordance with the Office for National Statistics.

The cost of the **preferred solution for Epoch 2** has been updated from 2019 to 2021 prices following CPI index in accordance with the Office for National Statistics.

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	2021 PV Costs (£k)	2021 Comments	2019 PV Costs (£k)	2019 Comments
Gwynedd Council staff costs	£115	Gwynedd Council Costs (2021) weekly rate based on construction period	£145	Gwynedd Council Costs (2019) weekly rate based on construction period
Consultant fees	£506	Assume 5% of construction cost for detailed design stage. Costs to include further detailed modelling to support the detailed design analysis.	£481	Assume 5% of construction cost for detailed design stage. Costs to include further detailed modelling so support the detailed design analysis.
Cost consultant fees	£19	1 day/week for 45 weeks for £55/hr	£19	1 day/week for 45 weeks for £55/hr
Site investigation/survey	£78	- o Trial pits along the promenade for the proposed alternative primary/ tertiary wall and at existing sheet pile - o Structural coring of the existing wall to inform the design - o Windowless sampling along the beach, supplemented with a small number of boreholes, to inform the settlement analysis and foundation details of the proposed rock armour. This will also inform the temporary works design for the sheet pile refurbishment. Includes 10% contingency.	£77	- o Trial pits along the promenade for the proposed secondary/ tertiary wall and at existing sheet pile - o Structural coring of the existing wall to inform the design - o Windowless sampling along the beach, supplemented with a small number of boreholes, to inform the settlement analysis and foundation details of the proposed rock armour. This will also inform the temporary works design for the sheet pile refurbishment. Includes 10% contingency.
Utility Diversions	£0	No diversions anticipated as part of the scheme, based on initial review	£0	No diversions anticipated as part of the scheme, based on initial review
Early Contractor Involvement	£25	One off cost to include drawings review, based on previous project experience.	£25	One off cost to include drawings review, based on previous project experience.
Other	£33	Marine licencing and stakeholder engagement	£32	Marine licencing and stakeholder engagement
Optimism bias	£193	26% applied to 'OBC to Construction' costs due to uncertainty pending ongoing study and further survey.	£224	30% applied to 'OBC to Construction' costs due to uncertainty pending ongoing study and further survey.
OBC to Construction Subtotal	£969	<i>Assumed to occur in Year 0.</i>	£1,004	Assumed to occur in Year 0.
Construction and Construction Support	£17,682	PV Capital cost, based on estimate from YGC provided Early Contractor Advisor. Includes: - o Preliminaries: 36 weeks at £25,000/wks. - o Material stock piling: 52 weeks at £5,000/wks. - o Profit + overheads: 10% of total direct cost + preliminaries + material stock piling - o Quantified Risk Assessment 95%ile (Appendix H). Construction Period: May 2022 to December 2022	£13,472	PV Capital cost, based on estimate from Gwynedd Council Twynn Scheme. Includes: - Preliminaries, overheads and profit: 25% - Contingency (including inflation): 15% Construction Period: Year 2 – March 2021 – June 2021 7wks +4wks de/re-mob Year 2 – Sept 2021 – Oct 2021 17wks+4wks de/re-mob Year 3 – March 2022- June 2022 7wks +4wks de/re-mob Year 3 – Sept 2022 – Oct 2022 17wks+4wks de/re-mob
Optimism bias	£4,597	26% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending ongoing study and further survey. Nominal allowance for Network Rail BAPA and reinstatement/replacement of street furniture, signposting, and amenity features included as Optimism Bias.	£8,083	60% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending ongoing study and further survey. Nominal allowance for Network Rail BAPA and reinstatement/replacement of street furniture, signposting, and amenity features included as Optimism Bias.
Subtotal	£23,248		£22,559	
Future costs (maintenance)	£178	PV Maintenance cost to include minor concrete repair works to sea wall, promenade and reseating of the rock armour and reinstatement of shingle.	£158	PV Maintenance cost to include minor concrete repair works to sea wall, promenade and reseating of the rock armour and reinstatement of shingle.
Optimism bias	£107	60% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending ongoing study and further survey.	£95	60% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending ongoing study and further survey.
Total	£23,533		£22,717	

Non-discounted costs are not presented in this table to allow easy comparison, they can be found in the respective OBC.

Appendix – Scope

Context

The Outline Business Case (OBC) demonstrates a strong case for change to reduce the coastal risk threat to the community. The preferred way forward is an adaptive pathway approach. The most economically favourable immediate action is the betterment of the existing defences. This will safeguard the community and the recreational value of the promenade in the medium term and is estimated to achieve a 1 in 50 annual chance standard of protection with allowance for the impact of climate change to 2069. Beyond 2069, managing coastal risk is increasingly challenging and the preferred approach is to transition to a form of managed realignment for the northern section, with beach management to the south.

The preliminary budget estimate of the preferred option of betterment of the existing defences totalled £23.1M (non-discounted costs). The OBC recognised the significant uncertainty in the scale and form of preferred option, and followed best-practice to include 60% optimism bias totalling £8.1M. We understand the challenge this presents to the wider coastal programme and further work is recommended to reduce uncertainty before proceeding to the next stage (detailed design and consenting before Full Business Case).

Targeted Effort to Reduce Uncertainty

The following sections expand on the OBC ‘key risk and proposed mitigation measures’.

Preliminary construction budget values quoted are non-discounted costs, excluding preliminaries (£2.4M), construction contingency (£1.4M) and optimism bias.

- *Condition and performance of existing defences (existing structure and geotechnical risk)*

The OBC preliminary budget included to replace the wave wall (£0.9M) and install a new set-back flood wall (£0.7M), new sheet piles at the toe (£2.1M) and void repairs (£0.6M). In the absence of information on the existing structure or intrusive surveys, the form/extent of works was inferred. The OBC took the precautionary approach of ignoring the existing primary wave wall, instead a new wave wall was proposed between the promenade and the highway.

The OBC geotechnical desk study recommended ground investigation to inform remedial works design. The OBC recommended structural investigation and surveys to confirm structural integrity, performance and construction details of the existing structure.

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Figure 1 – Extract from OBC geotechnical desk study recommendations

- Ground investigation will likely be required to inform the design of any remedial works undertaken. The scope of investigation will be dependent on the preferred option, but the main objectives of the ground could include the following:
 - Establish the ground conditions and their engineering properties along the promenade
 - Establish the groundwater conditions along the promenade
 - Undertaken geo-environmental sampling and subsequent assessment to inform risk to the environment, risk to site users and offsite disposal.
 - The potential localised variation in ground conditions around the historic watercourses.
 - Investigate potential mining activity within the area.
- In addition to the above, further investigation of the existing promenade structure may be required to confirm its conditions, geometry and any required engineering assessments. Elements which may require investigation are as follows:
 - Investigate the potential for voiding beneath the revetment and promenade which may comprises a combination of geophysical and intrusive techniques
 - Depth, condition and ground conditions for the sheet piles
 - Depth, condition and ground conditions for the precast concrete piles
 - Foundation details of the wave wall, secondary and tertiary walls
 - Structural coring of the walls and revetment

Provide advisory support services to YGC's emerging geophysical and geotechnical specifications and proposals.

- *Design of preferred option based on assumed wave loading (wave overtopping and loading)*

The OBC highlighted limitations with empirical methods to estimate wave overtopping and loading to better define the requirements for a wave wall, given the aggressive wave climate. Physical coastal modelling is required however this is costly (circa £40-60k). Whilst there is uncertainty with the preferred option raised defence form (e.g. no allowance for a wave wall piled foundation), the OBC preliminary budget precautionarily replaces rather than enhances the existing wave wall, and also includes for a setback flood wall.

The physical modelling would also allow optimisation of the height of the proposed rock armour revetment (£0.7M) as it could be relaxed to only protect the sheetpile rather than reduce overtopping. However, the modelling cost and scale of uncertainty reduces the priority of this recommendation relative to other risks.

Physical wave modelling has been deferred until detailed design when the scheme is better defined.

- *Beach recharge and coastal processes*

The OBC preliminary budget included significant allowances for beach nourishment (£4.6M). The OBC Coastal Process Assessment summarised coastal processes affecting the defences and the conceptual understanding of the dynamics at North Promenade, and the wider area. This desk study indicated there is not a strong transport regime along the frontage, despite a southerly transport direction being inferred from numerous site visits and the conflicting observations from bed level changes between 2013 and 2014 suggesting a more dominant northerly transport nearshore.

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The foreshore generally comprises of sand with localised areas of shingle/cobbles along the upper foreshore. At a few locations where there is limited mobile surface deposits, clay or hard rock outcrops are visible along the lower foreshore. Along North Promenade the foreshore is primarily comprised of sand with isolated pockets of shingle/cobbles. This continues along the northern section of South Promenade, where shingle/cobbles are constrained within the groyne bays. However, there is uncertainty in the long-term stability and viability of the proposed shingle beach. The comprehensive baseline completed for the OBC provides a sound evidence base for sediment modelling.

The frontage is adjacent to the Pen Llyn a'r Sarnau SAC and designated for its mudflats and sandflats and may be subject to Environmental Statement and Habitats Regulation Appraisal, with the potential requirement for compensation for coastal squeeze. Coastal process information is likely to be required for subsequent environmental assessments.

Sediment transport modelling will test how the nourished beach will evolve as sediment is transported along the coastline due to long/cross shore drift and understand how the beach is likely to respond under different circumstances, including:

- Whether the proposed shingle nourishment will be stable under extreme events;
- The rate of sediment transport and loss from the system (under non-extreme conditions) and identify the need and frequency of sediment recycling nourishment;
- The potential need for associated beach retaining structures (groynes);
- Number and length of structures (if required); and hence
- Allow refinement of budget estimates.

Longshore beach modelling over different periods using MIKE Littoral Processes FM Coastline Evolution model which will seek to test how the nourished beach will evolve as sediment is transported along the coastline due to longshore drift. We understand there is little shingle present on the coastline and little information available from which we can validate the model. However, using the model to test different scenarios, with the results interpreted by experienced coastal geomorphologists, will provide valuable information on how the beach is likely to respond under different circumstances.

The individual tests would be agreed but are likely to include a combination of:

- Long term evolution (nourished single beach without structures): This could be undertaken using circa 2, 5- or 10-year wave timeseries to understand how the shingle is likely to be transported over a long period of time. This will provide information on the likely need for recycling, structures or other measures.
- Response to severe events (new profile without structures): Representing a severe month, such a December 2013 will allow us to understand how the beach will respond under severe conditions. Note that we recommend using a period of 'real' extreme data rather than a defined return period.
- Tests for different wave conditions;
- Tests for different sea levels (climate change); and
- Tests for different scheme options.

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The model results will be interpreted in the context of the OBC Coastal Process Baseline to provide advice and recommendations on how the OBC beach scheme could be developed.

- *Costing of preferred option and buildability advice*

The preliminary construction budget was based on provided information by YGC from comparable schemes such as Tywyn (£5.3M); the Environment Agency Long-term costing tool and YGC QS input (£2.1M); and other costing information (£2.1M). The remote location of Barmouth increases uncertainty with application of unit rates.

YGC will arrange for Early Contractor Advice to review the buildability and cost of the preferred option.

- *Quantified risk register*

Welsh Government's Business Case Guidance notes contingency provision should *reflect the sum of measured risk (costs of risks avoided, shared and mitigated on an expected likelihood basis) and Optimism Bias adjustment estimated in nominal prices.*

Each element of the design will be reviewed to identify the degree of risk associated with each item. This will be a quantitative assessment as recommended by Welsh Government's Business Case Guidance. This will allow the current optimism bias (£8.1M) to be significantly reduced (see BCG Supplementary Technical Note 03).

DOCUMENT CHECKING (not mandatory for File Note)

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