DBS Offshore Wind

# RWE Renewables UK Dogger Bank South (West) Limited

# RWE Renewables UK Dogger Bank South (East) Limited

# Dogger Bank South Offshore Wind Farms

## Coastal Erosion Rate Technical Note (Revision 2) (Clean)

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| 02 | 7 | 2.0 | Inclusion of Natural England's advice to incorporate the outputs from NCERM2 |
| 02 | 15 | Table 2-2 | Inclusion of RCP 8.5 70$^{th}$ and 95$^{th}$ percentile sea-level rise scenarios |
| 02 | 16 | Plate 2-5 | Updated to include changes in sea-level rise under the RCP 8.5 70th and 95th percentile scenarios |
| 02 | 14 | 2.4 | Removal of text referencing the outdated original NCERM outputs |
| 02 | 17 | 2.4 | Updated coastal erosion assessment to include RCP 8.5 70$^{th}$ and 95$^{th}$ percentile sea-level rise projections |
| 02 | 18 | Table 2-4 | New table showing projected cliff erosion rated based on the RCP 8.5 70$^{th}$ percentile |
| 02 | 18 | Table 2-5 | New table showing projected cliff erosion rated based on the RCP 8.5 95th percentile |
| 02 | 19 | Table 2-6 | New table comparing the projected cliff erosion rates for all scenarios presented |
| 02 | 20 | 2.5 | Removal of text referencing the outdated original NCERM outputs |
| 02 | 21 | 2.5 | Inclusion of $NECRM_2$ coastal erosion assessment |
| 02 | 20 | Table 2-7 | New table showing comparison between different methods to assess coastal erosion, Leatherman and NCERM2 |
| 02 | 23 | Section 3.4 | Inclusion of RCP 8.5 70$^{th}$ and 95$^{th}$ percentile sea-level rise scenarios |
| 02 | 25 | 4.0 | Updated summary to reflect the updated coastal erosion assessment |

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# Glossary

| Term | Definition |
|---|---|
| Erosion | Wearing away of the land or seabed by natural forces (e.g. wind, waves, currents, chemical weathering). |
| Intertidal | Area on a shore that lies between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS). |
| Landfall | The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the onshore cables at the Transition Joint Bay (TJB) above mean high water. |
| The Applicants | The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake). |
| The Projects | DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms). |

# Acronyms

| Acronym | Definition |
|---|---|
| DGPS | Differential Global Positioning System |
| ES | Environmental Statement |
| ERYC | East Riding of Yorkshire Council |
| Lidar | Light Detection and Ranging |
| NCERM | National Coastal Erosion Risk Mapping |
| RCP | Representative Concentration Pathway |

# 1 Introduction

1. This technical note addresses **Natural England's Relevant Representations** [RR-039] and comments received from the **Environment Agency** in an email sent to the Applicants on 23rd August 2024 related to coastal change (beach elevation change, platform lowering, and cliff erosion) presented in **Chapter 8 Marine Physical Environment** [APP-080].

2. Following submission of this technical note, Natural England responded during the examination period (**Natural England's comments and updated advice on 10.38 Coastal Erosion Technical Note** [REP1-064]) requesting that the findings from NCERM2 which were published on 28th January 2025 be incorporated in the coastal erosion assessment initially outlined in **Chapter 8 Marine Physical Environment** [APP-080].

3. This technical note provides the data, information and updated coastal erosion assessment to supplement **Chapter 8 Marine Physical Environment** [APP-080].

# 2 Natural England Responses

4. Natural England are concerned that:

- The beach elevation change data presented in **Chapter 8 Marine Physical Environment** [APP-080] from 2008 to 2015 is out of date and there is insufficient information regarding beach elevation change and shore platform lowering; and
- The use of the UKCP18 high emission scenario (RCP8.5) at the 50% confidence level is not consistent with the National Coastal Erosion Risk Mapping project (NCERM2) which uses the 70% and 95% confidence levels.
- The NCERM2 data has not been included in the assessment of coastal erosion due to it not being published at the time of DCO submission. However, the data were publicly released on 28th January 2025 and can therefore be considered during the examination period.

## 2.1 Beach Elevation and Platform Lowering Comments

5. The Natural England comment RR-039: B20 and RR-039: B36 reads:

*Natural England notes that it is stated that "The drill, or other trenchless installation, bore would be of sufficient depth below the ground level to have no effect on coastal erosion. The TJBs (Transition Joint Bays) would be located beyond any areas at risk of natural coastal erosion across the anticipated operational life of the Projects". However, we note that East Riding of Yorkshire Council (ERYC) historical and recent cliff recession rates have been used to demonstrate rates of change at landfall. Therefore, we consider the beach elevation change data presented in the ES from 2008-2015 to be out of date.*

*Establishing historical and more recent trends in beach and shore platform elevation change is a key part of the baseline characterisation for the marine (coastal) physical environment. This will help inform understanding of how the coast (at landfall) may evolve naturally over the lifetime of the Projects, establish coastal morphology sensitivity to scheme impacts, and inform asset integrity and cable burial assessments.*

*Natural England is concerned that currently there is insufficient information regarding beach elevation change and shore platform down wearing to inform the assessment of potential construction- and operation-related impacts to coastal morphology at landfall.*

## 2.2 Beach Elevation and Platform Lowering Response

6. The Applicants have received Light Detection and Ranging (Lidar) data for the beach at the landfall from East Riding of Yorkshire Council. Data has been made available from 2008, 2013, 2018 and 2024, which are compared here to assess beach/shore platform elevation change across the intertidal landfall area. The results are shown in **Plates 2-1** to **2-4**.

7. Comparison of the Lidar data between 2008 and 2013 shows that most of the intertidal area eroded or was relatively stable. Between 2013 and 2018, most of the intertidal area accreted with small areas of erosion. Over the most recent period 2018-2024, a degree of stability has been established at the landfall. Although there have been short-term changes in morphology, over the medium term (16 years), between 2008 and 2024 the elevation of the intertidal area at the landfall has been relatively unchanged (**Plate 2-4**). There is a linear strip of erosion at the top of the beach, which is likely related to removal of sediment from within the toe of the cliff.

8. The new information presented here is sufficient to demonstrate that the conclusions reached in section 8.7.3.9 of **Chapter 8 Marine Physical Environment** [APP-080] are robust and the magnitude of impact of construction activities remains negligible with a minor adverse significance of effect.

9. With respect to operation, one of the main uncertainties is the depth to which the cables should be buried across the beach. At the landfall, beach sand overlies the shore platform. A linear extrapolation of the intertidal elevation (beach and platform) established through the Lidar comparisons would mean that over the lifetime of the Projects the average elevation would remain stable. However, the future evolution of the intertidal area is unlikely to be linear and will largely depend on the position of future water (sea) levels. Accelerated sea-level rise will tend to increase the potential for erosion if a constant sediment supply is assumed. Even with the potential for increased intertidal erosion, the cables will be buried at depths that are sufficient so that they will not be exposed over the Projects lifetime. Hence, from an operational perspective there will be no impacts on coastal erosion/processes during operation.

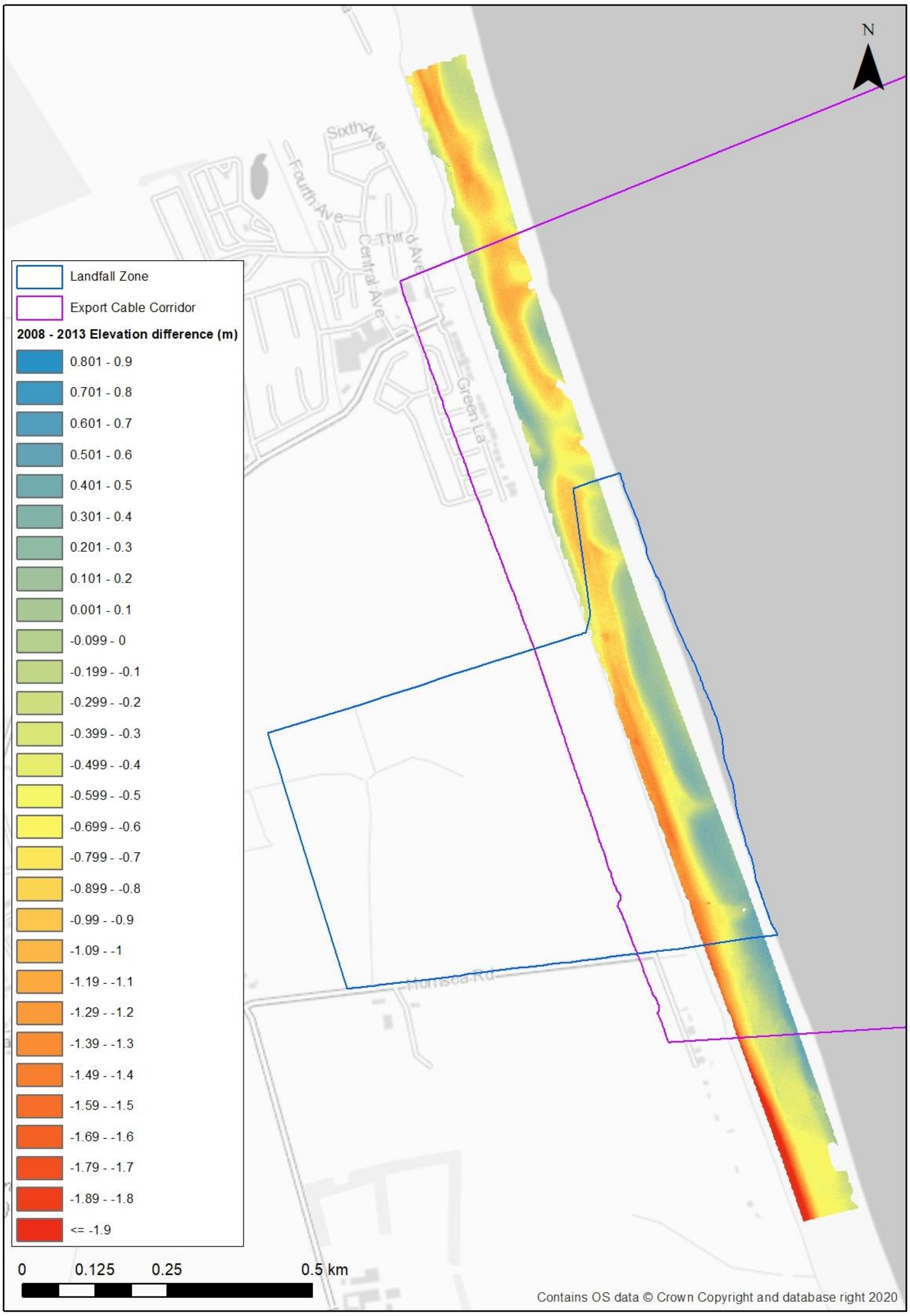


**Plate 2-1 Elevation difference between the 2008 and 2013 Lidar surveys across the intertidal area of the landfall**

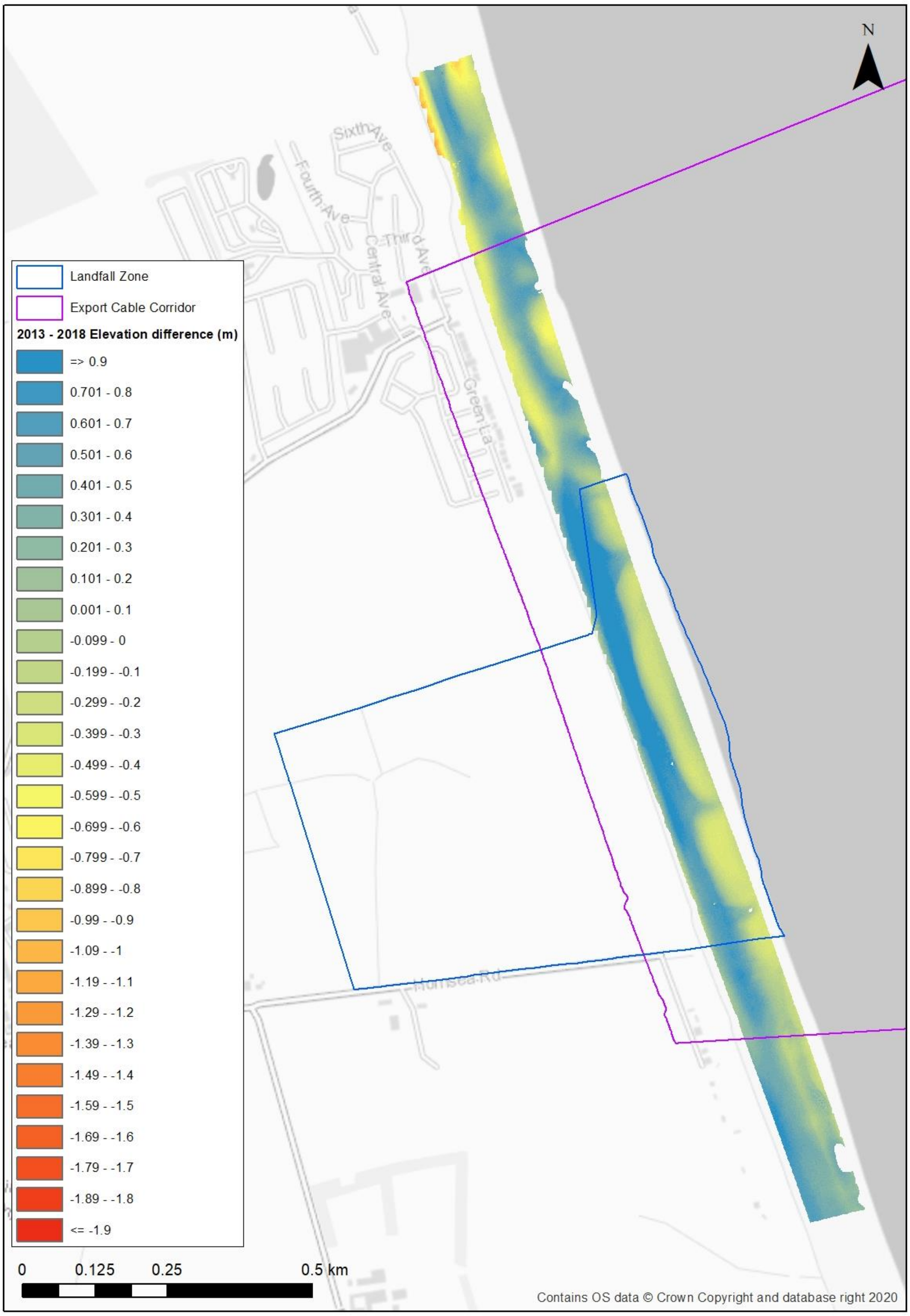


**Plate 2-2 Elevation difference between the 2013 and 2018 Lidar surveys across the intertidal area of the landfall**

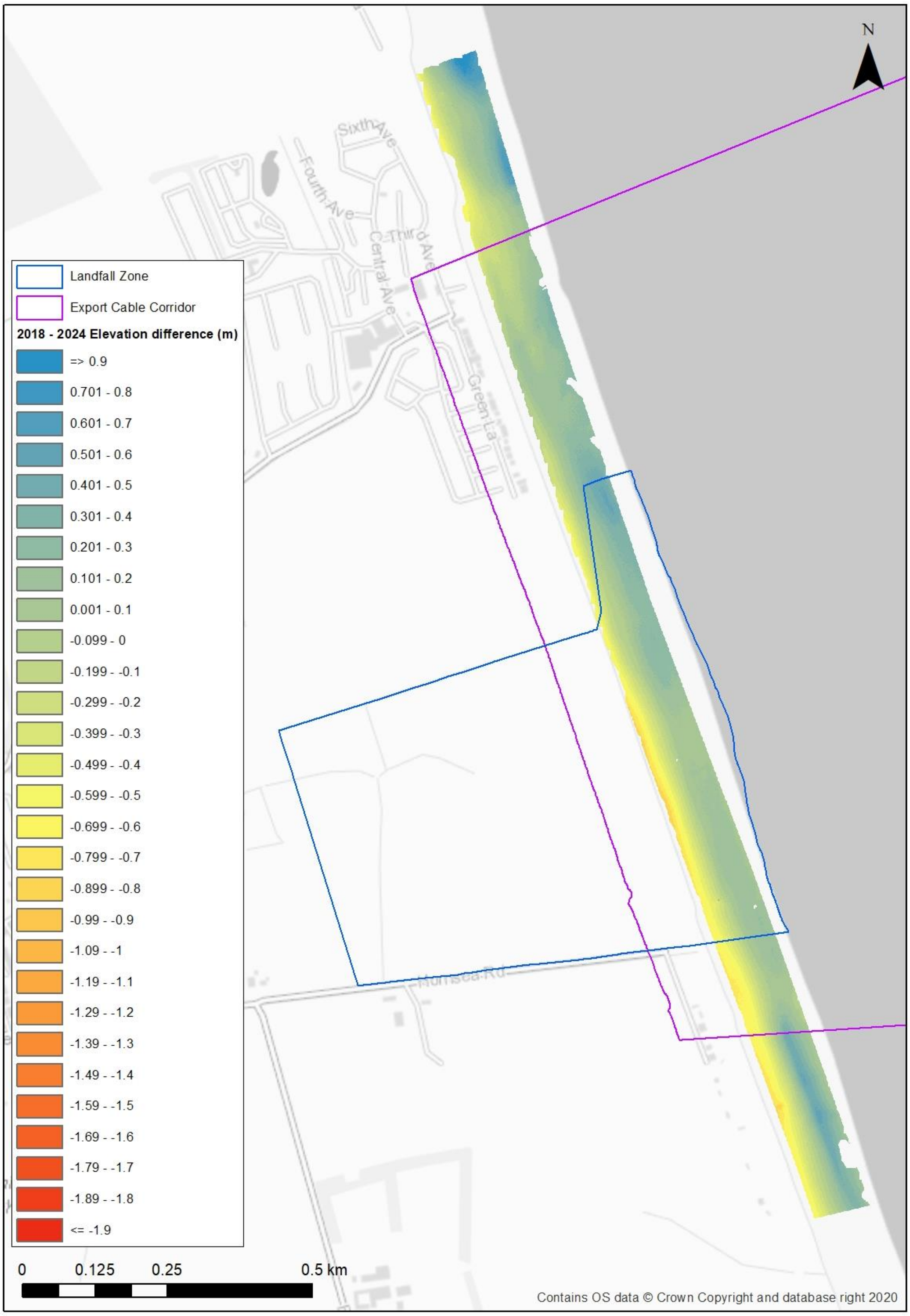


**Plate 2-3 Elevation difference between the 2018 and 2024 Lidar surveys across the intertidal area of the landfall**

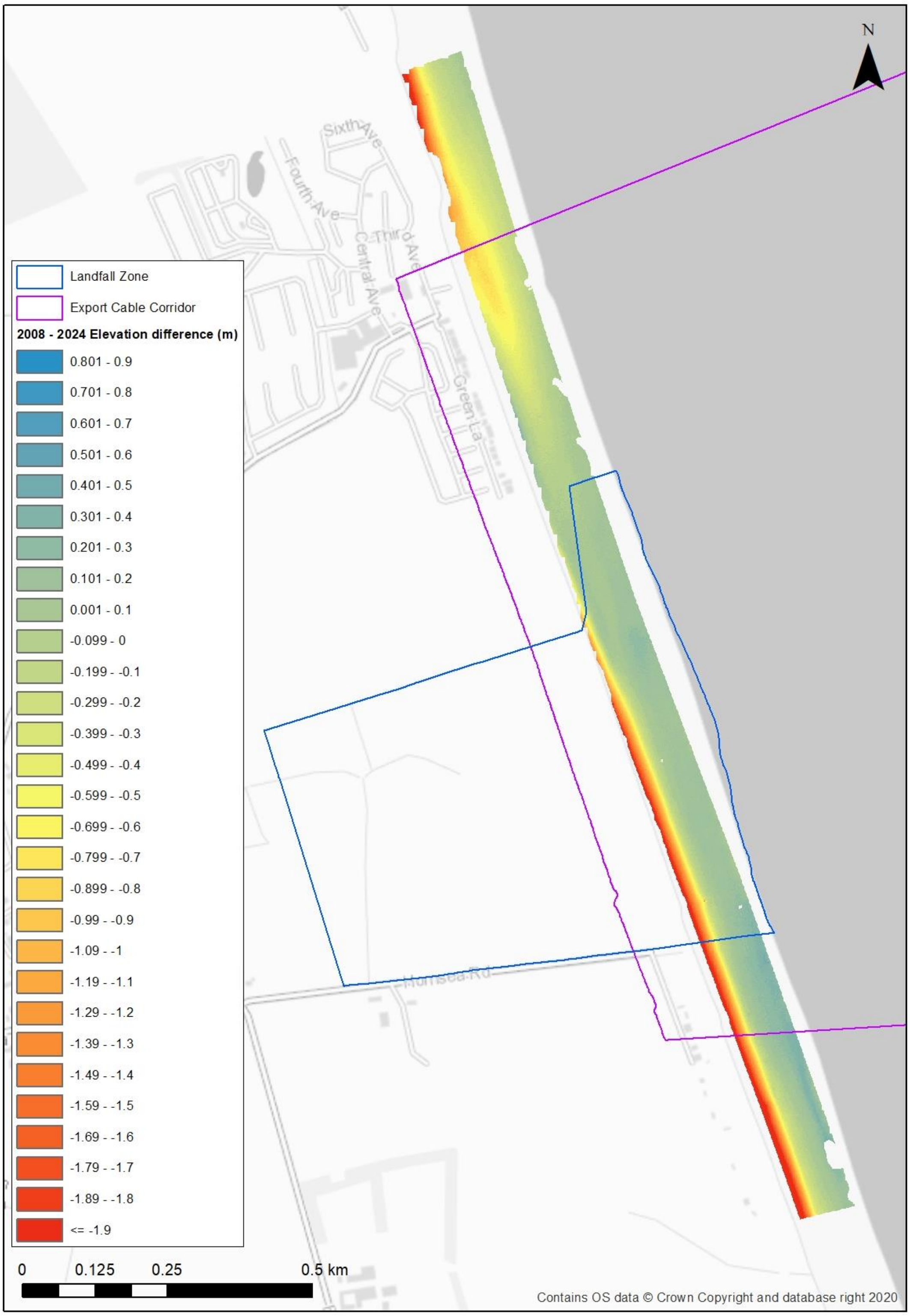


**Plate 2-4 Elevation difference between the 2008 and 2024 Lidar surveys across the intertidal area of the landfall**

## 2.3 Coastal Erosion and UKCP18 Emissions Scenarios Comments

10. The Natural England comment RR-039: B23 reads:

*Natural England notes that data on coastal erosion was obtained from East Riding of Yorkshire Council to provide an historic understanding of coastal change. Predictions of coastal erosion were made using the UKCP18 high emission scenario (RCP8.5) at the 50% confidence level. However, we advise that the revised National Coastal Erosion Risk Mapping project (NCERM2; https://www.data.gov.uk/dataset/4b723013-b676-4202-aab5-a2bc449c72fb/national-coastal-erosion-risk-management-ncerm), which uses the 70th and 95% confidence level to predict worst case erosion rates should be used.*

## 2.4 Coastal Erosion and UKCP18 Emissions Scenarios Response

11. The Applicants have received up-to-date coastal erosion data (up to May 2024) from ERYC. The erosion rates at profiles 24 to 31 up to May 2024 are shown in **Table 2-1** spanning the record between 1852 and 2003 (historic erosion rates) and the record between 2003 and 2024 (recent erosion rates). The distinction between historic and recent erosion rates is made as they have been determined using different techniques. The recent erosion rates are considered more accurate as they are measured using Differential Global Positioning System (DGPS). It should be noted the values presented in **Table 2-1** differ from those presented in Table 8-18 of **Chapter 8 Marine Physical Environment** [APP-080] in response to the Environment Agency's comments (see section 3.6 for further details).

**Table 2-1 Average historic cliff erosion at the landfall for each of the ERYC coastal profiles**

| Profile | Location | Historic erosion rate (1852 to 2003) (m/year) | Recent erosion rate (2003 to 2024) (m/year) |
|---|---|---|---|
| 24 | Between defences opposite Southfield Lane, Ulrome | 1.48 | 1.44 |
| 25 | North end of Green Lane, Skipsea | 1.48 | 1.77 |
| 26 | South of Green Lane, Skipsea | 1.53 | 1.38 |
| 27 | Opposite Skipsea village | 1.22 | 1.57 |
| 28 | Opposite bungalows to south of Skipsea | 1.17 | 1.84 |

| Profile | Location | Historic erosion rate (1852 to 2003) (m/year) | Recent erosion rate (2003 to 2024) (m/year) |
|---|---|---|---|
| 29 | To south of Withow Gap, Skipsea | 0.96 | 1.90 |
| 30 | Within golf course to north of Skirlington | 0.99 | 1.30 |
| 31 | North end of Skirlington campsite | 1.07 | 1.03 |

12. The Representative Concentration Pathways (RCPs) present possible 21st century trajectories of atmospheric concentrations of greenhouse gases, based on various levels of emission mitigation. For RCP2.6, 4.5 and 8.5, the UK MetOffice used a range of climate models to present ranges of expected sea level rise under each pathway (expressed as percentiles of the range of model results), as part of their UKCP18 product. As such, the RCPs by themselves do not represent a likelihood of occurrence, rather, together they present the range of potential future sea-level rise based on different emission scenarios, including the uncertainty in climate modelling (through the percentiles for each scenario). It should, therefore, be noted that the Environment Agency's use of the RCP8.5 70th and 95th percentile sea-level rise predictions in their guidance for flood and coastal risk projects, schemes and strategies, but also as part of NCERM, is a consciously conservative choice, based on the risk that is at stake in flood and coastal erosion risk management.

13. Predicted changes in future relative sea-level using UKCP18 RCP 4.5 50% confidence level are shown in **Table 2-2** (representing a pathway with mid-range mitigation and emissions stabilizing and declining later in the 21st century). Predicted changes in future relative sea-level rise for the 70th and 95th percentiles of the RCP8.5 emissions scenario (representing a pathway where greenhouse gas emissions continue to grow unmitigated), are also presented in **Table 2-2**Error! Reference source not found., in a ccordance with the Environment Agency's guidance for flood and coastal risk projects, schemes and strategies (Environment Agency 2020). The sea-level rise relative to 2024 for all scenarios is presented visually in **Plate 2-5**.

**Table 2-2 Changes in relative sea level under the 50th percentile RCP4.5 and 70th and 95th percentile RCP 8.5 emissions scenario using a 2024 baseline**

| Year | RCP4.5 50th percentile | RCP 8.5 70th percentile | | RCP 8.5 95th percentile | |
|---|---|---|---|---|---|
| | Relative sea-level (m) | Average rate of relative sea-level rise (mm/year) | Relative sea-level (m) | Average rate of relative sea-level rise (mm/year) | Relative sea-level (m) | Average rate of relative sea-level rise (mm/year) |
| 2024 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2034 (10 years) | 0.047 | 4.70 | 0.062 | 6.20 | 0.077 | 7.67 |
| 2044 (20 years) | 0.099 | 4.97 | 0.134 | 6.71 | 0.168 | 8.40 |
| 2054 (30 years) | 0.155 | 5.16 | 0.217 | 7.24 | 0.277 | 9.24 |
| 2074 (50 years) | 0.271 | 5.42 | 0.415 | 8.31 | 0.541 | 10.83 |

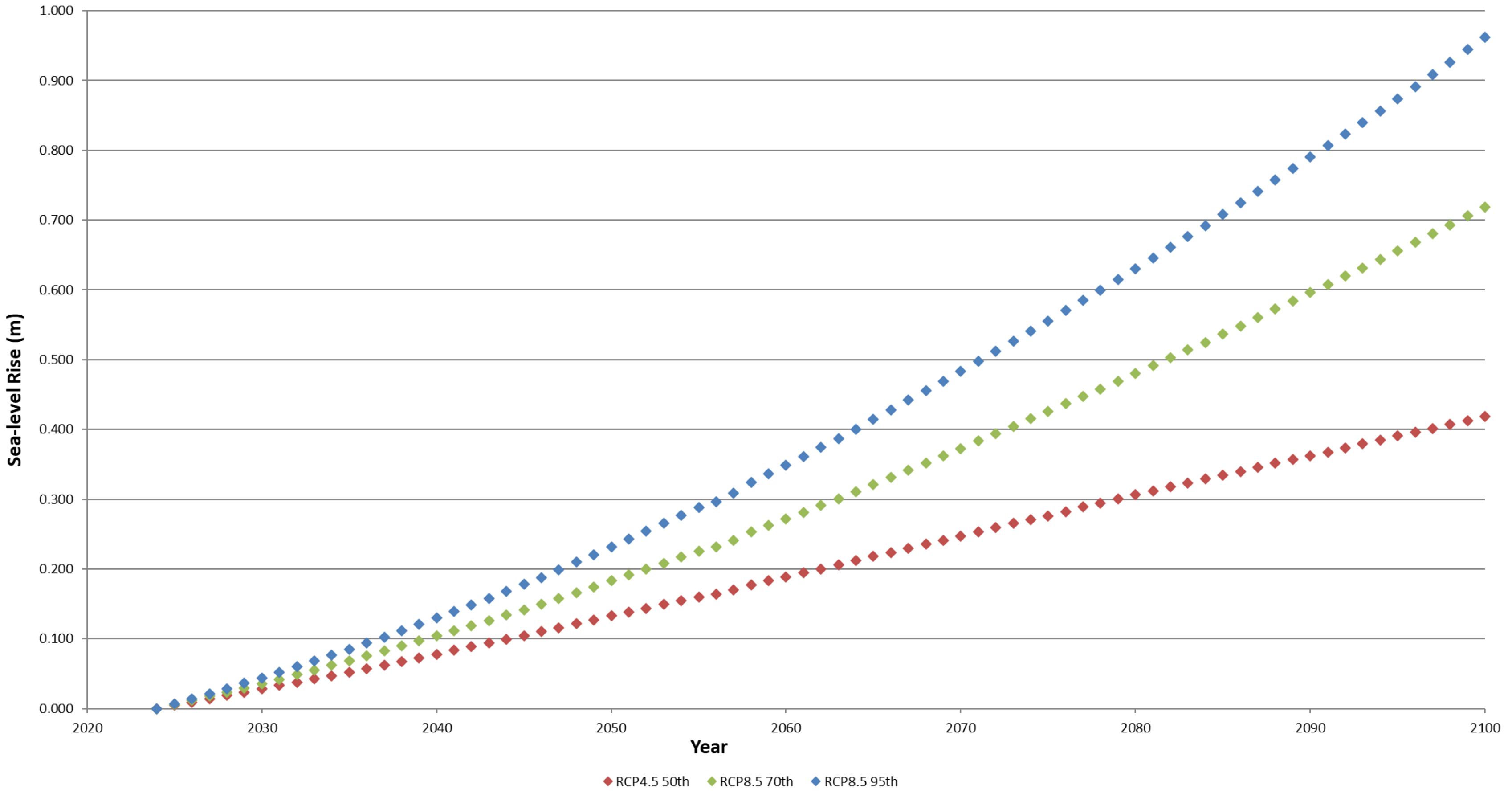


**Plate 2-5 Changes in relative sea level under 50th percentile RCP4.5 emissions scenario, and the 70th and 95th percentile RCP8.5 emissions scenario using a 2024 baseline**

14. To predict future coastal erosion rates, the forward projection equation of Leatherman (1990) can be used (unchanged from the analysis presented in **Chapter 8 Marine Physical Environment** [APP-080]): **Equation 1: $R_P = R_H. (S_P/1.73)$** where:

- $R_P$ = predicted erosion rate (m/year);
- $R_H$ = historic erosion rate (m/year); and
- $S_P$ = predicted relative sea-level rise (mm/year).

15. A historic sea-level rise of 1.73mm/year is used (unchanged from the analysis presented in **Chapter 8 Marine Physical Environment** [APP-080]).

16. The predicted future erosion rates at each profile ,combining the historic cliff erosion rates with the 50th percentile of RCP4.5 and 70th and 95th percentiles of RCP8.5 estimates of future sea-level rise, are shown in **Table 2-3**, **Table 2-4** and **Table 2-5,** respectively. It should be noted that these values present an update to the values presented in Table 8-20 of **Chapter 8 Marine Physical Environment** [APP-080]. These values were used to indicate a potential future baseline of trends of cliff erosion. The updated values presented below do not affect the original assessment conclusions reached in **Chapter 8 Marine Physical Environment** [APP-080] as the commitment to trenchless techniques for cable installation at the landfall means there will be no effect on the Holderness cliffs as a coastal receptor.

**Table 2-3 Projected cliff erosion rates at the landfall profiles based on the RCP4.5 50th percentile scenario**

| Erosion Profile Details | | Erosion rate (m/year) | | | | |
|---|---|---|---|---|---|---|
| | | Historic | Future | | | |
| Profile | Location | 2003 to 2023 | 10 years | 20 years | 30 years | 50 years |
| 24 | Between defences opposite Southfield Lane, Ulrome | 1.44 | 3.90 | 4.13 | 4.29 | 4.50 |
| 25 | North end of Green Lane, Skipsea | 1.77 | 4.82 | 5.10 | 5.29 | 5.56 |
| 26 | South of Green Lane, Skipsea | 1.38 | 3.74 | 3.96 | 4.11 | 4.32 |
| 27 | Opposite Skipsea village | 1.57 | 4.27 | 4.51 | 4.68 | 4.92 |
| 28 | Opposite bungalows to south of Skipsea | 1.84 | 5.00 | 5.29 | 5.49 | 5.77 |
| 29 | To south of Withow Gap, Skipsea | 1.90 | 5.17 | 5.46 | 5.67 | 5.96 |
| 30 | Within golf course to north of Skirlington | 1.30 | 3.54 | 3.74 | 3.88 | 4.08 |

| Erosion Profile Details | | Erosion rate (m/year) | | | | |
|---|---|---|---|---|---|---|
| | | Historic | Future | | | |
| 31 | North end of Skirlington campsite | 1.03 | 2.80 | 2.96 | 3.08 | 3.23 |

**Table 2-4 Projected cliff erosion rates at the landfall profiles based on the RCP8.5 70th percentile scenario**

| Erosion Profile Details | | Erosion rate (m/year) | | | | |
|---|---|---|---|---|---|---|
| | | Historic | Future | | | |
| Profile | Location | 2003 to 2023 | 10 years | 20 years | 30 years | 50 years |
| 24 | Between defences opposite Southfield Lane, Ulrome | 1.44 | 5.15 | 5.57 | 6.01 | 6.90 |
| 25 | North end of Green Lane, Skipsea | 1.77 | 6.36 | 6.88 | 7.42 | 8.51 |
| 26 | South of Green Lane, Skipsea | 1.38 | 4.94 | 5.34 | 5.76 | 6.61 |
| 27 | Opposite Skipsea village | 1.57 | 5.63 | 6.09 | 6.57 | 7.54 |
| 28 | Opposite bungalows to south of Skipsea | 1.84 | 6.60 | 7.14 | 7.71 | 8.84 |
| 29 | To south of Withow Gap, Skipsea | 1.90 | 6.81 | 7.37 | 7.96 | 9.13 |
| 30 | Within golf course to north of Skirlington | 1.30 | 4.66 | 5.05 | 5.45 | 6.25 |
| 31 | North end of Skirlington campsite | 1.03 | 3.70 | 4.00 | 4.32 | 4.95 |

**Table 2-5 Projected cliff erosion rates at the landfall profiles based on the RCP8.5 95th percentile scenario**

| Erosion Profile Details | | Erosion rate (m/year) | | | | |
|---|---|---|---|---|---|---|
| | | Historic | Future | | | |
| Profile | Location | 2003 to 2023 | 10 years | 20 years | 30 years | 50 years |
| 24 | Between defences opposite Southfield Lane, Ulrome | 1.44 | 6.37 | 6.98 | 7.67 | 8.99 |

| Erosion Profile Details | | Erosion rate (m/year) | | | | |
|---|---|---|---|---|---|---|
| | | Historic | Future | | | |
| 25 | North end of Green Lane, Skipsea | 1.77 | 7.86 | 8.61 | 9.47 | 11.10 |
| 26 | South of Green Lane, Skipsea | 1.38 | 6.11 | 6.69 | 7.36 | 8.62 |
| 27 | Opposite Skipsea village | 1.57 | 6.96 | 7.62 | 8.39 | 9.83 |
| 28 | Opposite bungalows to south of Skipsea | 1.84 | 8.16 | 8.94 | 9.84 | 11.53 |
| 29 | To south of Withow Gap, Skipsea | 1.90 | 8.43 | 9.23 | 10.16 | 11.90 |
| 30 | Within golf course to north of Skirlington | 1.30 | 5.77 | 6.32 | 6.95 | 8.15 |
| 31 | North end of Skirlington campsite | 1.03 | 4.57 | 5.01 | 5.51 | 6.46 |

17. Based on predictions of future coastal erosion using the 50th percentile of RCP4.5 and 70th and 95th percentiles of RCP8.5, **Table 2-6** shows the suggested maximum cliff retreat distance at the landfall over the next 10, 20, 30 and 50 years.

**Table 2-6 Suggested maximum cliff retreat distance at the landfall site for the RCP4.5 50th percentile and RCP8.5 70th and 95th percentile scenarios.**

| Period | Maximum Expected Erosion Distance (m) | | |
|---|---|---|---|
| | RCP4.5 50th | RCP8.5 70th | RCP8.5 95th |
| 10 years | 52 | 68 | 84 |
| 20 years | 109 | 147 | 185 |
| 30 years | 170 | 239 | 305 |
| 50 years | 298 | 456 | 595 |

## 2.5 Incorporation of NCERM2 data

18. A new version (v2) of the National Coastal Erosion Risk Mapping NCERM2 (published 28th January 2025) splits the English coast into frontages defined as lengths of coast with consistent characteristics based on the cliff behaviour and the type of defence present. It provides a dataset showing erosion extents under both the "No Future Intervention" scenario and the "Shoreline Management Plan Delivered" coastal management scenario under a Present Day Climate and two Climate Change scenarios: higher central (RCP8.5 70th percentile) and upper end (RCP8.5 95th percentile). Results are available for the following two periods:

- 2020 – 2055; and
- 2020 – 2105.

19. NCERM2 is based on national-scale methods whilst incorporating locally available datasets. Input data and interim results were reviewed and verified by relevant Local Risk Management Authorities responsible for the frontage.

20. Based on the current condition of defences and their future deterioration, and predicted recession rates based on historical data and the expected effects of sea level rise, a semi-probabilistic calculation provides a probability of recession reaching a certain location behind the defences by a certain year. The published NCERM2 results are a cross-section of this calculation: they represent the expected value of recession within the period considered.

21. At Skipsea (NCERM frontage ID 15242), due to the Shoreline Management Plan's No Active Intervention policy, the results for the Shoreline Management Plan Delivered and No Future Intervention Scenarios are the same.

22. The resulting expected recession at Skipsea is presented in **Table 2-7**. To enable a direct comparison between Leatherman (1990) and NCERM2, erosion distances were recalculated using Leatherman for 2055 and 2105, including a shift in baseline from 2024 to 2020 using measured erosion distances.

**Table 2-7 Results from NCERM2 at the landfall site (frontage ID 15242) for both periods and under all climate change scenarios as well as suggest erosion distance based on Leatherman (1990).**

| Climate Change Scenario | Recession in Period (m) | | | |
|---|---|---|---|---|
| | 2020-2055 | | 2020-2105 | |
| | NCERM2 | Leatherman | NCERM2 | Leatherman |
| Present Day (2020 data) | 48 | N/A | 116 | N/A |

| Climate Change Scenario | Recession in Period (m) | | | |
|---|---|---|---|---|
| | 2020-2055 | | 2020-2105 | |
| | NCERM2 | Leatherman | NCERM2 | Leatherman |
| Climate Change (Higher Central RCP 8.5 70th percentile) | 73 | 257 | 233 | 866 |
| Climate Change (Upper End RCP 8.5 95th percentile) | 79 | 326 | 266 | 1,164 |

23. The Leatherman (1990) predictions are shown to be the more conservative than NCERM2 in predicting cliff erosion at the landfall site at Skipsea. Therefore, a review of NCERM2 outputs indicates coastal erosion and cliff setback may be less than outlined in section 8.6 of **Chapter 8 Marine Physical Environment** [APP-080].

# 3 Environment Agency Responses

24. The Environment Agency comments (issued by email to the Applicants on 23rd August 2024) relate specifically to the coastal erosion analysis presented in **Chapter 8 Marine Physical Environment** [APP-080] (see **Appendix A –Environment Agency's Marine Physical Environment Queries** for a copy of the EA's original request for further information). A summary of their comments is presented below:

- Has the Leatherman equation used in the prediction of cliff erosion rates been validated elsewhere?
- Are there any other places/methods which show a five-fold increase in erosion rate within 10 years?
- Why is the historic erosion rate (1852-1989) higher than the most recent rate (1989-2023)?
- In Table 8-20 why is the 20-year rate lower than the 10-year rate for all locations?

## 3.1 Leatherman Equation Comment

25. The Environment Agency comment reads:

- *(The EA) would like some more information on the coastal erosion rates they are planning on using Leatherman equation - has this been validated in any other part of the world or a coast similar to the Holderness? Are there any other places/methods which show a five-fold increase in erosion rate within 10 years?*

## 3.2 Leatherman Equation Response

26. The estimation of the future shoreline along Holderness is complex, due to the stochastic nature of cliff erosion, which is apparent from irregular cliff lines and the observation data that records losses up to 10m within a single year. The most widely used models to forecast cliff-top erosion are empirical and use historical trend analysis from a knowledge of historic cliff erosion rates (Leatherman, 1990; Bray and Hooke, 1997; Lee and Clark, 2002; Lee 2012, 2014; Gorokhovich and Leiserowiz, 2012; Castedo *et al.*, 2015, 2017). Two methods of historical trend analysis have typically been adopted to predict future cliff erosion:

- Direct extrapolation of historic trends into the future without incorporating potential increases due to higher rates of relative sea-level rise (Lee and Clarke, 2002); and
- Forward projection including potential increases to account for higher rates of relative sea-level rise (Leatherman, 1990).

27. Other methods to predict cliff erosion include systems-based models such as the Soft Cliff and Platform Erosion (SCAPE) model (Walkden and Hall, 2005) and Coastal Modelling Environment (CoastalME) model (Payo *et al*., 2018). These systems-based models have not been used, and the forward projection method is preferred, for the following reasons:

- Projection uses a constant (historic erosion) in the method adding a degree of certainty that is not inherent in systems-based models. The systems-based models, whilst considering material strength, and wave and tidal characteristics, do not include historic data in their calculations. Past activity is a better indicator of how a coast will respond to future relative sea-level rise, subaerial forcing and wave action compared to systems-based models.
- Systems-based models are limited by the assignment of a single material strength to a cliff that may have different strengths. Also, they only consider influencing marine processes and do not take account of subaerial drivers of cliff recession, which contribute to mass movement.
- The projection equation is simple and has few uncertain elements, whereas systems-based modelling is more complex with a range of elements that introduce more uncertainty.

28. Although there are limitations and uncertainties with all the possible methods that could be used to estimate future cliff recession rates, the Leatherman method was chosen in this case because the uncertainties inherent in the projection method are smaller than those associated with the other methods. Also, it has been used by Lee (2012, 2014) on similar coasts in the UK.

## 3.3 Erosion Rate Comments

29. The Environment Agency comments read:

- *Are there any other places/methods which show a five-fold increase in erosion rate within 10 years?;* and
- *In Table 8-20 why is the 20-year rate lower than the 10-year rate for all locations?*

## 3.4 Erosion Rate Response

30. After a review of **Chapter 8 Marine Physical Environment** [APP-080], the predicted erosion rates data provided in Table 8-20 using the UKCP18 high emission scenario (RCP8.5) at the 50% confidence level were identified as being incorrect. They are revised here using May 2024 coastal erosion data (provided by ERYC) and the UKCP18 RCP4.5 $50^{th}$ percentile and RCP8.5 $70^{th}$ and $95^{th}$ percentile predictions of sea-level rise (the latter two corresponding with the Environment Agency's Higher Central and Upper End allowances). The methodology and results are presented in section 2.4 of this document, including comparison with NCERM2.

## 3.5 Historic v Recent Erosion Rates Comment

31. The Environment Agency comment reads:

- *Why is the historic erosion rate (1852-1989) higher than the most recent rate (1989-2023) - is it a variation in how the rate is calculated using maps v surveying? It would be expected that the historic rate, when there was less carbon in the atmosphere and a more stable sea level, to be lower than the last 25 years or so, when the sea level rise and associated issues would be more pronounced. Any errors in measurement should be removed if possible before using erroneous data to calculate future recession rate;* and
- *If they combine the most recent and historic rates whole rate as they are proposing, they will need to provide more information on how representative it is. By averaging the rate over the whole time the rate it is higher than the most recent rate, which is good in terms of conservativism in the approach but we will need assurances that it is representative of how the coast is changing in the environment - especially as the historic rates has the longest period of time and so the rate will be weighted to take that more into account*.

## 3.6 Historic v Recent Erosion Rates Response

32. For the reasons stated, cliff erosion rates would typically be higher in more recent times. The 'recent' average erosion rate detailed in Table 8-18 of **Chapter 8 Marine Physical Environment** [APP-080] utilised a date range between 1989 and 2023, which potentially trended the average erosion lower due to average erosion rates pre-2003 being historically lower than rates post-2003. As such, in **Table** 2-1 the original date ranges for the 'historic' and 'recent' average erosion rates have been amended to better reflect the changes in recent erosion rates from the historic values and provide a more representative value for recent average erosion rates.

33. Using the recently provided May 2024 data from ERYC, average erosion rates between 2003 and 2024 are generally higher than those between 1852 and 2003 (profiles 25, 27, 28, 29, and 30) (**Table 2-1**). The historic and recent rates are similar along two profiles (24 and 31). Only one profile (26) shows a significant reduction in average erosion rate. Hence, most of the cliff at the landfall is eroding faster now (last 20 years) than it did for the 150-year period prior to 2003.

# 4 Summary

34. The beach elevation change data presented in **Chapter 8 Marine Physical Environment** [APP-080] has been updated in this note to include data from 2008, 2013, 2018 and 2024. The time series has been compared to assess beach/shore platform elevation change across the intertidal landfall area. The results show:

- Between 2008 and 2013 shows that most of the intertidal area eroded or was relatively stable.
- Between 2013 and 2018, most of the intertidal area accreted with small areas of erosion.
- Between 2018 and 2024, most of the intertidal area was stable.
- Overall, between 2008 and 2024 the elevation of the intertidal area at the landfall has been relatively unchanged.

35. The new information presented here does not affect the conclusions reached in **Chapter 8 Marine Physical Environment** [APP-080] on the impacts and effects of construction and operation at the landfall.

36. The prediction of future cliff erosion presented in **Chapter 8 Marine Physical Environment** [APP-080] has been updated here to consider the 70$^{th}$ and 95$^{th}$ percentile of the RCP 8.5 scenario, and to consider the outputs of the newly released NCERM2.

37. The results show that the use of Leatherman (1990) to predict coastal erosion is a conservative approach when compared to NCERM2, which in itself is conservative as it considered the higher central (RCP8.5 70$^{th}$ percentile) and upper end (RCP8.5 95$^{th}$ percentile climate change scenarios.

38. Considering NCERM2 is published by the Environment Agency, and that is advertised as 'providing the most up to date national picture of coastal erosion risk for England', understanding of cliff retreat rates at the landfall should be informed by this national dataset. Therefore, the predicted cliff retreat distance at the landfall will be between 73 and 79m by 2050 and 233-266m by 2105. This represents a reduction in the values presented in **Chapter 8 Marine Physical Environment** [APP-080] which noted a potential maximum cliff retreat distance at the possible landfall location of 56m over the next 10 years, 110m over the next 20 years, 175m over the next 30 years and 322m over the next 50 years.

39. In this note using historic cliff erosion data up to May 2024, the UKCP18 medium emission scenario (RCP4.5) at the 50% confidence level results show that the landfall cliff will erode 52m over the next 10 years, 109m over the next 20 years, 170m over the next 30 years and 298m over the next 50 years. This represents a reduction to the values presented in the original version of **Chapter 8 Marine Physical Environment** [APP-080], which noted a potential maximum cliff retreat distance at the possible landfall location of 56m over the next 10 years, 110m over the next 20 years, 175m over the next 30 years and 322m over the next 50 years.

# 5 References

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# Appendix A – Environment Agency's Marine Physical Environment Queries

Outlook

## FW: URGENT Dogger Bank South Offshore Wind Farm- further info requested

**From:** [redacted]@environment-agency.gov.uk>
**Sent:** Friday, August 23, 2024 3:16 PM
**To:** Dogger Bank South <dbs@rwe.com>
**Cc:** [redacted]@environment-agency.gov.uk> [redacted]@environment-agency.gov.uk>; [redacted]@environment-agency.gov.uk>; Sustainable Places, Yorkshire <sp-yorkshire@environment-agency.gov.uk>
**Subject:** [EXT] URGENT Dogger Bank South Offshore Wind Farm- further info requested
**Importance:** High



Hello,

I'm contacting you on behalf of other Env Agency colleagues who are presently on leave. I've been forwarded the below email and now seeking your URGENT assistance to gain further information/ clarification ahead of an approaching deadline for written representations.

Would someone be able to assist in replying to me with the requested details between where highlighted?

Apologies if this information has already been requested/ obtained – I'm not involved in this scheme.

Thanks.

[redacted]

**Planning Specialist** - Sustainable Places (Yorkshire)
**Email:** sp-yorkshire@environment-agency.gov.uk
**Environment Agency** | Lateral, 8 City Walk, Leeds, LS11 9AT

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I have gone through the Marine Physical Environment chapter, and I have some concerns about the recession rate and the calculation of the increased rate with sea level rise in this submission and the other ongoing Dogger Bank scheme – which is why [redacted] are copied in.

I would like some more information on the coastal erosion rates they are planning on using Leatherman equation - has this been validated in any other part of the world or a coast similar to the Holderness? Are there any other places/methods which show a five-fold increase in erosion rate within 10 years?

Why is the historic erosion rate (1852-1989) higher than the most recent rate (1989-2023) - is it a variation in how the rate is calculated using maps v surveying? I would expect the historic rate, when there was less carbon in the atmosphere and a more stable sea level, to be lower than the last 25 years or so, when the sea level rise and associated issues would be more pronounced. They need to make sure any errors in measurement are taken out if possible before using erroneous data to calculate future recession rate. If they combine the most recent and historic rates whole rate as they are proposing, they will need to provide more information on how representative it is. By averaging the rate over the whole time the rate it is higher than the most recent rate, which is good in terms of conservativism in the approach but we will need assurances that it is representative of how the coast is changing in the environment - especially as the historic rates has the longest period of time and so the rate will be weighted to take that more into account.

Please could you also ask why in Table 8-20 why is the 20 year rate lower than the 10 year rate for all locations?

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**From** [redacted]@environment-agency.gov.uk>
**Sent:** Thursday, August 8, 2024 5:01 PM
**To:** [redacted]@environment-agency.gov.uk>; [redacted]@environment-agency.gov.uk>; NE Yorkshire Groundwater <NEYorkshireGroundwater@environment-agency.gov.uk>; [redacted]@environment-agency.gov.uk>; L&W Coast, Hull, Esk and Derwent <CHED1@environment-agency.gov.uk>; Yorkshire Waste <YorkshireWaste@environment-agency.gov.uk>; [redacted]@environment-agency.gov.uk>; [redacted]@environment-agency.gov.uk> [redacted]@environment-
**Subject:** ACTION REQUIRED by 30/08: Dogger Bank South Offshore Wind Farm Relevant Representations
**Importance:** High

Good afternoon all,

This is to make you aware of an important consultation we have received which we are required to review.

**DPS Ref: RA/2024/147428/01**
**Cost Code: ENVPAC/1/YOR/00305 – Please record all time spent against this code**

**Project Description**
Dogger Bank South Offshore Wind Farm

The RWE application for the Dogger Bank South (DBS) Offshore Wind Farm Project Development Consent Order has been submitted to and accepted by the Planning Inspectorate. The statutory consultation period has formally commenced and we need to review the proposals in so far as they relate to our remit.

**Project Description**
In summary, the Projects involve construction of two offshore wind farms known as Dogger Bank South East ("DBS East") and Dogger Bank South West ("DBS West"), both located in the North Sea on the Dogger Bank and the associated development to connect the proposed offshore wind farms to the national grid. The Projects would have a combined maximum number of 200 turbines. The offshore array areas for DBS West and DBS East are situated at a minimum of 100km and 122km from shore respectively. The proposed onshore works consist of installation of buried onshore export cables, from a landfall on the East Riding of Yorkshire coastline near Skipsea to (up to) two newly constructed onshore converter stations near the hamlet of Bentley, before onward onshore cable routeing to the proposed Birkhill Wood National Grid substation close to the existing Creyke Beck substation. Further information about the proposed Projects is available at www.doggerbanksouth.co.uk.

All of the consultation documents are on the Planning Inspectorate website Dogger Bank South DCO submission documents (planninginspectorate.gov.uk)

There are a lot of documents and a huge amount of information, so please see the **Application Guide** (attached), which lists all documents submitted to help you focus on the most relevant documents. Links to the documents can be found in the Examination Library (https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010125/EN010125-000619-Dogger%20Bank%20South%20-%20Examination%20Library.pdf)

I suggest that all consultees review the following documents:

- 1.1 Cover letter
- 1.4 Application Guide
- 2.1 Site Location Plan (Offshore)
- 2.2 Site Location Plan (Onshore)
- 3.1 Draft Development Consent Order - this is the drafted consent, it is subject to change as we go through the examination. Specific area of interest includes Schedule 2, part 1, which lists the conditions on the DCO, known as Requirements.
- 3.2 Explanatory memorandum
- 7.1 ES Introduction
- 7.4 Consideration of Alternatives
- 7.5 ES Project Description
- 7.6 EIA Methodology

In addition to these documents you should review the chapters of the Environmental Statement and any other documents that are relevant for you to consider. It is helpful if in your response you are clear about the documents you have reviewed and are referring to.

Please can you review these documents having regard to any comments you made during previous consultations on this project and identify any issues or impacts associated with the project that you feel have yet to be resolved or require further information / work before we can agree to the proposals?

**Consultation Deadline**
Please ensure that you / your team provide your comments either by email or on DPS (if you have access), under DPS reference RA/2024/147428/01. If you do not have access to DPS, please respond via return to this email. Your deadline to respond is **Friday 30th August**. Please try to stick to this. Our final response must be registered with PINS by midnight on 6th September – this is non-negotiable. Speak to me asap if you are struggling. At this stage in the process I would rather have a less detailed response but on time, than one which is late.

*Please note this is a statutory consultation and following changes to legislation we now recover all costs for work on NSIPS, therefore please record all time against:* **ENVPAC/1/YOR/00305**

If you have any questions, please contact me asap. Please be aware, I am on leave from 15th August until 3rd September. If you have any queries in this time please email our team inbox sp-yorkshire@environment-agency.gov.uk.

Many thanks

[redacted]
Planning Specialist - Sustainable Places (Yorkshire)
**Environment Agency** | Foss House, Kings Pool, Peasholme Green, York, YO1 7PX

Email : [redacted]@environment-agency.gov.uk
Team email : sp-yorkshire@environment-agency.gov.uk
External: [redacted]
Mobile: [redacted]

Working days: Monday to Thursday (Tuesday-Friday from September)

Pronouns: he/him (why is this here?)

Creating a better place for people and wildlife

RWE Renewables UK Dogger Bank
South (West) Limited

RWE Renewables UK Dogger Bank
South (East) Limited

Windmill Business Park
Whitehill Way
Swindon
Wiltshire, SN5 6PB