APPENDIX UES13-1

UPDATED HUMBER EXTREME WATER LEVELS

ABLE MARINE ENERGY PARK
(Material Change 2 – TR030006)

Humber Extreme Water Levels (2020)

Version 2, 18th February 2021

Headline

Extreme still water levels have been produced as part of the Humber 2100+ project. This information is now available to inform wider flood risk management work around the Humber estuary and on its tidal tributaries.

Background

New water level data was due to be produced by the Humber Extreme Water Levels (HEWL) project. However, due to overwhelming challenges with the HEWL methodology, this task was incorporated into the Humber 2100+ project in 2019.

Humber 2100+ is developing a new Strategy that will redefine the approach to tidal flood risk management on the Humber for the next 100 years.

The Humber 2100+ study area covers the whole Humber estuary plus the lower reaches of the rivers Ouse, Aire, Don and Trent, as illustrated in Figure 1. Extreme water levels have been produced for this entire area.

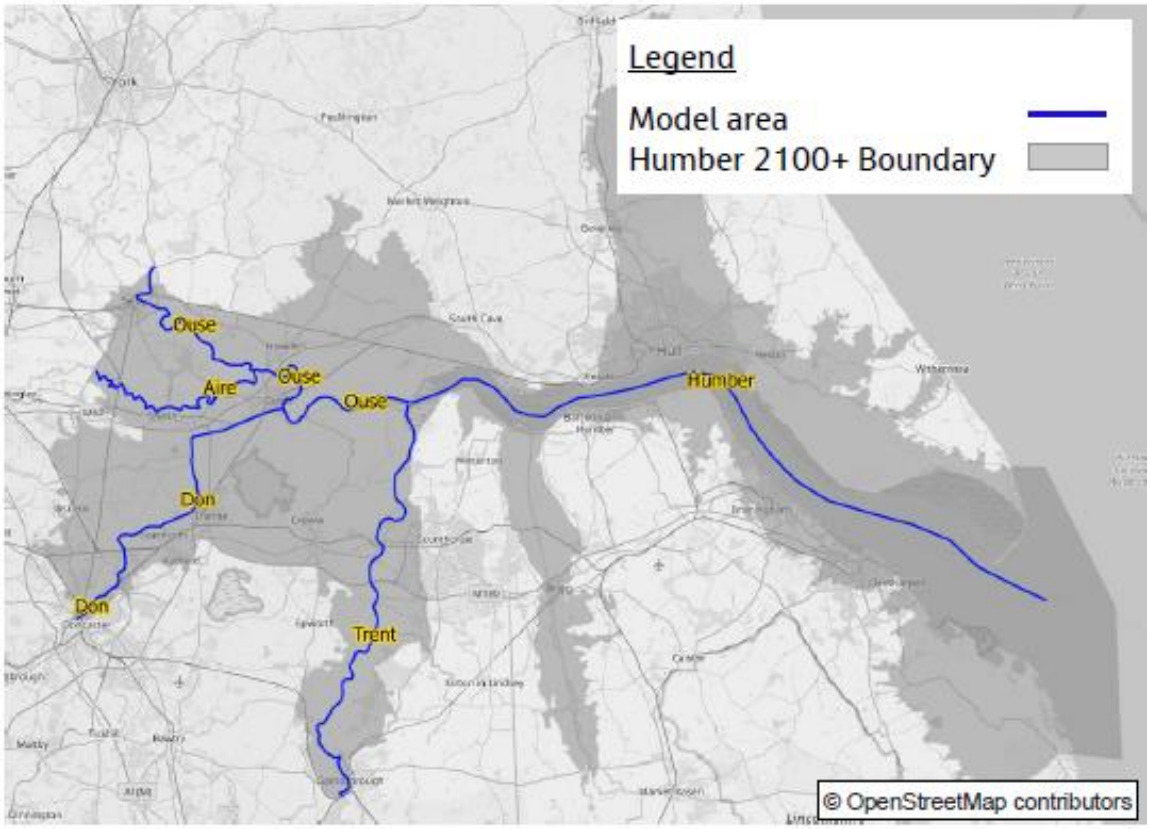


Figure 1: Humber 2100+ study area and modelled reach

Modelling Approach

The Humber extreme water levels have been produced using a joint probability modelling approach, which considers the interaction between fluvial and tidal conditions.

Joint probability modelling has been undertaken in line with Defra/Environment Agency FD2308 technical guidance[1]. In short, this process involves a tidal/fluvial dependency analysis which is used to generate joint probability scenarios for the full range of annual exceedance probability (AEP) events. These are then run through a hydraulic model and maximum water levels extracted at each location for each AEP.

The work has been undertaken using the Humber 1D Flood Modeller Pro (FMP) model. Developed by the Humber 2100+ project, this model was constructed from existing Environment Agency models. The 2018 Coastal Flood Boundary (CFB18) data has been used as the basis for the modelled downstream boundary conditions, with sea level rise also applied (see below for more details). The model has been calibrated to multiple extreme fluvial and tidal events, including the December 2013 tidal surge event, and updated to represent a 2021 baseline.

The Humber extreme water levels have been produced using a 2021 baseline. This includes the representation of;

- Projected climate change (sea level rise and fluvial flow uplifts) in line with the latest guidance[2]
- Schemes due for completion by 2021 at the time that extreme water modelling was undertaken[3]

Technical modelling reports relating to the development of the Humber 1D FMP model and the production of the Humber extreme water levels can be obtained by contacting the Environment Agency Humber Strategy team.

Scenarios and Epochs

The Humber extreme water levels are available for the following scenarios;

AEP (%)	**50**	**20**	**10**	**5**	**2**	**1.33**	**1**	**0.5**	**0.2**	**0.1**
Scenario (years)	2	5	10	20	50	75	100	200	500	1000

Table 1: AEPs for which the Humber extreme water levels are available

In addition to present-day extreme water levels, information has also been produced for several future epochs;

19 years	**25 years**	**50 years**	**100 years**
2040	2046	2071	2121

Table 2: Epochs for which the Humber extreme water levels are available

[1] Following a review of FD2308, this is no longer considered to be best practice when undertaking joint probability. However, at the time of writing, updated guidance on best practice has not been published.

[2] *Flood and coastal risk projects, schemes and strategies: climate change allowances* https://www.gov.uk/guidance/flood-and-coastal-risk-projects-schemes-and-strategies-climate-change-allowances

[3] Changes to scheme delivery programmes may mean that some ongoing schemes are not actually delivered by 2021 (e.g. Outstrays to Skeffling managed realignment scheme, now due for completion in 2023/24).

Note that extreme water levels have been produced for the 19-year epoch (2040) to support projects looking to calculate OMs in line with the latest Environment Agency Partnership Funding guidance (published November 2020).

Climate Change

Sea level rise and peak river flow uplifts have been calculated based on Environment Agency climate change guidance[2] (published July 2020). UK Climate Projections 2018 (UKCP18) have been used where applicable for sea level rise. At the time of writing, peak river flow allowances and the H++ scenario have not been updated based on UKCP18; however, it is acknowledged that updated guidance is expected to be published in 2021. Users of the Humber extreme water levels are therefore advised to consult the latest climate change guidance available at the time and undertake further checks where necessary.

The main Humber extreme water levels dataset has been produced using a high climate change scenario, defined using the Upper End allowances. Water levels have also been produced in line with a medium (Higher Central) and a more extreme (H++) scenario. Table 3 provides more detail on how each climate change scenario has been modelled.

	2021	2040	2046	2071	2121
Medium (M) Higher Central	0.02m SLR +15% flows	0.14m SLR +20% flows	0.19m SLR +20% flows	0.42m SLR +30% flows	1.02m SLR +30% flows
High (H) Upper End	0.03 SLR +20% flows	0.18m SLR +30% flows	0.23m SLR +30% flows	0.54m SLR +50% flows	1.38m SLR +50% flows
Extreme (HPP) H++	0.03 SLR +20% flows	0.28m SLR +35% flows	0.37m SLR +35% flows	0.97m SLR +65% flows	2.64m SLR +65% flows

Table 3: Climate change scenarios

Limitations

When using the Humber extreme water levels, it is important to be aware of the following key limitations and uncertainties;

- The accuracy of this information is dependent upon of the accuracy of the underlying data. The Humber extreme water levels have been produced based on the best available data at the time; however, they should be reviewed when new data becomes available, particularly regarding climate change, coastal flood boundaries, fluvial hydrology, joint probability methods or defence heights.
- Only main river inflows to the Humber (i.e. Ouse, Aire, Don and Trent) have been considered; smaller tributaries with control structures are assumed to be hydraulically isolated and are not accounted for.
- The modelling approach could be seen as slightly conservative as it assumes the worst case scenario of rivers concurrently attaining their highest marginal flows.
- Extreme water levels are available for in-channel areas only; floodplain water levels have not been produced. However, the modelling has accounted for floodplain losses and the subsequent impact on in-channel water levels.
- The 1D FMP model provides a single water level output per modelled cross-section. Therefore variations in water levels between the north and south bank of the Humber estuary (as observed during the December 2013 tidal surge event) are not replicated.
- The impact of existing floodplain storage in upstream washlands has not been accounted for. Extreme water levels for future epochs could therefore potentially be overestimated.

- The Humber extreme water levels are still water levels only and do not take account of wave action. Humber 2100+ is however developing an updated extreme waves dataset that will be available for use by the wider business. This work does not constitute new wave modelling; rather it aligns existing wave datasets from several different sources. At the time of writing, this work is not yet complete.

Data Application

The Humber extreme water levels provide an update to the water level profile for the Humber estuary and its tidal tributaries. This means that in some locations, the 'best available' water level data has changed.

The Humber extreme water levels have been compared in detail to existing water level datasets to understand the similarities/differences. The final decision on how these datasets will be applied going forward to define the water level profile has been made jointly by the Humber Strategy team and relevant Area teams, with support from Evidence and Risk.

The sections below outline, for each part of the Humber;

- how the Humber extreme water levels should be used alongside other datasets to define the water level profile
- how the Humber extreme water levels compare to the outputs of previous studies

Figure 2 shows the spatial extent over which the Humber extreme water levels should be used to define the water level profile and where the transition to other datasets occurs.

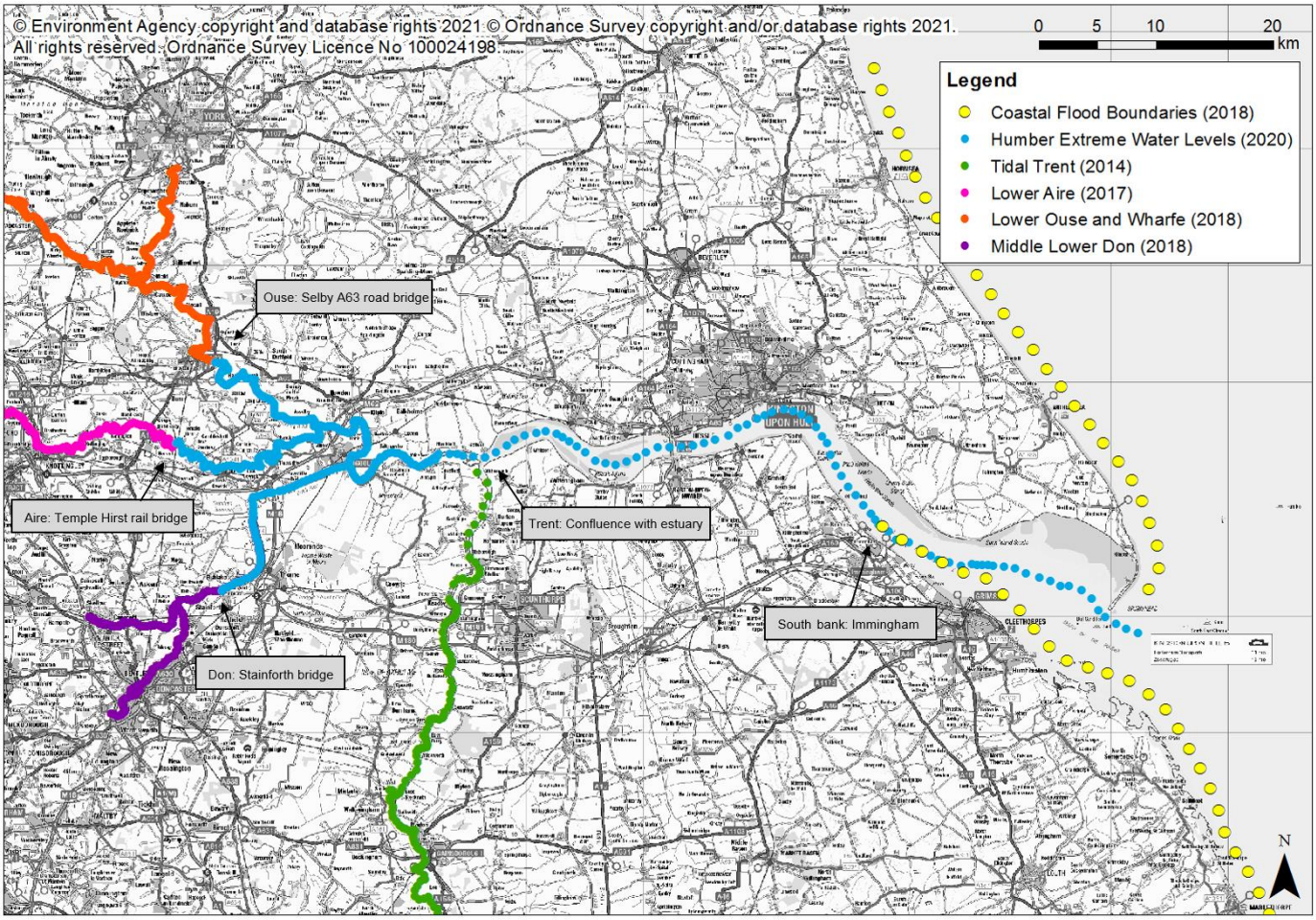


Figure 2: Datasets used to define the water level profile on the Humber estuary and its tidal tributaries

Humber Estuary

The Humber extreme water levels should be used to define the water level profile for the main Humber estuary.

- **In Yorkshire** *(i.e. on the north bank of the estuary), the Humber extreme water levels should be used between Trent Falls and the North Sea. This approach supersedes the use of the 2014 Interim Water Levels for the whole of the estuary.*
- **In Lincolnshire** *(i.e. on the south bank of the estuary), the Humber extreme water levels should be used between Trent Falls and Immingham. This approach supersedes the use of the 2014 Interim Water Levels in this part of the estuary. Between Immingham to the North Sea, the water levels will continue to be defined by CFB18.*

In the inner estuary, the Humber extreme water levels are generally lower than the Interim Water Levels (by up to 0.23m) for events up to and including 1% AEP, but slightly higher (by up to 0.11m) for greater magnitude events. In the middle estuary, and also at Goole, the Humber extreme water levels are lower than the Interim Water Levels, by up to 0.29m. In the outer estuary, the Humber extreme water levels are also generally lower than the Interim Water Levels, though to a lesser degree.

The Humber extreme water levels provide an improved dataset for the main Humber estuary because they are based on more robust methods compared to the Interim Water Levels. In particular, the Humber extreme water level modelling has used the latest tidal information, allowed for bank overtopping and taken account of fluvial conditions, which the Interim Water Levels did not.

Note that other datasets used to support planning decisions and guidance on the Humber estuary, such as breach and impact modelling data for the North and South banks, remain relevant and should still be used where applicable alongside the Humber extreme water levels.

River Ouse

The Humber extreme water levels should be used to define the water level profile for the River Ouse between the A63 road bridge at Selby and Trent Falls. This approach supersedes the previous use of the 2016 Upper Humber water level outputs along this reach. Upstream of the A63 road bridge at Selby, the water level profile continues to be defined by the 2018 Lower Ouse and Wharfe outputs.

The Humber extreme water levels are largely similar to the Upper Humber water levels on the tidal River Ouse. In general, the Humber extreme water levels are slightly lower than the Upper Humber water levels downstream of Selby. However, this difference is generally minimal (i.e. 0.10m or less) for events above and including 1.33% AEP. This pattern changes at Selby where the Humber extreme water levels become consistently higher than the Upper Humber water levels for all events, particularly for lower magnitude events. This difference is thought to be the result of (1) a more significant hydraulic 'jump' at Selby bridges than modelled by previous studies, and (2) the representation of fluvial climate change in the present-day modelling. The Humber extreme water levels provide an improved dataset to define the tidal River Ouse water level profile because the modelling has used the latest information relating to Humber estuary defence heights, coastal flood boundaries and climate change.

At the A63 road bridge at Selby, the Humber extreme water levels are consistently lower than the Lower Ouse and Wharfe water levels. The transition between the two datasets therefore creates a 'jump' in the water level profile of between 0.08m and 0.39m. Further details are provided in Appendix A.

It is anticipated that the Lower Ouse and Wharfe model will be rerun with new downstream boundary conditions defined by the Humber extreme water levels to update the water level profile further upstream, or else a sensitivity analysis undertaken.

River Aire

The Humber extreme water levels should be used to define the water level profile for the River Aire between Temple Hirst railway bridge and the confluence with the River Ouse. This approach supersedes the previous use of the 2016 Upper Humber water level outputs along this reach. Upstream of the Temple Hirst railway bridge, the water level profile continues to be defined by the 2017 Lower Aire outputs.

The Humber extreme water levels are largely similar to the Upper Humber water levels on the tidal River Aire. In general, the Humber extreme water levels are slightly lower than the Upper Humber water levels in most locations. However, the difference is generally minimal, averaging 0.02m across the equivalent events available for comparison. The Humber extreme water levels provide an improved dataset to define the tidal River Aire water level profile because the modelling has used the latest information relating to Humber estuary defence heights, coastal flood boundaries and climate change.

At the Temple Hirst railway bridge, the Humber extreme water levels are consistently lower than the Lower Aire water levels. The transition between the two datasets therefore creates a 'jump' in the water level profile of between 0.14m and 0.49m. Further details are provided in Appendix A.

River Don

The Humber extreme water levels should be used to define the water level profile for the River Don between Stainforth Bridge and the confluence with the River Ouse. This approach supersedes the previous use of the water level outputs from the 2016 Upper Humber and 2018 Middle Lower Don studies along this reach. Upstream of the Stainforth Bridge, the water level profile continues to be defined by the 2018 Middle Lower Don outputs.

The Humber extreme water levels are generally higher than the Middle Lower Don water levels. However, this difference varies significantly depending on the event magnitude. For example, the average difference is 1.01m for the 50% AEP event but only 0.09m for the 0.1% AEP event. This difference is likely to primarily be a result of the Humber extreme water levels being based on a joint probability approach whilst the Middle Lower Don study focused on fluvial risk. Other differences in modelling approaches, such as the representation of boundary conditions, and the calibration of the Humber 1D FMP model to the most recent flood event (November 2019) may also be contributing factors. The Humber extreme water levels provide an improved dataset to define the tidal River Don water level profile because they take account of (1) both fluvial and tidal conditions and (2) flooding in November 2019. Also, the modelling has used the latest information relating to Humber estuary and River Don defence heights (including the Fishlake recovery works), coastal flood boundaries and climate change.

The Humber extreme water levels are also generally higher than the Upper Humber water levels and, like the Middle Lower Don results, most significantly so for the lower AEP events. However, the difference between the two datasets is less extreme than for the Middle Lower Don, averaging between 0.00m and 0.35m across all comparable AEP events for the reach downstream of the River Went where the Upper Humber water levels were previously used on the River Don. The Humber extreme water levels provide an improved dataset to define the tidal River Don water level profile because the modelling has used the latest information relating to Humber estuary defence heights, coastal flood boundaries and climate change.

Stainforth Bridge marks the most upstream point where the Humber extreme water levels are tidally dominated or defined by a joint probability scenario. The transition between the Humber extreme water levels and Middle Lower Don water levels at Stainforth Bridge will create a 'jump' in the water level profile of between 0.03m and 0.91m. Further details are provided in Appendix A.

River Trent

The Humber extreme water levels will shortly be used to update downstream boundary conditions in the Tidal Trent model and the model will be rerun to derive a new water level profile for the River Trent

between Winthorpe Bridge and Trent Falls. Outputs are expected in late 2021 and will supersede the existing 2014 Tidal Trent water level outputs. In the meantime, this data remains the best available information to define the River Trent water level profile (and floodplain information). Urgent studies progressing ahead of the Tidal Trent model rerun may wish to consider the Humber extreme water levels for sensitivity purposes.

The Humber extreme water levels are largely similar to the existing Tidal Trent water levels downstream of West Stockwith. For this reach, the Humber extreme water levels tend to be lower than the Tidal Trent water levels for lower magnitude events (up to and including 2% AEP) but are generally higher than the Tidal Trent water levels for higher magnitude events. For events up to and including 1% AEP, the difference between the datasets is generally less than 0.2m. For higher magnitude events, this difference does increase, with the Humber extreme water levels being up to 0.5m higher in some locations in the 0.1% AEP event. Between West Stockwith and Gainsborough, the Humber extreme water levels are higher than the Tidal Trent water levels for most events and the difference is more significant than further downstream, reaching above 1.00m for the 0.1% AEP event. This difference is likely due to this reach being fluvially dominated.

Currently, the tidal River Trent water level profile is based on modelling that used the 2014 Interim Water levels to define the downstream boundary conditions. Rerunning the Tidal Trent model with an updated downstream boundary based on the Humber extreme water levels is therefore considered to provide an improved and more robust water level profile. This is because the Humber extreme water level modelling has used the latest tidal information, allowed for bank overtopping and taken account of fluvial conditions, which the Interim Water Levels did not.

Floodplain Mapping

The Humber extreme water level data provides an in-bank water level profile only; no new information regarding water depths and/or flows routes on the floodplain is available.

Floodplain mapping information is typically updated when new evidence becomes available. However, in some areas around the Humber, the new Humber extreme water levels may not mean significant changes on the floodplain. Where it is necessary to update floodplain mapping information, Area teams are advised to consider the range of options available to do so; not all will require rerunning existing models. Modelling projects that are being planned should consider the opportunity to update floodplain mapping information.

Contact Us

Have you got further questions about the Humber extreme water levels?

For more information, please contact the Environment Agency Humber Strategy team at HStrategy@environment-agency.gov.uk

Appendix A

Below are details of the 'jump' in the water level profile on each of the Yorkshire tidal rivers (Ouse, Aire and Don) caused by the transition between the Humber extreme water levels and other data sources further upstream.

Note that the approach taken to define the water level profile on the River Trent (i.e. using the Humber extreme water levels to update and rerun the Tidal Trent model) means that there is no 'jump' on this watercourse.

River Ouse

Table A.1 shows the 'jump' in the water level profile between the Humber extreme water levels and the Lower Ouse and Wharfe (LOW) modelled water levels at the A63 road bridge at Selby.

The model nodes that have been compared are; CS33i in the Humber model (grid reference: 463526, 431682) and OUSE01_00013 in the Lower Ouse and Wharfe model (grid reference: 463515, 431682).

The difference has been calculated by subtracting the Lower Ouse and Wharfe water levels from the Humber water levels; this shows the 'jump' moving in an upstream direction.

AEP	50%	20%	10%	5%	2%	1.33%	1%	0.5%	0.2%	0.1%
Humber	5.92	5.94	6.01	6.14	6.17	6.28	6.30	6.33	6.35	6.36
LOW	6.31	6.33	6.34	6.35	6.36	6.38	6.38	6.43	6.44	6.45
Difference	-0.39	-0.39	-0.33	-0.21	-0.19	-0.1	-0.08	-0.1	-0.09	-0.09

Table A.1: Water level 'jump' per AEP on the River Ouse

River Aire

Table A.2 shows the 'jump' in the water level profile between the Humber extreme water levels and the Lower Aire (L.Aire) modelled water levels the Temple Hirst railway bridge.

The model nodes that have been compared are; 026705000581D in the Humber model (grid reference: 460220, 424742) and 02670500285 in the Lower Aire model (grid reference: 460034, 424593).

The difference has been calculated by subtracting the Lower Aire water levels from the Humber extreme water levels; this shows the 'jump' moving in an upstream direction.

AEP	50%	20%	10%	5%	2%	1.33%	1%	0.5%	0.1%
Humber	7.06	7.06	7.06	7.07	7.09	7.11	7.16	7.28	7.53
L.Aire	7.37	7.37	7.37	7.37	7.38	7.40	7.41	7.42	8.02
Difference	-0.31	-0.31	-0.31	-0.3	-0.29	-0.29	-0.25	-0.14	-0.49

Table A.2: Water level 'jump' per AEP on the River Aire

River Don

Table A.3 shows the 'jump' in the water level profile between the Humber extreme water levels and the Middle Lower Don (MLD) modelled water levels Stainforth Bridge.

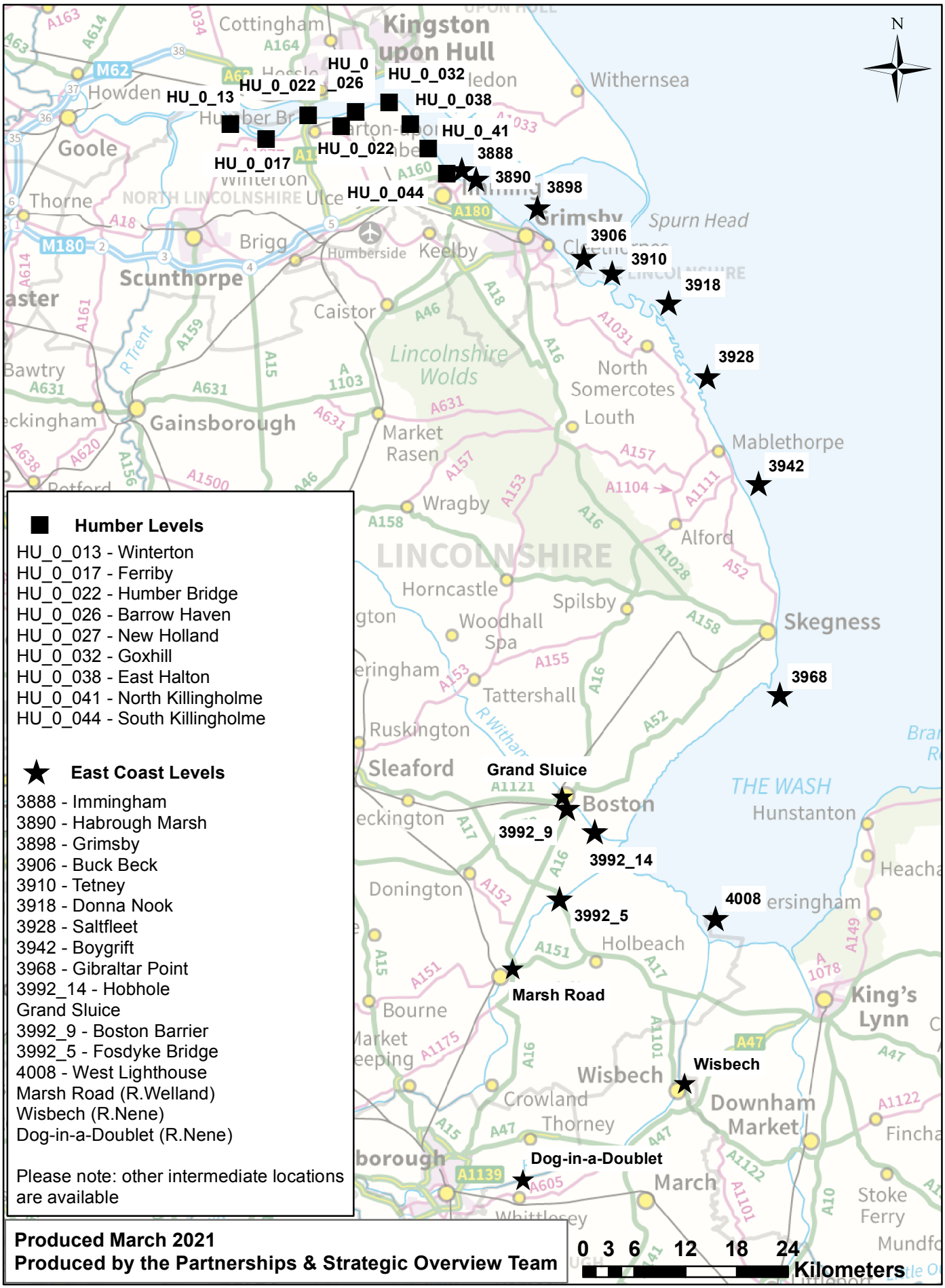
The model nodes that have been compared are; DON00_18858d in the Humber model (grid reference: 464098, 412118) and DON00_18858u in the Middle Lower Don model (grid reference: 464082, 412113).

The difference has been calculated by subtracting the Middle Lower Don water levels from the Humber water levels; this shows the 'jump' moving in an upstream direction.

AEP	50%	10%	5%	2%	1.33%	1%	0.5%	0.1%
Humber	6.59	7.02	7.02	7.02	7.04	7.04	7.04	7.05
MLD	5.68	6.47	6.93	7.05	7.14	7.18	7.21	7.23
Difference	0.91	0.55	0.09	-0.03	-0.1	-0.14	-0.17	-0.18

Table A.3: Water level 'jump' per AEP on the River Don

Tidal Level Location Map
Lincolnshire & Northamptonshire Area



Humber Levels

HU_0_013 - Winterton
HU_0_017 - Ferriby
HU_0_022 - Humber Bridge
HU_0_026 - Barrow Haven
HU_0_027 - New Holland
HU_0_032 - Goxhill
HU_0_038 - East Halton
HU_0_041 - North Killingholme
HU_0_044 - South Killingholme

East Coast Levels

3888 - Immingham
3890 - Habrough Marsh
3898 - Grimsby
3906 - Buck Beck
3910 - Tetney
3918 - Donna Nook
3928 - Saltfleet
3942 - Boygrift
3968 - Gibraltar Point
3992_14 - Hobhole
Grand Sluice
3992_9 - Boston Barrier
3992_5 - Fosdyke Bridge
4008 - West Lighthouse
Marsh Road (R.Welland)
Wisbech (R.Nene)
Dog-in-a-Doublet (R.Nene)

Please note: other intermediate locations are available

Produced March 2021
Produced by the Partnerships & Strategic Overview Team

Humber Estuary

2021 Water Level Profile

Ref	Location	X	Y	Annual Chance (1 in x) of Tide Level (metres ODN)																							
				2021						2046						2071						2121					
				2	10	50	100	200	1000	2	10	50	100	200	1000	2	10	50	100	200	1000	2	10	50	100	200	1000
HU_0_013	**Winterton**	494381	424469	5.00	5.26	5.56	5.70	5.87	6.09	5.18	5.44	5.73	5.85	5.99	6.19	5.42	5.68	5.92	6.02	6.14	6.30	5.97	6.13	6.27	6.33	6.40	6.51
HU_0_017	**Ferriby**	497698	422893	4.95	5.21	5.50	5.64	5.81	6.06	5.12	5.39	5.67	5.80	5.94	6.16	5.37	5.62	5.88	5.98	6.10	6.29	5.93	6.10	6.27	6.34	6.41	6.54
HU_0_022	**Humber Bridge**	502336	424388	4.83	5.10	5.39	5.52	5.69	5.96	5.01	5.28	5.56	5.69	5.84	6.08	5.26	5.51	5.78	5.88	6.01	6.22	5.83	6.02	6.20	6.28	6.36	6.54
HU_0_026	**Barrow Haven**	506176	425059	4.72	4.98	5.28	5.41	5.58	5.86	4.90	5.16	5.45	5.58	5.73	5.99	5.14	5.40	5.68	5.79	5.92	6.14	5.73	5.94	6.13	6.21	6.30	6.48
HU_0_027	**New Holland**	507322	425442	4.69	4.96	5.25	5.39	5.56	5.84	4.87	5.14	5.43	5.56	5.71	5.97	5.12	5.38	5.65	5.77	5.90	6.13	5.71	5.92	6.12	6.20	6.29	6.47
HU_0_032	**Goxhill**	512120	427621	4.57	4.84	5.13	5.26	5.43	5.73	4.75	5.02	5.31	5.44	5.59	5.87	5.00	5.26	5.54	5.66	5.80	6.05	5.60	5.82	6.04	6.13	6.22	6.40
HU_0_038	**East Halton**	516057	423749	4.43	4.70	4.99	5.12	5.28	5.59	4.61	4.87	5.16	5.29	5.45	5.75	4.85	5.11	5.40	5.52	5.66	5.94	5.46	5.70	5.94	6.04	6.14	6.35
HU_0_041	**North Killingholme**	517581	421056	4.38	4.63	4.92	5.05	5.21	5.53	4.55	4.81	5.10	5.23	5.38	5.69	4.79	5.05	5.33	5.46	5.61	5.90	5.40	5.65	5.90	6.00	6.11	6.33
HU_0_044	**South Killingholme**	519538	418746	4.32	4.58	4.86	4.99	5.15	5.47	4.50	4.75	5.04	5.16	5.32	5.63	4.73	4.99	5.27	5.40	5.54	5.84	5.34	5.59	5.85	5.95	6.08	6.30
For **Immingham** and downstream refer to east coast levels page																											

NOTE:

- The base date for the data is 2021.
- Models are based on current defence configuration (i.e. Location and heights)
- Model includes projected climate change (sea level and fluvial flow uplifts) in line with UKCP18 guidance.
- Intermediate locations are available.
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- Levels for other annual chance probabilities are available if required.
- *The levels for Immingham are taken from the 2018 Coastal Flood Boundary dataset.

Customer services line: 03708 506 506
Calls to 03 numbers cost the same as calls to standard geographic numbers
(i.e. numbers beginning with 01 or 02)

Email: enquiries@environment-agency.gov.uk
www.gov.uk/environment-agency

East Coast and Wash: Immingham to the West Lighthouse

2018 Coastal Flood Boundary Extreme Sea Levels

CFB Ref	Location	Easting	Northing	Annual Chance (1 in x) of Tide Level in metres ODN																		
				1			10			50			100			200			300			1000		
				Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound			Confidence Bound		
				2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
3888	**Immingham**	520440	417625	4.16	4.17	4.19	4.50	4.53	4.62	4.73	4.80	5.00	4.83	4.93	5.19	4.93	5.06	5.41	4.98	5.14	5.55	5.15	5.38	6.01
3890	**Haborough Marsh**	522100	416512	4.14	4.15	4.17	4.48	4.51	4.60	4.70	4.77	4.97	4.80	4.90	5.16	4.90	5.03	5.38	4.94	5.10	5.51	5.11	5.34	5.97
3898	**Grimsby**	529295	413162	3.98	3.99	4.01	4.31	4.34	4.43	4.53	4.60	4.80	4.61	4.71	4.97	4.71	4.84	5.19	4.74	4.90	5.31	4.88	5.11	5.74
3906	**Buck Beck**	534709	407369	3.87	3.88	3.90	4.19	4.23	4.31	4.41	4.50	4.68	4.50	4.61	4.86	4.61	4.75	5.10	4.64	4.82	5.22	4.80	5.05	5.66
3910	**Tetney**	538035	405537	3.85	3.86	3.89	4.17	4.22	4.30	4.40	4.50	4.67	4.49	4.61	4.86	4.60	4.75	5.10	4.63	4.82	5.21	4.80	5.06	5.66
3918	**Donna Nook**	544641	401997	3.82	3.83	3.86	4.14	4.19	4.27	4.38	4.48	4.65	4.47	4.60	4.85	4.58	4.74	5.10	4.63	4.82	5.22	4.81	5.08	5.68
3928	**Saltfleet**	549131	393360	3.78	3.79	3.82	4.11	4.16	4.26	4.36	4.46	4.64	4.47	4.59	4.86	4.57	4.74	5.11	4.63	4.83	5.25	4.83	5.11	5.74
3942	**Boygrift**	555131	380860	3.72	3.74	3.77	4.06	4.11	4.22	4.33	4.43	4.65	4.43	4.57	4.87	4.56	4.73	5.13	4.62	4.83	5.28	4.85	5.15	5.82
3968	**Gibraltar Point**	557652	356181	4.16	4.17	4.20	4.51	4.56	4.67	4.76	4.85	5.08	4.85	4.97	5.27	4.94	5.10	5.49	4.99	5.18	5.63	5.14	5.41	6.09
3992_14	**Hobhole**	535990	340116	4.96	4.97	5.01	5.40	5.44	5.56	5.66	5.76	5.98	5.78	5.90	6.20	5.88	6.04	6.44	5.92	6.11	6.57	6.03	6.31	6.99
	Grand Sluice*	532366	344510	4.93	4.94	4.98	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
3992_9	**Boston Barrier**	532754	342852	4.93	4.94	4.98	5.41	5.45	5.57	5.73	5.83	6.05	5.85	5.97	6.27	5.93	6.09	6.49	5.94	6.13	6.59	5.98	6.26	6.94
3992_5	**Fosdyke Bridge**	531886	332234	4.87	4.88	4.92	5.31	5.35	5.47	5.58	5.68	5.90	5.71	5.83	6.13	5.82	5.98	6.38	5.87	6.06	6.52	6.01	6.29	6.97
4008	**West Lighthouse**	550094	329971	4.87	4.88	4.91	5.21	5.26	5.37	5.46	5.56	5.78	5.56	5.68	5.98	5.66	5.82	6.21	5.71	5.90	6.35	5.86	6.14	6.81
-	**Marsh Road**	525988	324065	-	5.04	-	-	5.44	-	-	5.73	-	-	5.85	-	-	5.98	-	-	-	-	-	-	-
-	**Wisbech**	546110	309940	-	4.83	-	-	5.25	-	-	5.53	-	-	5.66	-	-	5.78	-	-	-	-	-	-	-
-	**Dog-in-a-Doublet**	527200	299287	-	3.67	-	-	4.00	-	-	4.22	-	-	4.32	-	-	4.42	-	-	-	-	-	-	-

See next page for notes

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East Coast and Wash: Immingham to the West Lighthouse

2018 Coastal Flood Boundary Extreme Sea Levels

NOTES:

The following notes apply to all CFB sites (ie all on table excluding Marsh Road, Wisbech, Dog-in-a-Doublet)

- The base date for the data is 2017.
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- Levels for other annual chance probabilities are available if required.
- For additional information relating to the 2018 Coastal Flood Boundary Extreme Sea Levels or to access the full dataset for the above sites or intermediate locations refer to the Defra Metadata Catalogue at https://deframetadata.com/geonetwork/srv/eng/catalog.search#/metadata/84a5c7c0-d465-11e4-b0bd-f0def148f590

The following notes apply to all Marsh Road, Wisbech, Dog-in-a-Doublet

- The base date for the data is 2006
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- Levels for other annual chance probabilities are available if required.
- These levels will be updated as their respective tidal river models are updated.

The following notes apply to Grand Sluice

- The data is based on CFB 2018 data for Boston Barrier site, capped at 5.3mAOD to reflect use of the barrier.
- The base date for the data is 2017
- The levels are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- For additional information relating to the 2018 Coastal Flood Boundary Extreme Sea Levels or to access the full dataset for the above sites or intermediate locations refer to the Defra Metadata Catalogue at https://deframetadata.com/geonetwork/srv/eng/catalog.search#/metadata/84a5c7c0-d465-11e4-b0bd-f0def148f590

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Daniel Watson

Subject: FW: Updated Humber Water Levels
Attachments: Humber EWL User Guidance_FINAL_v2_18022021.pdf; 2021 Tide Levels Map and Tables.pdf

From: Coe, Steven [redacted]@environment-agency.gov.uk>
Sent: 26 March 2021 14:31
To: Richard Cram [redacted]@ableuk.com>
Cc: Hewitson, Annette [redacted]@environment-agency.gov.uk>
Subject: Updated Humber Water Levels

Hi Richard

As discussed I have attached our new data sheet for the updated Humber water levels. I can confirm that the datasheet has used the Higher Central climate change allowances (70th percentile).

The briefing note produced as part of the modelling is attached. Please note that this does refer to the main dataset having used the Upper End allowances but these are not what is shown on the datasheet.

To confirm the levels are presented in the following table in mODN:

Reference	Location	0.5% AEP Higher Central	0.5% Upper End
HU_0_041	North Killingholme	6.11	6.35
HU_0_044	South Killingholme	6.08	6.33

Guidance on the use of the climate change allowances recommends that the Higher Central is used as the design allowance and the Upper End can be used to test the sensitivity. Testing the sensitivity is important as it will help inform potential future impacts as climate change allowances will continue to be revised at key points in the future. So it may be beneficial to do some works now in order to be able to comply with the legal agreement going forwards.

The briefing note also explains that the Humber 2100+ team is developing an updated extreme waves dataset. This will not be new modelling but it will bringing together existing data. The current timetable has this producing outputs in May this year. The Humber strategy modelling work may have produced some wave datasets as part of previous modelling work which I am seeking more information on.

Regards
Steve

Steven Coe MSc MCIWEM
Flood and Coastal Risk Management Advisor
South Humber and East Coast Partnerships and Strategic Overview Team
Lincolnshire and Northamptonshire Area
Environment Agency | Ceres House, Searby Road, Lincoln, LN2 4DW
[redacted]@environment-agency.gov.uk
External: [redacted] | Mobile: [redacted]