crew

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Dynamic Coast - National Coastal Change Assessment: Whole Coast Assessment

DANGER
These dunes are very unstable due to coastal erosion
Keep away from top and bottom

National Coastal Change Assessment Steering Committee

Whole Coast Assessment

Dynamic Coast – Scotland's National Coastal Change Assessment

Executive Summary

- The NCCA seeks to address a gap in the national understanding of the resilience and vulnerability of Scotland's coastal assets. No organisation has an overarching view of the past and recent coastal changes affecting the country nor the implications for society's adjacent assets. Whilst some Local Authorities and advisors have a good understanding of some local areas, the lack of consistent national overview hinders strategic assessments and the implementation of numerous national and regional policies by the Scottish Government and its public bodies.

- The NCCA assessment is summarised in 20 reports supported by web-maps that allow public access to the evidence base (dynamiccoast.com) and allow inspection of the underlying data and trends. The NCCA does not take account any future management choices (improving resilience) or accelerating erosion due to climate change (increasing vulnerability).

- The NCCA focused on identifying significant change in Mean High Water Springs (MHWS) greater than 10m or faster than 0.5m/year.

- To provide an indication of assets that could be at risk from more modest levels of erosion or failure of existing artificial structures, a Whole Coast Assessment was carried out to identify all assets sited within set distances (10m and 50m) of the shoreline, irrespective of coastal type (hard & mixed, soft or artificial) and whether these assets are sited within areas that are potentially erodible or not.

- The Whole Coast Assessment shows that within 10m of MHWS, and lying behind coasts that are potentially erodible, there are 332 residential and 245 non-residential properties, 181 septic tanks and 14 utilities, as well as 9 km of railway, 68 km of road and 41 km of clean water pipeline.

- Within 50m of MHWS, and lying behind coasts that are potentially erodible, there are 15,276 residential and 5101 non-residential properties, 769 septic tanks and 184 utilities, as well as 45 community services, 61 km of railway, 590 km of road and 452 km of clean water pipelines and parts of 14 runways.

Contents

1.0 Introduction

The National Coastal Change Assessment has concentrated on the soft or erodible sections of coast, under the assumption that these areas are most vulnerable to coastal erosion and therefore pose the greatest potential risk to society's assets. Unlike other parts of the UK, Scotland's rocky shores are highly resistant to erosion and erode at very slow rates i.e. millimetres per year (May and Hansom, 2003). Faster rates occur on the soft and erodible coast yet changes of less than +/- 10 m may be masked by errors inherent within the mapping datasets, rather than actual coastal change. As a result, the NCCA has focused on the identification of significant change (greater than +/- 10 m or faster than 0.5 m/year). Whilst this is a robust approach the potential exists to omit areas where change occurs yet is more modest. To provide an indication of assets that could be at risk from modest levels of erosion or failure of existing artificial structures, a Whole Coast Assessment was carried out. This identifies all assets within set distances from the coast, irrespective of coastal type (i.e. hard & mixed, soft or artificial). This section of the report outlines the approach taken and the assets found within 50 m and 10 m of the shoreline.

2.0 Methods

To appreciate the distribution and proximity of assets to the shoreline, the asset datasets have been compared against a series of zones measured inland from the MHWS: 50 m and 10 m using a 1:25,000 mapping dataset (Ordnance Survey Vector Map District). The asset dataset used is directly comparable to that used by SEPA within the National Flood Risk Assessment, but has been supplemented with additional road, water network and heritage sites. Each of the asset datasets were intersected with the Coastal Type, derived within the NCCA (see section 5.1) to establish if these assets are located on hard/mixed, soft or artificial shores. The asset datasets were also considered alongside a measure of inherent erodibility of the coastal zone as identified by Fitton *et al* (2016). The whole Coast Assessment here used the Underlying Physical Susceptibility Model (UPSM) to incorporate the ground elevation, rock head altitude (i.e. amount of erodible material above) and wave exposure but does not incorporate the presence of coastal defences, nor coastal proximity (Fitton *et al.,* 2016). As a result, it can be used to identify which assets may be susceptible to erosion in the long term, or if defences fail or are not maintained into the future. Once intersected the number, length and area of assets were compiled and reported.

2.1 Data sources

The data sources for the assets considered are shown in Table 2.1.

Table 2.1:Data sources for the asset data used within the whole coast assessment.

Short Name	Description	Unit of measurement	Precision	Source
Community Services	Community Service Facilities identified within the National Flood Risk Assessment. e.g. Fire Stations.	Number	Central point of the building	SEPA NFRA
Non Residential Property	Non-Residential Properties identified within the National Flood Risk Assessment.	Number	Central point of the building	SEPA NFRA
Residential Property	Residential Properties identified within the National Flood Risk Assessment.	Number	Central point of the building	SEPA NFRA
Scottish Water Septic Water	Location of septic tanks	Number	Location of the tank	Collected by Scottish Water, provided by SG
Utilities	Utilities identified within the National Flood Risk Assessment. E.g. XXXXXXXXXXXX	Number	Central point of the building	SEPA NFRA
Rail	Railway lines identified within the National Flood Risk Assessment.	Length in km	Central line of the railway	SEPA NFRA
Roads	Roads identified within the National Flood Risk Assessment, supplemented by additional minor roads.	Length in km	Central line of the road	SEPA supplemented with OS
Scottish Water Clean Water	Distribution of the clean water distribution network	Length in km	Central line of the water pipe route	Collected by Scottish Water, provided by SG
Runway	Extent of airport runway and taxi areas.	Number	Extent of the mapped area	SEPA NFRA
Cultural Heritage	A selection of cultural heritage interests identified within the National Flood Risk Assessment.	Area in Hectares	Extent of the designated sites.	SEPA NFRA

Short Name	Description	Unit of measurement	Precision	Source
Environment	A selection of natural heritage interests identified within the National Flood Risk Assessment.	Area in Hectares	Extent of the designated sites.	SEPA NFRA
SEPA 200yr	The anticipated still water flood extent for a 1:200 yr event, 0.5% return probability.	Area in Hectares	Extent of the anticipated flood extent	SEPA
SEPA 1,000yr	The anticipated still water flood extent for a 1:200 yr event, 0.1% return probability.	Area in Hectares	Extent of the anticipated flood extent	SEPA
Battlefield	Historic Environment Scotland maintains a list of nationally important battlefields in Scotland that meet the criteria published in the Scottish Historic Environment Policy 2011.	Area in Hectares	Extent of the designated sites.	HES
Gardens of Designed Landscape	Sites listed within the Inventory of gardens and designed Landscapes, in support of the Ancient Monuments and Archaeological Areas Act 1979.	Area in Hectares	Extent of the designated sites.	HES
Properties in Care	Properties which are listed in the care of Scottish Ministers, under the Historic Environment Scotland Act 2014	Area in Hectares	Extent of the designated sites.	HES
Marine Protected Areas	Scottish Ministers designated a suite of Nature Conservation Marine Protected Areas to conserve some of Scotland's most important marine wildlife, habitats and geodiversity. Covering over 10% of our seas, Nature Conservation MPAs will play an important role in delivering a healthy, productive and biologically diverse marine environment for Scotland.	Area in Hectares	Extent of the designated sites.	SNH
National Nature Reserves	National Nature Reserves contain are made up of the best wildlife sites in Scotland so everyone can appreciate and be proud of Scotland's wonderful nature. Most reserves have habitats and species that are nationally or internationally important so the wildlife is managed very carefully.	Area in Hectares	Extent of the designated sites.	SNH
Special Areas of Conservation	A site designated under the Habitats Directive. These sites, together with Special Protection Areas, are collectively known as Natura sites and are internationally important for threatened habitats and species	Area in Hectares	Extent of the designated sites.	SNH
Special Protection Area	A site designated under the Birds Directive. These sites, together with Special Areas of Conservation, are collectively known as Natura sites and are internationally important for threatened habitats and species	Area in Hectares	Extent of the designated sites.	SNH
Site of Special Scientific Interest	Areas of land and water (to the seaward limits of local authority areas) considered by Scottish Natural Heritage to represent the best of our natural heritage - its diversity of plants, animals and habitats, rocks and landforms, or a combination of such natural features.	Area in Hectares	Extent of the designated sites.	SNH

Please note 1Ha is 10,000m^2 or 100m x 100m

3.0 Results

Table 3.1 summarises the number of assets/receptors found within 50 m and 10 m of Mean High Water Springs. Please refer to Section 2.1 for definitions of the asset / receptors.

3.1 Within 50 m and 10 m of the coastline:

At such small distances from the coast however, caution is urged. For example, these data show the central line of a road or a central point of a building yet erosion will first affect an edge or perhaps a corner so that the NCCA underestimates the risk to the integrity of the asset. It is also important to acknowledge that the +/-10 m precision of the NCCA means that the minimum change that NCCA captures as significant reflects source errors within the 1890s and 1970s OS map datasets. Despite many of the modern (OS MasterMap) datasets having good accuracy (2.5 m in many cases), it is almost certain that there are areas where erosion has been less than 10 m or slower than 0.5 m/yr, but that also contain threatened assets that have not been identified by the NCCA. Making these data available to Local Authorities can act as a back-up analysis for those assets on shorelines, which although insignificant amounts of change have occurred, remain very close to MHWS and so may be at risk.

3.1.1 All coastal types

The following results are based on the coastal type categories of Hard & Mixed, Soft and Artificial, which were based on map and air photography analysis (see Methodology Report).

Within 50 m of Mean High Water Springs there are:

- 24,449 residential properties of which 7,194 (29%) are on soft coasts,
- 9,045 non-residential properties of which 2,309 (26%) are on soft coasts,
- 1,656 septic tanks of which 677 (41%) are on soft coasts,
- 312 utilities of which 80 (26%) are on soft coasts,
- 78 community services of which 20 (26%) are on soft coasts,
- 1,336 km of roads of which 497 km (37%) are on soft coasts,
- 104 km of rail lines of which are 58 km (56%) are on soft coasts and
- 931 km of drinking water network pipelines of which 304 km (33%) on soft coasts.

Within 10 m of Mean High Water Springs, there are:

- 458 residential properties of which 109 (24%) are on soft coasts,
- 463 non-residential properties of which 103 (22%) are on soft coasts,
- 367 septic tanks of which 139 (38%) are on soft coasts,
- 25 utilities of which 7 (28%) are on soft coasts,
- 1 community services of which none are on soft coasts,
- 156 km of roads of which 53 km (34%) are on soft coasts,
- 15 km of rail lines of which are 9 km (65%) are on soft coasts and
- 87 km of drinking water network pipelines of which 22 km (25%) on soft coasts.

3.1.2 Within potentially erodible land

The following results are based on the erodibility assessment (Fitton *et al* 2016), which includes altitude, rock head depth, coastal proximity and wave exposure. It excludes the presence and direct influence of sediment supply and coastal defences, and therefore provides an impression of the long-

term erodability of the land (see Methodology Report). Within 50 m of Mean High Water Springs and lying behind coasts that are potentially erodible, there are:

- 15,276 residential properties, 5,101 non-residential properties, 769 septic tanks, 184 utilities and 45 community services.
- There is 590 km of roads, 61 km of rail lines and over 450 km of drinking water network pipelines.
- Parts of 14 runways lie within 50 m of MHWS.

Within 10 m of Mean High Water Springs and lying behind coasts that are potentially erodible, there are:

- 332 residential properties, 245 non-residential properties, 181 septic tanks and 14 utilities, together with 9 km of railway, 68 km of road and 41 km of drinking water pipelines.

Table 3.1: Whole Coast Assessment identifying the assets within 50 m and 10 m of the shoreline

| Asset / Receptor | Unit | Within 50 m of MHWS | | | | | Within 10 m of MHWS | | | | |
| | | | Coastal Type | | | | | Coastal Type | | | |
		All	Hard & Mixed	Soft	Artificial	Erodible (UPSM40+)	All	Hard & Mixed	Soft	Artificial	Erodible (UPSM40+)
Community Services		78	48	20	10	45	1	1	0	0	0
Non Residential Property		9,045	4,393	2,309	2,343	5,101	463	197	103	163	245
Residential Property	#	24,449	9,966	7,194	7,289	15,276	458	107	109	242	332
Septic Water Tanks		1,656	954	677	25	769	367	219	139	9	181
Utilities		312	137	80	95	184	25	10	7	8	14
Rail		103	27	58	18	61	15	2	9	3	9
Roads	km	1,336	733	497	107	590	156	87	53	16	68
Clean Water Network		931	507	304	120	452	87	50	22	16	41
Cultural Heritage		1,029	471	438	120	529	135	63	55	17	74
Environment	ha	23,430	14,873	8,424	133	8,615	4,204	2,575	1,586	43	1,790
Runway		2.7	1.7	0.3	0.6	1.5	0.1	0.1	0.0	0.0	0.0

4.0 Proximity of designated sites

Historic Environment Scotland (HES) and Scottish Natural Heritage (SNH) have (at the least) an advisory role a large variety of protected sites across the country. Whilst the results in table 5 consider the extent of assets, this masks the number and location of these sites within 50 m of MHWS.

4.1 Cultural Heritage Designations at the coast

HES have 874 sites within 50 m of Mean High Water Springs. This includes: 10 Battlefields, 70 Gardens of Designed Landscape, 746 Scheduled Monuments and 48 Properties in Care.

4.2 Natural Heritage Designations at the coast

SNH have 637 sites within 50 m of Mean High Water Springs. This includes: 104 Special Areas of Conservation, 90 Special Protection Areas, 425 Sites of Special Scientific Interest and 18 National Nature Reserves.

5.0 The Value of Assets at Risk from Coastal Erosion

Whilst the Whole Coast Assessment above provides the numbers of assets at reducing proximity to the coastline, the assets that lie within areas categorised with very high erosion susceptibility by the underlying physical susceptibility model (UPSM) and the coastal erosion susceptibly model (CESM) (see Fitton et al., 2016), which may extend further inland than the 50 m used above are shown in Table 5.1. The UPSM represents areas that are inherently susceptible to erosion irrespective of any coastal protection that they enjoy. The CESM includes the protection afforded by either artificial or natural defences (e.g. sea walls, and natural sediment accretion). The difference between the UPSM and CESM represents the assets that are not protected by coastal defences or natural sediment supply. Nature conservation designated sites are also listed, including Sites of Special Scientific Interest (SSSI), Geological Conservation Review Sites (GCRs), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs). Further description of these designations is provided within the glossary within the National Overview.

Table 5.1: Summary of overlying areas inherently erodible (UPSM) and those inherently erodible once defences and sediment supply have been incorporated (CESM). See Fitton et al., 2016.

		UPSM	CESM	Difference between UPSM and CESM
Property	Count	13,289	3,310	9,979
Road	km	313.6	178.7	134.9
Railway	km	26.4	13.3	13.1
Key Assets	Count	1024	287	737
Golf Courses	km^2	5.3	2.3	3.0
Listed Buildings	Count	1145	316	829
Scheduled Monuments	km^2	4.37	2.03	2.34
SSSI	km^2	42.48	25.61	16.87
GCR	km^2	24.08	13.24	10.84
SAC	km^2	21.9	13.86	8.04
SPA	km^2	29.22	17.26	11.96

The direct, like for like replacement costs of some coastal assets has also been calculated (**Error! Not a valid bookmark self-reference.**). This analysis shows that a considerable value of assets are situated in naturally highly susceptible locations, and in locations that are susceptible to erosion, but have undergone management e.g. construction of a sea wall. Both situations will potentially create issues for future coastal management.

The costs have been calculated using postcode property prices, examples of repairs to road and rail track after damage by coastal erosion (A2 road repairs in Northern Ireland in 2014, and the Dawlish, England rail repairs in 2014), and the value of the golf industry to Scotland based on a report by KPMG (2013). Since some of these assets are transport links, the costs of their loss multiply greatly when the

extensive relocation of connecting links and the wider economic impacts are considered, the values quoted here are therefore likely to be an underestimate.

Table 5.2: Total direct replacement cost of assets overlying areas inherently erodible (UPSM) and those inherently erodible once defences and sediment supply have been incorporated (CESM). See Fitton et al., 2016.

	UPSM		CESM		Difference between UPSM and CESM	
Roads	£	2,038,673,506	£	1,161,303,487	£	877,370,019
Railway	£	3,966,649,203	£	2,001,720,238	£	1,964,928,965
Property	£	2,210,653,845	£	525,972,088	£	1,684,681,757
Golf Courses	£	9,664,787	£	4,195,331	£	5,469,456

References

Fitton, J.M., Hansom, J.D. & Rennie, A.F. (2016) A national coastal erosion susceptibility model for Scotland. *Ocean & Coastal Management*, 132, pp.80–89. Available from: <http://dx.doi.org/10.1016/j.ocecoaman.2016.08.018>.

KPMG (2013) The Value of Golf to Scotland's Economy.

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