DRUMBURGH TO SCOTTISH BORDER (CARLISLE CC)

Baseline Information

Start co-ordinate:	327936, 560460	**Finish co-ordinate:**	332593, 566617
Total length:	25km	**Defended length:**	11.4km
Earth Embankment:	11.4km	**Saltmarsh:**	25km

Environmental designations:
- SSSI
- SAC
- SPA
- Ramsar
- AONB

Monitoring carried out:
- 13 beach profiles
- Coastal defence inspection (Bowness on Solway)

Site overview:
This section is within the boundaries of Carlisle City Council. Upstream from Drumburgh the Solway channel moves to the south opposite Glasson. Upstream from Glasson extensive areas of saltmarsh (Easton Marsh and Burgh Marsh) have developed. The Eden channel runs along the edge of Easton Marsh, which is consequently susceptible to erosion.

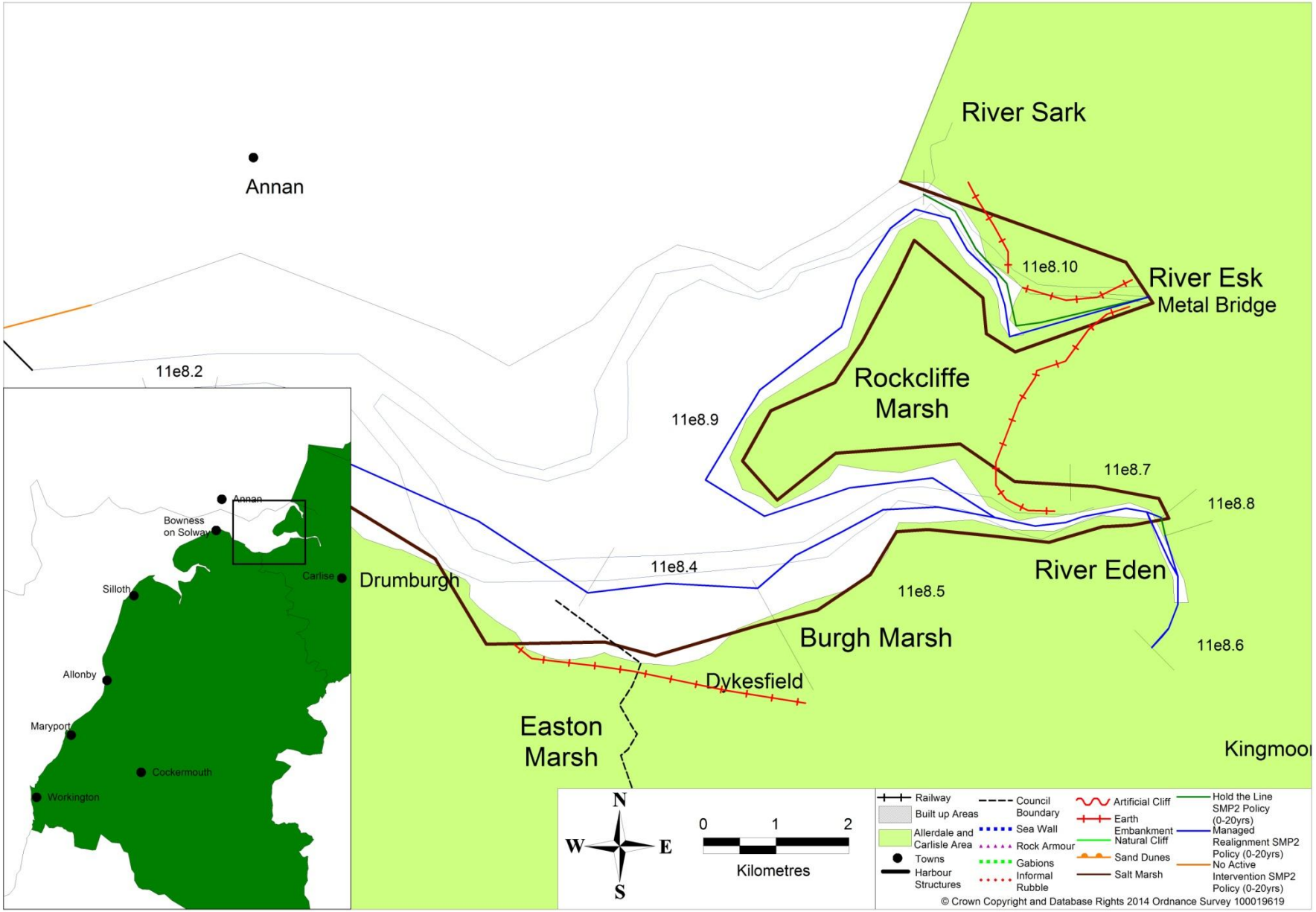
This section is a sink for sediments with material having historically been moved into the inner Firth from offshore or flushed into it by the rivers which feed into the head of the estuary. This has resulted in the development of two extensive areas of saltmarsh, which front low-lying hinterland. To the south is Burgh Marsh whilst Rockcliffe marsh resides between the outlets of the rivers Eden and Esk and protrudes westerly into the Firth. The west coast railway line and the A74 main west coast trunk road linking England and Scotland cross the River Esk, immediately upstream of Rockcliffe Marsh.

Earth floodbanks have been constructed along the landward boundaries of Rockcliffe marsh to protect the low lying land behind from flooding.

The west coast railway line and the A74 main west coast trunk road linking England and Scotland cross the River Esk, immediately upstream of Rockcliffe Marsh.

The Current (SMP2) Policy:
- **Drumburgh to Rockcliffe:** Managed Realignment in the short term (0-20yrs), medium term (20-50yrs) and long term (50-100yrs);.
- **Rockcliffe:** Hold the Line in the short term (0-20yrs), medium term (20-50yrs) and long term (50-100yrs).
- **Rockcliffe to Metal Bridge:** Managed Realignment in the short term (0-20yrs), medium term (20-50yrs) and long term (50-100yrs); and
- **Metal Bridge to the River Sark:** Managed Realignment in the short term (0-20yrs), medium term (20-50yrs) and Hold the Line in the long term (50-100yrs).

The plan overleaf summaries the above information graphically:


River Sark
Annan
11e8.10
River Esk
Metal Bridge
11e8.2
Rockcliffe
Marsh
11e8.9
11e8.7
11e8.8
River Eden
11e8.4
Drumburgh
11e8.5
Burgh Marsh
11e8.6
Dykesfield
Easton
Marsh
Kingmoor
Annan
Bowness
on Solway
Carlise
Silloth
Allonby
Maryport
Cockermouth
Workington
N
W
E
S
0
1
2
Kilometres
Railway
Built up Areas
Allerdale and
Carlisle Area
Towns
Harbour
Structures
Council
Boundary
Sea Wall
Rock Armour
Gabions
Informal
Rubble
Artificial Cliff
Earth
Embankment
Natural Cliff
Sand Dunes
Salt Marsh
Hold the Line
SMP2 Policy
(0-20yrs)
Managed
Realignment SMP2
Policy (0-20yrs)
No Active
Intervention SMP2
Policy (0-20yrs)
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Summary of behaviour

This section of frontage is exposed to locally generated waves. Flood currents combine with prevailing south-westerly winds to push water into the upper estuary. These currents result in grading of material, with sediments becoming finer towards the north east of the estuary. Localised erosion and undercutting of the saltmarsh results from the meandering of the river channels concentrating waves and current towards the shoreline. Little sediment is supplied by the rivers due to the low hydraulic power they have before entering the Solway estuary.

The following key points arise from analysis of the contemporary monitoring data:

Offshore Wave Climate:

- No relevant data available.

Wind Climate:

- No relevant data available.

Sea Levels:

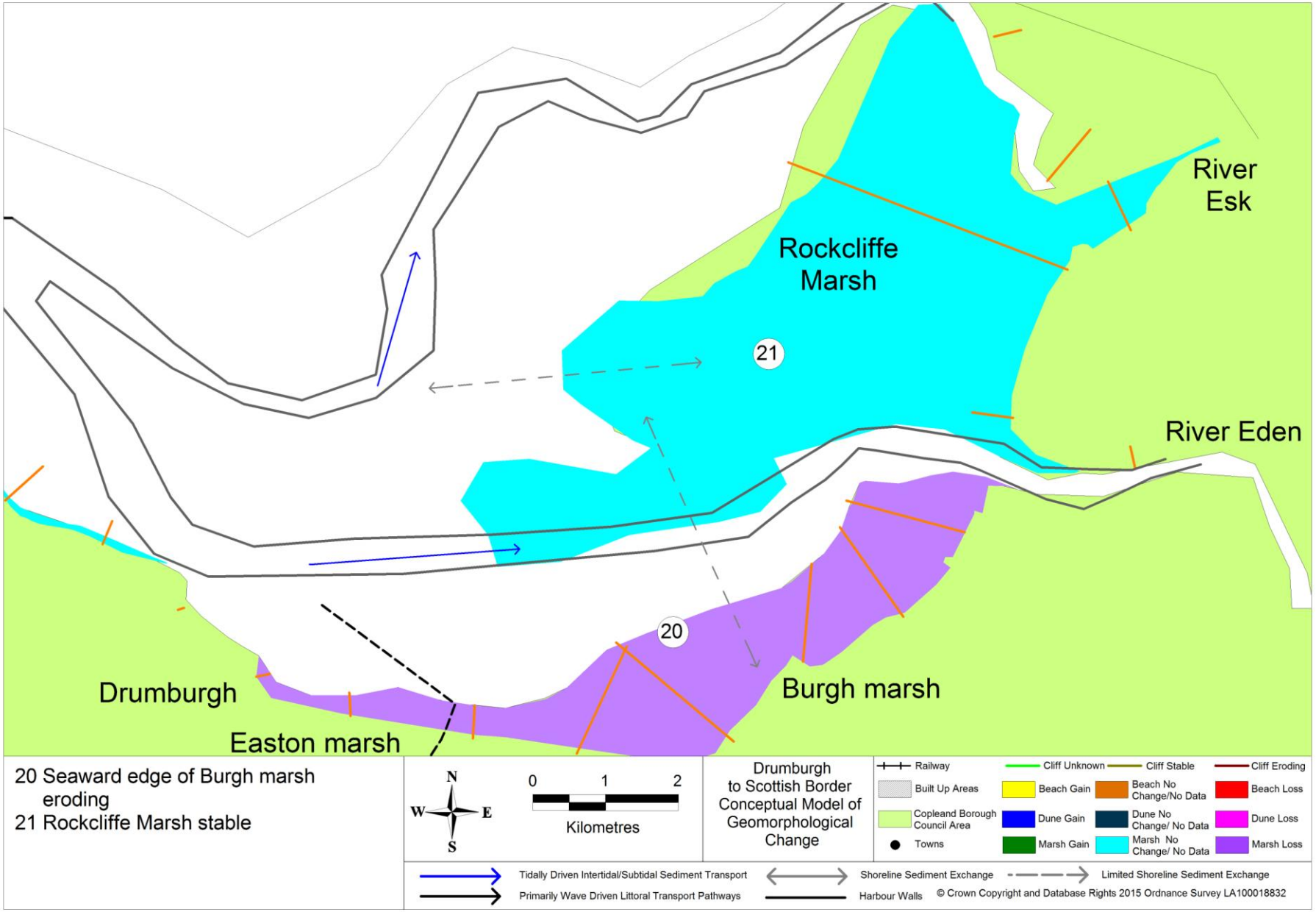
- Maximum tide level recorded at Workington in the last 20 years = +5.76 (m ODN) in February 1997, which equates to approximately a 1 in 50 return period; and
- The following predicted extreme tide levels apply (m ODN):

Return Period (years)	Workington	Bowness
10	5.49	6.84
100	5.84	7.67
1000	6.18	8.59

Foreshore & Shoreline Changes:

- Profiles cover saltmarsh;
- Erosion of seaward edge of Easton Marsh.
- Saltmarsh modestly receding at Burgh Marsh
- Saltmarsh edge stable at Rockcliffe Marsh; and
- Slow erosion of edge at Mossland Hall Marsh.

This behaviour is illustrated graphically on the plan overleaf.


River Esk
Rockcliffe Marsh
21
River Eden
20
Drumburgh
Easton marsh
Burgh marsh
20 Seaward edge of Burgh marsh eroding
21 Rockcliffe Marsh stable
N
W
E
S
0
1
2
Kilometres
Drumburgh to Scottish Border Conceptual Model of Geomorphological Change
Railway
Cliff Unknown
Cliff Stable
Cliff Eroding
Built Up Areas
Beach Gain
Beach No Change/No Data
Beach Loss
Copleand Borough Council Area
Dune Gain
Dune No Change/ No Data
Dune Loss
Towns
Marsh Gain
Marsh No Change/ No Data
Marsh Loss
Tidally Driven Intertidal/Subtidal Sediment Transport
Shoreline Sediment Exchange
Limited Shoreline Sediment Exchange
Primarily Wave Driven Littoral Transport Pathways
Harbour Walls
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Risk Assessment

The primary risks arising from the behaviour of coastal forcing processes (wind, waves and tides) and the reaction of the shoreline (beach and cliff changes, artificial defence conditions) across this frontage are:

- Overtopping and/or breaching of artificial defences causing flooding of the hinterland; and
- Erosion of marsh reducing natural protection and habitat loss.

The primary consequences of this behaviour are:

- Damage to and/or loss of agricultural land and associated property and infrastructure; and
- Damage to environmental habitats.

The table below shows the overall risk rating(s) that apply within this section of frontage. Overall risk is defined from the probability of conditions/behaviour occurring and the consequences the conditions/behaviour would have.

Drumburgh to Scottish Border (Carlisle CC) Overall Risk Rating					
Policy Unit (11e)	**Section of Frontage**	**Exposure**	**Probability Index**	**Consequence Index**	**Overall Risk Rating**
8.4	Drumburgh to Dykesfield	Low	Low	Medium	Low
8.5	Dykesfield to Kingsmoor (Eden Normal Tidal Limit)	Low	Low	Medium	Low
8.6	Kingsmoor (Eden Normal Tidal Limit) to Rockcliffe	Low	Low	Medium	Low
8.7	Rockcliffe	Low	Low	Medium	Low
8.8	Rockcliffe to Demesne Farm	Low	Low	Medium	Low
8.9	Demesne Farm to Metal Bridge (Esk)	Low	Low	Medium	Low
8.10	Metal Bridge (Esk) to the River Sark	Low	Low	Medium/High	Medium

Current Behaviour

Analysis of the monitoring data collected in 2015 provides the following key points:

Offshore Wave Climate:

- No new data available for analysis.

Wind Climate:

- No new data available for analysis.

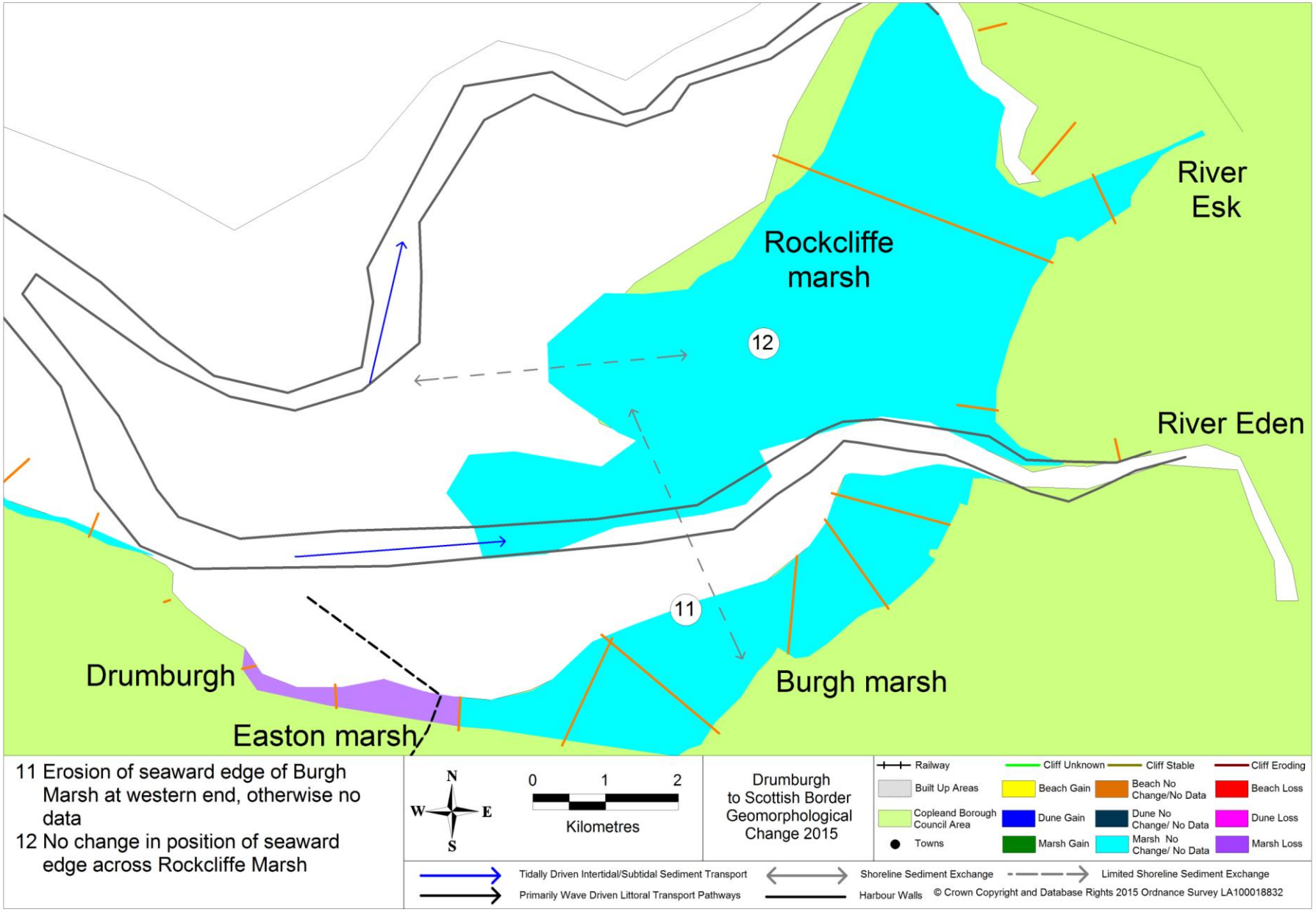
Sea Levels:

- Maximum tide level recorded on Workington tide gauge = +5.164 (m ODN) on 22nd February 2015, equivalent to a level that would be expected to be exceeded once every 1 to 2 years.

Beach Changes:

- Edge of Easton Marsh eroded by 2 metres in 2015;
- No data on marsh edge movement at Burgh Marsh in 2015;
- Marsh edge stable at Rockcliffe Marsh in 2015; and
- Marsh edge stable at Mossland Hall Marsh in 2015;

The plot overleaf summarises the results from the monitoring data analysis for this section in 2015.


River Esk
Rockcliffe marsh
12
River Eden
11
Drumburgh
Easton marsh
Burgh marsh
11 Erosion of seaward edge of Burgh Marsh at western end, otherwise no data
12 No change in position of seaward edge across Rockcliffe Marsh
N
W
E
S
0
1
2
Kilometres
Drumburgh to Scottish Border Geomorphological Change 2015
Railway
Cliff Unknown
Cliff Stable
Cliff Eroding
Built Up Areas
Beach Gain
Beach No Change/No Data
Beach Loss
Copleand Borough Council Area
Dune Gain
Dune No Change/ No Data
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Uncertainties & Issues

The following uncertainties have arisen from the data monitoring programme and analysis of the data collected:

- Quantities of sediment finding its way into this section of the Solway;
- Magnitude and frequency of bank and channel movements;
- Changes in lower foreshore conditions between marsh edge and channels; and
- Changes in the overall area of the saltmarsh.

Future Management Actions

The following monitoring and management actions are recommended:

- Continue current monitoring regime;
- Improve additional remote sensing e.g. LiDAR;
- On-going monitoring of condition of artificial defence structures; and
- Carry out remedial works to maintain integrity of defences, as required.

Linkage(s) to Decision Making

The monitoring provides information to support:

- Implementation of SMP2 policies, particularly identification of timing for future capital works or capital maintenance works for artificial defences;
- Decision making process in relation to development planning control; and
- Habitat Change.