Cumbria Coastal Strategy

Technical Appraisal Report for Policy Area

11d2 Selker to Eskmeals

(Technical report by Jacobs)

Policy area: 11d2 Selker to Eskmeals

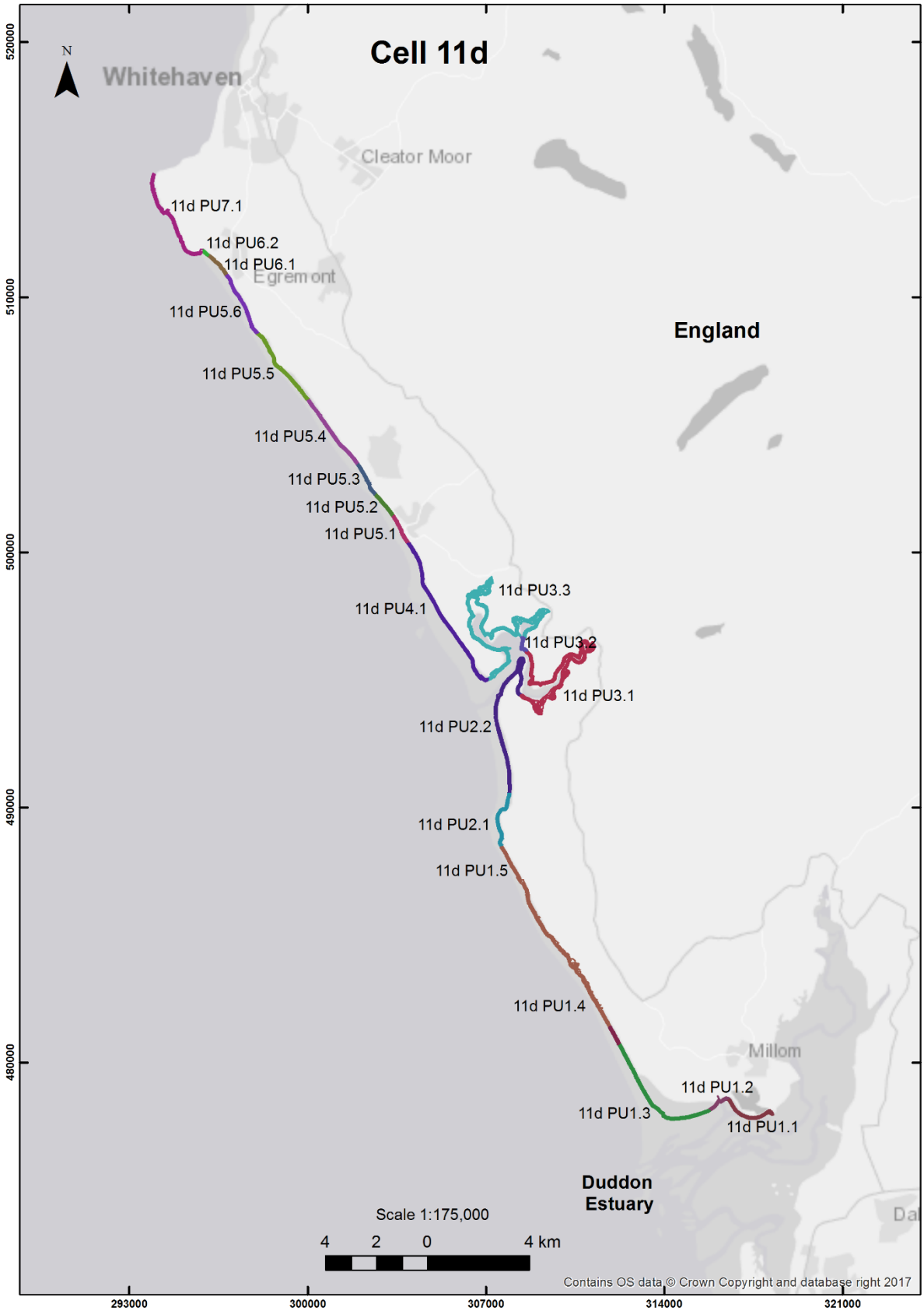

Figure 1 Sub Cell 11d Hodbarrow Point to St Bees Head Location Plan of policy units. Baseline mapping © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.

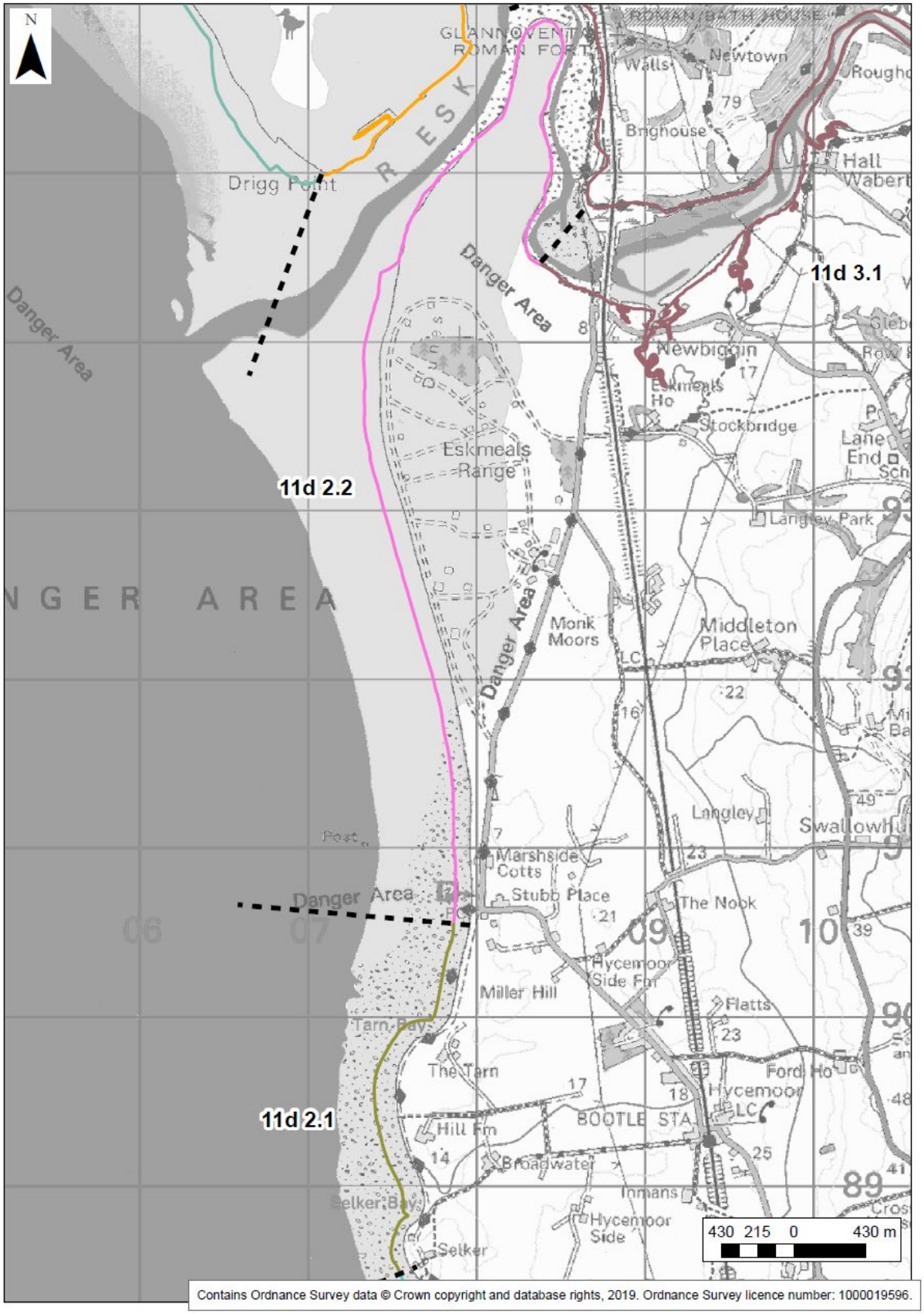

Figure 2 Location of Policy Area 11d2: Selker to Eskmeals. Baseline mapping © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.

1 Introduction

1.1 Location and site description

Policy unit:	11d2.1 Selker to Stubb Place **11d2.2 Stubb Place and Eskmeals Dunes (priority unit)**
Responsibility:	Copeland Borough Council Ministry of Defence (MoD) and QinetiQ – Eskmeals Range Cumbria County Council – C4027 Road Lake District National Park Authority
Location:	The policy area 11d2 Selker to Eskmeals falls within Sub cell 11d: Hodbarrow Point to St Bees Head. It is located to the south of the Ravenglass estuary.
Site overview:	The coast is characterised by low till cliffs which diminish in height towards the north and are replaced by sand dunes, forming the Eskmeals dune system. The cliffs and dunes are fronted by an upper shingle beach, which forms a distinct barrier ridge along the MoD site, and lower sandy beach. As along adjacent stretches, boulder beds (scars) are exposed along the lower foreshore, some of which provide localised protection to the backshore. The beach, an important amenity for the local community in the past, has been compromised due to erosion of the frontage. At the southern end of this unit are the uplands of Selker Point and Tarn Point, which are cut into glacial till, between which lies Selker Bay. North of Tarn Point is Tarn Bay. Both Selker Bay and Tarn Bay have become infilled with raised beach deposits, which form a plateau in front of the till. Selker Point is believed to be a local drift divide; here a rock platform extends several metres seaward, impacting on wave processes at this location and marking a change in coastline orientation. The cliffs along this frontage vary in height and are fronted by a shingle beach. In the recent past, i.e. over the last two centuries, Ordnance Survey maps (dating from the 1860s) suggests that Selker Point has eroded tens of metres (Halcrow, 2011). The cliffs along this section show signs of current activity. Moving northwards, the cliffs decrease in height towards Stubb Place, which lies on the coast between Bootle and Waberthwaite. To the north of Stubb Place is the Ministry of Defence (MoD) site of Eskmeals Range, operated by QinetiQ; the site is accessed via an unclassified road, locally known as the C4027, which lies immediately adjacent to the shoreline at Stubb Place. There has been localised erosion along this section of coastline meaning there is a risk that access to Eskmeals could be lost. The C4027 is currently the only viable access to Eskmeals Range as alternative routes pass under the Eskmeals viaduct and therefore have height, width and tidal restrictions. A number of attempts to protect the frontage have been made since the 1970s but have since failed. The latest construction of pre cast concrete Pendine blocks were placed in 2010 as a short term measure to slow erosion, but these have progressively become displaced and collapsed. North of Stubb Place, along Eskmeals Range, the shingle barrier ridge forms the main protection to frontal MoD assets; here the immediate hinterland is low lying, with dunes lying behind. Any breach in the ridge causes flooding to the backshore assets, which include fixed point firing mounts. It is understood that QinetiQ, who manage the site on behalf of the MoD, undertake repair works following storm damage to the ridge. There are no formal shore protection defences along much of the Eskmeals Range, with the exception of isolated

	areas of rock work protection. The dunes themselves have been heavily modified by military activity. In contrast, further north, the dunes are more natural in form and there are no defences present. The dunes form a spit which extends into the Ravenglass Estuary complex and diverts the course of the River Esk to where it now confluences with the Rivers Irt and Mite. The dune system as a whole is understood to be stable at present, but in the future this frontage may be affected by any changes within the Ravenglass Estuary and in particularly to the outer banks. The frontage is undeveloped, but farmsteads lie along the coastal strip and there are properties at Stubb Place; link roads to these properties are also at potential risk from erosion and tidal flooding. Agricultural land fringes the coastline and would be affected by any coastal management decisions. The frontage lies within the Lake District National Park and World Heritage Site and there are multiple footpaths and cycleways throughout the area. The coastline supports a range of habits and includes the designated sites of Drigg Coast SSSI, Drigg Coast SAC, Morecambe Bay and Duddon Estuary SPA. Most of the Eskmeals Range is excluded from Drigg Coast SSSI and Drigg Coast SAC, but the intertidal is included in the SPA. To the north of the area is the Cumbria Coast Marine Conservation Zone (MCZ) and Drigg Dunes and Gullery, Ravenglass Local Nature Reserve. Tarn Point has also previously been identified as a recommended Reference Area (rRA) in support of MCZs, for its blue mussel beds and honeycomb worm reefs. There are no statutory historical sites (listed buildings or Scheduled Monuments) along the coast, but Ravenglass to the north was an important Roman site and therefore there is high potential for undiscovered archaeology in this area.

1.2 Current SMP policy

The policy details for the whole policy area are shown in the table below, taken directly from the SMP2 (Halcrow, 2011), but non priority units have been greyed out.

Table 1 Current SMP policy for policy area 11d 2

Overview: *The long term vision here is for a naturally functioning system without any defences or interventions. Promotion of a naturally functioning coastline helping to maintain a number of habitats and SSSIs, although limited number of properties and a strip of agricultural land will be at increasing risk of flooding and erosion. Infrastructure including a minor road, the Cumbrian Coastal Railway, and the Cumbrian Coastal Way may also become at greater risk of flooding in the long term. Consequently, the implementation of this plan will need to manage residual risks to isolated properties, assets and infrastructure.*

Location		Policy and Approach (from 2010)		
		0-20 years	20-50 years	50-100 years
11d2.1	Selker to Stubb Place	**No active intervention** – Allow natural erosion of cliffs.	**No active intervention** – Allow natural erosion of cliffs.	**No active intervention** – Allow natural erosion of cliffs.
11d2.2	Stubb Place and Eskmeals Dunes	**Managed realignment** – Allow continued natural coastal evolution and roll back of dunes with localised limited intervention to manage risk to assets. Beach management measures should be incorporated along the frontage. Undertake short term measures to allow continued use of road at Stubb Place whilst medium or long term Managed realignment adaptation approach is investigated.	**Managed realignment** – Allow continued natural coastal evolution and roll back of dunes with localised limited intervention and beach management.	**Managed realignment** – Allow continued natural coastal evolution and roll back of dunes with localised limited intervention and beach management.

2 Appraisal of priority units

2.1.1 Justification of current SMP policy

One unit within this area has been defined as a priority unit:

- 11d2.2 Stubb Place and Eskmeals Dunes

Although there is a single SMP policy for this unit, management of the frontage varies, such that splitting the policy unit into sub areas may be more appropriate: one covering Stubb Place; one covering Eskmeals Ranges and one covering the undefended frontage of Eskmeals dunes.

2.1 Existing approach to flood and coastal risk management

2.1.1 Justification of current SMP policy

Section 1.2 sets out the SMP policies for this priority unit. The primary justification for the policies at SMP level were:

- Social: Maintenance of private defences in front of properties at Stubb Place and at Eskmeals is likely to be acceptable (subject to gaining necessary consents) as long as there are no adverse effects on sediment movement or coastal processes. Assumes that Eskmeals range facilities in the dune system and access road could be rolled back in response to coastal change.
- Environmental: Allows a continuation of natural processes supportive of the international and national conservation designations.
- Economic: Insufficient economic justification for public funding of defences at Stubb Place. However, provision to private funding of defences or management practices is expected to continue. Dunes not formally defended at present; and not considered economically viable to construct new defences in dune system. Policy delivery in the noted frontage may be compromised by funding prioritisation due to the low Benefit Cost Ratio and therefore opportunities for co-funding need to be investigated.

2.1.2 Current defences

The majority of this frontage is undefended (see Figure 3); exceptions being the defences currently along the Stubb Place frontage and short stretches of informal defences along Eskmeals Range.

At Stubb Place, the backshore consists of raised beach deposits, which form a low lying plain before the land rises again further inland. This stretch of shoreline is therefore vulnerable to both shoreline erosion and overtopping during storms. In recent years, localised flooding of the road has resulted from wave overtopping during storms in 2011, 2014 and 2018.

In response to the risk to the access road, defences have been built to attempt to slow or halt erosion along this short frontage. Asset inspections, carried out as part of the North West Regional Monitoring Programme, record that defences here have been described as being in a poor condition in all of the annual inspection reports since 2001, despite continued efforts to maintain some form of defence.

The original gabion baskets were reported as having failed in 2010 (CEUK, 2010). Further defences, in the form of concrete blocks (Pendine blocks) were placed along the southern section of the shoreline in 2010 as a result of community work partially financed by the Parish Council, but by 2012 these had largely collapsed (Capita Symonds, 2012) and are continuing to fail. Figure 4 to Figure 7 shows the failure progression of the Pendine blocks.

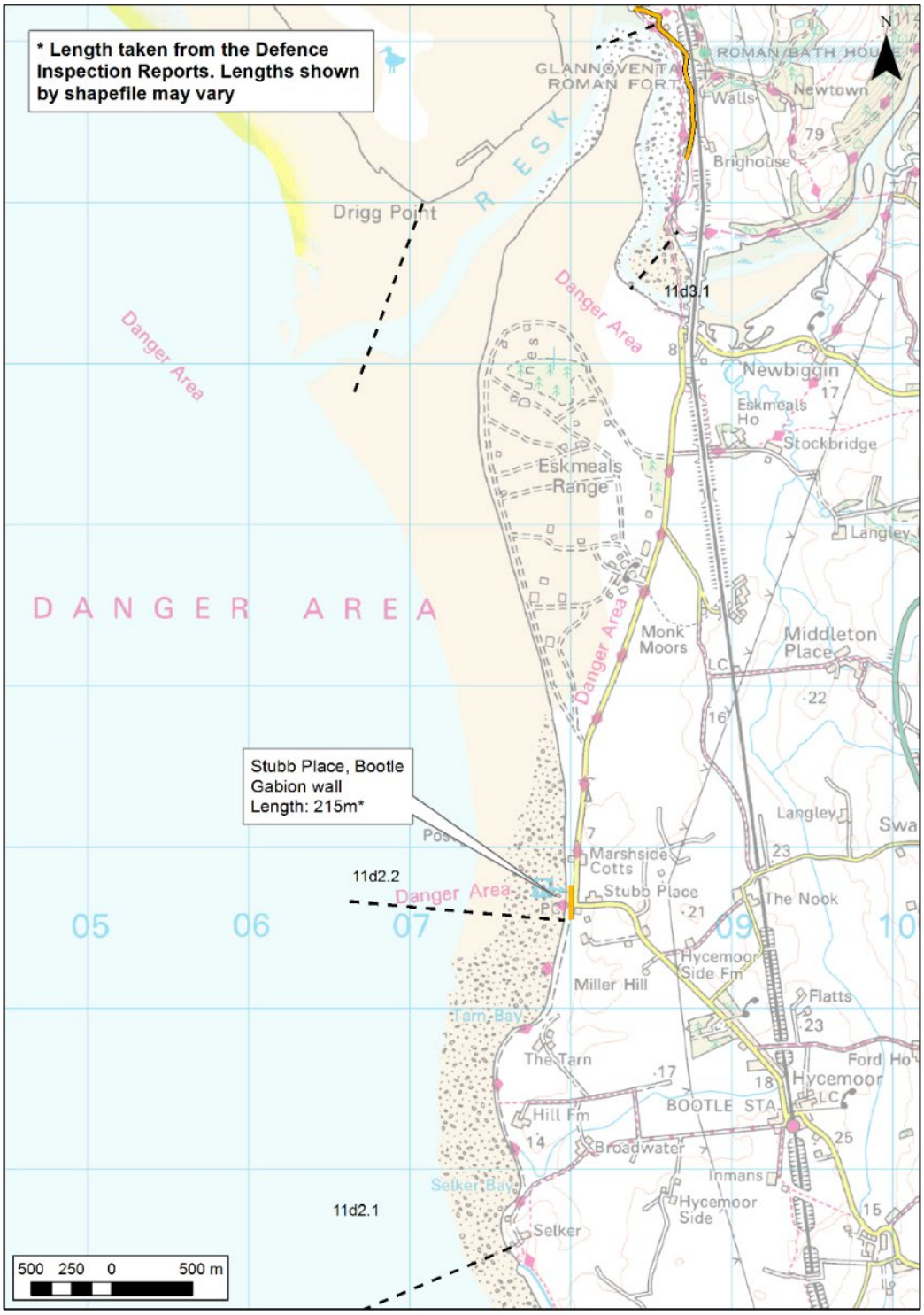

Figure 3 Policy unit location plan and defence overview Baseline mapping © Crown copyright and database rights, 2019. Ordnance Survey licence number: 1000019596.

Figure 4: Pendine concrete blocks being installed in 2010, Photos courtesy of David Bechelli.

Figure 5: Pendine concrete blocks - October 2013, Photos courtesy of David Bechelli.

Figure 6: Pendine concrete blocks - February 2014, Photos courtesy of David Bechelli.

Figure 7: Pendine concrete blocks – March 2018.

At Stubb Place, storms of winter 2013 and 2014 caused further damage to the Pendine blocks and destroyed the central access ramp reducing the overall level of protection (see Figure 7). Defence inspections note evidence of overtopping, with damage to the boundary wall on the landward side of the public highway. In 2015, clay was placed on the foreshore at the northern end of the Pendine blocks as infill between the blocks and the eroding shoreline behind. The clay placed in the centre of the frontage was mostly washed away by 2016 and at the southern end, the clay placed has since eroded with a crest width of 1 to 2 m to seaward of the boundary fence (CH2M, 2017b).

The August 2017 defence inspection (CH2M, 2017b) identified that additional blocks have been displaced on the beach compared to previous inspections. In some places blocks have narrowed but no significant erosion was observed. In 2018 clay material was placed along the crest to infill voids and address localised cliffing. A recent defence inspection report (CH2M, 2017b) classified the defences as 4 – poor, with a residual life of 10 to 20 years, depending upon exposure conditions.

These blocks have been placed at varying crest levels along their length, to provide protection against overtopping the crest level would need to be increased. The structure is porous which allows material from behind the defences to be washed out through the blocks by water that overtops the structure or percolates through it. The positioning of the blocks along the face of the shoreline is also inadvisable as this may interfere with natural processes of sediment transport northwards along the shoreline.

Figure 8: a) Boundary with MoD frontage at north end; b) and c) Displaced concrete blocks in front of Stubb Place; d) Field boundary south of Stubb Place.

Along Eskmeals Range, there are localised stretches of rock protection and the MoD currently undertake management activities along the shingle ridge. Although reportedly this is only undertaken following storms, the current profile of the ridge is artificial (Figure 8) and in some stretches contains a large proportion of non-native materials (Figure 10). Post storms, material is currently drawn up from the mid beach by excavator and placed to re-form the ridge. The coast to the north is undefended.

Figure 9 Artificially maintained shingle beach ridge along the shoreline of the MoD Eskmeals Range

Figure 10 Shingle ridge along Eskmeals Range

Table 2 provides the defence details for policy unit 11d2.2; no details are available for Eskmeals Range:

Table 2 Existing Defence Details, taken from CH2M 2017b)

Location	Structure Type	Length (m)	Crest Level (mOD)	Foreshore Toe Level (mOD)	Residual Life (years)	Responsibility
11d2.2 Stubb Place, Bootle	Gabion baskets/ Concrete (pre-cast)	260	+6.8 to +7.2	+5.85 to +7.2	10-20	Cumbria County Council

2.1.3 Shoreline change

The coast is characterised by low till cliffs which diminish in height towards the north to be replaced by raised beach deposits at the southern end and then sand dunes further north, forming the Eskmeals dune system. The cliffs and dunes are fronted by an upper shingle beach and lower sandy beach. This coast is not believed to receive significant amounts of sediment from further south, i.e. Morecambe Bay, the offshore or rivers (Halcrow, 2011). Erosion of the beach and backshore deposits is, therefore, the key contemporary source of sediment.

Sediment drift is net northwards but as the coastline is orientated almost perpendicular to the prevailing wave direction, drift rates are likely to be low. Ravenglass Estuary, to the north, has historically been a net sink for sediment, and this process is believed to be still taking place; the composition of the estuary sediments suggests that these tend to be fine sands and silts (Halcrow, 2010).

Historically there has been significant erosion along the Stubb Place frontage, although data indicates that annual erosion rates are generally low, but cyclical, with erosion largely being driven by storm events (Capita Symonds, 2012). The beach crest along the Stubb Place frontage is also vulnerable to overtopping during storm events. In February 2002, approximately 2 to 3 m of erosion occurred along this stretch (JBA, 2005). The defences along this frontage were realigned or replaced in 2011 and 2012 advancing the shoreline position by around 3 m, forming an informal sloping revetment, but during the winter storms of 2013 and 2014 the back of the beach (low cliff edge) receded between 2 and 5 m (CH2M, 2017a). Beach levels along this stretch can fluctuate by up to a metre as material is moved along the frontage (CH2M, 2017a).

The beach management activities undertaken along the MoD frontage mean that assessment of natural shoreline change is not possible, without further information on the timing, extent and nature of activities.

The Eskmeals dunes to the north of this unit are currently considered to be stable. No monitoring data is currently undertaken along this frontage but aerial images indicate well vegetated dune fronts, suggesting little or no change is currently taking place along the coastal frontage.

The SMP2 suggested that the erosion risk would be between 2 and 10 m by Year 20, 5 and 50 m by year 50 and 10 and 50 m by year 100, covering the coastline from Silecroft to Eskmeals. National Coastal Erosion Risk Mapping (NCERM) predicts the following: 2 to 8 m by year 20, 10 and 20 m by year 50 and 20 and 40 m by year 100, equating to around 0.2 to 0.4 m per year. These rates seem low compared to recent rates; however, erosion is episodic and storm driven, when several metres can occur. This make predicting future change difficult as it is fully dependent upon the frequency and severity of future storm events and the residual protection provided by the blocks.

Figure 11 Eskmeals dunes and spit. Image © North West Regional Monitoring Programme, 2009.

2.2 Outline of the problem

2.2.1 Background

The key risk is erosion and flooding due to overtopping, potentially resulting in loss of access (C4027 road) to Eskmeals Range. This is currently the only viable access as the alternative route road passes under Eskmeals viaduct and therefore has height, width and tide restrictions. The Eskmeals site is understood to be a critical MOD testing facility and is also a defined COMAH (Control of Major Accident Hazards) site regulated site for which emergency access is critical. Eskmeals is the only site of its kind in England and one of the only two in the UK that offers long range ballistic weapons testing. A study was commissioned in 2012 (Capita Symonds, 2012) to assess the current defences and appraise options for temporarily defending the C4027 road from erosion in its current alignment, until a new access road to the Eskmeals Range has been constructed. The study covered the section of foreshore between Stubb Place and the Beach House, around 200 m long. Further work was undertaken by Jacobs in 2019 to provide design advice for a short term solution to address the erosion risk to the road at Stubb Place.

In addition to the nationally importance of Eskmeals Range, the beach fronting this section of coastline used to be an important amenity for the locals. The damaged defences currently pose a health and safety issue for the local community accessing the beach, as no formal access or car park facilities are provided.

2.2.2 Issues, constraints and opportunities

Due to the likelihood of losing the access to the MoD site, Cumbria County Council had previously identified realignment of the C4027 road in its Local Transport Plan, but it was defined as a low priority and unlikely to attract funding in the short term (JBA, 2005). Therefore, a study to appraise short term coastal defence options was commissioned in 2012 (Capita Symonds, 2012), while the funding and construction of a new route was developed.

The long list of options considered by Capita Symonds (2012) has been reviewed and is considered appropriate; these options have therefore been carried forward to this strategy.

Following the appraisal report, discussions between Cumbria County Council, Copeland Borough Council and QinetiQ were held to agree a short term approach to protect the road. Following discussions, it was agreed (April 2016) that the beach area in Stubb Place is needed to perform two vital functions:

a) maintain coastal road to protect existing business and access to properties independent of tides,

b) maintain safe access for leisure activities for locals and tourism.

Mitigation undertaken since 2007 by locals has helped to prevent the road from being washed away during the successive winter storms, but the road has still suffered from debris being washed onto it and hundreds of tons require removal following significant storm events.

More recently, the likelihood of losing the access road has increased. The risk of road closure is the highest business continuity risk for MoD and QinetiQ; the site is a strategic asset with unique capability and unencumbered access for large equipment is required at all times to ensure continuity. The site employs 37 people is both a significant contributor to the local economy and has wider economic benefits.

Loss of this road would also compromise the access for residents and workers to the coastal hamlet of Monks Moors: this is the only access road to Monks Moors.

Copeland Borough Council as Coast Protection Authority is responsible for managing the coast, whilst responsibility for protection of the road lies with Cumbria County Council. However, lack of funding is a key constraint in terms of future management of the road.

Any works would have potential impacts on designated sites: namely Morecambe Bay and Duddon Estuary SPA, which includes the intertidal areas and is an important site for large numbers of wintering and passage waterbirds, as well as qualifying for breeding terns, and Drigg Coast SAC and SSSI, which as well as covering the larger area of Eskmeals Dunes, also includes a small site just to the north of Stubb Place. This area is also important for its high landscape value, recognised in its inclusion in the Lake District National Park and World Heritage Site.

There is an opportunity to increase tourism in the area. The Wellbank Site Bootle has been granted planning permission in 2016 for 50 houses, hotel and business units and works are planned to start in 2019. The beach area is a potential community amenity that could attract tourism and more residents to the area, which represents a possible funding opportunity to short term options and new road construction.

2.2.3 Strategy considerations and general approach

Key considerations

Since the SMP was produced, further studies and monitoring data has been collated. The strategy has considered this more recent data to appraise:

- current defence conditions and risks
- recent shoreline change

A review of the Stubb Place Coastal Protection Options Appraisal (Capital Symonds, 2012) has also been undertaken, taking account of any recent changes in conditions and designations.

Strategy approach

The following situation applies to this frontage, and will be addressed as follows:

- SMP appropriate - the SMP2 policy does not need review so the aim of the strategy is to develop measures to implement the policy. Future works to manage flood and erosion risk may be eligible for a proportion of FDGiA funding and the economic appraisal will consider costs and benefits, following FCERM-AG guidance.

2.3 Options development and appraisal

There are three distinct areas, in terms of their management approach: (1) Stubb Place, where management of risks to the road in the short term is the key concern, (2) Eskmeals MoD range,

where QinetiQ reactively manage the shingle ridge and (3) natural unmanaged frontage of Eskmeals Dunes, to the north of the MoD site.

This options development and appraisal considers area (1) Stubb Place. Areas (2) and (3) are briefly discussed within Section 3, together with the non priority unit d2.1.

2.4 11d2.2 (part) Stubb Place and Eskmeals Dunes (south)

2.4.1 11d2.2 (part) - Initial screening of options

The Stubb Place Coastal Protection Options Appraisal Report (Capita Symonds, 2012) considered a number of options (see Table 3). It should be noted that these are to address protection of the road in the short term, while a new route is planned. They are therefore not intended to be long term measures.

Table 3 Review of short list options presented in Capita Symonds (2012)

Capita Symonds short list (2012)	Description	Equivalent strategy option	Strategy option number
Option 1 Do nothing	Considered as a baseline against which the other options can be compared. The option entailed a complete cessation of maintenance and management of the coastline and natural processes would be allowed to continue, with the eventual loss of the road due to erosion.	Do nothing	Option 1
Option 2 Do minimum	Maintaining the current defences as they stand. The gabions have already reached the end of their useful lifespan and would thus be allowed to continue to deteriorate. The Pendine block defences would be maintained in their current configuration with maintenance likely to be required after storms to reinstate displaced blocks. If necessary the blocks could be extended northwards along the frontage currently covered by the gabions if and when that section of the road became threatened by erosion.	Do minimum	Option 2
Option 3A Do Something: reconstructing existing Pendine block defences	Reusing the existing Pendine blocks with the addition of extra blocks if required along the existing alignment. Although they are not an established method of providing erosion protection, they are considered practical for the temporary structure required and are a low cost option.	Hold the line: improve existing defences	Option 3
Option 3B Do something: reconstructing of set back Pendine block defences	Reusing the existing Pendine blocks but reconstructing along a setback line.	Managed realignment: construct defences once set back	Option 6a
Option 3C Rock armour defences to replace existing Pendine block defences	Construction of new rock armour defences along the existing alignment	Hold the line: improve – construct new revetments	Option 4
Option 3D Set back rock armour revetment	Construction of new rock armour defences along a setback line.	Managed realignment: construct defences once set back	Option 6b
Option 3E Construction of defences using sand filled geotextile containers	Construction of defences utilising geotextile filled with sand. [This was included in the Capita Symonds study as CBC had previously discussed this option with a company producing geotextile products of this nature.]	Managed realignment: construct erosion slowing defences	Option 5

As part of the Capita Symonds appraisal, the following options were rejected at the long list stage:

- Construction of gabion basket defences. This option was rejected as gabion baskets were concluded to be not suitable for the exposure conditions at the site.
- Concrete sea wall. This option was rejected due to the requirement for defences to be temporary and removable at the end of the 20 year period: disposal of concrete would also incur extra costs.
- Construction of defences using sheet piles adjacent to the road. This option was rejected due to the requirement for the defences to be temporary and removable.

Proposed options not considered within the Stubb Place Coastal Protection Options Appraisal Report (Capita Symonds, 2012) are:

- Hold the line: improve – construct new shore control structures
- Hold the line: improve –beach recharge

These are considered in Table 4 below:

Table 4 Screening of long list options not considered by Capita Symonds, 2012

Long list options	Description	Short listed?	Rationale
Hold the line: improve through constructing new shore control structures	Construction of new shore control structures, such as groynes, reefs, breakwaters to manage the ongoing erosion.	No	This option would provide long term protection to the road and properties and would therefore require a change in SMP policy, which only refers to short term measures to protect the road. There is limited natural input to this frontage, therefore this approach would need to be undertaken in conjunction with beach recharge (see below). The capital cost investment required and limited assets would make funding difficult as well as the potential to have implications to the natural coastal process along the wider frontage. It is unlikely that this would be acceptable given the SPA status of the intertidal area.
Hold the line: improve through beach recharge	Recharge beach through either nourishment or recycling, which could include a range of different sediments.	No	This option would provide long term protection to the road and properties and would therefore require a change in SMP policy, which only refers to short term measures to protect the road. Due to exposure conditions along this frontage, it would probably need to be undertaken in conjunction with beach control structures (see above). The capital cost investment required and limited assets would make funding difficult as well as the potential to have implications to the natural coastal process along the wider frontage. It is unlikely that this would be acceptable given the SPA status of the intertidal area.

2.4.2 11d2.2 (part) - Development and appraisal of short listed options

In terms of designations, since the Capita Symonds' report was produced (2012), the Lake District National Park has become a World Heritage Site (WHS). With respect to the coast, the principles of the World Heritage Site are aligned to those of the National Park as the primary purpose of being a World Heritage Site is to conserve the globally important natural or cultural heritage of a location. The nearshore and intertidal zone is now also covered by Morecambe Bay and Duddon Estuary SPA, which was designated in 2017 and replaced two individual sites, Morecambe Bay SPA and Duddon Estuary SPA, involving an extension to include the Ravenglass Estuary and intervening coast and the

shallow offshore area off south west Cumbria coast. The landward boundary of the site follows mean high water, whilst the seaward boundary reaches a maximum of 8 km offshore. The foreshore around Tarn Point, to the south of this frontage, is also recognised as an important area for its blue mussel beds and honeycomb worm reefs, although currently it is not a defined MCZ.

Road protection works at Stubb Place are not likely to represent significant direct risks to protected sites due to the absence of any designated habitat in the immediate vicinity, although impacts on the adjacent SAC need to be considered. In terms of condition, since the Capita Symonds' report, there has been damage to the defence, structure, with removal of the infill between the blocks and leading to their collapse. This has effectively resulted in a retreat of the backshore by between 4 and 7 m, with much of this change having taken place during winter 2013 and 2014, but further damage caused in winter 2015 and 2016 and January 2018.

This section re-assesses the conclusions reached by Capita Symonds (2012) regarding each of the short listed options, taking account of these changes.

As highlighted above, these options only discuss the short term (up to 10 years) management of defence to the road whilst a long term, more permanent solution is discussed to relocate the C4027 road.

Do nothing (Option 1)

This is considered as a baseline against which other options can be appraised. Under this option all maintenance and management of the defences would cease and defences would be allowed to fail.	
Technical	The current defences are in a poor condition and provide very little protection against storms. Further movement of the blocks is expected during high energy events. Overtopping is already an issue, which causes debris to be spread across the road during storms, making its use during and post storms hazardous. It is anticipated that the road will be lost very shortly: in 2012 it was estimated that storm events similar to those of 2002 could result in loss of the road in two events, and since then the land between the shoreline and the road has narrowed further. Capita Symonds (2012) suggested that subsequent erosion of the shoreline along the study frontage would supply relatively little extra sediment to supplement the existing quantities, which is reasonable given the low height of the cliff here. Erosion here is currently cutting into raised beach deposits and it is anticipated that in the very long term a more sustainable bay form would be achieved, if erosion were allowed to continue.
Environmental	Loss of use of the road would impact on the viability of the MoD site as it would impair access to and from the site (24 emergency access is a key requirement), with subsequent knock on effects on the local community through loss of employment, given the national strategic importance of the site. Loss of the road would also impact on connectivity to Monk Moors and the smaller farm holdings. As the defences collapse and debris is dispersed along the frontage there would initially be an adverse aesthetic and health and safety impact on the area which could impair its current use as a popular amenity area. This would also be in conflict with the landscape designation of the area, as part of the Lake District National Park and World Heritage Site. However, in the longer term, a move towards a naturally functioning system and the protection and enhancement of 'wildness' with emphasis on sustainability are objectives of the National Park Management Plan, which this option would help to meet; however, some terrestrial features that contribute to the landscape character may be lost in the long term including coastal access. Similarly, a continuation of natural coastal processes is likely to be beneficial for the Drigg Coast SAC and SSSI and the river estuaries are likely to remain in a very natural state. The extent of estuary habitats is unlikely to change (beyond natural channel movements) and will continue to support a range of biotopes. A Habitat Regulations Assessment may be required (since this policy involves complete cessation of management and maintenance) to assess the impacts of Do nothing on the Drigg Coast SAC and Morecambe Bay and Duddon Estuary SPA under the Habitats and Species Conservation Regulations (2017), and the policy may require assessment under the Countryside and Rights of Way Act (2000) in relation to the Drigg Coast SSSI. As the shoreline retreats there could be implications for the boundary with Eskmeals Ranges, and at the southern end of the QinetiQ managed MoD site, there may be a need to consider allowing some roll back or realignment of the shingle ridge to address this. However, this could increase the risk of environmental contamination and risk to life due to unexploded ordnance within the MoD site.
Cost	There are no costs associated with the Do nothing option.

Damages	Potential failure of the existing defences, further erosion of the land between the defences and the road, and eventual loss of use of the road itself would lead to a potential discontinuity of the MoD site (Capita Symonds, 2012). The cost of damages related to property loss risk is estimated to be £50 k. The value of economic loss related to closure of the MoD / QinetiQ site due to lack of access has not been fully quantified. However, the MoD has confirmed that the road is critical to the operation of and emergency access to the site, which they consider is *"… a nationally important strategic site for the testing of new and existing weapons systems. This is the only site of its kind in England and one of only two in the UK (the other being at Aberporth in the Hebrides which is remote and subject to restrictions) that offers long range ballistic weapons testing. In addition to its strategic importance the site provides considerable economic benefits to both the local and national economies. The site employs 37 people and a recent analysis indicates it directly contributes at least £4.5 million to the local economy. In addition to there can be upwards of 30 visitors per day which could be contractors, QinetiQ staff from other sites or customers for trials. Eskmeals will have approximately 30 trials per year but the activities are not just trials, they could be works done on the SSSI sites, tree felling, rebuilding the sea walls, maintenance to buildings etc often using local contractors. The wider economic benefits are more difficult to quantify but the value of the contracts for testing at Eskmeals can be measured in tens of millions. Any loss of the access road, even on a temporary basis, will have a significant impact on these economic benefits."* The FCERM national economic damages in relation to the erosion risk to the access road would be capped at the cost of provision of alternative access or road diversion.

Do minimum (Option 2)

This is also considered as a baseline against which other options can be appraised. Under this option only reactive patch and repair maintenance would be undertaken, with no works to address any increase in risk due to sea level rise. The Do minimum option consists of maintaining the existing block defences in their current configuration, carrying out repairs as and when necessary. Note that in Capita Symonds appraisal it also included partial reconstruction of the structure in year 10.	
Technical	Since the Capita Symonds 2012 report, there has been further displacement of the blocks, with erosion of the shoreline behind. The Jacobs (2019) report determined that due to further deterioration of defences, do minimum is no longer a realistic option along much of the exposed parts of the road. As part of their assessment, Capita Symonds proposed partial reconstruction in year 10. Given the more recent deterioration, it is not thought likely that this option would provide sufficient time for the road to be relocated, unless the reconstruction was brought forward to the present day (which is effectively considered as part as option 3). Even if this were undertaken, unless the design of defences was modified there is a risk that a single storm event could return the defence to its current condition, given the changes that have taken place in the past.
Environmental	Given recent deterioration, it is thought unlikely that a do minimum approach will provide adequate protection. Therefore the situation would quickly revert to do nothing, with possible loss of the road within 5 years. Impacts will therefore be very similar to Option 1.
Costs	Regular ongoing maintenance would be required to reinstate displaced blocks and this will increase as the overall structure deteriorates. Capita Symonds estimated an initial sum of £2,500/ year, but suggested that to take account of increasing maintenance requirements this sum should be raised by 10% per annum over the 20 year assessment period to a ceiling of £7,500 per annum. A sum of £10,000 was included in year 10 for a partial reconstruction of the structure: this would probably need to be brought forward to the present day and repeated at 5 year intervals. Uplifting these estimates to 2018, the total present value cost is £110 k. The total present value cost with optimism bias for this option is £180 k.
Benefits	This option would only maintain the current level of protection of the road for a very short time; it would remain at very high risk of failure and overwashing with beach material during storms. The strategy benefits assessment for property risk does not distinguish monetised damages under this option from the Do nothing. The reduced value of economic loss related to closure of the QinetiQ site due delay to loss of lack of access has not been quantified, the upper limit would be the cost of relocating the road.

Hold the line: improve existing defences (Option 3)

This is Capita Symonds Option 3A and involves measures to improve the existing defence through reusing the existing Pendine blocks, with the addition of extra blocks if required, along the existing alignment. The reconstructed wall would follow the same line as the existing wall and along the full 250 metre length of the frontage to protect the land between the road and the current shoreline and maintain its amenity use.

Technical	As identified by Capita Symonds (2012), the current Pendine block structure currently suffers from two design issues: (1) the wall has no foundation meaning the blocks have subsided and collapsed; (2) material behind the wall is washed out by waves and from rainwater percolating through the wall. Any future re-design would need to ensure an adequate foundation to support the wall, for example a layer of bedding stone below and behind the wall to provide support, as well as by setting the toe into the existing beach below expected scour depths. A geotextile membrane would also be required (Capita Symonds, 2012). Placement of the blocks would also need to be considered; to date the blocks have not been interlocked or fixed together, allowing movement. This is a particular risk given the fronting beach is fairly volatile and the location exposed to direct wave attack. As highlighted by Capita Symonds, detailed design would also need to consider whether the blocks should be stacked or laid to provide a smoother 'apron' to dissipate wave energy, topped by a wall to reduce overtopping. As the reconstructed defence will generally follow the same line as the existing, it will not encroach any further onto the beach than at present and given the low rates of transport along the frontage should not have an adverse effect on sediment transport across the frontage and northwards, but this would need to be confirmed at design stage. No increase in crest height is assumed, as this would require significant import and additional fill material, significant number of blocks and therefore additional costs.
Environmental	This option is not likely to represent a significant direct risk to any protected site due to the absence of any designated habitat in the immediate vicinity. The works would involve maintaining the same alignment as the current defence and therefore interruption to alongshore drift is likely to be negligible. As the intention is also that this would be a short term measure only, the works are unlikely to impact on the Drigg coast SAC/ SSSI dunes to the north. Implementation of this option must not constrain the achievement of the Water Framework Directive (WFD) objectives for the Cumbria Coastal water body. As this only involves reconstruction of the existing structure, it is unlikely to significantly impact on the landscape value and views of the frontage, particularly in relation to the Lake District World Heritage Site and National Park, with potential to improve landscape quality by replacing failed defences. Accessibility to the beach could be improved as part of a modified design.
Costs	Capita Symonds' estimated reconstruction to cost £40,100, with additional maintenance of the structure required following storms costing around £1,000/ year, increasing by 10% per annum to a ceiling of £3,000. Uplifting these estimates to 2018, the total present value cost is £140 k. The total present value cost with optimism bias for this option is £220 k. QinetiQ have previously offered to make available at least 200 extra blocks which could be used in the new structure: the Jacob's report suggested that an additional 180 blocks would be required. It is now considered unlikely, however, that sufficient additional blocks will be available.
Benefits	This option should enable continued protection to the frontage for the short term, assuming the recommended modification to the design are undertaken, but is dependent upon availability of additional blocks. With no increase in crest level, overtopping of waves and beach material would still occur during extreme events, which would affect the use of the road. The property related benefits are £50 k compared to Do nothing option. The benefits from delay in closure of access to the QinetiQ site have not been quantified but may be significantly greater than the cost of the works, the upper limit would be the cost of relocating the road.

Hold the line: improve through constructing new revetments (Option 4)

This is Capita Symonds Option 3C and involves measures to improve the existing standard of protection by replacing the existing Pendine blocks with rock armour along the existing alignment and along the full length of the frontage. The rock armour revetment would be constructed utilising a geotextile membrane and bedding stone as required, similar to Option 3. It would first be necessary to remove the Pendine blocks and the remains of the dilapidated gabion baskets.	
Technical	As the reconstructed defence will generally follow the same line as the existing, it will not encroach any further onto the beach than at present and given the low rates of transport along the frontage should not have an adverse effect on sediment transport across the frontage and northwards, but this would need to be confirmed at design stage. It may also be possible to create a higher structure than currently present, to reduce the risk of overtopping during storms.
Environmental	As for Option 3, this option is not likely to represent a significant direct risk to any protected site due to the absence of any designated habitat in the immediate vicinity. The works would involve maintaining the same alignment as the current defence and therefore interruption to alongshore drift is likely to be negligible. As

	the intention is also that this would be a short term measure only, the works are unlikely to impact on the Drigg coast SAC/ SSSI dunes to the north. Implementation of this option must not constrain the achievement of the WFD objectives for the Cumbria Coastal water body. Alteration to existing defences may impact on the landscape value and views of the frontage, particularly in relation to the Lake District World Heritage Site and National Park; however, it would be replacing a similar structure and would represent a potential improvement from the current situation. Accessibility to the beach could also be improved as part of a modified design. If the blocks cannot be reused as bedding stone, appropriate removal and disposal of the Pendine blocks needs to be considered.
Costs	To take into account the possibility of re-using the Pendine blocks, Capita Symonds developed two estimates: (i) assumes their suitability for reuse as bedding stone: £495 k Uplifting these estimates to 2018, the total present value cost is £570 k. The total present value cost with optimism bias for this option is £920 k. (ii) assumes that they have to be removed and disposed of: £750 k. Maintenance is included for the rock armour at £2,000 every 4 years. Uplifting these estimates to 2018, the total present value cost is £870 k. The total present value cost with optimism bias for this option is £1,390 k.
Benefits	As for Option 3. this option should enable continued protection to the road and properties for 5 to 10 years, assuming the recommended modification to the design are undertaken. Improvement to beach accessibility could be considered at scheme design stage. There may be a possibility of increasing the crest height or width to reduce the risk of overtopping during extreme events, which would affect use of the road. The property benefits are £50 k compared to Do nothing option. The benefits from delay in closure of access to the QinetiQ site have not been quantified but may be significantly greater than the cost of the works, the upper limit would be the cost of relocating the road.

Managed realignment: construct erosion slowing defences (Option 5)

This is Capita Symonds Option 3E and involves the use of sand filled geotextile containers to form a sloping revetment at angle of 45 degrees over a 200 m length along the Stubb Point frontage.	
Technical	Construction is relatively simple with the only technical issue being a source of sand to fill the bags. However, the existing Pendine blocks would have to be removed and disposed of and it was assumed that this would have to be to landfill to compare this option on an equal basis (Capita Symonds, 2012). As highlighted by Capita Symonds, a key issue is the source of sand to fill the bags. The concept design assumed that beach material would be used, but this is not recommended as removal of material from the beach could have an adverse effect on the adjacent coastline. Use of material from the modified dune area in the MoD site could be an alternative option, but there may be contamination and UXO risks associated with dune material from within the Range. Obtaining material from the dunes further north is unlikely to be permitted as the area is a designated SSSI and SAC. The dunes in the Range near the southern boundary are also part of the SSSI. The origins and nature of any imported material would need to be carefully considered as this material will eventually re-enter the sediment system. With this option, there is a high level of flexibility in terms of the configuration of the defence structure. There is, however, the potential for the structures to be susceptible to vandalism and once torn or split their ability to retain the sand is lost and so is their effectiveness. However, there have been recent advancements in their design and a better understanding of the optimum sand fill ratio to achieve best hydraulic stability. The effectiveness of these structures remains highly dependent upon the quality of the product and installation.
Environmental	As works will follow a similar alignment to options 3 and 4, this option is not likely to represent a significant direct risk to any protected site due to the absence of any designated habitat in the immediate vicinity. The works would involve maintaining the same alignment as the current defence and therefore interruption to alongshore drift is likely to be negligible. As the intention is also that this would be a short term measure only, the works are unlikely to impact on the Drigg coast SAC/ SSSI dunes to the north. Given the limited resource of sand locally and designation of the foreshore and adjacent dunes (outside of the Ranges), sourcing appropriate sand will be an issue. In addition, once the road is relocated, wholesale removal of the containers is unlikely to be possible (unlike rock or Pendine blocks), therefore it is assumed that they would either be allowed to degrade naturally or the containers would be split and sand allowed to be distributed naturally: therefore, the impacts of this would need to be considered further at design stage.

	The installation of new geobags may affect the visual amenity of the site and its landscape value, particularly with relation to the World Heritage Site and the National Park.
Costs	A budget estimate for construction of a 200 m long revetment was provided as part of discussions with CBC and Capita Symonds (2012), using material from the beach to fill the geotextile bags. As noted in the environmental assessment, this is unlikely to be a viable option and material would have to be imported. The total cost for construction of defences using sand filled geotextile containers was estimated by Capita Symonds (2012) to be £560 k, including use of imported material. This also includes an allowance of £2,000 every 4 years for maintenance. Uplifting these estimates to 2018, the total present value cost is £650 k. The total present value cost with optimism bias for this option is £1,040 k.
Benefits	As for Option 3 and 4, this option should enable short term protection to the road and properties for the short term, assuming a high quality product is used. It is unlikely that it would be possible to raise the crest height above the current shoreline height, therefore, as for Option 3 it is possible that overtopping could still occur during extreme events, which would affect use of the road. The property benefits are £50 k compared to Do nothing option. Benefits from delay in closure of access to the QinetiQ site have not been quantified but may be significantly greater than the cost of the works, the upper limit would be the cost of relocating the road.

Managed realignment: construct defences once set back (Option 6a, b)

This would involve the set back of defences. Option 6a assumes use of Pendine blocks (Capita Symonds Options 3B), 6b assumes rock armour revetment (Capita Symonds Options 3D).	
Technical	In both cases, the existing Pendine blocks and dilapidated gabions would be removed from the beach and new defences would be constructed alongside the road to provide protection from erosion as and when the intervening land is eroded. The structure would also have a raised crest level to reduce the volume of overtopping. According to the Capita Symonds report, construction would involve excavating a trench parallel to the road to a sufficient depth and width to construct the defences. In case of the rock armour option, geotextile and bedding stone (possibly reusing the Pendine blocks) would also be laid parallel to the road, placing the rocks and then backfilling with the excavated material. The new alignment may depend upon existing utility services. When Capita Symonds undertook their appraisal, at the southern end of the frontage the backshore was within 5 to 6 m of the road, but at the northern end of the frontage there was approximately 15 m of land that would be eroded before the shoreline face was within 5 to 6 metres from the road edge. Capita Symonds suggest that construction could be in phases: phase 1 immediately (90 m), phase 2 in 2020 (80 m) and phase 3 in 2027 (80 m). The concept is to allow a more natural embayment to form which could make the defences more sustainable. However, there is very limited space to allow set back and therefore it is unlikely that this option would actually provide much benefit in terms of a more natural coastline developing. It could, however, mean that a larger defence could possibly be built without encroaching on the current designated intertidal area. Since the report there has been further erosion, and now more than 165 m of the road is within 5 m of the backshore. At the next 150 m, the road is within 20 m of the backshore. Therefore, the phase one works would now need to include the phase 2 works, and phase 3 works may need to be brought forward.
Environmental	This option would allow continued erosion of the land between the current shoreline edge and the road; however, the land is used as an informal car park for members of the public using the beach as an amenity area. Numbers of visitors are unknown but anecdotally the beach is a popular area (Capita Symonds, 2012). Formal access to the beach would become unavailable. As for the other options, there this option is not likely to represent a significant direct risk to any protected site due to the absence of any designated habitat in the immediate vicinity. The installation of new set back defences may change the visual amenity of the site and its landscape value, particularly in relation to the World Heritage Site and the National Park; however, it would be replacing a similar structure, particularly if Pendine blocks were used.
Costs	Assuming (a) Pendine Blocks: the original estimate for phase 1 was £23 k, with total present value costs are estimated to be £86,000. This assumed use of 200 blocks offered by QinetiQ. These costs are now likely to be an underestimate due to the additional erosion that has occurred since the Capita Symonds report. Uplifting these estimates to 2018, the total present value cost is £100 k. The total present value cost with optimism bias for this option is £160 k. Assuming (b) rock armour: as for Option 4, Capita Symonds provided two estimates: (i) reusing Pendine blocks as bedding stone - £400 k (Phase 1 - £135 k)

		Uplifting these estimates to 2018, the total present value cost is £460 k. The total present value cost with optimism bias for this option is £740 k.
	(ii)	assuming disposal of Pendine blocks required - £605,000 (Phase 1 - £205 k). As stated above these costs are now likely to be an underestimate due to the additional erosion that has occurred since the Capita Symonds report. Uplifting these estimates to 2018, the total present value cost is £700 k. The total present value cost with optimism bias for this option is £1,120 k.
Benefits	As for Option 3 this option should enable continued protection to the road and properties for the short term, and there may be a possibility of increasing the crest height or width to reduce the risk of overtopping during extreme events. This option would, however, allow loss of amenity use of the land between the defences and the road, also affect access to the beach. The property benefits are £50 k compared to Do nothing option. Benefits from delay in closure of access to the QinetiQ site have not been quantified but may be significantly greater than the cost of the works, the upper limit would be the cost of relocating the road.	

2.4.3 11d2.2 (part) - Discussion

Table 5 provides a summary of the cost and benefits calculated for the above options. None of the options achieve a cost-benefit ratio greater than 1; however, the calculated benefits do not include value of road access to the QinetiQ Eskmeals site and other properties. If money is not available to fund new works then the situation will revert quickly to Do nothing, due to the current state of defences.

The preferred long term solution is the construction of a new access road further inland, which would not be subject to the same risk of erosion as the current road. This would mean that defences would not be maintained along the frontage and would allow erosion of the shoreline to a more sustainable location, which could also have benefits for designated sites. Discussions between QinetiQ, CBC and Cumbria CC are ongoing, but it is unlikely that a new road will be constructed within the next few years therefore it has been assumed works will be required to protect the road for 5 to 10 years.

Capita Symond's 2010 appraisal of possible options for defending the road in its current alignment until the new road has been constructed concluded that Option 3B: Construction of setback defences using Pendine blocks was the most sustainable option (considered here as Option 6a). A particular advantage of this was the possibility of constructing defences in phases, which reduces initial investment. However, since the 2010 report, there has been further erosion of the frontage, meaning that a longer defence would need to be constructed during phase 1 than originally assumed. Although there remains potential for works to be undertaken in a phased way, there is a risk that outflanking may simply accelerate erosion at the terminal ends of the defence, such that extensions are required earlier. Therefore options 3, 4 or 5 are now more likely to be effective than options 6a and b.

Whether Pendine blocks (Option 3) or rock (Option 4) is used is likely to depend upon available funding and availability of additional blocks. It is uncertain whether there are enough additional Pendine blocks available and although more expensive, rock armour would be a technically better coastal defence solution due to reduced wave reflection which should result in less beach scouring during storms. Rock has been used in many locations and therefore there is much better understanding regarding design approaches; it is also potentially easier to remove and re-use in other locations. It is possible that a combination of Pendine blocks and imported rock will be the most appropriate approach: the costs of this are likely to lie between those presented for Options 3 and 4.

Geotextile sand filled containers (Option 5) remain a viable option, given improvements to the technology; the advantage of this approach is that it can use locally sourced sand (if available) and that the defence is easy to dismantle when it is no longer required. However, if using locally derived material is not feasible or environmentally unacceptable, given the SPA designation of the intertidal

and SAC designation to the north, then the cost of importing sand and the potential 'contamination' implications would mean this is unlikely to be the best solution for this frontage.

During consultation, a number of respondents expressed that their preferred option would be to construct a new road back but to continue to protect the frontage with new structures preferably using a new rock armour revetment. This would also allow potential for the creation of new visitor's facilities and car park. However, at the time of writing, funding is unlikely to be justifiable unless an economic case is developed including the new developments in Bootle and the benefits of the MoD site to the local economy. This would also be contrary to the existing SMP policy of Managed Realignment. Should an alternative road route be agreed, then options to Hold the line may need to be considered, but approaches to this have not be considered by this strategy. It should be noted however, that the proposed approaches to protecting the road in the short term would not limit a different option being considered in the future.

Table 5 Policy unit 11d2.2 Summary of economics

Option	Present Value Total cost (PVc) £m	Present Value Total cost (PVc)* with optimism bias £m	PV Benefit (Damage Avoided) £m++	Average Benefit Cost Ratio
Option 1 Do nothing	0.00	0.00	0.00	-
Option 2 Do minimum	0.11	0.18	0.00	0.00
Option 3 Hold the line: improve existing defences	0.14	0.22	0.05	0.23
Option 4.1 Hold the line: improve – construct new revetments (Re-use Pendine blocks as bedding stone)	0.57	0.92	0.05	<0.1
Option 4.2 Hold the line: improve – construct new revetments (Pendine stones are removed and disposed)	0.87	1.39	0.05	<0.1
Option 5 Managed realignment: construct erosion slowing defences	0.65	1.04	0.05	<0.1
Option 6a Managed realignment: construct defences once set back (Concrete wall)	0.10	0.16	0.05	0.3
Option 6b.1 Managed realignment: construct defences once set back (Rock revetment, re-use of Pendine stones)	0.46	0.74	0.05	<0.1
Option 6b.2 Managed realignment: construct defences once set back (Rock revetment, Pendine stones are removed)	0.70	1.12	0.05	<0.1

**Present Value cost (PVc) inclusive of 60% optimism bias*
++ Note: *PV Benefits do not include the QinetiQ Eskmeals site and associated properties. Avoidance of loss could potentially justify the costs of short term defence to the road and longer term realigning the road.*

2.4.4 11d2.2 (part) - Strategic way forward

The long term preferred approach is relocation of the road and removal or abandonment of defences. This would also be the preferred environment approach. However, plans and funding are not yet in place to enable this and therefore in the short-term the approach is to secure the ongoing operation of the road whilst longer term realignment options are developed. The current state of the defences means that a do minimum approach is no longer a viable option, therefore works will be required to improve or replace the existing structures.

In the short term, the preferred approach is to reconstruct defences to a modified design along a similar alignment to present. Whilst economically the preferred option is to re-use existing Pendine blocks and supplement with additional Pendine blocks, it is likely that there will not be sufficient materials to cover the frontage. Therefore the most likely solution will involve using a combination of Pendine blocks and rock. Both Pendine blocks and rock would have similar environmental impacts. To minimise any impact on the environment, as far as possible works should take place within the existing defence footprint, which will mean no encroachment on the foreshore and limit any obstruction to alongshore sediment transport. Opportunity should also be sought at design stage to improve beach access for users.

Reconstructing and modifying the defences should extend their effective life by approximately 5 to 10 years, whilst medium or long term managed realignment adaptation approaches are investigated. Whether overtopping risk is reduced will depend upon scheme-level design, and in turn on the materials used and funding available: a higher crest level would improve protection but at greater cost. One approach could be to vary the level of defences along the frontage, creating a variable standard of protection: lower and using less materials (rock or blocks) at the northern end to slow rather than halt erosion, and a higher defence where the road is closest to the backshore. If it is not possible to increase crest level, there will be continued risk of overtopping during storms and therefore road closures may be required.

Along the stretch of coast north of the MoD boundary to Eskmeals Range it is assumed that QinetiQ will continue to manage risk to the Eskmeals Range, through reprofiling of the shingle ridge when required, for example, following storm damage (see section 3.2 below).

Future recommended activities include:

- CCC Highways to work with stakeholders to implement short term works to temporarily retain the road whilst a longer term approach is developed.
- Monitoring of short term defences and coastal change
- Monitoring of highway condition and safe usage: implementation of road closures during extreme events and better communication of risk to road users. This could include improved signage and provision of tide timetables to increase awareness of potential risk when using the tidal road
- Development of a longer term option for relocating the road (CCC highways led), involving engagement with all stakeholders (including LDNPA) to facilitate relocation of other assets.

Further details on actions and responsibilities are provided in the **Action Plan**

3 Appraisal of non priority units

There is one additional policy units within this area, which has been defined as a non priority unit:

- 11d2.1 Selker to Stubb Place

In addition, the northern stretch of unit 11d2.2 Stubb Place and Eskmeals Dunes has been discussed here.

A light touch review has been undertaken of current SMP recommendations, taking into account conclusions from option appraisals for the adjacent frontages, where appropriate.

3.1 11d2.1 Selker to Stubb Place

3.1.1 11d2.1 - Existing approach to flood and coastal erosion risk management

The existing SMP2 policy along this frontage is No active intervention from the short term. The primary justification for this was that it would allow a continuation of natural processes, providing sediment to local and updrift beaches and that there was also insufficient national economic justification for new defences.

There are currently no defences along this frontage.

3.1.2 11d2.1 - Strategy considerations

Since the SMP2 was adopted, the Lake District National Park has become a World Heritage Site (WHS). With respect to the coast, the principles of the World Heritage Site are aligned to those of the National Park as the primary purpose of being a World Heritage Site is to conserve the globally important natural or cultural heritage of a location. The England Coast Path (due to open in 2020) runs along the top of cliffs, but it is recognised that the path would have to be rolled back as cliff erosion continues, with potential for the path to be moved further landward if it is not possible to find a viable route.

The nearshore and intertidal zone is now covered by Morecambe Bay and Duddon Estuary SPA, which was designated in 2017 and replaced two individual sites, Morecambe Bay SPA and Duddon Estuary SPA, involving an extension to include the Ravenglass Estuary and intervening coast and the shallow offshore area off south west Cumbria coast. The landward boundary of the site follows mean high water, whilst the seaward boundary reaches a maximum of 8 km offshore. The foreshore around Tarn Point is also recognised as an important area for its blue mussel beds and honeycomb worm reefs, although currently it is not a defined Marine Conservation Zone.

Erosion of the shoreline has continued since the SMP: comparison of aerial images from 2008 (GoogleEarth) and 2016 (www.magic.gov.uk) indicates that around 10 m of erosion has occurred over this period at Selker Point, which equates to an average annual rate of 1.2 m per year; a similar rate has been experienced south of Tarn Point. Currently three farmsteads lie within 60 m of the coast. At Selker Point, a section of the access track that links the farm to the main road lies along the cliff edge and is therefore at near imminent risk of erosion (see Figure 11). A small building formerly located seawards of the track near Selker Point has previously been lost.

The SMP2 suggested that the erosion risk would be between 2 and 10 m by Year 20, 5 and 50 m by year 50 and 10 and 50 m by year 100. These rates seem a little low compared to recent change, although it was recognised by the SMP2 that there could be up to 10 m recession during a single landslide event. National Coastal Erosion Risk Mapping (NCERM) predicts the following: 4 to 8 m by year 20, 10 and 20 m by year 50 and 20 and 40 m by year 100. Again, these rates are low compared to recent rates.

A local drift divide is understood to exist in the vicinity of Selker Point, but erosion around this headland will depend upon changes to the south, which may affect the course of the River Annas.

For much of the frontage to the south (11d1) the SMP2 policy is No active intervention, allowing continued erosion of the cliffs, with a short section at Silecroft where the policy is Hold the Line; therefore, little change is therefore anticipated from the current day situation.

Figure 12 Selker Point, showing the proximity of the farm and access track to the actively eroding cliffs. The diverted path of the River Annas, which lies south of this unit is also shown in the foreground. Image © North West Regional Monitoring Programme, 2015

3.1.3 11d2.1 - Discussion

Although there are three farmsteads at potential risk of erosion and loss within the strategy lifetime (100 years), there is no national economic justification for constructing new defences along this frontage. Any new defences would also have a potentially significant negative impact on the intertidal zone, which is designated as part of Morecambe Bay SPA and Duddon Estuary SPA and is internationally recognised for the habitats it supports. Impacts would result from both the physical footprint of defences and the reduction in sediment input from the cliffs, which feeds updrift and downdrift areas; it is uncertain, however, how much beach sediment the cliffs actually contribute and inputs may be predominately fine sand and silt. Any new defences would also have a visual and landscape impact, contrary to the National Park and World Heritage site designations. Plans for relocating assets would also need to consider impacts on the landscape.

There is therefore no justification for a change in SMP policy from No active intervention, but continued erosion of the cliffs is anticipated, which could impact on farmsteads and properties, therefore effect livelihoods of the agricultural community. There is also a risk that the access track at Selker could be lost, and so would need re-routing prior to loss of the farm.

3.1.4 11d2.1 - Strategic way forward

The preferred strategic approach is to implement the existing SMP policy of No active intervention through Do nothing (no new defences).

Future recommended activities include:

- Continued monitoring of the frontage, with consideration of additional profiles to monitor erosion where assets are located, to appraise changes in risk.

- Liaison between LNDPA, Copeland BC and landowners to facilitate relocation of assets and the access track and to minimise risk to life due to ongoing coastal cliff erosion, through advising on changes in risk.

Further details on actions and responsibilities are provided in the **Action Plan**

3.2 11d2.2 (part) Stubb Place and Eskmeals Dunes (north)

This section covers the section of 11d2.2 north of the MoD boundary to the Eskmeals Range. The southern part of 11d2.2 is the priority area discussed in Section 2.4 above.

3.2.1 11d2.2 (part) - Existing approach to flood and coastal erosion risk management

QinetiQ, on behalf of the MoD, currently undertake beach management activities along the shingle ridge: post storms, material is currently drawn up from the mid beach by excavator and placed to re-form the ridge. Further north, beyond the limits of Eskmeals Range, no management of the natural dune system is undertaken.

3.2.2 11d2.2 (part) - Strategy considerations

It is understood that beach management following storms has been undertaken on the site for many years and that QinetiQ are currently reviewing possible coastal management options for their site, with the intention that for the strategy lifetime the site will remain active and strategically important. As a result of a 120-year history as a weapons testing range the site is likely to be contaminated and could result in pollution of the environment. In addition, there is a risk resulting from the probable existence of unexploded ordnance which could be triggered and exploded if the shingle ridge is not maintained.

The SMP policy recognises and allows for beach management measures being undertaken as part of the management of the frontage.

As with 11d2.1 the nearshore and intertidal zone is now covered by Morecambe Bay and Duddon Estuary SPA, which was designated in 2017 and replaced two individual sites, Morecambe Bay SPA and Duddon Estuary SPA, involving an extension to include the Ravenglass Estuary and intervening coast and the shallow offshore area off south west Cumbria coast. The landward boundary of the site follows mean high water, whilst the seaward boundary reaches a maximum of 8 km offshore. Additionally, the dunes in the southern end of Eskmeals Range where the road moves away from the coastline form a part of the Drigg Coast SSSI and SAC. Eskmeals Dunes is a mosaic of sand dunes and heathland with some areas of deciduous woodland; all of which are BAP habitats which are of national importance.

Since the SMP2 was adopted, the Lake District National Park has become a World Heritage Site (WHS). With respect to the coast, the principles of the World Heritage Site are aligned to those of the National Park as the primary purpose of being a World Heritage Site is to conserve the globally important natural or cultural heritage of a location. The England Coast Path runs inland of the dunes and would not be affected by any change in management.

3.2.3 11d2.2 (part) - Discussion

It is assumed, at the time of writing, that QinetiQ will continue to manage risk to the Eskmeals Range, through reprofiling of the shingle ridge when required, for example, following storm damage. The current SMP policy is for Managed realignment, but includes allowance for limited intervention and beach management, which such works could be considered to fall under. However, any future works will need to consider the following:

- impact on the intertidal zone, which is designated as part of Morecambe Bay SPA and Duddon Estuary SPA and is internationally recognised for the habitats it supports. Possible impacts could occur through movement of material from the mid and lower beach to the

upper beach. This needs to consider the whole policy unit as moving material from the active beach to the upper beach or backshore could impact on adjacent frontages. Indeed, there is a local belief that beach management process to the north have been increasing erosion at Stubb Place. This requires further assessment. Timing of works would also need to be considered, as there is potential to affect breeding birds.

- impact on the floodplain and coastal grazing marsh (BAP habitat) at Williamsons Moss.
- wider scale impacts on adjacent designated areas of Drigg Dunes and Gullery, Ravenglass Local Nature Reserve, particularly considering whether works would inhibit the continued growth of the spit into the estuary.
- any additional defences could also have a visual and landscape impact, contrary to the National Park and World Heritage site designations.
- decisions regarding continued managed of the coast to the south – further erosion here would have implications for managed of the southern end of the Range. Beach management within the Range must consider potential for impacts on this area.

3.2.4 11d2.2 (part) - Strategic way forward

The preferred strategic approach is for a more proactive approach to management than the current reactive practice implemented along the MoD frontage. This would benefit the Eskmeals Range, which is recognised as a strategically important site, through reducing the risk of erosion and flooding. It would also reduce potential contamination risk from the site, which could otherwise enter the water environment.

Future recommended activities include:

- QinetiQ (on behalf of the MoD) to develop management options and beach management plan to proactively manage the frontage to ensure risks to the site are minimised, including liaison with Natural England and Lake District National Park Authority to ensure impacts on adjacent designated sites are considered appropriately.
- Continued monitoring of the frontage (as part of North West Regional Monitoring Programme by QinetiQ), with consideration of impacts on adjacent shorelines, including assessment of potential increased erosion at Stubb Place due to beach management to the north
- Liaison between QinetiQ and MoD, Copeland Borough Council, Cumbria County Council (highways), Lake District National Park Authority and landowners to facilitate continued access to the Eskmeals Range (see section 2.3 above) and reach a decision regarding management of the Stubb Place frontage.

Further details on actions and responsibilities are provided in the **Action Plan**

4 Summary of proposed strategy: 11d2

Preferred strategic approach: Promote a more sustainable defence position – continue to reduce risk of coastal flooding and erosion to the coastal road at Stubb Place, whilst investigating options for a longer term relocation of the road. North of Stubb Place allow area to function as naturally as possible, whilst recognising the need to reduce risks to the MoD site.

		Next 10 years	Beyond 10 years
11d2.1	**Selker to Stubb Place**	Allow area to function as naturally as possible, through implementing no active intervention (no new defences).	
11d2.2 (part)	**Stubb Place and Eskmeals dunes (south of MoD site boundary)**	Along Stubb Place, continue to manage erosion risk in the short term whilst a longer term solution for relocating the road is considered.	Long term approach will depend upon outcome of studies to consider relocation of road.
11d2.2 (part)	**Stubb Place and Eskmeals dunes (north of MoD site boundary)**	Allow area to function as naturally as possible, through implementing no active intervention (no new defences), but allow localised management of the shingle ridge to minimise risk to Eskmeals Range.	

Key actions and activities (next 10 years):

- Monitor beach and cliff behaviour
- Monitor condition of defences at Stubb Place – particularly post-storm

- Scheme to implement short term works to reconstruct and modify defences at Stubb Place

- Studies to develop a longer term option for relocating the road
- Development of beach management plan to proactively manage Eskmeals frontage (Qinetiq)

- Raise awareness of flood and storm risk to road users
- Raise awareness of ongoing coastal change to local communities
- Engagement with communities affected by changes to the road

- Liaison with affected communities to facilitate any relocation of assets (Stubb Place, Selker Point)

- Development of funding strategy for long term relocation of road

Further details on actions and responsibilities are provided in the **Action Plan**

5 References

Capital Symonds (2012). Stubb Place Coastal Protection Options Appraisal. Produced for Copeland Borough Council. April 2012.

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