



## **Cell 1 Regional Coastal Monitoring Programme Walkover Inspection Surveys 2016**

**Scarborough  
Borough Council**

**September 2016**



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# Scarborough Borough Council

## Walkover Inspection Surveys 2016

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## Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 0-1). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial till to varying thicknesses, softer rock cliffs, and extensive landslide complexes.

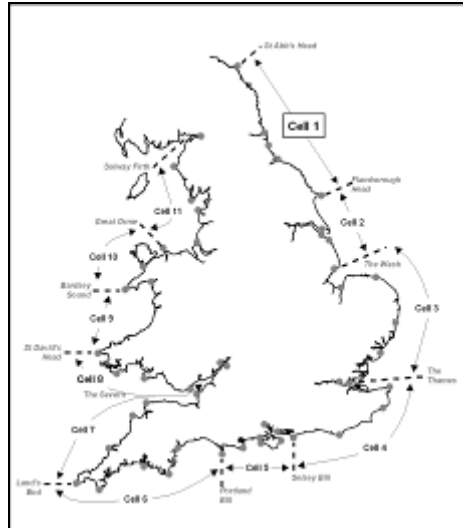


Figure 0-1 - Sediment Cells in England and Wales

The work commenced with a three-year monitoring programme in 2008 that was managed by Scarborough Borough Council on behalf of the North East Coastal Group. This initial phase was followed by a five-year programme which started in 2011 and the current five-year programme which started in 2016. The programme funded by the Environment Agency, working in partnership with the following organisations.



The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walkover inspection surveys

Royal HaskoningDHV has been appointed to provide Analytical Services in relation to the Cell 1 Regional Coastal Monitoring Programme 2016 - 2021.

The present report is **Walkover Inspection Surveys 2016** and provides a summary of the main findings from the walkover inspections of Redcar & Cleveland Borough Council's frontage that are undertaken once every 2 years.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as beach profile, topographic and cliff top surveys, wave data collection, bathymetric and sea bed sediment data collection, and aerial photography.

# 1. Introduction

## 1.1 Study Area

Scarborough Borough Council's coastal frontage extends from Staithes in the north to Speeton in the south, and is shown in **Figure 1-1**. Detailed maps showing the location of each of the coastal defence assets considered in this report are presented in **Appendix A**. In addition, the cliffs within the frontage have been classified according to their characteristic behaviour condition and a series of Cliff Behaviour Units (CBUs) have been defined and mapped. The location of the CBUs is presented in **Appendix B**.



**1-1: Scarborough Borough Council study area**

*Figure*

## 1.2 Methodology

This section presents the approach taken by the asset inspectors for the Scarborough Borough Council coastal frontage.

The walkover inspection surveys for the Scarborough Borough Council frontage were undertaken between June and August 2016. The weather conditions experienced during the inspections were generally warm and fine with no access or visibility problems caused by adverse weather despite some drizzle and light rain on occasions.

The frontage has been split into a number of 'asset lengths' (Appendix A), as defined in the National Flood and Coastal Defence Database (NFCDD) that was established by the Environment Agency.

The walkover inspections cover both built defence assets and natural defence assets such as cliffs, slopes and dunes. All assets were visually inspected, photographed and graded based on their condition and an estimate made of their residual life.

For built assets the grading classification was undertaken in accordance with the Condition Assessment Manual (EA, 2012), with estimates made of the urgency of any necessary repairs. An extract of the grading classification for built assets is presented in **Table 1-1**. For ease of reference the built asset photographs presented in this report have also been bordered with the colours key indicated below.

Grade	Rating	Description
1	Very Good	'As built' condition or cosmetic defects that have no effect on performance.
2	Good	Minor defects that will not reduce overall performance of the asset.
3	Fair	Defects that could reduce overall performance of the asset.
4	Poor	Defects that would significantly reduce overall performance of the asset.
5	Very Poor	Severe defects resulting in overall performance failure of the asset.

*Table 1-1: Condition assessment grading for man-made assets.*

In addition to the above grading classification, for natural assets such as cliffs and slopes the same five point activity scale used in previous walkover inspections within Cell 1 was used. This grading classification is presented in **Table 1-2**. For ease of reference the natural asset photographs presented in this report have also been bordered with the colours key indicated below.

Grade	Class	Description
1	Dormant	Features with no interaction with marine processes.
2	Inactive	Features with no visible evidence of erosion or landsliding activity.
3	Locally active	Features with localised evidence of small erosion or landsliding activity.
4	Partly active	Features with widespread evidence of small erosion or landsliding activity or areas of intense erosion or landsliding.
5	Totally active	Features with large-scale or intense erosion or landsliding.

*Table 1-2: Condition assessment grading used for natural assets (cliffs/ slopes).*



This report provides an overview of the findings from the walkover inspections, summarising each locality in general but also specifically identifying individual assets in 'poor' or 'very poor' condition. It is anticipated that this summary will help identify areas for maintenance or capital investment. Full details of the inspection of each asset are provided in **Appendix B**.

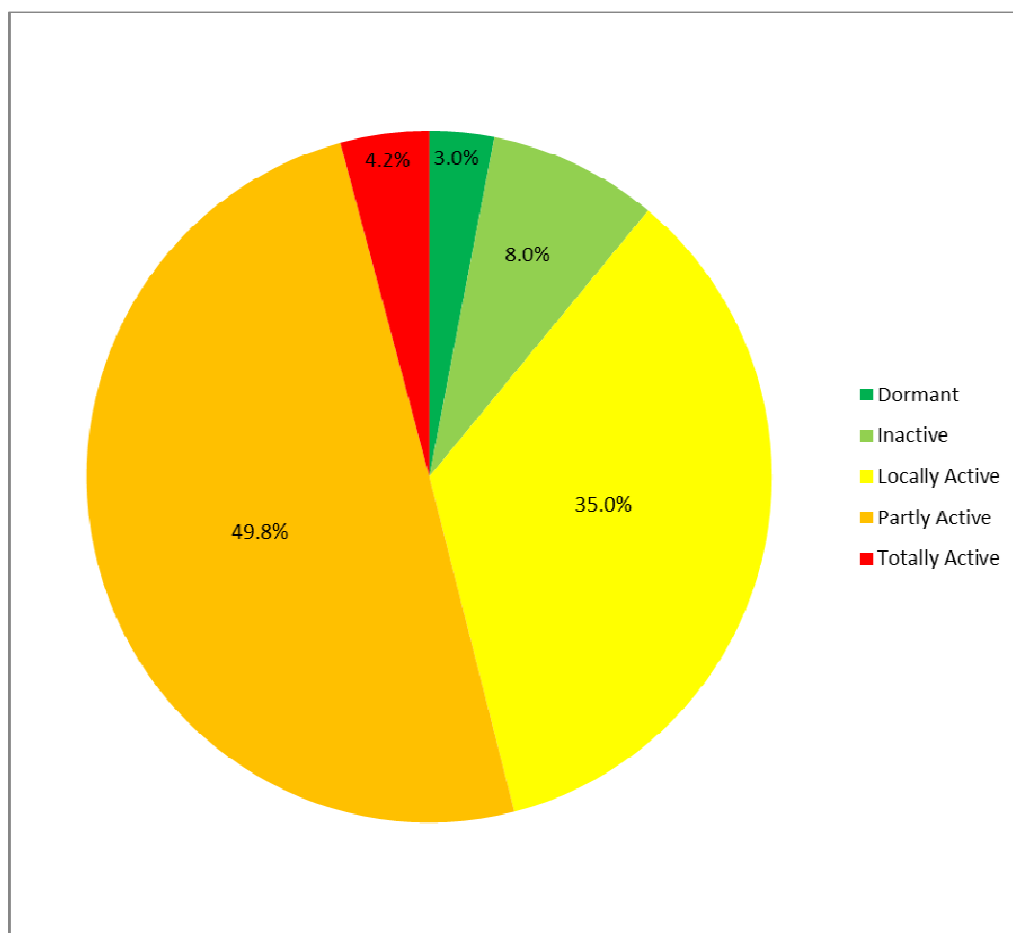
In addition to this report, full details of the inspection and a selection of appropriate photographs have been entered into the SANDS (Shoreline And Nearshore Database System) database and provided along with this report with SANDS viewer software.

## 2. Overview

### 2.1 Overview of Coastal Slope Condition Assessment

There is significant variation in the level of cliff activity within the SBC region, reflecting the diverse geology, history of landsliding and the range of cliff protection and stabilisation measures in place to tackle erosion and slope instability issues.

In total 265 cliff behaviour units (CBUs) have been assessed across the region during the 2014 walkover survey, of which Partly Active and Locally Active cliffs are the most common (Figure 1).



**Figure 1 – Cliff activity classification within SBC frontage**

The vast majority (just under 85%) of the 265 units surveyed during the 2016 walkover retained the same activity status as they had in 2014, with around 7.5% worsening and around 8% improving in condition.

One of the most significant worsenings in condition was at **Port Mulgrave**, where a large landslide occurred a few months before the inspection. One of the greatest improvements was at **Sandsend Road**, where the high coastal slopes to the rear of the coastal highway have been stabilised in 2015/16 by North Yorkshire County Council by means of mechanical re-grading and slope drainage works.

In addition to the new landslide at Port Mulgrave, sustained levels of high erosion activity were observed along part of **Tenants' Cliff** within Cayton Bay, along the south side of **Filey Brigg** and at **Hunmanby Gap**.

## **4.2 Overview of Coast Protection Asset Condition Assessment**

There are a large number of built coastal defence assets along this stretch of coastline, generally associated with the coastal towns and villages. Many of these assets are in good or fair condition but there are a large number that require minor repair works, a few where more significant works are recommended and several locations where urgent attention to provide further more detailed assessments are recommended. The most common works required include blockwork repointing, resealing of joints, reinforcement of undercut sections, repairing cracks and resurfacing.

A brief overview for each of the key locations of coastal defences, highlighting areas of concern is given below.

### **MU4 – Staithes**

- The North Breakwater has undercutting on the inner-facing side, perhaps caused or exacerbated by propeller thrust.
- Some of the structures extending into the beck as either riverside walls or property walls are locally in poor condition, with notable gaps and voids, despite obvious previous repairs.

### **MU7 - Runswick Bay**

- There are proposals for a capital scheme in 2017 to refurbish the sea wall and construct a rock fillet at its toe in the northern-most section of the bay. To enable this, Yorkshire Water plans to re-locate its sewer asset, which currently runs across the foreshore seaward of the sea wall, in September 2016.
- There is ongoing erosion of the undefended cliff at the southern end of the rock revetment that protects the car park, which should continue to be monitored for signs of outflanking of the revetment.

### **MU9 – Sandsend Village**

- The concrete sea wall around the car park at the western end of Sandsend is showing exposed rebar on the apron which should be re-covered.
- The concrete sea wall extending from Sandsend Beck to the east has exposed timber breastwork at the toe and occasional cracking in the concrete and heavy abrasion at the access steps. The sea wall is generally in poor condition and would benefit from some improvement works.
- The former sloping concrete revetment protecting the Sandsend Road was in failing condition at the time of the previous inspections and has since been replaced in 2015/16 by a new defence structure.

### **MU11-13 - Whitby**

- Whitby West Beach promenade deck has suffered cracking in the past. Some previous repairs are re-opening, requiring further attention.
- The sea wall sections of West Beach not protected by a fronting rock revetment have extensive abrasion and undercutting. Some affected sections have been covered by a new toe beam, but this does not cover the full extent of defective toe.
- The defences below Whitby Pavilion Theatre remain in poor condition and would benefit from repairs.

- Previous identified defects at Whitby Harbour Piers remain evident and, in places on the inner face of the East Pier in particular have considerably worsened. Locally, the East Pier is in very poor condition. A major capital scheme to refurbish the structures is scheduled for 2017/18.
- The quay walls within Whitby Harbour are generally in fair condition, but locally poor in places due to specific defects. For example, in the blockwork sections, there are sections of wall with open joints which require sealing and in the suspended deck section on the western quay there remains corrosion to the steel piles.

#### **MU16 – Robin Hood’s Bay**

- The large vertical defence wall continues to show deterioration with seepage and cracking and is scheduled for capital refurbishment in 2017/18.

#### **MU20-21 – Scarborough North Bay and Headland**

- Overall the structures are in fair condition, but due to their age require ongoing maintenance to infill open joints and cracks.

#### **MU21-22 – Scarborough Harbour**

- Overall the structures are in fair condition and have experienced previous repairs and maintenance works. However, due to their age they require ongoing maintenance to infill open joints and cracks.
- The most notable defects are on the seaward end and outer face of the West Pier, where repairs are recommended.

#### **MU22-23 – Scarborough South Bay**

- Overall the structures are in fair condition, but due to their age require ongoing maintenance to infill open joints and cracks.
- Some capital refurbishment works are planned for the Spa sea wall in 2017 as part of the wider coast protection and slope stabilization works.
- Many of the sea walls south of the Spa are heavily abraded and locally damaged. Specific defects were noted at South Cliff Gardens (despite considerable previous repairs). Two voids in the sea wall at this location were reported to Scarborough Borough Council from site during the inspections and were repaired within 2 weeks.

#### **MU24-25 – Cayton Bay**

- At the time of the inspections, the defences at the public access steps, south of the former pumping station, had failed, with large voids present and very significant overall damage. These defects were reported to Scarborough Borough Council from site during the inspections and were repaired within 2 weeks.

#### **MU28a-29a – Filey**

- The central steel sheet pile section of the defences at Filey Sailing Club has been replaced since the previous inspections.
- The main sea wall defences through the town show evidence of significant maintenance and repair works over recent years, but ongoing maintenance work is required due to the age of the

structure and the presence of remaining cracks and damage, which appears to worsen with progression south.

- A short section of rock revetment with gabion baskets beneath is located at the southern end of the sea wall near Martin's Gill. This defence is in fair condition but, the coastal slopes behind the revetment still appear to be active and some form of improved outflanking defence remains necessary in the medium term.

### 3. Condition Assessment

#### 3.1 Management Unit 4 - Staithes

##### *Coastal Slope Condition Assessment*

This Management Unit comprises the high cliffs of Cowbar Nab composed of sandstone and those behind and immediately to the east of Staithes composed of sandstone overlain by ironstone, all fronted by a rock platform.

The eastward facing cliff of Cowbar Nab (MU4/1a and E60/1a) is steep and composed of unvegetated sandstone. The cliff exhibits overhangs and scars with some rock falls at its base. This level of activity means that these units are classified as Partly Active, downgraded from Totally Active in 2014.

Unit MU4/1b is the south facing side of Cowbar Nab which runs adjacent to the north bank of Staithes Beck. This sandstone unit is sheltered from wave action behind the harbour walls. The cliff fails occasionally and is therefore classified as Locally Active, downgraded from Partly Active in 2014.

Unit MU4/2 is located behind Staithes Harbour. This sandstone cliff is well vegetated with small localised slumps and is classified as Locally Active, unchanged from 2014.

Further east, beyond the extent of Staithes Harbour is unit MU4/3. The cliffs are steep and the unvegetated sandstone is exposed to waves at its toes. This unit was classified as Partly Active in 2014, but is downgraded to Locally Active in 2016, because of the lack of evidence of significant continued activity.



East-facing Cowbar Nab. E60/1a (right) and MU4/1a (left). Partly Active in June 2016



East-facing Cowbar Nab MU4/1a (right) (Partly Active in June 2016) and south-facing Cowbar Nab along Staithes Beck MU4/1b (left) (Locally Active in June 2016)



MU4/2 behind Staithes Harbour. Locally Active in June 2016



Exposed sandstone of MU4/3. Locally Active in June 2016

### *Coast Protection Asset Condition Assessment*

A number of the coastal defence assets within the village of Staithes have been renewed or repaired in recent years through £140k of investment shortly after the 2012 inspection.

In addition to this, two repairs have recently been made upstream of the bridge across Staithes Beck. The upstream reaches are not part of the present inspections, which only extend up to the bridge, but these repairs are mentioned for wider interest.

On the south side of the beck, a section of collapsed wall has been repaired by Scarborough Borough Council and is now protected with stone-filled gabion baskets through works completed in 2013.

On the north side of the beck, a section of collapsed cliff has been stabilised by Redcar & Cleveland Borough Council using hydraulic jacks commonly used in underground mines. These have been encased in mass concrete and faced with stone cladding to produce an aesthetic finish. These works were undertaken in 2013.



*Works completed upstream of bridge in 2013 to repair collapsed wall (no asset ref)*



*Works completed upstream of bridge in 2013 to repair collapsed cliff (no asset ref)*

At Staithes Harbour, the breakwater arms were protected in 2002 by 5-8 tonne rock armour placed on the seaward side. This acts to provide a greater defended height and to dissipate waves from the breakwater surface. Stainless steel handrails and a new concrete topping, cast over the original outer breakwater added further height to the structures at this time.

The North Breakwater (0402C01) is in fair condition overall, but certain elements are poor. The rock armour added in 2002 to the seaward face and wrapping around the end of the breakwater mostly remains tightly packed and in good condition. The missing crest blocks reported in 2014 have been replaced.



*Rock armour revetment on seaward face of North Breakwater (/0402C01)*



*Crest blocks and deck of North Breakwater (/0402C01)*

Part way along its length, the deck splits into two levels, with the lower level having cracking and abrasion in places. There is also abrasion, fairly heavily in localised patches, and rust-staining along parts of the inner-facing edge of the North Breakwater's deck and wall.



*Abrasion on lower deck of North Breakwater (/0402C01)*



*Abrasion and rust-staining on inner-facing edge of North Breakwater (/0402C01)*



The sheet piling on the inner face of the east end of the breakwater is heavily corroded but the more major defect is undercutting to the inner-facing side of the North Breakwater wall.



*Corroded steel sheet piling on inner-face of North Breakwater (/0402C01)*



*Undercutting to a significant length of the inner-facing wall of North Breakwater (/0402C01)*

The rock armour defence running south from the North Breakwater to the end of Cowbar Lane (/0402C02) was constructed after the 2002 upgrade to the main breakwaters and is in good condition, with replacement of the previously displaced armourstones as noted across the pedestrian access deck near the root of the North Breakwater in 2014. The short section of seawall which is exposed at the southern end of the rock armour, adjacent to the slipway, is in fair condition.



*Rock revetment (/0402C02)*



*Exposed section of wall south of rock revetment (/0402C02)*

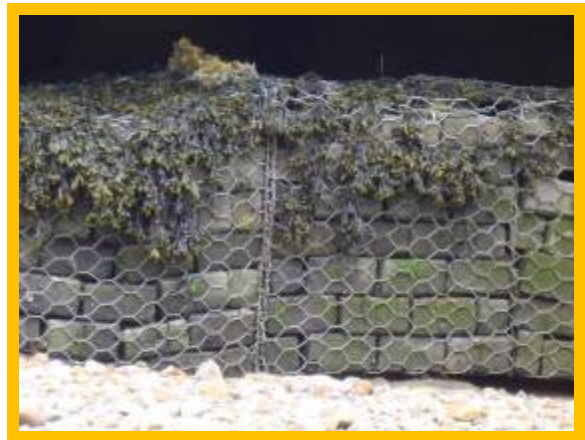
The defences that extend into the northern side of Staithes Beck are split into two asset lengths (/0402C03 and /0402C06), with the intersection at the west side of the RNLI slipway. The eastern section (/0402C03), which is in fair overall condition includes the slipway with gabion baskets beneath and a vertical concrete wall to the rear, tapering into a stone blockwork wall at the landward end of the slipway. The gabions are in a fair condition despite some settlement, but the stone wall is in poor condition along its length, with open joints between blocks and one hole caused by a missing block. The concrete wall to the rear of the slipway appears in fair condition along its landward section, but in poor condition further seaward with long longitudinal cracks and cold joints. The slipway itself is heavily covered in algae at its seaward end and is very slippery.



*Poor condition stone wall to rear of slipway (/0402C03)*



*Missing blockwork in stone wall to rear of slipway (/0402C03)*



*Settlement of bricks in gabion baskets, but otherwise in generally fair condition (/0402C03)*



*Cracks and cold joints in concrete seawall to rear of slipway (/0402C03)*

The walls between the RNLI slipway and the footbridge over Staithe Beck (/0402C06) are in a poor condition with missing pointing, settlement of blockwork and exposure of the toe. The small size rock toe protection that was placed as part of the 2002 works has been scattered in the beck or removed and no longer provides any protection. It is only the newly constructed wall immediately in front of the RNLI building that is in good condition, but there is a gap in the older stone blockworks wall at its interface with the newer wall which could compromise overall stability if voiding occurs behind.



*Wall on northern side of beck (missing blocks, open joints and voids) (/0402C06)*

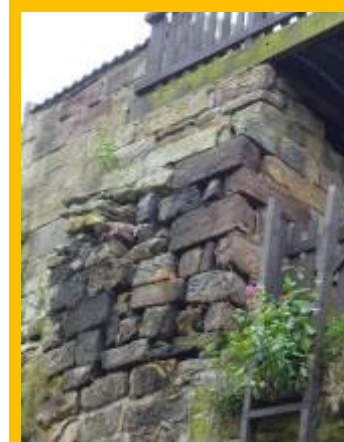


*Gap at base of interface between new and older walls in front of RNLI station (/0402C06)*

On the south side of the beck a hotchpotch of walls extends from the footbridge over Staithe Beck (/0402C04). Some of these have received previous repairs but whilst the walls generally remain in fair condition, locally this reduces to poor, with sections of loose blockwork, abrasion, cracking and vegetation growth in joints.



*Cracking, open joints and vegetation growth (/0402C04)*



*Loose blockwork wall (/0402C04)*

The walls continue as a series of masonry blockwork walls, often exterior walls of private properties (/0402C22), which continue to display visible loss of mortar causing open joints and missing blocks. It is recognised that some previous repairs have been undertaken, but deterioration continues. Although undercutting of the toe has previously been reported in several locations, exposing timber piling, this was not observed at the time of the present inspections.



*Cracking, open joints and vegetation growth (/0402C22)*



*Cracking, open joints and vegetation growth (/0402C22)*

The masonry blockwork side walls to the slipway are in poor condition, with missing blocks, open joints and undermining. Some of the open joints are in an area of previous repair and need re-filling.

Whilst repairs and improvements have previously been undertaken a section of wall west of the Cod & Lobster (/0403C05), the wall remains heavily abraded and cracked in places, although in fair overall condition. There is notable cracking and loss of render at the interface between adjacent seawall sections. The concrete groyne (/0403C07) limiting sediment movement within the harbour is in fair condition.



*Recent toe berm addition to wall west of Cod & Lobster (/0403C05)*



*Abrasion and cracking to seawall face and crest (/0403C05)*

The seawalls extending to the Staithes Harbour Office (/0403C01 and /0403C02) are in fair condition, with previous repairs to cracks holding well. However, there is one full height vertical crack at the interface of adjacent wall sections which needs filling. The slipway and adjacent boat storage area at Staithes Harbour Office remain in good condition.



*Full height vertical crack (/0403C01)*



*Previous seawall repairs holding well (/0403C01)*

The inner harbour concrete breakwater (/0403C04) remains in good condition. The main South Breakwater of Stathes harbour (/0403C03) also is in good overall condition, although there is minor abrasion and spalling at the access steps and one local area of cracking at the edge of the deck and wall on the lower (inner-most) deck of the structure. The rock armour revetment appears to have had one or two blocks displaced as they remain scattered on the foreshore, but is otherwise in good condition.



*Inner harbour concrete breakwater (/0403C04)*



*South Breakwater (/0403C03)*



*Local abrasion, cracking and spalling, but otherwise good condition (/0403C03)*



*Local cracking, but otherwise good condition (/0403C03)*

### 3.2 Management Unit 5 - Jet Wyke

#### *Coastal Slope Condition Assessment*

Jet Wyke forms the embayment between Penny Steel and Old Nab and consists of unit MU5/1, which remains classified as Partly Active in 2016. The lower slopes of the cliff are very steep, unvegetated and subject to gradual marine erosion. The upper cliff is composed of softer material and supports some vegetation cover.

At the eastern extent of the unit is the western side of Old Nab, a headland composed of highly weathered shales. This unit has not changed activity status and remains as Partly Active in 2014.



**MU5/1** – The including the highly weathered headland at Old Nab (Partly Active).

#### *Coast Protection Asset Condition Assessment*

There are no coastal defence assets within this Management Unit.

### 3.3 Management Unit 6 - Old Nab to Runswick Bay

This Management Unit consists of three Sub-management Units; MU6A – Brackenberry Wyke, MU6B - Port Mulgrave; and MU6C – Lingrow Cliffs.

#### MU6A – Brackenberry Wyke

This sub-management unit consists of unit MU6/1 only.

This section of cliff line remains classified as Partly Active in 2016, unchanged since 2012. Marine erosion is cutting into the hard stratified rock at the base of the cliffs. Some vegetation is supported on the upper slopes with exposed shales lower down showing evidence of on-going erosion. A number of small failures were noted in the centre of the management unit as coastal erosion continues.



**MU6/1** – Looking southeast across Brackenberry Wyke from Old Nab (Partly Active). August 2014.



**MU6/1** – The eroding shales of the east facing side of Old Nab (Partly Active). The stabilised lobe of material in the background is MU6/2. August 2014.

#### MU6B – Port Mulgrave

This sub-management unit consists of units MU6/2 to MU6/5.

Units MU6/2, MU6/3 and MU6/4 all show evidence of localised instability but also are substantively vegetated and therefore remain classified as Locally Active in 2016.

Unit MU6/5 is the most southerly cliff within this sub-management unit. It was characterised in 2014 by well-vegetated slopes with local areas of activity on the steeper, lower slopes, and classified as Locally Active in 2014. However, a few months prior to the August 2016 inspections, a large landslide occurred within the unit, rendering the public footpaths unsafe. The North York Moors National Park has closed off the site to public access by signage at each of the three access points to Port Mulgrave foreshore but despite this fishermen are regularly seen fishing from the dilapidated jetty.



**MU6/5** – The unit was substantially vegetated in 2014 but active marine erosion and localised failures in the cliff are evident (Locally Active).



**MU6/5** – The unit was subject to a large landslip a few months prior to the inspections in August 2016 (Totally Active).



Footpath closure by North York Moors National Park



Fishermen on Port Mulgrave Jetty





**MU6/5** – View of the landslip looking across Port Mulgrave from west to east (Totally Active)



**MU6/5** – View of the landslip looking across Port Mulgrave from east to west (Totally Active)

### **MU6C – Lingrow Cliffs**

This sub-management unit consists of units MU6/6 to MU6/8.

**Unit MU6/6** forms the northern part of the Lingrow Cliffs. The upper slopes support some vegetation cover while lower slopes are actively eroding. The unit continues to be classified as Partly Active in 2016 following a localised rock fall that has occurred since the previous inspections.



**MU6/6** – Localised rock fall (Partly Active)

**Unit MU6/7** forms the central part of this sub-management unit and consists of a large relict debris run-out lobe. The cliff is well-vegetated with only localised activity at the toe. It remains classified as Locally Active in 2016, unchanged since 2002.

Unit MU6/8 is located north of the northern end of Runswick Bay seawall. The main bulk of the cliff is mudstone capped by sandstone. The main mudstone part of the cliff is vegetated in its upper part and is eroding in its lower part with debris fans splayed across the toe and occasional rock falls at the base. The sandstone top is a vertical unvegetated cliff. The activity in the mudstone cliff means the unit is classified as Partly Active in 2016, the same as 2014.



MU6/7 (right) and MU6/8 (left)  
(Partly Active in June 2016)



Debris fan at south end of MU6/8.  
(Partly Active in June 2016)

*Coast Protection Asset Condition Assessment*

There are no coastal assets within Sub-Management Units 6A and 6C.

## MU6B (MA20) – Port Mulgrave

The jetty of the former port and ironstone mine at Port Mulgrave has been derelict for many years and is considered to be redundant. Virtually all coastal defences have been lost to the sea. What is left of the southern breakwater is undergoing large scale cracking, deformation, undercutting and outflanking. It is estimated that more than half of its original length has now been eroded (\0502C01).



Overview of asset in 2012 (\D0502C01)



Overview of asset in 2016 (\D0502C01)



Dilapidated asset in 2016 (\D0502C01)

## **Management Unit 7 - Runswick Bay**

Runswick Bay is a deep, wide bay located between mudstone headlands to the west (Cobble Dump) and east (Kettle Ness). The bay has a sand beach in its western two-thirds where the backing cliffs are composed of glacial till at sea level. Further to the east the beach gives way to a rock shore platform where the backing cliffs are mudstone. The village of Runswick Bay is protected by concrete seawalls and rock revetments.

This Management Unit is divided into two Sub-management Units; MU7A – Runswick Bay Village and MU7B – Runswick Sands.

### **MU7A – Runswick Bay Village**

This Sub-management Unit consists of units MU7/1 and MU7/2.

Unit MU7/1 includes Runswick Bay village and the adjacent glacial till slopes. It is well vegetated and defended at the toe by seawalls and rock armour. This unit is classified as Dormant in 2016, unchanged since 2014.

Unit MU7/2 occupies the area adjacent to and south of Runswick Bay village. It is well vegetated glacial till and defended at the toe by rock armour. This unit is classified as Locally Active, the same as 2014.



Slopes of Runswick Bay village. MU7/1  
Dormant in June 2016



MU7/1 (background) (Dormant in June 2016)  
and MU7/2 (foreground) (Locally Active in June 2016)

### **MU7B – Runswick Sands**

This Sub-management Unit consists of units MU7/3 and MU7/4.

Unit MU7/3N is adjacent to and south of the southern end of Runswick Bay sea defences and comprises glacial till forming a landslide complex down to beach level. The cliff slope is relatively shallow and well vegetated and erosion is occurring along the active toe. Mudslides and shallow slumps are evident at the top of the beach. Due to this activity, this unit is upgraded from Locally Active in 2014 to Partly Active in 2016. Unit MU7/3S is a similar geomorphology to unit MU7/3N, but the till is well vegetated almost to beach level. There is little evidence of significant activity at the toe, and so is classified as Locally Active, the same as 2014.

MU7/4 consists of a steep unvegetated cliff toe composed of mudstone behind which are shallower well-vegetated mid to upper slopes of till with local slumping. The cliff toe is generally steep but there is little evidence of recent activity, and so the unit is classified as Locally Active, unchanged since 2014.



Active toe of till cliffs in Runswick Bay. MU7/3N  
Partly Active in June 2016



Active toe of till cliffs in Runswick Bay. MU7/3N  
Partly Active in June 2016



Well vegetated till in Runswick Bay. MU7/3S  
Locally Active in June 2016



Well vegetated till in Runswick Bay. MU7/3S  
Locally Active in June 2016



Steep mudstone cliffs with overlying shallower  
sloping till with local slumps. MU7/4 Locally  
Active in June 2016



Steep cliff toe of mudstone. MU7/4 Locally  
Active in June 2016

**MU7A – Runswick Bay**

Properties in the north of Runswick Bay are protected by sea wall defences, while rock armour revetment extends around the toe of the cliffs further south in the village to reduce the risk of landslips. There are proposals for a capital scheme in 2017 to refurbish the sea wall and construct a rock fillet at its toe in the northern-most section. To enable this, Yorkshire Water plans to re-locate its sewer asset, which currently runs across the foreshore seaward of the sea wall, in September 2016.

The most northern sea wall (/0601C01) is suffering from very heavy surface abrasion on its facing, as well as at both the toe and capping beam. Undercutting has led to small hole formation in places and erosion of the undefended cliffs to the north presents a risk of outflanking of the wall. Further defects include wash out of the joints under the capping beam and vertical cracks through the wall. The wall has been in this (fair to poor) condition since the time of the first Cell 1 Regional Coastal Monitoring Programme inspections in 2009 and is due to be refurbished as part of future capital works.



*Sea wall with undermining, surface cracks and heavy abrasion – note erosion of undefended cliffs to north (/0601C01)*



*Wash out of joints under the capping beam (/0601C01)*

Moving south, the protruding section of wall (/0601C06) protecting the thatched cottage is in fair to poor condition. There are signs of repairs to the large vertical cracks in the wall and toe apron. However there are cracks remaining in the top of the concrete bagwork part of the wall. The concrete casing protecting the sewer pipe by the outfall of Runswick Beck is in undermined and failing condition, but the sewers are due to be relocated by Yorkshire Water as enabling works for the placement of the rock fillet in front of the sea wall.



*Bagwork wall in front of thatched cottage (/0601C06)*



*Previous repairs to crack in toe apron are holding well (/0601C06)*

The toe apron continues below a stone wall and exhibits signs of notable longitudinal cracking in the concrete. The stone wall itself also shows signs of diagonal cracking, open joints, missing blocks and loose coping.



*Diagonal cracking in stone wall (/0601C06)*



*Longitudinal cracking in concrete toe apron (/0601C06)*

The main length of sea wall below the properties (0601C03) is in variable condition. Although there are signs of previous repair works there are significant cracks and open joints remaining in the wall and undercutting of the toe in several locations.





*Undermining, cracking and open joints in sea wall (/0601C03)*



*Previous repairs to toe apron next to heavily abraded section (/0601C03)*

The concrete breakwater or groyne (/0601C02) to the north of the pumping station and old RNLI slip continues to be actively breaking up on both sides and remains in poor condition.



*Undermining, cracking and open joints in sea wall (/0601C02)*



*Previous repairs to toe apron next to heavily abraded section (/0601C02)*

The sea wall around the recently built pumping station remains in good condition (/0601C07), with the slipways and boat storage area associated with the RNLI building (/0601C04) in good condition. The timber slipway was repaired following damage in the December 2013 storms.



*New seawall around pumping station (/1003C07)*



*RNLI slipway and adjacent boat storage (/1003C04)*

The rock armour defences (/0602C01) remain generally in very good condition, with the rocks tightly packed with good coverage. However, there is ongoing erosion of the undefended cliff at the southern end of the defence which should continue to be monitored for signs of outflanking of the revetment.



*Rock armour revetment (/0602C01)*



*Active cliffs near southern end of revetment (/0602C01)*

#### **MU7B – Runswick Sands**

The Sailing Club is located in the bay some 600m south of the village, where the beach is wider. It has been constructed on timber struts and features a mix of coastal defences (/0602C05). A number of boulders and concrete blocks have been placed in front of the timber sleeper retaining wall defences which protect the main building since the previous inspections. This defence, and the white-washed wall to the north, are both in fair condition.



*Sailing Club defences (/0602C05)*

### 3.4 Management Unit 8 - Runswick Bay to Sandsend

This Management Unit is divided into two Sub-management Units; MU8A – Runswick Sands to Kettle Ness and MU8B - Kettle Ness to Sandsend.

#### MU8A – Runswick Sands to Kettle Ness

This Sub-management Unit consists of units MU8/1 to MU8/4.

Unit MU8/1 is located behind Runswick Sands. The toe is steep with little or no vegetation cover and composed of mudstone (a continuation of unit MU7/4). There is little evidence for recent activity such as rock falls and slides. The mid and upper slopes are more densely vegetated till with localised slumping. The unit is Locally Active, downgraded from Partly Active in 2014.

Unit MU8/2 is a shallow-angle relict debris run-out lobe with a well-defined head scarp. The cliff toe is steep and composed of mudstone with localised rock falls on the fronting shore platform. This unit is classified as Locally Active in 2016, unchanged since 2014.

MU8/3 is located in front of the village of Kettle Ness. The cliff is high and steep with only the very top part covered in vegetation. The cliff slope comprises large debris flows, which extend as fans from near the cliff top to the toe, and slumps. This level of activity means this unit is classified as Partly Active, the same as 2014.

MU8/4 is immediately west of Kettle Ness headland. This unit is classified as Partly Active in 2016, unchanged since 2014.



Steep mudstone cliffs with overlying shallower sloping till with local slumps. MU8/1 Locally Active in June 2016



Relict debris run-out lobe. MU8/2 Locally Active in June 2016



Steep cliff with debris flows. MU8/3 Partly Active in June 2016



MU8/4 (foreground) and west side of MU8/5 (background) (both Partly Active in June 2016)

## MU8B – Kettle Ness to Sandsend

This Sub-management Unit consists of units MU8/5 to MU8/15.

Unit MU8/5 forms the headland of Kettle Ness. This area has been extensively quarried for alum and as a result is now subject to ongoing erosion of the exposed weak bedrock. It remains classified as Partly Active in 2016, unchanged since 2014.



Kettleness headland. MU8/5 Partly Active in June 2016



East side of Kettleness headland. MU8/5 Partly Active in June 2016

**Unit MU8/6** is located to the east of the Kettle Ness headland and remains classified as Partly Active in 2016. Along most of its length this unit is steep with little vegetation cover.

**Units MU8/7 and MU8/8** comprise the relict debris run out lobes of Seaveybog Hill and Ovalgate Cliff. They are generally well-vegetated, but localised activity at the toe and headscarp mean the units are classified as Locally Active in 2016.

**Unit MU8/9** is located at Loop Wyke and is classified as Partly Active in 2016. The upper slopes support some vegetation cover, but the lower slopes are steeper, free of vegetation and subject to on-going toe erosion.

**Unit MU8/10** forms a relict debris slide lobe. The unit is well-vegetated with localised erosion at the headscarp and the toe. This unit is classified as Locally Active in 2016.

**Unit MU8/11** is located at Keldhowe Steel and is classified as Partly Active in 2016. The upper slopes are vegetated, with localised areas of activity at the headscarp. The lower slopes are experiencing ongoing toe erosion.

**Unit MU8/12** is south of Keldhowe Steel and is classified as Partly Active in 2016. The upper slopes are vegetated, with localised areas of activity at the headscarp. The lower slopes are experiencing on-going toe erosion.

**Units MU8/13, MU8/14 and MU8/15** form the headland of Sandsend Ness and its adjacent cliffs. All units remain classified as Partly Active in 2016. The toes of these cliffs are subject to ongoing erosion and there is evidence for localised erosion on the upper slopes.



MU8/9 and MU8/11 are Partly Active sea cliffs. MU8/10 is a debris slide deposit classified as Partly Active.



MU8/14 Sandsend Ness Partly Active in August 2016

### *Coast Protection Asset Condition Assessment*

Two short lengths of retaining walls believed to have been originally intended to protect and support the disused railway line were identified along this section of coast in the 2009 inspection report. These are a brickwork wall at Deepgrove Wyke and a masonry wall south of The Scar that was noted to have failed. However, these two walls were not classed as coastal defences and were reported to be redundant in 2010, so as in 2012 and 2014 they have not been included in this inspection report.



Redundant retaining wall in MU8/14

### 3.5 Management Unit 9 – Sandsend

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into three Sub-Management Units.

#### **MU9A and MU9B – Sandsend Village**

Management units MU9/1 and MU9/2 are Dormant cliffs behind Sandsend village. They are defended at the toe by a sea wall, groynes and rock armour. No evidence of activity was seen in 2016.



**MU9/1 and MU9/2** are located close to Sandsend and show no signs of activity (Dormant).  
(Figure reproduced from August 2014)

#### **MU9C – East Sandsend**

This sub-management unit consists of unit MU9/3 only. This unit is located above the concrete sea defences immediately to the east of Sandsend. The previously failing sea defences had been replaced by a new stepped concrete apron with upper Dycel units by the time of the inspections, with construction works still ongoing to stabilise the backing slopes. The slopes have historically been subject to slippage which, at times, has caused the temporary closure of the A174 Sandsend Road. The intent of the slope stabilisation works is to improve the condition of the slopes to an inactive state through means of re-grading, drainage and seeding.



**MU9/3** Coastal slopes to rear of new sea defences in an inactive state following capital works involving re-grading, drainage and seeding as part of the Sandsend Road Coast Protection & Slope Stabilisation Scheme

**MU9A and MU9B – Sandsend Village**

Coastal defences at Sandsend village vary from fair to poor condition.

The most northerly defence is located at Sandsend car park. It is a sloping concrete revetment with a recurve crest wall (D0701C02). The concrete wall remains in fair condition with minimal damage to the surface, however the revetment has lost thickness of concrete at the base through abrasion, with exposure of reinforcement bars. Encasement of this reinforcement is advised from a structural perspective, as well as preventing any Health & Safety incidents occurring due to sharp edges of the exposed bars on this popular amenity beach. At the northern end of the structure is a tie-in section, comprised of steel sheet piling which is heavily corroded. At the southern end is a slipway adjacent to Sandsend Beck. The slipway is undermined in places, despite previous repairs at this location.



Sandsend car park sea wall (D0701C02)



Exposed rebar (D0701C02)

A concrete seawall (D0702C01) extends from Sandsend Beck to the east. The groyne field fronting the seawall is derelict and the remains have no significant impact on sand movement. The wall is fairly heavily abraded and timber breastwork exposed at the toe has progressively deteriorated since first observed in 2009. In some local areas it appears that new timber has been used to replace rotten sections of this breastwork. Where exposed at the toe, the steel sheet piling is heavily corroded. There are occasional cracks in the wall and significant abrasion at the steps. Also at most steps there are missing or heavily corroded sections hand rails.



Poor condition sea wall (D0702C01)



Particular defects at access steps (D0702C01)



The newer short section of masonry blockwork sea wall (\D0702C04) that supports a cantilevered promenade just north of East Row Beck is in fair condition, although the steel toe piling is corroded and abraded. At the eastern end there are voids and undermining of a concrete apron which should be further investigated. The timber decking of the cantilever footway was destroyed during the December 2013 surge and repairs were made late 2014.



Masonry blockwork sea wall with cantilevered footway (\D0702C04)



Voiding and undermining of concrete apron (\D0702C04)

The low masonry wall (\D0702C03) that returns into both sides of East Row Beck adjacent to the road bridge is in fair condition. There is a slipway on each side of the beck, with gabion baskets on the eastern side protecting the café. These gabions are in fair condition, but with some 'sagging' of the baskets, perhaps due to being underfilled.

### MU9C – East Sandsend

The sloping concrete revetment (\D0702C02) which used to provide the main coastal defence to the A174 Sandsend Road against erosion and overtopping was in a poor and deteriorating condition for many years and became further damage by the December 2013 storm surge, resulting in a previous grading of very poor condition in 2014, despite post-storm repairs.



Previous storm damage and very poor condition of sloping revetment at Sandsend Road



Previous temporary repairs to sloping revetment at Sandsend Road (\D0702C02)

These failing structures have now been replaced by new coastal defences constructed between early 2015 and summer 2016. The new defences comprise a lower section with a stepped revetment built from pre-cast concrete units and a buried concrete toe beam that was cast *in situ*, with an upper section of interlocking pre-cast Dycel units. Natural coastal slope extends above the upper units to the plateau upon which the highway and footpaths sit, with re-graded and stabilised high coastal slopes to landward of the road. Sloping concrete tie-in revetments exist at either end of the structure. The overall plan form of the new defence adopts a subtle 'S' curve when viewed in plan.



Cross section of coastal defences at Sandsend Road in 'as built' condition showing stepped pre-cast apron and upper Dycel units (\D0702C02)



Oblique view of coastal defences at Sandsend Road in 'as built' condition showing subtle 'S' curve (\D0702C02)

At lengths along the frontage is a series of ribs used as areas for connecting pre-cast units and accommodating subtle changes in alignment. Several of the ribs incorporate drainage outfalls. Formalised access steps are located at discrete points along the frontage.



Drainage outfalls and construction ribs  
(\D0702C01)



Access steps (\D0702C01)

At the eastern end of the concrete defences, Raithwaite Gill has been infilled with material won from re-grading of the backing coastal slopes. The outfall which discharges through the gill has been extended to accommodate this infill.

With construction of the scheme having been completed in August 2016, the new defences are in very good (as built) condition.

### 3.6 Management Unit 10 – Upgang Beach

#### *Coastal Slope Condition Assessment*

This Management Unit comprises units **MU9/4**, **MU10/1** and **MU10/2**.

**Unit MU9/4** is comprised of well vegetated slopes which are protected along part of its length by the new coastal defence scheme which was officially opened on 19<sup>th</sup> August 2016. The slope stabilisation works have also extended partly into this unit and their intent is to render the slopes inactive. At the eastern end of the unit, where the new coastal defences tie-in into Raithwaite Gill, material won from the slope re-grading works in Units MU9/3 and MU9/4 has been placed to substantially infill Raithwaite Gill. The original outfall through the Gill was extended and material was placed and shaped within the Gill, with a new footpath constructed to provide access from the highway to the foreshore. The backing slopes behind the new coastal defences and the material infilling Raithwaite Gill are both currently inactive.

**MU10/1** was inactive in 2012, but this was revised to Locally Active following the December 2013 storm surge that caused toe erosion. This erosion has stopped and the classification is returned to inactive in 2016.

**MU10/2** comprises the till cliffs behind Upgang Beach that are prone to episodic mudslides and block failures. Vegetation cover is limited along the cliff face and the unit is classified as Partly Active in 2016, unchanged since the 2005 survey.



**MU9/4** Infilling of Raithwaite Gill at the eastern end of the coastal slopes (Inactive) in 2016



**MU10/2** Slumping cliffs along Upgang beach (Partly Active) in 2016

#### *Coast Protection Asset Condition Assessment*

There are no coast protection assets within this Management Unit.

### 3.7 Management Unit 11 – Whitby West

#### Coastal Slope Condition Assessment

This Management Unit is divided into 2 Sub-Management Units.

#### MU11A – Whitby Sands West

This Sub-Management Unit consists of units **MU11/1** and **MU11/2**.

These units are comprised of re-graded slopes protected by a sea wall and promenade. The slopes are well-vegetated, and whilst they are generally stable there is evidence of localised instability in the lower slope in places within both units. There is evidence of some previous stabilisation works and in one location within MU11/1 these have become exposed and the stone-filled plastic baskets have split, requiring repair or replacement. Both these units are classified Locally Active in 2016.



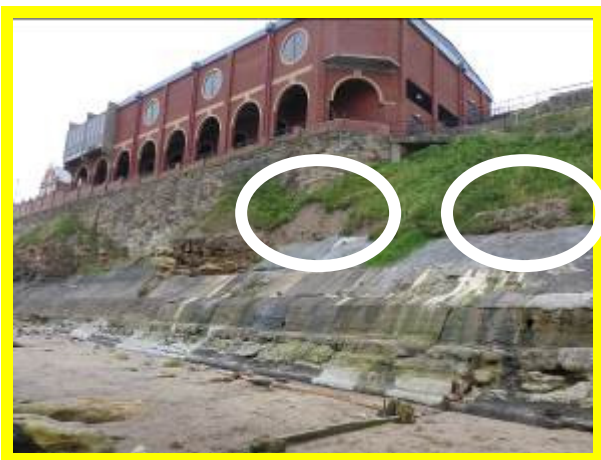
**MU11/1** Evidence of slumping in the lower coastal slopes (Locally Active)



**MU11/1** Exposed previous repairs (Locally Active)

#### MU11B – Whitby Sands East

This Management Sub-Unit consists of units **MU11/3** and **MU11/4** that are protected by a variety of coastal structures. The coastal slope of **MU11/3** has localised failures of the till and is therefore classified as Locally Active in 2016. Exposed rock faces are showing minor erosion in the absence of defences in places within **unit MU11/4**, which remains classified as Locally Active in 2016.



**MU11/3** Local slips in till above defences (Locally Active)



**MU11/4** Minor erosion in undefended cliff (Locally Active)

**MU11A – Whitby Sands West and MU11B – Whitby Sands East**

This Management Unit encompasses various sea walls and rock revetment to the west of Whitby Harbour. The most westerly defence is a rock armour revetment fronting the seawall and promenade (D0801C01). As in previous inspections, the rock armour is in good condition with only minor movement visible. The asset is in overall good condition although the promenade is rated as fair despite areas of repairs, due to previous longitudinal cracking. There is also damage to the wall to the rear of the promenade.



Rock revetment, promenade and coastal slopes of Whitby West Cliff (D0801C01)



Damage to low wall at rear of promenade (D0801C01)

There are two sections of seawall along the frontage with no protective rock armour. One occupies a short gap between the two areas of rock armour, whilst the other is to the east, backed by beach chalets on the promenade. Both of these sections have experienced considerable abrasion damage to the face. Due to the absence of rock armour, the toe at both sections has also been subject to undercutting. Recent repairs since the previous inspection appear to have cast a new concrete toe over much of the affected sections, but their overall condition remains poor and there are short lengths adjacent to where the new toe ends where boulders and rock outcrops are present and the original toe is still being undercut. There is also local damage (cracking and abrasion) to the wall coping beam and at each set of access steps along these lengths with no protective rock armour.



Junction between new concrete toe and original undercut toe (D0802C01)



Junction between new concrete toe and original undercut toe (D0802C03)

East of the beach chalets the steps and ramps show signs of repairs, but are generally in poor overall condition with defects such as undercutting, erosion, cracking, exposure of aggregate and rounding of step edges. In general all sections of sea wall between the eastern end of the rock revetment and the Whitby Pavilion show extensive damage to the coping and abrasion to the face and are in overall poor condition.



Damage to sea wall coping (D0802C03)



Abrasion damage to sea wall face (D0802C03)

The masonry blockwork walls by the RNLI lifeguard station are in fair overall, with a new capping beam recently constructed to repair previously reported damage. There remains a sunken block and open joints in the blockwork below the new capping beam.



Fair condition masonry wall with recent capping beam to repair previous defects (D0802C07)



Local defect (sunken blockwork) below new capping beam (D0802C07)

The area below the Whitby Pavilion consists of a variety of defences, which are formed in several vertical stages or layers, with concrete/stone on the beach and with cliff toe protection walls formed of timber breastwork, rock armour and vertical walls. These have multiple defects remain in poor condition. To the east of the theatre the natural cliff is intermittently defended with a series of blockwork and brickwork sections. These vary in construction and are generally in fair condition. Previously reported areas of undercutting were not noted due to high beach levels.

The Battery Wall, just west of Whitby West Pier, is formed of large sandstone blocks. Although repairs to some gaps between blocks are evident, further repairs are deemed necessary in numerous areas, especially at the wing wall of the access steps to the beach. Despite this, the asset remains in overall fair condition.



Open joints in wing wall to access steps  
(\D0802C12)



Battery Wall, with some open joints between  
blocks (\D0802C12)



### 3.8 Management Unit 12 – Whitby

#### *Coastal Slope Condition Assessment*

This Management Unit consists of unit **MU12/1**, which is situated beneath Whitby Abbey and St Mary's Church on the town's East Cliff. The slopes comprise a well-vegetated debris apron with toe protection afforded by the harbour walls. Localised activity occurs at the headscarp and in the debris apron. This unit is classified as Locally Active in 2016.



**MU12/1 Slumps in lower cliff (Locally Active)**

Note: A significant but localised failure of the headscarp occurred on 29 November 2012, which led to loss of part of the graveyard of St Mary's church and deposition of debris on properties along Henrietta Street. It is thought that the failure was associated with damaged drainage pipes and the very wet conditions of 2012 and was unrelated to coastal erosion.

#### *Coast Protection Asset Condition Assessment*

This Management Unit encompasses the harbour structures and quay walls of Whitby Harbour.

The harbour piers and pier extensions were inspected during a low spring tide to maximise the visibility, but even at low tide parts of the structures are below water and so not visible. Furthermore, there is no pedestrian access onto the East Pier extension so this was observed from a distance, including from an aerial perspective at the top of the recently re-opened West Pier lighthouse.

The piers have each been classified as generally fair, but the West Pier is locally poor in condition and the East Pier locally very poor in condition.



West Pier, generally in fair condition but locally poor (803C02)



East Pier, generally in fair condition but locally very poor (803C03)



West Pier extension, generally in fair condition (\803C01)



East Pier extension, generally in fair condition (\803C04)

Both main harbour piers have loose and cracked blocks and vertical movement (settlement) in at least one location on each arm. This potentially is indicative of wash-out of backing fill material and voiding. It is recommended that the proposed capital works to the main piers are implemented as soon as practically possible. Loose blocks could potentially become displaced or missing during a storm and there may be a significant quantity of wash-out of material from the core, leading to the consequent weakening and collapse of the structure. The situation is particularly bad on the inner face of the East Pier.



Local poor condition of West Pier due to open joints between blocks (\803C02)



Local very poor condition of East Pier due to open joints and settled blocks (\803C04)

The pier extensions are generally considered to be in fair condition, despite considerable abrasion along almost their entire length, although it should be noted that the lower sections of each structure were fully submerged by water at the time of the inspections. An urgent works scheme was undertaken in 2011/12 to repair the southern end of the East Pier extension where a large void had formed in the structure behind the sheet pile toe which had failed following corrosion and abrasion.

The western quayside of the Risk Esk from the harbour to the Swing Bridge consists partly of blockwork quay walls, similar in construction to the harbour piers, and partly of sections of concrete slab suspended over the original quay wall with concrete filled vertical and raking steel pile supports. The quayside structures are generally in fair condition, but poor in places due to specific localised defects. For example, in the blockwork sections, there are sections of wall with open joints which require sealing. In the suspended deck section, there remains corrosion to the steel piles. It was not possible to inspect the underside properly as this would require a boat even at low tide. A more detailed structural inspection of the quay walls is therefore recommended.



Generally fair condition of suspended deck section of quay wall (\803C06)



Generally fair condition of blockwork section of quay wall (\803C07)

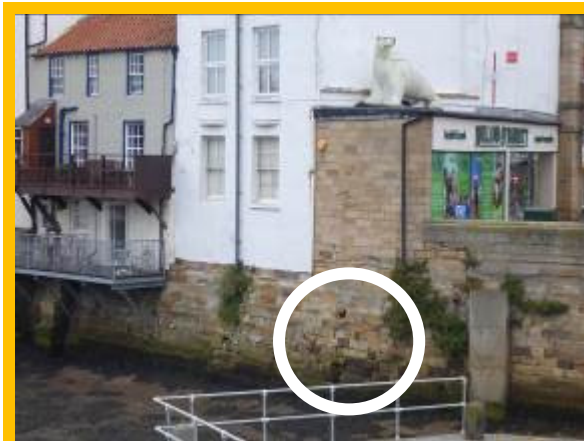


Local poor condition of quay wall due to open joints between blocks (\803C06)



Local poor condition of quay wall due to open joints between blocks (\803C06)

The eastern quayside of the Risk Esk consists partly of blockwall quay walls, similar in construction to the harbour piers, and partly of sections of property walls. Similar to the western quayside, the quayside structures are generally in fair condition, but poor in places due to specific localised defects. For example, in the property wall sections there are areas of sunken blocks or missing pointing and in the blockwork quay walls there are also several areas of open joints and heavily abraded blocks, most notably on Tate Hill Pier.



Local poor condition of quay wall due to open joints between blocks (\803C06)



Local poor condition of quay wall due to open joints between blocks (\803C06)

North of Tate Hill Pier, the harbour wall is fronted by a sand beach, initially with a variety of riparian walls at the back and then with a rock revetment protecting the toe of the slope at the Haggerlythe. Due to both the condition of the revetment and the occurrence of slippages in the slopes above the revetment (as described previously for Cliff Behaviour Unit MU12/1), this area should be given further consideration in due course, as recommended in the Whitby Coastal Strategy.

### 3.9 Management Unit 13 – Whitby East

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into 2 Sub-Management Units:

#### **MU13A – Cliffs east of Whitby Harbour**

Unit **MU12/2** comprises high cliffs protected by rock armour. There is evidence of a past rockfalls from the upper part of the cliff in the form of debris slopes and almost the entire cliff face is exposed, with very little vegetation cover. The cliffs therefore remain classified as Partly Active.



MU12/2 Cliffs east of Whitby (Partly Active)



MU12/2 Cliffs east of Whitby (Partly Active)

#### **MU13B – Whitby East to Widdy Head**

This Sub-Management Unit consists of **units MU13/1 to MU13/6** and part of unit MU14/1 (which is discussed under Management Unit 14).

**Unit MU13/1** is located immediately east of Whitby and is classified as Partly Active. The lower slopes are almost entirely exposed and are subject to marine erosion. The upper slopes are actively retreating through periodic rockfalls.

**Unit MU13/2** comprises the eroded headland of Saltwick Nab. This unit is continuing to actively erode and supports little vegetation cover. Rilling and gullyng is evident on the exposed faces. As a result this unit remains classified as Partly Active in 2016.

The cliffs within **unit MU13/3** are located within Saltwick Bay. The cliffs of this embayment are protected to some extent from marine action by the high stable beach. As a result, the unit is generally less active and well vegetated and was classified as Locally Active in 2014. This remains a valid classification, despite the occurrence of a local rockfall since that time.



MU13/2 Saltwick Nab (Locally Active)



MU13/3 Rockfall at cliffs within Saltwick Bay (Locally Active)

**Unit MU13/4** is located just east of Saltwick Bay and is fronted by a narrower beach than adjacent unit MU13/3. Consequently it is subject to more regular wave attack at the toe and much of the slopes are active and exposed. There is evidence of small slumps of debris and rockfall activity and there is ongoing localised and minor recession of the headscarp. This unit remains classified as Locally Active in 2016.

**Unit MU13/5** is formed by the shallow, relict debris flow lobe at Black Nab. The slopes of this unit are well vegetated, with localised activity evident at the toe and headscarp. Activity noted at the headscarp and toe meant it was classified as Partly Active in 2012, this appeared to have reduced by 2014 resulting in re-classification as Locally Active and this status remains valid in 2016.

**Unit MU13/6** is a long, steep-faced unit near the Whitby Fog Signal and the former lighthouse. The slopes are largely exposed with evidence of rockfalls from the upper cliff. There are also signs of ongoing weathering and marine erosion of the lower layers. This unit remains classified as Partly Active in 2016.

**MU13A – Cliffs east of Whitby Harbour**

There is a section of rock armour giving protection to the toe of Abbey Cliff directly to the east of Whitby Harbour's East Pier. The rock armour varies in size from 1-4 tonnes to 5-8 tonnes and is in fair overall condition.



Rock armour protection to toe of Abbey Cliff  
(\803C06)



Rock armour protection to toe of Abbey Cliff  
(\803C06)

**MU13B – Whitby East to Widdy Head**

There are no coastal assets within this Sub-Management Unit.



### 3.10 Management Unit 14 – Widdy Head to Pursglove Styé Batts

#### *Coastal Slope Condition Assessment*

The only unit within this Management Unit is **MU14/1**. The cliffs within this unit remain classified as Locally Active in 2016 because whilst the slopes are partly vegetated, there remain small areas of erosion evident.

#### *Coast Protection Asset Condition Assessment*

There are no coastal assets within this Management Unit.

### 3.11 Management Unit 15 – Pursglove Styé Batts to Robin Hood’s Bay

#### *Coastal Slope Condition Assessment*

This Management Unit consists of **units MU15/1 to MU15/4**.

**Unit MU15/1** is a long unit, generally well vegetated at the cliff top and classified as Locally Active due to a small number of localised areas of intense erosion in places and a substantively unvegetated cliff toe.

**Unit MU15/2** is located at Far Jetticks. This cliff has widespread activity, with ongoing marine erosion evident at the toe and localised activity on the cliff face. It remains classed as Partly Active in 2016. Note: A series of arcuate tension cracks were observed during the 2014 inspections (and also seen during the 2016 inspections) on the cliff top at grid reference 495076 507274, indicating an incipient failure that poses a hazard to walkers on the Cleveland Way. The site has been brought to the attention of Scarborough Borough Council who have informed the North York Moors National Park Authority.

**Unit MU15/3** is largely comprised of the headland of Bay Ness, north of Robin Hood’s Bay. The cliffs are high and steep and composed mainly of sandstone overlain by a thin cap of glacial till. There is evidence of debris fans in the lower half of the cliff face with localised slumping of the head scarp cut into the till. Several exposed head scarps are going to potentially undermine the Cleveland Way. This unit is classified as Locally Active in 2016, downgraded from Partly Active in 2014. Just north of Robin Hood’s Bay village is unit MU15/4, which has a similar geomorphology to MU15/3, although the till cap appears to be less active than further north. This unit is classified as Locally Active in 2016, downgraded from Partly Active in 2014.



Local slumping of head scarp in MU15/3 (Locally Active in June 2016)



Steep sandstone cliffs of MU15/4 (Locally Active in June 2016)

#### *Coast Protection Asset Condition Assessment*

There are no coastal assets within this Management Unit.

### 3.12 Management Unit 16 – Robin Hood’s Bay

#### *Coastal Slope Condition Assessment*

This stretch of coast comprises a deep, wide bay located between a sandstone, ironstone and mudstone headland to the north and sandstone and mudstone to the south. Although similar in shape to other bays, Robin Hood’s Bay is not ‘till controlled’ but formed in an anticlinal structure where less resistant mudstone located centrally has been eroded. The bay contains an extensive shore platform of mudstone. At points around the bay, till approaches sea level and forms the entire cliff.

This Management Unit is divided into three Sub-management Units; Mu16A – Robin Hood’s Bay Village, Mu16B – South of Robin Hood’s Bay Village and Mu16C – Cowling Scar.

#### **MU16A – Robin Hood’s Bay Village**

This Sub-management Unit is composed of units MU16/1, MU16/2 and MU16/3.

Unit MU16/1 is the composite cliff complex fronting the northern part of Robin Hood’s Bay village and is classified as Partly Active in 2016, the same as 2014. The cliff comprises a near-vertical lower cliff of mainly sandstone overlain by shallower sloping heavily vegetated glacial till with evidence of slumping and recession of the head scarp.

Units MU16/2 is a stabilised landslide that forms the southern part of Robin Hood’s Bay village. There is little evidence of any activity and so it is classified as Inactive in 2016, downgraded from Locally Active in 2014. MU16/3 protected by sea defences retains its Dormant status in 2016.



MU16/1 Sandstone cliff overlain by shallow till (Partly Active)



MU16/2 Stabilised landslide (Inactive)

#### **MU16B – South of Robin Hood’s Bay Village**

This Sub-management Unit consists of unit MU17/1, which is defended at the toe by a seawall and rock armour. The slopes show little evidence of recent activity. As a result this unit is classified as Dormant in 2016, no change from 2014.

#### **MU16C – Cowling Scar**

This Sub-management Unit consists of unit MU17/2 and part of unit MU17/3.

Unit MU17/2 comprises glacial till cliffs to beach level protected by rock armour at their toe. The slopes are generally well vegetated with some exposed areas at the head scarp and mid-slope where there is evidence of slumping. This unit is classified as Partly Active in 2016, due to the evidence of instability. Slumping at the head scarp could undermine the Cleveland Way.

Further south, within unit MU17/3, defences are absent and the cliffs are active. There is massive slumping at beach level and in the mid to upper slopes. This unit is classified as Partly Active in 2016, no change from 2014.



Protected toe of till cliffs in Robin Hood's Bay. MU17/2 (Partly Active in June 2016)



Head scarp in MU17/2 (Partly Active in June 2016)



Active toe of till cliffs in Robin Hood's Bay. MU17/3 (Partly Active in June 2016)



Active toe of till cliffs in Robin Hood's Bay. MU17/3 (Partly Active in June 2016)



Head scarp in MU17/3 (Partly Active in June 2016)

**MU16A – Robin Hood’s Bay**

Robin Hood’s Bay village is defended by an extensive system of coast protection defences which was upgraded and extended in 2001. Most of the defences at Robin Hoods Bay are in a fair to good condition, but the older original structures dating from the 1970s are showing evidence of damage and defects. The recent strategy study has proposed a capital scheme for the large vertical sea wall (/D1003C02) that protects the main part of the lower village. Maintenance recommendations elsewhere include re-pointing and repairing cracks in the walls and keeping localised areas of vegetation growth in the walls under control to avoid damage.

The most northern defence is a section of rock armour that gives some limited protection to the cliff toe to the north of the northern slipway / beach access ramp (/1002C02). This rock armour was constructed as part of the 2001 scheme and remains in good condition. As the rock armour extends south (/1002C01) it fronts the wingwall of a slipway / ramp from the boatyard and then a large blockwork sea wall that was built in 2001. Overall, both the wall and the revetment are in good condition. Cliffs to the rear of the slipway have rock netting which remains in good condition.



*Rock revetment fronting sea cliffs (/1002C02)*



*Rock revetment fronting large sea wall (/1003C01)*

The rock armour extends south of the end of the wall, remaining in good condition, to protrude beyond the toe of the short length (~25m) of adjacent undefended shale cliffs. The cliffs (/1003C03) are generally eroding at slow rates, except for in one location at the cliff top near the interface with the southern large sea wall where a local slippage has occurred in the overlying till. The present minor outflanking at this location will worsen over time.



*Rock revetment protruding beyond undefended cliffs (/1003C01)*



*Erosion of cliffs immediately adjacent to large northern end of large sea wall (/1003C03)*

The large vertical pre-cast concrete panel wall that was constructed in 1975 (1003C02) is in poor condition, showing evidence of surface cracking, rust marks indicating corrosion of the reinforcement steel, mineral encrustation, seepage, and extensive cracking and repair work to the crest of the wall. Previous inspections have also noted some evidence of undercutting at the toe, but this was not visible at the time of inspection due to the beach levels. A recently developed Project Appraisal Report has proposed a capital scheme to repair and refurbish this wall.



*Large sea wall in poor condition will benefit from future planned capital scheme (/1003C02)*



*Typical defects on large sea wall (/1003C02)*

Immediately south of the large concrete sea wall, a private blockwork wall fronts the Bay Hotel (/1003C04). This wall extends south to the central slipway and is in overall poor condition with open joints between blocks despite obvious previous repairs having been undertaken (some of which are re-opening). Some of these align to form continuous near-vertical cracks down a significant extent of the wall's height. There is a particularly notable area of concern at the interface between the blockwork wall and the adjacent concrete panel wall. Above the blockwork wall there has been loss of the render to the upper property wall.



*Blockwork wall in poor condition fronting the Bay Hotel (/1003C04)*



*Typical defects on blockwork wall (/1003C04)*

The adjacent central slipway (/1003C05) is in an overall fair condition, with minor damage to an area of previous concrete repairs near one corner.

The mixed construction defence (/1003C06) on the south side of the slipway has mass concrete toe at the base with a variety of stone and blockwork above. The defence has a patchwork of previous repairs and repointing throughout but despite this a small number of open joints remain

(mostly in areas of previous repairs) and there is one area of cracking in the concrete at the apron. Overall the structure remains in fair condition, but it would benefit from some minor maintenance.



*Slipway in fair condition (/1003C05)*



*Wall and apron in fair condition but minor maintenance needed (/1003C06)*



*Typical defects (gaps) on blockwork wall (/1003C06)*



*Typical defects (cracking) on toe apron (/1003C06)*

At the south of the village is the concrete sea wall at the Quarter Deck (/1003C10). This structure was given rock armour toe protection as part of the 2001 scheme. The rock armour remains in good condition with the sea wall in fair condition. There are some notable defects at the access steps at the southern end of the wall, with render cracking and falling away and abrasion of the concrete beneath. There is also some local abrasion and spalling at the coping and around joints, but the joints themselves remain well sealed.



*Concrete sea wall generally in fair condition (/1003C10)*



*Defects at access steps (/1003C10)*

South of the Quarter Deck there is a length of rock armour defence with a slipway / ramp, both of which were constructed in 2001 and remain in good condition (/1003C09). One or two displaced armourstones from the revetment are now almost fully buried below beach level.

To the immediate south of the ramp is a short section of rock armour built in 2001 to stabilise the cliff (/1003C07). In one place the cliff is slumping behind this defence and there is further, pronounced, slumping immediately south of the structure's terminal end, although the defence remains fair and is not currently compromised.



*Rock revetment and slipway remain in good condition (/1003C09)*



*Slumping of cliffs immediately adjacent to southern end of rock armour (/1003C07)*

### 3.13 Management Unit 17 – Cowling Scar to Peak Steel

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into two Sub-management Units; MU17A – Boggle Hole and MU17B– Boggle Hole to Peak Steel.

#### **MU17A – Boggle Hole**

This Sub-management Unit consists of part of unit MU17/3 only. This unit is described under Management Unit 16C.

#### **MU17B – Boggle Hole to Peak Steel.**

This Sub-management Unit consists of units MU17/4 to MU17/9.

Units MU17/4 is located between Boggle Hole and just west of Stoupe Beck and has a near-vertical lower cliff formed in mudstone and an upper shallower part formed in glacial till. Due to lack of recent activity, this unit has a status of Locally Active in 2016, downgraded from Partly Active in 2014.

MU17/5 is located south of Stoupe Beck and is classified as Partly Active, same as 2014. The cliff toe is slumped till at beach level nearer Stoupe Beck becoming bedrock with overlying till to the southeast, which is regularly slumped over the cliff face and on to the beach. The mid and upper slopes of the composite cliff are shallower gradient.



Steep composite cliff of mudstone overlain by till. MU17/4 Locally Active in June 2016



Steep composite cliff of mudstone overlain by till. MU17/4 Locally Active in June 2016



Active till cliffs down to beach level in Robin Hood's Bay. MU17/5 Partly Active in June 2016



Active till cliffs down to beach level in Robin Hood's Bay. MU17/5 Partly Active in June 2016



Further southeast, units MU17/6 and MU17/7 are classified as Locally Active, downgraded from Partly Active in 2014. The lower slopes are steep cliffs composed of mudstone overlain by shallower sloping till. The cliff face suffers localised rock falls and localised slumping of till from above.



Steep composite cliff of mudstone overlain by till. MU17/6 (right) and MU17/7 (left) (both Locally Active in June 2016)



Recent local rock fall in the mudstone cliff. MU17/6 Locally Active in June 2016

Units MU17/8 and MU17/9 are located immediately west of Park Steel. **Unit MU17/8** has a steep lower slope which is actively eroding and a shallower upper slope which supports some vegetation cover. **Unit MU17/9** is steep with little vegetation. These units remain classified as Partly Active in 2016.

#### *Coast Protection Asset Condition Assessment*

#### **MU17A and MU17B – Boggle Hole to Peak Steel**

There are no coastal defences present here, but fluvial assets include a stone slipway integrated with a concrete revetment, a fuel bund and the outfall of Mill Beck. Boggle Hole Youth Hostel and footbridge is located 50m upstream of the mouth of the beck. Access is provided to the beach via a concrete slipway.

A short section of rock armour revetment and concrete and timber piling are providing protection to the mouth of the Stoupe Beck just to the south of Boggle Hole. However these are fluvial rather than coastal sea defences and are therefore not included in the coastal defence asset inspection.

### 3.14 Management Unit 18 – Peak Steel to southern end of Beast Cliff

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into 2 Sub-Management Units, as follows (Appendix A, Maps 4 and 5):

#### **MU18A – Peak Steel to Blea Wyke Steel**

This Sub-Management Unit consists of **units MU18/1 and MU18/2**.

**Unit MU18/1** is located at Peak Steel, below Ravenscar. The cliffs in this region have a distinct two-tiered form. Much of the upper headscarp is densely vegetated with little evidence of recent activity. The lower headscarp, exposed to the sea, is more active and subject to episodic slides and falls evident. This unit is classified as Locally Active in 2016.

**Unit MU18/2** is a well vegetated, relict system with no signs of activity. As a result it is classified as Inactive.



**MU18/1** Peak Steel (circled)  
(Locally Active)



**MU18/2** Distinct two-tiered cliffs  
(Inactive)

#### **MU18B – Common Cliff and Beast Cliff**

This Sub-Management Unit consists of **units MU18/3 and MU18/4**, both of which are classified as Locally Active. The cliffs have a distinct 'undercliff', likely to be formed by seepage erosion and landsliding processes. The slopes show only localised patches of activity.

#### *Coast Protection Asset Condition Assessment*

There are no coastal assets within this Management Unit.

### 3.15 Management Unit 19 – Beast Cliff to Scalby Ness

#### Coastal Slope Condition Assessment

This Management Unit is divided into 5 Sub-Management Units (Appendix A, Maps 5 and 6):

#### MU19A – Beast Cliff to Herbert Hole

This Sub-Management Unit consists of **unit MU19/1** only. The cliffs are relatively stable and failures are localised, although a large failure in the upper cliff did occur ~ 5-10yrs ago. This unit is classified as Locally Active, and has not changed since the previous survey.



**MU19/1** well vegetated cliff face (Locally Active)



**MU19/1** well vegetated cliff face (Locally Active)

#### MU19B – Herbert Hole to Tindall Point

This Sub-Management Unit consists of **unit MU19/2** and **part of units MU19/1** (described previously) **and MU19/3**.

**Unit MU19/2** is located on the north side of Hayburn Wyke and is classified as Locally Active because of minor activity at the headscarp and some evidence of past rockfalls at the toe. The stabilisation works at the slopes around the footpath on the northern side of Hayburn Wyke were reported in the 2012 survey as being effective. However, it was noted during the 2014 survey that there was deformation of the steps here, indicating possible renewed movement. Despite this, the 2016 inspection showed no further deterioration or movement.

**Unit MU19/3** is located around and to the south of Hayburn Wyke. These cliffs are well vegetated, with localised erosion at the toe and headscarp. This unit remains classified as Locally Active.



**MU19/2** Looking north across Hayburn Wyke at the vegetated cliffs (Locally Active)



**MU19/3** – Well vegetated undercliff on south side of Hayburn Wyke (Locally Active)

### MU19C – Tindall Point to North of Cloughton Wyke

This Sub-Management Unit comprises parts of **units MU19/3** (described above) and **MU19/4**.

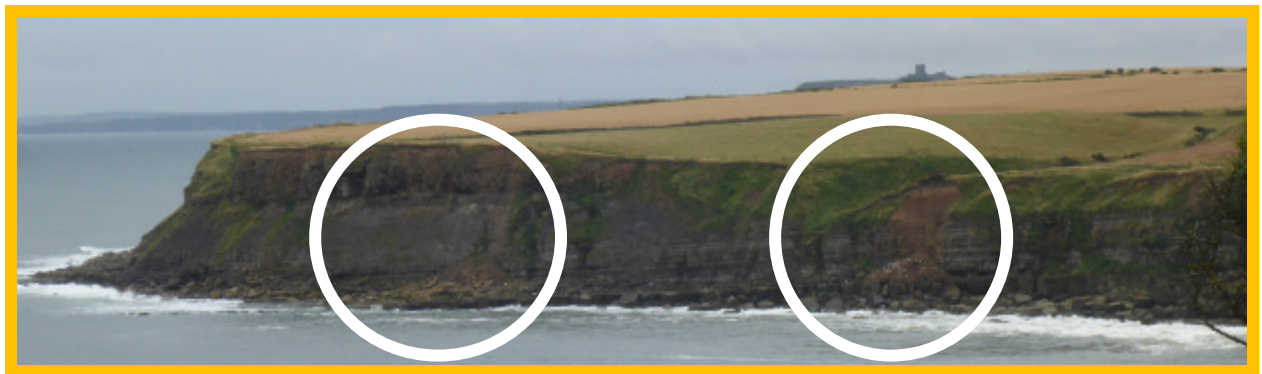
**Unit MU19/4** is located immediately to the north of Cloughton Wyke. The unit is characterised by high, steep cliffs which are more active than those cliffs further north and south. There is some recession of the headscarp. This unit continues to be classified as Partly Active in 2016.

### MU19D – Cloughton Wyke

This Sub-Management Unit consists of **units MU19/5 and MU19/6**.

**Unit MU19/5** is located on the northern side of Cloughton Wyke and is classified as Locally Active, unchanged since 2012. The near vertical cliffs are composed of hard rock which have failed through a series of small rockfalls. The cliffs support some vegetation, primarily in the northern end of the unit cover and are subject to ongoing marine erosion at the toe.

**Unit MU19/6** forms the southern part of Cloughton Wyke and extends southwards to Long Nab. The lower cliff is near vertical and actively eroding. There is evidence of rockfall (large, angular boulders) from this part of the cliff onto the shoreline below. The upper part of the cliff is shallower angled and much less active. This unit is classified as Partly Active in 2016 due to the presence of at least two apparently recent rockfalls.



**MU19/6** Rockfalls on southern side of Cloughton Wyke (Partly Active)



**MU19/6** Rockfall on southern side of Cloughton Wyke (Partly Active)



**MU19/6** Rockfall on southern side of Cloughton Wyke (Partly Active)

## MU19E – Hundale Point to Scalby Ness

This Sub-Management Unit consists of part of **unit MU19/6** (described previously) and **units MU19/7 to MU19/11**.

**Units MU19/7 and MU19/8** extend from Long Nab in the north to Cromer Point in the south. They are remain classified as Locally Active in 2016 because minor activity is evident at the toe as a result of marine action and there is localised recession of the headscarp.

**Units MU19/9 and MU19/10** are located between Cromer Point and Scalby Ness. The toe of these units is subject to marine action and the headscarp is steep, exposed and actively retreating through slippages at numerous places throughout the units. The cliffs have been given a worsened status of Partly Active because of the extent of activity along their lengths being more than simply 'local'.



**MU19/9** Landsliding (Partly Active)



**MU19/10** Landsliding (Partly Active)

The Scalby Ness headland comprises **unit MU19/11**. This area is well vegetated on its more landward extents, but was noted during the December 2013 inspections to be eroding severely in the lower half of the cliff with some failure in the upper part and was therefore upgraded to Partly Active; this status has been retained following the 2014 and 2016 inspections.

### *Coast Protection Asset Condition Assessment*

#### **MU19 – Beast Cliff to Scalby Ness**

There are no formal sea defences within MU 19. However there is an outfall pipe which has been laid across the mouth of Scalby Beck and continues north across the foreshore in front of Scalby Ness. This acts as a weir controlling the flow of the beck at low tide. As the outfall pipe is not a coastal defence asset it has not been included in the inspections.

### 3.16 Management Unit 20 – Scarborough North Bay

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into 2 Sub-Management Units.

#### **Mu20A – Northern North Bay**

This Sub-Management Unit consists of **units MU20/1 and MU20/2.**

Both of these units are defended at the toe by the sea wall which runs the entire length of North Bay. The slopes are well vegetated, show no evidence of recent activity and are both classified as Dormant, as they were in previous surveys.



**MU20/1** Cliffs in northern North Bay (Dormant)



**MU20/2** Cliffs in northern North Bay (Dormant)

#### **MU20B – Southern North Bay**

This Sub-Management Unit comprises **units MU20/3, MU20/4a and MU20/4b.**

**Unit MU20/3** is well vegetated and shows no obvious evidence of recent instabilities. It is classified as Dormant, unchanged since previous surveys.

**Unit MU20/4a** is located to the rear of North Sands. The relict slopes are well vegetated with only minor and localised evidence of erosion at the headscarp, it remains classified as Inactive, unchanged since previous surveys.

**Unit MU20/4b** covers the area of Clarence Gardens and has previously been slightly more active than the adjacent unit MU20/4a. However, remediation works have repaired cracks and the slopes are now well vegetated with exposed rock at the headscarp. This unit was downgraded to Inactive in 2012 and retained this status in 2014. However, because of evidence of some (very) shallow slips in one local area near to parking bays, it has been altered to Locally Active in 2016.



**MU20/4b** Cliffs in southern North Bay  
(Locally Active)



**MU20/4b** Cliffs in southern North Bay  
(Locally Active)



**MU20/4b** Cliffs in southern North Bay showing some signs of shallow slippage (Locally Active)

## MU20 – Scarborough North Bay

There are formal defences throughout the whole length of Scarborough North Bay, many of which are currently in fair condition but most of the concrete and blockwork structures show some evidence of defects such as cracking, loss of mortar, loss of expanding sealant and surface abrasion to the front face. There are also a number of defects such as structural cracks and abrasion in the back wall behind the promenade where this acts as a retaining wall to the road and also in the promenade deck. A number of major repairs and capital works improvement to refurbish the North Bay defences were undertaken in 2014 and are generally holding up well.

### MU20A – Northern North Bay Sealife Centre 20A/1

The most northerly seawall (/1201C01) starts adjacent to the footbridge at Scalby Mills and is in fair condition. Moving south the seawall (/1201C02), around the promontory on which the Sea Life centre is built is in overall fair condition, but with some local areas of abrasion. This is especially heavy around the access steps at the junction with the adjacent seawall to the south. Previous joint repairs are holding well.



Fair condition seawall at Scalby Beck (/1201C01)



Fair condition seawall at Sea Life Centre (/1201C02)

### North Bay Cliffs – 20A/2 to 20A/7

A series of seawalls (/1201C03, C24, C25, and C04) lie between the Sea Life Centre and the small promontory at the south of the mini golf course. The seawalls within this frontage are formed of blockwork with a concrete crest wall with a promenade beyond, backed by a grouted stone revetment.

The northermost section (/1201C03) has a short length of heavily corroded handrailing at the seaward edge of the promenade and notable abrasion damage to the deck. However damage to the wave return wall, steps and grouted stone revetment at the rear of the promenade has been repaired.

There is considerable abrasion damage to the front face, and spalling of the capping beam along the entire length of this frontage. The beach access steps are particularly heavily abraded and the southernmost set of steps have been subject to substantial repair which, to date, is holding well. However, there is a small crack between the repaired steps and the seawall which should continue to be monitored and beach levels were low at the time of the inspections, exposing the sheet piled foundations below the access steps landing. The concrete repairs extend northwards from the steps along the toe apron and remain effective.





*Fair condition seawall with recent repairs to access steps (/1201C24)*



*Fair condition seawall with recent repairs to toe apron (/1201C24)*

The wall around the promontory (/1201C04) is more exposed and has had relatively recent repairs to both the front face and the low crest wall, although abrasion damage remains heavy in other places (especially on the unrepaired sections of lower wall) and there is damage to the rear crest wall in two places. The new drainage outfall and entry guard are in good condition.



*Area of recent repairs to promontory wall (/1201C04)*



*Area of heavy abrasion damage to promontory wall (/1201C04)*

Between the promontory and Peasholm Gap, the frontage has been split into a series of asset lengths (/1201C10, C26, C11, C12, C13, C14, C15, C16, C05, C17, C18 and C06, running from north to south). The beach was relatively high along all this length, so only the upper wall and beach access steps were visible. In some areas only the capping beam was exposed, with areas of recent repairs clearly evident. Previous repairs to the grouted stone revetment to the rear of the promenade, below the beach huts, remained effective. Abrasion damage continues to be evident to the access steps along this section, although several sets have recently been repaired.



*Previous repairs to capping beam at rear of promenade (/1201C05)*



*Previous repairs to stone revetment at rear of promenade (/1201C05)*

The wall to the north of the ramp at Peasholm Gap (/1201C06) continues to show several (currently minor) vertical cracks in the rear wall protecting the new development behind the wall, as well as one area of notable abrasion damage to the facing.



*Vertical cracks in wall protecting recent development (/1201C06)*



*Vertical cracks in wall protecting recent development (/1201C06)*

### **Southern North Bay**

#### **Peasholm Gap and Clarence Gardens - 20B/1 to 20B/3**

The wall at Peasholm Gap (/1201C19) has had an extensive number of significant repairs in 2014 which are holding well, with sections rebuilt or overlaid. However, there are still some damaged areas of blocks and spalling to the splash beam in areas not yet repaired. Overall, the wall remains in fair condition.



*Previous repairs to wall at Peasholm Gap (/1201C19)*



*Previous repairs to wall at Peasholm Gap (/1201C19)*

South of Peasholm Gap the beach levels drop and Royal Albert Drive is protected by an increasingly high curve-profiled blockwork wall (/1201C07 and C21) that runs south to the slight promontory at the ramp opposite the recently redeveloped Oasis Café. The previous repairs to joints, damaged wing-walls to beach access steps and entire sections of full height wall are holding well. However, one crack has opened in the wing-wall to the access ramp (which is closed off to the public) and another in the coping above the blockwork. The promenade along part of this section was re-laid in 2012 but remaining poor in other sections. Beach levels were relatively low at the time of the inspections, exposing the concrete apron which seems in fair condition although was subject to extensive algae growth.



*High curved-profile seawall (/1201C07)*



*Toe apron with algae growth (/1201C07)*



*Previous repairs to wing-wall (/1201C07)*



*Previous repairs to seawall (/1201C21)*



*One of two notable cracks visible in wing-wall at access ramp (/1201C21)*



*Small crack in coping of seawall (/1201C21)*

At the southern end of the North Bay, there is a large stepped concrete blockwork sea wall structure (/1201C08) constructed with nine large buttresses/bastions which protrude from the wall out onto the beach. The apron of the structure becomes increasingly exposed with progression north along the wall. There is one longitudinal crack in the blockwork across several adjacent blocks but otherwise the wall is in fair condition, although the promenade surface is poor in places.



*Concrete blockwall wall with buttresses (/1201C08)*



*Longitudinal crack in blockwall wall (/1201C08)*

There is a short section of vertical blockwork wall (/1202C23) between the stepped concrete blockwork wall and the rock armour revetment to the south. This short wall is in fair condition and previously reported defects of cracking and missing blockwork have been rectified.

The southern-most section of defence in North Bay is the first section of the rock armour at Clarence Gardens that was constructed in 2004/5 (1202C01). This is in good condition, protecting the original wall behind.



*Concrete blockwall wall in fair condition (/1202C23)*



*Rock revetment fronting seawall (/1202C01)*

### 3.17 Management Unit 21 – Castle Cliff, Scarborough

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into 2 Sub-Management Units.

#### **MU21A – Castle Cliff**

This Sub-Management Unit consists of **units MU21/1 and MU21/2.**

**Unit MU21/1** is located at The Holms and continues to be classified as Inactive, unchanged from previous surveys. The unit comprises a series of relict rotational landslides and is prone to rockfalls. However, there was no evidence during the 2016 inspection of recent rockfall activity.

**Unit MU21/2** forms the Castle Cliff promontory and continues to be classified as Locally Active, unchanged from recent inspections. The cliffs are steep with extensive toe protection measures. Locally, bedrock is exposed where it is subject to ongoing weathering and erosion from rainfall.



**MU21/2** Castle Headland cliff (Locally Active)



**MU21/2** Rock netting on parts of Castle Headland cliff (Locally Active)

#### **MU21B – The Harbour**

There are no natural cliff units within this Sub-Management Unit.

**Mu21A/1 and 21A/2 – The Holms and Castle Headland**

Part of the wider East Pier to the Holms Coast Protection Scheme, constructed between 2003 and 2005, protects this frontage with a rock armour revetment which extends from the southern end of North Bay (/1202C03). This continues through the Holms as rock armour with concrete toe piles to reduce the footprint of the defence, thus limiting encroachment into the foreshore SSSI (/1202C04). There is a continuous wave return wall along the crest of these defences, which remain in good condition along both of these asset lengths. Where there are beach access steps through the rock armour in the south part of North Bay (/1202C01), there is considerably more abrasion damage to the steps and locally scoured areas of the beach which leave a standing pool of water at low tide, making access to and from the beach difficult, but the structures themselves remain sound.



*Rock armour revetment and wave return wall (/1202C03)*



*Rock armour revetment and wave return wall (/1202C03)*

The section of defence continuing around the Castle Headland to the harbour is an Accropode revetment with concrete toe piles and a rock armourstone crest, with a concrete wave return wall (/1202C02). The inspection was limited to views from the crest wall and it was not possible to inspect the toe as along most of the length it is below water in all tide conditions. Overall, these defences remain in good condition with only localised evidence of concrete abrasion and cracks in the Accropodes. The crest wall is generally sound with only minor cracking and good joint seals. The promenade remains in overall good condition.



*Accropode revetment with concrete toe piles, rock crest and wave return wall (/1202C04)*



*Promenade deck and wave return wall around Castle Headland (/1202C04)*



*Locally abraded Accropode unit but otherwise good condition revetment (/1202C04)*



*Locally cracked Accropode unit but otherwise good condition revetment (/1202C04)*

### **Mu21B/1 and 21B/2 – The Harbour**

Scarborough Harbour comprises both the inner Old Harbour and the newer East Harbour and is located at the southern side of the Castle Headland at the old part of the town. There are continuous formal defences throughout the whole extent, ranging from the 2005 rock armour and Accropode sections to very old stone quay walls. Around the commercial side of the harbour many of the defences are aged, and are constructed using sheet metal piles back-filled with mass concrete. The inspection of this area took place on a very low tide on 9<sup>th</sup> June 2016.

The outer facing pier of East Harbour's outer pier is protected by rock armour and Accropode units (/1301C01) and is in good overall condition. Towards the seaward end of the pier, many of the original wall blocks on the crest of the outer wall are heavily abraded and some are partially cracked.



*East Harbour outer pier (/1301C01)*



*Abrasion towards seaward end of East harbour outer wall (/1301C01)*

The inner facing wall of East Harbour's outer pier (/1301C16) was refurbished as part of the 2005 scheme, with missing blocks replaced and joints filled. Minor missing joints and cracks appear throughout the harbour masonry walls. The inner face remains in fair condition.





*Previous repairs to inner-facing wall of East Harbour outer pier (/1301C16)*



*Previous repairs to inner-facing wall of East Harbour outer pier (/1301C16)*

At the landward end of East Harbour is a short section of low wall (/1301C02) which is largely obscured by fairground attractions and could not easily be inspected. However, as this wall is not subject to marine influence, its condition is somewhat less critical than other harbour structures. Where observable, the pointing between blocks was in good condition but render on the upper section of wall is starting the break away in places. This wall extends to a slipway to East Harbour which is located on the inner side of Vincent's Pier and is in fair condition.

Vincent's Pier (/1301C04) separates East Harbour from Old Harbour and is in overall fair condition. The wall facing East Harbour is largely covered by timber boarding and algae growth, making inspection difficult, but where visible the blockwork and joints are sound. The pier deck is in good condition.



*Wall of Vincent Pier facing East Harbour covered by timber boarding and algae (/1301C04)*



*Good condition pier deck on Vincent's Pier (/1301C04)*

At the harbour arm beyond the Captain Sydney Smith Bridge, near the lighthouse, the steel sheet piling on the outer wall (/1301C17) is corroded but no holes were obviously apparent. However, it is notable that the blockwork walls at the end and inner facing walls (/1301C03) of this pier have open joints, although the overall condition of the pier remains fair.



*Corroded steel sheet piling (/1301C17)*



*Some open and some sealed joints in pier wall near lighthouse (/1301C03)*

Moving westwards from the landward end of Vincent's Pier, the RNLi have temporary portable cabins at the top of the slipway whilst a new lifeboat station is being constructed at the site of the former station, immediately adjacent to West Pier at the northern end of Scarborough South Bay. The promenade eastwards of here is supported by several arches built in front of the original quay. These appear in fair condition with well pointed stonework, but there previously reported damage to the concrete capping remains unrepaired.



*Portable cabins used by the RNLi while a new lifeboat station is being built in South Bay (/1301C05)*



*Some open and some sealed joints in pier wall near lighthouse (/1301C05)*

West of the arches, the quay wall leading to the slipway midway along Sandgate is formed by steel sheet piling (1301C12) which is corroded but otherwise appears in fair condition. The slipway (1301C11) is in fair condition, as is the short length of visible blockwork quay wall (1301C06) adjacent to the slipway. Immediately west of here is a concrete jetty which has been constructed to extend a suspended deck seaward of the wall. Previous inspections have reported signs of movement of the jetty and original quay wall, but this was not obviously apparent at the time of the present inspections and there was no sign of cracking in the deck. The slipway and wall at the western end of Sandgate (/1301C14), adjacent to the West Pier, is in fair condition.



*Slipway, quay wall and concrete jetty (/1301C11 and C06)*



*Suspended deck of concrete jetty (/1301C6)*

The inner face of the West Pier (/1301C13) appears to be mostly in fair condition, but the steel sheet piling is corroded. The seaward end (/1301C18) also has corroded steel sheet piling but the concrete capping beam at the crest is heavily abraded and suffers longitudinal cracks. Due to this, its condition has been downgraded to poor and repairs are recommended.



*Corroded steel sheet piling on inner face of West Pier (/1301C13)*

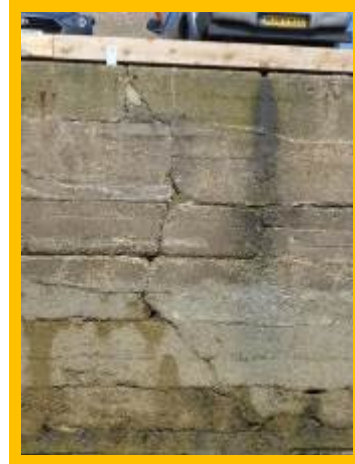


*Corroded steel and cracked capping beam on seaward end of West Pier (/1301C1718)*

The outer face of West Pier (/1301C07) continues to show several significant defects including numerous longitudinal cold joints, several large full height cracks and exposure of aggregates. Its condition has been recorded as poor since 2009. Some previous repairs are obvious but in places cracks remain partly open. There is one area of voiding near the toe of the wall and spalling and loss of render near the seaward end of this southern face. Repairs are recommended.



*Longitudinal cold joints in south face of West Pier wall (/1301C07)*



*One of several full height cracks in south face of West Pier wall (/1301C07)*



*Void at toe in south face of West Pier wall (/1301C07)*



*Spalling and loss of render in south face of West Pier wall (/1301C07)*

The poor condition of the seawall extends to its landward end (/1301C19) and repairs are recommended here once construction of the RNLI lifeboat station is complete.

### 3.18 Management Unit 22 – Scarborough South Bay

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into two smaller Sub-Management Units.

#### **MU22A – St Nicholas Cliff**

There are no natural cliff units defined within this Sub-Management Unit, but terraced gardens are present near the Town Hall.



**Terraced gardens at St. Nicholas Cliff**

#### **MU22B – South Cliff and Holbeck Gardens**

This Sub-Management Unit consists of **units MU22/1 to MU22/8**, all of which are protected at the toe by the sea wall, promenade and in places, rock armour. Some areas within South Cliff Gardens have been subject to historic shallow slips which have been remediated by soil nails. A major slope stabilization scheme to reduce the risk of both shallow and deep seated failures behind the Spa is currently under design. Holbeck Gardens was subject to a catastrophic deep-seated landslide in 1993.

**Unit MU22/1** is the most northerly unit located in Scarborough's South Bay and is classified as Inactive in 2016.

**Unit MU22/2** comprises the area around and to the north of the Spa complex. The unit was downgraded from Locally Active to Inactive in 2012 and remains Inactive to 2016.

**Unit MU22/3** is located just south of the Spa Complex in the vicinity of the cliff lift. The steep slopes of this unit are well vegetated with little evidence of instability. Therefore, this unit is classified as Inactive in 2014, unchanged since previous surveys.

**Units MU22/4 and MU22/5** comprise the northern part of the South Cliff Gardens and are both classified as Inactive in 2014, unchanged since previous surveys.

**Unit MU22/6** is located behind the former bathing pool and is classified as Inactive in 2016, also unchanged.

**Unit MU22/7** is located at Holbeck Gardens and is classified as Inactive in 2016, unchanged since 2012. A number of footpaths in have previously been closed due to cracking and ongoing instability. Otherwise, the slopes are well vegetated except for an area of exposed bedrock subject to small rockfalls at the cliff toe. The promenade at the base of the cliff is protected by a rockfall catch fence.

**Unit MU22/8** comprises the stabilised Holbeck Hall landslide run-out lobe and is protected at the toe by boulder armour. Localised sections near the headscarp are exposed. This unit is classified as Locally Active in 2016, unchanged.



**MU22/2** Coastal slopes near the Spa (Inactive)



**MU22/7** Coastal slopes near Holbeck Gardens (Inactive)



**MU22/2** Coastal at Holbeck Hall landslide (Locally Active)



**MU22/2** Coastal at Holbeck Hall landslide (Locally Active)

**MU22 – Scarborough South Bay**

A wide range of coastal defence assets are located in Scarborough South Bay. Throughout the defences there are vertical cracks, defects and areas of heavily abraded blockwork. Although there are numerous defects to the sea walls, the structures are generally sound and well maintained but ongoing repair work is needed to maintain or improve the condition of the assets and capital schemes have been recommended in the Coastal Strategy at several locations. Common defects visible throughout include mortar loss, blockwork abrasion and surface cracking.

**Foreshore Road and St Nicholas Cliff - MU 22A1/ and 22A/2**

The South Bay defences start at the RNLI lifeboat station, adjacent to West Pier (/1301C08 and C20). At the time of the inspection the former lifeboat station and slipway had been demolished and the larger replacement station and slipway was being constructed by BAM Nuttall. Once complete, the assets will be in 'as built' condition.



*Construction of new RNLI lifeboat station and slipway (/1301C08 & C20)*



*Construction of new RNLI lifeboat station and slipway (/1301C08 & C20)*



*Construction of new RNLI lifeboat station and slipway (/1301C08 & C20)*

The low defence wall along the east side of Foreshore Road is split into a number of asset lengths between sets of access steps. These are, running from north to south /1301C15, C21, C22, C23, C24 and C25. Due to high beach levels at the time of inspections, sand was often flush with the promenade or, at best, only the top one or two courses of stone blocks were visible along most of this length. Due to the high beach levels, the northern section of frontage is classed as being in good condition, with the wall where exposed around the Olympia Leisure reducing to fair condition because of frequent washed out joints and abrasion to blocks, which would benefit from repair.



*Beach levels flush with promenade at north end of Foreshore Road seawall (/1301C15)*



*One of the worst areas of abrasion and open joints (/1301C25)*

At the subway beach access in the vicinity of the Spa Bridge (1301C09), repairs have previously been made to the northern section of beach landing apron to the access steps and these remain in good condition. However, central and southern sections of the apron remain in fair condition. They are heavily abraded and in need of attention.



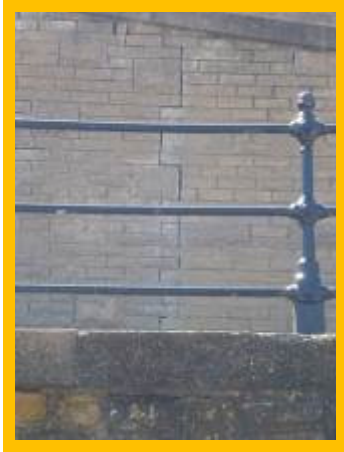
*Previous repairs remain in good condition locally, but overall asset condition is fair (/1301C09)*



*Abrasion of toe apron south of previous repairs (/1301C09)*

Immediately south of the beach access steps, this wall continues alongside a beach access ramp (1301C10) and there is a vertical crack in the brick retaining wall to the rear of the ramp which needs monitoring for further movement and repair. More significantly, there are major defects in the main wall (longitudinal and vertical cracks, gaps between the wall and its capping) and the lower wing-wall of the access ramp, especially around the Spa feature, which will need attention to prevent rapid further deterioration. Due to this, the wall is downgraded to poor condition. The seaward end of the ramp has been recently repaired and those works are holding well.





*Vertical crack in wall above access ramp (/1301C10)*



*Vertical crack in wall above access ramp (/1301C10)*

### **Spa Chalet – MU 22/A3**

The recurved sea wall between Valley Road and the promontory at the Spa (/1301C26) continues to show occasional defects throughout, such as washout of joints and abrasion to the blockwork surface or coping, and some cracked blocks although they appear stable. It is in overall fair condition, with parts of the upper section having been rebuilt, but ongoing maintenance is needed. In one location, the timber piles at the toe of the structure were exposed and future inspections should check for signs of undercutting.



*Occasional minor defects but overall fair condition seawall (/1301C26)*



*Exposed timber toe piles (/1301C26)*

### **The Spa – MU 22A/4 to 22B/2**

The Spa frontage comprises the following elements:

- Northern tie-in – masonry blockwork wall with access steps to the beach.
- Northern section (Spa and Sun Court) - masonry blockwork wall with splash wall along the crest, and a concrete apron/sheet piling toe along part of the length. The section in front of the Sun Court additionally has a wave deflector just below the parapet.
- Closed colonnade section - masonry blockwork wall with historic colonnade section, now closed-off with in-filled concrete blockwork.
- Open colonnade section – featuring a sheltered seating area on the lower level and steps to the beach and upper promenade/road.
- Southern tie-in – masonry blockwork wall with access steps to the beach.

The masonry sea wall at the northern end of the Spa frontage (/1301C27) remains in fair condition following previous repairs, including reinstatement of a section of the masonry/concrete parapet after December 2013 storm damage. Previous repairs to fill joints between blocks in the wall's face also remain effective, but there are other occasional open joints between blocks which would benefit from filling and cracks are evident across the corners or full height of the face of some blocks. In front of the Spa building's entrance, one section of sea wall has longitudinal cracks across three adjacent masonry blocks, which is likely to be an area of potential weakness.

A small number of blocks near the toe of the sea wall at the apron section and to the immediate south appear slightly recessed within the wall and a few also have small gaps opening. The toe apron itself appears in fair condition, although there is a lot of marine growth on the concrete and sheet piling which may cover defects and the steel piling is corroded. Additionally, due to relatively high beach levels at the time of the inspections, previous observations of scour hole development under the concrete apron (following the December 2013 storm) could not be checked. The drainage holes appear mostly in working order and the local area of wall containing ties shows no obvious signs of deflection.

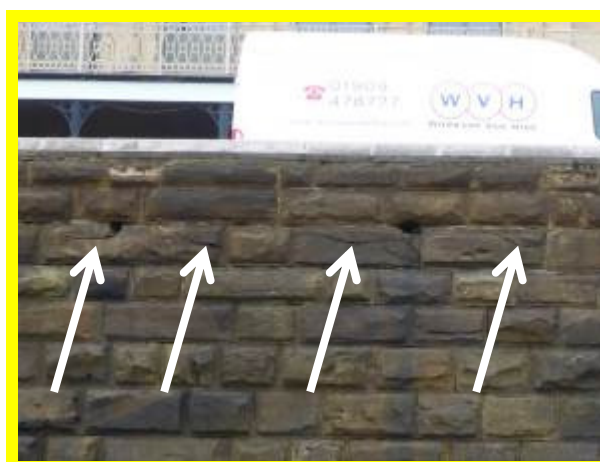
In front of the Sun Court (/1301C28), the wall has a concrete 'nosing' intended to act as a wave deflector below the parapet. Previous repairs to this element remain effective. The concrete toe beam was partially exposed along the length of the Sun Court and visible sections appeared in fair condition.



*Masonry sea wall at The Spaw access steps in fair overall condition (/1301C27)*



*Example of gaps between blocks in sea wall (/1301C27)*



*Longitudinal cracks across blocks in sea wall (/1301C27)*



*Previous repairs to wave deflector wall in front of the Sun Court (/1301C28)*

The wall between the Sun Court and the closed colonnade (/1301C29), remains in fair overall condition but has several small open joints. However, the closed colonnade section (/1301C29) has major spalling and loss of concrete to the lower splash beam below in-filled openings, tending towards poor condition. There is also an area of displacement in the blocks and loss of facing masonry at the toe near to the south end adjacent to the beach access steps between the closed and open colonnade sections. A large crack also runs down a section of the outer face of the access steps, just below its parapet. The pillars between adjacent in-filled openings show some minor cracking.



*Spalling to the lower splash beam at closed colonnade section (/1301C29)*



*Crack in wall and displacement/loss of facing masonry in blocks at toe (/1301C29)*

Along the open colonnade section (1302C01) there are three flights of access steps from the low level promenade to the beach, all of which are heavily abraded. The wall itself is in generally in poor condition despite previous December 2013 repairs remaining effective, with significant areas of open joints in other sections of the lower wall. The support pillars are heavily stained and in places there is some cracking. The access steps to the beach at the southern tie-in have been subjected to extensive repairs following previous damage in December 2013.



*Previous repairs (Dec 2013) at the open colonnade remain effective, but extensive open joints remain in lower wall (/1302C01)*



*Previous repairs at southern tie-in following December 2013 storm damage (/1302C01)*

**South Cliff Gardens – MU 22B/3 and 22B/4**

The low stone wall at South Cliff Gardens (/1302C03) has had a considerable number of repairs and rebuilding over the last few years, however notable cracks and gaps remain in need of further attention.



*Overall fair condition of low stone wall (/1302C03)*



*Gaps in need of filling (/1302C03)*

The low stone wall continues at the rear of the promenade around South Cliff Gardens with a seawall in front (/1302C02). The seawall has considerable previous repairs to the blocks and coping, but a group of three blocks is missing in one area. This needs to be addressed before more unravelling of the structure occurs. At the southern end of the wall, a short section of concrete bagwork is present at the tie-in to the South Bay Pool seawall to the south. Here one bag has been plucked from the wall, creating a small void which also needs attention. These defences have caused the structure to be regraded to poor.



*Overall fair condition of low stone wall (/1302C02)*



*Gaps in need of filling (/1302C02)*

**South Bay Pool MU 22B/5**

A concrete block wall (/1303C02) extends around the infilled lido pool, which is now used as a Star Disk. This wall has slightly stepped blocks on its face and these blocks and the wave return capping beam show continued signs of considerable abrasion. Some areas of the wall have been subject to beneficial repairs, but there are numerous other areas of open joints. In one location a failed outfall pipe extends across the foreshore. The wall's condition has previously been classed as poor and ongoing repairs/maintenance would be beneficial.



*Concrete block wall with open joints and heavy abrasion (/1303C02)*



*Previous repairs to wave return coping (/1303C02)*

### **Holbeck Gardens MU 22B/6**

There is a bastion groyne at the north of this frontage (/1304C02) which has trapped sand between here and the rock revetment around the Hoilbeck Hall landslide to the south. The lower sections of the backing seawall have areas of previously repaired and currently heavily abraded coping, with previous repairs also evident on the upper wall. The backing promenade deck has some cracks.



*Bastion groyne in overall fair condition (/1304C02)*



*Seawall in overall fair condition although with heavy abrasion damage locally (/1304C02)*

**Holbeck Cliff MU 22B/7**

The rock armour revetment (/1304C01) defending the relict debris flow lobe at the site of the Holbeck Hall landslide remains in good condition, with the armour tightly packed and good coverage. At the southern end of the defence the beach access ramp has a short vertical drop to rocks at the end making its use slightly difficult and there is a minor crack in the most seaward concrete section which would benefit from repair.



*Rock revetment around debris lobe of Holbeck Hall landslide (/1304C01)*



*Vertical drop and crack in concrete at end of access ramp at south end of revetment (/1304C01)*



*Rock revetment around debris lobe of Holbeck Hall landslide (/1304C01)*

### 3.19 Management Unit 23 – Holbeck to Knipe Point

#### *Coastal Slope Condition Assessment*

This Management Unit consists of a large number of units, from MU23/A in the north to MU24/A7 at Knipe Point in the south.

**Unit MU23/A** is located immediately south of the Holbeck Hall landslide run-out lobe and is classified as Partly Active. This unit has well-vegetated upper slopes, but the cliff experiences ongoing marine action and rockfalls.

**Units MU23/B** continues to be also classified as Partly Active in 2016.

**Unit MU23/C** is well-vegetated in the upper cliff but with a steep and eroding cliff toe and remains classified as Partly Active in 2016.

**Units MU23/D1, MU23/D2 and MU23/D3** are located at Wheatcroft Cliff above Black Rocks. These units are active down much of their length, with ongoing recession of the headscarp, slumping in the mid-slope and erosion of the toe. They are classified as Partly Active in 2016.



**View from MU23/A to MU23/D3 All Partly Active**

**Unit MU23/E** is located at White Nab and remains classified as Locally Active in 2016. The slopes of this unit support some vegetation cover with intermittent areas of more intense erosion mid-slope and at the unit toe.

**Unit MU23/F** is a narrow, thin unit which follows a small valley occupied by an outflow channel for a pipeline and pumping station. The slopes inland are well vegetated and show very little evidence of recent activity. As a result, this unit is classified as Inactive in 2016. Works have recently been undertaken to repair the Yorkshire Water outfall at this site (with a replacement long sea outfall scheduled to be built in the future).



**MU23/E** Vegetation and localised erosion (Locally Active). August 2014.



**MU23/F** Works encountered during the 2014 survey (Inactive). August 2014.

**Units MU23/G1 and MU23/G2** form the northern part of Frank Cliff and are both classified as Partly Active in 2016. The upper slopes of these units support some vegetative cover. The unit toes are highly active with evidence of rockfalls, slumping and sliding onto the beach below.

**Unit MU23/H** forms the headscarp and upper zone of a large mudslide embayment at Frank Cliff. Little erosion is evident and it is classified as Locally Active in 2016. **Unit MU23/H2** forms the main body of the mudslide and has a greater level of activity, and is classified as Partly Active. The mudslide toe comprises a series of smaller mudslides forming **units MU23/H1, MU23/H2a, MU23/H2b and MU23/H3**. In 2016, Partly Active status has been retained for these lower units due to evident toe erosion.

**Unit MU23/I** comprises the main body of the Cornelian Bay mudslide and was classified as Locally Active in 2016. **Units MU23/I1, MU23/I2 and MU23/I3** form smaller mudslides at the toe of unit 23/I. All these units have been classified as Locally Active.

**Unit MU23/I4** is situated on the north side of the Knipe Point headland and is composed of soft glacial material. The unit was downgraded from Totally Active to Locally Active in 2012 but is classified as Partly Active in 2016 as erosion appears to be continuing on a fairly widespread basis.

**Unit MU23/J** is also located on the north side of Knipe Point. This unit is composed of hard, well jointed rock and was upgraded from Locally Active to Partly Active in 2014 due to the actively receding toe and exposed bedrock in the mid-cliff which is a source of rockfall. This classification is retained to 2016.

**Units MU24/A8 and MU24/A7** are situated on the east and south facing sides of Knipe Point respectively and are both classed as Partly Active in 2016, no change from previous inspections. The unit frontages are almost entirely exposed and experiencing intense erosion. There is some evidence of past rockfall activity.

#### *Coast Protection Asset Condition Assessment*

There are no coastal defence assets within this Management Unit.



### 3.20 Management Unit 24 – Cayton Bay

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into two Sub-management Units.

#### **MU24A – Cayton Bay North**

This Sub-management Unit consists of units MU24/A and MU24/A2, MU24/B and MU24/B1 to MU24/B10.

Immediately south of Osgodby Point, unit MU24/A comprises mudstone at beach level of the Cayton Cliff landslide complex. The wide expanse of Cayton Cliff is capped by till which is heavily vegetated. Significant recession of the head scarp occurred during an event in 2008-2009, resulting in the loss of land and properties at Knipe Point Drive. The cliff at the toe of the complex is steep and comprises uplifted debris from deep landslide movement. Only localised activity is evident at the toe and head scarp, with no evidence for movement in the body of the landslide, and so the unit is considered to be Locally Active in 2016, the same as 2014.



Heavily vegetated till of Cayton Cliff. MU24/A Locally Active in June 2016



Toe of Cayton Cliff. MU24/A Locally Active in June 2016



Toe of Cayton Cliff. MU24/A Locally Active in June 2016



MU24/A Locally Active in June 2016

Tenants' Cliff is a complex of terraced landslips in mudstone and sandstone and is divided into 11 units. Unit MU24/B forms the main part of the Tenants' Cliff landslide and is classified as Inactive in 2016, no change from 2014. The toe of Tenants' Cliff is categorised into ten smaller landslide units comprised of massive displaced blocks of sandstone. Each of MU24/B1 to MU24/B10 is classified with a different level of activity in 2016. The more northerly units (MU24/B1 and MU24/B2) are classified as Locally Active, MU24/B3 to MU24/B8 as Partly Active and MU24/B9, where there is intense erosion of the unit toe, classified as Totally Active. All these units are classified the same as they were in 2014. MU24/B10 is protected by the seawall which extends northwards from the pumping station. During the 2016 survey it was completely vegetated and is classified as Inactive.



Heavily vegetated part of Tenants' Cliff complex. MU24/B Inactive in June 2016



Toe of Tenants' Cliff complex. MU24/B1 Locally Active in June 2016



Toe of Tenants' Cliff complex. MU24/B4 (right) to MU24/B6 (left) Partly Active in June 2016



Intense erosion in MU24/B9 (Totally Active in June 2016)

#### MU24B – Cayton Bay South

This Sub-Management Unit consists of units MU24/C to MU25/T.

Units MU24/C to MU24/O are composed of glacial till down to beach level and stretch south from the pumping station as Killerby Cliffs. Apart from MU24/H and MU24/J, they are all classified as Partly Active in 2016, unchanged from 2014. The Partly Active units show active recession of the head scarp and slumping in mid and lower slopes. At the cliff toes there is evidence of instability through slumping and erosion. In the south-central units (MU24/K to MU24/O), the slumped till may be masking bedrock in the lower cliff. An exception to the Partly Active classification is MU24/H which comprises the access route to the beach. The slope of this unit is engineered and well vegetated, with no obvious signs of recent activity, and so is classified as Inactive. Also, although there is activity throughout much of the head scarp of MU24/J, there is less than in adjacent units, and so it is classified as Locally Active.



Till of Killerby Cliffs. MU24/C Partly Active in June 2016



Till of Killerby Cliffs. MU24/F Partly Active in June 2016



Vegetated till slopes of Killerby Cliffs. MU24/H Locally Active in June 2016



Till of Killerby Cliffs. MU24/I Partly Active in June 2016



Vegetated till slopes of Killerby Cliffs. MU24/J Locally Active in June 2016



Till of Killerby Cliffs. MU24/M1 (right) and MU24/M2 (left) (both Partly Active in June 2016)

Units MU24/P to MU25/T are predominantly exposed near-vertical sandstone at the toe of a steep cliff overlain by mudstone with a thin capping of till. The sandstone is characterised by local rock falls on to the beach and platform with local small debris cones off the base of the mudstone. Given this level of activity, they are all classified as Locally Active in 2016, downgraded from Partly Active in 2014.



Composite sandstone and mudstone cliffs in south Cayton Bay. MU24/P (right) to MU24/S (left) (both Locally Active in June 2016)



Local rock fall and debris cone in MU24/P (Locally Active in June 2016)

**MU24A – Cayton Bay North**

There are no coastal defence assets within this Sub-Management Unit.

**MU24B – Cayton Bay South**

Cayton Bay is predominantly a natural bay, mostly free from coastal defences. However, there are a series of defences at Cayton pumping station, which extend to the beach access ramp to the south.

To the north of the pumping station (which is now converted to a private residence) is a private blockwork defence with concrete toe slab (/1402C02), which ties into the eroding cliffs to the north with a mixture of brick, stone blocks and concrete. The wall itself is in fair condition and appears newer than the wall to the south, although the toe apron is undermined. There was significant erosion of the undefended cliff immediately to the north of the tie-in between 2012 and 2014, but this has not significantly worsened since.



*Private sea wall in fair condition (/1402C02)*



*Erosion of undefended cliffs at tie-in of sea wall private sea wall (/1402C02)*

There is a complex series of private blockwork and concrete sea walls (/1402C05) protecting the main pumping station building.

The condition of the defences varies with the higher, red brick walls appearing sound, the lower, concrete and sandstone blockwork remaining in fair condition but the apron at the toe being the worst affected.

Overall the structure remains in fair condition.



*Private sea wall in fair overall condition but with the toe apron subject to ad hoc repairs (/1402C05)*

Between the southern end of the pumping station defences and the landing of the beach access steps, there is a length of defence (/1402C04) which exhibits major undercutting and blockwork loss leading to washout of backing material and the creation of large voids. Parts of the upper deck are badly cracked and breaking up and there is **very significant overall damage**.

The structure has deteriorated in condition since inspections undertaken in May 2015 as part of the *Filey & Cayton Bay Coastal Strategy*. In the northern section, concrete slurry appears to have been poured to cover previously identified defects, but there is one section below this with a void remaining at the toe. The greatest concern, however, is within the southern section which in one place has now been totally undermined at the toe and the material behind has entirely washed out leaving a large void below the deck. The deck has opened into a fairly large hole but the remainder of the undermined section is still covered by (now cracked) deck and this is likely to be subject to imminent failure and collapse. Adjacent to this section, an area of missing blockwork has expanded, with further block loss and washout of backing material. In its present condition, this structure should be deemed as 'dangerous' given that it is used by member of the public and is in such close proximity to the access steps.



*Sea wall in very poor condition with areas of significant undercutting and areas of missing blockwork leading to large voids (/1402C04)*



*Undercutting at toe leading to voiding behind and break-up of deck (/1402C04)*



*Large hole in deck surface with visibility through to foreshore due to size of void underneath (/1402C04)*



*Large hole in deck surface (/1402C04)*



*Missing blockwork in May 2015 (/1402C04)*



*Further missing blockwork in June 2016 (/1402C04)*

The concrete structure at the beach landing of the public access point is in a very poor condition with large cracks and voids throughout (/1402C06). Previous poured concrete skim has covered some voids on the deck to make the structure safer for pedestrians but slumps in the cliff behind are continuing to threaten the access and it is recommended that this structure is demolished and removed and replaced with a simple, safer and more adaptable public access.



*Landing at beach access and slumping cliffs adjacent to steps (/1402C06)*



*Slumping cliffs adjacent to steps leading to outflanking – northern end (/1402C04)*



*Cracked concrete at landing at beach access (/1402C06)*



*Slumping cliffs adjacent to steps leading to outflanking – southern end (/1402C04)*

**The condition of the defences at the Cayton Bay pump house access is very poor and the structures present a significant health and safety risk to the general public. It is recommended that access arrangements to Cayton Bay at this location are re-evaluated at the earliest opportunity in line with the *Filey & Cayton Bay Coastal Strategy*.**

Around 300m south of the pumping station beach access, there is beach access point for the path from the public car park at the surf shop. There are a set of beach access steps that were previously protected by gabion baskets, which have distorted and split under wave action. This is not a formal coastal defence, so has no asset number.



*Failed gabion baskets at surf shop car park beach access (no asset reference)*



*Failed gabion baskets at surf shop car park beach access (no asset reference)*



### 3.21 Management Unit 25 – Lebberston Cliff and Gristhorpe Cliff

#### Coastal Slope Condition Assessment

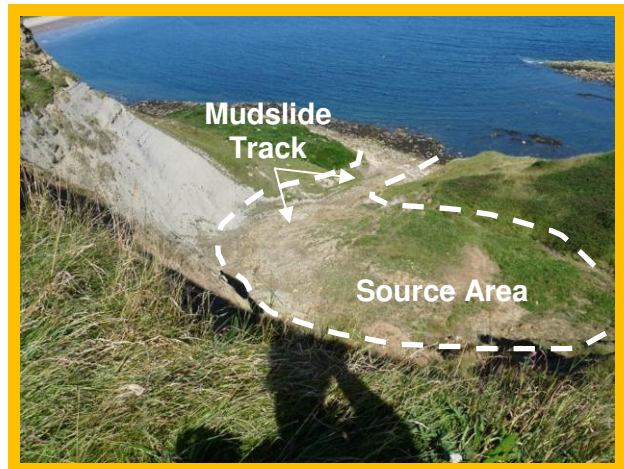
This Management Unit consists of units MU25/U at Lebberston Cliff to MU25/AE at the eastern end of Gristhorpe Cliff.

**Unit MU25/U** is located above Red Cliff Hole and is classified as Locally Active in 2016, unchanged from 2014. The steep cliffs are characterised by localised areas of erosion, but are otherwise well vegetated.

**Unit MU25/V** is located at Lebberston Cliff and comprises a large, periodically active mudslide system. The unit appears to be prone to regular change and recession. This unit was downgraded from Totally Active to Partly Active following the 2012 walkover and this grading has been retained for 2016.



Composite sandstone and mudstone cliffs in south Cayton Bay. **MU24/T** (right) to **MU24/U** (left) (both Locally Active in June 2016)



**MU24/V** - view from directly above the mudslide (Partly Active). [Reproduced from August 2014].

**Unit MU25/W** is situated at Red Cliff Point and relatively recent headscarp activity has caused this unit to be graded as Partly Active in 2016.

**Unit MU25/X** is classified as Partly Active in 2016. Despite being well vegetated, the slopes of this unit appear to be subject to ongoing instability, with evidence of mudsliding and recession at the headscarp.

**Units MU25/Y and MU25/Z** are located at the northwest end of Gristhorpe Cliff and are classified as Partly Active. These units are characterised by numerous areas of activity, with headscarp recession, slumps in the mid-slope and ongoing erosion of the toe.

**Unit MU25/AA** comprises soft till cliff which continues to erode at the headscarp with slumping and sliding mid-slope. Marine erosion is apparent at the cliff toe and therefore a Partly Active status has been retained in 2016.

**Units MU25/AB and MU25/AC** form the main part of Gristhorpe Cliff and are adjacent to a caravan park. The upper cliff slopes are composed of soft glacial sediments and experience localised slumping, with headscarp recession. The face of the cliff is steeper with active erosion and formation of debris aprons. Unit **MU25/AB** is Partly Active, while **MU25/AC** is Locally Active. Neither unit has changed status since 2012.

**Units MU25/AD and MU25/AE** are similar in form to adjacent units MU25/AB and AC. There is some erosion of the headscarp and localised areas of more intense erosion on the lower slopes. These units are classified as Locally Active in 2016, unchanged since 2012.

*Coast Protection Asset Condition Assessment*

There are no coastal assets within this Management Unit.

### 3.22 Management Unit 26 – Newbiggin Cliff and North Cliff

#### *Coastal Slope Condition Assessment*

This Management Unit comprises **unit MU26/AF** in the northwest to **unit MU26/AX** just to the west of Filey Brigg.

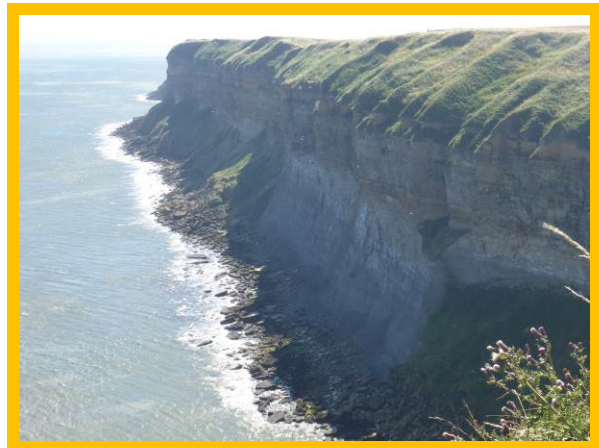
**Units MU26/AF, MU26/AG and MU26/AH** are located at The Wyke, to the west of Newbiggin Cliff and are all classified as Locally Active in 2016, unchanged since inspections began in 2002. These units are characterised by a soft till overlying resistant rock cliff that is fronted by a debris apron. There is minor, localised activity within the till capping including recession of the headscarp in places. The rock cliff is largely stable, but the debris apron shows evidence for recent rock falls and is subjected to marine erosion.

**Units MU26/AI and MU26/AJ**, form the western part of Newbiggin Cliff and are both classified as Partly Active. These units are of a similar form to the adjacent Locally Active units, described above. However, they are characterised by a greater level of activity within both the upper and lower cliff layers and less continuous vegetation cover.

**MU26/AK and MU26/AL** are changed in grading to Partly Active, having experienced widespread rockfalls and mudslides along their length.



**MU26/AF** Soft till overlying resistant rock (Locally Active).



**MU26/AK and MU26/AL** Cliffs experiencing rockfalls and mudslides.

**Units MU26/AM, MU26/AN and MU26/AO** form the main part of Newbiggin Cliff and are classified as Locally Active in 2016, unchanged since 2002. These cliffs are again characterised by a soft upper layer, a hard rock middle layer and series of debris cones at the unit base. There is localised activity within these units, especially within the soft upper layer.

**Unit MU26/AP** was classified Partly Active in 2012 but downgraded to Locally Active during the 2014 survey. This classification has been retained in 2016 as there is no evidence of renewed activity.

**Unit MU26/AQ** was upgraded to Partly Active in the 2014 walkover survey. However, there is no evidence of further activity and therefore a grading of Locally Active is applied in 2016.

**Unit MU26/AR** shows few signs of instability in the upper cliff and has been assigned Locally Active status in the 2016 survey.

Remaining **Units MU26/AS to MU26/AY** have all been assigned a status of Locally Active in 2016. The upper part of the cliffs, comprised of soft glacial sediment is exhibit only localized, rather than

widespread, erosion in the form of headscarp recession and mud sliding. There is also localised marine erosion of the toe.

*Coast Protection Asset Condition Assessment*

There are no coastal assets within this Management Unit.

### 3.23 Management Unit 27 – Filey Brigg

#### *Coastal Slope Condition Assessment*

This Management Unit comprises units MU27/AY to MU27/O on the northern and southern sides Filey Brigg.

**Units MU27/AY and MU27/AZ** both have a similar form to those units described in Management Unit 26, with till overlying rock cliffs and both are classified as Locally Active in 2016. The upper slopes show intermittent zones of activity in the form of headscarp recession and rilling of exposed sediment.

**Units MU27/BA to MU27/BD** are located on the northern side of Filey Brigg and are all Partly Active in 2016. The upper slopes of these units support some discontinuous vegetation cover. Headscarp recession, localised mudslides and rilling are common in the upper till unit.

**Unit MU27/BE and 27/BF** are also located on the northern side of Filey Brigg but until 2012 were less active than adjacent units. However, much of the upper slopes have been unvegetated and eroding since then and both retain classification of Partly Active.

**Units MU27/A and MU27/B** are located at the tip of Filey Brigg. Both remain classified as Partly Active in 2016. These units are composed entirely of the soft glacial material which is particularly susceptible to erosion. There is frequent mud sliding within these units.

Units **MU27/C to MU27/G** are located at the western end of the south side and of Filey Brigg. The cliffs are composed predominantly of vegetated glacial till with a low underlying cliff of limestone and sandstone to beach level. They contain local mid-slope activity and erosion of the cliff toes and are therefore classified as Locally Active in 2016, no change from 2014.

**MU27H to MU27/J** are located in the central part of the south side of Filey Brigg and are variously vegetated and unvegetated. These units comprise simple mudslides, each with an arcuate head scarp and elongate flow tracks. They are classified as Partly Active in 2016, the same as 2014.

**Units MU27/K to MU27/O** are also located on the south side of the Brigg at its western end. They are predominantly unvegetated and are undergoing intense erosion and are therefore classified as Totally Active in 2016, the same as 2014.



Composite cliffs on the south side of Filey Brigg. MU27/C (right) to MU27/G (left) (all Locally Active in June 2016)



Composite cliffs on the south side of Filey Brigg. MU27/I Partly Active in June 2016



Composite cliffs on the south side of Filey Brigg. MU27/K (right) to MU27/N (left) (all Totally Active in June 2016)



Composite cliffs on the south side of Filey Brigg. MU27/N (right) & MU27/O (left) (both Totally Active in June 2016)

### *Coast Protection Asset Condition Assessment*

There are no formal coast protection structures in this unit. However, at the eastern end of Filey Brigg a cabin structure and wall exists, tucked away against the cliffs. The structure comprises of a blockwork wall, poured concrete apron and blockwork cabin build onto the cliff strata. The previous inspection noted that undercutting is occurring to the apron as well as washout of the joints to the wall, the cabin is in structurally sound condition. Access is restricted due to the eroded path leading to the asset and as it is not a formal coast protection asset and as in 2012 inspections it was not inspected in the 2014 or 2016 asset inspections.

### 3.24 Management Unit 28 – Filey Bay North

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into two Sub-management Units; MU28A – North of Filey Town and MU28B – Filey Town Frontage.

#### MU28A – North of Filey Town

This Sub-management Unit consists of units MU27/P to MU27/X, located to the north of Filey town. Units MU27/P to MU27/S are situated below the North Cliff Country Park. These cliffs are composed of glacial till down to beach level and are undergoing erosion down much of their length. Erosion is particularly intense along the steep toes in MU27/R and MU27/S. At mid- and upper-slope levels, there is greater vegetation cover but still with areas of sliding and head scarp erosion. These units are classified as Partly Active in 2016, the same as 2014.

Units MU27/T surrounds Filey sailing club and comprises glacial till down to beach level. The cliff slope is relatively shallow with an exposed eroding toe, and shallow slumps across better vegetated mid- to upper-slopes. This unit is classified as Partly Active in 2016, the same as 2014. MU27/U is classified as Locally Active, the same as 2014.

Unit MU27/V and MU27/W are located between the sailing club and the north end of Filey seawall. These units are classified as Partly Active in 2016 with large-scale head scarp recession, slumping throughout the profile and erosion at the toe.

Units MU27/X is located behind the northern end of Filey seawall and town. It is classified as Inactive in 2016, downgraded from Locally Active in 2014.



Till cliffs between Filey Brigg and Filey sailing club. MU27/Q Partly Active in June 2016



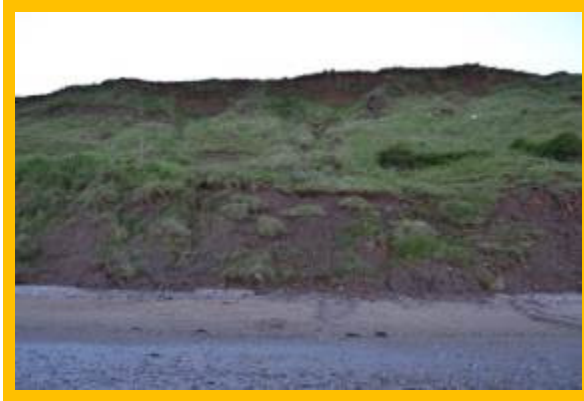
Till cliffs between Filey Brigg and Filey sailing club. MU27/R Partly Active in June 2016



Till cliffs between Filey Brigg and Filey sailing club. MU27/S Partly Active in June 2016



Till cliffs at Filey sailing club. MU27/T Partly Active in June 2016



Till cliffs between Filey sailing club and Filey town. MU27/V Partly Active in June 2016



Till cliffs between Filey sailing club and Filey town. MU27/W Partly Active in June 2016

#### MU28B – Filey Town Frontage

This Sub-management Unit consists of units MU28/Y and MU28/Z at Filey town.

Units MU28/Y and MU28/Z are located behind Filey seawall and town. They are classified as Inactive in 2016, unchanged from 2014.

#### *Coast Protection Asset Condition Assessment*

#### **MU28A – North of Filey Town**

To the north of the town, Filey Sailing Club is located at the back of the beach and is partly protected by some coastal defences. However, the section of cliff below the boat park (which is located on a terrace part way up the cliff) north of the club building is undefended (/1601C01) and suffering active slumping along its length.

Immediately north of the club building there was formerly a defence structure (/1601C02) that consisted of timber breastwork retaining rock armour. However, all that remains of this now failed structure is the rock debris scattered on the beach.



Undefended cliffs below boat storage yard (/1601C01)



Remnants of former defences north of club building (/1601C02)

At the club building, there is a section of sheet piling (/1601C03) which showed significant corrosion leading to sizeable holes forming in the steel in the central section and voids behind due to wash out of material as recently as May 2015. At that time, the concrete slipway had been repaired not long before and the southern sections of steel piles had been replaced between 2009 and 2012. However, repairs have been made since May 2015 and the sheet piling is now in good condition.





*Failed central section of steel sheet piling as observed in May 2015 (/1601C01)*



*Repaired central section of steel sheet piling as observed in June 2016 (/1601C02)*

The previously repaired lower section of the access slipway remains in good condition, but the section immediately above this is starting to show signs of undercutting at its toe.

### **MU28B – Filey Town Frontage**

The Filey Town frontage is protected by a sea wall just over 1km in length between Coble Landing in the north and Martin's Gill at the south and is split into 9 asset lengths. The sea wall is generally in fair condition although it shows evidence of minor, localised defects including cracks and chipping within the capping beam, surface abrasion and mortar loss. However, the significant number of repairs and maintenance works to the defences between 2012 and 2014 are working effectively. The description of the inspection runs from north to south.

The most northerly asset in the defence system consists of the rear wall and slipway at Coble Landing (/1602C01). The slipway blockwork appeared in fair condition although, as noted during previous inspections, the rear wall below the chalets has a long horizontal crack in the wall and is in fair condition.



*Coble Landing slipway blockwork in fair condition (/1602C01)*



*Longitudinal cracks in rear wall (/1602C01)*

The next asset (/1602C09) is essentially a wing wall protecting the slipway. Repairs to this wall were made between 2012 and 2014 and are holding well and the overall asset condition remains as fair. However, the toe apron has some signs of abrasion damage and undercutting which need continued monitoring and likely future maintenance.



*Previous repairs to slipway 'wing-wall' holding well (/1602C09)*



*Abrasion of concrete toe apron (/1602C09)*

The wall located north of Ravine Road (/1602C06) is in fair overall condition, although there are areas of damage that have been previously repaired. There occasional remaining cracks, washed out joints / missing mortar between the masonry blocks in several locations both the wall and the slipway / beach access ramp next to the car park.



*Sea wall near Ravine Road in fair condition (/1602C06)*



*Occasional open joints with missing mortar (/1602C06)*

The sections of sea wall between Ravine Road and the access point east of Cargate Hill Road (/1602C08) and between Cargate Hill Road and Crescent Hill (/1602C03) are both in fair overall condition, although in some sections several blocks have abrasion damage to the front face, particularly just above beach level. Many of the splash coping blocks have been replaced along the length of these assets, but others are cracked or damaged. The damage appears to get worse with progression south and is mainly focused around the lower blockwork or upper splash wall / coping.



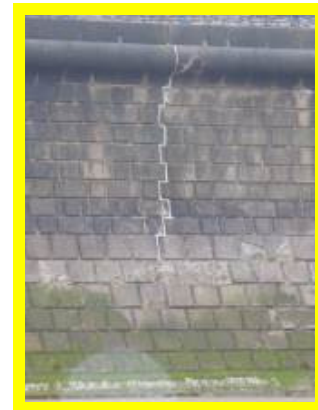
*Sea wall south of Ravine Road in fair condition but with damaged coping and lower blockwork abrasion (/1602C08)*



*Abrasion damage and open joint in sea wall south of Cargate Hill (/1602C03)*



*Previous repairs to coping and wave return feature (/1602C08)*



*Previous repairs to joints (/1602C03)*

The next defence assets to the south are the wall around the Royal Parade promontory (/1602C04) and the wall between here and the southern-most promontory (/1602C07). These sections of wall are in fair overall condition (including previous repairs to one long vertical gap between adjacent blocks running over half the height of the wall), although there is cracking to the coping and numerous abraded, chipped or damaged blocks. Previous repairs to the lower section of the access steps at Royal Parade are holding well but the cracks and open joints in the southern set of access steps makes it vulnerable to damage during storms.



*Royal Parade sea wall in fair condition but with some blockwork abrasion (/1602C04)*



*Access steps at Royal Parade sea wall (/1602C04)*

The southernmost section of the main wall includes the southern promontory and the return section to Martin's Gill (/1602C05). This structure is overall in fair condition, although there is chipping and cracking to the coping in small areas throughout length and numerous lower blocks area abraded. Cracks in the side wall to the slipway / access ramp at the southern end of the wall appear to have been filled.

A short section of rock revetment with gabion baskets beneath is located at the southern end of the sea wall near Martin's Gill (/1602C02). This defence extends into Sub-Management Unit Mu29A and is intended to manage the interface between the hard defences to the north and eroding natural cliff to the south. The rock armour has been re-profiled on occasion after movement of some armourstones during storms. However, at the time of the inspections, the structure was in fair condition. Despite this, there coastal slopes behind the revetment still appear to be active and some form of improved outflanking defence remains necessary in the medium term.



*Slipway / access ramp at southern end of Filey Sea Wall (/1602C02)*



*Rock revetment at southern end of Filey Sea Wall (/1602C02) – note active coastal slopes to rear*

### 3.25 Management Unit 29 – Filey Bay

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into three Sub-management Units.

MU29A – Muston Sands

This Sub-management Unit comprises **units MU29/AA to MU29/AI** along Muston Sands.

**Units MU29/AA and MU29/AI** which are composed of glacial till down to beach level and stretch south of Filey town are all classified as Partly Active in 2016. This is unchanged from 2014 for units **MU29/AA to MU29/AH**, but **MU29/AC and MU29/AI** are upgraded from Locally Active in 2014. The entire length of cliff is partly vegetated and suffers from head scarp erosion and slumps and slides are causing failure throughout the cliff face. The toes are undergoing various degrees of marine erosion.



Till cliffs adjacent to Filey town. MU27/AA Partly Active in June 2016



Till cliffs along Muston Sands. MU27/AD Partly Active in June 2016



Till cliffs along Muston Sands. MU27/AA (right) to MU27/AD (left) (all Partly Active in June 2016)



Till cliffs along Muston Sands. MU27/AF Partly Active in June 2016



Till cliffs along Muston Sands. MU27/AH Partly Active in June 2016



Till cliffs along Muston Sands. MU27/AI Partly Active in June 2016

### MU29B – Hunmanby Sands

This Sub-management Unit consists of units MU29/AJ at Mile Haven to MU29/BE2 at Hunmanby Gap.

**Units MU29/AJ to MU29/AS** are all classified as Partly Active in 2016. This is an upgrade from Locally Active in 2014 for **MU29/AJ to MU29/AQ** and the same in 2014 for **MU29/AR and MU29/AS**. They all comprise glacial till down to beach level, which is partially vegetated and slumped throughout the cliff profiles, with active head scarp and toe erosion.



Till cliffs along Hunmanby Sands. MU27/AK Partly Active in June 2016



Till cliffs along Hunmanby Sands. MU27/AP Partly Active in June 2016



Toe of till cliffs at Flat Cliffs. MU27/AQ Partly Active in June 2016



Toe of till cliffs at Flat Cliffs. MU27/AR Partly Active in June 2016



Toe of till cliffs at Flat Cliffs. MU27/AR (right) and MU27/AS (left) (both Partly Active in June 2016)



Toe of till cliffs at Flat Cliffs. MU27/AS Partly Active in June 2016

**MU29/AT** is classified as Locally Active in 2016 (unchanged from 2014) as it is generally well vegetated and there is only local evidence for toe erosion or activity at mid to upper levels.



Well vegetated till cliffs along Hunmanby Sands. MU27/AT Locally Active in June 2016



Well vegetated till cliffs along Hunmanby Sands. MU27/AT Locally Active in June 2016

**Units MU29/BA to MU29/BE2** are located between Butcher Haven and Hunmanby Gap and are all classified as Partly Active, unchanged from 2014, apart from **MU29/BA and MU29/BE2** which are upgraded from Locally active. These cliffs are steeper than further north and are characterised by head scarp erosion and common areas of intense erosion. The toes are active with slumping and sliding on to the beach.



Till cliffs north of Hunmanby Gap. MU27/BB Partly Active in June 2016



Till cliffs north of Hunmanby Gap. MU27/BD Partly Active in June 2016



Till cliffs north of Hunmanby Gap. MU27/BE Partly Active in June 2016



Till cliffs at Hunmanby Gap. MU27/BE2 Partly Active in June 2016

### MU29C – Reighton Sands

This Sub-management Unit consists of units MU29/BF near Hunmanby Gap to MU29/BQ below Reighton Moor.

Unit MU29/BF includes Hunmanby Gap itself. This unit is partly shielded from wave erosion by unit MU29/BG and is classified as Locally Active in 2016, unchanged from 2014. MU29/BG to MU29/BJ are located south of Hunmanby Gap. These cliffs are steep and affected by intense erosion throughout most of their height. The head scarp is retreating and there is significant slumping on to the beach. MU/29BG to MU29/BJ are classified as Totally Active in 2016, unchanged from 2014.



Intense erosion of till cliffs south of Hunmanby Gap. MU27/BG Totally Active in June 2016



Intense erosion of till cliffs south of Hunmanby Gap. MU27/BH Totally Active in June 2016



Intense erosion of till cliffs south of Hunmanby Gap. MU27/BI Totally Active in June 2016



Intense erosion of till cliffs south of Hunmanby Gap. MU27/BJ Totally Active in June 2016



Further south, units MU29/BK to MU29/BQ are located above Reighton Sands. All of these units are classified as Partly Active in 2016, unchanged from 2014. They are characterised by steep slopes partially covered in vegetation. There is recession of the head scarp, common areas of erosion in the mid-slopes and slumping on to the beach. The toes are steep and eroding.



Till cliffs at Reighton Sands. MU27/BL Partly Active in June 2016



Till cliffs at Reighton Sands. MU27/BM Partly Active in June 2016



Till cliffs at Reighton Sands. MU27/BO Partly Active in June 2016



Till cliffs at Reighton Sands. MU27/BQ Partly Active in June 2016

#### *Coast Protection Asset Condition Assessment*

There are no formal coastal defence assets within Management Unit 29, although the rock revetment and baskets extend into this Sub-Management Unit from MU28B. See the Coast Protection Asset Assessment section for MU28B for details. There are no other coastal defence assets within this Sub-Management Unit.

### 3.26 Management Unit 30 – Filey Bay South

#### *Coastal Slope Condition Assessment*

This Management Unit is divided into two Sub-management Units.

#### MU30A – Reighton Gap

Sub-management Unit MU30A is located beneath Reighton Sands Holiday Village and consists of units MU29/BR to MU29/CCa.

**Units MU29/BR, MU29/BS and MU29/CA** form the majority of this Sub-management Unit and are classified as Partly Active in 2016, unchanged from 2014. These units are partially vegetated, and contain large slumps and erosion at their head scarps.



Till cliffs beneath Reighton Sands Holiday Village. MU27/BR Partly Active in June 2016



Till cliffs beneath Reighton Sands Holiday Village. MU27/BR Partly Active in June 2016



Till cliffs beneath Reighton Sands Holiday Village. MU27/BS Partly Active in June 2016



Till cliffs beneath Reighton Sands Holiday Village. MU27/CA Partly Active in June 2016

**Unit MU29/CB** is at the eastern end of the holiday village. The unit exhibits mudslides and an eroding head scarp, and is classified as Partly Active in 2016, the same as 2014. Unit **MU29/CCa** forms a shallow mudslide embayment extending on to the beach. The unit is classified as Partly Active, unchanged from 2014.



Till cliffs in MU27/CB  
(Partly Active in June 2016)



Mudslide embayment of MU27/CCa  
(Partly Active in June 2016)

Sub-management Unit 30B comprises units MU29/CC to MU29/CJ above Speeton Sands.

**Unit MU29/CC** forms a large, shallow, well vegetated embayment known as Middle Cliff with a steep well-defined eroding toe in mud. There is also activity at the unit head and mid slope. The unit is classified as Partly Active in 2016, the same as 2014.

**Unit MU29/CD** is similar to MU29/CC but with more recent activity in the form of slumps, slides, block failures and mudflows at the toe. As a result this unit is classified as Partly Active, as it was in 2014.



Toe of mud cliff in MU27/CC  
(Partly Active in 2016)



Toe of mud cliff in MU27/CC  
(Partly Active in 2016)



Toe of mud cliff in MU27/CD  
(Partly Active in 2016)



Mudflow from mud cliff in MU27/CD  
(Partly Active in 2016)

**Unit MU29/CE** is similar in form to unit MU29/CC but is classified as Locally Active in 2016. The slopes are well vegetated with dense trees and shrubs in places. Erosion at the toe is extends relatively high above the beach in places, but the upper slopes are well vegetated.

**Units MU29/CF to MU29/CI** are located at Speeton Cliffs and are all classified as Locally Active in 2016. These units are characterised by outcrops of chalk near the unit toes which are actively eroding onto the beach below. In places the headscarp is near vertical and exposed.

The high chalk cliffs within unit **MU29/CJ** are much steeper than those to the north, with large mantles of slumped material at the unit toe. There is some evidence of rockfall and marine erosion at the cliff base but otherwise the cliffs appear fairly stable. Therefore, this unit has been classified as Locally Active in 2016.

#### *Coast Protection Asset Condition Assessment*

There are no coastal defence assets within this Management Unit.

## 4. Comparison with Previous Assessment

### 4.1 Coastal Slope Condition Assessment

The vast majority (just under 85%) of the 265 units surveyed during the 2016 walkover retained the same activity status as they had in 2014.

Around 7.5% of the units exhibited a worsening in condition, mostly changing from Locally Active to Partly Active. Some of this is due to an actual change in conditions at the site, but it must be acknowledged that some may be attributable to different interpretations of classification gradings by different cliff inspectors.

At Port Mulgrave, a landslip occurred a few months before the inspection and this resulted in its classification changing to Totally Active at the present time. The North York Moors National Park Authority has closed public footpath access to the landslip, but fishermen are still seen accessing the site despite this.

Around 8% of units exhibited an improvement in condition, mostly from Partly Active to Locally Active. Again, some of this will be attributable to actual improvements in stability, but some will be due to different interpretations of classification gradings by different cliff inspectors.

Most notably, gradings were improved from Locally Active to Inactive at three locations. Two of these are previously stabilised landslides behind existing sea walls, one at Robin Hood's Bay and the other at Filey town. At both sites there was no evidence of any movement in the slopes behind the sea wall and therefore Inactive classifications were applied. The other location was at Sandsend Road, where the high coastal slopes to the rear of the coastal highway have been stabilized in 2015/16 by North Yorkshire County Council by means of mechanical re-grading and drainage works.

In addition to the new landslip at Port Mulgrave, sustained levels of high erosion activity were observed along part of **Tenants' Cliff** within Cayton Bay, along the south side of **Filey Brigg** and at **Hunmanby Gap**.

### 4.2 Coast Protection Asset Condition Assessment

Generally, the condition of the defences has not changed dramatically since the last inspections in November 2015. Recent repair work was evident in a number of places and therefore some conditions of the defences improved. However, some defences where repair work has not been undertaken have deteriorated and are now in further need of repair.

#### **MU4 – Staithes**

There is little change since the previous inspections in the condition grading of the defences within Staithes harbour, with the overall classification generally ranging from fair to poor.

The rock armour to the harbour breakwaters remains mostly in good condition but the concrete piers and sea wall structures within the harbour are abraded in places and, where used, steel sheet piling is generally heavily corroded. The North Breakwater has undercutting on the inner-facing side, perhaps caused or exacerbated by propeller thrust.

Some of the structures extending into the beck as either riverside walls or property walls are locally in poor condition, with notable gaps and voids, despite obvious previous repairs.

#### **MU7 - Runswick Bay**

Many of the defences along the sea front at Runswick Bay mostly remain in a similar or slightly worse condition to that reported by the previous inspections. There are proposals for a capital scheme in 2017 to refurbish the sea wall and construct a rock fillet at its toe in the northern-most

section. To enable this, Yorkshire Water plans to re-locate its sewer asset, which currently runs across the foreshore seaward of the sea wall, in September 2016.

The sea wall around the recently built pumping station remains in good condition, with the slipways and boat storage area associated with the RNLI building in good condition. The timber slipway was repaired following damage in the December 2013 storms.

The rock armour defences in front of the car park remain generally in very good condition, with the rocks tightly packed with good coverage. However, there is ongoing erosion of the undefended cliff at the southern end of the defence which should continue to be monitored for signs of outflanking of the revetment.

Defence to the Sailing Club, located some 600m south of the village, has been improved since the previous inspections through the placement of a number of boulders and concrete blocks in front of the timber sleeper retaining wall defences which protect the main building.

### **MU9 – Sandsend Village**

The concrete sea wall around the car park at the western end of Sandsend is showing exposed rebar on the apron which should be re-covered. The concrete sea wall extending from Sandsend Beck to the east has exposed timber breastwork at the toe and occasional cracking in the concrete and heavy abrasion at the access steps. The sea wall is generally in poor condition and would benefit from some improvement works.

The former sloping concrete revetment protecting the Sandsend Road was in failing condition at the time of the previous inspections and has since been replaced in 2015/16 by a new defence structure. This comprises stepped concrete revetment with upper Dycel units and a concrete toe beam. This has improved the condition of the defences from very poor to very good. There is some local damage to the step corners on some of the pre-cast units, but this is cosmetic damage that does not unduly affect its coast protection function.

### **MU11-13 - Whitby**

Whitby West Beach promenade deck has suffered cracking in the past. Some previous repairs are re-opening, requiring further attention. The sea wall sections not protected by a fronting rock revetment have extensive abrasion and undercutting. Some affected sections have been covered by a new toe beam, but this does not cover the full extent of defective toe. The defences below Whitby Pavilion Theatre remain in poor condition and would benefit from repairs.

Previous identified defects at Whitby Harbour Piers remain evident and, in places on the inner face of the East Pier in particular have considerably worsened. Locally, the East Pier is in very poor condition. A major capital scheme to refurbish the structures is scheduled for 2017/18.

The quay walls within Whitby Harbour are generally in fair condition, but locally poor in places due to specific defects. For example, in the blockwork sections, there are sections of wall with open joints which require sealing and in the suspended deck section on the western quay there remains corrosion to the steel piles.

### **MU16 – Robin Hood's Bay**

Defences around the settlement of Robin Hood's Bay are in a similar state to that observed during previous surveys. The large vertical defence wall continues to show deterioration with seepage and cracking and is scheduled for capital refurbishment in 2017/18.

### **MU20-21 – Scarborough North Bay and Headland**

Defences here are generally in a similar state to when visited in 2015, and have benefited from some repairs in recent years around Clarence Gardens South and Peasholm Gap. Overall the structures are in fair condition, but due to their age require ongoing maintenance to infill open joints and cracks.

The rock armour and Accropode revetment with a raised concrete sea wall behind between the south end of Clarence Gardens and the East Pier of Scarborough Harbour remain in good condition.

#### **MU21-22 – Scarborough Harbour**

Overall the structures are in fair condition and have experienced previous repairs and maintenance works. However, due to their age they require ongoing maintenance to infill open joints and cracks. The most notable defects are on the seaward end and outer face of the West Pier, where repairs are recommended.

#### **MU22-23 – Scarborough South Bay**

As is the case for North Bay, the defences in South Bay are generally in a similar state to when visited in 2015, and have benefited from some maintenance (joint sealing) in recent years around Foreshore Road and repairs around Spa Chalet (rebuilt wall sections). Overall the structures are in fair condition, but due to their age require ongoing maintenance to infill open joints and cracks.

Some capital refurbishment works are planned for the Spa sea wall in 2017 as part of the wider coast protection and slope stabilization works. Specific defects were also noted at South Cliff Gardens (despite considerable previous repairs). Two voids in the sea wall at this location were reported to Scarborough Borough Council from site during the inspections and were repaired within 2 weeks. Many of the sea walls south of the Spa are heavily abraded and locally damaged.

#### **MU24-25 – Cayton Bay**

At the time of the inspections, the defences at the public access steps, south of the former pumping station, had failed, with large voids present and very significant overall damage. These defects were reported to Scarborough Borough Council from site during the inspections and were repaired within 2 weeks.

#### **MU28a-29a – Filey**

The central steel sheet pile section of the defences at Filey Sailing Club has been replaced since the previous inspections. The main sea wall defences through the town show evidence of significant maintenance and repair works over recent years, but ongoing maintenance work is required due to the age of the structure and the presence of remaining cracks and damage, which appears to worsen with progression south.

A short section of rock revetment with gabion baskets beneath is located at the southern end of the sea wall near Martin's Gill. This defence is intended to manage the interface between the hard sea wall defences to the north and eroding natural cliff to the south. The rock armour has been re-profiled on occasion after movement of some armourstones during storms. However, at the time of the inspections, the structure was in fair condition. Despite this, there coastal slopes behind the revetment still appear to be active and some form of improved outflanking defence remains necessary in the medium term.

## 5. Problems Encountered and Uncertainty in Analysis

### 5.1 *Coastal Slope Condition Assessment*

As in 2014, no significant problems were encountered during the inspections of the coastal slopes. Whilst a limited view of the cliff was afforded at a small number of locations, sufficient lengths of the cliff could be seen to assess its overall condition. Generally the inspections were undertaken from the clifftop path, but where public access permitted visits were made to additionally view the cliffs from the foreshore.

All three public access routes to the cliffs and foreshore at Port Mulgrave were closed due to recent landsliding behaviour, but the cliffs and foreshore were clearly visible from the cliff top path.

### 5.2 *Coast Protection Asset Condition Assessment*

Very few problems were encountered the inspections of the coastal defence assets.

The toe of structures around Staithes Harbour, Whitby Harbour, Castle Cliff and Scarborough Harbour are constantly submerged and therefore an inspection of only the visible elements from land or pier deck was undertaken.

Assets that proved difficult to inspect leading to uncertainty in analysis were those situated in a marginal or submarine environment throughout all tide conditions;

When more detailed inspections of these assets is required, a vessel based survey is recommended.

## 6. Conclusions and Recommended Actions

Further to the visual inspection of all assets, specific conclusions and recommendations for individual assets are given in **Appendix C**.

In addition, the cliffs have been characterised according to their present activity status and details are given in **Appendix D**.

All condition assessment data and selected photographs have been uploaded to SANDS (Shoreline And Nearshore Database System). This includes all data and photographs from the previous inspections since 2002 that were originally held on an MS Access Databases that had become obsolete.



# Appendices

# **Appendix A**

## **Asset Location Maps**

# **Appendix B**

## **Cliff Behaviour Units**

# **Appendix C Asset Condition & Recommendations**

# **Appendix D**

## **Cliff Condition Assessments**















UNIT	2002	2005	2008	2009	2012	2013 post-surge	2014	2016	2018	2020
MU29/BR	Locally Active	Partly Active	Partly Active	Partly Active	Partly Active	Not Inspected	Partly Active	Partly Active		
MU29/BS	Locally Active	Partly Active	Partly Active	Partly Active	Partly Active	Not Inspected	Partly Active	Partly Active		
MU29/CA	Partly Active	Partly Active	Partly Active	Partly Active	Partly Active	Not Inspected	Partly Active	Partly Active		
MU29/CB	Partly Active	Partly Active	Totally Active	Totally Active	Partly Active	Not Inspected	Partly Active	Partly Active		
MU29/CC	Locally Active	Totally Active	Locally active	Locally Active	Partly Active	Not Inspected	Partly Active	Partly Active		
MU29/CCa	Locally Active	Partly Active	Locally active	Locally Active	Totally Active	Not Inspected	Partly Active	Partly Active		
MU29/CD	Locally Active	Locally Active	Locally active	Partly Active	Partly Active	Not Inspected	Partly Active	Partly Active		
MU29/CE	Locally Active	Locally Active	Locally active	Locally Active	Locally Active	Not Inspected	Locally Active	Locally Active		
MU29/CF	Locally Active	Partly Active	Partly Active	Partly Active	Locally Active	Not Inspected	Locally Active	Locally Active		
MU29/CG	Locally Active	Partly Active	Partly Active	Partly Active	Locally Active	Not Inspected	Locally Active	Locally Active		
MU29/CH	Locally Active	Locally Active	Partly Active	Partly Active	Locally Active	Not Inspected	Locally Active	Locally Active		
MU29/CI	Locally Active	Locally Active	Partly Active	Partly Active	Locally Active	Not Inspected	Locally Active	Locally Active		
MU29/CJ	Locally Active	Locally Active	Locally active	Locally Active	Locally Active	Not Inspected	Locally Active	Locally Active		