ROYAL HASKONING

Halcrow

NECAG Coast Protection Assets and Coastal Slope Condition Analysis

Scarborough Borough Council Final Report

April 2009

Preamble

The North East Coastal Authorities Group (NECAG) comprises the following organisations, each of whom has certain responsibilities for managing the coastline between the River Tyne and Flamborough Head:

- South Tyneside Council;
- Sunderland City Council;
- Easington District Council;
- Hartlepool Borough Council;
- Redcar and Cleveland Borough Council;
- Scarborough Borough Council;
- East Riding of Yorkshire Council;
- Environment Agency;
- North York Moors National Park;
- Natural England;
- The National Trust.

Collectively, NECAG produced a 'second generation' Shoreline Management Plan (or 'SMP2') for its coastal frontage in 2007. In this SMP2, recommendations were made for condition assessments of the coastal protection assets and coastal cliffs and slopes along this frontage, as part of a broader coastal monitoring programme.

To this end, Scarborough Borough Council, acting as the 'lead authority' for NECAG, commissioned a team from Royal Haskoning and Halcrow to undertake the '*NECAG Coastal Protection Assets and Coastal Slope Condition Analysis*' between August 2008 and January 2009. Fieldwork was undertaken in the summer to autumn of 2008.

The joint team approach between Royal Haskoning and Halcrow has enabled skilled staff with previous expertise of the specific stretches of frontage to work together and offer best value to NECAG. The asset and slope inspectors have included Chartered Engineers (focusing mainly on the built coastal protection structures) and Engineering Geomorphologists (focusing mainly on the natural cliffs and coastal slopes) ensuring suitable skills are applied to each length of frontage.

To ensure a consistency of approach in reporting, a standard template has been used for each of the seven Local Authorities within NECAG. In addition, the findings from the inspections have been entered into the Environment Agency's National Flood and Coastal Defence Database (NFCDD) for each identified length of 'defence', be it an engineered structure or a natural cliff/slope. This ensures that each Local Authority is complying with its High Level Target to ensure that the NFCDD is regularly updated.

Following these initial 2008/09 inspections, it is intended that future inspections are undertaken within the recently commissioned Cell One Coastal Monitoring Programme, which again is being undertaken jointly by Royal Haskoning and Halcrow under Scarborough Borough Council's leadership. This ensures that future work will be undertaken by the same teams and that the 2008/09 inspections will provide a baseline against which future changes, such as deterioration of defences or erosion of cliffs, can be compared.

1. Introduction

Methodology

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

Coastal Slope Condition Assessment
The Coastal Slope Condition Assessment was undertaken by systematic walk-over inspection of the whole coastline by a team of geomorphologists. The inspection involved visual assessment of cliff activity and noting specific areas of activity (e.g. landslides and tension cracks). All observations were documented with photographs and annotated field maps. Each unit was identified, photographed and classified according to the five point activity scale as defined in Table 1.1. This classification scheme is the same as that used in the Staithes to Speeton assessment undertaken by Halcrow for Scarborough Borough Council in May 2005 and in May 2002 (Halcrow 2002, Halcrow 2005). Brief descriptions of the condition of the cliffs were also entered into the National Flood and Coastal Defence Database (NFCDD) for all areas of undefended coastline.

This report provides a summary of the cliff condition as assessed in August 2008, and how this differs to assessments from previous years. A fuller discussion of geology and specific mechanisms of cliff failure can be found in previous reports (Halcrow 2002, Halcrow 2005, High Point Rendel 2002).

Activity Class	Description
Totally Active	Retreating cliffline almost entirely affected by large-scale landsliding or intense erosion
Partly Active	Retreating cliffline with very common smaller-scale landslides or areas of intense erosion
Locally Active	Retreating cliffline with localised small landslides or areas of erosion
Inactive	Relict cliffs or landslides with vegetated slopes and localised erosion of the toe or failure of the headscarp
Dormant	Protected cliffline or landslide complex with no visible evidence of landslide activity

Table 1.1. Cliff activity classes used in the August 2008 assessment

The inspection was primarily conducted from the cliff top, due to access restrictions and health and safety concerns associated with the cliff toe and beaches along this stretch of coast. In the Scarborough Borough Council region, the coastline is followed for the most part by the Cleveland Way cliff top footpath. Where the footpath moved inland the inspection kept to the cliff edge to ensure the whole coastline was observed and activity recorded. The beach and foreshore were only inspected where access could be safely achieved from the cliff top, as at the coastal towns of Whitby, Scarborough and Filey.

The Coastal Slope Condition Assessment walkover survey for the Scarborough Borough Council frontage was conducted between 4th and 19th August 2008 in a north to south direction. The weather during this time was warm with frequently showers.

Coast Protection Asset Assessment
The structural assessment of assets within the Scarborough Borough Council area was carried out by a team of asset inspectors and structural engineers in September and October 2008. Assets were graded based on their condition, residual life and urgency of repair work, following standard Environment Agency guidelines. Observations were photographed and all data were stored 'live' in the NFCDD using onsite laptops.

The asset descriptions provide an overview of findings, summarising each locality and identifying individual assets of poor condition, failing structures and assets that have the potential to fail. It is anticipated that this will help identify areas for investment, including repair

work, replacement or the installation of a different asset type. This report will also highlight assets with a certain level of importance or interest.

The Coast Protection Asset Assessment for the Scarborough Borough Council frontage was conducted between 23rd September and 8th October 2008 by the structural engineer and a rivers and coastal asset inspector working from South to North. The weather experienced during this period was of a fair to mild nature.

Study Area

The study area covered by this report runs from Staithes in the north to Speeton in the south. The cliffs units previously used by Halcrow (2002, 2005) were used for this area. During the walkover assessment the boundaries of these units were reviewed and any significant changes in cliff form, due to landsliding or marine erosion, were noted. These units are coded as follows:

- Management Units (Mu)
- Sub-Management Units (SMU)
- Coastal Behaviour Units (CBU)

For example, unit Mu4A/1 refers to Management Unit 4, Sub-Management Unit 4A and Coastal Behaviour Unit 1.

2. Overview

Condition Assessment

Coastal Slope Condition Assessment

There is significant variation in the level of cliff activity in the region, reflecting the diverse geology, history of landsliding and the range of cliff protection and stabilisation measures to tackle erosion and slope instability issues. In total 272 cliff behaviour units (CBUs) have been mapped across the region of which Locally Active and Partly Active cliffs are the most common (Figure 1). There are numerous assets along this stretch of coastline, ranging from the busy coastal towns of Scarborough, Filey and Whitby to smaller settlements such as Staithes, Robin Hood's Bay and Runswick Bay. The Cleveland Way footpath follows the cliff top along the coastline and in other areas, such as Cayton Bay, strategic roads are routed close to the cliff top.

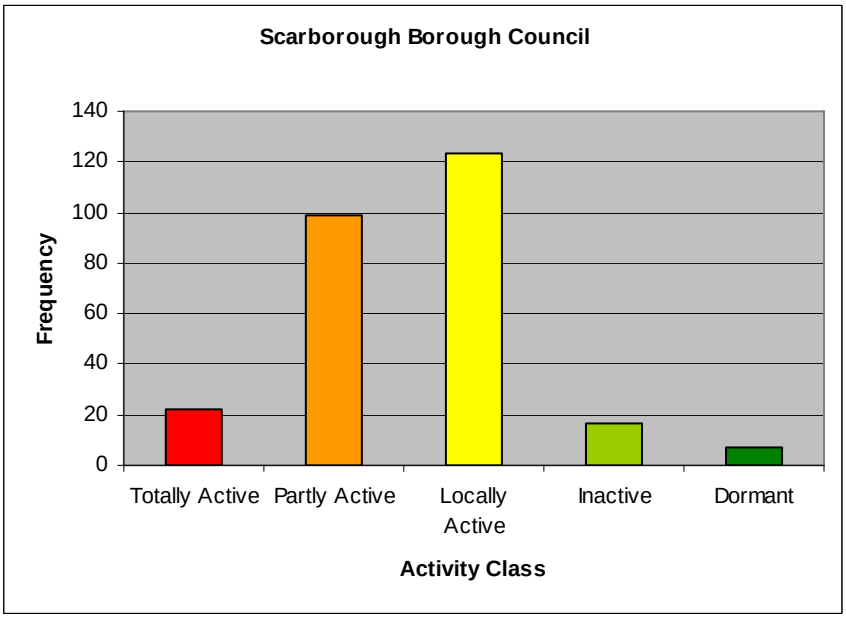


Figure 1. Frequency of cliff activity along the SBC frontage

Significant cliff activity was observed in the vicinity of a number of key assets including:

- **Cayton Bay North:** The Knipe Point headland was affected by a major reactivation of large scale deep-seated landsliding activity in early 2008. The impact of cliff instability and cliff top recession has resulted in the loss of land and property and closure of the Cleveland Way footpath. The landslide and surrounding area is currently the subject a ground investigation for SBC, the results of which are expected in March 2009.
- **Filey Town:** Localised cliff instability has led to the closure of certain footpaths in Filey. These issues are likely to relate to the significant rainstorm event which affected the town in 2007, and which led to widespread damage. The impacts of this event have been remediated, but the coastal cliffs fronting the town should be regularly inspected to minimize the threat to people and property.

Coast Protection Asset Condition Assessment

A large number of coastal defence assets are situated along this stretch of coastline. Many of these assets are in good condition but a large number require minor repair works. The most common works required include blockwork repointing, resealing of joints, reinforcement of undercut zones, repairing cracks, replenishment of rock armour and resurfacing.

There are a number of large full height cracks in sea walls throughout the Scarborough Borough Council frontage, particularly in Scarborough's North and South Bays and in Filey. Investigation of the problem and subsequent remedial works are required.

Of particular concern is the potential for significant 'blow-out' of the eastern harbour arm at Whitby and the lower blockwork of the Cayton pumping station. In both cases mortar loss has led to the loosening and washout of blocks. Investigation of the problem and urgent repair is required.

Comparison with Previous Assessments and Recommendations

The most significant changes in the cliffs since the 2005 inspection survey are seen at Cayton Bay, where a large landslide reactivation occurred in early 2008, and at Filey Town where localised landslide activity is still apparent following the significant rainstorm event in 2007. Both of these sites have been the focus of recent detailed investigations and are the subject of on-going work.

Many of the coastal defence assets were found to be in a similar condition to that reported in 2005. However, some assets showed a degree of degradation in condition since the previous survey. These include the blockwork sea wall in west Whitby, the defences just east of Whitby harbour, and assets within Scarborough's North Bay, Harbour and South Bay, which have all suffered loss of mortar and joint washout. The breakwaters at Whitby and assets within Cayton Bay have also been assigned a reduced condition grading due to cracking, deformation and blockwork displacement.

The whole coastline will be subjected to repeat inspections under the Cell 1 Monitoring Programme recently awarded to Royal Haskoning and Halcrow Group Ltd, but key areas that should be closely monitored comprise the northern end of Cayton Bay and at Filey.

3. Condition Assessment

This section provides an account of observations made on the condition of cliffs and coastal assets within Scarborough Borough Council's coastline, running from north to south. Brief descriptions and photographs are presented for each Management Unit. Cliff activity data is also provided in Maps 1-12. A full assessment of cliff and asset condition has been entered into NFCDD.

Management Unit 4 – Staithes
(Map 1 – Staithes to Runswick Bay)

Coastal Slope Condition Assessment
This Management Unit comprises high cliffs behind and adjacent to the village of Staithes and cliffs are generally classified as Partly Active (Mu4/1b, Mu4/3). Within Mu4/2 the cliffs are generally well vegetated and feature small, localised patches of erosion (Locally Active). Other cliffs in MU4 are free of vegetation (with the exception of the upper part of Mu4/3) and show signs of active erosion. Mu4/1a, which has toe protection, is particularly active, with evidence of recent rock fall of large blocks (Map 1).

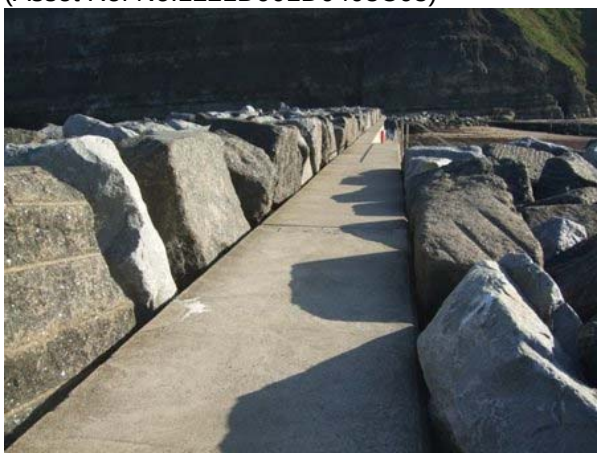
Mu4/2 well vegetated high cliffs behind Staithes (Locally Active)

Mu4/1a exposed, bedded and jointed rock face at Cowbar Nab, Staithes (Totally Active)

Coastal Asset Assessment
A number of the assets within the village of Staithes have recently been renewed or repaired. The most significant of these are the breakwater arms where 5-8 tonne rock armour has been placed on the seaward side and fixed using a concrete resin. This acts to provide a greater defended height and to dissipate waves from the breakwater surface. New stainless steel handrails have been added and a new concrete topping, cast over the original breakwater adds further height to the defence. The sheet piling coping piece (horizontal) on the landward side of the breakwater has failed due to corrosion at fixing points. It is recommended that this is replaced to prevent seawater intruding behind the piles. The eastern breakwater has a spur at the tip; the void of which is filled with rock armour (Asset Ref No.1221D901D0403C03).

Corrosion of sheet piling on the landward side of the breakwater
(Asset Ref No.1221D901D0403C03)

Rock armour lines the seaward side of the breakwater
(Asset Ref No.1221D901D0403C03)



Eastern breakwater with 5-8 tonne rock armour
(Asset Ref No.1221D901D0403C03)

The harbour wall extends around much of the Staithes sea frontage. The rear wall of the harbour is in good condition. Minor cracking and surface erosion is present although currently it appears sustainable. A concrete groyne preventing sediment movement within the harbour is also in good condition (Asset Ref No. 1221D901D0403C01).

Older sections of the harbour wall consist of masonry blockwork and are often exterior walls of private properties displaying visible loss of mortar and blocks. Although there is evidence of repair work, maintenance needs to be implemented at regular intervals (Asset Ref No. 1221D901D0402C05). Should these repairs continue to fail, replacement of this asset should be considered.

Some sections of the harbour wall also show evidence of undercutting at the toe. It is anticipated that this is due to the dynamic movement of sand, however further investigation would be necessary to establish this for certain (Asset Ref No. 1221D901D0402C04).

Rear harbour wall and concrete groynes in good condition (Asset Ref No. 1221D901D0403C01)

Older sections of harbour wall in need of regular maintenance (Asset Ref No. 1221D901D0402C05)

Undercutting at the toe of some parts of the harbour wall (Asset Ref No. 1221D901D0402C04)

Management Unit 5 – Jet Wyke
(Map 1 – Staithes to Runswick Bay)

Coastal Slope Condition Assessment
Jet Wyke forms the embayment between Penny Steel and Old Nab and is classified as Partly Active (Mu5/1). 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 Old Nab, a Partly Active headland composed of highly weathered shales.

MU5 overview of Jet Wyke looking east (Partly Active)

Mu5/1 Old Nab headland (Partly Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 6 – Old Nab to Runswick Bay
(Map 1 – Staithes to Runswick Bay)

Coastal Slope Condition Assessment
This Management Unit consists of 3 Sub-Management Units, as follows:

Mu6A – Brackenberry Wyke
This section of cliffline is Partly Active (Mu6/1). Marine erosion is cutting into the hard stratified rock at the base of the cliffs. The cliffs support some vegetation cover but shale exposed in many areas, indicating on-going erosion, which is especially intense around the east facing side of Old Nab.

Mu6/1 looking southeast from Old Nab (Partly Active)

Mu6/1 east facing side of Old Nab (Partly Active)

Mu6B – Port Mulgrave
The undefended cliffs to the north of Port Mulgrave show signs of recent activity and are classified as Partly Active (Mu6/2). There is evidence of recent failures and erosion of the cliffs. Further south, the CBUs are Locally Active, with large areas covered by dense vegetation and some areas of activity (Mu6/3, Mu6/4, Mu6/5).

Mu6/2 cliffs north of Port Mulgrave (Partly Active)

Mu6/4 cliffs south of Port Mulgrave (Locally Active)

Mu6C – Lingrow Cliffs

The central part of this area (Mu6/7) consists of a large debris run-out lobe fronting cliffs and is classified as Locally Active. The stepped terrain is well vegetated and shows only localised evidence of activity at the toe. Immediately to the north and south of this unit, the cliffs are much higher, steeper and are Partly Active (Mu6/6, Mu6/8).

Mu6/7 looking southwards across Lingrow Cliffs (Locally Active)

Mu6/6 looking south from Port Mulgrave (Partly Active)

Coast Protection Asset Assessment

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

Mu6B – Port Mulgrave

Sub-Management Unit 6B features relict assets at Port Mulgrave. This is a former port and ironstone mine which has been derelict for 70 years. Virtually all coastal defences have been lost to the sea. What is left of the breakwater is undergoing large scale cracking, deformation, undercutting and outflanking. It is estimated that half of its original length has now been eroded (Asset Ref No. 1221D901D0502C01). As a result, the launching and retrieval of boats would be difficult here. If regular access by sea was required, a regeneration project to remove the breakwater ruins and build a new access point would be of benefit.

Looking along the breakwater with evidence of surface erosion (due to deformation) (Asset Ref No. 1221D901D0502C01)

Outflanking and erosion occurring behind the breakwater

Management Unit 7 – Runswick Bay
(Map 1 – Staithes to Runswick Bay and Map 2 – Runswick Bay to Sandsend)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu7A – Runswick Bay Village
The area in and around the settlement of Runswick Bay is classified as Inactive (Mu7/1). The toe is defended by a sea wall with some rock armour to the south. The outflanking of these defences to the north (within Mu6C) indicates the nature of the erosion which may be occurring here if it were not for the protective influence of these structures. There is some minor evidence of very localised, small scale erosion on the engineered slopes to the south of the village, but this does not appear to be significant (Mu7/1).

Mu7/1 looking west across Runswick Bay (Inactive)

Mu7/1 slopes south of Runswick Bay village (Inactive)

Mu7B – Runswick Sands
The cliffs around Nettle Dale are well vegetated, partly protected by the rock armour extending south from Runswick Bay village and are classified as Inactive (Mu7/2). Further round the bay there is no toe protection and the slopes are Locally Active

(MU7/3, Mu7/4). The toe is generally steep, does not support any vegetation cover and there is evidence of recent slumping and sliding activity.

Overview of Mu7B showing well vegetated slopes and active erosion at the toe

Mu7/3 minor activity at the headscarp (Locally Active)

Coast Protection Asset Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu7A – Runswick Bay Village
Runswick Bay has recently undergone the installation of new coastal defences inline with the building of a new pumping station (adjacent to the lifeboat station). Rock armour defences are tightly packed with extremely sound coverage. They are in very good condition with no evidence of deformation or settling. Near Runswick Sailing Club there is a new concrete slipway and revetment. These are also both in a very good condition displaying few defects (Asset Ref No. 1221D901D0602C01). The Sailing Club itself, located just south of the village, has been constructed on timber struts and features a mix of coastal defences (Asset Ref No. 1221D901D0602C03).

The sea wall defences to the north of the new pumping station are showing defects. These range from minor to quite significant issues. The northern coastal sea wall, which gives direct protection to private property, is suffering from surface cracking and erosion. Erosion of the underlying bedrock is causing undercutting of the sea wall and the reinforcing bars are also visible in places. Further investigation is required to determine the rate of undercutting. Further defects include washed out sealant joints and weep holes which have seized shut. It is recommended that these issues are addressed (Asset Ref No. 1221D901D0601C01).

Beneath some properties, two significant cracks can be seen propagating from the toe right up through the tiered sea walls behind. Cracking in the toe, which has been recently rendered indicates that the deformation is active. Installation of a tell tale would give precise levels of ground movement. Further studies are required (Asset Ref No. 1221D901D0601C06).

Runswick Sailing Club built on timber struts (Asset Ref No. 1221D901D0602C03)

Looking southeast away from Runswick Bay village across the new rock armour defences (Asset Ref No. 1221D901D0602C01)

Undercutting of the northern coastal sea wall (Asset Ref No. 1221D901D0601C01)

Two significant cracks propagating up through the tiered sea walls indicates active deformation (Asset Ref No. 1221D901D0601C06)

Mu7B – Runswick Sands
The rock revetments described for Mu7A extent into this area (see above) but otherwise there are no other coastal assets here.

Management Unit 8 – Runswick Bay to Sandsend
(Map 2 – Runswick Bay to Sandsend)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu8A – Runswick Sands to Kettle Ness
The CBUs behind and adjacent to Runswick Sands are Locally Active (Mu8/1, Mu8/2). The toe is steep with little vegetation cover and evidence of recent falls and

slides. The mid and upper slopes are more densely vegetated with localised patches of erosion. Further south, closer to Kettle Ness, units become more active. The sparsely vegetated slopes are undergoing intense weathering and erosion and are Partly Active (Mu8/3, Mu8/4).

Mu8/2 looking east (Locally Active)

Mu8/4 Kettle Ness (Partly Active)

Mu8B – Kettle Ness to Sandsend

In the north-western part of this Sub-Management Unit is the headland of Kettle Ness, which has been extensively quarried for alum in the past, and is classified as Partly Active (Mu8/5). Further east around the headland there is evidence of recent rock fall activity near a vertical exposed cliff face (Mu8/6). The southern part of this Sub-Management Unit from Keldhowe Steel to Sandsend is also Partly Active (Mu8/12, Mu8/13, Mu8/14, Mu8/15). The steep cliffs are being eroded by marine activity at the toe. There is some evidence of rockfall on the shore platform and extensive erosion of the mid-slopes. Like Kettle Ness, Sandsend Ness is also undergoing severe weathering (Mu8/14). In between these two areas there is a zone of lesser activity (Locally Active- Mu8/7, Mu8/8, Mu8/10, Mu8/11). This mainly comprises a large relict debris lobe which is densely vegetated (Seaveybog Hill- Mu8/7). There is minor localised erosion at the headscarp and toe.

Mu8/5 Kettle Ness headland (Partly Active)

Mu8/6 Rock fall near Holmsgrove Sand (Partly Active)

Mu8/7 Relict debris lobe at Seaveybog Hill, with on-going erosion of the toe (Locally Active)

Mu8/15 Cliffs north of Sandsend (Partly Active)

Asset Condition Inspection
There are no coastal assets within Management Unit 8.

Management Unit 9 – Sandsend
(Map 3 – Sandsend to Whitby East)

Coastal Slope Condition Assessment
This Management Unit is divided into three Sub-Management Units, as follows:

Mu9A and Mu9B – Sandsend Village
These CBUs are classified as Dormant (Mu9/1, Mu9/2). They are defended by the sea wall, groynes and some rock armour and as a result there is no evidence of recent activity.

Mu9/1 and Mu9/2 (Dormant)

Mu9C – East Sandsend
Above the concrete sea defences the slopes of this unit are Partly Active (Mu9/3). There has been some effort to stabilise the slopes; however the presence of tension cracks and rilling and gullying in exposed materials provides evidence of ongoing instability.

Mu9/3 looking up from Sandsend Beach (Partly Active)

Mu9/3 looking up from Sandsend Beach (Partly Active)

Coast Protection Asset Assessment

Mu9A and Mu9B – Sandsend Village
Coastal defences at Sandsend are in fair to poor condition. A concrete revetment, the most northerly defence, is in fair condition with minimal damage to the surface. There is some minor cracking, surface erosion and joint washout occurring which is typical of concrete defences such as this. The toe of the revetment is exposed in places resulting in undercutting. This could be ameliorated by increasing the basal rock armour protection (Asset Ref No.1221D901D0701C02).

The remnants of timber groynes are visible in front of Sandsend village. These are in such a poor state that it is now unlikely that they have a significant impact on sand movement. The toe of the seawall is also showing evidence of significant damage and movement (Asset Ref No. 1221D901D0702C01).

A fairly new short section of blockwork sea wall supports a cantilevered promenade along part of the Sandsend frontage. As demonstrated by the photo below (lower left), undercutting of the toe of this structure has revealed steel sheet piling. It is recommended that remedial repair work is undertaken now to prevent further damage (Asset Ref No. 1221D901D0702C04).

Mu9C – East Sandsend
Southeast of Sandsend, a large concrete revetment covering light weight rock armour runs parallel to the coastal road. The 800m long structure features many major defects all along its length. The most common of these being surface cracking and localised spalling, the most significant defect being major undercutting and erosion of the toe (Asset Ref No. 1221D901D0702C04).

Concrete revetment located in the north of Sandsend (Asset Ref No.1221D901D0701C02)

Timber groynes in front of Sandsend (Asset Ref No. 1221D901D0702C01)

Relatively new blockwork sea wall with undercutting at the toe (Asset Ref No. 1221D901D0702C04)

Undercutting and erosion of the concrete revetment backing Sandsend Beach (Asset Ref No. 1221D901D0702C04)

Management Unit 10 – Upgang Beach
(Map 3 – Sandsend to Whitby East)

Coastal Slope Condition Assessment
The eastern end of this Management Unit is Partly Active (Mu10/2). The glacial sediments in which the cliff is cut are subject to undergoing episodic failure in the form of localised mudsliding and block failure onto the beach. The western end is less active, comprising well vegetated slopes with minor localised toe erosion. Units are Locally Active or Inactive (Mu9/4, Mu10/2).

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Mu10/1 looking across the western end of Upgang Beach (Inactive)

Mu10/2 looking eastwards across the eastern end of Upgang Beach (Partly Active)

Management Unit 11 – Whitby West
(Map 3 – Sandsend to Whitby East)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu11A – Whitby Sands West
This Sub-Management Unit mostly consists of regraded slopes which are largely protected by the sea wall and promenade. As a result there is very little evidence of activity and slopes are classified as Inactive (Mu11/1). In some areas, slope wash and footpath erosion has caused localised disintegration of the underlying slope stabilisation fabrics.

Mu11/1 looking east (Inactive)

Mu11/1 degradation of slope and underlying slope stabilisation fabrics by slope wash (Inactive)

Mu11B – Whitby Sands East
This Management Sub-Unit is generally protected by a variety of coastal structures and the cliffs are Inactive (Mu11/3). In units where defences are absent the exposed rock faces show minor erosion and the cliffs are Locally Active (Mu11/4).

Mu11/3 sporadic defence structures (Inactive)

Mu11/4 exposed rock faces above Whitby Sands (Locally Active)

Coast Protection Asset Assessment

Mu11A – Whitby Sands West and Mu11B – Whitby Sands East
Rock armour defences along the promenade to the west of Whitby are in very good condition. The promenade and low concrete retaining wall are in good condition although lateral cracking in the promenade is evident in places along with loss of expandable sealant between concrete sections (Asset Ref No. 1221D901D0801C01).

Rock armour along the promenade, west of Whitby (Asset Ref No. 1221D901D0801C01)

Management Unit 12 – Whitby
(Map 3 – Sandsend to Whitby East)

Coastal Slope Condition Assessment
This Management Unit is below Whitby Abbey and is classified as Locally Active (Mu12/1). The slopes are generally well vegetated, with some exposure of rock just below the headscarp which is supported by wire netting.

Mu12/1 below Whitby Abbey, showing degraded cliffs and localised wire netting (Locally Active)

Coast Protection Asset Assessment

This Management Unit encompasses the sea walls and the East and West Piers (or 'harbour arms') of Whitby's harbour. In general, coastal defences found at Whitby are in a reasonable condition with few major problems.

Cracking, loss of mortar and expansion sealant and surface erosion are common to virtually all concrete and blockwork structures, including the west and east harbour arms (where visible) and the adjacent sea wall. Although defects are localised, it is recommended that repointing is undertaken to prevent areas of weakness being exploited further. Sections of sea wall not protected by rock armour revetment are particularly susceptible to increased levels of surface erosion and exploitation of joints between concrete sections (Asset Ref No. 1221D901D0802C03 and 1221D901D0802C07).

The west and east harbour arms (Asset Ref No. 1221D901D0803C01/04) were not inspected thoroughly due to limited access even at low tide. It is recommended that inspection via boat is the only option here. The left bank harbour wall (Asset Ref No. 1221D901D0803C01) would also need to be inspected via a boat. Both cases would need to involve the harbour master due to commercial boat activity in the near vicinity. The eastern harbour arm (Asset Ref No. 1221D901D0803C04) shows mortar loss, loose blocks and possible vertical movement in one location. It is recommended that the fixity of the loose blocks is investigated urgently, and that subsequently the hole is filled. It is possible that this block could disappear and that there may be a significant quantity of wash-out material behind it, leading to the consequent weakening and collapse of the structure. In the longer term, the monitoring of movement of this structure is recommended, along with establishing the reason for movement if there is any.

Large concrete aprons are offering protection to the toe and rear walls on private property and are acting as the right bank harbour wall. Although the walls are in a sound condition, it is recommended that constant monitoring is required to maintain a good condition. Vegetation build up is common although currently does not seem to be posing a problem (Asset Ref No. 1222101600101R02).

Erosion and exploitation of joints in sea wall (Asset Ref No. 1221D901D0802C03)

Mortar loss, surface erosion and cracking in blockwork wall
(Asset Ref No. 1221D901D0802C07)

Harbour walls are still partly submerged during low tide preventing a detailed inspection on foot (Asset Ref No. 1221D901D0803C01)

Eastern harbour arm showing mortar loss and deformation of blockwork (inspection below the water line is necessary before replacement of blocks) (Asset Ref No. 1221D901D0803C04)

Concrete apron protecting toe and rear walls of private property
(Asset Ref No. 1222101600101R02)

Management Unit 13 – Whitby East

(Map 3 – Sandsend to Whitby East and Map 4 – Whitby East to Pursglove Stye)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu13A – Cliffs east of Whitby Harbour
The high cliffs of this Sub-Management Unit are Partly Active (Mu12/2). There is evidence of a large recent rock fall from the upper part of the cliff. Almost the entire cliff face is exposed with very little vegetation cover.

Mu12/2 looking east from Whitby's East Pier showing recent failure from the cliff top (Partly Active)

Mu13B – Whitby East to Widdy Head
The CBUs within this Sub-Management Unit are a combination of Locally (Mu13/3, Mu13/5, Mu14/1) and Partly Active cliffs (Mu13/1, Mu13/2, Mu13/4, Mu13/6). Saltwick Nab (Mu13/2) is undergoing intense erosion, with rilling and gullying evident on exposed surfaces. Further south the cliffs alternate between being Locally and Partly Active. The Locally Active CBUs (such as within the bay at Saltwick (Mu13/3) and the relict debris lobe near Black Nab (Mu13/5)) are much more densely vegetated with minor erosion at the head and toe. The Partly Active CBUs are subject to marine erosion at the toe, with sliding and rock falling occurring on much of the steep, exposed slopes (Mu13/4, Mu13/6).

Mu13/1 looking west (Partly Active)

Mu13/3 and Mu13/4- showing alternating zones of Locally and Partly Active cliffs

Coast Protection Asset Assessment

Mu13A – Cliffs east of Whitby Harbour
There is a section of rock armour protecting the eastern side of the harbour and toe of natural cliff directly to the east of Whitby. The rock armour varies in size from 1-4 tonnes to 5-8 tonnes. Recent rockfall in this area, identified by the Coastal Slope Condition Assessment, highlights the need for either replenishment with larger rock armour or a larger scale repair (Asset Ref No.1221D901D0803C05).

Close up of the base of recent rockfall over rock armour defences
(Asset Ref No.1221D901D0803C05)

Mu13B – Whitby East to Widdy Head
There are no coastal assets within this Sub-Management Unit.

Management Unit 14 – Widdy Head to Pursglove Stye Batts
(Map 4 – Whitby East to Pursglove Stye)

Coastal Slope Condition Assessment
The cliffs within this Management Unit have been classified as Locally Active (Mu14/1). The slopes are generally well vegetated, with small local patches of erosion evident. Parts of the lower cliff are mantled by vegetated debris and the cliff toe is characterised by extensive boulder lobes.

Mu14/1 looking southeast, showing vegetated debris aprons and boulder lobes (Locally Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 15 - Pursglove Stye Batts to Robin Hood's Bay
(Map 5 – Pursglove Stye to Tinkler's Stone)

Coastal Slope Condition Assessment
The northern part of this Management Unit is Locally Active (Mu15/1). The upper slopes are well vegetated with intermittent areas of activity. The lower slopes are largely devoid of vegetation cover, with abundant evidence for activity. The mid part of this Management Unit is Totally Active (Far Jetticks- Mu15/2). The cliff face is steep and exposed with materials slumping and sliding down the entire length. Further south, the CBUs are classified as Partly Active (Mu15/3, Mu15/4). The upper slopes support some continuous vegetation cover. The lower slopes are steep and exposed with erosion of materials through sliding and rock fall.

Mu15/1 looking northwest (Locally Active)

Mu15/2 looking southeast across Far Jetticks (Totally Active)

Mu15/3 looking south (Partly Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 16 – Robin Hood's Bay
(Map 5 – Pursglove Stye to Tinkler's Stone)

Coastal Slope Condition Assessment
This Management Unit is divided into 3 Sub-Management Units:

Mu16A – Robin Hood's Bay Village
The northerly part of this Sub-Management Unit is Partly Active (Mu16/1). The upper slopes are composed of soft material and support some vegetation cover with evidence of slumping and sliding in places. The lower slopes are near vertical with no vegetation cover and are stained by the material eroded from the upper slopes. Sliding and marine undercutting is also occurring. Further south, the CBUs are protected by sea defences and show no evidence of recent activity (Dormant- Mu16/2, Mu16/3).

Mu16/1 looking towards Robin Hood's Bay (Partly Active)

Mu16/2 (Dormant)

Mu16B – South of Robin Hood's Bay Village

This Sub-Management Unit is classified as Inactive and is defended at the toe by a sea wall and rock armour (Mu17/1). The slopes are densely vegetated with trees and shrubs and show little evidence of recent activity.

Mu17/1 looking north towards Robin Hood's Bay Village (Inactive)

Mu16C – Cowling Scar

The northern part of this Sub-Management Unit is protected in part by rock armour at the toe. The slopes are generally well vegetated with some exposed areas at the head and mid-slope where sliding and some rilling is occurring (Locally Active- Mu17/2). Further south defences are absent and the cliffs are more active. There is significant slumping and sliding activity at beach level as well as at the cliff head and mid-slopes (Partly Active- Mu17/3).

Mu17/2 mid-slope activity (Locally Active)

Mu17/3 looking south (Partly Active)

Coast Protection Asset Assessment

The town of Robin Hood's Bay benefits from extensive coast protection. All defences within Mu16 are in a fair to good condition, with the older original structures showing evidence of damage or minor defects. Recommendations include repointing and repairing of minor cracks where identified. Localised areas of vegetation growth could also be sprayed or removed to prevent increasing amounts of growth during successive summers.

Mu16A – Robin Hood's Bay Village

At the northern end of this Sub-Management Unit there is a newly built sea wall in very good condition. Joints and sealant show no signs of damage or minor defects. Rock armour protecting the toe of the wall is tightly packed with good coverage throughout. The northern slipway is supporting some vegetation growth but is overall in good condition (Asset Ref No. 1221D901D1003C01).

Further south there is a large vertical defence wall, directly protecting houses located behind. The concrete is in a fair to poor condition, showing evidence of surface cracking, rust marks and seepage, and cracking to the crest of the wall. However, the toe appears to be in a stable condition with no visible undercutting (Asset Ref No. 1221D901D1003C02).

Sea wall at the northern end of Mu16A (Asset Ref No. 1221D901D1003C01)

Large vertical wall at Robin Hood's Bay (Asset Ref No. 1221D901D1003C02)

Mu16B – South of Robin Hood's Bay Village

This small Sub-Management unit features a short section of sea defence and some rock armour revetment extending to the south.

The short section of defence has an exposed toe with evidence of undercutting at its southern end. The wall surface is showing some evidence of surface erosion and joint washout and requires repointing. Overall however, the structure is sound with no signs of deformation. The adjacent slipway is also in a good condition, with some signs of wear but otherwise minimal cracking and loss of cobble stones (Asset Ref No. 1221D901D1003C04).

The rock armour is in a good condition. It is tightly packed and giving good protection to the toe of the sea wall behind. The upper sections of the sea wall itself show some evidence of seepage through the blockwork joints, rather than visible cracking. The promenade above the sea wall is in a good condition, with only minor defects present (Asset Ref No. 1221D901D1003C09).

Looking northwards at the short section of defence in the south of Robin Hood's Bay village (Asset Ref No. 1221D901D1003C04)

The rock armour just south of the short sea defence, sea wall and promenade above (Asset Ref No. 1221D901D1003C09)

Mu16C – Cowling Scar

The rock armour described for Mu16B extends southwards into this Sub-Management Unit. There is also a section of newly installed rock armour which is in very good condition, is tightly packed and performing well (Asset Ref No. 1221D901D1003C07). Vegetation is present on the defences in localised spots, however it is anticipated that this will die away in the winter months. As described in the Coastal Slope Condition Assessment, there is noticeably greater erosion of the natural cliffs where the rock revetment finishes to the south.

Looking southwards across the promenade and newly installed rock armour (Asset Ref No. 1221D901D1003C07)

Management Unit 17 – Cowling Scar to Peak Steel
(Map 5 – Pursglove Stye to Tinkler's Stone and Map 6 – Tinkler's Stone to Common Cliff)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu17A – Boggle Hole
This Sub-Management Unit has been classified as Partly Active (Mu17/3). The cliffs are commonly free of vegetation with evidence for activity at all parts of the cliff.

Mu17/3 looking north (Partly Active)

Mu17B – Boggle Hole to Peak Steel
The northern part of this Sub-Management Unit is Partly Active Mu17/4, Mu17/5). The lower cliff face is near vertical and lacking in vegetation cover. The upper cliff is a shallower gradient, composed of softer, glacial sediments, and is better vegetated. Further south, the upper cliff becomes more stable with more continuous vegetation cover. Some activity at the headscarp and toe is evident, but to a lesser extent and the cliffs are classified as Locally Active (Mu17/6, Mu17/7). Towards Peak Steel the cliffs become more active, particularly in the upper, softer sediments. Debris is present at the base of the cliffs, which are classified as Partly Active (Mu17/8, Mu17/9).

Mu17/4 looking south (Partly Active)

Mu17/6 looking south towards Peak Steel (Locally Active)

Mu17/8 looking south (Partly Active)

Coast Protection Asset Assessment

Mu17A – Boggle Hole
There are no coastal defences present here, but 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.

Mu17B – Boggle Hole to Peak Steel
A short section of rock armour revetment and concrete and timber piling are providing protection to the mouth of the Stoupe Beck (Asset Ref No.1221D901D1003C08), however these are fluvial rather than coastal sea defences.

Stone slipway giving access to beach and water at Boggle Hole

Looking upstream at Boggle Hole Youth Hostel, footbridge, slipway and fuel bund.

Mouth of Stoupe Beck
(Asset Ref No.1221D901D1003C08)

Rock armour revetment at the mouth of Stoupe Beck
(Asset Ref No.1221D901D1003C08)

Management Unit 18 – Peak Steel to southern end of Beast Cliff
(Map 6 – Tinkler's Stone to Common Cliff and Map 7 – Beast Cliff to Hundale Point)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units, as follows:

Mu18A – Peak Steel to Blea Wyke Steel
The northern part of this Sub-Management Unit is Locally Active (Mu18/1). 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 with slides and falls evident. The southern part of the Sub-Management Unit is well vegetated with no signs of instability and is classified as Inactive (Mu18/2).

Mu18/1 looking north (Locally Active)

Mu18/2 looking north (Inactive)

Mu18B – Common Cliff and Beast Cliff
The entirety of this Sub-Management Unit is classified as Locally Active (Mu18/3, Mu18/4). The stepped terrain is a likely relict of former slumps or debris flow events. It is well vegetated with only localised patches of activity evident at the slope toe.

Mu18/3 looking north (Locally Active)

Mu18/3 looking north across Beast Cliff (Locally Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 19 – Beast Cliff to Scalby Ness
(Map 7 – Beast Cliff to Hundale Point and Map 8 – Scarborough North)

Coastal Slope Condition Assessment
This Management Unit is divided into 5 Sub-Management Units:

Mu19A – Beast Cliff to Herbert Hole
This Sub-Management Unit is Locally Active (Mu19/1). The cliffs are well vegetated, with minor localised patches of erosion.

Mu19/1 looking north (Locally Active)

Mu19B – Herbert Hole to Tindall Point
This Sub-Management Unit has been classified as Locally Active (Mu19/1, Mu19/2, Mu19/3). There is minor activity at the headscarp and some evidence of past rock falls at the toe. The slopes around the footpath on the northern side of Hayburn Wyke itself have been susceptible to instability in the past, but recent stabilisation works have remedied immediate problems.

Mu19/2 looking north across Hayburn Wyke (Locally Active)

Mu19/3 looking south past Hayburn Wyke (Locally Active)

Mu19C – Tindall Point to North of Cloughton Wyke

The northern part of this Sub-Management Unit is characterised by stepped, well vegetated terrain classified as Locally Active (Mu19/3). There are minor localised patches of activity. The southern part consists of higher, steeper cliffs which are more active (Partly Active- Mu19/4). These cliffs are undergoing some recession of the headscarp, sliding and falling of materials down the mid-slopes to form debris cones and rock fall deposits at the cliff base.

Mu19/4 looking northwest (Partly active)

Mu19D – Cloughton Wyke

The majority of this Sub-Management Unit is classified as Locally Active (Mu19/5, Mu19/6. The near vertical cliffs support some vegetation cover. Marine action is eroding the toe and there is some evidence of past small rock fall events on the shore.

Mu19/5 the east facing part of Cloughton Wyke (Locally Active)

Mu19/6 the north facing part of Cloughton Wyke (Locally Active)

Mu19E – Hundale Point to Scalby Ness

The northern part of this Sub-Management Unit is Locally Active (Mu19/6, Mu19/7, Mu19/8). The cliffs are generally well vegetated, with boulder deposits at the base of the cliff, and with minor activity evident at the toe and locally at the head. At the southern part of this MU, the toe is subject to marine action and is slumped in places. The headscarp is steep and exposed over much of the section. Mid-slope there are tension cracks, slumping, sliding and gliding blocks (Partly Active- Mu19/9, 19/10). The Scalby Ness CBU, which extends up Scalby Beck is well vegetated with occasional activity from base to top of the cliff, and is classified as Locally Active (Mu19/11).

Mu19/8 looking south (Locally Active)

Mu19/10 looking south (Partly Active)

Mu19/11 inland of Scalby Ness (Locally Active)

Coast Protection Asset Assessment
The only coastal assets within this Management Unit are located in the Scalby Mills area of Sub-Management Unit Mu19E.

Mu19E – Hundale Point to Scalby Ness
There are no formal sea defences within the Scalby Mills area. However there is a coastal asset- a service pipe which has been laid across the mouth of Scalby Beck (Asset Ref No. 1221D901D1201C09). This acts as a fixed crest weir controlling the flow of the beck at low tide. In a high tide situation this would have minimal affect on water dynamics, be they tidal or fluvial. At low tide, the pipe can be inspected throughout its length. Generally it is in a fair condition displaying cracking and spalling in localised spots. In one location the concrete protective surround has been damaged revealing the inner brickwork pipe (see photo below right). Repair work is recommended in order to prevent potential sewage pollution.

Service pipe running across the mouth of Scalby Beck (Asset Ref No. 1221D901D1201C09)

Close up of pipe at low tide showing damage to concrete surround and exposure of inner brickwork pipe (Asset Ref No. 1221D901D1201C09)

Management Unit 20 – Scarborough North Bay
(Map 8 – Scarborough North)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu20A – Northern North Bay
The CBUs within this section are defended by the sea wall which runs the entire length of North Bay. There is no obvious evidence of recent activity, thus they are classified as Dormant (Mu20/1, Mu20/2).

Mu20/1 above the miniature railway (Dormant)

Mu20/2 looking south towards Scarborough (Dormant)

Mu20B – Southern North Bay

The northern end of this Sub-Management Unit shows no obvious evidence of recent instabilities and therefore is classified as Dormant (Mu20/3). Further south, the area of Clarence Gardens is showing some minor signs of activity in the form of small surface sliding on the mid-slopes and exposed rock near the head (Locally Active-20/4b).

Mu20/3 looking south (Dormant)

Mu20/4b looking up in the region of Clarence Gardens (Locally Active)

Coast Protection Asset Assessment

The coastline of Scarborough stretches for approximately 6.5km and is protected by a wide variety and large number of coastal flood defences. Given that many of the defences stretch between both areas, Sub-Management Units Mu20A and Mu20B shall be described together within this asset assessment section.

There are formal defences throughout the whole length of the North Bay, many of which are currently stable but show some evidence of damage; cracking, loss of mortar and expanding sealant and surface erosion are common to virtually all concrete and blockwork structures. The promenade shows many gaps at joints and lateral cracks which run parallel with the coastline, set back about 1m from the top of the wall. There are also a number of structural cracks in the back wall behind the promenade which acts as a retaining wall to the road.

Steel reinforcing bars (or 'rebar') are exposed to the front face of the sea wall (Asset Ref No. 1221D901D1201C03. They may be evidence that repairs have been undertaken in the past

which have not held. There are also missing joints between the blockwork throughout the length of the wall (see photo below, top left).

The most northern section of the wall has been repaired, but this now shows several large vertical cracks running the full height of the wall (Asset Ref No. 1221D901D1201C06, see photo below, top right). The faces of many blocks are missing and there is eroded coping.

Further south, there is cracking along joints and loss of material of the sea wall (Asset Ref No. 1221D901D1201C07). The promenade also shows cracking in many places. Towards the southern end, particularly around the built out section and steps there are several large vertical cracks running the full height of the wall. The slipway in the south has been closed due to health and safety concerns during storm conditions and shows several structural cracks running the full height of the wall.

There is a large extent of rock armour and tetrapods around the south end of North Bay which continues around the headland (into Management Unit Mu21A) and towards the harbour (Asset Ref No's. 1221D901D1202C01 and 1221D901D1202C02 respectively). These were built in approximately 2005 and are, on the whole, in good condition with some evidence of cracking along the arm joints (see photo below, bottom right). It was not possible to inspect the toe as it was below water in all tide conditions.

Exposed rebar and missing joints along sea wall (Asset Ref No. 1221D901D1201C03)

Large vertical cracks running the full height of the sea wall (Asset Ref No. 1221D901D1201C06)

Joint cracking and loss of material from the sea wall (Asset Ref No. 1221D901D1201C07)

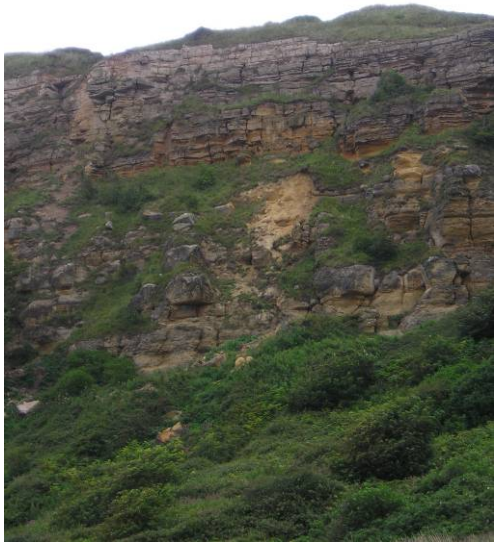
Rock armour and tetrapods around the southern end of North Bay (Asset Ref No's. 1221D901D1202C01 and 1221D901D1202C02 respectively)

Management Unit 21 – Castle Cliff, Scarborough
(Map 8 – Hundale Point to Scarborough North and Map 9 – Scarborough South to Cayton Bay)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu21A – Castle Cliff
The cliffs within this Sub-Management Unit are Locally Active (Mu21/1, Mu21/2). They are generally well vegetated with small patches of exposed material. In the region of 'The Holms' there is evidence of recent rock fall from an exposure of well jointed hard rock, resulting from on-going weathering of the exposed rock face (Mu21/1).


Mu21/1 looking across The Holms (Locally Active)


Mu21/1 local rock fall activity at northeast end of The Holms (Locally Active)

Mu21B – The Harbour
There are no natural cliff units within this Sub-Management Unit.

Coast Protection Asset Assessment

Mu21A – Castle Cliff
The sea defences within this Sub-Management Unit consist of rock armour and tetrapods. Please see the Coast Protection Asset Assessment for Management Unit 20 for detail.

Mu21B – The Harbour
Scarborough Harbour runs from the southern side of the headland and through the centre of the town. There are continuous formal defences throughout the whole extent. These range from very new rock armour and tetrapod 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 harbour wall (Asset Ref No. 1221D901D1301C01) is in very good condition, with only minor cracking to the crest wall and individual tetrapods. A raised section has recently been added to the top of the existing defence along almost the entire length (see photo below, top left). At one point at the seaward end of the harbour arm there are signs of deformation within the rock armour and at another location rock armour is not present in such quantities behind the tetrapods as is present along the rest of the headland (see photo below, top right).

The faces of many blocks are missing or cracked at the seaward end of the original harbour wall (Asset Ref No. 1221D901D1301C16, see photo below, middle left). The landward part of the arm shows recent maintenance work- many cracks and joints have been repaired or repointed. The timber fenders also appear newer on the landward side of the arm than they do on the seaward side.

A number of the defences in the harbour area show corrosion to the steel piling of varying degrees (Asset Ref No. 1221D901D1301C17 and 1221D901D1301C13), as would be expected in an environment such as this. Locals report the steel to be up to 50 years old. Significant erosion is evident in the photo below (middle, right), located on the harbour arm near the lighthouse.

The original quay wall (Asset Ref No. 1221D901D1301C06) shows signs of deformation. The newer concrete jetty which has been constructed above (see photo below, bottom left) also shows signs of movement. In several places there is loss of concrete in small patches at the top of columns.

The new harbour wall with rock armour, tetrapods and raised section (Asset Ref No. 1221D901D1301C01)

Lack of rock armour present behind the tetrapods (Asset Ref No. 1221D901D1301C01)

The original harbour wall (Asset Ref No. 1221D901D1301C16)

Significant corrosion of steel piling (Asset Ref No. 1221D901D1301C17)

The original quay wall beneath the newer concrete jetty (Asset Ref No. 1221D901D1301C06)

Overview of assets from the commercial harbour looking towards the lifeboat station (Asset Ref No. 1221D901D1301C07 and 1221D901D1301C18)

Management Unit 22 – Scarborough South Bay
(Map 9 – Scarborough South to Cayton 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 within this Sub-Management Unit.

Mu22B – South Cliff and Holbeck Gardens
This Sub-Management Unit consists of a number of small CBUs which are all classified as Inactive (Mu22/1, Mu22/3, Mu22/4, Mu22/5, Mu22/7) or Locally Active (Mu22/2, Mu22/6, Mu22/8) and are protected at the toe by a sea wall. The Inactive CBUs appear to be largely stable with occasional evidence of activity such as minor cracks in footpaths and exposed rock faces. Within the Locally Active CBUs there is evidence of localised recent instability which has resulted in the loss of footpaths in some places. Cracks in footpaths and slumping provide further evidence of ongoing activity. The regraded slopes of the former Holbeck Hall landslide are well vegetated but are very hummocky and there is evidence of localised activity at the headscarp (Mu22/8).

Mu22/7 looking south (Inactive)

Mu22/2 recent landslide activity on the steep wooded slopes of South Cliff Gardens (Locally Active)

Mu22/8 looking up the Holbeck stabilised landslide run out lobe to localised erosion at the head (Locally Active)

Mu22/6 recent slumping (Locally Active)

Coast Protection Asset Assessment

Within South Bay are a wide range of coastal defence assets. All assets have been given a residual life of >20 years, except the blockwork sea wall (6-10 years) (Asset Ref No. 1221D901D1302C02). This positive outcome reflects on all assets indicating that they are in a sound condition throughout. Common defects that are evident are mortar loss and surface cracking.

Mu22A – St Nicholas Cliff

At the northern end of South Bay, cracking is evident in the sea wall and footing for the Lifeboat Station (Asset Ref No.1221D901D1301C08). A tell tale has been installed on the corner of the Lifeboat Station to monitor deformation. Repointing is recommended here.

A sea wall runs in front of Foreshore Road, backing the beach at South Sands. Due to high levels of sand only the top two courses of bricks are visible here. However, the sea wall is in good condition with no visible defects (Asset Ref No. 1221D901D1301C15).

Cracking in the sea wall and footing of the Lifeboat Station (Asset Ref No. 1221D901D1301C08)

Sea wall running in front of Foreshore Road, South Bay (Asset Ref No. 1221D901D1301C15)

Mu22B – South Cliff and Holbeck Gardens

A sea wall and promenade runs for the length of this section. The recurved sea wall (Asset Ref No. 1221D901D1301C10, see photo below, top left) is missing some masonry joints throughout and erosion to the blockwork surface is prevalent. It is recommended that repointing is undertaken to prevent block washout and further damage.

At the southern end of the sea wall the blockwork is in fair condition (Asset Ref No. 1221D901D1302C02, see photo below, top right). There is a section of concrete where rebar is exposed and corroded. Many large cracks and poor areas are evident in the back wall and the coping. Furthermore, expansion joints within the promenade have been washed out and need re-sealing.

The lower section of the concrete wall is showing evidence of significant surface erosion (see photo below, bottom left). It is recommended that the wall needs re-surfacing. It is probable that the localised erosion results from a weaker mix of concrete used to create the defence (Asset Ref No. 1221D901D1303C01).

A relatively new rock armour revetment defends the relict debris flow lobe at Holbeck. This is in good condition, is tightly packed and has good coverage. There are no signs of deformation or rock movement (Asset Ref No. 1221D901D1304C01, see photo below, bottom right).

Recurved sea wall (Asset Ref No. 1221D901D1301C10)

Concrete promenade (Asset Ref No. 1221D901D1302C02)

Lower section of concrete wall with significant surface erosion

Rock armour revetment at Holbeck (Asset Ref No. 1221D901D1304C01)

Management Unit 23 – Holbeck to Knipe Point
(Map 9 – Scarborough South to Cayton Bay)

Coastal Slope Condition Assessment
There is much variation in the level of activity within this Management Unit. The majority of CBUs within the northern part of this unit are classified as either Locally (Mu23/B, Mu23/C, Mu23/E, Mu23/G1) or Partly Active (Mu23/A, Mu23/D1, Mu23/D2, Mu23/D3). The Locally Active CBUs are generally well vegetated with small patches of exposed and eroding materials. For example, Mu23/E is characterised by an exposed toe where activity is triggered by marine action. There is also localised activity on the steep mid-slopes. Partly Active CBUs are more sparsely vegetated with sliding, falling and rilling evident down much of the exposed faces. There is a single CBU classified as Inactive (Mu23/F), which is a small, recently re-engineered valley with a footpath and drainage channel overlying a pipeline. The slopes are well vegetated with little evidence of recent activity.

Within the southern part of this Management Unit the coast is characterised by large Locally Active mudslide embayments, with a series of Partly to Totally Active failures in the toe of the slope which have been classified as separate CBUs.

The most southerly tip of this Management unit is Knipe Point. Mu23/I4 on the north facing side of the headland is cut in glacial materials and is Totally Active. This may be related to recent landslide activity in nearby Cayton Bay. The remainder of the headland is composed of more resistant rock, with some evidence of rock fall, and is classified as Partly Active (Mu24/A8, Mu24/A7).

Mu23/E looking south from White Nab (Locally Active)

Mu23/D1 looking east from Black Rocks (Partly Active)

Mu23/G2 toe uplift on the beach within Cornelian Bay (Partly Active)

Mu23/F looking up the well vegetated valley (Inactive)

Mu23/I the headscarp of the back most units within Cornelian Bay (Locally Active)

Overview of basal units Mu23/H1 (closest) to Mu23/I1 in the distance (combination of Totally and Partly Active)

Mu23/I4 north facing side of Knipe Point (Totally Active)

Mu24/A8 Knipe Point headland with evidence of rock fall (Partly Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 24 – Cayton Bay
(Map 9 – Scarborough South to Cayton Bay and Map 10 – Cayton Bay to North Cliff)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu24A – Cayton Bay North
The northern part of this Sub-Management Unit is classified as Totally Active due to recent reactivation of a landslide in this area (Mu24/A, Mu24/A1, Mu24/A2). This landslide is the subject of an on-going investigation by Halcrow on behalf of Scarborough Borough Council and the National Trust. There has been significant recession at the headscarp resulting in the loss of land and property at Knipe Point. Tension cracks are evident throughout the main body of the landslide and toe uplift of around 0.5m was observed at beach level. Further south, at Tenants' Cliff, the CBUs are more stable. The body of the Tenant's Cliff landslide (Mu24/B) is classified as Inactive, while the seaward CBUs of this landslide are Locally Active, with localised evidence of rock fall and slumping.

Mu24/A2 toe uplift on the beach at Cayton Bay (Totally Active)

Mu24/A headscarp failure at Knipe Point

Mu/B8 to Mu/B10 basal units of Tenants Cliff (Locally Active)

Mu24/B back unit of Tenants Cliff (Inactive)

Mu24B – Cayton Bay South

There is significant variation in activity within this Sub-Management Unit. All cliffs are composed of glacial sediment which is vulnerable to instability. Vegetation cover is variable and probably related to cycles of activity events. Those CBUs classified as Partly or Totally Active have headscarp recession, and localised mudsliding (Mu24/E, Mu25/M1, Mu25/N, Mu25/O, Mu25/P, Mu25/S, Mu25/T, Mu25/U). Locally Active CBUs have very localised activity and only limited recession of the headscarp (Mu24/C, Mu24/D, Mu24/F, Mu24/G, Mu24/I, Mu24/J, Mu24/K, Mu24/L). Generally, the level of activity increase southwards.

Mu24/J looking south across southern part of Cayton Bay (Locally Active)

Mu24/N looking down at failing slopes (Totally Active)

Coast Protection Asset Assessment

Mu24A – Cayton Bay North

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

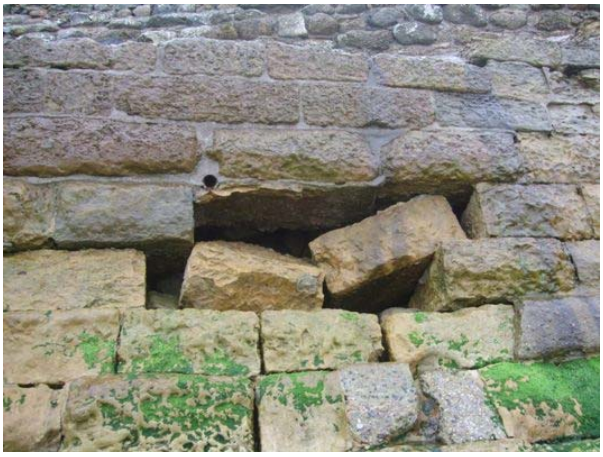
Mu24B – Cayton Bay South

Cayton Bay is predominantly a natural bay free from coastal defences. Cayton pumping station, (located 506665,484520 OS Grid) is protected against wave attack by a series of blockwork and concrete sea walls (Asset Ref No. 1221D901D1402C05). The condition of the defences varies from very poor to good and relates to the height from the high water mark. The higher, red brick walls are in a sound condition, displaying limited mortar washout (see photo below, top left). The lower, concrete and sandstone blockwork is of fair to poor condition. Mortar loss has led to blockwork washout and the potential for significant 'blow out' (see photo below, top right). This requires urgent attention to replace blockwork and to repoint other sections which are showing evidence of mortar loss. It is worth noting that access can be difficult as the pumping station is situated on private land.

The southern end of the pumping station defences consist of a patchwork of makeshift additions which lack unity (Asset Ref No. 1221D901D1402C04, see photo below, bottom left). This has resulted in major undercutting, blockwork washout and significant damage. Repair work is required to prevent further block work washout and collapse.

To the south of the pumping station, footpath access to the beach is provided by a wooden staircase (Asset Ref No. 1221D901D1402C01). This footpath is regularly used by walkers and surfers. The toe of the stairwell is protected by gabion baskets which will need to be replaced in the near future to maintain a useable footpath.

High sea defences below the pumping station, including the upper tier of red brick walls (Asset Ref No. 1221D901D1402C05)



Lower section of concrete and sandstone, with blockwork wash out (Asset Ref No. 1221D901D1402C05)

Patchwork of makeshift defences to the south of the pumping station (Asset Ref No. 1221D901D1402C04)

Staircase with gabion baskets located to the south of the pumping station (Asset Ref No. 1221D901D1402C01)

Management Unit 25 – Lebberston Cliff and Gristhorpe Cliff
(Map 10 – Cayton Bay to North Cliff)

Coastal Slope Condition Assessment
The majority of vertical cliff CBUs in this Management Unit are classified as Locally or Partly Active. The Locally Active cliffs have some activity mid-slope. There is also some exposure and erosion at the head and toe (Mu25/V, Mu25/Y, Mu25/AD, Mu25/AE). The Partly Active units are subject to erosive activity over much of their length. The toe is steep and exposed with evidence of rock fall at the base. The head scarp is receding and the mid slopes are undergoing slumping and sliding (Mu25/T, Mu25/U, Mu25/X, Mu25/AA, Mu25/AB, Mu25/AC). There is one CBU classified as Totally Active at Lebberston Cliff, where mudslide and rock fall activity was ongoing and widespread (Mu25/W).

Mu25/Y looking southeast from Lebberston Cliff (Locally Active)

Mu25/AA and Mu25/AB looking southeast across Gristhorpe Sands (Partly Active)

Mu25/W looking down at lower part of debris flow (Totally Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 26 – Newbiggin Cliff and North Cliff
(Map 10 – Cayton Bay to North Cliff)

Coastal Slope Condition Assessment
This Management Unit is comprised of alternating zones of Locally Active and Partly Active cliffs. The Locally Active zones are characterised by a soft upper layer, a hard rock middle layer and a series of vegetated debris cones at the toe. The upper layer is well vegetated but features localised slumping and head scarp recession. Rock fall debris is evident at the cliff base. The Partly Active cliffs are composed of the same layered structure as the Locally Active cliffs within this Management Unit. However, they are characterised by more exposed, active lower and upper layers.

Mu25/AM to Mu25/AP looking eastwards towards Filey Brigg (Locally Active)

Mu26/AK (Partly Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 27 – Filey Brigg
(Map 10 – Cayton Bay to North Cliff and Map 11 – Filey Brigg to Reighton)

Coastal Slope Condition Assessment
This Management Unit is comprised of CBUs of varying activity. The north facing side of Filey Brigg is more active than the south facing side. The upper glacial sediment is undergoing mass failure (CBUs are Totally or Partly Active- Mu27/AZ, Mu27/BA, Mu27/BB, Mu27/BC, Mu27/BD, Mu27/BE). The southern side is much more heavily vegetated with only localised patches of erosion (Locally Active). There is intense erosion at the southwestern corner of the Brigg where CBUs are Totally Active (Mu27/L, Mu27/M, Mu27/N, Mu27/O).

Mu27/BA looking east along northern side of Filey Brigg (Totally Active)

Mu27/E to Mu27/I looking east along southern side of Filey Brigg (Locally Active)

Mu27/K to Mu27/O looking north from Filey Bay
(Totally Active)

Coast Protection Asset Assessment
There are no coastal assets within this Management Unit.

Management Unit 28 – Filey Bay North
(Map 11 – Filey Brigg to Reighton)

Coastal Slope Condition Assessment
This Management Unit is divided into 2 Sub-Management Units:

Mu28A – North of Filey Town
The CBUs within this Sub-Management Unit are a combination of Locally and Partly Active. The Partly Active zones are lacking in vegetation cover, receding at the head scarp and are heavily rilled and gullied on the mid-slopes. The toe is steep and exposed and there is evidence of recent slumping and sliding of material onto the beach. The Locally Active zones have minor activity at the head, toe and occasionally mid-slope.

Mu27/P to Mu27/S looking south towards Filey
(Partly Active)

Overview of Mu27/V to Mu27/X (mostly Locally Active)

Mu28B – Filey Town Frontage
The main CBU within this Sub-management Unit is classified as Inactive and comprises the slopes in and around the frontage of Filey Town Mu28/Y). There is some evidence of minor instability on some of the slopes, but most are stable. It is evident that some relatively recent erosion has been repaired. To the north and south of this unit, are areas of Local activity (Mu27/X, Mu28/Z). Here, there is evidence of minor landsliding in places which has lead to the closure of footpaths.

Mu28/Y looking north across Filey (Inactive)

Mu28/Y recently re-engineered slope (Inactive)

Mu28/Z recent minor landsliding activity (Locally Active)

Mu28/Z recent landsliding and footpath damage (Locally Active)

Coast Protection Asset Assessment

The coastal town of Filey is protected by a continuous sea wall which runs for the entire length of the town (1.1km). The sea wall shows evidence of minor, localised defects including cracks within the coping stone, surface erosion and mortar loss (see photo below, top left). However, the overall condition is fair to good. Six access points (slipways) are built into the sea wall along with a number of outfalls/non returned flap valves (200mm – 1500mm). Active repair work is also apparent (see photo below, top right).

Mu28A – North of Filey Town

To the north of the town, Filey Sailing Club is located at the back of the beach and receives protection from a primitive concrete and sheet pile construction (Asset Ref No. 1221D901D1601C01). The piles at the northern end of the Sailing Club show surface corrosion but are generally in a sound condition. At this location there is also a concrete slipway giving access to the beach and a natural accumulation of pebbles in front of the structures (see photo below, middle left). The sheet piles at the southern end of the Sailing Club are not in a sound condition (see photo below, middle right). The piles have corroded away, leading to undercutting of the slipway and outflanking of adjacent piles. It is recommended that repair work is needed to prevent any further undercutting.

Mu28B – Filey Town Frontage

The Filey frontage is protected by the sea wall as described previously. A short section of rock revetment is located at the southern end of the coastal defences, with gabion baskets beneath (Asset Ref No. 1221D901D1602C02, see photo below, bottom left). This defence extends into Sub-Management Unit Mu29A. The revetment coverage is not 100% which may be the result of washout or on-going stability issues in the glacial sedients. It is suggested that monitoring of the revetment would help to establish if the defence is unstable and whether it requires an increase in coverage.

Sea wall with minor, localised defects

Repair work to the coping stone of the Filey sea wall

Concrete and sheet pile defences at the northern end of the Sailing Club

Corroded concrete and sheet pile defence at the southern end of the Sailing Club

Rock revetment with gabion baskets beneath

Management Unit 29– Filey Bay
(Map 11 – Filey Brigg to Reighton)

Coastal Slope Condition Assessment
This Management Unit is divided into three smaller Sub-Management Units, as follows:

Mu29A – Muston Sands
This Sub-Management Unit mostly consists of Locally Active CBUs. The low lying cliffs are composed of soft glacial sediment which is generally well vegetated. The toe is steep and exposed with evidence of mudsliding and erosion. In places the head scarp is also exposed and eroding. A small area in the north of this Sub-Management Unit is classified as Partly Active, due to ongoing mudsliding in the upper slopes (Mu29/AA, Mu29/AB).

Mu29/AH low lying well vegetated cliffs (Locally Active)

Mu29/AA just south of Filey town frontage (Partly Active)

Mu29B – Hunmanby Sands
The CBUs within the northern part of this Sub-Management Unit, which includes the Flat Cliff hamlet, are predominantly classified as Locally Active. The cliffs are low lying and composed of glacial material and are generally well vegetated. There is erosion at the toe and localised mudsliding mid-slope. Further south, the CBUs become more active, with less vegetation cover and greater areas affected by mudslides (Partly Active- Mu29/BB, Mu29/BC, Mu29/BD, Mu29/BE).

Mu29/AS looking southwards along Flat Cliff (Locally Active)

Mu29/BE looking southwards near Hunmanby Gap (Partly Active)

Mu29C – Reighton Sands
This Sub-Management Unit is characterised by greater levels of activity than Mu29A and Mu29B. Four CBUs in the northern part of this section are classified as Totally Active (Mu29/BF, Mu29/BG, Mu29/BH, Mu29/BI). They are steep, largely devoid of vegetation cover and are undergoing active slumping and sliding of the soft material onto the beach. Further south, the CBUs are less active with

greater vegetation cover. There is active erosion at the toe and head with some sliding of materials down the mid-slope and onto the beach (Partly Active).

Mu29/N and Mu29/O Cliffs above Reighton Sands (Partly Active)

Mu29/BF and Mu29/BG looking south past Hunmanby Gap (Totally Active)

Coast Protection Asset Assessment

Mu29A – Muston Sands
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 assets within this Sub-Management Unit.

Mu29B – Hunmanby Sands
No formal coastal defence structures exist along this length of coastline. Historical structures including World War II pill box relics and temporary localised coastal defences are located intermittently and are in a variable condition.

For example, at approximately 512469, 478254 (east of Flat Cliffs) there is a poured concrete structure which appears to be giving protection to a service pipe underneath (Asset Ref No. 1221D901D1603C01). This structure is now being outflanked and undercut (see photo below, top left).

At another location situated at approximately 513050, 477410 (Hunmanby Gap, seaward end of Sands Road) an outfall is evident which was previously supported by gabion baskets (Asset Ref No. 1221D901D1603C01). The baskets have deformed so that they now only offer limited protection and support to the outfall. It is possible that the failure of these defences has also lead to destabilisation of the cliff toe behind.

Mu29C – Reighton Sands
There are no coastal defence assets within this Sub-Management Unit.

Management Unit 30 – Filey Bay South
(Map 12 – Reighton to Speeton)

Coastal Slope Condition Assessment
This Management Unit is divided into two smaller Sub-Management Units, as follows:

Mu30A – Reighton Gap
Most of this Sub-Management Unit is classified as Partly Active. The glacial cliffs have a large, steep, exposed toe zone which is undergoing active mudsliding onto the beach. Active erosion is also occurring at the head and mid-slopes. There is some discontinuous vegetation cover with channels of water formed on the slope surface. In the southern part of the Unit, one CBU is classified as Totally Active due to more extensive active erosion including tension cracking and sliding (Mu29/CB).

Another CBU is classified as Locally Active with much denser vegetation cover and active erosion only evident at the toe (Mu29/CCa).

Mu30/CB looking down from cliff top (Totally Active)

Mu30/CCa looking down (Locally Active)

Mu30B – Speeton Sands

The cliffs within the northern part of this Sub-Management Unit are classified as Locally Active (Mu29/CC, Mu29/CD, Mu29/CE). The slopes are well vegetated with small patches of erosion evident at the head and occasionally mid-slope. Further south, the CBUs are more active and there is evidence of ongoing mudsliding over much of the slope, with lobes of debris running out to the beach (Partly Active- Mu29/CF, Mu29/CG, Mu29/CH, Mu29/CI). At the south end of this Sub-Management Unit the cliffs are much higher and composed of chalk rock. There is some evidence of rock fall and sliding (Partly Active).

Mu30/CC looking northwest towards Reighton Sands Holiday Village (Locally Active)

Mu30/CF Speeton Cliffs (Partly Active)

Coast Protection Asset Assessment

There are no coastal defence assets within this Management Unit

4. Comparison with Previous Assessments

Coastal Slope Condition Assessment

The change in condition of the cliffs is shown in Maps 13 to 24. Areas of increased, or sustained high levels of activity are summarised below:

Increased activity

Notable areas of increased activity were found at Cayton Bay north (Mu24/A), Lebberston Cliff (Mu25/W) and Filey town (Mu28/B):

- Cayton Bay North (Mu24/A) Major landsliding activity is occurring at Cayton Bay with significant headscarp recession, tension cracking mid-slope and uplift of the toe at beach level. This has resulted in the loss of land and property at Knipe Point Drive during 2008. (See Map 21 – Scarborough South to Cayton Bay Change Analysis)
- Lebberston Cliff (Mu25/W) A large debris flow is situated to the base of Lebberston Cliff, with evidence of cracking, rock fall and toppling. This is a clearly defined feature which is approaching the high water mark. (See Map 22 - Cayton Bay to North Cliff Change Analysis)
- Filey Town (Mu28/B) The units in and around Filey town are also showing signs of some recent minor landsliding activity. Unit Mu28/Y is classified as Inactive, however a recently regraded slope, newly planted hedges and rebuilt garden structures provide evidence of relatively recent activity here. Furthermore, there is fresh evidence of landsliding activity within unit Mu28/Z and associated closure of footpaths. (See Map 23 – Filey Brigg to Reighton Change Analysis)

Sustained high activity

Sustained levels of high activity were observed at Far Jetticks (Mu15/2), the toe of Cornelian Bay (Mu23), Filey Brigg (Mu27) and Reighton Sands (Mu29C). These units were classified as Totally Active in 2005 and 2008.

- Far Jetticks (Mu15/2) This is a steep, exposed cliff face with ongoing slumping and sliding down its entire height.
- Cornelian Bay (Mu23) The particularly active units here are the toe sections of a larger mudslide embayment.
- Filey Brigg (Mu27) A number of units here show ongoing intense erosion and failure of the glacial sediments.
- Reighton Sands (Mu29C) The steeps cliffs below Hunmanby Moor are devoid of vegetation cover with sustained slumping and sliding onto the beach.

Coast Protection Asset Assessment

Previous asset condition data was available in the form of data stored within NFCDD. However this data was frequently incomplete, spatially incorrect or missing entirely. Most asset inspections required the re-digitisation of assets within NFCDD to correct spatial positioning.

Many of the assets were found to be in a similar condition to that previously reported. For example, many of the existing assets were classed as having a residual life of either 6-10 or 11-20 years under an asset condition assessment undertaken in 1998. However, Halcrow surveyors inspected the assets this year (2008) and found the assets in much the same condition and therefore upgraded the residual life classification to 11-20 or >20 years. Previous assessments also suggested that a policy of 'no repairs' was applicable for many assets, whereas Halcrow have suggested that a routine monitoring programme is more appropriate. In only a couple of cases were there condition grading discrepancies between the existing data and the new Halcrow inspection data. These generally included improved or repaired assets or assets which have experienced degradation. It is these assets which are highlighted below.

Mu4 - Staithes

According to Halcrow (2005), the western breakwater was causing concern when last surveyed in 2005 due to the presence of large cracks and the displacement of rock armour. Upon inspection in 2008 it was found that many of these defects had been repaired and that the defence is now in a

good condition overall. The only element still requiring attention is the sheet piling which remains significantly corroded.

The rock armour (Asset Ref No. 1221D901D0402C02) has also been improved, through reconstruction. A new concrete promenade with rock armour protection is now in place which replaces the remnants of the old promenade.

The RNLI slipway (Asset Ref No. 1221D901D0402C03) was not present within the NFCDD and therefore a condition comparison is only possible against the Halcrow (2005) inspection. In this year's survey, the sea wall around the slipway was found to have been newly constructed and the gabions which were mentioned in the 2005 report remain in fair condition.

There is little change since 2005 in the condition grading of the defences within Staithes harbour which range from a classification of fair to poor. The eastern breakwater has been improved and a new breakwater constructed since the Halcrow inspection in 2005. There is also a new concrete structure built on top of the original harbour arm and new rock armour protects the structure on the seaward side.

Mu6 - Port Mulgrave
The condition of assets at Port Mulgrave, including the breakwater, has not changed significantly since the previous survey (Halcrow 2005). The jetty remains in a poor condition which appears to be worsening.

Mu7 - Runswick Bay
Many of the defences along the sea front at Runswick Bay remain in a similar condition as reported by the Halcrow 2005 inspection. In fact, several of the assets here required repair to prevent further undercutting and erosion.

Mu11-13 - Whitby
Defences along West Cliff in Whitby appear to be in a generally good condition, with only minor cracking or erosion and loss of sealant evident. However several defences show more notable defects. It is difficult to assess whether some of these defects were present previously, as low sand levels during the current survey revealed an exposed toe and eroded apron, which may not have been visible during the previous survey. Loss of mortar and material defects occurred in the blockwork sea wall (Asset Ref No's 1221D901D0802C06 and 1221D901D0802C07), where repointing is required to prevent potential further loss of material. At the eastern end of these defences previously unsafe abraded step access points to the beach have been repaired and now consist of ramps.

The two breakwaters in Whitby (1221D901D0803C02 and 1221D901D0803C03) show some signs of deformation including cracking. The western breakwater also shows evidence of block displacement. Both breakwaters appear stable at present. It was not possible to survey the outer breakwater walls (1221D901D0803C01 and 1221D901D0803C04) very closely as this would require boat access. The same is true of the harbour wall, asset 1221D901D0803C06.

The defences to the east of the harbour show more evidence of erosion and most assets show cracking and erosion or loss of joint material. The asset 1221D901D0803C05, to the east of Whitby harbour, contains an element of rock armour which requires replenishment.

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 (Asset Ref No. 1221D901D1003C02) continues to show seepage and cracking while the short, low section of defence (Asset Ref No. 1221D901D1003C04) shows erosion and joint washout but is in a slightly better condition than when surveyed previously. It is thought that several defences have been repaired or replaced but subsequently damaged further by wave action during this time, for example, the rock armour (Asset Ref No. 1221D901D1003C07) extending to the south of Robin Hood's Bay village.

Mu20-21 – Scarborough North Bay
Defences here are generally in a poorer state than when visited previously and are often one condition grade lower than previously reported. There are obvious signs of damage due to wave action including joint washout and areas where repairs have been washed away, for example within the sea wall (Asset Ref No. 1221D901D1201C03). Blockwork sea walls along the promenade continue to exhibit full height cracks in numerous places along length.

The area between the North and South bay consists of new rock armour and tetrapods with a raised concrete sea wall behind. These defences were being constructed during the previous survey and therefore were not inspected. As these defences are new, their condition is good.

Mu21-22 – Scarborough Harbour
The walls around the Old Harbour are aged and exhibiting mortar loss in many places throughout their lengths. No comparison with the previous survey (Halcrow 2005) is possible as this area was not included in the previous report. However a 1998 survey was entered into NFCDD where most defences were in 'good' condition. The current inspection graded most of these assets as 'fair' and in one case 'poor' due to significant mortar loss and erosion, for example the old pier (Asset Ref No 1221D901D1301C04. An overall degradation of assets is apparent, although there have been some localised repairs particularly to joints.

The west pier appears to be in much the same condition as previously reported, with corrosion to steel work, cracks and erosion in prominence.

Mu22-23 – Scarborough South Bay
Like within Scarborough Harbour, there has been a general degradation of assets within this area since the previous survey. Loss of joint material and full height cracks are visible. Sand levels were very high during the survey so that anchors and ties observed during the previous survey were not observed during this campaign. This suggests a large scale repair may have been undertaken. The asset south of the Spa which had failed previously has now been replaced in part but adjacent defences are still showing current and progressing defects.

Mu24-25 – Cayton Bay
Although it appears that several defences in Cayton Bay have been repaired or upgraded since the previous survey (Halcrow 2005), these are also now showing defects. For example, there is cracking and displacement of blocks from the sea wall (Asset Ref No. 1221D901D1402C05). Other defences appear not to have been improved. The overall condition of assets in this area is lower than when previously inspected.

Mu28a-29a – Filey
Defences to the north of Filey around the sailing club continue to show significant corrosion and washout, and are in a similar state as when previously surveyed. Defences present through the town show evidence of maintenance and repair in the form of repointing and the replacement of coping stones. However several full height cracks are still in evident and still require repair. Likewise rock armour and gabion defences to the south are still affected by wave action and are no longer tightly packed.

5. Problems Encountered and Uncertainty in Analysis

Coastal Slope Condition Assessment
No significant problems were encountered in the Coastal Slope Condition Assessment. A limited view of the cliff was afforded at a small number of CBUs, but in all cases, sufficient lengths of the cliff could be seen to assess its condition. Alternative approaches include inspection via a boat or use of remote sensing, such as aerial photographs, to assess conditions and measure change.

Coast Protection Asset Assessment
Very few problems were encountered onsite during the Coast Protection Asset Assessment. Access issues posed the largest problem although most assets were located in public spaces and were easily accessible. Access to private property was not an issue. Local tides tables provided key information

for the appropriate planning of each day's inspections. Assets around Castle Cliff and Scarborough Harbour are constantly submerged and therefore an inspection of only the visible elements has been 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;

- Whitby Offshore Breakwaters (West/East) (1221D901D0803C01/C04)
- Whitby Harbour LB – Fishing boat fuelling, docking area (1221D901D0803C06)
- All assets around Scarborough's Castle Cliff and Harbour

A future solution to this problem would be to use a boat. Although, obviously these areas are used by commercial boats and therefore access could be problematic. Furthermore, boat handlers may not want to work at close proximity to hard structures in a period of tide change and slack water may not give enough time to inspect assets properly. It would be necessary to consult the harbour master before any work was undertaken.

6. Conclusions and Recommended Actions

Monitoring of the entire frontage should be continued on an annual basis to ensure that hotspots of activity continue to be recognised and managed effectively. CBUs that are totally active are listed below. Many of these are in isolated areas with few assets, and therefore risk relates to damage to the Cleveland Way footpath and loss of farm land. However at some locations there are further risks, as indicated below.

- Mu4/1a Staithes: A large rockfall has occurred on the east facing side of Cowbar Nab which poses a risk to people on the shoreline below.
- Mu15/2 Far Jetticks: Intense erosion is occurring down the steep, exposed cliff.
- **Mu23, Mu24 Cornelian Bay and Cayton Bay:** The toe units at Cornelian Bay have sustained a high level of activity since the 2005 inspection. There has been recent reactivation of large scale landsliding at the south side of Knipe Point. The A174 coast road and properties at Knipe Point are at risk (this location is the subject of an ongoing investigation by Halcrow for SBC and the National Trust).
- Mu24B Cayton Bay South: The CBUs along this frontage are highly susceptible to slumping and sliding. Continued erosion presents a risk to nearby properties, public access to the beach and to users of the beach below.
- Mu25 Lebberston Cliff: Large debris flow.
- Mu27 Filey Brigg: Units on the north facing side of the Brigg in particular show sustained high levels of activity since 2005. Instability here poses a risk to walkers along the Brigg and beach users.
- Mu29, Mu30 Reighton Sands: The till cliffs between Hunmanby Gap and Middle Cliff are experiencing on going mudsliding which presents a risk to parts of the Reighton Sands Holiday Village.

Of these totally active areas, sustained high activity since 2005 was found at Far Jetticks, Cornelian Bay, Filey Brigg and Reighton Sands. The most significant increases in activity in the cliffs since the 2005 inspection occurred at Cayton Bay and at Filey Town. At Cayton Bay, a large landslide reactivated in early 2008 resulting in the loss of land and property and closure of the footpath. At Filey Town, localised landslide activity is still apparent following the significant rainstorm event in 2007. This has led to the closure of footpaths. Both of these sites have been the focus of recent detailed investigations and are the subject of on-going work.

The whole coastline will be subjected to repeat inspections under the Cell 1 Monitoring Programme recently awarded to Royal Haskoning and Halcrow, but key areas that should be closely monitored comprise the northern end of Cayton Bay and at Filey.

It is highly recommended that continued monitoring of all assets is undertaken, with more specific recommendations for individual assets given in the table below.

Recommended Actions for Assets

Defence	Location	Priority	Recommended Action
1221D901D0402C01	Staithes	Medium	Repair cracking to concrete wall, replace sheet piling
1221D901D0402C04	Staithes	Medium	Repoint blockwork, repair cracks, replace missing blocks
1221D901D0402C05	Staithes	Medium	Repair cracking in wall surface and toe
1221D901D0402C06	Staithes	Low	Repoint blockwork
1221D901D0502C01	Port Mulgrave	Medium	Either repair breakwater or conduct a study into the potential effects of the removal of this breakwater on other sections of the coastline
1221D901D0601C01	Runswick Bay	Medium	Investigation of reasons and mitigations for undercutting. Replace missing joint sealant and free-up seized weepholes
1221D901D0601C06	Runswick Bay	Medium	Repair large cracks, install tell-tales to monitor crack and investigate reasons for cracking
1221D901D0701C02	Sandsend	Medium	Increase volume of rock armour to cover exposed toe
1221D901D0702C01	Sandsend	Low	Re-seal joints between poured sections of sea wall
1221D901D0702C04	Sandsend	Medium	Repair exposed toe and sections of undercutting to prevent further damage to this new section of defence
1221D901D0702C01	Sandsend	Low	Re-seal joints between poured sections of sea wall
1221D901D0802C07	Whitby	Low	Repoint blockwork
1221D901D0803C02	Whitby	Medium	Re-inspect with boat
1221D901D0803C05	Whitby	Medium	Replenish rock armour or more large scale replacement
1221D901D0802C06	Whitby	Medium	Repair cracking in masonry wall
1221D901D0802C12	Whitby	Medium	Repoint and repair cracks, investigate apron
1221D901D0803C08	Whitby	Medium	Repoint blockwork and replace heavily eroded blocks
1221D901D0803C09	Whitby	Medium	Repoint where needed. Replace missing blocks
1221D901D0803C03	Whitby	Low	Repoint blockwork
1221D901D0803C04	Whitby	High	Investigate loose block and **repair urgently**. Monitor and investigate potential movement
1221D901D0803C05	Whitby	Medium	Enlarge and replenish rock armour in areas lacking coverage
1221D901D1003C04	Robin Hood's Bay	Medium	Repoint masonry joints, repair toe-undercutting
1221D901D1003C07	Robin Hood's Bay	Medium	Possible extension to southern end
1221D901D1201C03	Scarborough North Bay	Medium	Repair abraded front face of blockwork

Defence	Location	Priority	Recommended Action
1221D901D1201C06	Scarborough North Bay	Medium	Repair cracks. Investigate and correct defects causing cracking
1221D901D1201C07	Scarborough North Bay	Medium	Repair cracks. Investigate and correct defects causing cracking
1221D901D1301C01	Scarborough Harbour	Medium	Replenish rock armour at outer end of breakwater arm
1221D901D1301C08	Scarborough South Bay	Medium	Monitor existing tell-tale over crack. Repoint
1221D901D1301C10	Scarborough South Bay	Low	Repoint.
1221D901D1302C02	Scarborough South Bay	Low	Repoint and re-seal joints
1221D901D1303C01	Scarborough South Bay	Medium	Re-surface lower section of wall to prevent further ingress of water and subsequent washout of filler
1221D901D1402C01	Cayton Bay	Medium	Repair washed out toe section.
1221D901D1402C04	Cayton Bay	Medium	Repair washed out toe section.
1221D901D1402C05	Cayton Bay	High	**URGENT - repair blockwork and repoint.**
1221D901D1601C01	Filey	Medium	Repair toe.
1221D901D1603C01	Hunmanby Sands	Medium	Monitor and replace protection when required. Rectify hanging outfall pipe - either reduce length of pipe or rebuild protection around pipe and down slope to beach.

N

0 0.25 0.5 1 1.5 Km

Cu4 Cu5 Cu6 Cu7

Mu4 Mu5 Mu6A Mu6B Mu6C Mu7A Mu7B

E60/1a
E60/1b
MU4/1a
MU4/1b
MU4/2
MU4/3
MU5/1
MU6/1
MU6/2
MU6/3
MU6/4
MU6/5
MU6/6
MU6/7
MU6/8
MU7/1
MU7/2
MU7/3
MU7/4
MU8/1

Staithes

Port Mulgrave

Runswick Bay

520000
519000
518000
517000
516000

479000 480000 481000 482000

Area covered by main map

Saltburn-by-the-Sea

Whitby

Scarborough

Filey

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 1 - Staithes to Runswick Bay

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

Halcrow

Halcrow Group Ltd
Lyndon House
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Birmingham
B16 8PE

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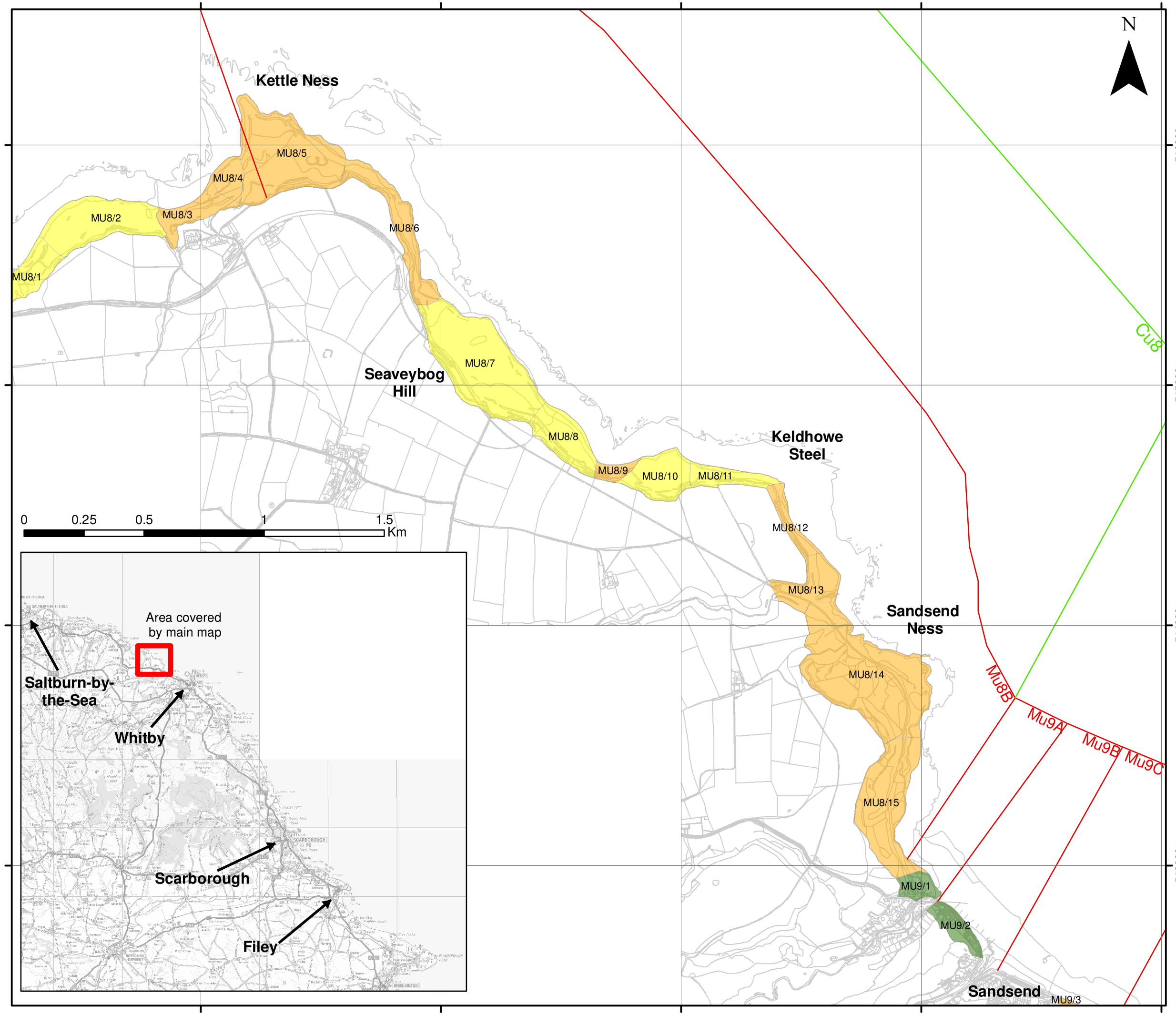

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 2 - Runswick Bay to Sandsend

Coastal Slope Condition 2008

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Lyndon House
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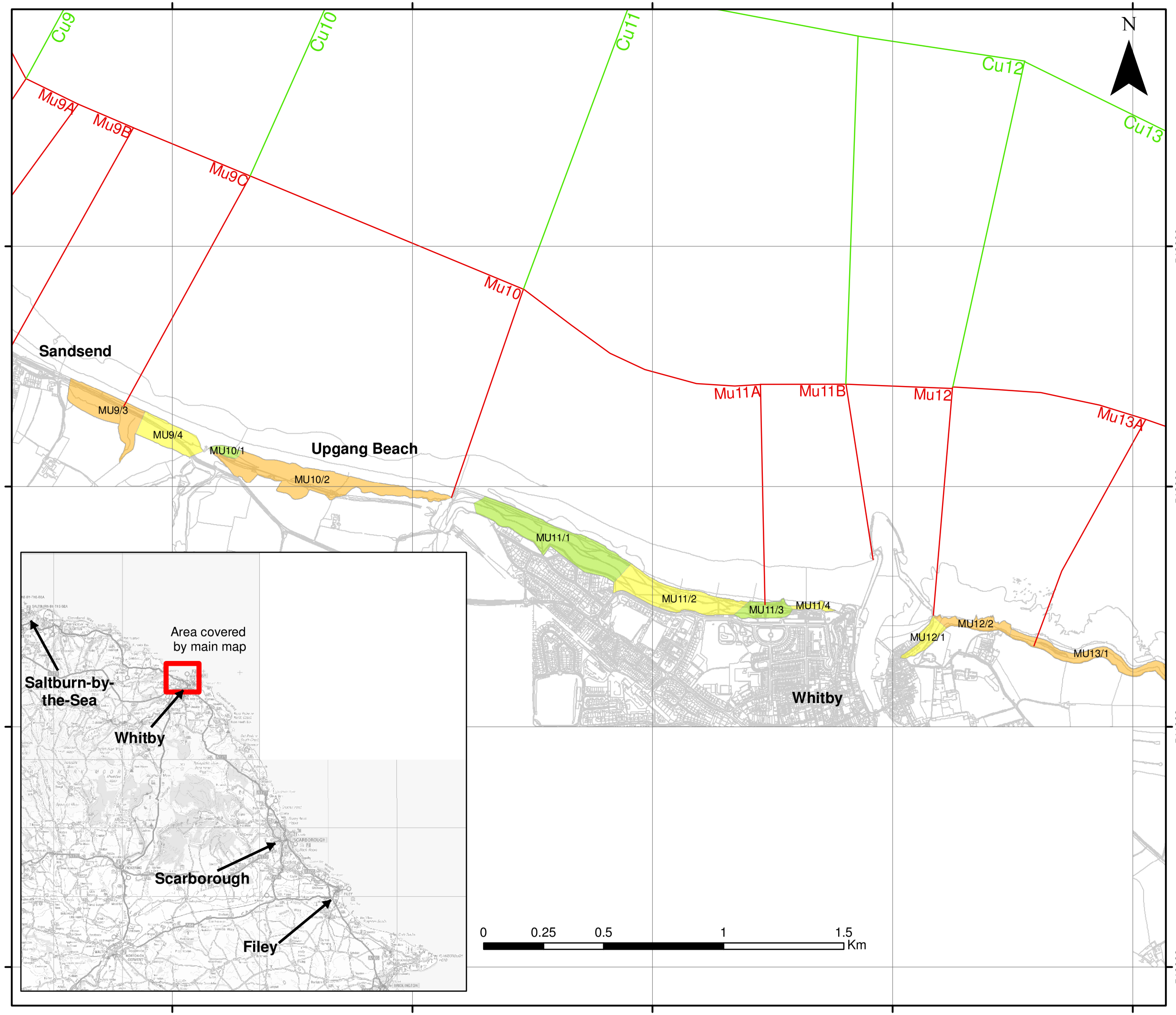

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 3 - Sandsend to Whitby East

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
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GIS Filename: SBC Map 3.mxd

N

0 0.25 0.5 1 1.5 Km

Saltwick Nab

MU13/1

MU13/2

MU13/3

MU13/4

MU13/5

MU13/6

Cu13

Cu14

Mu13B

Widdy Head

MU14/1

Mu14

Mu15

Pursglove Stye

MU15/1

MU15/2

511000

510000

509000

508000

507000

491000

492000

493000

494000

495000

Area covered by main map

Saltburn-by-the-Sea

Whitby

Scarborough

Filey

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 4 - Whitby East to Pursglove Stye

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Halcrow Group Ltd
Lyndon House
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Birmingham
B16 8PE

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GIS Filename: SBC Map 4.mxd

N

0 0.25 0.5 1 1.5 Km

MU14/1

Pursglove Stye

MU15/1

Far Jetticks

MU15/2

MU15/3

MU15/4

Robin Hood's Bay

MU16/1

MU16/2

MU16/3

MU17/1

MU17/2

MU17/3

MU17/4

MU17/5

Mu15

Mu16A

Mu16B

Mu16C

Mu17A

Boggle Hole

Tinkler's Stone

508000

507000

506000

505000

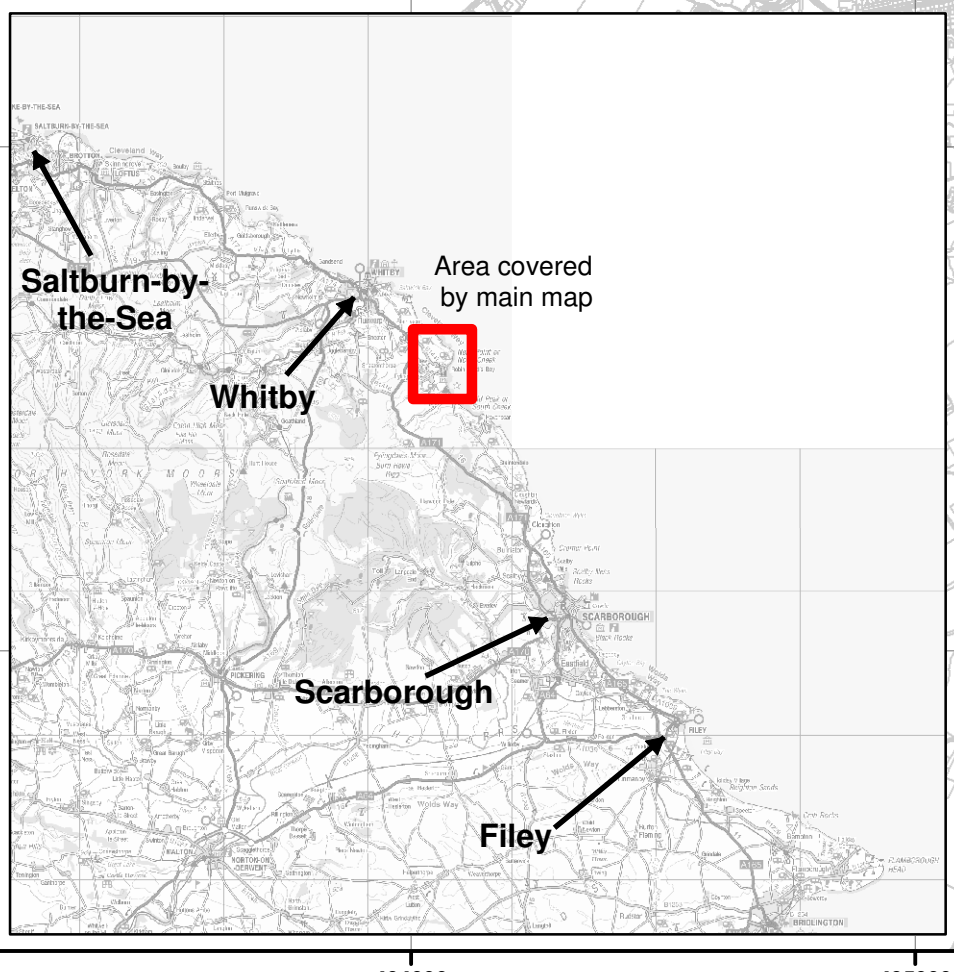
504000

494000

495000

496000

497000



Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 5 - Pursglove Stye to Tinkler's Stone

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

Tel: +44 (0)121 456 2345
Fax: +44 (0)121 456 1569
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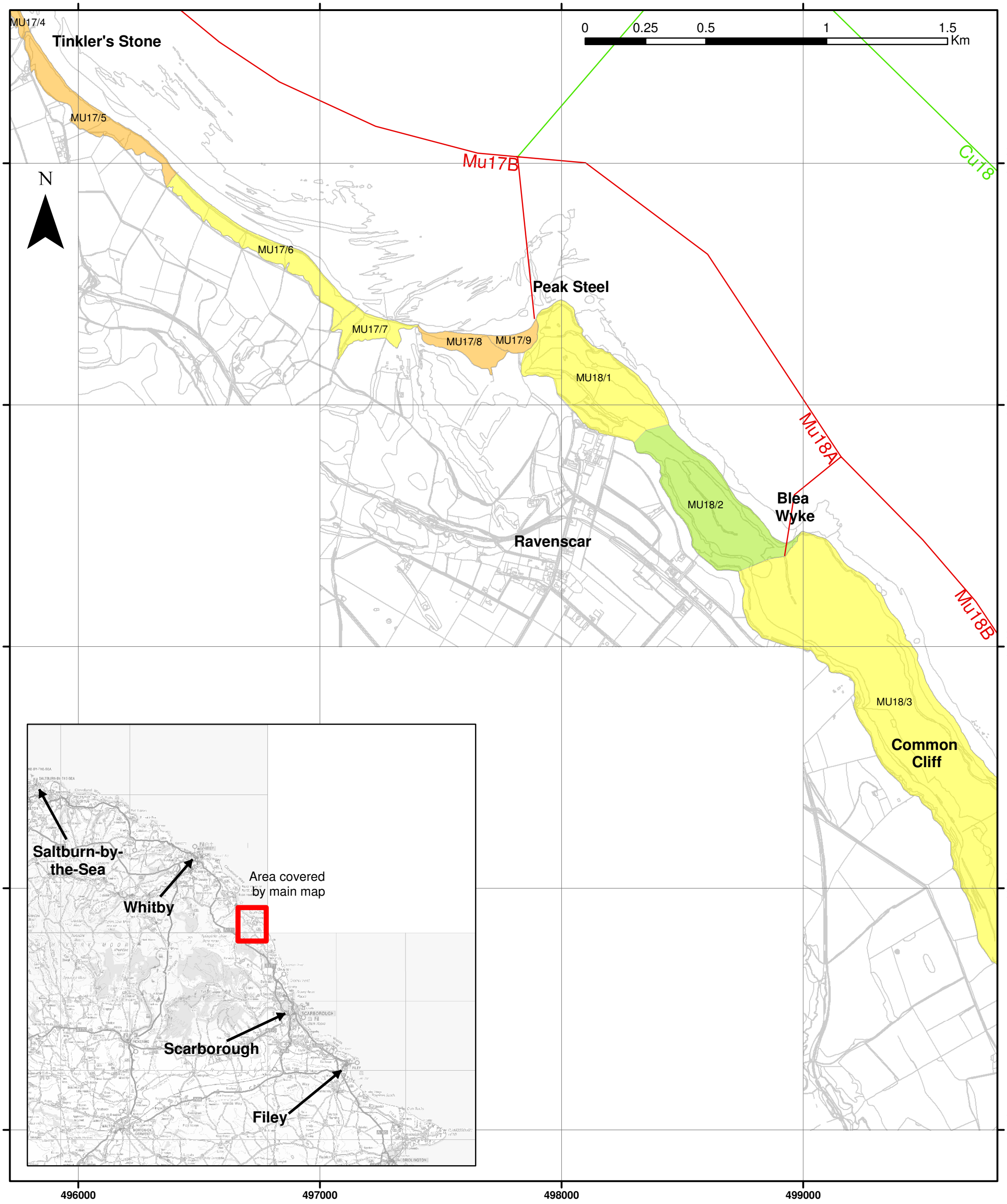

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 6 - Tinkler's Stone to Common Cliff

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Edgbaston
Birmingham
B16 8PE

Tel: +44 (0)121 456 2345
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GIS Filename: SBC Map 6.mxd

N

0 0.25 0.5 1 1.5 Km

Beast Cliff

MU18/3

MU18/4

Mu18B

Cu18

Cu19

MU19/1

Mu19A

Herbert Hole

MU19/2

Hayburn Wyke

Mu19B

MU19/3

MU19/4

Mu19C

MU19/5

Cloughton Wyke

MU19/6

Hundale Point

Saltburn-by-the-Sea

Whitby

Area covered by main map

Scarborough

Filey

499000 500000 501000 502000 503000

496000 497000 498000 499000 495000

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 7 - Beast Cliff to Hundale Point

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
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Lyndon House
62 Hagley Road
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Birmingham
B16 8PE

Tel: +44 (0)121 456 2345
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GIS Filename: SBC Map 7.mxd

N

0 0.25 0.5 1 1.5 Km

The Hundales

MU19/6

MU19/7

MU19/8

MU19/9

MU19/10

MU19/11

Scalby Ness

Scalby Mills MU20/1

MU20/2

Cu19

Mu19E

Mu20A

494000

493000

492000

491000

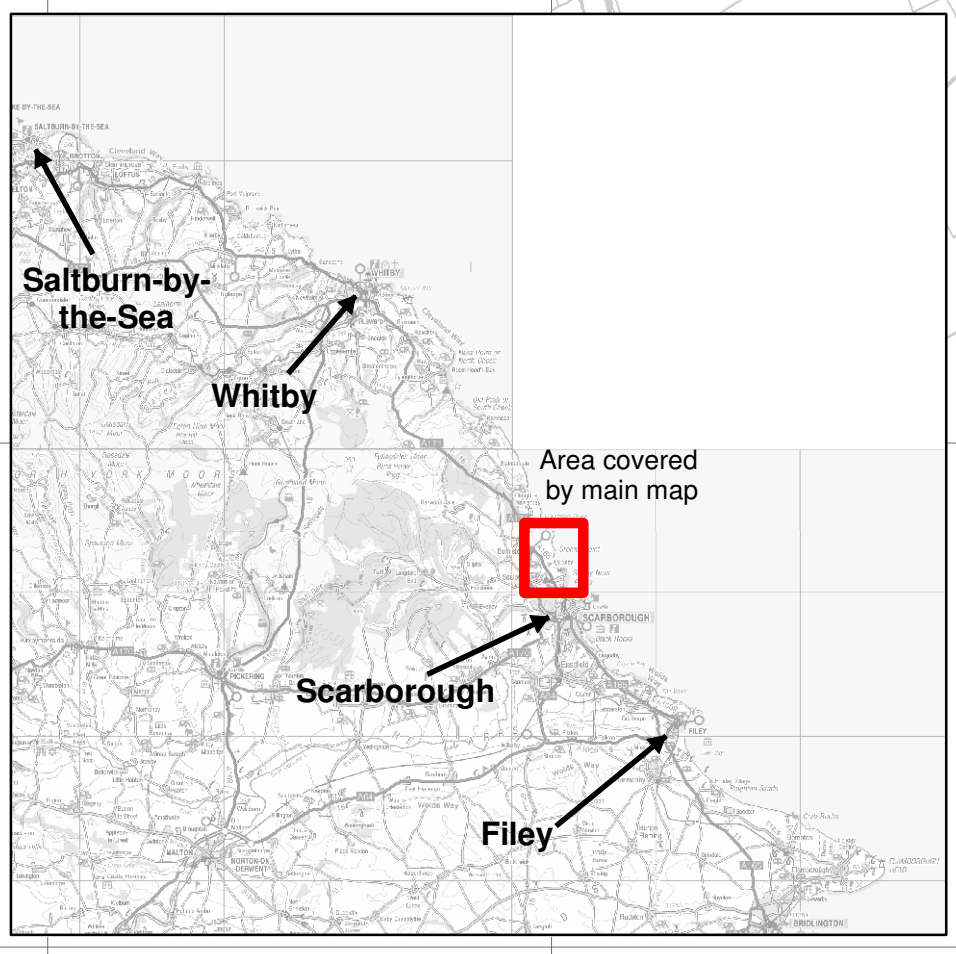
490000

501000

502000

503000

504000



Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 8 - Scarborough North

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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Tel: +44 (0)121 456 2345
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N

MU20/3
Mu20B
Mu21A
MU20/4a
MU21/1
MU21/2
MU20/4b
Scarborough
Mu21B
Mu22A
Cu21
Cu22
Mu22B
MU22/1
MU22/2
South Bay
South Cliff Gardens
MU22/3
MU22/4
MU22/5
MU22/6
MU22/7
Holbeck Gardens
MU22/8
Mu23
0 0.25 0.5 1 1.5 Km
MU23/A
MU23/B
MU23/C
MU23/D1
MU23/D2
MU23/E
MU23/F
MU23/G1
MU23/H1
Cornelian Bay
MU23/G2
MU23/H2a
MU23/H2b
MU23/H
MU23/I1
MU23/H2
MU23/I2
MU23/I3
MU23/I
MU23/I4
MU23/J
Knipe Point
MU24/A8
Mu24/A7
MU24/A
Cayton Bay
MU24/A2
Mu24/B1
Mu24/B
MU24/B2
Saltburn-by-the-Sea
Whitby
Area covered by main map
Scarborough
Filey
504000
505000
506000
507000
489000
488000
487000
486000
485000

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 9 - Scarborough South to Cayton Bay

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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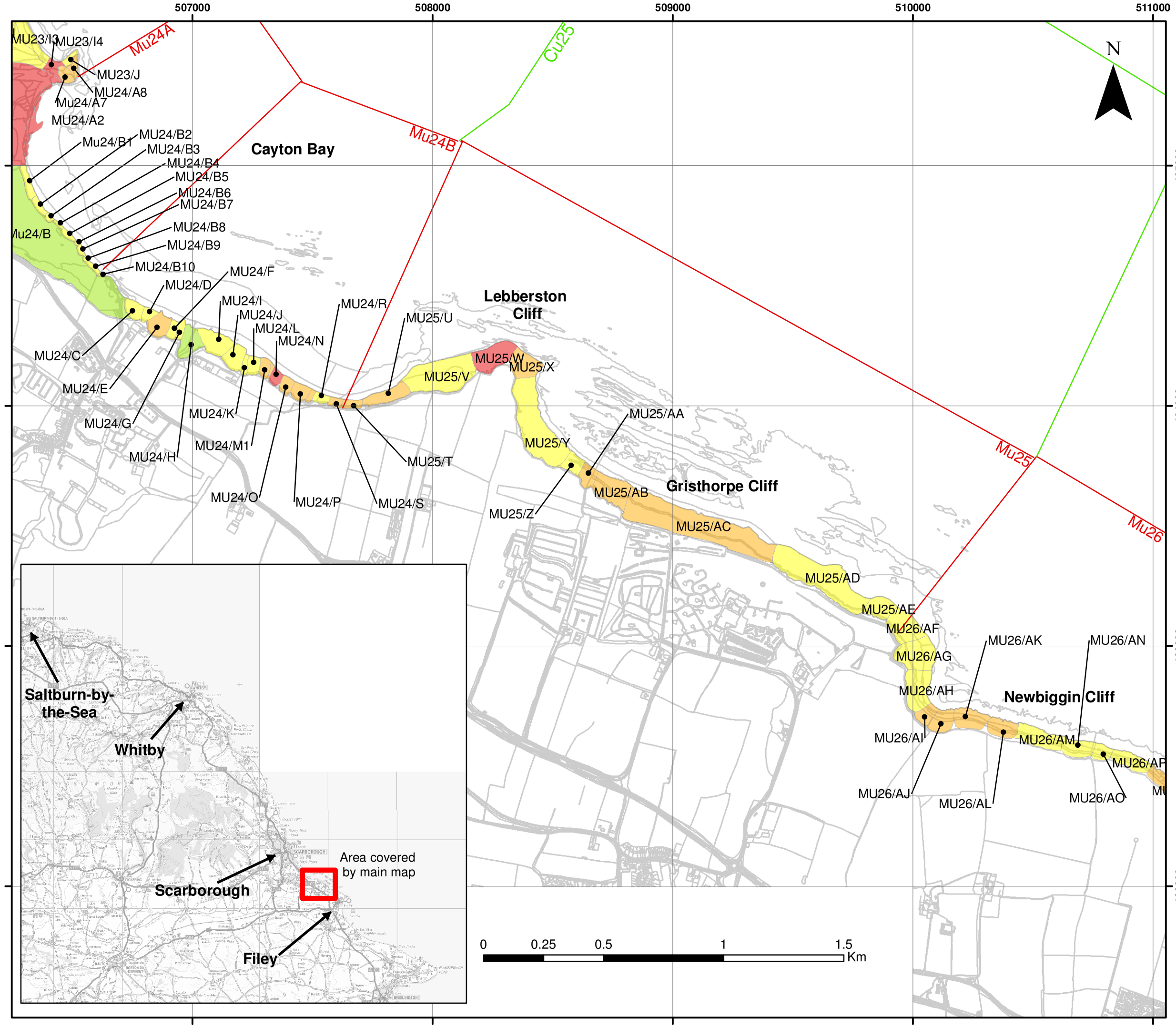

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 10 - Cayton Bay to North Cliff

Coastal Slope Condition 2008

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NE1 4EE

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Birmingham
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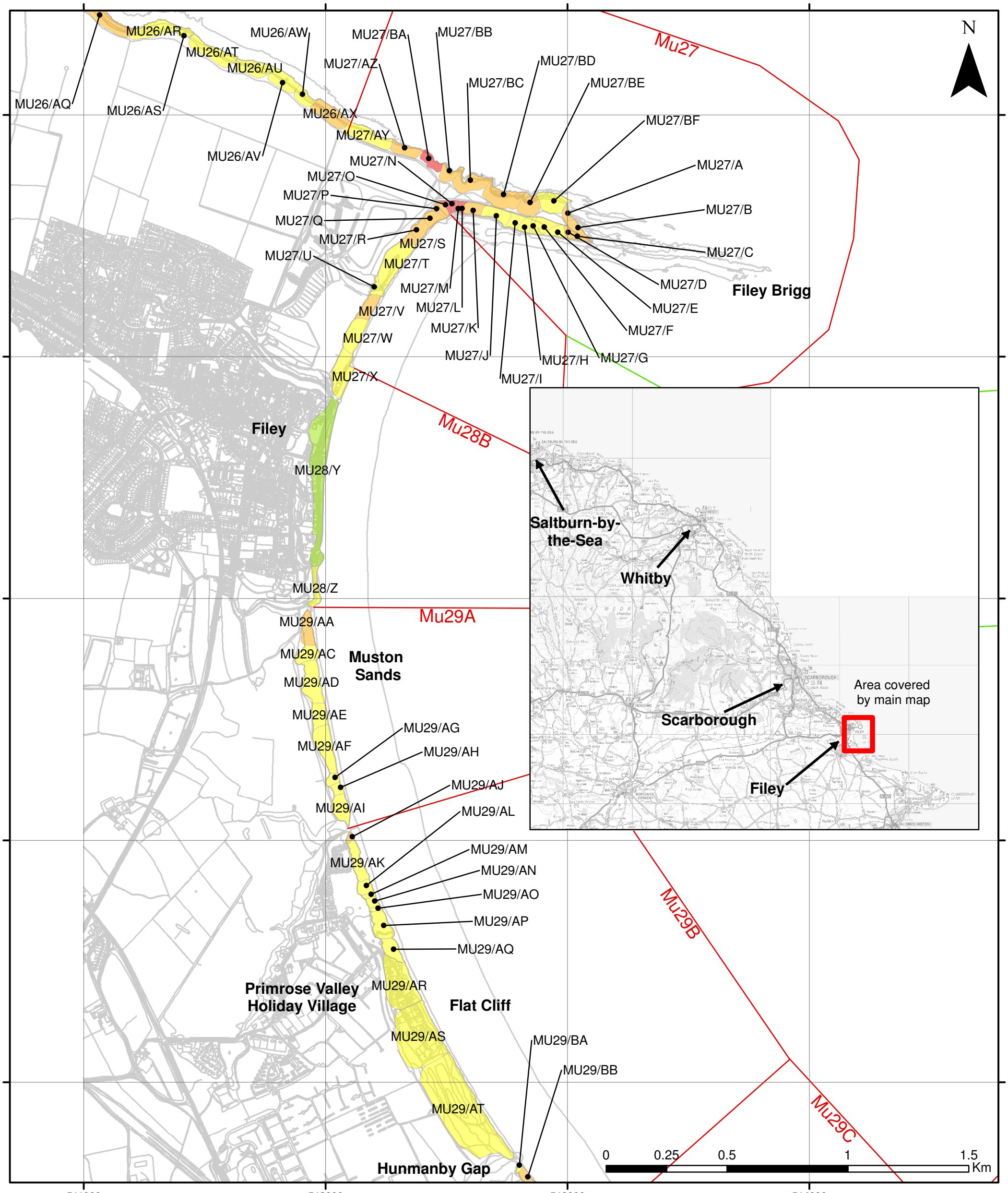

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 11 - Filey Brigg to Reighton

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
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NE1 4EE

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www.royalhaskoning.com

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513000 514000 515000 516000 517000

478000 477000 476000 475000

N

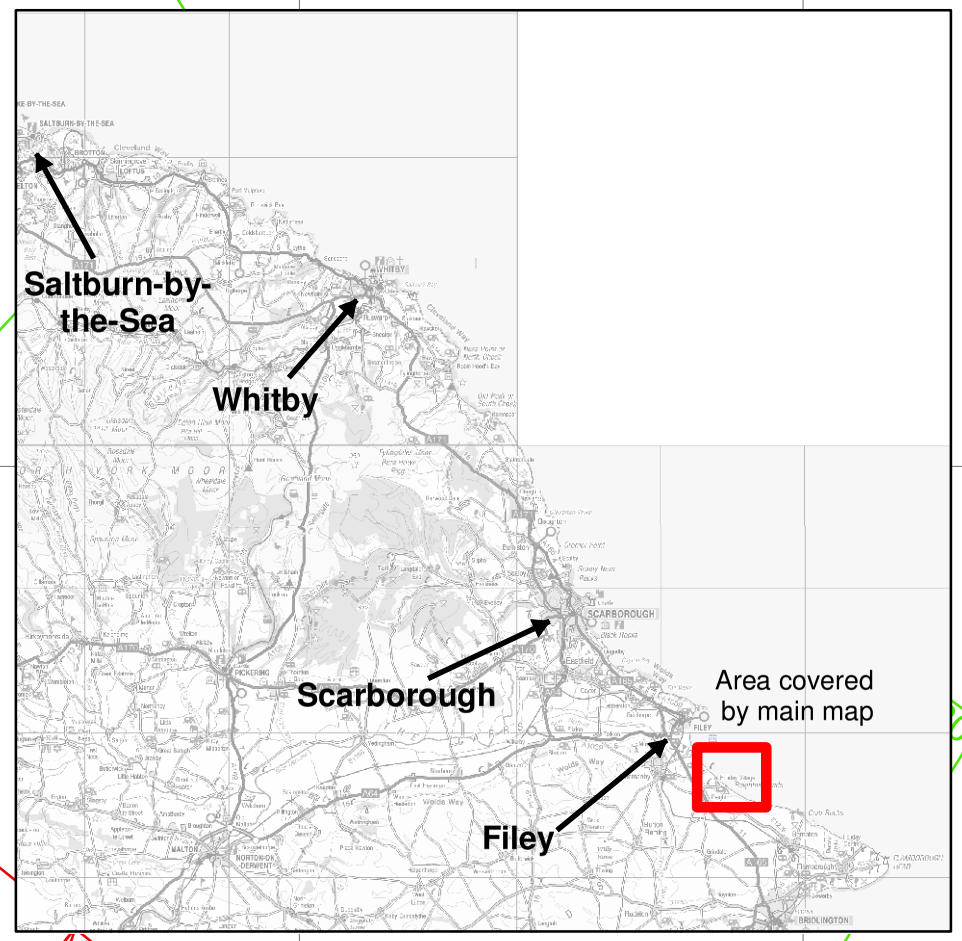
Mu29B Mu29C Mu30A Mu30B

MU29/AT
MU29/BA
MU29/BB
MU29/BC
MU29/BD
MU29/BE
MU29/BF
MU29/BG
MU29/BH
MU29/BI
MU29/BJ
MU29/BK
MU29/BL
MU29/BM
MU29/BN
MU29/BO
MU29/BP
MU29/BQ
MU29/BR
MU29/BS
MU29/CA
MU29/CB
MU29/CCa
MU29/CC
MU29/CD
MU29/CE
MU29/CF
MU29/CG
MU29/CH
MU29/CI
MU29/CJ
E108/2
E108/3
E108/4a

Reighton Sands

Reighton Sands Holiday Village

Speeton Sands



0 0.25 0.5 1 1.5 Km

Legend

Cliff Activity Status 2008

- Dormant
- Inactive
- Locally Active
- Partly Active
- Totally Active

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 12 - Reighton to Speeton

Coastal Slope Condition 2008

Drawing Scale 1:15,000 at A3

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
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GIS Filename: SBC Map 12.mxd

N

0 0.25 0.5 1 1.5 Km

Cu4 Cu5 Cu6 Cu7

Mu4 Mu5 Mu6A Mu6B Mu6C Mu7A Mu7B

E60/1a
E60/1b
MU4/1a
MU4/1b
MU4/2
MU4/3
MU5/1
MU6/1
MU6/2
MU6/3
MU6/4
MU6/5
MU6/6
MU6/7
MU6/8
MU7/1
MU7/2
MU7/3
MU7/4
MU8/1

Staithes
Port Mulgrave
Runswick Bay

Area covered by main map
Saltburn-by-the-Sea
Whitby
Scarborough
Filey

520000
519000
518000
517000
516000

479000 480000 481000 482000

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 13 - Staithes to Runswick Bay

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

Halcrow

Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

Tel: +44 (0)121 456 2345
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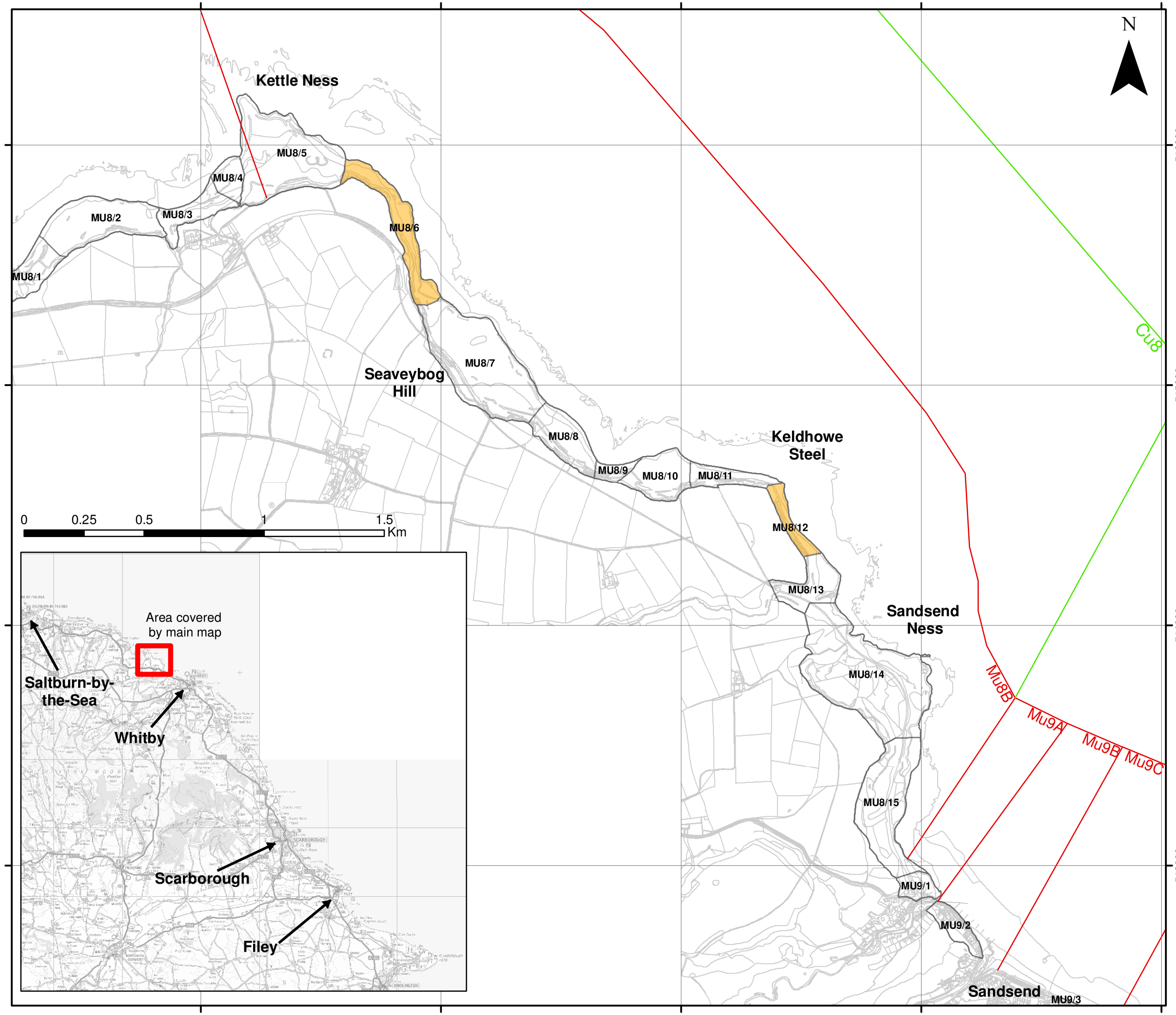

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 14 - Runswick Bay to Sandsend

Coastal Slope Condition
Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Lyndon House
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GIS Filename: SBC Map 14 CHANGE.mxd

487000 488000 489000 490000 491000

513000 512000 511000 510000

N

Cu9 Cu10 Cu11 Cu12 Cu13

Mu9A Mu9B Mu9C Mu10 Mu11A Mu11B Mu12 Mu13A

Sandsend

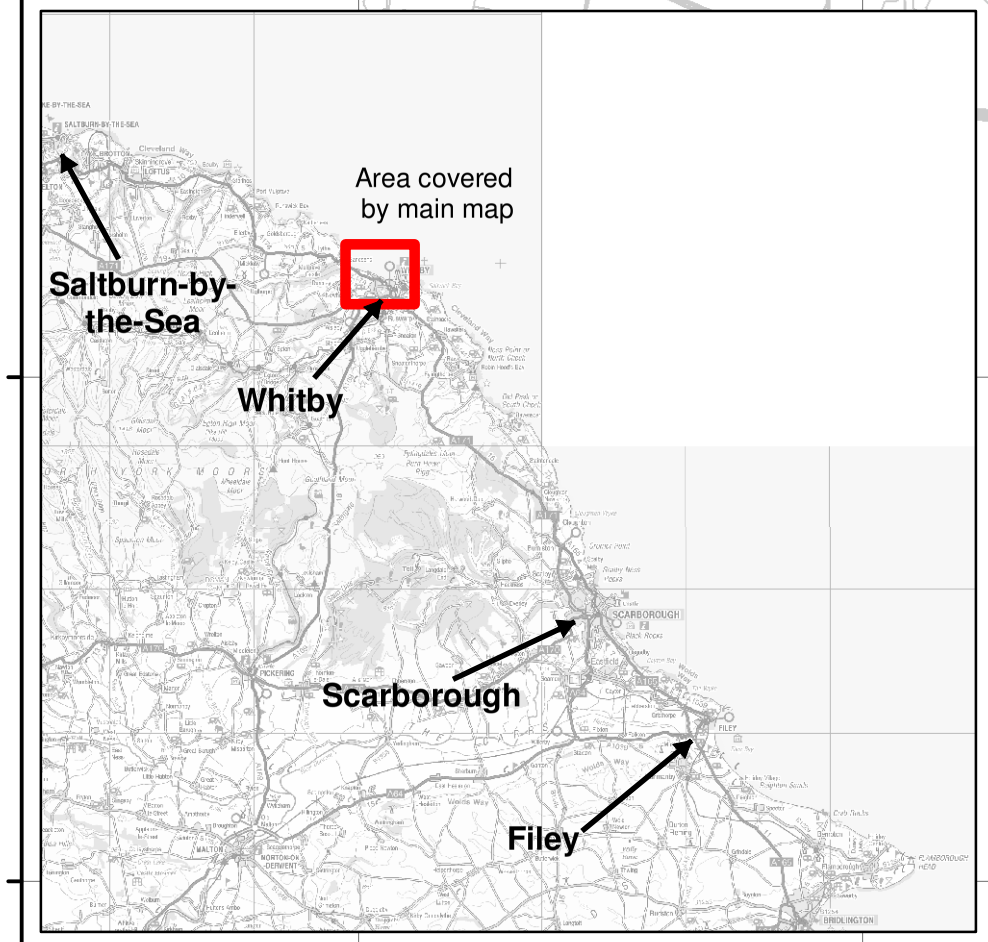
MU9/3 MU9/4 MU10/1 MU10/2

Upgang Beach

MU11/1 MU11/2 MU11/3 MU11/4

MU12/1 MU12/2 MU13/1

Whitby



0 0.25 0.5 1 1.5 Km

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 15 - Sandsend to Whitby East

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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Fax: +44 (0)191 211 1313
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N

0 0.25 0.5 1 1.5 Km

Saltwick Nab

MU13/1

MU13/2

MU13/3

MU13/4

MU13/5

MU13/6

Cu13

Cu14

Mu13B

Widdy Head

MU14/1

Mu14

Mu15

Pursglove Stye

MU15/1

MU15/2

511000

510000

509000

508000

507000

491000

492000

493000

494000

495000

Area covered by main map

Saltburn-by-the-Sea

Whitby

Scarborough

Filey

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 16 - Whitby East to Pursglove Stye

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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N

0 0.25 0.5 1 1.5 Km

MU14/1

Pursglove Stye

MU15/1

Far Jetticks

MU15/2

MU15/3

MU15/4

Robin Hood's Bay

MU16/1

MU16/2

MU16/3

MU17/1

MU17/2

MU17/3

MU17/4

MU17/5

Mu15

Mu16A

Mu16B

Mu16C

Mu17A

Boggle Hole

Tinkler's Stone

Saltburn-by-the-Sea

Whitby

Scarborough

Filey

Area covered by main map

508000

507000

506000

505000

504000

494000

495000

496000

497000

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 17 - Pursglove Stye to Tinkler's Stone

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
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Edgbaston
Birmingham
B16 8PE

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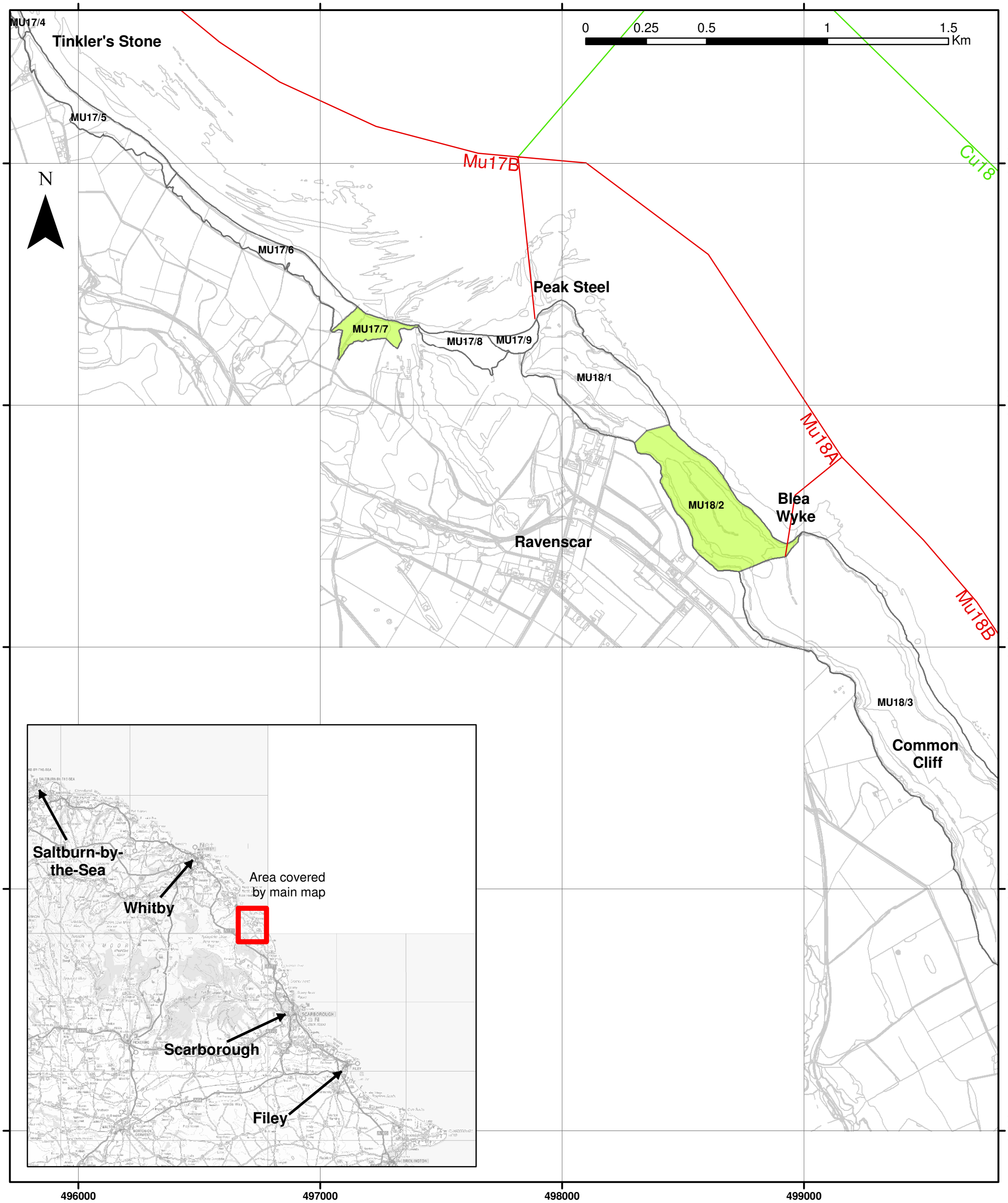

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 18 - Tinkler's Stone to Common Cliff

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough Crescent
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Birmingham
B16 8PE

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N

0 0.25 0.5 1 1.5 Km

Beast Cliff

MU18/3

MU18/4

Mu18B

Cu18

Cu19

MU19/1

Mu19A

Herbert Hole

MU19/2

Hayburn Wyke

Mu19B

MU19/3

MU19/4

Mu19C

MU19/5

Cloughton Wyke

MU19/6

Hundale Point

499000 500000 501000 502000 503000

497000 496000 495000

Saltburn-by-the-Sea

Whitby

Scarborough

Filey

Area covered by main map

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 19 - Beast Cliff to Hundale Point

Coastal Slope Condition Change Analysis 2005 to 2008

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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Fax: +44 (0)191 211 1313
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Lyndon House
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Birmingham
B16 8PE

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GIS Filename: SBC Map 19 CHANGE.mxd

N

0 0.25 0.5 1 1.5 Km

The Hundales

MU19/6

MU19/7

MU19/8

MU19/9

MU19/10

MU19/11

Scalby Ness

Scalby Mills MU20/1

MU20/2

Mu19E

Cu19

Mu20A

494000

493000

492000

491000

490000

501000

502000

503000

504000

Saltburn-by-the-Sea

Whitby

Scarborough

Filey

Area covered by main map

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 20 - Scarborough North

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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N

MU20/3
MU20/4a
MU20/4b
Mu20B
MU21/1
MU21/2
Mu21A
Scarborough
Mu21B
Mu22A
Cu21
Cu22
Mu22B
MU22/1
MU22/2
South Bay
South Cliff Gardens
MU22/3
MU22/4
MU22/5
MU22/6
MU22/7
Holbeck Gardens
MU22/8
Mu23
MU23/A
MU23/B
MU23/C
MU23/D1
MU23/D2
MU23/E
MU23/F
MU23/G1
MU23/G2
MU23/H1
MU23/H2a
MU23/H2b
MU23/H
MU23/H2
MU23/I1
MU23/I2
MU23/I3
MU23/I
MU23/I4
MU23/J
Knipe Point
MU24/A8
Mu24/A7
MU24/A
Cayton Bay
MU24/A2
Mu24/B1
Mu24/B
MU24/B2
Cornelian Bay

0 0.25 0.5 1 1.5 Km

489000
488000
487000
486000
485000

504000 505000 506000 507000

Saltburn-by-the-Sea
Whitby
Area covered by main map
Scarborough
Filey

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 21 - Scarborough South to Cayton Bay

Coastal Slope Condition Change Analysis 2005 to 2008

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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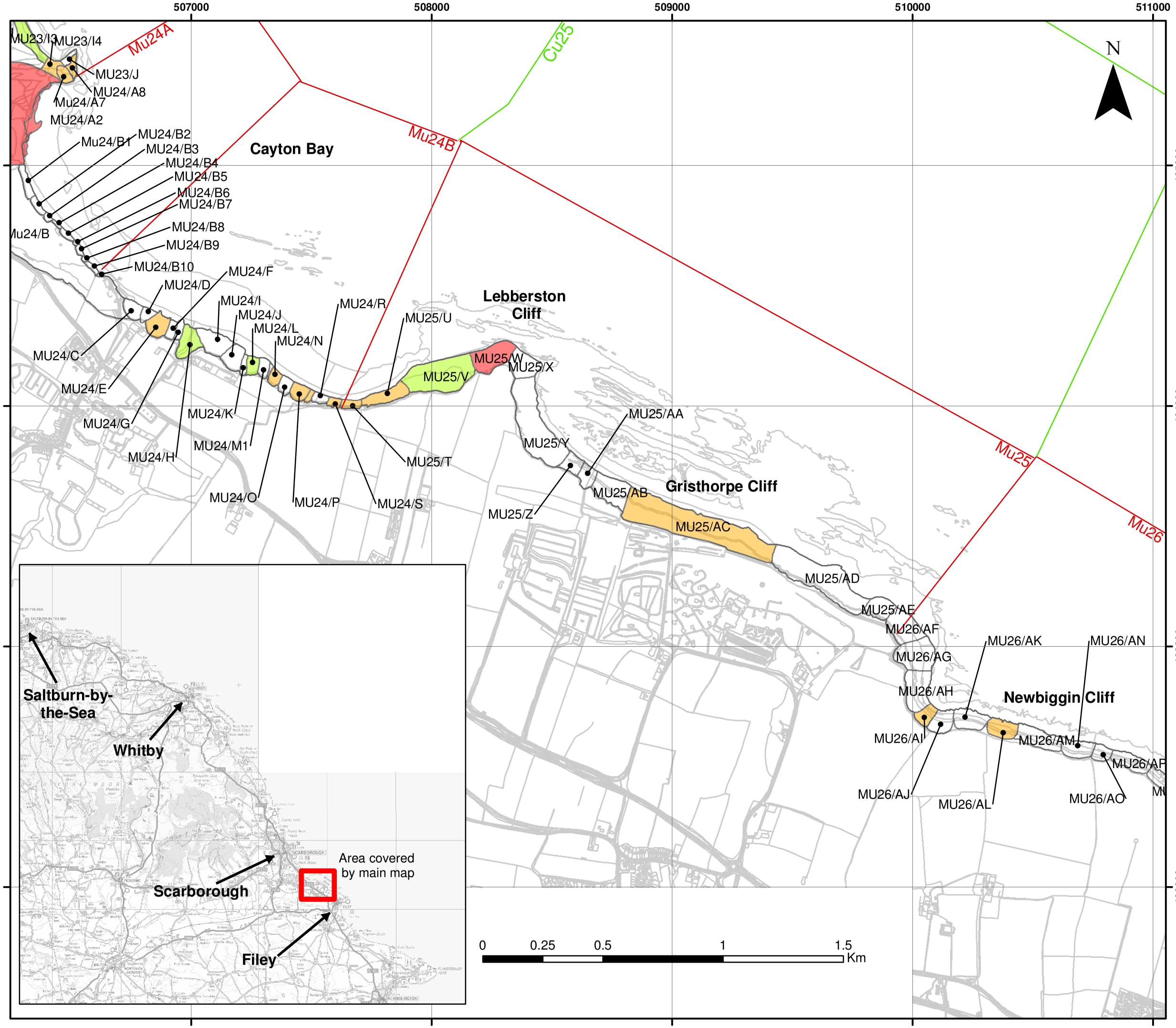

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 22 - Cayton Bay to North Cliff

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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Fax: +44 (0)191 211 1313
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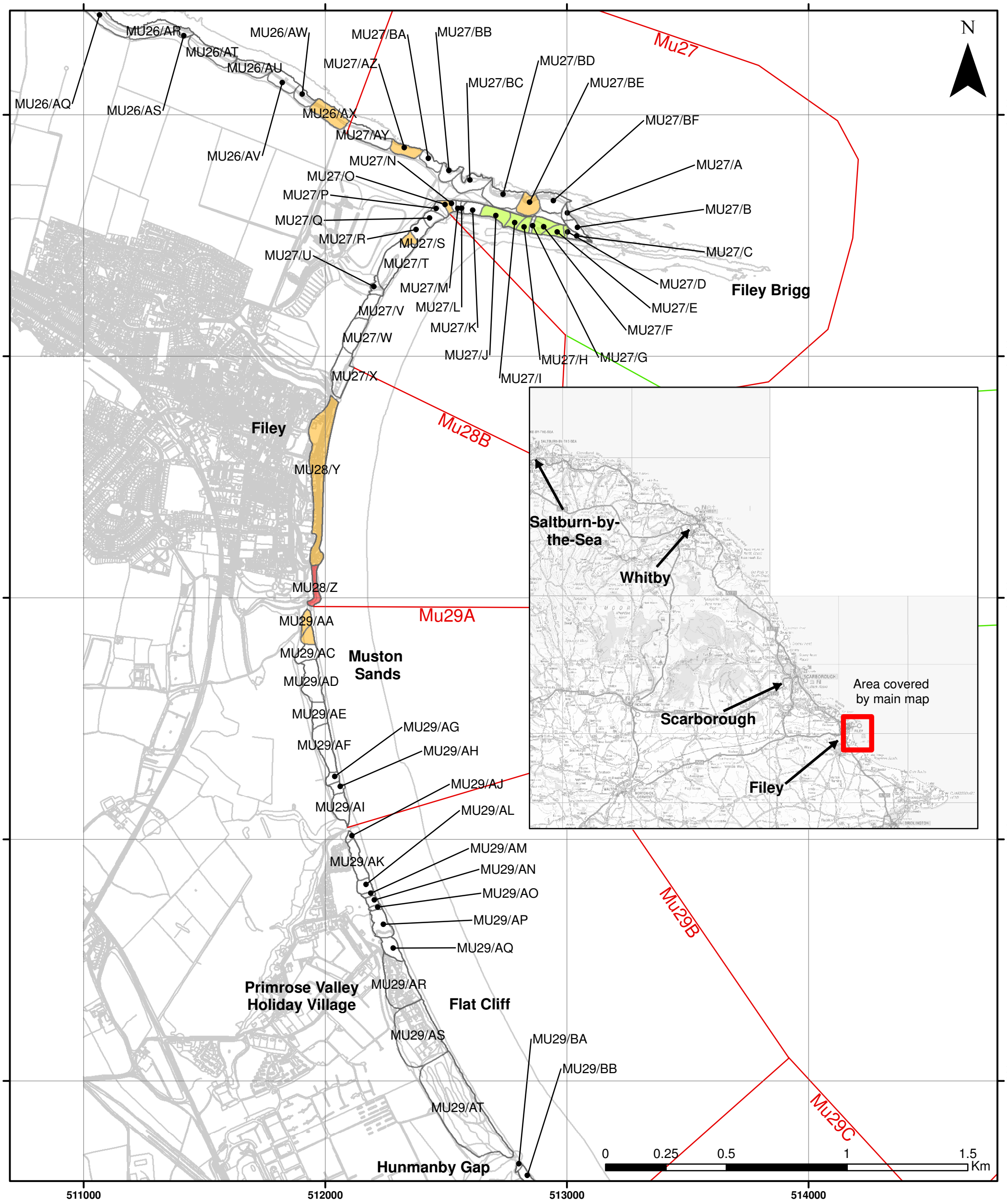

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 23 - Filey Brigg to Reighton

Coastal Slope Condition Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough Crescent
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NE1 4EE

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513000 514000 515000 516000 517000

478000 477000 476000 475000

N

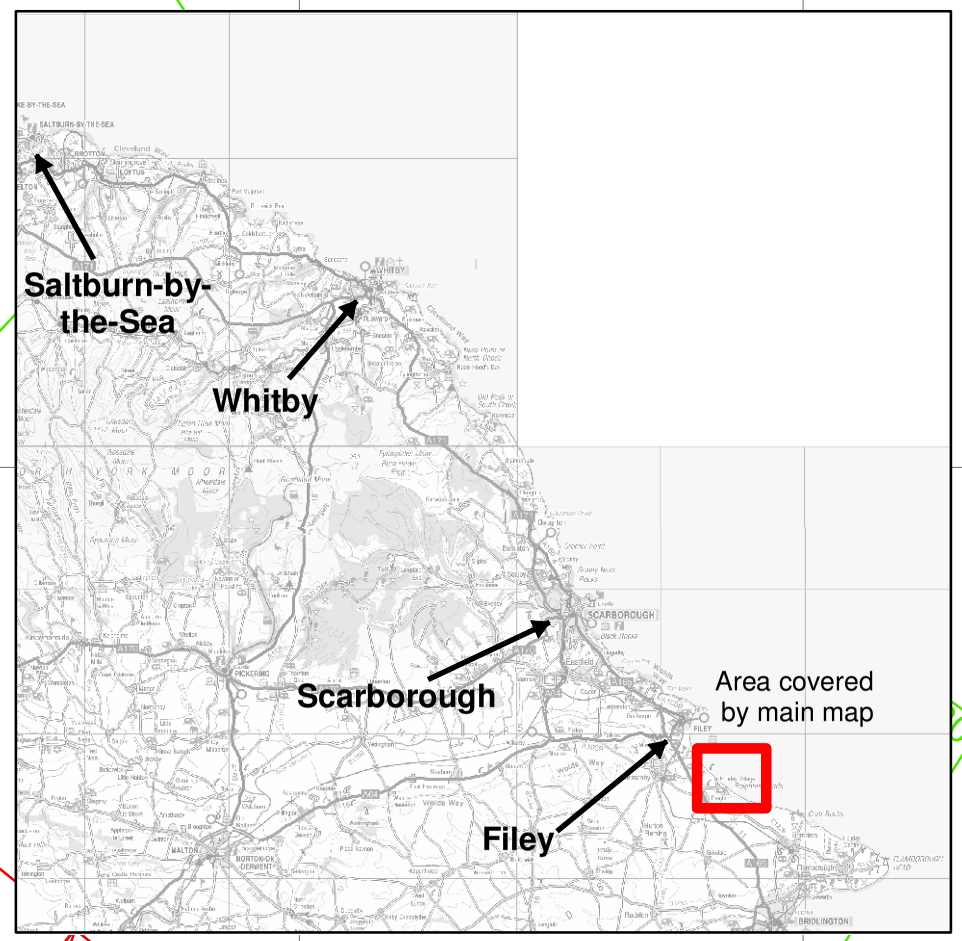
Mu29B Mu29C Mu30A Mu30B

MU29/AT MU29/BA MU29/BB MU29/BC MU29/BD MU29/BE MU29/BF MU29/BG MU29/BH MU29/BI MU29/BJ MU29/BK MU29/BL MU29/BM MU29/BN MU29/BO MU29/BP MU29/BQ MU29/BR MU29/BS MU29/CA MU29/CB MU29/CCa MU29/CC MU29/CD MU29/CE MU29/CF MU29/CG MU29/CH MU29/CI MU29/CJ E108/2 E108/3 E108/4a

Reighton Sands

Reighton Sands Holiday Village

Speeton Sands



0 0.25 0.5 1 1.5 Km

Legend

Change in Cliff Activity 2005-2008

- Major increase in activity
- Minor increase in activity
- No change
- Minor decrease in activity
- Major decrease in activity

Unit Divisions

- Management Unit
- Sub-Management Unit

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 24 - Reighton to Speeton

Coastal Slope Condition
Change Analysis 2005 to 2008

Drawing Scale 1:15,000 at A3

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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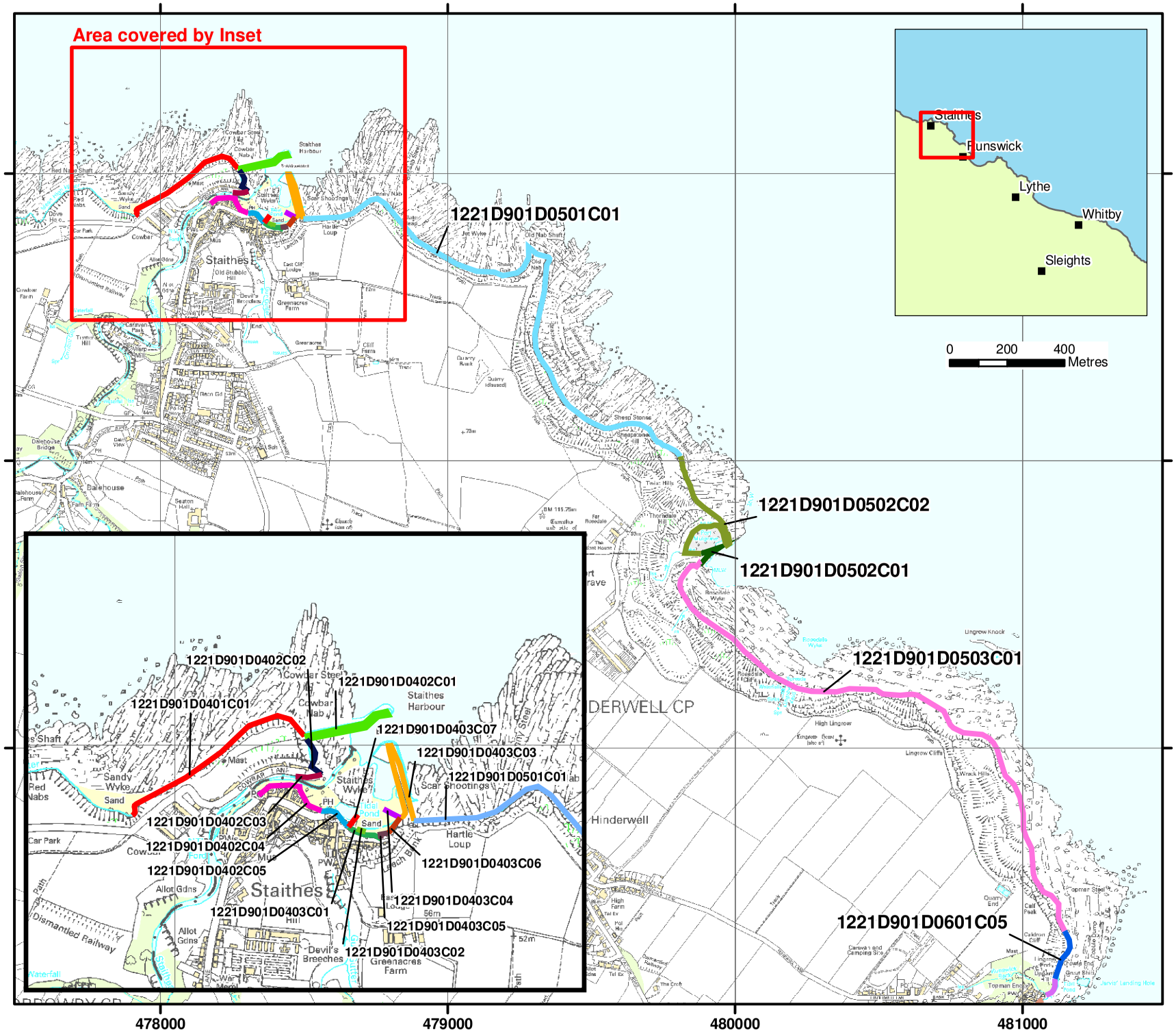

Asset location

NFCDD Asset Number

A great place to live, work & play

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 1 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:18,000 at A4

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
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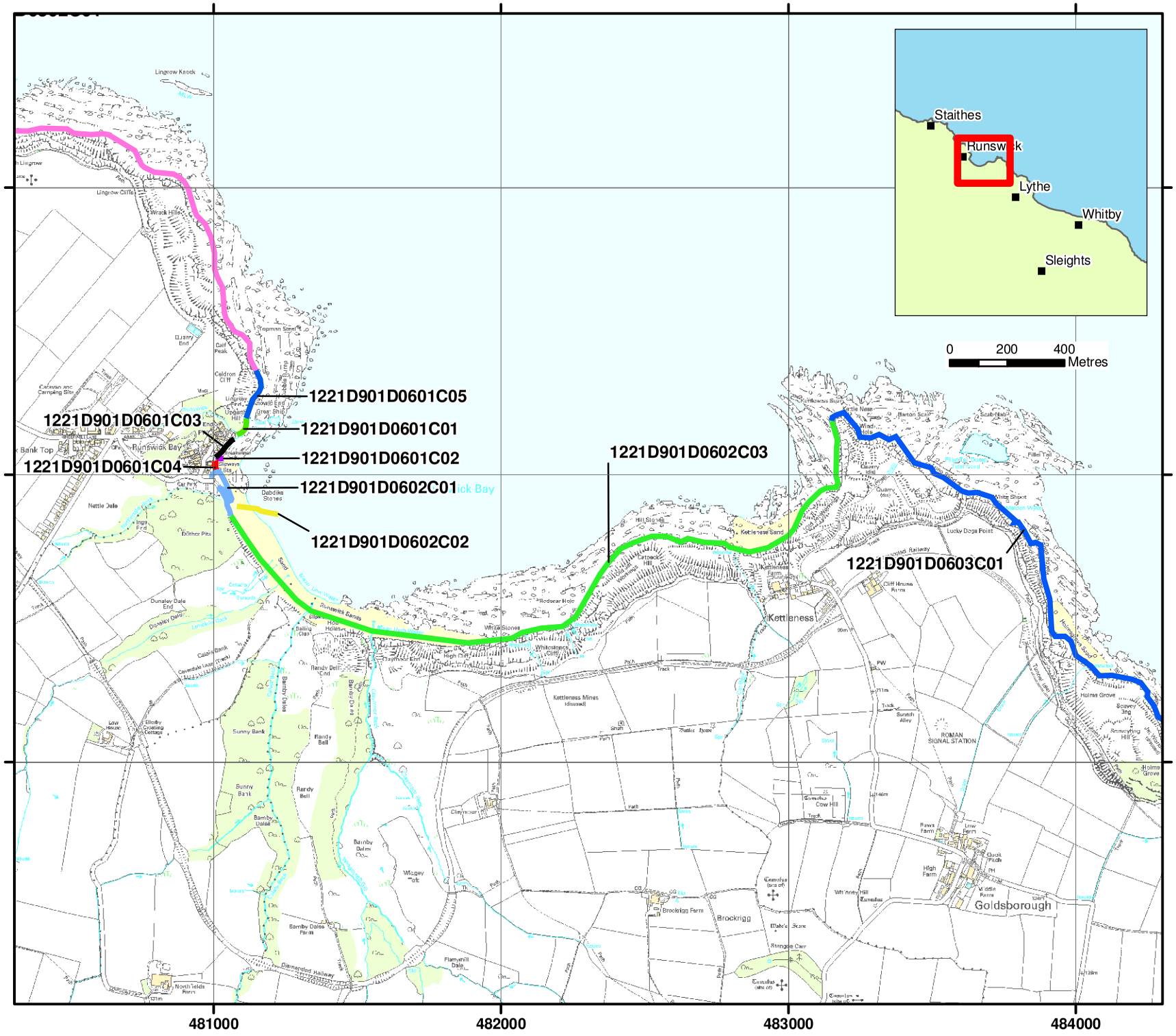

Asset location

NFCDD Asset Number

A great place to live, work & play

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 2 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:18,000 at A4

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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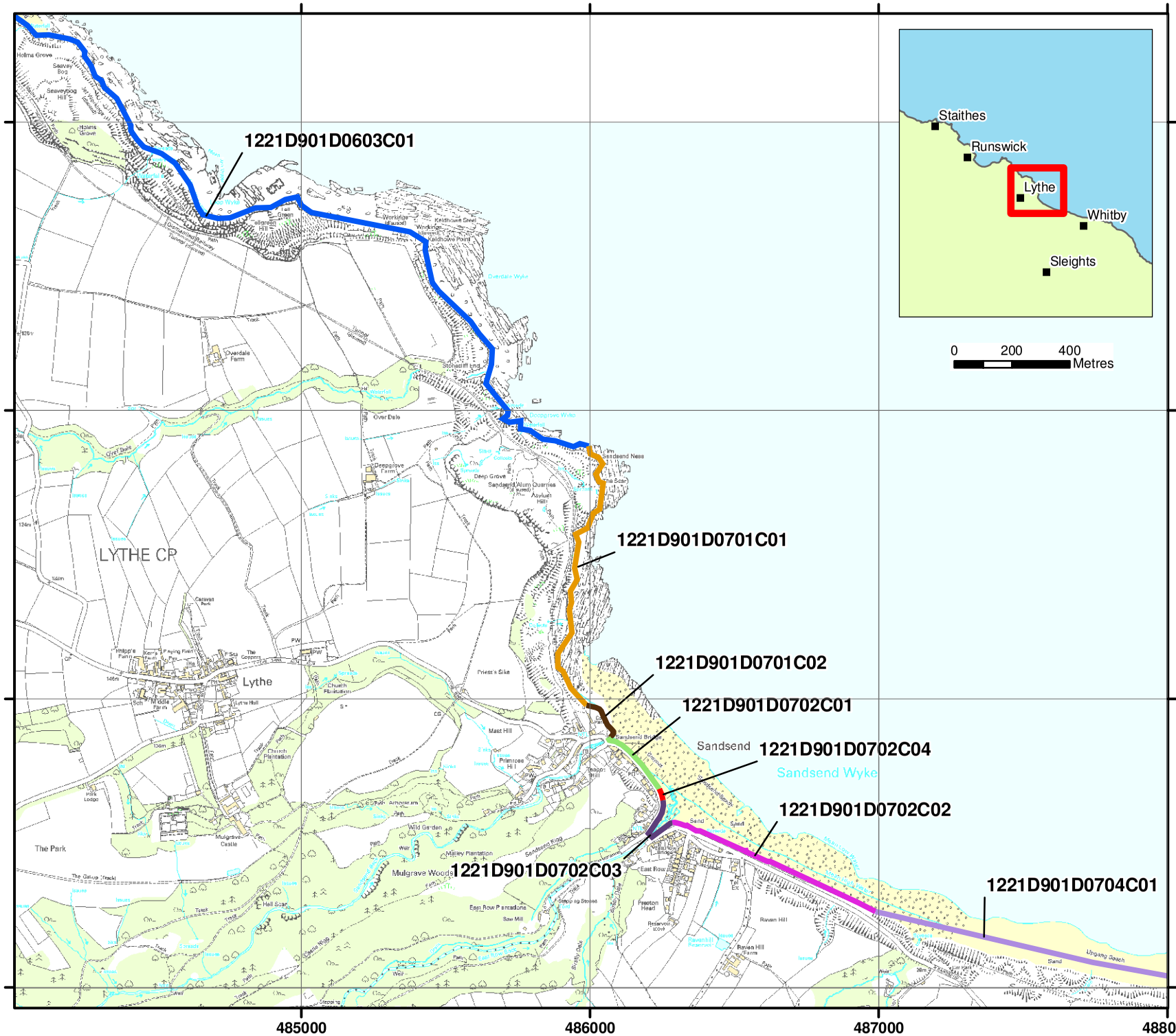

Asset location

NFCDD Asset Number

A great place to live, work & play

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 3 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:18,000 at A4

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

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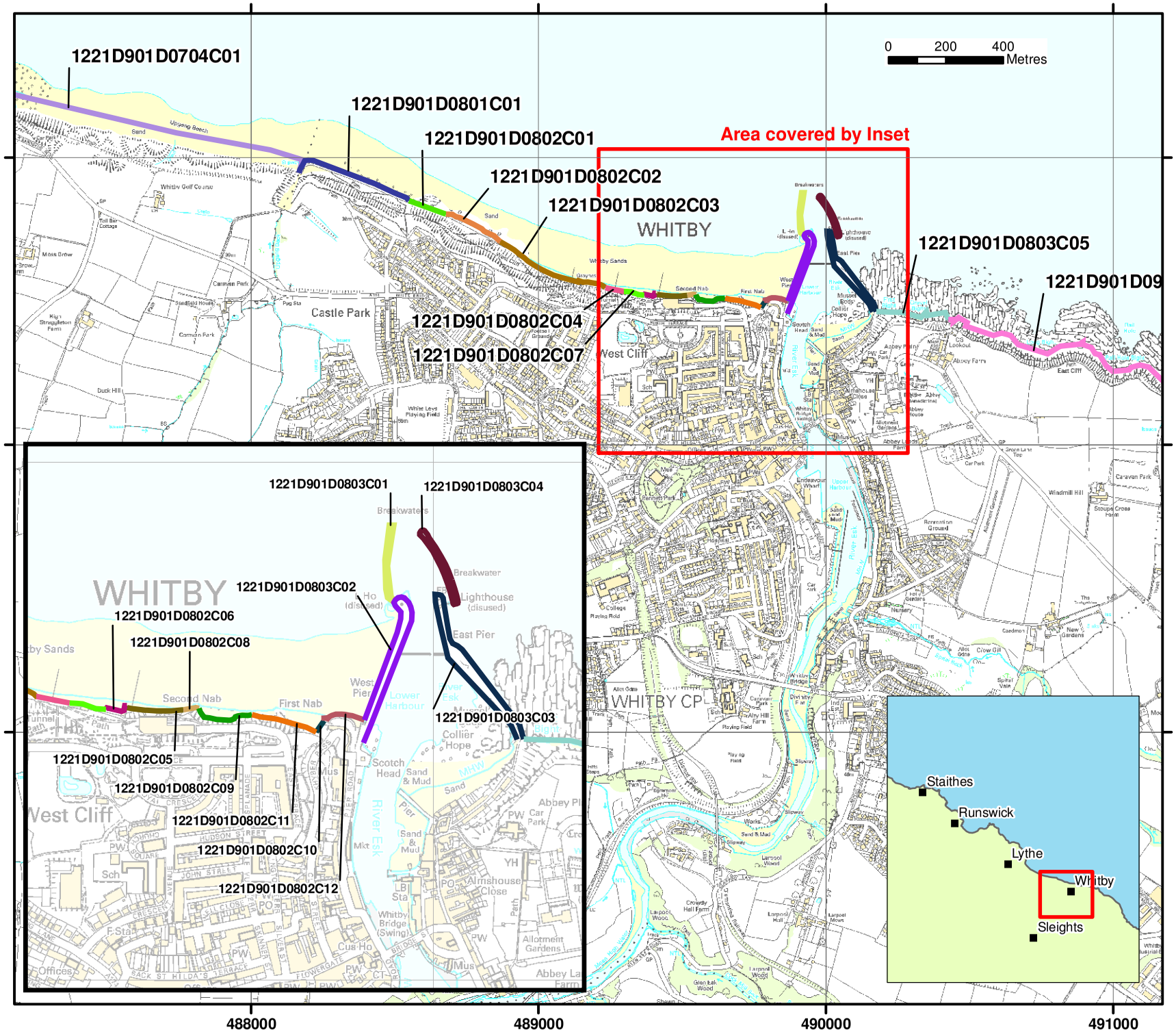

Asset location

NFCDD Asset Number

A great place to live, work & play

Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 4 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:18,000 at A4

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

Halcrow

Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

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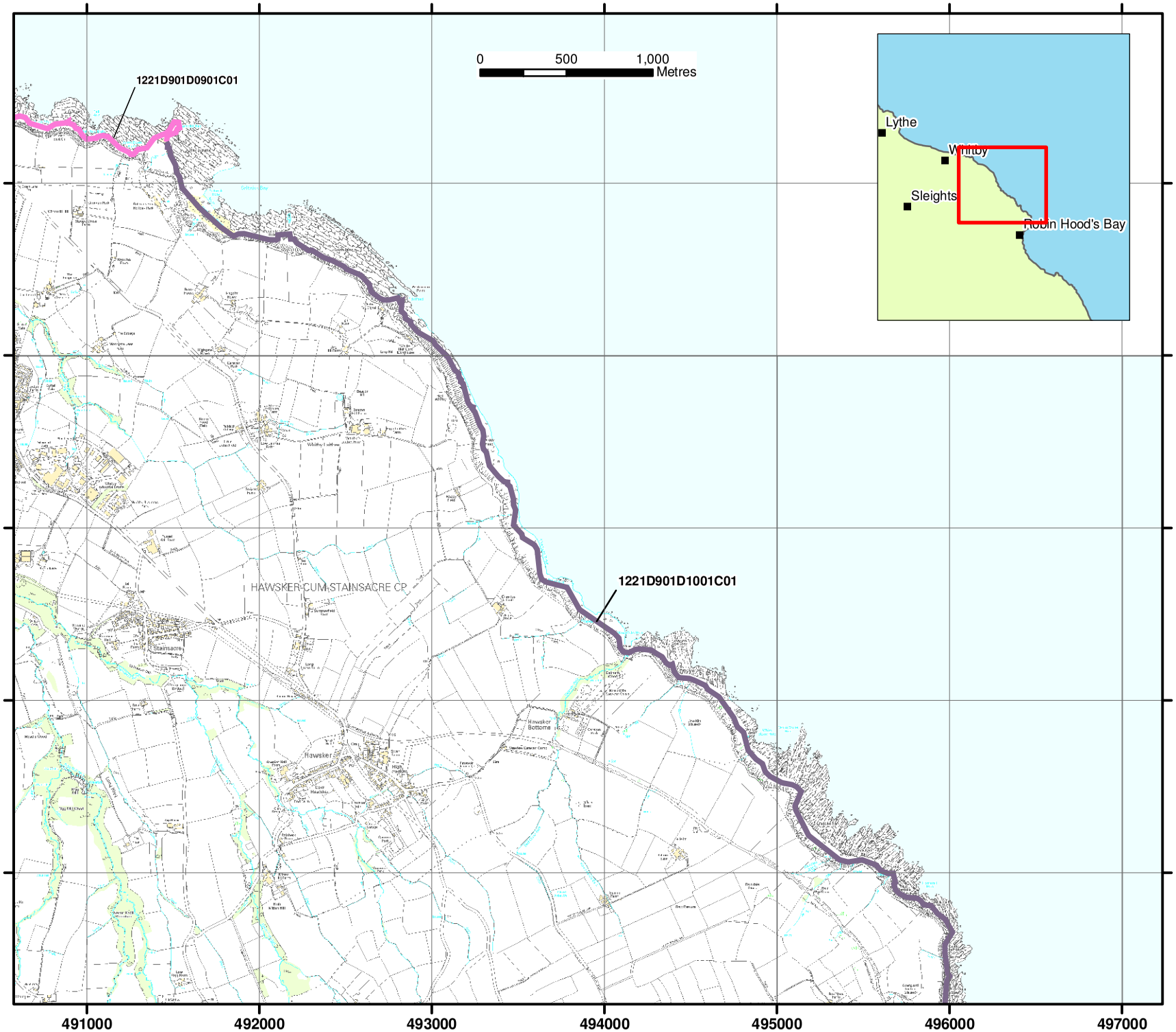

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 5 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:30,000 at A4

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ROYAL HASKONING

Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

Halcrow

Halcrow Group Ltd
Lyndon House
62 Hagley Road
Edgbaston
Birmingham
B16 8PE

Tel: +44 (0)121 456 2345
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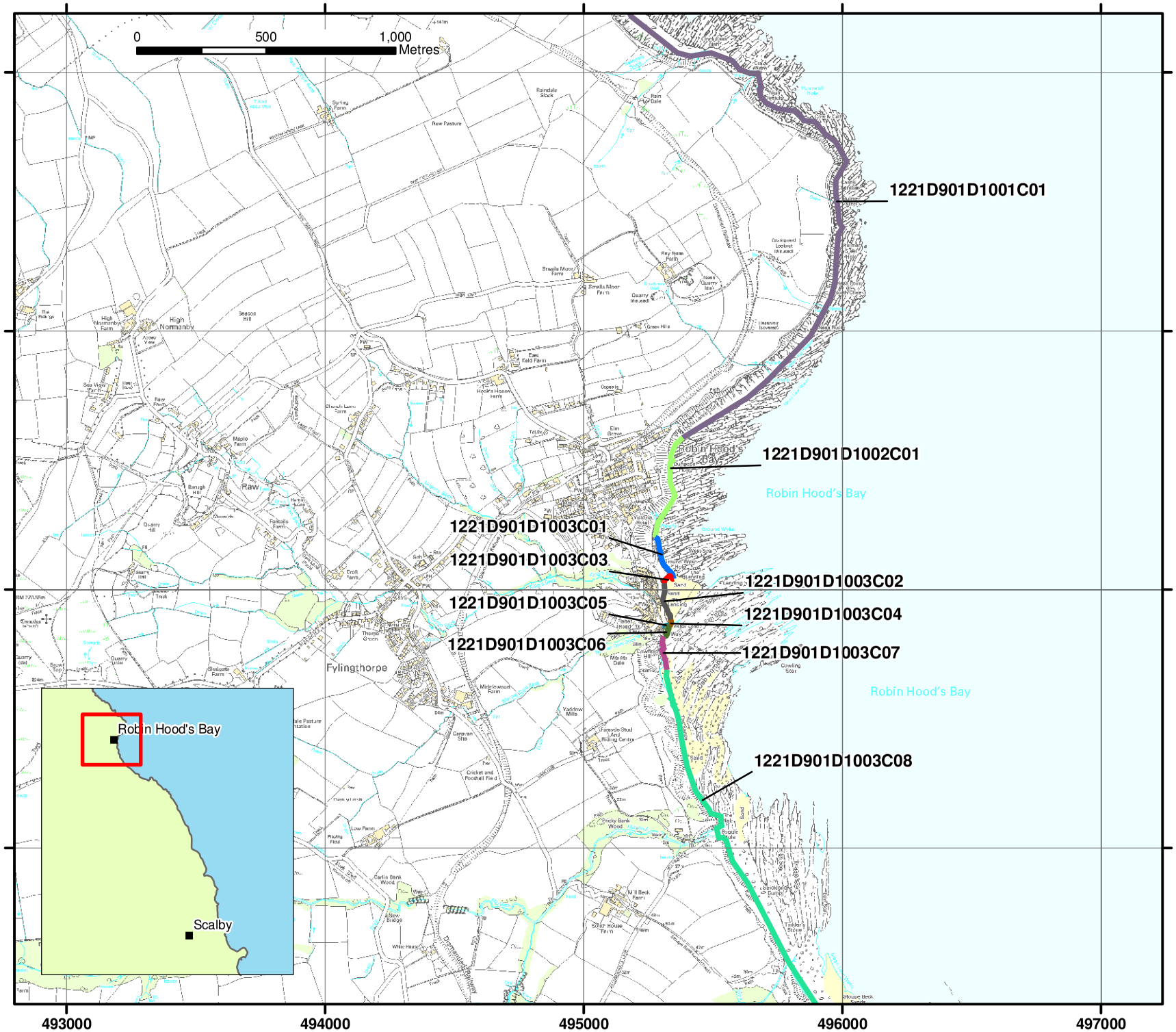

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 6 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Lyndon House
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Edgbaston
Birmingham
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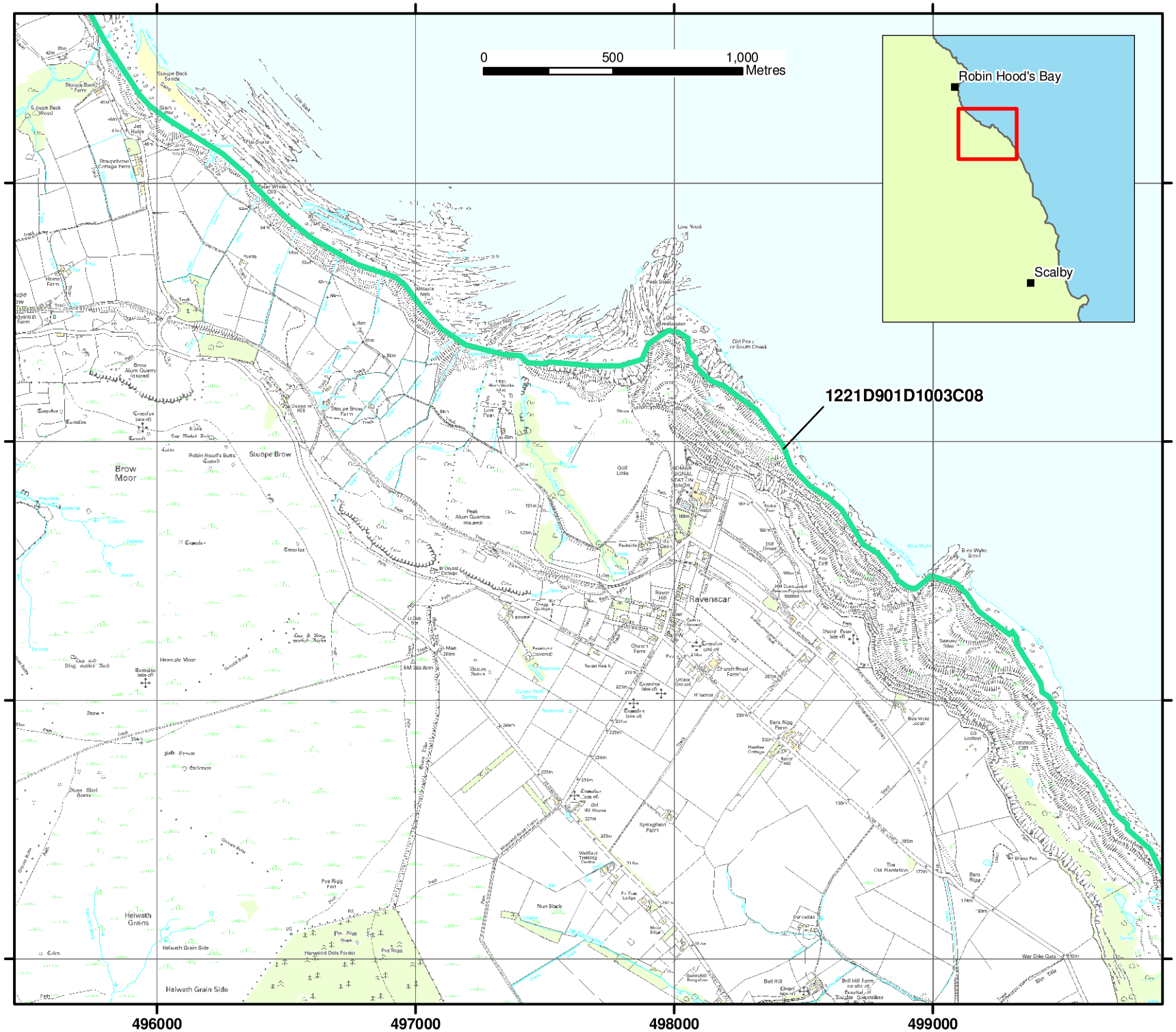

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 7 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Lyndon House
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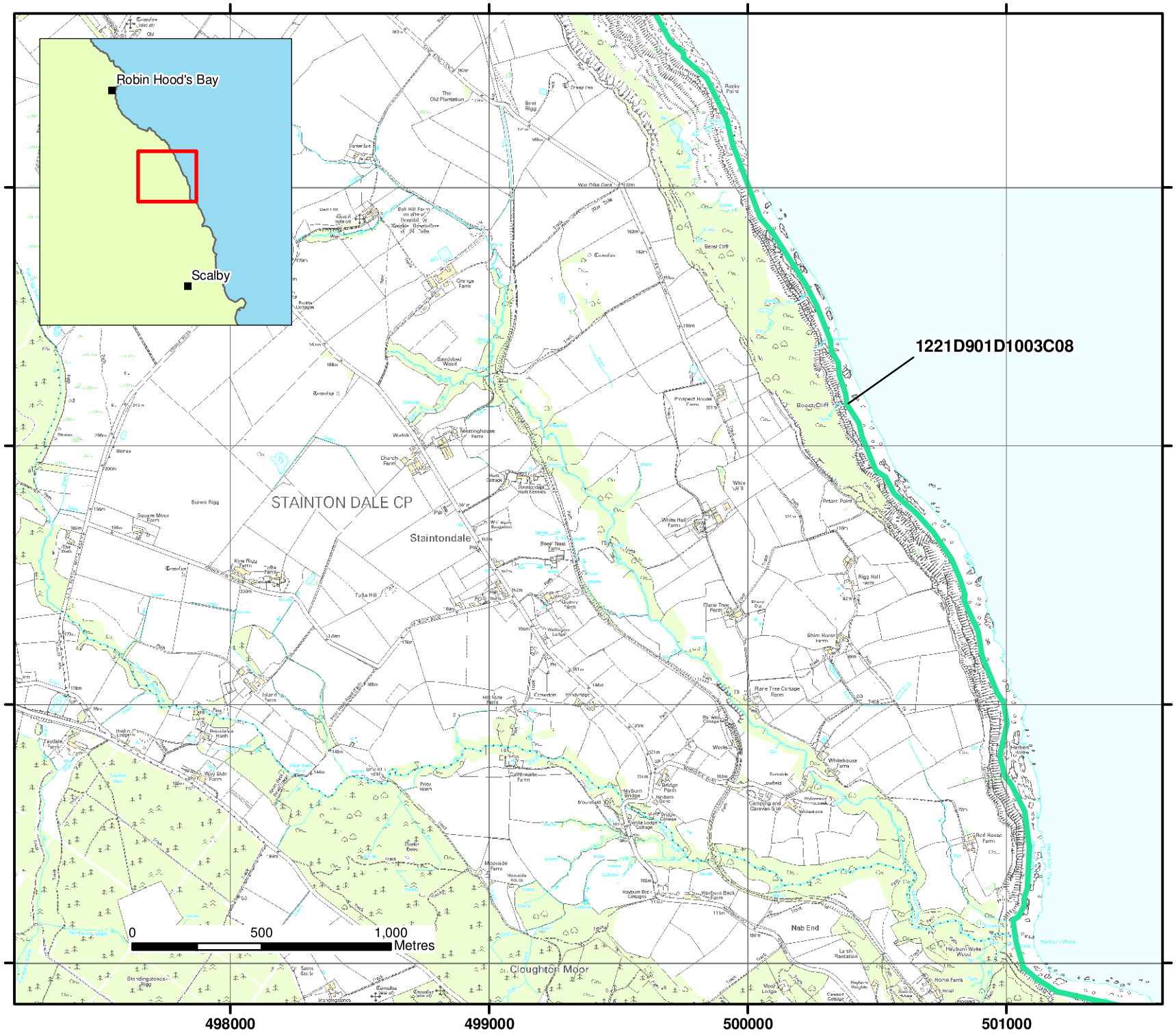

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 8 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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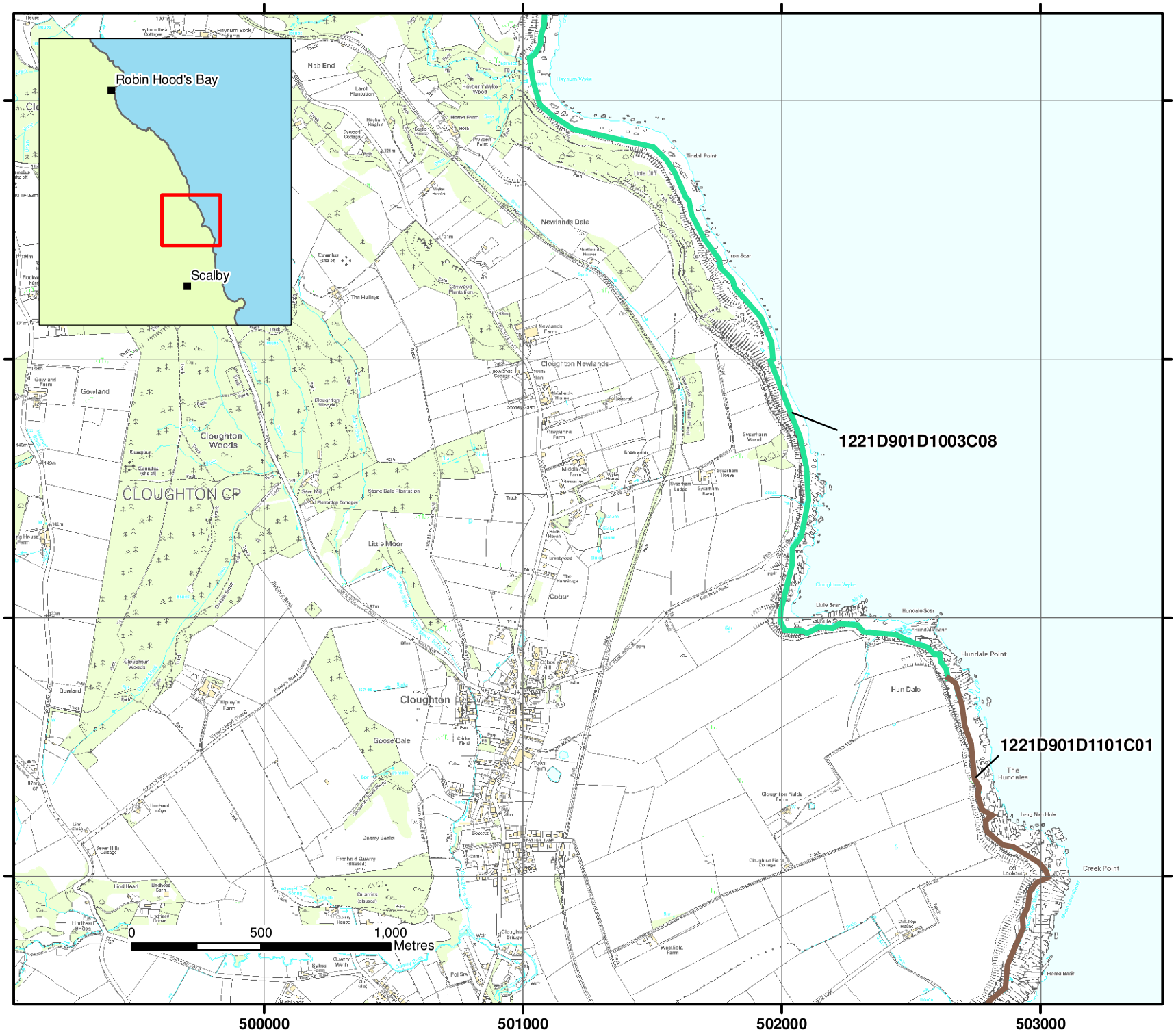

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 9 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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Birmingham
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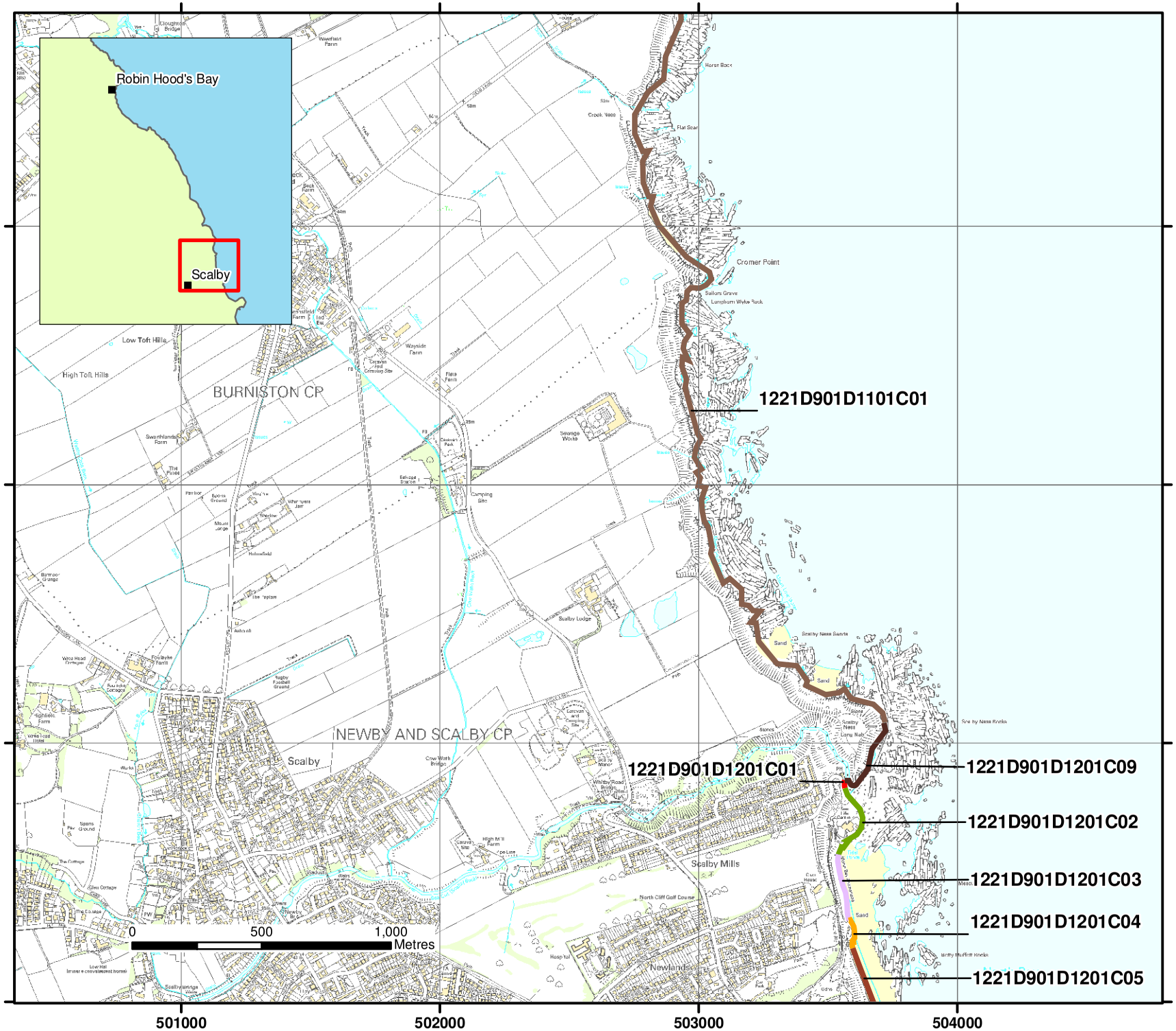

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 10 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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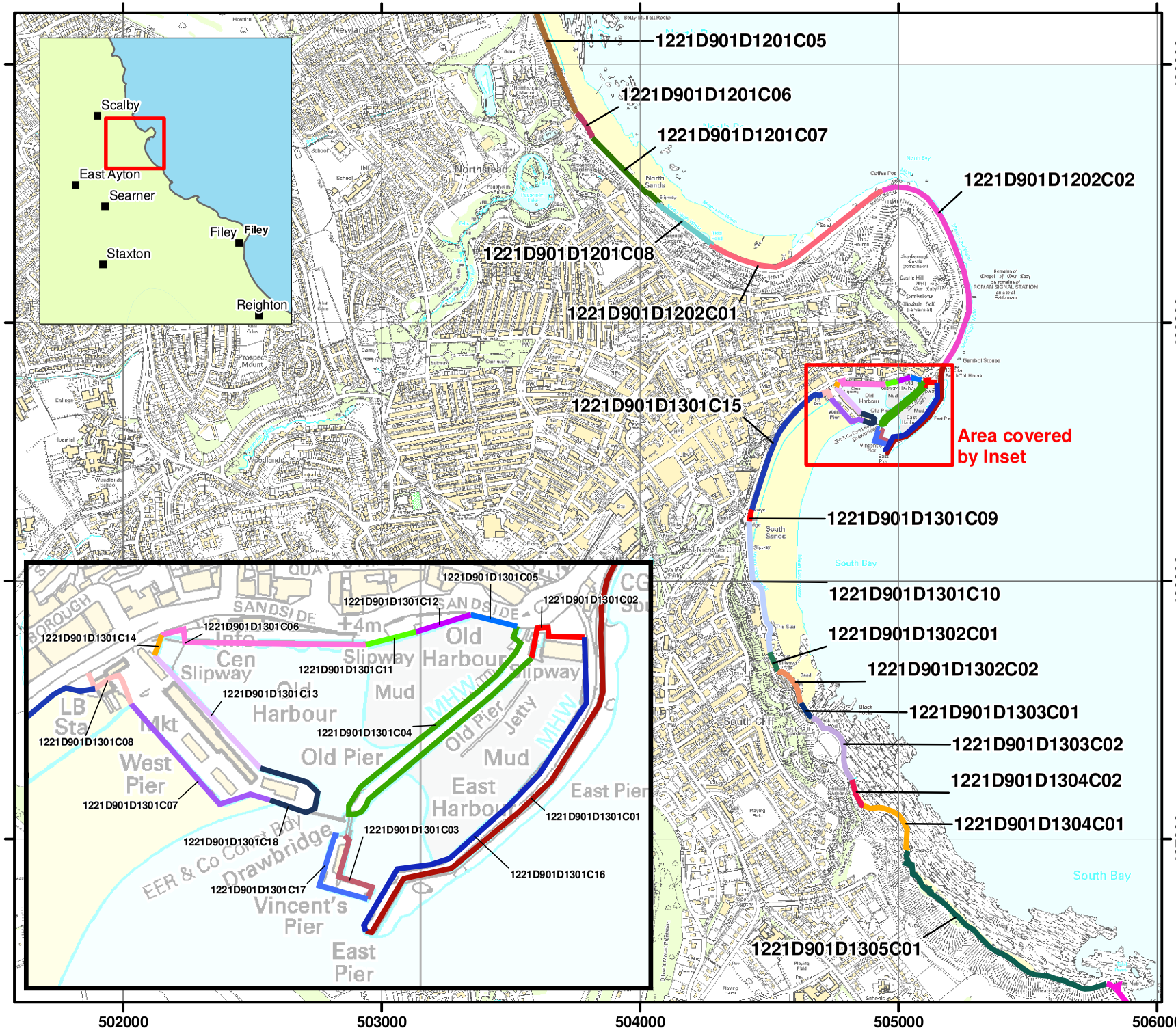

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 11 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
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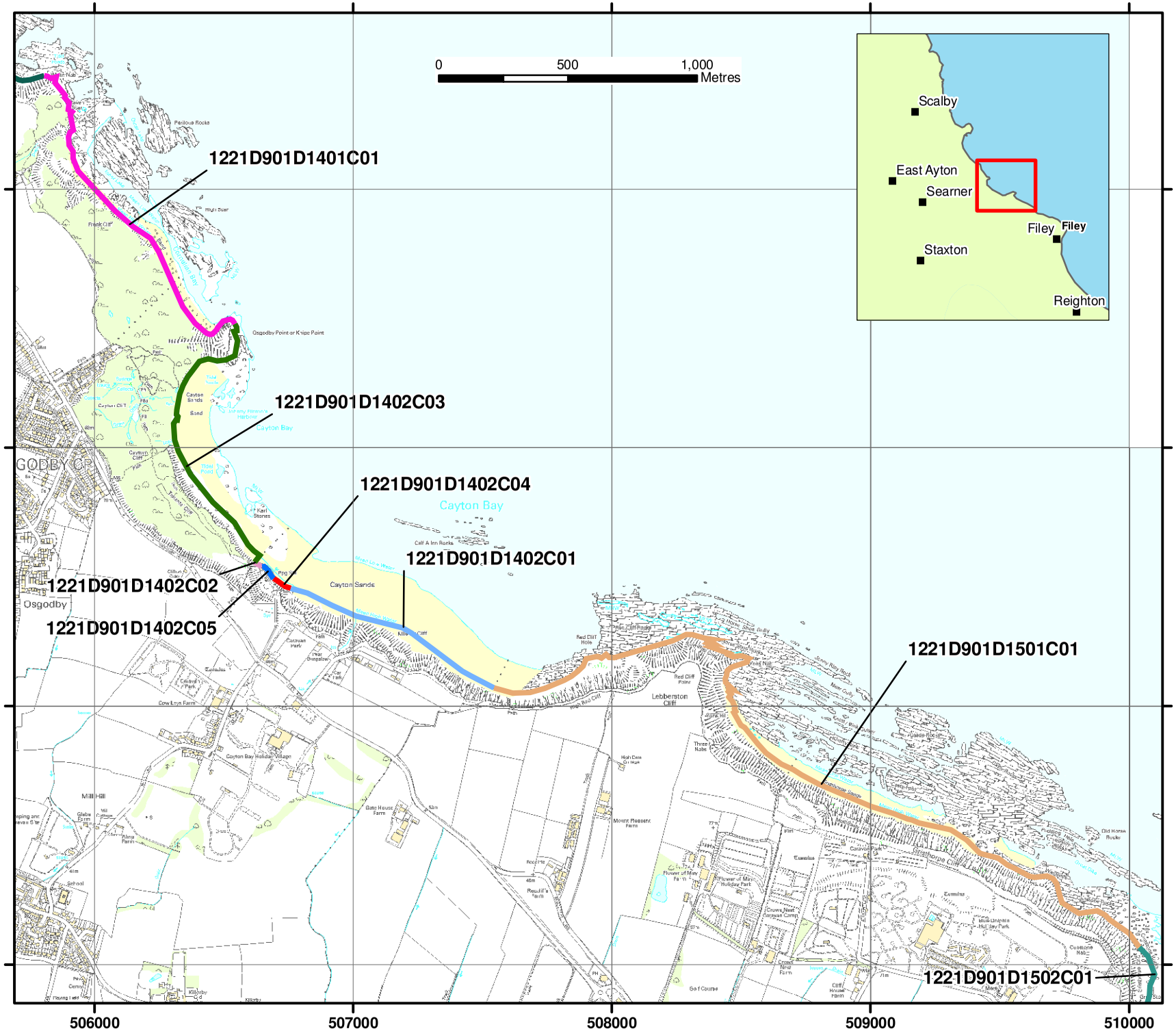

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 12 - Scarborough Council Frontage

Asset Condition 2008

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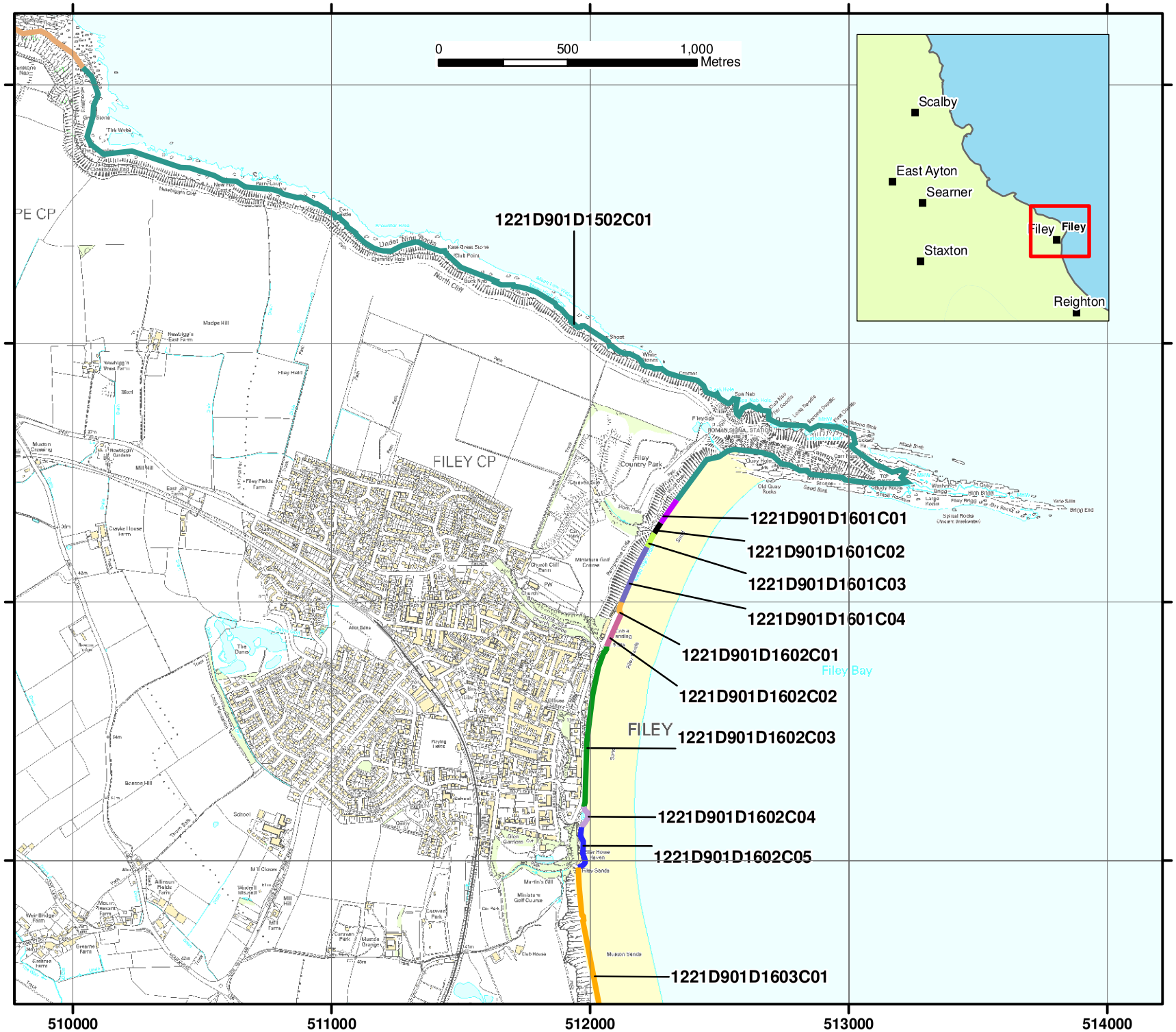

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 13 - Scarborough Council Frontage

Asset Condition 2008

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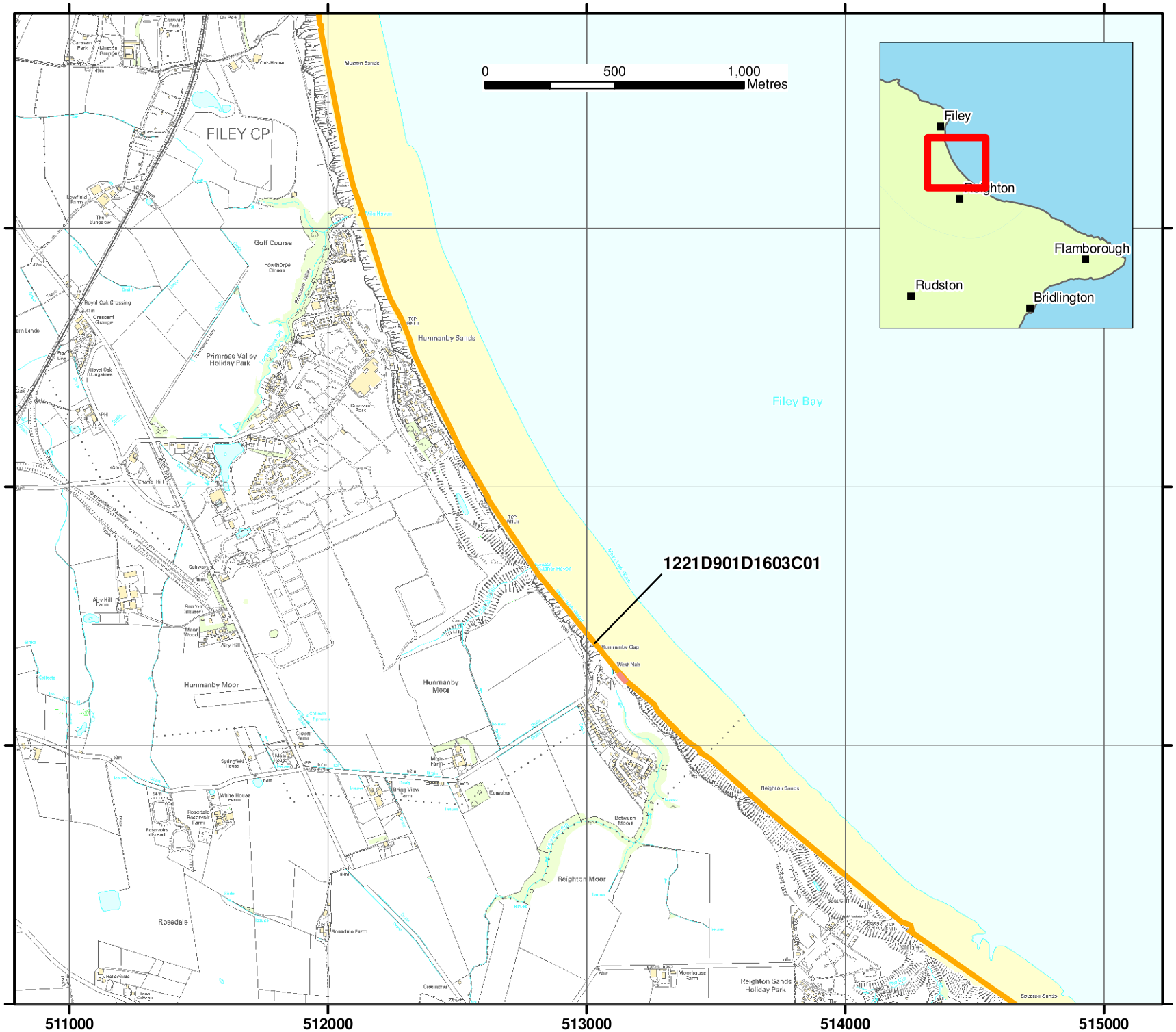

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 14 - Scarborough Council Frontage

Asset Condition 2008

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Royal Haskoning
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Marlborough Crescent
Newcastle upon Tyne
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Fax: +44 (0)191 211 1313
www.royalhaskoning.com

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Lyndon House
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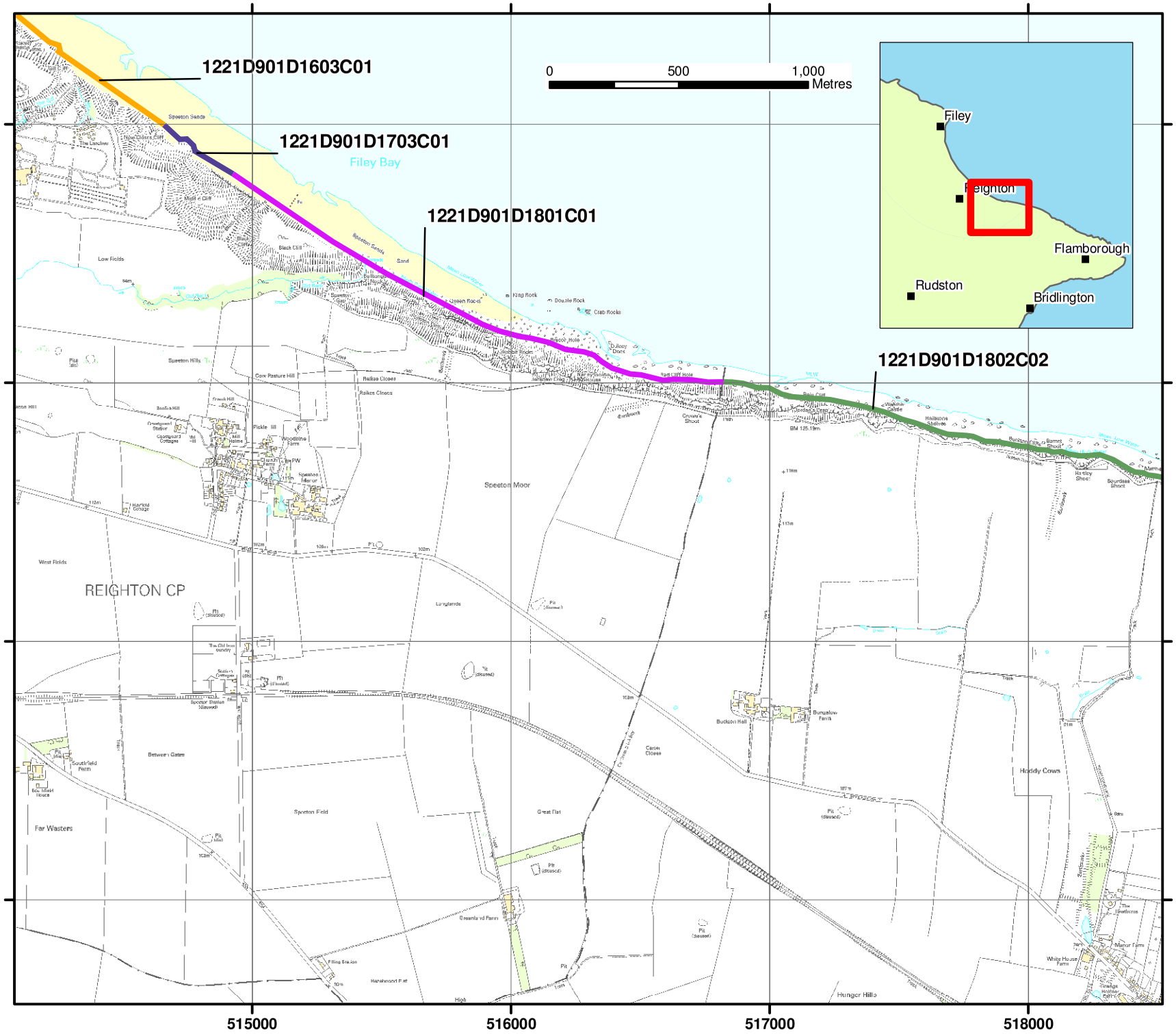

Asset location

NFCDD Asset Number

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Client: North East Coastal Authorities Group

Project: Coastal slope and asset condition inspection, summer 2008

Map 15 - Scarborough Council Frontage

Asset Condition 2008

Drawing Scale 1:20,000 at A4

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Royal Haskoning
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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Lyndon House
62 Hagley Road
Edgbaston
Birmingham
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