

Cell 1 Regional Coastal Monitoring Programme Lynemouth Laserscan Surveys 2018-19

Contents

Disclaimer	iii
Preamble	iv
1. Introduction	1
2. Laserscan Surveys	4
3. Results.....	5

Disclaimer

Royal HaskoningDHV has prepared this report in accordance with the instructions of our client Scarborough Borough Council (SBC) for the sole and specific use of SBC and their partner Northumberland County Council (NCC). Any other persons who use any information contained herein do so at their own risk. Royal HaskoningDHV has used reasonable skill, care and diligence in the interpretation of data provided to them and accepts no responsibility for the content, quality or accuracy of any Third party reports, monitoring data or further information provided either to them by SBC or, via SBC from a Third party source, for analysis under this term contract.

Data and reports collected as part of the Cell 1 Regional Coastal Monitoring Programme are available to download via the North East Coastal Observatory via the webpage: www.northeastcoastalobservatory.org.uk.

The North East Coastal Observatory does not "license" the use of images or data or sign license agreements. The North East Coastal Observatory generally has no objection to the reproduction and use of these materials (aerial photography, wave data, beach surveys, bathymetric surveys, reports), subject to the following conditions:

1. North East Coastal Observatory material may not be used to state or imply the endorsement by North East Coastal Observatory or by any North East Coastal Observatory employee of a commercial product, service, or activity, or used in any manner that might mislead.
2. North East Coastal Observatory should be acknowledged as the source of the material in any use of images and data accessed through this website, please state "Image/Data courtesy of North East Coastal Observatory". We recommend that the caption for any image and data published includes our website, so that others can locate or obtain copies when needed. We always appreciate notification of beneficial uses of images and data within your applications. This will help us continue to maintain these freely available services. Send e-mail to Robin.Siddle@scarborough.gov.uk
3. It is unlawful to falsely claim copyright or other rights in North East Coastal Observatory material.
4. North East Coastal Observatory shall in no way be liable for any costs, expenses, claims, or demands arising out of the use of North East Coastal Observatory material by a recipient or a recipient's distributees.
5. North East Coastal Observatory does not indemnify nor hold harmless users of North East Coastal Observatory material, nor release such users from copyright infringement, nor grant exclusive use rights with respect to North East Coastal Observatory material.
6. North East Coastal Observatory material is not protected by copyright unless noted (in associated metadata). If copyrighted, permission should be obtained from the copyright owner prior to use. If not copyrighted, North East Coastal Observatory material may be reproduced and distributed without further permission from North East Coastal Observatory.

Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1).

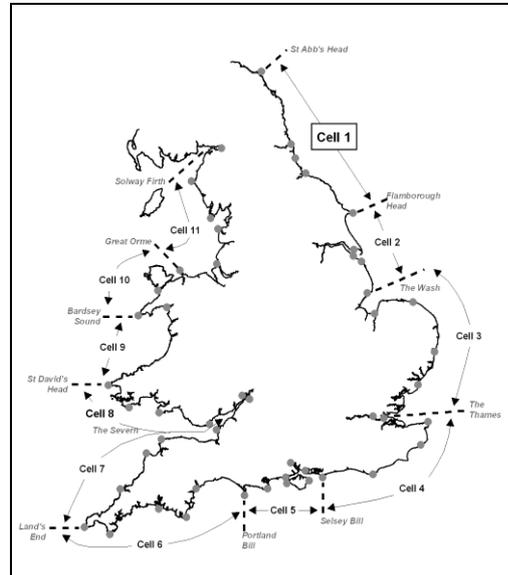


Figure 1 Sediment Cells in England and Wales

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

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- LiDAR Surveys
- walk-over cliff and coastal defence asset surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey.

In recent years, terrestrial laser scanning has also been undertaken at certain locations where capital schemes or hot-spots of erosion are occurring. These include Lynemouth Bay (Northumberland), Marsden Bay (South Tyneside), Runswick Bay (North Yorkshire) and Whitby (North Yorkshire).

This report relates to the laserscan surveys of Lynemouth Bay in Northumberland from 2018 and 2019.

1. Introduction

Lynemouth Bay extends between Snab Point in the north and Beacon Point in the south, passing the small, unconstrained, channel of the River Lyne (Figure 1). The beaches in Lynemouth Bay experienced extensive tipping of colliery spoil for many decades, resulting in an artificially advanced shoreface. This led to subsequent development of the reclaimed land with the Lynemouth Power Station towards the centre of the bay.

The power station was constructed between 1969 – 1971 as a coal-fired plant and first generated electricity in March 1972, powering the Alcan aluminium smelter at Lynemouth. The plant has recently been converted to biomass, extending the life of the power station and feeding electricity into the national grid.

The backing sea cliffs to the north of the power station and the backing sand dunes to the south became detached from marine processes due to the progradation of the shoreface by colliery spoil tipping and these landforms currently remain stable, relict features.

Following closure of the Ellington Colliery and cessation of spoil tipping (temporarily in 1994 and permanently in 2005), the artificial beaches within the bay started to measurably erode. Due to the threats posed by erosion and sea flooding (due to wave overtopping) to the Lynemouth Power Station, a major capital scheme was undertaken in 1995 (Posford Duvivier, 1993; 1995) to construct a rock revetment coastal defence structure. This structure was extended in 2005/06 around the coal-stocking yard to the north of the power station (Posford Duvivier, 2000; Royal Haskoning, 2009). The full history of colliery spoil tipping and the effects of its cessation is documented elsewhere (Royal HaskoningDHV, 2014; Cooper *et al.*, 2017).

It is important to note that in undefended sections of the bay, erosion of the artificial beaches continues to the present day at measurable rates (Figure 2). The Cell 1 Regional Coastal Monitoring Programme is capturing these changes through walkover inspections, aerial photography and beach surveys, whilst the Cell 1 Landfill Study (Royal HaskoningDHV, 2019) has also considered the erosion of the colliery spoil and other associated wastes within the Bay.

Over the winter of 2017/18, considerable erosion of the cliff line of colliery spoil to the immediate south of the Power Station was observed. The aerial photography captured as part of the Cell 1 Regional Coastal Monitoring Programme clearly shows that erosion at this location was measurable between 2015 and 2017 (Figure 3). Across this area, typically 15m of spoil was lost over those 2 years. Initially this presented concerns about potential outflanking of the revetment protecting the Power Station but subsequent investigations revealed that when the revetment was built, a tie-in section of revetment was also constructed, but this subsequently became buried by continued colliery spoil tipping. Ongoing erosion of the spoil will eventually expose the original tie-in structure, which would then provide continued defence to the Power Station. Notwithstanding this, a decision was made to monitor any erosion of the cliff line of colliery spoil adjacent to the revetment over the winter of 2018/19 to determine if any further erosion had occurred. This report covers the findings of two laserscan surveys over this period.

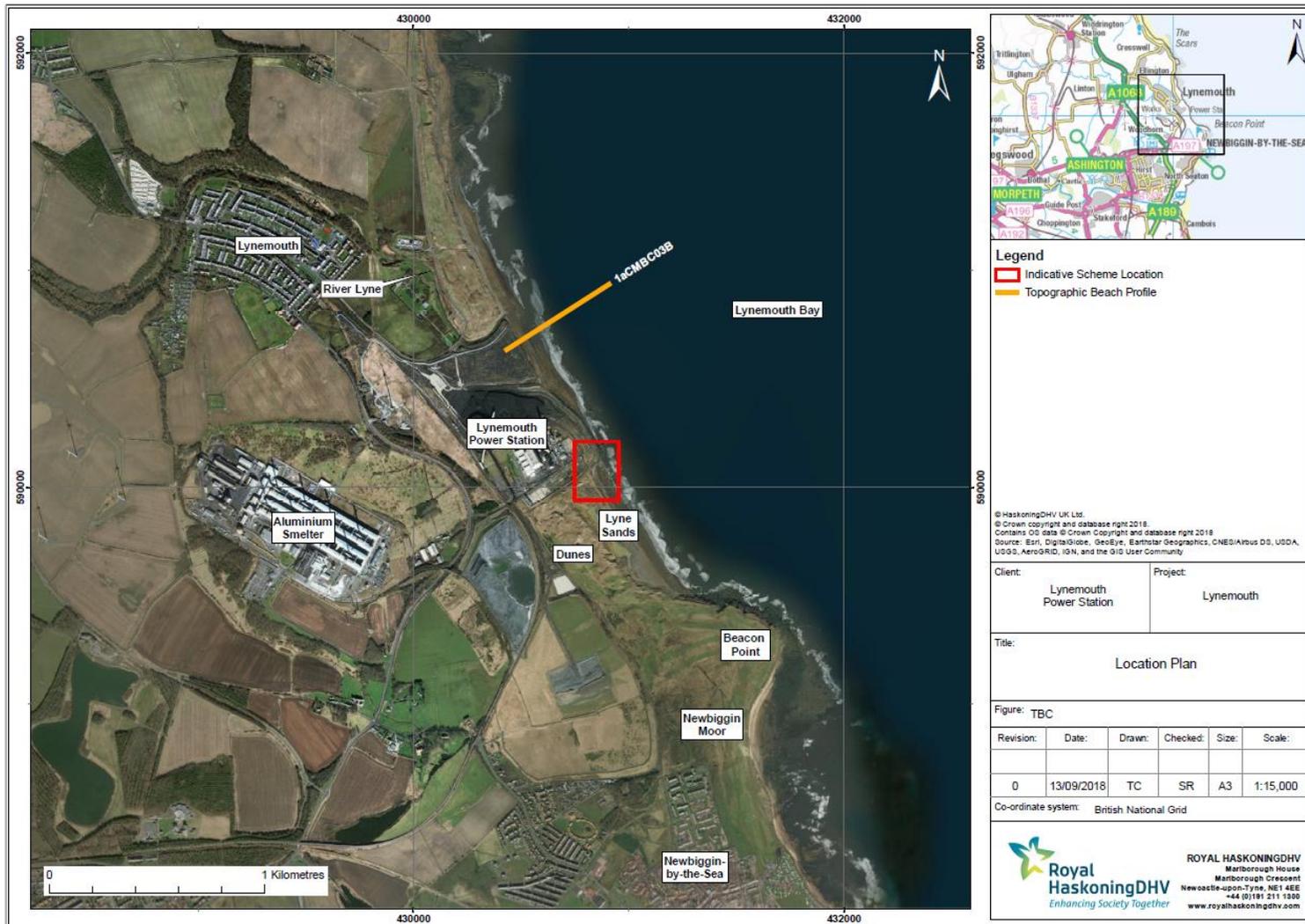


Figure 1 – Location plan



Figure 2 – Erosion of colliery spoil beach, Lynemouth Bay



Figure 3 – Coastal erosion at the southern end of the Lynemouth rock revetment

2. Laserscan Surveys

Laserscan surveys were undertaken by Academy Geomatics on the following dates:

- 13/09/2018
- 08/04/2019

These dates were selected to ensure that any changes over the winter 2018/19 were captured.

Outputs are available as an Autodesk Recap project cloud data for each survey and as an Autodesk Recap project cloud data for the comparison between surveys.

A Scanimation showing a visualization flyover of the 13/09/2018 survey was provided at the time of that survey.

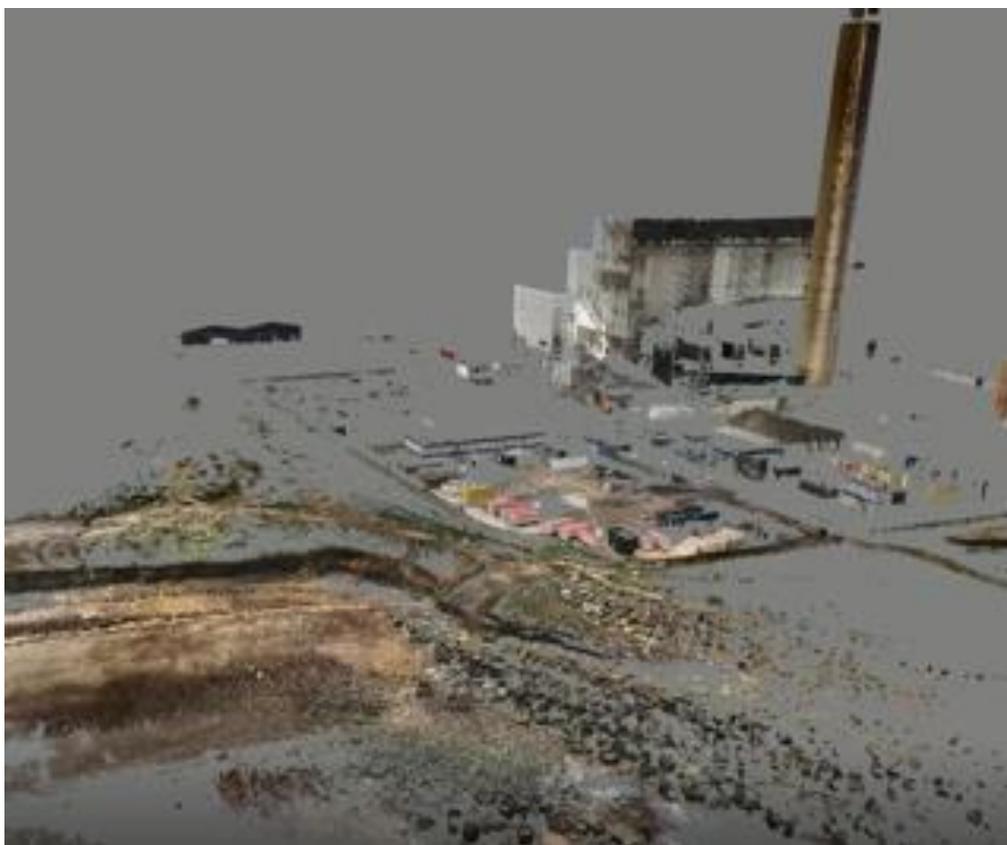


Figure 4 – Scanimation of the 2018 survey

A further Scanimation was provided with the 08/04/2019 survey, showing the following aspects:

- 0'0" to 0'48" – a visualization flyover of the 08/04/019 survey
- 0'48" to 1'10" – a comparison of representative surfaces from both the 13/09/2018 and 08/04/2019 surveys
- 1'10" to 1'48" – a comparison of the changes over the winter 2018/19.

3. Results

Results show that there was an accumulation of a small volume of material generally along the colliery spoil beach to the south of the Power Station across a short cross-shore width of upper beach, but a more widespread trend of beach lowering over the winter of 2018/19 (Figures 5 and 6). The scale of change is consistent with previous beach surveys and is likely to be caused by storm waves over the winter reducing the beach profile in level and volume. It is envisaged that over the summer of 2019, beach levels will rebuild slowly but progressively back towards September 2018 levels.

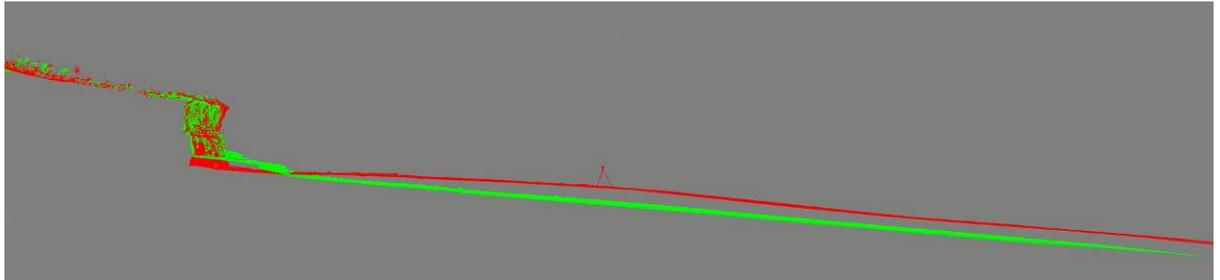


Figure 5 – Cross-section comparison of September 2018 (red) and April 2019 (green) laserscan surveys

There were also four areas south of the Power Station where cliff collapses occurred over the winter of 2018/19 (Figure 6). One of these areas was immediately behind the existing revetment but involved only a small local collapse of cliff and is not compromising the integrity of the defence. The other collapses, one larger and two very small, were located further south of the revetment along the undefended colliery spoil cliff line. In all cases, areas of distinct material loss can be seen from the cliff face (green and blue areas in Figure 6), with debris accumulating at the cliff toe (red and purple areas in Figure 7). It is anticipated that this debris will be relatively quickly washed away by marine action, suggested that the collapses occurred relatively shortly prior to the April 2019 survey.

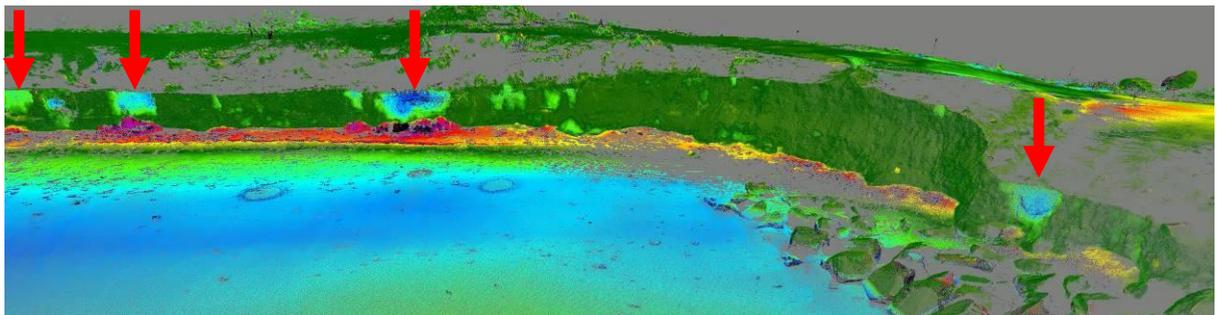


Figure 5 – Orthophoto of changes over winter 2018/19 (blue and green = erosion; yellow, orange, red and cerise = accretion)

4. References

Cooper NJ, Benson N, McNeill A & Siddle R, 2017. *Changing coastlines in NE England: a legacy of colliery spoil tipping and the effects of its cessation. Proceedings of the Yorkshire Geological Society*, Vol. 61, pp. 217–229.

Posford Duvivier, 2000. *Lynemouth Bay Strategy Study*. Report to Wansbeck District Council. October 2000.

Posford Duvivier, 1995. *Lynemouth Coast Protection Detailed Project Appraisal*. Report to Wansbeck District Council, June 1995.

Posford Duvivier, 1993. *Study of Possible Impact of Proposed Ending of Beach Tipping*. Report to Wansbeck District Council, November 1993.

Royal HaskoningDHV, 2019. *Cell 1 Coastal Landfills Study – Phase 2 Main Report*. Report to North East Coastal Group. July 2014.

Royal HaskoningDHV, 2014. *Cell 1 Sediment Transport Study – Phase 2 Main Report*. Report to North East Coastal Group. July 2014.

Royal Haskoning, 2009. *Northumberland and North Tyneside Shoreline Management Plan*. Report to Northumbrian Coastal Authorities Group. May 2009.