Analysis of the Hollin Hill Landslide, Low Mowthorpe, North Yorkshire; Field reconnaissance survey and proposed survey recommendations

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Analysis of the Hollin Hill Landslide, Low Mowthorpe, North Yorkshire; Field reconnaissance survey and proposed survey recommendations

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Foreword

This report describes a field reconnaissance survey carried out by the BGS in October 2005 and March 2006, in advance of detailed surveys to monitor slope instability at Hollin Hill Farm, Low Mowthorpe, North Yorkshire.

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Summary

This report is a result of a study by the British Geological Survey (BGS) investigating a landslide complex at Hollin Hill, Low Mowthorpe in North Yorkshire. The report provides an initial appraisal of a slope, and the proposed survey to be carried out in the autumn of 2006.
1 Introduction

BGS was alerted to the presence of a landslide at Birkdale Farm by the landowner, Mr Stephen Gibson, who approached field survey geologist Jon Ford at a meeting of the Ryedale Vernacular Building Materials Research Group.

A visit was made to the farm by the landslide and mapping team during the October 2005 field reconnaissance survey. A walkover survey of the slope proved that the landslide was very active, with common slumping and arcuate backscarsps. It was evident, due to the morphology and immaturity of the landslide features that movement on the slope has occurred relatively recently. The landslide at Hollin Hill provides BGS with a unique opportunity to monitor an active terrestrial landslide.

A second visit was made to the site in March 2006 by BGS staff Lee Jones, Gareth Jenkins and Mike Raines. The purpose of this visit was to conduct a second walkover survey in order to assess the best strategy for surveying and monitoring of the slope.

2 Geological Background

The slope at Hollin Hill consists of Redcar Mudstone (Lower Lias) at the base, with an outcrop of the Staithes Sandstone Formation (Middle Lias) running across the middle section of the slope (evidenced from sandy soil excavated by badger setts). The Whitby Mudstone Formation (Upper Lias) overlies this, with the upper part of the slope composed of the Dogger Formation. Both the Redcar Mudstone and the Whitby Mudstone are highly susceptible to landsliding, and movement across the entire slope is facilitated by these two Formations.
The Redcar Mudstone forms the base of the Lias Group and comprises (at maximum) up to 200m of mainly dark grey mudstones and siltstones; subsidiary thin limestones (concentrated in the lower third), very fine grained sandstones, and sideritic and ‘chamositic’ ironstone beds and nodules are also present (Powell, 1984).

The Staithes Sandstone Formation comprises approximately 20m (at maximum) of fossiliferous, micaceous, calcareous, very fine- to fine-grained sandstone. It is yellow-brown at outcrop but grey when fresh with interbedded grey siltstone and silty mudstone.

The Whitby Mudstone Formation, which forms the upper part of the Lias Group, typically consists of bluish grey to dark grey, sparsely fossiliferous, fissile, locally bituminous mudstones and siltstones. Bands of calcareous concretions are common at some horizons. At its thickest it reaches about 25-30m thickness in the study area.

The Dogger Formation is composed of a massive, fine to medium-grained sandstone, up to 2.7 metres in thickness. The matrix is calcareous and in places poikilitic, and the basal part is almost a sandy limestone. Scattered to locally abundant ooliths are present except near the top of the formation (Gaunt et al., 1980).

3 Nature of slope

Observation of the Hollin Hill landslide during the walkover survey showed it to be approximately 150 metres in length (downslope) with a width of at least 260 metres (across slope). These dimensions refer to the area of unstable ground that will be covered during the monitoring of the slope. The unstable ground was observed to continue into the wooded area to the west of the study area (Figure 2), but due to the dense cover of mixed woodland, it is not
possible to monitor this area. The slope faces south to south-south-east and the gradient shallows to form a wide, flat field to the south of the landslide. The morphology of the slope is complex with numerous isolated shallow failures and slumping (Figures 3 and 4). Locally the slope becomes very steep where slipped material has accumulated to form lobes (Figure 5).

The Dogger Formation is believed to be present in the fields immediately above the landslide (the area is currently being re-mapped by the BGS), and conversation with the landowner suggests that water drains from the Dogger Formation into the Lias sediments that underlie the slope. This causes the sediments to become saturated, leading to increased pore water pressure, which causes the slope to fail.

Figure 2. SW corner of the Hollin Hill landslide. Photograph taken from 468046 468799, orientation 250° (ESE).
Figure 3. Shallow rotational failures in the Hollin Hill landslide. Photograph taken from 468107 468858, orientation 045° (NE).

Figure 4. Small scale rotational failures in the Hollin Hill landslide. Photograph taken from 468082 468822, orientation 065° (ENE).
4 Survey Plan

From the walkover survey, it is evident that the slope at Hollin Hill was, at the time of survey, an active site. The landowner is very interested in the site and it provides BGS with a unique opportunity to monitor an active terrestrial landslide.

A BGS team of Lee Jones and Gareth Jenkins will undertake an initial baseline survey of the site, using the Riegl LPM880HA laser scanner, coupled with a Leica SR530 differential global positioning system (dGPS). The survey will involve 15 scans, orientated in a 5x3 grid across the slope (Figure 6). (Additional scans may be necessary in order to capture areas of shadowing). This will enable a 3-dimensional, geo-rectified model of the slope to be produced, from which any future slope movement can be compared, thus providing an insight into the mechanisms and volumes of movement. Repeat surveys will initially be undertaken every 6 months. This may potentially be extended to 12 months depending on the level of activity. It is also anticipated that responsive surveys may also be undertaken if significant movement occurs at the site in the intervening periods.
Figure 6. Proposed Hollin Hill survey station locations.

References

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