Hastings Borough Council
Ecclesbourne Glen – Landslides - 2014

May 2014

Results emerge
when local knowledge
intersects with
global expertise

Job title:	Ecclesbourne Glen - landslides		Job number 02255AA
Document title	Desk Study and Inspection Report		File reference
Document ref	02255AA_R_005A_RDS_initial report		

Issue	Date				
1	April 2014	Filename			
		Description	Desk Study and Inspection Report - Draft		
			Prepared by	Checked by	Approved by
		Name	R D Sibley	S Fairchild	I Nettleton
		Signature			
2	May 2014	Filename			
		Description	Desk Study and Inspection Report - Revised		
			Prepared by	Checked by	Approved by
		Name	R D Sibley	I Nettleton	I Nettleton
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Atlantic House Atlas Business Park Simonsway Manchester M22 5PR United Kingdom
T (+44) (0) 161 499 6800 F (+44) (0) 161 499 6802 coffey.com
Registered Office: 1 Northfield Road Reading Berkshire RG1 8AH United Kingdom
Registered in England No. 06328315

Atlantic House Atlas Business Park Manchester M22 5PR United Kingdom
T (+44) (0) 161 499 6800 F (+44) (0) 161 499 6802 coffey.com
Registered Office: 1 Northfield Road Reading Berkshire RG1 8AH United Kingdom
Registered in England No. 06328315

CONTENTS

Figures

1 INTRODUCTION

Several suspected landslides have recently occurred in Ecclesbourne Glen, east of Hastings, and these have resulted in the closure of a number of public footpaths crossing the Hastings Country Park. Consequently, Hastings Borough Council (HBC) appointed Coffey Geotechnics Ltd (Coffey) to provide geotechnical advisory services in relation to this matter.

The scope of services that Coffey has been appointed to undertake, at this stage, can be summarised as follows:

- Desk study of the area
- Site walkover survey
- Site Inspection Report

The site walkover survey was undertaken on Wednesday 9th April 2014 by Dr. R. Sibley an Associate Engineer for Coffey. He was accompanied by J. Apps and C. Morns the local Park Rangers. This letter report is provided by Coffey to HBC following the site walkover, to give an overview of the findings.

2 SETTING AND LOCATION

Ecclesbourne Glen is located about 2km to the east of the centre of Hastings, within the Hastings Country Park. It comprises a south-west trending, steep valley down which a watercourse flows, passing between cliffs and discharging into the English Channel. The study area is located on the north western side of the glen (see Figure 001). This area impinges on a caravan park, the Rocklands Holiday Park, which is bordered to the south west, south east and north east by sections of the Country Park (see Figures 001 and 002). The caravan park is located in the north western part of study area, i.e. in the upslope section.

The study area is (was) crossed by a number of public footpaths, which converge at a junction on the south eastern boundary of the Rocklands caravan park (See Fig. 002):

- Footpath 379a extended NNE from this point, along the boundary with the caravan park and beyond.
- Footpath 364a extended ENE from this point. Previously it became footpath 394 close to a stream crossing at the low point of the Ecclesbourne Glen; at this point it split in two, with one path following the alignment of the watercourse, upstream in a NE direction. However, following the footpath closure, 364a and 394 no longer connect directly.

The study area comprises south-east to east facing slopes, with slope angles typically between about 15 degrees and 25 degrees. There appear to be locally steeper sections, up to about 35 degrees. Some 200-300m south and south east of the study area, the shoreline (high water line) is delineated by steeper (near-vertical) cliffs, up to about 50-60m high.

The Country Park section of the study area is located within both a Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC). This poses limitations on activities that can be undertaken, and may restrict potential remedial measures that could cause damage or impact.

3 GEOLOGY AND GROUND CONDITIONS

From an initial review of the available desk study information the following comments can be made regarding the geology of the study area and ground conditions.

The consulted published geological maps (Refs. 1-4) of the study area indicate the ground surface to be underlain by strata of the Cretaceous Wadhurst Clay, close to the interface with the underlying

Ashdown Beds. The area is indicated to be devoid of natural Drift Deposits, although alluvial sediments may exist in the bed of the Ecclesbourne Glen watercourse.

The horizons of the Wadhurst Clay in the study area are indicated to comprise predominantly clays (weathered mudstones) with subordinate beds of siltstone and sandstone; the latter appear to form relatively continuous topographic features through the area (Figure 003).

A distinct sandstone horizon, known as the Cliff End Sandstone, lies just above the base of the Wadhurst Clay; beneath this are strata of the Ashdown Beds (sandstone beds with interbedded siltstones and silty mudstones). The Cliff End Sandstone and underlying sandstone strata of the Ashdown Beds dominate the coastal topography of the cliffs, south and east of the study area. These cliffs are prone to landslips and rock falls, particularly where clay beds are exposed within the face and at the foot of the cliffs. Erosion or landslips of the clay strata in the area are prone to undermine competent overlying sandstone horizons leading to toppling failures.

The Wadhurst Clay is known to be susceptible to slope instability (see Refs. 5-7). The Wadhurst Clay strata are indicated to dip to the south or south east at relatively shallow angles in the local area.

No geological faults or major structures are depicted within the study area. However an NW-SE trending fault, the Foul Ness Fault, is depicted about 50-300m to the south west of the study area. This is indicated to have a down-throw of about 17m to the north east. The down-throw introduces a greater thickness of the Wadhurst Clay within the cliff in the study area compared with the cliffs to the west of the Foul Ness Fault.

4 HISTORY OF MOVEMENT

According to information kindly provided by the Rangers of Hastings Country Park, the following summary can be made.

The first reported evidence of movement was in January 2013, when “small cracks” were noticed in the footpath along the boundary of the caravan park (i.e. footpath 379a). It is conjectured these could have related to incipient ground movements down slope (i.e. south east) of the footpath at this time. This occurred following a particularly wet November and extended wet period from April to July in 2012 (Ref. 8).

By February 2013, the cracks had increased in size, and as a result a section of footpath 379a was closed (Fig. 002). The (HBC) land to the south east of the footpath is reported to have subsided and the boundary fence had moved in places.

In December 2013 the extent of movement is reported to have increased suddenly, and most of the movement “currently visible” is reported to have occurred.

In/by February 2014 movements occurred lower down the glen, following which the footpath adjacent to the stream (footpath 394) was closed. Again this coincided with/followed a period of extreme weather conditions, relating to a succession of major winter storms during December 2013 and January 2014; the highest amount of rainfall has fallen during the two consecutive winters (2012-13 and 2013-14) in over 100 years (since 1910), typically 2-3 times the long-term average for the time of year (Ref. 8).

Since February 2014, there is reported to have been further movement, although “*the lower extent of the slide*” is reported to have remained about the same.

During the visit/inspection of 9th April 2014, the Park Ranger indicated further movement of the landslide along the upper part of the south eastern path, which had apparently occurred during the preceding 2-3 weeks.

5 DESCRIPTION AND FORM

The following brief description is based on observations made during the site inspection of 9th April 2014.

During the inspection it was noted that two recent landslides have occurred in the study area. The larger/main of these is located to the west, while the smaller is to the east, adjacent to the watercourse near the bottom of the glen. These are described in more detail as follows.

In terms of landslide description and features, reference has been made to the nomenclature and terms presented in the paper by Cruden and Varnes (Ref. 9).To assist further, a glossary of terms and a pictorial illustration of landslide morphology and features are presented in Section 10. Figure 003 depicts the features identified at the site. It should be noted that observation points were located using a hand-held GPS; these are reported to be accurate within +/- 2-3m, and hence Figure 003 represents an engineering geology sketch map.

5.1 Larger/Main Landslide

The larger landslide extends across sections of the Country Park and Rockland caravan park, where the intervening boundary had previously been formed by a section of the north western footpath. This footpath and boundary is now entirely eradicated. The plan shape of this landslide could be described as lobate. It appears to measure up to 80m wide (at its widest part, near its crown) reducing to less than 10m wide near the tip of the toe. The length is estimated to be about 100m from its main-scarp to the tip of the toe. The general direction of movement is indicated to be from WNE to ESE, i.e. essentially down slope.

From the inspection, three scarp features were observed, together with a number of other minor scarp features and tension cracks. The main-scarp was located within the caravan park land, impinging upon the concrete bases of the lowest row of caravans. From inspection soil appeared to have recently been placed against this main-scarp, within the landslide area, presumably to reduce the ground surface gradient along this feature. This is likely to surcharge the head of the landslide and could give rise to enhanced further movement.

This landslide is indicated to be “Retrogressive” and “Complex” in nature (See Glossary – Section 10) with back-rotation apparent on the section below the (current) main-scarp (albeit masked by the apparent placement of soil materials) and the toe/lower section taking the form of a mudslide or mud flow. This is, apparently, not uncommon for the local area and geology. Between the uppermost (back-rotated) section and the mudslide, the degree of ground disturbance (and damage to vegetation caused by the movement) was noted to increase with distance down slope.

It was not possible to estimate with any accuracy the magnitude of vertical movement that has occurred across the uppermost back-scarp; however, this is conjectured to be several metres of drop, from observations of features in this area, such as a partially buried tree, which was reportedly at the same level as the row of caravans, prior to the landslide formation.

The side margins of the landslide were observed in a number of locations; the interfaces, where inspected, were noted to be distinct and relatively steep, particularly towards the upper part of the landslide. At lower levels the mudslide appeared to have flowed across the ground surface, and in parts was confined laterally by the local topography and vegetation. The southern margin of the landslide was irregular in plan form, and in once location appeared to be deflected around a sandstone outcrop that did not appear to have moved substantially.

It was noted that the ground surface at the margins of the landslide, particularly close to the interfaces, was very wet. In addition ponded surface water was observed in several locations, in the upper and

middle parts of the landslide. Sections of pipe, which could have related to land drainage, were also observed exposed at the ground surface within the slipped mass in several locations. These included sections of yellow plastic pipe (observed from the southern margin) and a metal pipe near the north-eastern margin (Fig. 003).

5.2 Smaller Landslide

The smaller landslide is located several hundred metres east of the larger/main landslide, on the western bank of the watercourse at the base of Ecclesbourne Glen, close to where it passes between cliffs before reaching the shoreline. It appears to be elliptical in plan shape, no more than about 10m across (back-scarp to toe tip and laterally). The direction of movement of this feature is indicated to be north-west to south-east.

Although relatively small (in comparison with the larger landslide) this feature is also significant in that its toe has extended across public footpath (394) in this area, causing it to be closed (Ref. 11). In addition, the toe is extending into the course of the south-west flowing stream, the flow of which is reported to increase substantially following periods of heavy rainfall.

From inspection, this landslide appears to be relatively shallow-seated and possibly translational in nature, which would be consistent with a Depth/Length ratio in the order of 0.10-0.15 (Ref. 9). Within the slipped mass there was not much evidence of significant rotation or vertical displacement of the ground surface, vertical displacement across the back-scarp was limited, and vegetation growth was not significantly disturbed, although there were tension zones within the upper part of the landslide.

5.3 Other Features/Observations

During the visit/inspection of the study area a number of other observations were made, detailed as follows.

In parts of the site the ground surface is very wet/muddy, with occasional small springs issuing; this was particularly evident along sections of footpath that are clear of vegetation cover. It is conjectured such wet/muddy areas and springs are associated with the interfaces between water-bearing sandstone/ siltstone beds and underlying, less-permeable, mudstone horizons intersecting the ground surface. In other words, these are inferred to reflect perched water tables intersecting the ground surface, at various locations along the hillside.

In several areas, the ground surface appeared to be irregular/hummocky, although this could not be confirmed due to the thick overlying vegetation cover. In addition, several clearings were noted within wooded areas. Both such observations are considered to represent evidence of the occurrence of older relatively-localised landslides similar to that observed and described under 5.2 above.

Areas of hardstanding for access and parking exist within the caravan park in the upper part of the slope bordering the study area. It is presumed that various underground services including drainage and freshwater services are present below this hardstanding. At this stage, the location and conditions of such (private) drainage systems and water supplies are not known.

Within the Caravan Park, a SW-NE trending linear topographical feature was observed about 40m up-slope of the current main-scarp of the landslide. This feature comprised a zone of steeper ground, between two areas of lower-gradient slope. This is likely to be related to the outcrop of a sandstone bed within the Wadhurst Clay formation. The potential significance of this feature is discussed in the following section.

6 PRELIMINARY ASSESSMENT

The larger landslide is a substantial feature which has already impacted on the caravan park and the two footpaths (379a & 364a). It appears to be a Retrogressive Complex landslide, featuring several scarps, and evidence of back-rotation within the upper reaches; the toe is currently formed of a mudslide. This landslide is inferred to be working its way up the slope, with the observed series of scarps presumed to represent former main-scarps. The development of each main-scarp reduces the support of land higher up the slope which then progressively fails and starts to slide, resulting in a further up-slope main-scarp.

From the available evidence it is conjectured this landslide developed initially within the Country Park, down-slope (east) of the north western path (379a) and progressively extended up the slope, into the caravan park, attaining its current configuration. The depth of the larger landslide cannot be determined accurately from inspection; however from Ref.10 the Depth / Length ratio for a rotational failure is typically in the range of 0.15 to 0.33; on this basis, the depth of the rupture surface could be in the order of 10-30m bgl.

However, in consideration of the local geology, relatively-competent shallow-dipping sandstone beds within the underlying Wadhurst Clay, may limit the depth (below the original ground surface level) of the rupture surface. Consequently, the depth of the rupture surface is likely to be nearer the lower end of the range given above (i.e. about 10m below surface level).

The inferred sandstone bed located about 40m up-slope of the current main scarp of the larger landslide will represent a more competent horizon within the Wadhurst Clay formation, and may impact upon the landslide, by impeding its development up-slope, when the retrogressive enlargement of the landside reaches this feature.

It is not possible, at this stage, to determine, definitively, the “cause” of the larger landslide. From the available information the slopes in Ecclesbourne Glen are marginally stable at best, with evidence of ground movements/landslides having occurred previously. In addition, groundwater (and variations in pore pressures) is a significant factor influencing the local slope stability. The very wet meteorological conditions of the recent winters will have resulted in very high (near-surface) groundwater levels and this is considered most likely to have instigated the initial movement; it almost certainly has with the smaller landslide near the Ecclesbourne Glen watercourse.

As indicated above, slope stability in the study area is very sensitive to groundwater level variations, and it should be appreciated that services and changes at the caravan park in the upper part of the slope could have had an influence on groundwater level variations.

It has been suggested that the construction of a new building within the caravan park may in some way have contributed to the landslide developing (Ref. 12). This building is located some 70-80m away from the margin of the landslide, along and slightly up-gradient. Consequently, it is considered highly unlikely this construction has had any detrimental impact upon the local slope stability or caused the development of the landslide. However, details of the drainage from the property should be investigated.

However, it should be noted that any (further) surcharge loading of the ground surface in the upper reaches of the larger landslide, such as placement of soil/material in front of the back-scarp within the caravan park, will tend to de-stabilise the situation and could well result in further movements.

During the (generally) drier summer and autumn seasons of the year, groundwater levels are likely to reduce, as a result ground movements may well slow or cease, temporarily. However, any such respite is likely to be only temporary; the available evidence indicates that the larger landslide is active, has not stabilised and is very likely to continue moving; further movements are more likely to occur in relation to periods of heavy precipitation, and given that the toe comprises a mudslide could result in sudden and

possibly relatively-rapid movements. This has significant health and safety risk implications, with specific reference to users of the caravan park and to human activity within the study-area section of the Country Park close to the larger (and smaller) landslip.

The smaller landslide has a similar potential for further movements, particularly given that its toe is within the margin of the Ecclesbourne Glen watercourse; erosion of the toe could lead to further movements, and significant further movements could result in the landslide extending across the stream, damming it and causing localised flooding.

7 RECOMMENDATIONS

7.1 Larger/Main Landslide

The following recommendations are made in relation to the larger/main landslide:

Short Term

- Given the active nature of this landslide and likelihood of further movements, there are significant health and safety risks to human activities in the affected areas. Therefore, the affected footpaths (379a, 364a & 394) should remain closed to public access for the foreseeable future.
- In addition, the caravans within the lowest terrace of the caravan park (i.e. close to the current back-scarp) are also currently at risk and should not be occupied; it is recommended that these are removed from the terrace completely, as soon as possible. They should be relocated elsewhere in a more stable part of the caravan park.
- We recommend that an initial stability assessment and hazard zonation of the main landslide is undertaken. In order to do this, a detailed topographical survey of the landslide will need to be carried out to enable its dimensions/extent and features to be determined more accurately.
- The initial stability assessment and hazard zonation should then be carried out utilising existing soil/rock parameters from previous work for the Council and British Geological Survey (BGS) records.
- For a more definitive stability assessment and hazard zonation, we would recommend further ground investigation which may include exploratory hole formation and the installation of monitoring instrumentation.
- In addition, investigations should be carried out to determine the location and condition of all surface and sub-surface drainage systems and fresh water services within the caravan park and (if any) extending into the study area.
- Furthermore, it is recommended that no further earthworks or drainage are undertaken within the caravan park, without their potential effects on slope stability being assessed in advance.

Intermediate/Longer Term

- Given the scale of the larger landslide and its location, it is considered that the design and construction of measures to stabilise it and mitigate risks of further movement are likely to be cost-prohibitive. Furthermore, any such measures will be inconsistent with restrictions on activities and operations, given that the study area is designated as an SSSI and SAC.
- In the longer term, consideration should be given to relocating permanently the alignments of the affected (closed) footpaths, to avoid the landslide zone completely. Any such re-alignments should be kept a safe distance up-slope of the landslide as it is likely that the toe (mudslide) will extend down-gradient from its current location.
- The realigned footpaths and associated drainage will need to be designed to take account of the sensitivity of the slope stability to groundwater level variations.
- The layout of the caravan park should also be reviewed and subjected to further assessment, in relation to long-term slope stability and risk mitigation. .

7.2 Smaller Landslide

The following recommendations are made in relation to the smaller landslide:

Short Term

- As with the larger landslide, the affected footpaths (364a & 394) should remain closed to public access in the short-term, to mitigate Health and Safety risks.
- The toe of this landslide should not be removed to open up the footpath; such actions could precipitate further movements.
- A detailed topographical survey of the smaller landslide should be undertaken, in order to confirm its dimensions/extent and features, and to provide information from which an initial stability assessment and hazard zonation of this landslide can be undertaken, as with the larger landslide.

Intermediate/Longer Term

- In the longer term, consideration could be given to realignment of the affected (closed) footpath to avoid the landslide zone completely.

8 CONCLUDING COMMENTS

The inspection at Ecclesbourne Glen identified two landslides which have recently occurred in the study area. The larger/main of these is located to the west and extends into the Rocklands caravan park, while the smaller is to the east, adjacent to the watercourse near the bottom of the glen. The occurrence of the landslides has resulted in the closure of several public footpaths crossing the study area (Fig. 002).

Both landslides are indicated to have been activated within the last couple of years, coincident with periods of extreme heavy rainfall. The larger landside appears to be complex and retrogressive, while the smaller appears to be shallow and translational in nature. Both landslides appear to be highly sensitive to water, and are inferred to be active; further movements are likely to occur associated with wet meteorological conditions.

Recommendations have been given in terms of short and intermediate to long term actions in relation to the two landsides. These recommendations take account of activities and land-uses at and adjacent to the two landslides, and potential risks, but also take cognisance of the fact that the study area is located within a SSSI and SAC.

It should be appreciated that the recommendations do not relate to major remedial works to stabilise the landslides; it would be more cost-effective to relocate and rebuild the footpaths and associated drainage which may assist in managing groundwater in the landslides/catchment zone.

It is also imperative that further investigations should be undertaken in full co-operation with the owners/ management of the Rocklands caravan park, to manage adverse impacts upon the SSSI and SAC. To this end, details of the existing drainage systems and freshwater supplies at the caravan park need to be investigated and determined.

We trust the foregoing report provides you with a suitable summary of our findings, following the initial desk study and site inspection. If you require further information or clarification, please do not hesitate to contact us.

9 REFERENCES

1. British Geological Survey 1980. 1:50,000 Solid and Drift Geology Plan, Sheet 320/321, Hastings and Dungeness.

2. British Geological Survey 1978. 1:10,560 Solid and Drift Geology, sheet TQ 80NW, Hastings.

3. British Geological Survey 1978. 1:10,560 Solid and Drift Geology, sheet TQ 81SW, Hastings.

4. R.D. Lake and E. R. Shephard-Thorn (British Geological Survey) 1987. Geology of the country around Hastings and Dungeness. Memoir for 1:50,000 geological sheets 320 and 321 (England and Wales).

5. Skempton, A. W. 1964. Long term stability of clay slopes. *Geotechnique*, **14**, 77-101.

6. Pedley, M. J & Pugh. R. S. 1995. Soil nailing in the Hastings Beds. In: *Engineering Geology of Construction*. Geological Society Engineering Group Special Publication No. 10, 361-368.

7. Pugh, R. S., Weeks, A. G & Hutchinson, D. E. 1991. Landslip and remedial works in Wadhurst Clay. In: *Slope Stability Engineering*. Thomas Telford, London, UK, 377-382.

8. Met Office website: http://www.metoffice.gov.uk/climate/uk/interesting#y2012

9. Cruden, D. M & Varnes, D. J. 1996. Landslide types and processes. In: Schuster, R. L & Turner, A. K. (eds) *Landslides, Investigation & Mitigation*. Special Report, **247**, 36-75. TRB, National Research Council, Washington D. C.

10. Skempton, A. W. and Hutchinson J. N. 1969. Stability of natural slopes and embankment foundations. In Proc., Seventh International Conference on Soil Mechanics and Foundation Engineering, Sociedad Mexicana de Mecana de Suelos, Mexico City, State of the Art Volume, pp. 291-340.

11. Rights of Way, East Sussex Government. http://www.eastsussex.gov.uk/leisureandtourism/countryside/rightsofway/rightsofwaymap/intro.htm

12. Email: Steven Ward to Sussex police, Hastings government, Natural England: Tues 25 Mar 2014, 15:18:21.

13.

14. AGS. 2007. Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Management. Australian Geomechanics Society, Australian Geomechanics, Vol 42, No1.

15. ISSMGE. 2004. Technical Committee TC32 (now TC304) Engineering Practice of Risk Assessment & Management. The International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE). .

10 GLOSSARY AND MORPHOLOGY

Definitions of the principal terms used in Landslide Zoning and Risk Management are given below. They are based, with additions, on those presented in the Australian Geomechanics Society (AGS) 'Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning' (2007) and The International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) Technical Committee 32 (2004).

- Landslide: The movement of a mass of rock, debris, or earth (soil) down a slope.

- Landslide Inventory: An inventory of the location, classification, volume, activity and date of occurrence of individual landslides in an area.

- Landslide Susceptibility: A quantitative or qualitative assessment of the classification, volume (or area) and spatial distribution of landslides which exist or potentially may occur in an area. Susceptibility may also include a description of the velocity and intensity of the existing or potential landsliding.

- Hazard: A condition with the potential for causing an undesirable consequence. The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material and the probability of their occurrence within a given period of time. Landslide hazard includes landslides which have their source in the area or may have their source outside the area but may travel onto or regress into the area.

- Heuristic: Expert judgement / experience-based techniques for problem solving, learning, and discovery.

- Risk: A measure of the probability and severity of an adverse effect to health, property or the environment. Risk is often estimated by the product of probability and consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form. For these guidelines risk is further defined as:

a) For life loss, the annual probability that the person most at risk will lose his or her life taking account of the landslide hazard and the temporal spatial probability and vulnerability of the person.

b) For property loss, the annual probability of the consequence or the annualised loss taking account of the elements at risk, their temporal spatial probability and vulnerability.

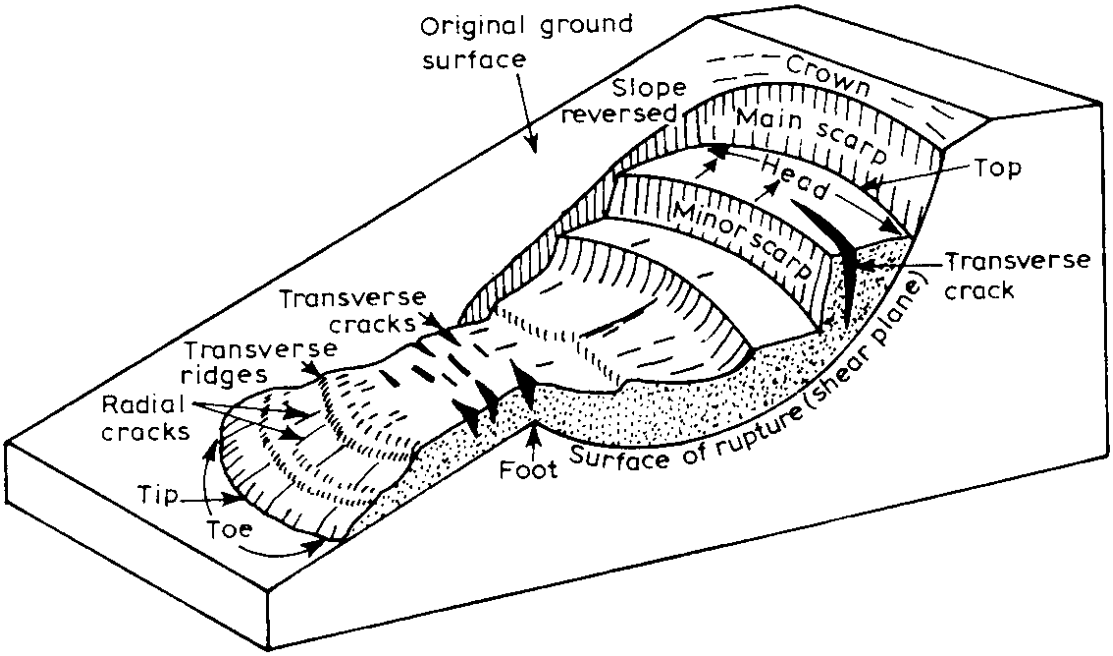
- Elements at Risk: The population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by the landslide hazard.

- Vulnerability: The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is (are) affected by the landslide.

- Zoning: The division of land into homogeneous areas or domains and their ranking according to degrees of actual or potential landslide susceptibility, hazard or risk.

In this report the use of the word ‘Landslide’ covers both existing known landslides and those which a practitioner might also reasonably predict based on geology, geomorphology, and terrain geometry. The terminology of landslides used in this report is based upon Cruden and Varnes (1996) – Ref. 9).

State		**Distribution**		**Style**	
Active	Currently moving	Advancing	Rupture extends in direction of movement	Complex	Different types of movements but in sequence
Reactivated	Active after being inactive	Retrogressive	Rupture extends away from direction of movement	Composite	Different types of movement in different areas
Suspended	Active during previous annual seasonal cycle	Widening	Rupture extends at lateral margin(s)	Multiple	Repeated movements of same type
Inactive • Dormant • Abandoned • Stabilised • Relict	Moved more than annual seasonal cycle ago	Enlarging	Continually adding to displaced material	Successive	Identical to earlier movements, but different displaced mass and rupture surface
		Confined	Scarp but no visible rupture at foot		
		Diminishing	Displaced material reduces with time	Single	Single movement type
		Moving	Displaced material moves, but rupture has not change	Complex	Different types of movements but in sequence



Pictorial illustration of landslide morphology and main features/descriptors

Figures