GeoReports

British Geological Survey

Mam Tor
Edale Valley
Derbyshire
United Kingdom

Landslide Assessment:

This report is for people carrying out preliminary site assessments or who have a general interest in the landslides of a particular area.

The report, prepared by BGS geologists, is based on analysis of:

- Geology maps from the BGS Digital Geological Map of Great Britain
- Records in the BGS National Landslide Database
- Maps and other information held in the National Geoscience Data Centre (NGDC)
- Hazard Potential maps from GeoSure
- Relevant photographs available from the National Archive of Geological Photographs, GeoScenic (http://geoscenic.bgs.ac.uk)
- Relevant published literature

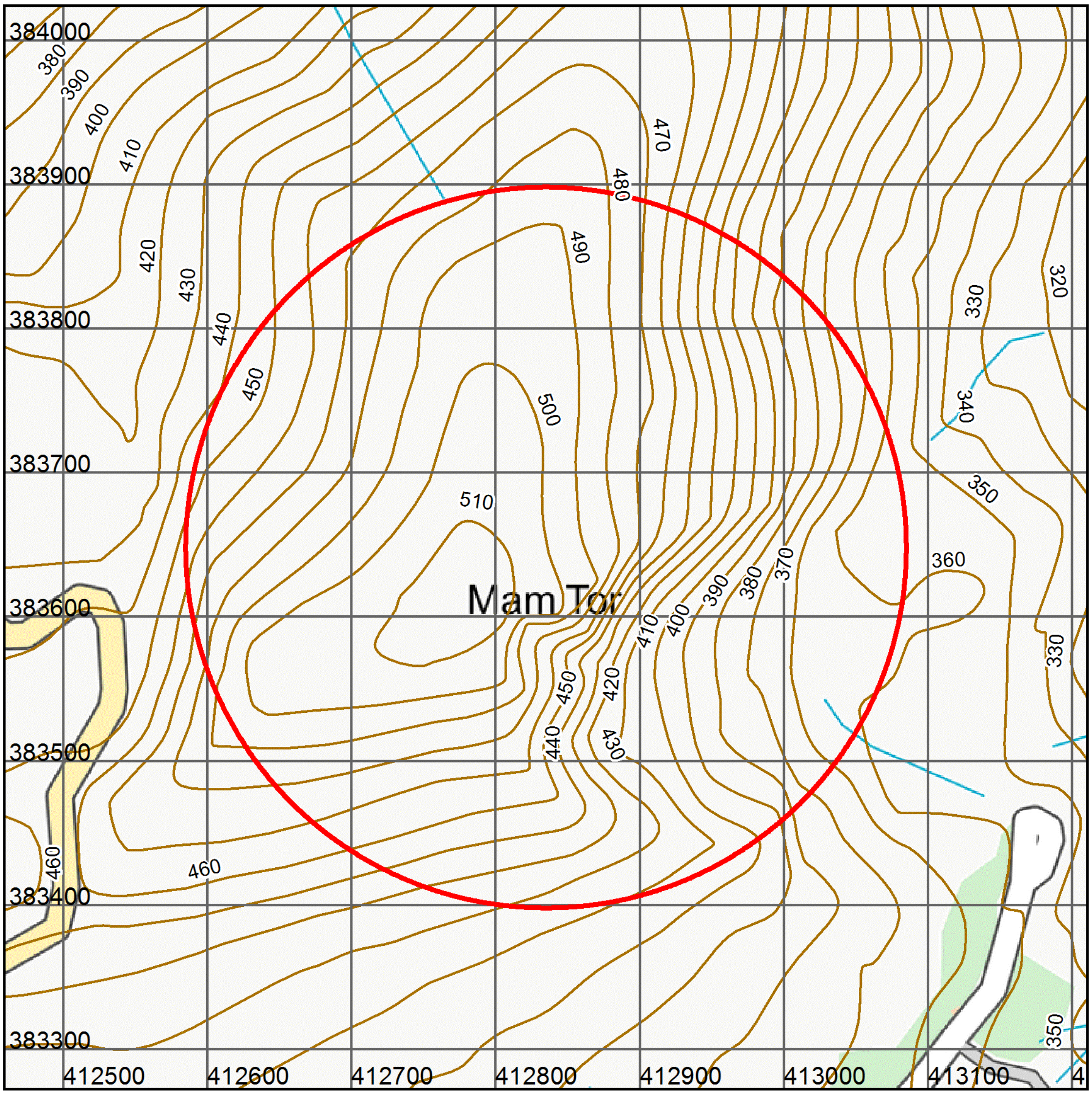
This report describes the rock types that might be encountered at the surface or at 'rockhead' beneath the specified site (meaning the bedrock lying directly beneath the soil layer or beneath superficial or landslide deposits). The report does not, however, consider the hydrogeology at the site: this would be described by other GeoReport modules.

Note that for some sites, the latest available records may be old, and while every effort is made to place the analysis in a modern geological context, it is possible that in some cases the detailed geology or landslide at a site may differ from that described.

Report Id: ***GR_999999/1***

Client reference:

Search location



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Search location indicated in red

Site Address:

Mam Tor
Edale Valley
Derbyshire
UK

Area centred at: 412835,383648
Radius of site area: 250 metres

Landslide Assessment

A landslide is a relatively rapid outward and downward movement of a mass of rock or soil on a slope due to the force of gravity. A slope is under stress due to the force of gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, increasing the water content of the materials forming the slope or by placing material on the slope, especially at the top. Property damage by landslides can occur through the removal of supporting ground from under the property or by the movement of material onto the property.

This report describes landslides that occur partly or wholly within the defined search area based on the information available to BGS. The search area is the extent of the location map. Landslides, by definition, are masses of soil, rock or debris that have moved, or are still in the process of moving, down slope. It is therefore possible that the mass may have moved, or the slope may have been remediated, since the survey was carried out and the data were recorded in the National Landslide Database. This is also true for the landslides mapped on BGS paper and digital maps.

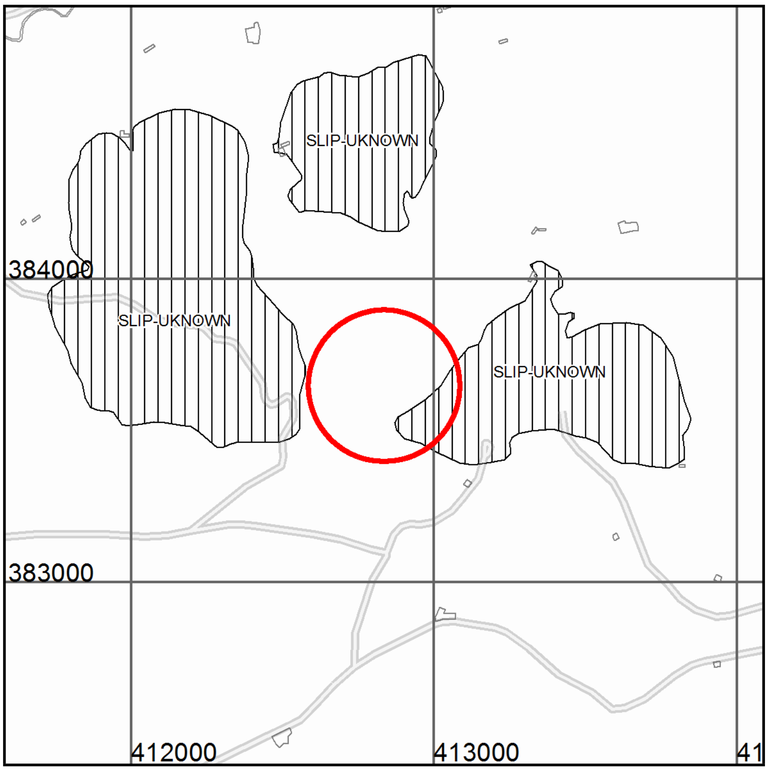
Landslides are named in the National Landslide Database according to the source of information. If the landslide was named by other databases, published work (e.g. journal publication, report), newspaper or other media, then that name has been retained. If the landslide has been taken from British Geological Survey geology maps, the landslide is named according to the nearest available landmark. In some areas, particularly remote locations, this can be for example the name of a woodland, hill, road, settlement, cliff, farm or any other building on the Ordnance Survey map. The landslide names are nominal only and in no way reflect the size, activity or nature of the landslide(s).

The data, information and related records supplied by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed ground investigations. The data must not be used for insurance purposes. You must seek professional advice before making technical interpretations on the basis of the materials provided.

For more information on landslides see www.bgs.ac.uk/landslides

Landslide Deposits

These include natural deposits formed by sliding and other mass-movement of soils and rocks on hill slopes (landslide deposits are a type of ‘Mass Movement Deposits’). An extract of the geology map around your site is provided in this section, taken from the BGS Digital Geological Map of Great Britain at 1:50 000 scale (DiGMapGB-50). The irregular outlines marked ‘SLIP’ indicate the extent of the landslide deposits (that is, not including the landslide back scarp, if any) observed at the time of the geological survey.



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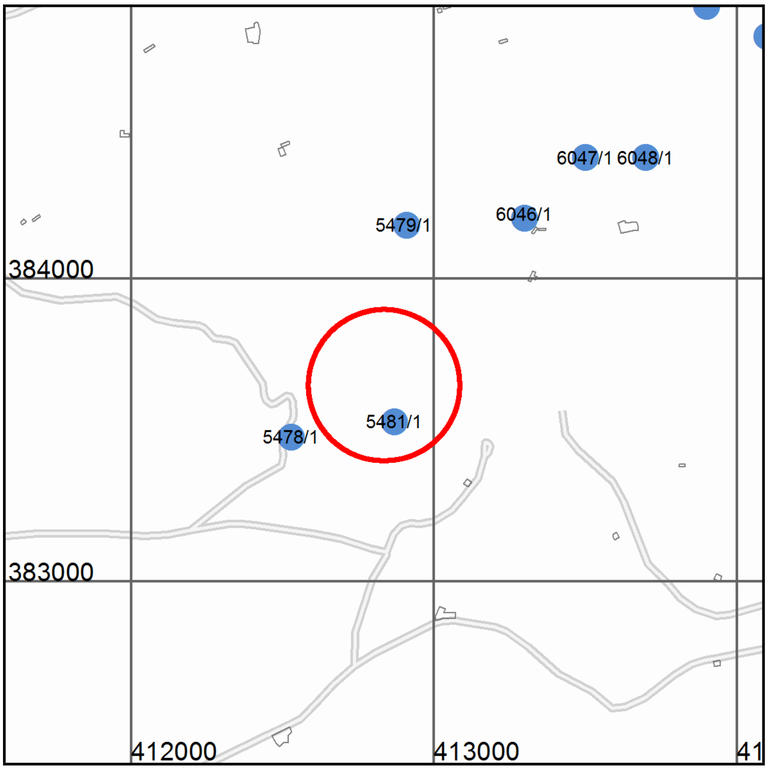
Scale: 1:25 000 (1cm = 250 m)
Search area indicated in red

Key to Landslide deposits:

Map colour	Computer Code	Rock name	Rock type
	SLIP-UKNOWN	LANDSLIDE DEPOSITS	UNKNOWN/UNCLASSIFIED ENTRY

BGS National Landslide Database

The National Landslide Database has been developed by the British Geological Survey. It is the most extensive source of information on landslides in Great Britain with over 17 000 records of landslide events.



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Scale: 1:25 000 (1cm = 250 m)
Search area indicated in red

The point symbols show whether the landslide record has been validated by BGS as follows:

●	Y	The Landslides Team have validated this landslide location to within a range of accuracy
●	N	The Landslides Team is yet to validate this landslide location
○	U	The Landslides Team has tried to find information about this landslide but the original reference material is unavailable

The point numbers refer to the NLD ID combined with the Survey No. in the table overleaf

What do the symbols mean?

Each landslide within the National Landslide Database is identified by a National Landslide Database ID number and a point location, as shown on this map. The National Landslide Database ID number represents an individual survey of a landslide, rather than just the landslide itself. This is because there could be several phases of movement within or extensions to the same landslide, particularly if it is a large and complex one. **Subsequent surveys of the same landslide may be recorded in the database with the same National Landslide Database ID number but with a new Survey number.** The point symbols at the designated location do not reflect the size and shape of the corresponding landslide, but just denote the recorded presence of a landslide within a range of accuracy. Where possible, each point is located at the highest point on the landslide backscarp feature. This is not always possible to locate as, for example, backscarp information is often omitted from older geological maps. In these cases, the highest point on the mapped landslide polygon is used. If this information is not available, the point is located approximately.

In the 1990s, BGS acquired approximately 8 500 landslide records from the then Department of the Environment (DoE). These records had been compiled by Geomorphological Services Limited (GSL) and involved their staff searching through the literature, including BGS maps and reports, to gain as much information as possible about landslides in Great Britain.

The location of each of the landslides in the DoE database was recorded as either a six-figure grid reference (1 km accuracy) or an eight-figure grid reference (100 m accuracy) thereby potentially incorporating a considerable locational inaccuracy. The BGS Landslides Team has been working for several years to re-locate these landslides with more accuracy and to remove duplicates or incorrect entries inherited from the DoE database. This process is still underway and will take several more years to complete. The BGS Landslides Team has also added information on British landslides from other sources, including dedicated field surveys.

Why are there National Landslide Database Points but no landslides on the geological map?

The geological map is just one of the many sources of information that populates the National Landslide Database (see below: Where have the data come from?). The geological maps are a time-stamped interpretation of the ground seen at the time of survey; any landslides that have occurred since that time will not be captured unless a bespoke survey has been commissioned and published on a later version of the digital geological map. The National Landslide Database holds the most up-to-date information on landslides in Great Britain.

National Landslide Database records of landslides

QA Check	NLD ID	Survey No	Name	Location	Easting	Northing	+/-m	References
Y	5478	1	Mam Nick	South side of Edale, Derbyshire, England	412529	383476	100	British Geological Survey DigMap50, EW099_chapel_v3. v 3.14. 05/04/2006 Cooper, R. G. and Jarman, D. (2007) Mam Tor, Derbyshire in Mass Movements in Great Britain, Geological Conservation Review Series, No 33, Joint Nature Conservation Committee, Peterborough, pp167-183. http://www.thegcr.org.uk/Sites/GCR_v33_C05_Site0803.htm Skempton, A W, Leadbetter, A, and Chandler, R J. 1989. The Mam Tor landslide, North Derbyshire. Philosophical Transactions of the Royal Society of London, Series A, Vol 329, 503-547 1988, M Cross, An Engineering Geomorphological investigation of hillslope stability in the Peak District of Derbyshire. Phd thesis (unpublished). University of Nottingham, University Park, Nottingham, NG7 2RD Waltham, A.C. & Dixon, N. 2000. Movement of the Mam Tor landslide, Derbyshire, UK. Quarterly Journal of Engineering Geology and Hydrogeology, Vol 33, p105-123. 1977, British Geological Survey, Sheet 99, Chapel en le Frith (drift) 1:50,000 1977, D S Buist and S Penn, Low cost aerial photography for terrain analysis, DoE/DTP construction Vol.24 pp.46-47 Stevenson I P and Gaunt G D. 1971. Geology of the country around Chapel en le Frith. Memoirs of the Geological Survey of Great Britain. London 1984, S Penn, Colour enhanced infra-red photography of landslips, Quarterly Journal of Engineering Geology. London Vol.17, pp.ii-v 1972, British Geological Survey, Sheet SK18 SW 1:10,560 1967 British Geological Survey Sheet 99 Chapel en le Frith 1:63,360 1981 S L Williams, Geotechnical mapping of slope stability, MSc thesis (unpublished)

QA Check	NLD ID	Survey No	Name	Location	Easting	Northing	+/-m	References
								Imperial College, University of London, Imperial College Road, London, SW7 2BU
Y	5479	1	Cold Side	Cold Side, Derbyshire, England.	412911	384176	10	British Geological Survey DigMap50 EQ099_chapel_v3. v 3.14. 05/04/2006. Cooper, R. G. and Jarman, D. (2007) Mam Tor, Derbyshire in Mass Movements in Great Britain, Geological Conservation Review Series, No 33, Joint Nature Conservation Committee, Peterborough, pp167-183. http://www.thegcr.org.uk/SiteReports.cfm?Step=3v 1977, British Geological Survey, Sheet 99, Chapel en le Frith (drift) 1:50,000 1972, British Geological Survey, Sheet SK18 SW, 1:10,560 Stevenson I P and Gaunt G D. 1971. Geology of the country around Chapel en le Frith. Memoirs of the Geological Survey of Great Britain. London
Y	5481	1	Mam Tor	Derbyshire, England	412796	383578	10	British Geological Survey DigMap50, EW099_chapel_v3. v 3.14. 05/04/2006 Cooper, R. G. and Jarman, D. (2007) Mam Tor, Derbyshire in Mass Movements in Great Britain, Geological Conservation Review Series, No 33, Joint Nature Conservation Committee, Peterborough, pp167-183. http://www.thegcr.org.uk/Sites/GCR_v33_C05_Site0803.htm Cripps, J. C. and Hird, C. C. (1992) A guide to the landslide at Mam Tor, Geoscientist v.2 (3), pp. 22-27. British Geological Survey Mam Tor Landslide Derbyshire http://www.bgs.ac.uk/landslides/MamTor.html Waltham, A.C. & Dixon, N. 2000. Movement of the Mam Tor landslide, Derbyshire, UK. Quarterly Journal of Engineering Geology and Hydrogeology, Vol 33, p105-123. Dixon, N. & Brook, E.2007. Impact of predicted climate change on landslide reactivation: case study of Mam Tor, UK. Landslides, 4, 137-147.

QA Check	NLD ID	Survey No	Name	Location	Easting	Northing	+/-m	References
								Rutter, E.H., Arkwright, J.C,Holloway,R.F. & Waghorn,D.2003. Strains and displacements in the Mam Tor landslip, Derbyshire, England. Journal of the Geological Society, London, 160, 735-744. J. Walstra, N. Dixon and J.H. Chandler (2007), Historical aerial photographs for landslide assessment: two case histories, Quarterly Journal of Engineering Geology and Hydrogeology 2007; v. 40; p. 315-332 1973, C Lant, The Mam Tor landslip, MSc thesis (unpublished) Imperial College, London University 1985, Nature Conservancy Council, Geological Conservation Review Unit. The distribution of mass movement sites. Unpublished report Northminster House, Peterborough, PE1 1A T Waltham. 1978. Catastrophe : The violent earth. Macmillan, London pp.49-79 1981, Sing-Lok Chiu, A review of methods of analysis of slope stability and back analysis of Mam Tor landslide, MSc thesis (unpublished) Department of Civil Engineering, Imperial College, Imperial College Road, London, SW7 2BU Skempton, A W, Leadbetter, A, and Chandler, R J. 1989. The Mam Tor landslide, North Derbyshire. Philosophical Transactions of the Royal Society of London, Series A, Vol 329, 503-547 1985, W Lutley, National Trust (unpublished records) 1972, British Geological Survey, Sheet SK18 SW 1:10,560 1985, M J McCullagh, M Cross and A D Trigg, New technology and supermicros in hazard map production, Proceedings of the second UK National Land Surveying and Mapping Conference and Exhibition, University of Reading pp.1-16 1981, A H Perry, Environmental hazards in the British Isles. George Allen and Unwin, London.

QA Check	NLD ID	Survey No	Name	Location	Easting	Northing	+/-m	References
								Al-Dabbagh, T H and Cripps, J C. 1987. Data sources in planning: geomorphological mapping of landslides in north-east Derbyshire. Geological Society, London. Engineering Geology Special Publications, vol 4. p.101-114 1986, A.W. Thompson, A reconnaissance survey for an analysis of the stability of a rock slope with reference to Mam Tor, Derbyshire. MSc thesis (unpublished) Royal School of Mines, Imperial College, Prince Consort Road, London SW7 2BP M Priestly, The impact of mass movement; a case study of the future of the A625, North Derbyshire, The Frontier 1981, S L Williams, Geotechnical mapping of slope stability, MSc thesis (unpublished) Imperial College, University of London, Imperial College Road, London, SW7 2BU 1968, G D B Jones and F H Thompson, Archaeological reports: excavations at Mam Tor and Brough-on-Noe 1965
Y	6046	1	Mam Farm	SW of Hollins Cross, Edale, Derbyshire, England	413300	384200	100	1988, M Cross, An Engineering Geomorphological investigation of hillslope stability in the Peak District of Derbyshire. Phd thesis (unpublished). University of Nottingham, University Park, Nottingham, NG7 2RD
Y	6047	1	Hollins Cross	100m SW of Hollins Cross, Edale, Derbyshire, England	413500	384400	100	1988, M Cross, An Engineering Geomorphological investigation of hillslope stability in the Peak District of Derbyshire. Phd thesis (unpublished). University of Nottingham, University Park, Nottingham, NG7 2RD
Y	6048	1	Woodseats	200m SE of Hollins Cross, Edale, Derbyshire, England	413700	384400	100	1988, M Cross, An Engineering Geomorphological investigation of hillslope stability in the Peak District of Derbyshire. Phd thesis (unpublished). University of Nottingham, University Park, Nottingham, NG7 2RD

See the map on the previous page for the locations of National Landslide Database ID (NLD ID).

Most of the landslides in this area have occurred where the Mam Tor sandstone beds overlie the mudstones of the Bowland Shale Formation (Waltham and Dixon, 2000) – see geology descriptions later in this report.

Mam Tor (National Landslide Database ID 5481/1). References in table above.
This landslide has been mapped by BGS and is well documented in the literature. The landslide itself is over 4000 years old and is a rotational landslide which has developed into a large flow at its toe (Waltham and Dixon, 2000). It is over 1000 m from backscarp to toe, has a maximum thickness of 30-40 m and the backscarp is over 70 m high.

The Mam Tor landslide. Photograph taken from toe looking up towards the backscarp.

Waltham and Dixon (2000) have divided the landslide into three distinct zones (backscarp area, transition zone and debris flow) according to their structure as follows:

1. *The upper part of the slide material is a series of rock slices or blocks that were produced by the non-circular rotational failure of the original slope; most of these slices above the upper road show little sign of current movement.*

2. *The central part of the slide is a transition zone, forming most of the ground between the two segments of road; it lies between the upper landslide blocks and the lower debris flow. It is composed of an unstable complex of blocks and slices, some of which can be identified by ground breaks along their margins; they overlie the steepest part of the landslide's basal shear, which was the hillside immediately downslope of the initial failure. The upper road lies along the highest section of the transition zone, which is currently the most active part of the whole slide.*
3. *Disintegration of the lower part of the slipped material has created a debris flow that now forms half the total length of the slide. This is described as a flow because it moves as a plastic deformable mass, but it may also be regarded as a debris flow slide because it has a well-defined basal shear surface.*

The Sheffield Turnpike Company first constructed the A625 Manchester to Sheffield road in 1819 using spoil from the nearby Odin mine (National Trust, 2009) and the road crosses the main body of the landslide twice as it winds its way up the slope. The following 160 years saw constant repairs and reconstruction. In 1977, the landslide moved again and the road was restricted to single-lane traffic (Cripps and Hird, 1992). In 1979, the road was permanently closed to traffic and what remains today is an interesting example of landslide movement and repeated road reconstruction and repair.

Damage to the road. The road was permanently closed to traffic in 1979.

Mam Tor is unusual in that it is still an active landslide, with spasmodic advances associated with peak rainfall and raised water table conditions. The current recession rate of the backscarp is 7m per century (Cooper and Jarman, 2007).

Mam Nick (National Landslide Database ID 5478/1). References in table above.
Mam Nick landslide is the largest in the area (twice the extent of Mam Tor) and has a series of short-travel sharp-crested slip masses 3–5m high. Beneath these, the main

failed mass is crossed by the road, below which an 'earthflow' extends at a lesser gradient for 500m down to an 8–15 m-high toe bank above Greenhill Farm (Cooper and Jarman, 2007). In its south-east corner, it breaks through the ridge to create the 'Nick' followed by the minor road over to Edale. Here it has lowered the ridge by about 40 m, and truncates the west flank of Mam Tor, including its hillfort rampart (Cooper and Jarman, 2007).

It is geologically similar to Mam Tor, but, in other respects, the two landslides exhibit strong contrasts. The slope angle at Mam Nick is 10° and the scarp face is grass covered. This landslide now appears to be almost stable but small movements disturbed the minor road running across it in 1977 (Waltham and Dixon, 2000; Skempton *et al*., 1989). Prior to this, the road showed no signs of movement for many years (even in the exceptional rainfall of December 1965) and the main stream carrying surface run-off has eroded a gulley through the lower part of the earthflow. These features indicate stable conditions characteristic of an old landslide; and a much greater age, relative to Mam Tor, is confirmed by a radiocarbon date of 5860+/-120 years (ca. 6600 calendar years BP) on charcoal fragments disseminating in a fossil soil exposed in the gully, under 10 m of slide debris, less than 100 m from the toe. The landslide might have started at least 2000 years before that date (Skempton *et al*., 1989). This landslide has also been mapped by BGS.

Cold Side (National Landslide Database ID 5479/1). References in table above.
This landslide is similar to both Mam Tor and Mam Nick and is in the same geology. This landslide has been mapped by the British Geological Survey. Cold Side (0.25km^2): the grassy scars in the source area are exposed just below the crest NE of Mam Tor. They are up to 32m in height, in a double-wedge obtuse splay. The main slip mass has a striking antiscarp (scarp facing upslope) 8m high impounding a pond, while the toe is a steep rampart 10-15m high (Cooper and Jarman, 2007). This landslide has been mapped by BGS.

Where have the data come from?

Most of the landslide data have come from BGS geological maps. Data from various other sources, listed here, have also been included in the database. Bibliographic references to such sources are included in the database, as shown in the table above.

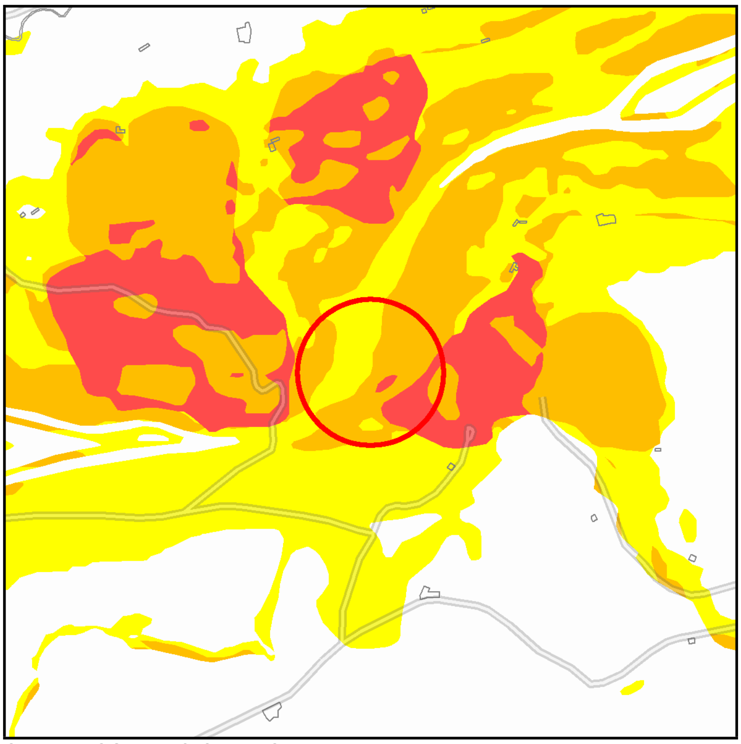
- BGS published paper geological maps
- DiGMapGB-50 and DiGMapGB-10 (BGS digital geological maps)
- BGS memoirs and sheet explanations
- BGS reports
- Journal articles, magazines, etc
- Non-BGS reports
- Local authority records
- Media reports e.g. newspapers, radio, television, web pages
- Inherited databases e.g. DoE database

Where can I obtain the references given in the table?

- BGS cannot provide any of the source references free of charge
- Paper geological maps at 1:50 000 and 1:10 000 scale and the accompanying memoirs or sheet explanations are available to purchase through the BGS Shop. Digital map data are available to purchase through enquiries@bgs.ac.uk, or may be viewed online, free of charge for non-commercial use at http://maps.bgs.ac.uk/geologyviewer.
- BGS memoirs and sheet explanations can be purchased through the BGS Shop, or viewed in the BGS Library.
- Some BGS reports may not be available due to confidentiality
- Journal articles and magazines cannot be provided free of charge but may be obtained through the BGS Library, local libraries, university libraries, online science libraries or the British Library
- Non-BGS reports – BGS cannot provide these without written consent from the authors
- Local authority records cannot be obtained through BGS. Please contact the appropriate local authority.
- Media reports cannot be obtained through BGS. They may still be available online or the publisher or broadcaster can be contacted direct to request the report

Maps of potential for natural landslide

The following map shows where significant natural ground instability due to landsliding could occur. The indicative implications are shown in colour and are described in the key. Please note that a landslide is reported as potentially significant only if it lies at least partly within the search area.The unshaded (white) areas on the map (levels A, B or 'No hazard') represent areas where the conditions that cause natural ground movements due to landslide are considered to be absent or unlikely to be significant. This does not take into account artificial drainage or man made changes to the ground such as buildings or retaining walls.



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Search area indicated in red

Key to Landslide Hazard:

Level	Hazard rating	Advice for public	Advice for specialist - compressible
C	Possibility of slope instability problems after major changes in ground conditions.	Ask about implication for stability if large changes to drainage or excavations take place near to buildings.	**New build** – Consider possibility of trench side or slope movement during excavations, or consequence of changes to drainage. Possible increase in construction cost to remove possibility of potential slope stability problems. **Existing property** – No significant increase in insurance risk due to natural slope instability problems.
D	Significant potential for slope instability with relatively small changes in ground conditions.	Avoid large amounts of water entering the ground through pipe leakage or soakaways. Do not undercut or place large amounts of material on slopes without technical advice.	**New build** – Assess slope stability of site and consequences of excavation, loading and water content changes during and after construction. **Existing property** – Probable increase in insurance risk due to natural slope instability after changes to ground conditions such as a very long, excessively wet winter.
E	Very significant potential for slope instability. Active or inactive landslides may be present.	Seek expert advice about stability of the ground and its management to maintain and increase its stability.	**New build** – Slope stability assessment necessary, special design may be necessary, construction may not be possible. **Existing property** – Significant increase in insurance risk in some cases. Site-specific consideration is necessary to separate cases where landslide are stabilised or ancient and stable from those that may be active or may fail.

The assessment of potential landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of new excavations.

Geological map extracts

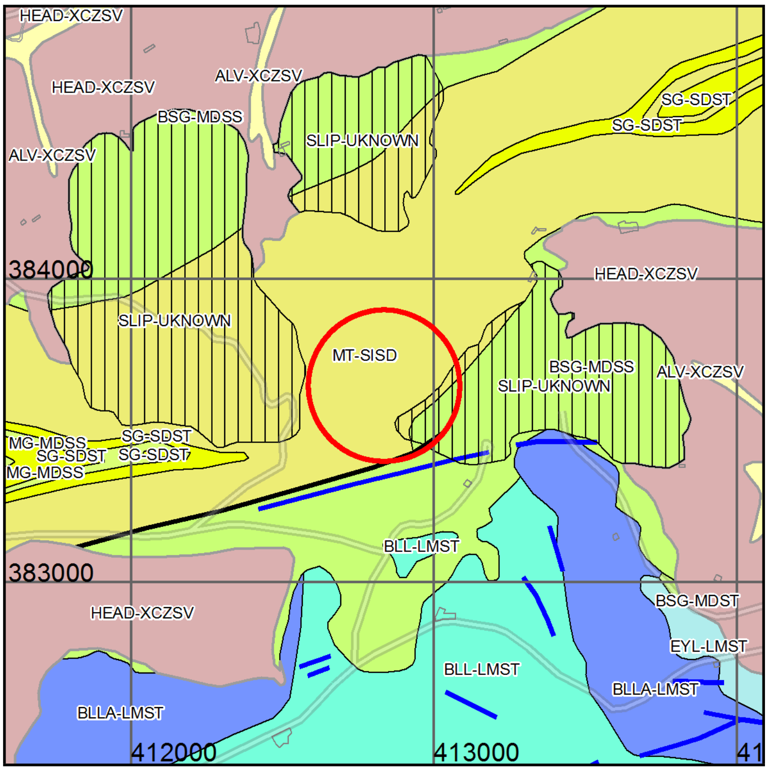
This section provides an extract of the geology map around your site, taken from the BGS Digital Geological Map of Great Britain at 1:50 000 scale (DiGMapGB-50). This map shows the surface elements of the four main layers of geology that may be present in an area – **artificial (man-made) deposits**, **landslide deposits**, **superficial deposits** and **bedrock**.

More information on DigMapGB-50 and how the various rock layers are classified can be found on the BGS website (www.bgs.ac.uk), under the DiGMapGB and BGS Rock Classification Scheme areas. Further descriptions of the rocks listed in the map keys can also be obtained by searching against the Computer Code in the *BGS Lexicon of named Rock Units*, which is also on the BGS Website, by following the 'GeoData' link. The maps are labelled with the Computer Codes, with a dot at the bottom left hand corner of each label. However, please treat these labels with caution in areas of complex geology, where some labels may overlap several geological formations. If in doubt, please contact BGS Enquiries.

The geological formations (and larger subdivisions, such as 'groups') are listed in order of age in the map keys (with the youngest first). However, subdivisions within formations ('members' and 'beds') may not be ordered by age.

Combined 'Surface Geology' Map

This map shows the surface elements of all four geological layers.



Contains OS data © Crown Copyright and database right 2025
Scale: 1:25 000 (1cm = 250 m)

Search area indicated in red

Key to Artificial ground:

No deposits recorded by BGS in the search area

Key to Landslide deposits:

Map colour	Computer Code	Rock name	Rock type
	SLIP-UKNOWN	LANDSLIDE DEPOSITS	UNKNOWN/UNCLASSIFIED ENTRY

Key to Superficial deposits:

Map colour	Computer Code	Name of geological unit	Composition
	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
	HEAD-XCZSV	HEAD	CLAY, SILT, SAND AND GRAVEL

Key to Bedrock geology:

Map colour	Computer Code	Name of geological unit	Rock type
	MT-SISD	MAM TOR BEDS	SILTSTONE AND SANDSTONE
	SG-SDST	SHALE GRIT	SANDSTONE
	MG-MDSS	MILLSTONE GRIT GROUP [SEE ALSO MIGR]	MUDSTONE, SILTSTONE AND SANDSTONE
	EYL-LMST	EYAM LIMESTONE FORMATION	LIMESTONE
	BLL-LMST	BEE LOW LIMESTONE FORMATION	LIMESTONE
	BLLA-LMST	BEE LOW LIMESTONES FORMATION (APRON-REEF)	LIMESTONE
	BSG-MDST	BOWLAND SHALE FORMATION	MUDSTONE
	BSG-MDSS	BOWLAND SHALE FORMATION	MUDSTONE, SILTSTONE AND SANDSTONE

Fault

Coal, ironstone or other mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Geological interpretation of landslides

There are several landslides that shape the ridge on the south side of Edale and most of these occur where the weaker Bowland Shale Formation underlies the more competent Mam Tor Beds (described below). This represents the typical slide-flow landslide seen throughout the Pennines where competent permeable rocks overlie weaker strata that are less permeable and prone to deformation.

Artificial Ground:

No artificial ground has been recorded up to the date of map compilation (1961).

Superficial Deposits:

Alluvium

Alluvium represents the deposits on present-day floodplains, forming low-lying ground adjacent to the River Noe in the far north of the search area, and is typically around 1 to 3 m thick hereabouts. It is likely to be composed of sand, silt and clay in varying proportions, probably overlying gravel. Alluvium may contain lenses of water-saturated sand, which could give rise to unexpected outflows (running conditions) in boreholes or excavations. It may also contain lenses of highly compressible, organic-rich material, such as peat. Alluvium, by definition, may be at risk from flooding.

Head

Head deposits are commonly present on slopes or on the floor of valleys. They formed mainly by gradual down-slope mass-movement (solifluction) under past conditions of cold climate, but can include the products of more recent soil creep or hill wash. Their composition reflects that of the local materials from which they were derived, either the bedrock or other types of superficial deposit, or both in combination. Head deposits typically are poorly stratified and poorly sorted, and can be variable in composition.

In the Edale valley, where exposures are most numerous, the deposit changes in two respects as it is traced towards the middle of the valley. The enclosed rock fragments become progressively more rounded and distinct stratification with layering caused by hill-wash.

In the Edale valley the thickest valley-fill head deposits occur along the lower courses of tributary streams and they thin towards the interfluvial areas and towards the middle of the main valley. This thickness variation suggests that the deposits consist of a number of interlinked fan-like spreads each radiating from the mouth of a tributary valley. Valley-fill head appears to pre-date all terrace, alluvium, peat and landslide deposits with which it is in contact. It appears likely that the deposit formed in later Weichselian and possibly earliest post-Weichselian times, when an abundance of ground and surface water combined with a lack of a substantial vegetation cover would be expected to facilitate this type of deposition.

Some head deposits, especially those composed mainly of clay, may contain gently dipping shear surfaces. These can significantly reduce the strength of the deposit and so constitute a potential hazard.

Bedrock Geology:

Mam Tor Beds

The summit and upper slopes of the Mam Tor landslide and the other landslides in this report expose the Mam Tor beds. These are of the order of 80-120 m thick and are a turbidite sequence of upward-fining cycles of grey-brown, very fine-to fine-grained, massive and laminated, micaceous sandstone overlain by grey, laminated siltstone and dark grey mudstone; these alternate in cycles about 1 metre thick and the sandstone beds are densely fractured. The sandstones are moderately strong to strong; the siltstones are moderately strong; the mudstones are weak to moderately weak. The Mam Tor beds are Kinderscoutian in age and are part of the Hebden Formation which is part of the Millstone Grit Group described below.

Shale Grit

The Shale Grit varies in thickness up to 200 m, but only the lower few metres are present in the search area. It is a sequence of often massive sandstones with shale beds. The Shale Grit is part of the Hebden Formation, which is fine- to very coarse-grained and pebbly, feldspathic sandstone interbedded with grey siltstone and mudstone, with subordinate marine black shales, thin coals and seatearths. The Shale Grit and Hebden Formation are part of the Millstone Grit Group described below.

Millstone Grit Group

The Millstone Grit Group typically consists of coarsening-upward cycles of dark grey carbonaceous mudstones, grey silty mudstones and siltstones, and fine- to very coarse grained feldspathic sandstones (formerly referred to as ‘grits’). Subordinate coals and residual soil horizons typically cap the cycles in the upper part of the group. The sandstones can range from coarse-grained and cross-bedded or massive, to fine-grained, micaceous and thinly laminated types. At Kinderscout, the Millstone Grit Group is about 1200 m thick.

Bee Low Limestone Formation and Bee Low Formation (apron reef)

These formations comprise pale grey, pale brownish grey to grey, fine- to medium-grained calcarenites that are thick-bedded with scattered crinoid debris; they are mainly biosparites, but biopelsparites and pelsparites also occur. The Bee Low Limestone Formation is Asbian in age and was proved to be 85 m thick in a borehole drilled at Eldon Hill Quarry. The Bee Low Formation (apron reef) is limestone that contains more micrite and is poorly bedded compared to the Bee Low Limestone Formation which is a strong to very strong limestone that contains joints, particularly near the surface.

Bowland Shale Formation
The Bowland Shale Formation (previously known as the Edale Shale Formation) is a weak to moderately strong laminated mudstone that weathers to become very weak. It is composed of mainly dark grey fissile and blocky mudstones and is around 300 m thick. It is weakly calcareous, with subordinate sequences of interbedded limestone and sandstone. It is fossiliferous in discrete bands. The Bowland Shale is Namurian in age and is commonly associated with landslides.

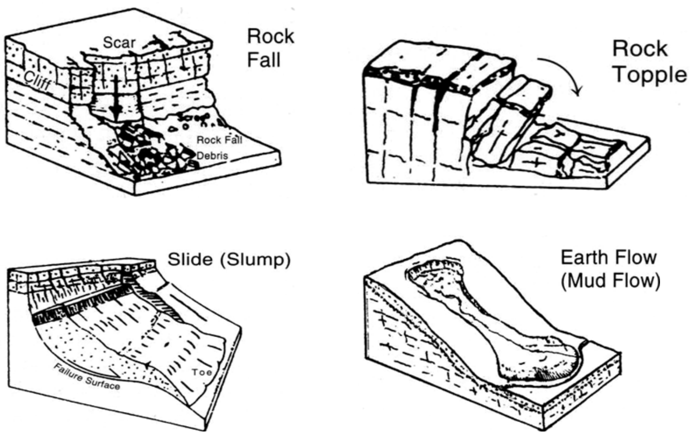
Faults
A minor fault runs through this area, it separates the Edale shales from the Mam Tor beds and cuts through the Mam Tor landslide in the southern edge of the slide scar, below which it is obscured beneath the landslide deposit (Waltham and Dixon, 2000). The fault has a downthrow of about 20 m to the north-west which diminishes to the north-east. The fault also offsets the Odin vein.

Mineral veins
The Odin vein contains galena, a sulphide ore mined for lead. This was mined from the Odin mine at Castleton which dates back to Roman or Saxon times.

NOTES ON LANDSLIDE HAZARDS

1. What is a landslide?

A landslide is the outward and downward movement of rock or soil on a slope. This takes place by falling, toppling, sliding, or flowing.



A landslide is rarely the consequence of a single type of movement; it is usually the result of a combination of several types, changing in nature with conditions and time.

2. Why do landslides occur?

A slope is under stress due to the force of gravity. It does not move if the shear strength of the material that forms the slope is greater than the stress due to gravity. If the balance is altered so that stress exceeds available strength, movement down slope will occur until a stable slope profile is formed.

3. What problems do landslides cause?

- Many landslides occurred in the past under different climatic conditions to those of the present day and, if left undisturbed, they may remain stable for many years
- Property is damaged if landslides remove ground that is supporting the property
- Property that is built on a landslide may be damaged by stretching or compression as the ground moves
- Property below a landslide may be damaged if material falls onto it from above or slides or flows into it from the side

4. What might I see?

- Piles of debris and fallen material below steep slopes and cliffs
- Hollows in slopes with lobes of material below them
- Bulges in the ground especially at the foot of slopes

- Ridges in the ground, usually along the slope but sometimes down the slope
- Open cracks in the ground
- Scarps or steps in the ground surface
- Patches of very wet soft ground on slopes
- Cracks in walls, paths and roadways
- Tilting of trees, fences, walls or buildings
- Doors or windows that stick

5. What action should I take?

If landsliding appears to be active on or near your property, inform your insurance company, mortgage lender or landlord, as appropriate, or get specialist advice from a suitably qualified expert such as a structural surveyor, geotechnical engineer or chartered engineering geologist.

If landsliding is not active but the area has a potential for landslide activity, take specialist advice before starting major building or drainage work or modifying the ground around your property.

6. DO

- Ensure water supply pipes are in good repair and are not leaking
- Ensure ditches and drains are directed away from potentially unstable ground and are well-maintained
- Maintain gutters and down pipes and direct them to piped drainage systems
- Manage wooded slopes to enhance stability

7. DO NOT

- Remove material from the bottom of slopes
- Place material on, or at the top of, slopes
- Dispose of rainwater or surface water to soakaways on a landslide
- Allow surface drainage to discharge water onto slopes or the ground behind slopes
- Remove vegetation whose roots may be strengthening loose or weak material or which may strengthen the slope by removing soil moisture

For more information on landslides, see www.bgs.ac.uk/landslides

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