

Mines and mineral waste tips

(A new plan included in May 2009)

1. A Definition

The extensive development of metalliferous deposits in Devon, most of which are related to the intrusion of the Dartmoor granite and related Variscan tectonic processes, inevitably resulted in a high concentration of mine workings. Although all these operations are now closed – most for over 100 years - they still are very important features of Devon's landscapes and its geodiversity. These sites offer access to parts of Devon's geology which is otherwise invisible, occasionally directly through the very few tunnels and shafts that survive, but typically, and more safely, through their tips of waste materials which reveal the characters of the deposits which were once worked.

The range of different ores produced in Devon is remarkable – the tin mines of Dartmoor are well known, but the county also contained the world's largest copper mine in the 1860s! Elsewhere ores of lead, zinc, arsenic, iron, antimony and even silver have all been extracted. Together, Devon and Cornwall contain one of the best records of hydrothermal mineralisation in the world due to their particularly high density of mines, their variety of minerals and their importance to the early history of geological science in Britain. Due to this, many sites are world type locations for various mineral species. The tremendous historical value of some of these workings is now firmly established through inclusion within the Cornish Mining World Heritage Site: www.cornish-mining.org.uk.

The mineral tips associated with mines are also a specialised habitat especially for lichens, many of which are immune to, and may even require, metal-rich substrates, such as lead, copper and tin. Metal tolerant mosses and higher plants may also be present, although surveys are often lacking on sites in Devon. Open shafts and adits (i.e. tunnels) may include rare lower plants around their entrances, especially where wet, but more significantly provide roosts for bats, including Greater Horseshoes.

This Action Plan includes all former metalliferous mining sites in Devon, their underground workings and surface waste tips. Associated geological exposures, for instance in open works, are also included.

2. Why an Action Plan?

Although geographically of comparatively limited extent, Devon's heritage of mines sites is one of the richest in the UK. This significance is now confirmed in a global context by the listing of the Cornish Mining World Heritage Site and inclusion of their mineralogy within Global Geosites categories. Many mine sites remain threatened, however: vegetation growth including forestry can damage and conceal features, perceptions of contamination and other risks can lead to removal, mine dumps are often excavated to supply stone and features can be landscaped as part of miss-directed 'derelict land' restoration schemes.

Mine sites can also be vulnerable to inappropriate mineral collecting, especially where rare minerals are present. Such activities frequently involve excavation which can damage archaeological features and habitats for little scientific gain.

Although commonly overgrown with scrub, woodland or heathland vegetation, mines and mineral waste tips can also include a range of rare and sensitive species. Most conspicuous are bats, which roost or hibernate in some old underground workings, less well known are metal-tolerant plants including mosses.

Whether they are opencasts, underground workings or surface waste tips, virtually all features of this habitat are in an archaeological context. Inevitably, therefore, conflicts in management and user aims can arise as geological, ecological and archaeological perspectives on site conservation interact. The purpose of this action plan is therefore to establish basic principals to guide a more holistic approach to the conservation of mines and mineral waste tips.

3. Characteristic wildlife

The stony waste tips which tend to dominate most old mine sites are often overgrown by heathland or woodland vegetation. Where mineral content of the tips is significant, however, high levels of sulphide, arsenic and metals such as copper and lead mean that the flora is much more restricted or even virtually absent. It is highly likely that such areas include a range of metal-tolerant plant species, including grasses and mosses, although survey data from Devon appears to be limited. Some of these species, such as Cornish Path Moss (currently only known from Cornwall), are of high conservation interest.

Rock outcrops including in damp areas fed by underground mine waters can have important lower plant assemblages, including lichens, liverworts, ferns and mosses. The last group includes the dramatic luminous moss *Schistostega pennata*, which appears to glow a golden-green colour when caught in the light.

Flooded workings can provide true wetland habitats, although again mineral rich groundwaters may produce conditions suitable for only a small range of species.

Some of the most significant species present in mine sites, however, are bats which use shafts and tunnels for roosting and hibernating. Devon's mines include internationally important colonies of greater horseshoe bats (see also Caves, karst and limestone habitats HAP).

4. Special species

Please note: this action plan has been developed from the former *Caves, karst and mines* plan. Caves and karst are now dealt with separately in the new *Caves, karst and limestone habitats* plan. The emphasis during the revision of this plan has been on geological features rather than wildlife. In due course, the 'Characteristic wildlife' and 'Special species' sections will be revised and enhanced to more fully reflect the true wildlife importance of these habitats.

In addition, quite a lot of additional research is required.

The following species of conservation concern are associated with Rhôs pasture in Devon. Species marked (p) are 'Species of Principal Importance in England' (NERC Act, S.41).

- **Mammals**: Greater horseshoe bat (p), lesser horseshoe bat (p)
- **Crustaceans**: Cave shrimp *Niphargus glenniei* (p)
- **Bryophytes**: luminous moss *Schistostegia pennata*
- **Lichens**: a number of species are associated with waste tips – this section to be enhanced
- **Vascular plants**: Tunbridge's filmy fern *Hymenophyllum tunbridgense*

5. Special geodiversity features

Key geological features well represented in the mines and mineral waste tips of Devon include:

- Stratigraphical (Phanerozoic): Devon (marine) carbonates and clastics
- Permian-Triassic red-bed sequence
- Igneous and metamorphic geology: Igneous rocks linked to the northern European Variscan fold-belt

- Igneous and metamorphic geology: Permian-Carboniferous igneous rocks of Britain
- Mineralogical, economic: Minerals and mineral assemblages in igneous intrusions
- Mineralogical, economic: Sn-Cu-AS veins associated with Cornubian batholith
- Mineralogical, economic: Contact metamorphic assemblages
- Mineralogical, economic: Supergene mineralisation
- *Structural: Variscan nappes and allochthon/ parautochthon of Devon and Cornwall

Other important Earth heritage features which are represented in the mines and mineral waste tips of Devon include:

- Devonian Igneous rocks
- Lower Carboniferous stratigraphy and palaeontology (marine)
- Upper Carboniferous stratigraphy and palaeontology (marine and non-marine)

6. Mines and mineral waste tips distribution in Devon

The main concentrations of pits and quarries in the County are as follows:

- Tamar-Tavy valleys to Mary Tavy, West Devon (copper, lead, zinc, arsenic, etc).
- Milton Abbot area (manganese)
- Dartmoor granite (tin)
- South east Dartmoor aureole (iron, lead, copper, arsenic, uranium, etc)
- Teign valley (lead, barite, iron)
- Okehampton area (north-west Dartmoor) (copper, arsenic, etc)
- Newton St. Cyres – Upton Pyne (manganese, lead)
- Combe Martin - Ilfracombe area (lead, silver, iron)

- South Molton area (copper, iron)
- Torbay (iron)

The most detailed records of the historical extent of the workings in these areas can be found in:

DINES, H.G. 1956. The metalliferous mining region of south-west England. Volume II. *Memoirs of the Geological Survey of Great Britain: England and Wales*. HMSO, London, 795 pp.

JENKINS, A.K.H. 1974. *Mines of Devon Volume 1: The Southern area*. David and Charles, Newton Abbot, 154pp.

JENKINS, A.K.H. 1981. *Mines of Devon – North and East of Dartmoor*. Devon Library Services, Exeter, 220pp.

7. Current extent

Although historical sources document all known former mine sites, there is no comprehensive, contemporary review of what features remain at most of these sites and hence no readily-available figures for the area of land in Devon occupied by mines and mineral waste tips.

8. Current problems for mines and mineral waste tips in Devon

- Waste disposal and landfill, including dumping of old agricultural machinery and other farm waste, obscures geological exposures and destroys wildlife habitats (and may risk contamination of groundwater and streams).
- Built development is locally a problem, especially where mine sites are levelled to construct farm and commercial buildings. In addition to direct loss of geological resource and habitat, such developments may also lead to restrictions on access.
- Vegetation growth can obscure geological exposures, prevent access and also loosen rock faces if present, creating safety/access problems. Tree roots can also disturb the delicate mineralogical systems which can become established in some tips, leading to the generation of new mineral species.
- Capping of mines and cave entrances for safety reasons prevents access both to specialist scientists and wildlife such as bats. Although difficult to quantify, mines are subject to loss due to natural collapse.

- The removal of mineral-rich tip material for hardcore or as part of 'restoration' schemes is often a very significant issue. Such material is often used for surfacing tracks and, as well as destroying the original feature, such movement can lead to contamination by both spreading of metal-rich materials and breaching of previously sealed mine waste tips systems. Some of this activity may be linked to ecological or archaeological initiatives, where insufficient consideration of geological issues has been made.
- Damage and disturbance to rare species and sensitive geological features through recreational activities such as mountain biking, motor biking and inappropriate 'caving'.
- In some instances, inappropriate mineral collecting targets the rarest of deposits leading to significant levels of local damage. As well harming sensitive geological features, many of which are finite, this activity may also damage archaeological features and disturb bats and other key species. Typical recorded activities include underground excavation of mineral veins, and a widespread digging into mine dumps.
- Most geologists (*including* amateur), however, and geological societies and educational institutions now apply national guidelines for the responsible use of sites, including concerning sample collecting for educational and scientific purposes. Responsible site use such as this is beneficial to conservation and both raises awareness of broader issues concerning the habitat and improves the documentation and understanding of the features being studied.
- Many new geological discoveries have been made in this way, although there is currently no centralised repository for the site and specimen records generated. As a result, key documentary information of potentially great value to conservation bodies, site managers and science is not being recorded. In addition, key specimens representing facets of Devon's rich geological heritage are being 'lost' as deposition in a Devon-based museum is not always encouraged or promoted. Conservation in a museological context is a natural extension of site-based conservation.

9. Recent changes in number and extent

Quantification of gains and losses is not easily achieved, but examples of damage and partial loss in Devon include:

- Excavation and disturbance of mine dumps and removal of underground deposits is widespread, including at Red-a-ven Mine near Okehampton, Virtuous Lady Mine near Tavistock and Devon United Mine near Mary Tavy.
- Removal of dump material to surface tracks, etc, including at several mines south-east of Dartmoor.

No gains can be reported as no mines have been operational in the county since the early 1970s.

10. Current site protection

SSSIs notified for the geological and biological features of their mine workings and mineral waste tips include: Bulkamore Iron Mine SSSI, Devon Great Consols SSSI, Devon United Mine SSSI, Haytor and Smallacombe Iron Mines SSSI, Lockridge Mine SSSI, Meldon Aplite Quarries SSSI, Wheal Emily SSSI.

Other SSSIs which include mine sites include: Berry Head to Sharkham Point SSSI, East Dartmoor SSSI, North Dartmoor SSSI, South Dartmoor SSSI.

There are a number of CGSs which are mine workings: the recent establishment of a database of CGS in Devon will ultimately facilitate the listing of all sites which have such features.

11. Current positive initiatives for mines and mineral waste tips in Devon

- The County Geological Sites (CGS) and County Wildlife Sites (CWS) schemes identify non-statutory sites of (at least) County importance for their geology and wildlife, and provide planning authorities with this information to steer development away from such sites or to ameliorate potential damage. Devon RIGS Group (see below) and Devon Wildlife Trust co-ordinate the identification of CGS and CWS, respectively.
- Devon RIGS Group (Regionally Important Geological/Geomorphological Sites) promotes geological conservation, by working with local authorities, landowners and others and provides advice, on request, on County Geological Sites and the management needed to retain or enhance their geological interest. The RIGS Group is undertaking detailed district by district surveys, completed surveys include North Devon AONB, mining districts in West Devon, Torbay, Exeter, South Hams, East Devon, Teignbridge and Dartmoor.
- The Ussher Society provides a forum for presenting and discussing the results of geological research into Earth heritage sites in the South West

of England. These results are published annually in *Geoscience in south-west England*.

- The Devon Educational Register of Geological Sites provides a web-based resource for educational groups and includes over 80 CGSs and SSSIs (www.devon.gov.uk/geology). Several of these sites are mine sites.
- Devon County Council and Natural England have supported Devon RIGS Group in the establishment of a database of County Geological Sites, including descriptions, maps and photographs. Some of this information is available via the newly established Devon RIGS website.
- The development of the UNESCO-supported Global Geosites initiative provides a context within which the international importance of the geological and mineralogical features of Devon's mines can be independently demonstrated.
- The recently listed Cornish Mining World Heritage Site has significant implications for the management of mining-linked geological sites and their associated biodiversity within and adjacent to its boundaries.
- Preservation and increased awareness and understanding of Devon's rich heritage of industrial archaeology at mines and mineral dumps across the County is providing opportunities for integrated land management and heritage protection.

12. Biodiversity planning context

National BAP Context

Habitats of Principal Importance in England (NERC Act, S.41):

- Calaminarian grasslands

Current national BAP targets can be viewed on the [Biodiversity Action Reporting System](#) (BARS).

Regional BAP Context

Regional targets for priority BAP habitats can be found on the website of [Biodiversity South West](#).

Associated Action Plans within the Devon BAP:

- Greater horseshoe bat
- Caves, karst and limestone habitats

- Cities, towns and villages
- Lowland heathland
- Oak woodland
- Pits, quarries and cuttings
- Sea cliff and slope
- Periglacial landscapes

13. Biodiversity objectives and targets mines and mineral waste tips in Devon

Objective 1

Seek to integrate the objectives of geological, ecological and archaeological conservation in the management of former mining sites.

Targets:

- Ongoing.

Objective 2

Identify and target for conservation effort those mine workings, including underground and surface workings and waste tips, that are of particular significance to the geological heritage and wildlife of Devon.

Targets:

- Complete survey and identification of County Geological Sites and County Wildlife Sites by 2010.
- Contact all owners of these sites by 2010 to advise on management options and where appropriate promote action to prevent damage to sensitive geological and ecological features (e.g. signing, gating entrances to underground workings, etc.).

Objective 3

Seek to reduce any potential conflicts between conservation objectives for former mining sites and their recreational / educational use.

Targets:

- Continued liaison with all user groups, and production of guidance for site owners, occupiers and site users.
- Identify or zone key sites for different user groups, including scientific research and managed specimen collecting for educational purposes.

Objective 4

Foster greater public awareness and understanding of the value of former mining sites, both as key opportunities to view and learn about Devon's geological heritage and also as unique wildlife habitats and as archaeological monuments.

Targets:

- By 2010 have a network of public trails which demonstrate the geology, ecology and archaeology of key former mining sites in Devon with public or permissive access.
- Ensure adequate educational materials are available via publications and / or web sites.

Objective 5

Improve the documentation of the geological features and fauna and flora of former mining sites to both facilitate educational and scientific study and inform decision making.

Targets:

- Establish a county geological records centre to gather and manage site records and reports, including a database of all former mining sites in Devon.
- Encourage the reporting of new discoveries and deposition of important specimens in county-based institutions.

14. Wider benefits from pursuing these objectives

The pursuit of the objectives and targets set out in this Plan will not only benefit the Earth heritage interest and biodiversity of former mining sites. Conservation also has wider benefits and advantages for society, by providing

a resource which is the basis of many aspects of the local economy, and by adding to the quality of life of the people of Devon in ways which are beyond financial measure. Thus enhancing the interests of geo- and biodiversity will also enhance the interests of society as a whole. Some of the wider benefits are as follows.

Benefits to the study of industrial archaeology, since all former mining sites provide insights into past industrial activity and the history of the county.

The conservation of geological materials, especially fossils and minerals, involves aspects of both site and specimen conservation. Specimen collecting is also an essential part of the scientific and educational process. In many cases, conservation on-site is also not an option as the natural processes of weathering and erosion and the risk of removal by inappropriate collecting make it essential to remove the specimen or specimens from the site on which it was found and place it in a secure location. Working with county-based museums will ensure that such material remains available for future study and display, including for raising awareness of Devon's rich geological heritage, thereby fulfilling a number of the key functions of such institutions.

Integration of recreational activities with Earth heritage, wildlife and archaeological conservation objectives. The objectives of this Plan aim to strike a workable balance between these three aspects of former mining sites and will demonstrate that management aims can be compatible, given co-ordination and careful thought.

15. Priority or indicative actions for mines and mineral waste tips in Devon

Action	Key Partners
1. Seek to integrate geological, ecological and archaeological conservation in the management of former mining sites, including underground workings, surface exposures and waste tips.	DRIGSG; DCC; DNPA; NE; Site owners; LAs; DWT
2. Seek to restrict access and use of sites that are particularly sensitive or vulnerable in a geological sense and at times of year when vulnerable species are breeding or hibernating. Appropriate access for continued bone-fide geological research should, however, be maintained. Consider using alternative sites to direct educational and recreational pressures away from sites with delicate or rare features, such as sensitive mineral deposits or animal and plant communities.	DRIGSG; DCC; DNPA; NE; Site owners; LAs; DWT
3. Provide advice and resources to owners of mine sites (especially SSSIs, CWS & CGS) to achieve sympathetic management for Earth heritage features and wildlife.	DWT; DRIGSG; NE; NPAs; DBG; Site owners; Las; DWT
4. Undertake surveys at appropriate intervals to monitor access, visitor pressure, disturbance or degradation of geological or ecological features of mine sites so that amelioration measures can be implemented if necessary.	DWT; DRIGSG; NE; NPAs; DBG; Site owners; Las; DWT
5. Increase public awareness of the important Earth heritage and wildlife resource contained in former mining sites including	DCC; DNPA; NE; DRIGSG;

Action	Key Partners
though establishing access to safe sites, interpretation, events and guided tours.	universities; BGS
6. Take action to protect vulnerable sites including signing, gating of entrances, etc, to ensure that all key sites are adequately protected.	NE; DWT; DRIGSG; NE; NPAs; Site owners; LAs; Police forces
7. Establish a geological records centre for Devon and promote the reporting and recording of new finds.	DRIGSG; museums; universities; DCC; BGS; landowners including NT

Mines and mineral waste tips Champion – to be established

Abbreviations used in text and table

BGS	British Geological Survey
BSBI	Botanical Society of the British Isles
BTO	British Trust for Ornithology
CLA	Country Landowners Association
CGS	County Geological Site
CWS	County Wildlife Site
DBG	Devon Bat Group
DBWPS	Devon Birdwatching and Preservation Society
DCC	Devon County Council
DIF	Devon Invertebrate Forum
DNPA	Dartmoor National Park Authority
DRIGSG	Devon RIGS Group
DWT	Devon Wildlife Trust
LAs	Local Authorities
NE	Natural England
NFU	National Farmers Union
NPAs	National Park Authorities
RIGS	Regional Important Geological/Geomorphological Sites
RSPB	Royal Society for the Protection of Birds
WT	Woodland Trust