



United Kingdom china-clay bearing grounds: mineral resource archaeological assessment



Cornwall Archaeological Unit

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Client	English Heritage
Report Number	2014R028
Date	December 2014
Status	Final
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Acknowledgements

This study was commissioned and funded by English Heritage. Dave Hooley and Jon Humble provided input during the project and the author is also grateful to Peter Herring for discussing aspects of characterisation and assessing significance.

Within Cornwall Archaeological Unit (formerly Historic Environment Projects), GIS mapping was produced by Sean Taylor and the author with technical help from Francis Shepherd and Peter Dudley. Sara Homes assisted with formatting the report. The Project Manager was Andrew Young. Dan Ratcliffe of Cornwall Council Historic Environment advised on aspects of the planning context for the china-clay industry.

Thanks are also particularly due to the following:

- Ivor Bowditch and Derek Giles of the China Clay History Society for their interest and for information, use of archive historic photographs and a copy of the DVD *St Austell's china clay district: a brief study of past working sites* (Bowditch 2013).
- Current and former colleagues in Cornwall Archaeological Unit, Cornwall Council, for past work which this project has been able to utilise, not least the ground-breaking 1991 report on the St Austell clay area by Peter Herring and John Smith.
- Bill Horner and Steve Reed of Devon County Council Historic Environment Team, for HER data, digital mapping, photographs and comments on a draft text; Andy Hill, Principal Planning Officer – Minerals and Waste, Devon County Council, for guidance on mineral planning matters.
- Jane Marchand, Senior Archaeologist, Dartmoor National Park Authority, for comments on a draft text and for photographs.
- Steve Hebdige for images from postcards from his collection. James Goodman for an extract from his poem, *The White Hill*, and Roy Goodman for use of his fine photograph, *Hendra Pit*.

The views and recommendations expressed in this report are those of Cornwall Archaeological Unit and are presented in good faith on the basis of professional judgement and on information currently available.

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Cover illustration

Late October sun illuminates the summits of two sky-tips ('burrows') at the disused New Halwyn china-clay works, on the north-west fringe of the St Austell china-clay district in Cornwall. In the foreground are modern operations on part of the giant Melbur china-clay works. (Photograph: Historic Environment, Cornwall Council: F87-237; 31 October 2008.)

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Abbreviations

ALSF	Aggregates Levy Sustainability Fund
BGS	British Geological Survey
CAU	Cornwall Archaeological Unit
CBI	Confederation of British Industry
CISI	Cornwall Industrial Settlements Initiative
CoP	Code of Practice
CSUS	Cornwall and Scilly Urban Survey
DCLG	Department for Communities and Local Government
DNPA	Dartmoor National Park Authority
EH	English Heritage
GIS	Geographical Information System
HE	Historic Environment, Cornwall Council
HER	Historic Environment Record
HLC	Historic Landscape Character / Characterisation
KABCA	Kaolin and Ball Clay Association
LDF	Local Development Framework
MCA	Mineral Consultation Area
MCO	Prefix to record numbers in Cornwall HER
MDF	Minerals Development Framework
MDV	Prefix to record numbers in Devon HER
MLP	Minerals Local Plan
NGR	National Grid Reference
NHPP	National Heritage Protection Plan
NMP	National Mapping Programme
NPPF	National Planning Policy Framework
ODPM	Office of the Deputy Prime Minister
OS	Ordnance Survey
PPS 5	Planning Policy Statement 5
PRN	Prefix to record numbers in Cornwall HER
ROMP	Review of Old Mineral Permissions
WSI	Written Scheme of Investigation

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Summary

The china-clay mineral resource assessment was commissioned and funded by English Heritage and was aimed at assessing the impact of past and potential future china-clay extraction on the historic environment across the china clay-bearing grounds of the United Kingdom. These are located in Cornwall and, to a lesser extent, in Devon. The overall project area totals 285 sq km and includes all areas mapped with kaolin resources, all those known to have been used for china-clay related activity and the St Austell, St Blazey and China Clay Area Regeneration Plan area.

The project included the capture on GIS digital mapping of historic and current china-clay associated features – pits, tips and infrastructure – and this was used in conjunction with information on known archaeology and historic features from the Cornwall and Devon Historic Environment Records to construct gazetteers of ‘lost’ and surviving heritage assets within the overall project area.

The project report (this volume) includes a short history of the china-clay industry, from its origins in the mid eighteenth century to the present and a brief account of historic extraction methods (section 2). Section 3 identifies the various historic landscape character Types which occur within the project area and for each assesses the key elements of character, archaeological potential, the potential impact of future china-clay or other related development and possible mitigation measures. A statement of significance is provided for each Type.

Section 4 offers quantitative analyses of the impact of past and current china-clay working on the historic environment, together with the potential impact of future working and of re-working of waste as secondary aggregates. It also examines the datasets on which the calculations are necessarily based and concludes that these are not comprehensive or consistent enough to enable adequate quantitative data on past impact and future risk to be generated.

Mitigation, past, present and future, is examined in section 5, reviewing past mitigation work, the development of the essential knowledge base and protection provided through designation. Current mitigation practices are demonstrated with a brief account of the results of large-scale excavations carried out in advance of the development of Scarcewater tip, near St Stephen-in-Brannel. It is suggested that a central concern of future mitigation is likely to be the way in which distinctive and significant elements of the modern china-clay industry are recognised as heritage assets and the development of appropriate means to record and conserve them.

The value of historic landscape characterisation (HLC) in assessing past loss and the risk of future damage to the historic environment is discussed in section 6, with the conclusion that, in the absence of comprehensive and consistent data on the location and nature of heritage assets, HLC offers a particularly revealing approach. This section also picks up earlier discussions of the potential for improving the knowledge base and designation within the project area and the challenges offered by the modern china-clay industry.

Finally, section 7 draws together a number of recommendations deriving from earlier sections of the report. Of particular importance among these is the recommendation that work is urgently required to identify the most characteristic and significant elements of the modern china-clay industry so that appropriate forms of mitigation can be adopted when these go out of use or are proposed for post-use development.

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1. Introduction

1.1 Project background

The project was commissioned by English Heritage (EH) and was aimed at assessing the impact of past and potential future china-clay extraction on the historic environment across the china clay-bearing grounds of the UK. It derived from a project proposal (Young and Thomas 2011) prepared in response to an English Heritage (EH) call for proposals for terrestrial mineral resource assessments under Topic 2D of EH's National Heritage Protection Plan (NHPP): Impact of Resource Exploitation.

The primary china-clay deposits of south-west England have yielded more than 165 million tonnes of marketable clay since production began in the middle of the eighteenth century. Kaolinisation that can be commercially exploited is confined to the granites, the most important area being the western and central parts of the St Austell granite, which accounts for about 85 per cent of annual production, and the south-western part of the Dartmoor granite in Devon. China clay has also been worked from the Bodmin Moor and Land's End granites.

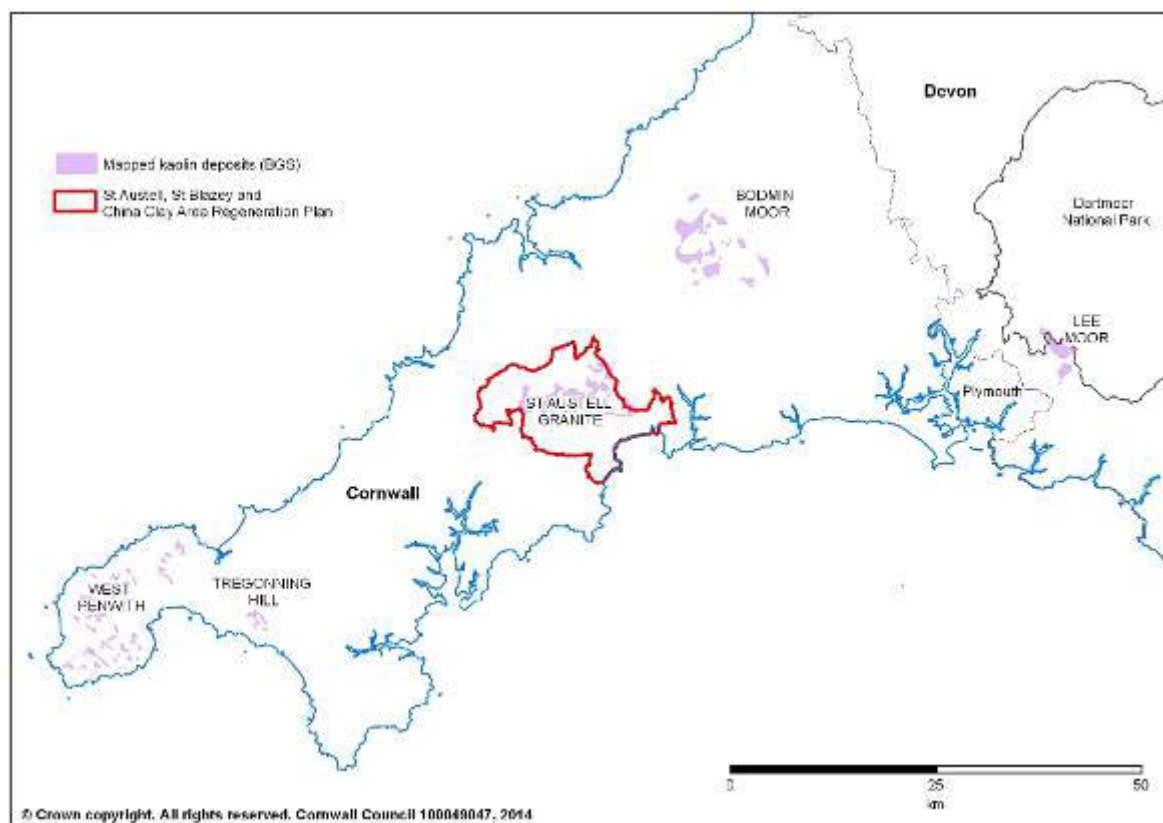


Figure 1 The principal current and historic china-clay areas, with mapped kaolin deposits and the St Austell, St Blazey and China Clay Area Regeneration Plan area.

1.2 Aims

The overarching aim of the project was to improve the management and understanding of the historic environment in china-clay extraction areas.

Deriving from this aim the following objectives were set out in the project design:

- To quantify the impact (both negative and positive) of past and present china-clay extraction on the historic environment of the china-clay bearing areas in the UK and to assess the impact of future china-clay extraction on the historic environment of the china-clay bearing areas.

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- To quantify and analyse the heritage assets within the clay-bearing grounds to assess the potential impact of the processing of china-clay waste as secondary aggregates.
- To assess the heritage value and Historic Landscape Character of the clay bearing grounds and the potential impact of planned landscape restoration and urban regeneration, particularly in the St Austell China Clay Area.
- To use this information to inform and underpin dialogue about the future conservation management of heritage assets and historic landscapes within the clay-bearing grounds.
- To produce outputs which can be used to develop appropriate policies, strategies and guidelines for strategic mineral planning, pre-determination evaluation and post-determination archaeological mitigation within the clay-bearing grounds.

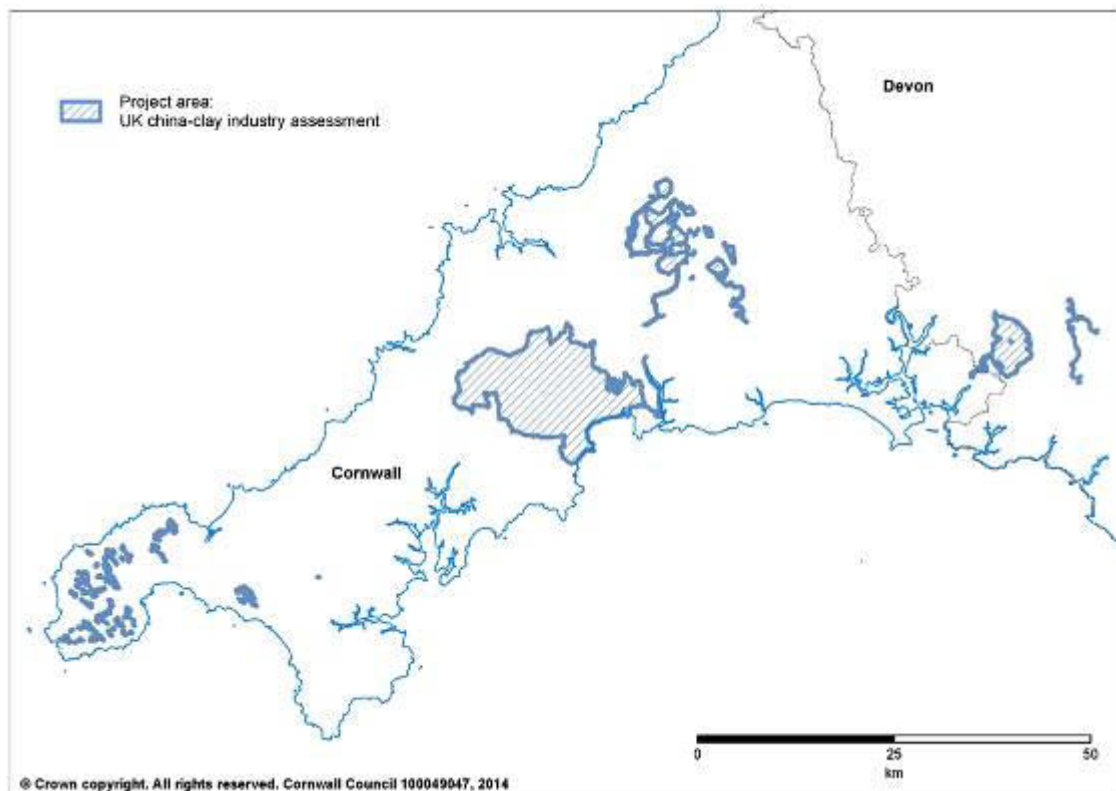


Figure 2 The project area, aggregating mapped kaolin deposits, historic and current china-clay working, the St Austell, St Blazey and China-Clay Area Regeneration Plan area and the buffer area mapped for the Lee Moor portion of the Devon Local Minerals Plan.

1.3 The project area

The area addressed by the current project is made up of the following components specified in the project design (Young *et al* 2012):

- The china-clay bearing grounds of Cornwall and Devon, depicted on mineral resource maps identifying the known extent of commercially viable kaolin deposits in the United Kingdom and accessible via the website of the British Geological Survey (BGS) (Figs 1, 3, 7-9).
- The extent of past china-clay extraction, waste dumping and infrastructure, as depicted on historic and current Ordnance Survey mapping. (This includes a small number of historic china-clay operations on southern Dartmoor; no BGS mapping of

kaolin resources in these areas is available because the deposits are 'not thought to constitute any future resource' (Bloodworth *et al* 2006, 10).)

- The St Austell, St Blazey and China Clay Area Regeneration Plan, defined on mapping supplied by Cornwall Council (Figs 1, 3).
- The Lee Moor portion of the project area in Devon is defined by the extent of past and current working and the mapped kaolin resource but also includes a 'buffer area' mapped as part of the *Devon County Minerals Local Plan* (Devon County Council 2004b, inset 37).

The total extent of the project area is 285.51 sq km, of which 256.51 sq km falls within Cornwall, 29 sq km in Devon. The complete project area is shown in Figure 2.

1.4 Current mineral planning within china-clay areas

Four Minerals and Waste Planning Authorities are relevant to the present project area: Cornwall Council, Devon County Council, Dartmoor National Park Authority and Plymouth City Council. The three first-named bodies make decisions on the release of land for mineral extraction and tipping; Plymouth City Council, while not having kaolin resources within its administrative area, is relevant because of the presence of clay industry infrastructure.

The Cornwall Minerals Local Plan (MLP) was adopted in December 1998. This plan was for the period up to the end of 2011 and stated that long-term plans allow for continuous production by the china-clay industry for at least 50 years (Cornwall County Council 1998, 3.54). The Devon County Minerals Local Plan, also for the period to 2011, was adopted in 2004 (Devon County Council 2004a), Minerals policy for Dartmoor National Park Authority (DNPA) is contained in the saved Minerals Local Plan adopted in 2004 (Dartmoor National Park Authority 2004) and the Authority's Core Strategy, together with the Minerals Consultation Areas on its policies map, adopted in 2012.

Government mineral planning policy is enshrined in the *National Planning Policy Framework* (NPPF) (Department for Communities and Local Government 2012). Under this, local planning authorities are required to produce Local Plans, which incorporate minerals planning and safeguarding policies. Under the NPPF the Cornwall MLP will be superseded by the Cornwall Minerals Safeguarding Development Plan, or Minerals Plan, currently under development. A Minerals Plan is being developed for Devon (Andy Hill, pers comm) and minerals planning for Dartmoor is also under review (Jane Marchand, pers comm).

1.5 Current china-clay extraction areas

1.5.1 Cornwall

China-clay extraction in Cornwall was until recently operated by two companies, Imerys Ltd (the main operator) and Goonvean Ltd; Goonvean was bought out by Imerys in 2012 and the acquisition was confirmed by the Competition Commission in October 2013 (Competition Commission 2013).

The Cornwall MLP and MDF documents show the extent of current china-clay operations and define Mineral Consultation Areas (MCAs). The MCAs are those areas with important mineral resources. Consultation area procedures exist to ensure that planning authorities do not sterilise these resources by permitting non mineral-related surface developments. In essence, the MCAs indicate those areas where extraction is most likely to take place in the future.

1.5.1.1 St Austell china-clay area

By far the most extensive MCA is the St Austell China Clay Area and the only workings currently in operation in Cornwall are located there. The St Austell china-clay district component of the overall project area is shown in Figure 3.

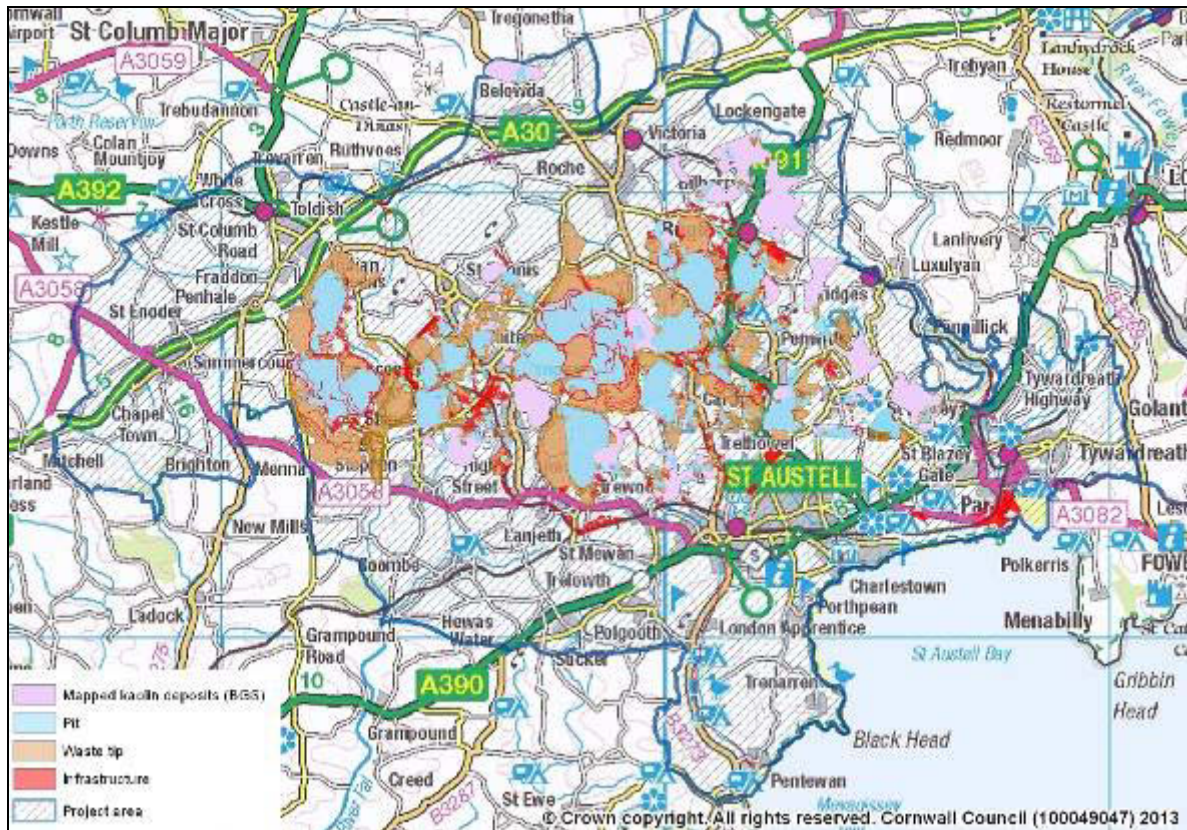


Figure 3 The St Austell china-clay district portion of the project area. The overall boundary follows that of the St Austell, St Blazey and China Clay Area Regeneration Plan.



Figure 4 A china-clay working landscape at West Gunheath in the St Austell granite district. Both historic and modern industrial landforms are in evidence, together with elements of infrastructure and surviving fragmented elements of earlier agricultural and rough ground landscapes. (Photograph: Historic Environment, Cornwall Council: F82-096; 16 April 2008.)

The area contains a singular landscape (Fig 4), essentially shaped by the china-clay industry, and its communities have a strong sense of identity (Mansfield 2012). However, the St Austell China Clay Area contains some of the most deprived areas in England (Cornwall Council 2011) and has been identified as a priority area for strategic regeneration and investment. In large part this is due to substantial job losses in the china-clay industry which have occurred over the last 20 years as a result of mechanisation and improved industrial processes and the transfer of production to other locations.



Figure 5 Par Docks, opened as a mineral port in 1840, equipped for mechanised drying after World War II and with major investment in the 1960-80s to expand shipping and processing facilities (Bowditch 2013). Much of the clay was brought by pipeline. (Photograph: Historic Environment, Cornwall Council; ACS 5983, 7 August 2003.)

The boundary for the St Austell, St Blazey and China Clay Area Regeneration Plan (*ibid*) extends beyond that of the china-clay area. This boundary, rather than that of the MCA, was the most appropriate for this project because it defines the area where regeneration development proposals are most likely to be submitted in the near future. Although many of these developments may not be directly related to china-clay extraction they will be indirectly related in that they are partly in response to the past impact of the china-clay industry. An example is Par Docks (Fig 5), formerly the main point of export for china clay and containing extensive infrastructure. The docks closed in 2007 and were sold in 2010 and are now the subject of proposed marina, housing and hotel development as one of a series of 'eco-communities' in the wider St Austell clay area (www.eco-bos.com).

1.5.1.2 Bodmin Moor

The only other Cornish china-clay extraction sites which have been active over the last two decades are at Stannon and Parson's Park on Bodmin Moor. Significant china-clay reserves are believed to remain at these sites but production has ceased, most of the plant and infrastructure has been removed and large-scale landscape 'restoration' has been undertaken (Cornwall County Council 2006) (Figs 6, 75). Significant china-clay resources are also believed to be present in the Hawkstor and Cardinham areas. These sites were considered in the Report on Preferred Options (Cornwall County Council 2006) and the stated policy is that it would be 'prudent to retain the former mineral

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consultation areas for the larger china-clay deposits and associated pipeline corridors for Stannon Pit, Parson's Park Pit and Hawkstor / Cardinham on Bodmin Moor.' The Bodmin Moor portion of the current project area is shown in Figure 7.



Figure 6 Park china-clay works on Bodmin Moor. The 2nd edition Ordnance Survey 25in: 1 mile map of c 1907 showed a small clay operation focused on the pit at bottom right. The large pit with its associated tips developed from c 1918, with the workings eventually extending over an area of more than 150 ha before the operation closed in 1997 (cf Smith 2008b, fig 94). The former waste tips have been extensively re-profiled. (Photograph: Historic Environment, Cornwall Council: F86-107; 23 September 2008.)

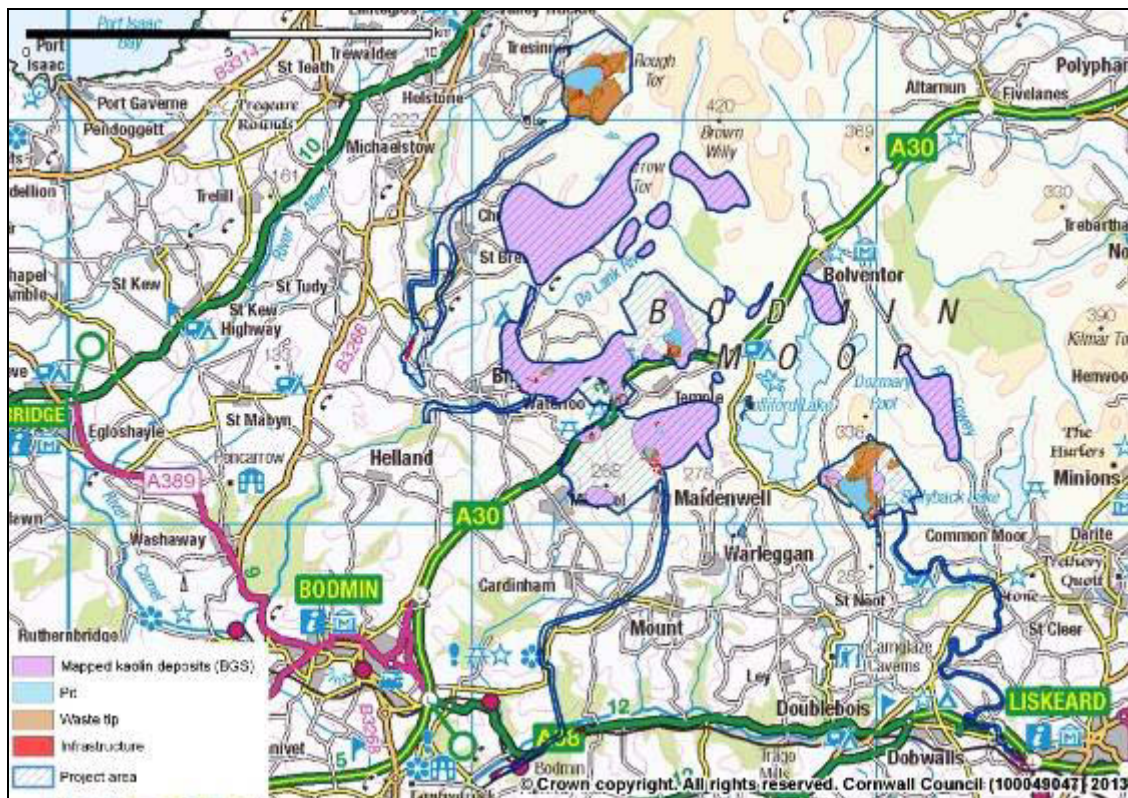


Figure 7 The Bodmin Moor project area.



Figure 8 The West Penwith and Tregonning Hill project area.

1.5.1.3 West Penwith

The Report on Preferred Options (Cornwall County Council 2006) states that significant clay resources are believed to be present at Lower Bostraze / Leswidden. The report recommends that the MCA for this area be retained. The West Penwith project area is shown in Figure 8.

1.5.1.4 Other sites in Cornwall

Historically there have been a number of smaller china-clay sites elsewhere in Cornwall. The Report on Preferred Options proposes that the MCAs for these smaller areas should be discontinued as there is no realistic prospect of clay production being resumed, except possibly in the Tregonning Hill area (Figs 1, 8) (*ibid*, 61; A Pattison, pers comm).

1.5.2 Devon

In Devon the only company currently undertaking extraction is Sibelco UK Ltd (which took over WBB Minerals), which supplies some clays to Imerys. Commercial production is focused on the Lee Moor area but in the nineteenth century and the early decades of the twentieth production also took place on south Dartmoor. The Devon portions of the current project area are shown in Figure 9.

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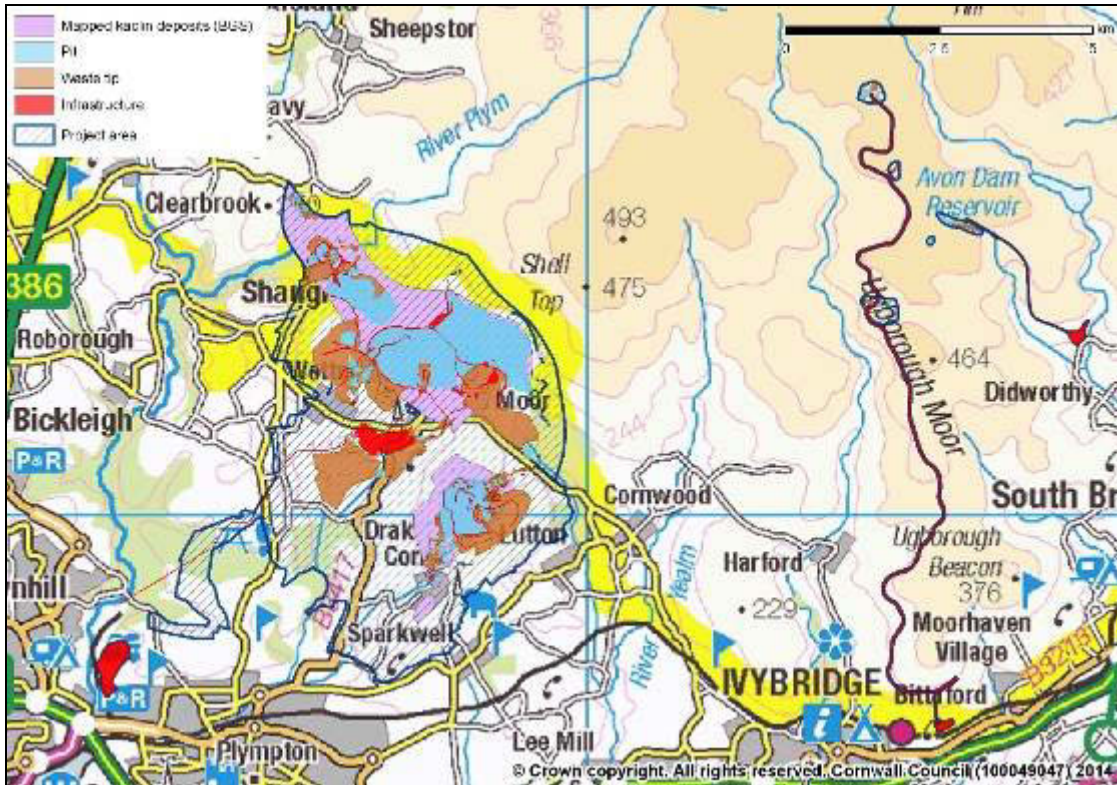


Figure 9 The Devon project area.



Figure 10 The china-clay industry has created striking and spectacular landscapes: a view in the Lee Moor area on the south-west fringe of the Dartmoor upland. (Photograph: Development Management Team, Devon County Council.)

The Dartmoor National Park designation acts as a significant constraint on minerals extraction. Dartmoor National Park [policy COR22](#) (Dartmoor National Park Authority 2008) [states that](#)

‘Major mineral development will not be allowed unless, after rigorous examination, it can be demonstrated that there is a national need which cannot reasonably be met in any other way, and which is sufficient to override the potential damage to the natural beauty, wildlife, cultural heritage or quiet enjoyment of the National Park.

Other mineral development will be carefully assessed, with great weight being given in decisions to the conservation of the landscape and the countryside, the conservation of wildlife and cultural heritage and the need to avoid adverse impacts on recreational opportunities’.

There are extant permissions for extraction within the National Park over areas which include Scheduled Monuments, and the National Park Authority has worked with the operators since the 1980s to avoid the use of these areas. There has been recent work by the Devon and Dartmoor minerals planning authorities working together to avoid the implementation of extant working rights within the National Park (section 5.1.2).

Plymouth City Council's area includes a currently-disused processing works at Coypool that is connected to the Lee Moor area by pipeline; the city also includes the wharves used for exporting the material. However, there are no china-clay resources in Plymouth and no current likelihood of expansion of the processing plant (A Hill, pers comm).

1.6 The clay winning process

Modern clay mining and subsequent processing is a complex series of activities that can be divided into three distinct stages:

Opencast extraction

This process firstly requires the removal of overburden. Once the clay-bearing rock is exposed, extraction is by a hydraulic mining process, where a high-pressure jet of water is directed at the pit face. This washing liberates the china clay, together with sand and mica. The material runs into the lowest level of the pit as a thick slurry, from where pumps lift the material to mechanical sand classifiers where the more coarse sand elements are removed. Once separated, the sand is disposed of to tip and the clay suspension is then moved by pipeline to the processing plant for the secondary process of refining.

Imerys has introduced dry mining techniques in recent years in several areas. Using this method, china clay and all associated waste minerals are removed by mechanical excavator and taken by haul lorry to the plant area for processing.

Refining

This consists of mineral processing techniques that are designed to remove the smaller sized waste particles that are mainly composed of very fine quartz and mica, leaving china clay behind. After refining, the clay is moved on to the final process of drying.

Drying

This consists of firstly converting the liquid clay into a solid material by filtration. Moisture content is further reduced by passing the clay through a thermal dryer. These dryers are fired by natural gas and produce clay with around 10 per cent moisture content.

1.6.1 Environmental impact

Because of the nature and scale of china-clay mining, the industry has had a dramatic impact on the environment. Most of the extraction sites are set in former moorland, heathland and the more peripheral agricultural land. The impact of china-clay extraction is most acute in the St Austell clay district. Here, land taken by the industry

has often fragmented previous land uses, undermining the viability of isolated residual pockets of land. The scale of past and current operations and the extensive areas of derelict former workings have resulted in a landscape which, while in some senses degraded, has also been positively regarded for its dramatic aesthetic qualities and for the significance of the historic remains of the clay industry itself (section 3). Waste tips dominate both distant and near views and the changing topography has influenced the area's micro-climates, changing wind and precipitation patterns and, in places, reducing the hours of sunlight received (Cornwall County Council 1998). The settlement pattern has also been affected – a number of farming hamlets have been destroyed and some villages expanded in the past to accommodate a growing work force.



Figure 11 Looking east over the clay settlement of Whitemoor to the complex and extensive workings of Littlejohns china-clay works. (Photograph: Historic Environment, Cornwall Council: F95-013; 10 September 2009.)

There are three visually most obvious impacts on the environment:

Extractive pits

China-clay pits can extend to a depth of 80m (Devon County Council 2004a, 103) and cover very large areas (for example, the workings at Whitemoor, near St Austell, cover more than 2 sq km) (Fig 11). Published figures indicate that more than 1100 ha of land in the St Austell china clay area is occupied by clay pits. (Mapping for the current project indicates a total of more than 1500 ha.)

Waste tips

For every tonne of china clay worked, approximately nine tonnes of clay waste is produced. Each type of waste is disposed of differently. Sand is tipped largely by conveyor and, until the late 1960s, formed steep-sided conical incline tips. Overburden is tipped by dumper truck, creating very large tips rising in steep-sided benches with flat tops (Fig 11). Mica is tipped in large lagoons behind embankments in stepped lifts.

Published figures show that in the St Austell china-clay area alone, clay tips occupy almost 1700 ha of land, and that over the years, approximately 500 million tonnes of waste have been tipped above ground (Cornwall County Council 2000). China-clay waste is the most important source of secondary aggregate in Cornwall (Cornwall County Council 2006, 49), and also in Devon (A Hill, pers comm; Devon County Council

2013). In recent years more than 50 per cent of secondary aggregates sales in Cornwall have been from china-clay waste sources (A Pattison, pers comm).



Figure 12 Part of the Drinnick refinery complex at Nanpean in 2005. The site is now out of use and is the location for one of a number of proposed 'eco-communities' in the St Austell china-clay district. (Photograph: Historic Environment, Cornwall Council: F67-026; 8 June 2005.)

Plant and infrastructure

These in the main comprise processing and refining facilities, sometimes sited at a distance from the pits themselves (Figs 12, 52). Infrastructure also includes extensive networks of internal tramways and railways (many now disused), haul roads, conveyors and pipelines used for the transportation of the clays. There are extensive plant and infrastructure facilities associated with the clay industry at both Par and Fowey harbours (Figs 5, 40). In the 1990s plant and infrastructure associated with the china-clay industry in the St Austell clay district occupied 640 ha of land (Cornwall County Council 1998).

1.7 The project methodology

The project design for the mineral resource assessment on china-clay bearing areas (Young *et al* 2012) specified that much of the work for the project would be carried out in a digital environment, using a GIS-based approach to define the extent of past, current and potential future china-clay extraction and identify, analyse and assess the archaeological resource within the extraction areas. The methodology would broadly follow that of the Aggregate Resource Assessments funded by English Heritage under the Aggregates Levy Sustainability Fund (ALSF) (for example, Young *et al* 2008).

As an initial step a number of GIS layers were created, including:

- Modern and historic Ordnance Survey mapping;
- Historic Landscape Characterisation mapping for Cornwall and Devon;
- Historic Environment Record (HER) and Events data for Cornwall and for Devon and Dartmoor;
- Historic designations (Scheduled Monuments, Listed Buildings, Registered Parks and Gardens);

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- British Geological Survey data showing the extent of commercially viable kaolin deposits;
- National Mapping Programme (NMP) mapping;
- Mineral Consultation Areas;
- St Austell, St Blazey and China Clay Area Regeneration Plan area.

A further GIS layer ('clay extent') was created in which polygons were drawn to map the extent of three fundamental components of the modern and historic china-clay industry: pits; tips; infrastructure. These data were for the most part captured from current Ordnance Survey mapping, but in some instances from historic maps (the 1st and 2nd edition Ordnance Survey 25in: 1 mile maps of c 1880 and 1907) and from transcriptions from air photographs produced by the National Mapping Programme.

A GIS layer defining the 'project area' was produced by aggregating the 'clay extent' layer with the British Geological Survey mapping of the extent of kaolin resources and the boundary of the St Austell, St Blazey and China Clay Area Regeneration Plan area (section 1.3).

Buffers were created around heritage asset records (based on HER and NMP data) to indicate their likely extent. As anticipated in the project design (Young *et al* 2012), applying buffers to records was an *ad hoc*, subjective process; for the most part, buffers were applied only to NMP mapping and Events record polygons where it was clear that the full extent of sites was only partially recorded.

Manipulation of the GIS data was undertaken to produce gazetteers of 'lost' and damaged sites – those coinciding with areas mapped as pits and infrastructure – and of surviving sites. Considerable detailed manual processing of these datasets was required in order to produce meaningful and valid results. Thus, for example, it is clear that a clay works or a pan kiln complex recorded in the HER records should not be regarded as 'lost' on the basis that they fall within the mapped polygons for those features. Some editing was also undertaken on the tables of 'surviving' sites in cases where, for instance, the feature described was itself recorded as 'lost' to subsequent development or was an uncontexted artefact find (other than lithic spreads).

The edited gazetteers and other sources were used to produce assessments of the loss and survival of heritage assets, the impact of the past china-clay industry and summaries of the total area of the china-clay resource and the proportion of this area which has been extracted and what remains for future exploitation.

HLC mapping, in conjunction with other GIS layers, was used as the starting point for producing text descriptions of the historic landscape character of principal landscape character Types intersecting with the project area, together with observations on the principal impacts of development on them, notes on mitigation and a statement of significance for each.

Analysis of grey literature associated with HER 'events' falling within the project area was used to enhance the site gazetteers and to inform commentary on past, present and future mitigation.

Illustrations have been sourced and produced from GIS mapping and text compiled to produce the current report.

GIS shapefiles and datasets have been compiled with the following data:

- Project area
- Clay extent
- HLC mapping
- Point and polygon data for sites recorded in the gazetteers of 'lost' and 'surviving' sites
- Events.

These may potentially be shared with English Heritage, the appropriate HERs and planning authorities.

2. A brief history of the china-clay industry

2.1 The industry to c 1860

The origins of the china-clay industry in the south west are usually attributed to the discovery of kaolin deposits and china stone on Tregonning Hill, Breage, in the mid or later 1740s by the Plymouth chemist, William Cookworthy (Barton 1966, ch 1; information in this section is based on this work unless otherwise stated). However, china stone had been extracted for architectural purposes considerably earlier than this: it is said to be incorporated in the fabric of St Stephen-in-Brannel, Probus and St Columb Major parish churches (Bowditch 2013) and Cookworthy himself noted that it had been used in the casemates of the garrison in Plymouth. China clay had also been worked for use in lining tin smelting furnaces and the fireboxes of steam engines used on mines in Cornwall.

Cookworthy – and possibly others at about the same period – was initially interested in the potential for utilising these materials in producing porcelain for the expanding market for fine pottery in Europe and North America. He experimented with material from Tregonning and in 1768 secured a patent on the use of china clay and stone in making porcelain, establishing his own factory in Plymouth. From 1770, probably earlier, he held a lease on a sett for china clay and stone on Carloggas Moor, St Stephen-in-Brannel; at about the same time production of his porcelain wares moved from Plymouth to Bristol. In 1774 he assigned the patent to a partner in the porcelain enterprises, Richard Champion. The latter attempted to extend the duration of the patent but this was challenged by established Staffordshire pottery manufacturers, led by Josiah Wedgwood and John Turner; their interest was in obtaining access to china-clay resources to improve fabrics and glazes for their fine 'Staffordshire wares' rather than for the manufacture of porcelain. This was achieved in 1775, Wedgwood and other manufacturers then taking leases on a variety of clay sites near Cookworthy's working at Carloggas.

These developments formed part of a wider search in Cornwall for materials which could be used in producing fine china: deposits of 'soapy rock' (steatite) on the Lizard were first exploited around 1749 at Gue Graze near Mullion by a Bristol manufacturer; others at Caerthillian and Kynance were worked for potters from Lambeth and, at Dorose, on the fringes of Predannack Downs, by the Worcester Porcelain Company (Barton 1966, 46-52; Kirkham 2007, 84-5; Perry and Thurlow 2008). The similar end uses may have led to some confusion between the talc-derived steatite deposits in this area and china clay: 'soapy rock' workings at Wheal Foss, near Predannack Wartha, were shown on the 1st edition Ordnance Survey 25in: 1 mile map of c 1880 as 'china clay, disused'.

By the early nineteenth century at least seven china-clay workings were in operation in the wider St Austell granite district. Fitton, who visited the area in 1807, noted two at Hendra in St Dennis, two at Treviscoe and others at Trethosa, Goonvean and Goonamarris in St Stephen (Fitton 1814, 181). Barton (1966, 40) has suggested that others were working at Hallow Moor and Carloggas Moor at about this time and press advertisements during the later 1810s and early 1820s refer to works at Halvigan and Carne in St Mewan, Carpalla in St Stephen and Bojea in St Austell parish (*Royal Cornwall Gazette*, 17 May 1817; 25 December 1819; 9 December 1820).

Operations at this period were on a relatively small scale. Warner (1809, 97) estimated that average annual production from the industry amounted to 'nearly 1200 tons' and Fitton (1814, 184) noted that Trethosa, one of the larger workings with a workforce of 13 in 1810 produced approximately 300 tons (Collins 1878, 13). Production expanded rapidly with the opening of new operations and working on an increased scale: in 1821 the Carpalla works was advertised to have facilities 'sufficient for Washing and Drying Eight Hundred Tons of Clay, per year' (*Royal Cornwall Gazette*, 13 October 1821).

China-clay pits at this period were shallow: Warner reported that clay occurred about 1.8m below the surface, continuing to an average depth of 5.4m (Warner 1809, 96). Fitton (1814, 182) noted a clay working with the base of the pit 'eight or nine feet from the surface' (2.4-2.7m), with deposits extending down another 3m; another had overburden 2.7m deep over the clay and at Trethosa the clay varied in depth from 0.3m to 5.4m.

Fitton's detailed description of working methods (below) makes it clear that the industry at this period was strongly labour intensive with relatively limited investment in infrastructure and plant. China stone was quarried using blasting and wedges and then broken up for transportation. China clay, however, required more elaborate methods:

'The "overburden" being removed to a considerable extent, the clay itself is dug progressively in steps, each four or five feet deep, the vertical faces of which are cut down with pickaxes and shovels, and the whiter parts conveyed in wheelbarrows to be "washed". At some of the works the clay is carefully mixed, in one large heap, before the washing; but in others this mixture is dispensed with, and it is removed directly from the pit to smaller heaps, on which a stream of water is allowed to pour, while the mass is frequently turned and supplied by a man or boy. The water in passing through the heap becomes charged with particles of clay, and is conveyed by wooden spouts to what are called the "pits" and "ponds," leaving the coarser parts behind.

These pits and ponds are merely rectangular excavations dug from the surface, and rendered water-tight by a floor and walls of cut granite, bedded in mortar made with lime from Aberthaw [Glamorgan], which has the property of forming a strong cement under water. The pits are in general about five or six feet by four, and about four feet in depth; the ponds, about twenty feet long by twelve in width, and four or five feet deep. At the middle of one side of each pond there is let into the wall a vertical board, pierced with two rows of holes placed alternately, and furnished with plugs, for the purpose of letting off the water gradually: and on the outside of the pond there is a small excavation lined with stone, with steps to enable a workman to descend and adjust the plugs, and an opening at the bottom, through which the water let off is conveyed to a drain underground. The pits also, when it is intended to preserve their contents, are furnished with a similar apparatus.

The water running from the heaps of clay is first received in a pit, which it is allowed to fill: the coarsest of the suspended particles subside, and the lighter and finer are conducted from the surface in the overflowing water by channels, or wooden spouts, to other contiguous pits of nearly the same dimensions: in these it deposits [sic] still further the coarser part of its contents, and overflowing carries off only the finest particles of clay.

In the bottom of the first pit there is an opening, with a trap or valve, through which the coarse parts that have accumulated are allowed to run off at the end of each day's work. The deposit of the second pits is collected from time to time, by gradually letting off the water from above it, for the purpose of being dried separately, and sent to the potteries. It bears the name of "mica," and appears, in fact, to consist principally of that mineral. There is, however, in this part of the process some variation, depending on the object and judgment of the manager. In some of the works the "mica" is not preserved; and in some there are three pits, through which the water passes before it arrives at the ponds, the deposit of one or more of them being preserved or rejected according to circumstances.

The water which has come from the pits being received in the ponds is allowed to extend itself, and gradually to deposit its contents. As the mass of clay increases at the bottom, the openings in the boards at the sides are successively stopped with plugs, which prevent the escape of any but the clearest water; and thus the accumulation continues until the pond is full.

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The contents of the ponds, when they are filled, are transferred from them in hand-barrows to what are called "pans," which are shallow excavations adjacent to the ponds, and like them lined with granite. They are generally about forty feet in length by twelve in width, and about fourteen inches deep; their extent and number being proportioned to the dimensions of the ponds. The clay, now in the state of a thick mud, is distributed uniformly over the bottom of the pans to the depth of from ten to fourteen inches, with a wooden instrument like that in common use for scraping roads; and it remains to dry for a length of time, which varies from four months to eight, according to the season and the weather. What has accumulated during the summer months, being put into the pans in September, is generally found to be firm and nearly dry about the following April or May'. The depth of the mass in this state varies with the height to which the pans have been filled, and the thickness of the clay when introduced. It is now cut with large knives into blocks resembling bricks, of the thickness of the mass in one direction, and varying in their other dimensions: these bricks are transferred to the shelves of a drying-house, or shed, which are formed of wooden bars freely admitting the passage of the air between them; and when quite dry, the pieces are scraped perfectly clean with an iron instrument, and the coarser parts, containing fragments of quartz and other impurities, which formed the bottom of the mass, carefully removed. The pieces are then put into casks, and broken down by ramming so as to fill them completely, and thus sent to the potteries. The finished clay, when well prepared, is of a beautiful and uniform whiteness, and breaks easily between the fingers without grittiness' (Fitton 1814, 182-4).

The only buildings involved were a shed for drying the clay, constructed of timber and open on three sides, and another structure which included an office for the 'overseer', a clay-packing area and a store for casks (*ibid*, 184).



Figure 13 The historic port of Charlestown, looking north west. Constructed during the 1790s, it was important in exporting both china clay and china stone from the early period of the industry. To the right are the remains of a large pan kiln complex built in 1906-7 for the Lovering company and used to refine clay brought by pipeline from Carclaze. (Photograph: Historic Environment, Cornwall Council: F82-127; 16 April 2008.)

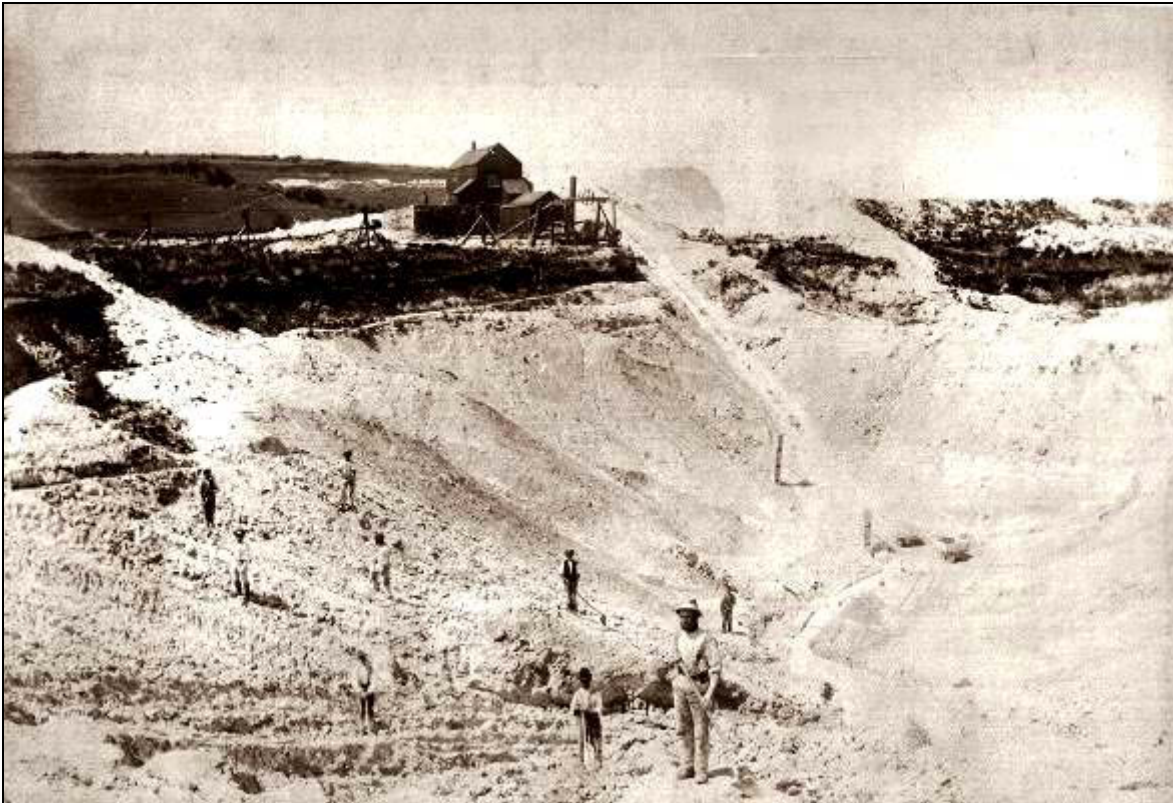


Figure 14 A late nineteenth – early twentieth century photograph of Temple clay works, on Bodmin Moor. The image recalls Walter White's description of clay working methods in the mid nineteenth century: 'Hither and thither stride the men, treading the clammy surface, stirring it with their implements, washing the clay, in fact, and presently the excavation resembles a pool of whitewash' (White 1855). (Photograph: China Clay History Society archive, HS 1340.1.)

Despite the small-scale nature of the industry, there were problems in transporting the refined clay to market. The Hensbarrow area had poor roads, no canals and as yet no railway or tramway systems. It was also at a distance from adequate harbour facilities; much of the early shipping of china clay and stone was probably done at beach landing places on the coast to the south (Herring and Smith 1991, 46). The construction of Charlestown harbour near St Austell during the 1790s was initially intended to facilitate the export of copper ore – it now falls within the Cornish Mining World Heritage Site – but then provided an easy shipping point for china stone and clay (Fig 13). The traveller Charles Hatchett noted in 1796 that at 'Mr C Rashleigh's new quay great quantities of the china stone or decomposed granite from St Stephens about 5 miles north of St Austle were laying to be shipped for Liverpool or to be sent to Worcestershire and Staffordshire for the Porcelain Ware' (Raistrick 1967, 26). A few years later Warner (1809, 96) recorded that as he entered St Austell he met 'several carts loaded with barrels . . . going for exportation' via Charlestown. A press advertisement for clay works at Halvigan and Carne in 1817 referred to Charlestown as the port 'whence all the China Clay in Cornwall is shipped' (*West Briton*, 9 May 1817, cited in Cole 2004). Henwood (1839) reported that exports of china stone and clay through the port rose from 1560 tons and 1890 tons respectively in 1810 to 5000 and 7090 tons in 1826; by 1838 shipments from Charlestown, Pentewan and Par combined totalled 6840 tons of china stone and 20,280 tons of china clay. By the mid-1850s 80,000 tons of china clay and 18,000 tons of china stone were being shipped annually from the Hensbarrow area, with more than 7,000 workers employed in the industry (White 1855, 191; cf Barton 1966, 93).

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Walter White visited clay workings above Tregonissey in 1854 and it is clear from his account that basic working methods remained highly labour intensive. After removal of overburden, a stream of water was directed onto the exposed clay surface; this, 'trampled by the heavy boots of the diggers, speedily becomes a bed of slime. Hither and thither stride the men, treading the clammy surface, stirring it with their implements, washing the clay, in fact, and presently the excavation resembles a pool of whitewash' (White 1855, 187) (Fig 14).

White also referred to significant technological innovations. Improved pumps enabled clay deposits to be worked at 12-24m below surface and he noted other innovations in the form of elaborate systems of settling tanks and new methods of accelerating drying times. These included coal-fired kilns for use in wet seasons – the first pan-kilns were constructed at Greensplat and Parkandillack in the mid-1840s – and a prototype 'drying-machine' in which 'two tons of clay are thoroughly dried in five minutes' (White 1855, 187-91; Barton 1966, 121).

Further investment in transport infrastructure, particularly new ports and the development of railways serving the industrial areas, made it easier to ship the increasing output of the industry. The harbour at Pentewan was constructed by Sir Charles Hawkins between 1817 and 1826 and subsequently linked to St Austell by a horse tramway (Barton 1966, 55-7; Lewis 1981). Par harbour (Fig 5) was constructed in the late 1820s by the industrial entrepreneur J T Treffry and later linked to the clay district at Bugle Molinnis by a horse tramway through the Luxulyan valley (Barton 1966, 75-6; St John Thomas 1988, 169). Treffry also developed a tramway linking the clay area near St Dennis on the north side of the St Austell granite upland with a new harbour at Newquay (Barton 1966, 79).



Figure 15 The Cornwall Minerals Railway works complex and roundhouse at St Blazey, a Grade II Listed Building. The opening up of a network of lines through the St Austell clay district was a major factor in the later nineteenth-century expansion of the china-clay industry. (Photograph: Historic Environment, Cornwall Council: F82-139; 16 April 2008.)*

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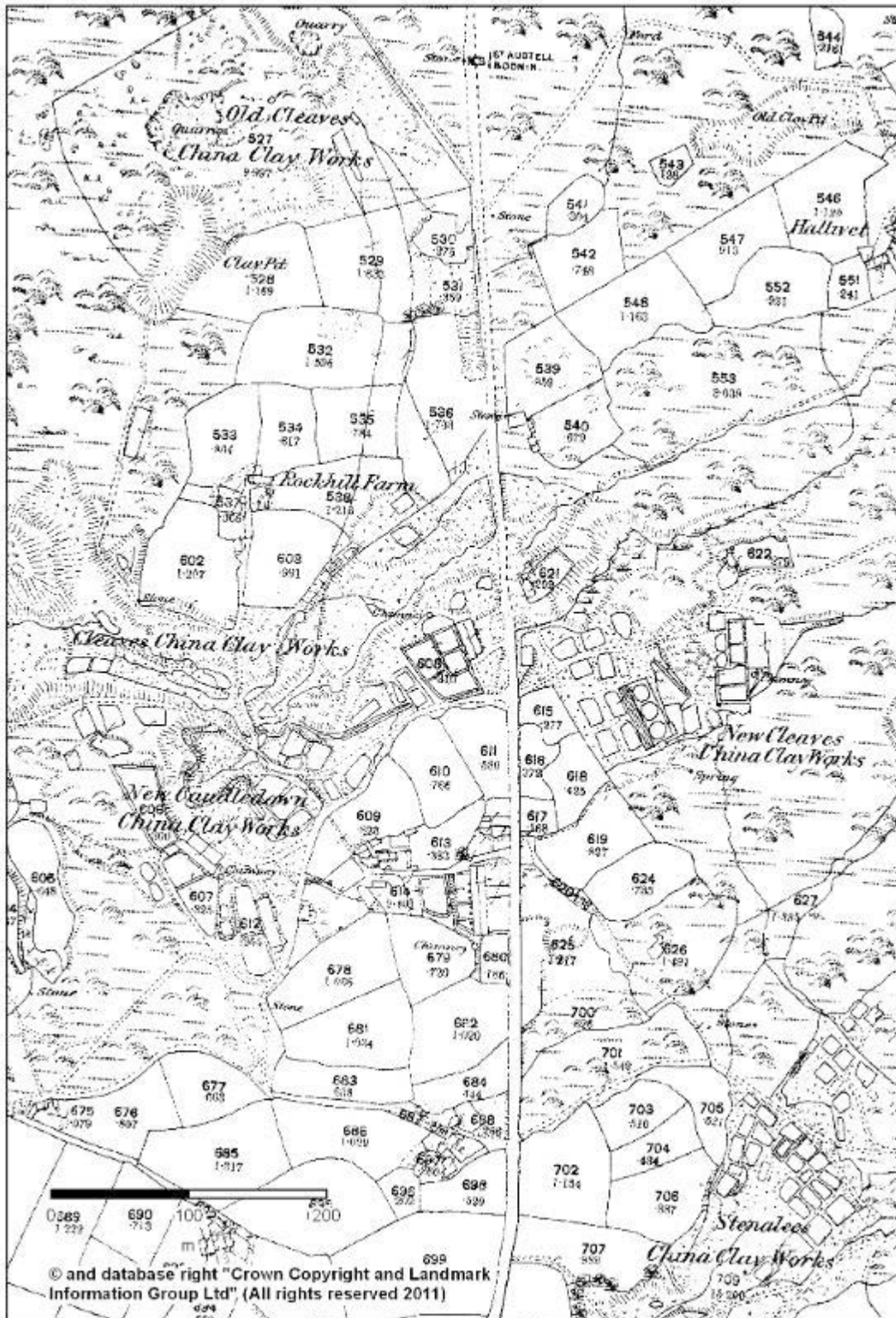


Figure 16 The 1st edition Ordnance Survey 25in: 1 mile map of c 1880 shows several small-scale clay operations on the St Austell granite in the area south of Bugle. Development of the industry in this area was aided by a new north-south turnpike road constructed in the 1830s, which cut through the earlier landscape of small upland farms and gave direct access to the south coast. With the exception of the road, very few of the features shown on the map now survive, almost all having been absorbed by much larger subsequent workings (cf Fig 114).

2.2 The developed industry in the St Austell clay district, c 1860-1900

The later nineteenth century was a period of rapid change and expansion in the china-clay industry (Barton 1966, ch 3). The wider use of steam power for pumping and winding made it possible to work considerably deeper deposits than had previously been exploited and clay 'drys' were constructed on an increasingly large scale (Perry and Thurlow 2006, 73). The late 1870s saw the first experiments in the use of water under pressure to remove clay from deposits (Collins 1878, 27); electricity began to be used for lighting and pumping during the same decade (Herring and Smith 1991, 145). Towards the end of the nineteenth century there was increasing use of pipelines for transporting liquid clay, either pumped or by gravity, from working areas to processing complexes; clay dries were frequently located alongside railway lines to facilitate not only transport of finished clay products but also the importation of the coal required for the kilns.

A number of major entrepreneurs emerged within the clay industry and a decline in mining in Cornwall in the early 1870s re-directed capital into it. Technical developments created new and rapidly expanding markets for china clay in the paper, textile and chemical industries: in 1878 Collins estimated that only one third of output continued to be used in the manufacture of porcelain [the term was probably used to indicate fine ceramics generally] (Collins 1878, 23). Developments in railway networks, particularly the Cornwall Minerals Railway network (St John Thomas 1988, 169ff) (Fig 15), and the opening up of the port of Fowey for clay shipments further eased transport problems.

While the second half of the nineteenth century saw significant technological innovation (Perry and Thurlow 2006), the expansion of the industry was also due to a considerable extent to the opening of new workings: in 1858 there were 89 active pits in the St Austell china-clay district, by 1878 there were 120 and this had risen to 159 by 1914 (Balchin 1983, 160-1).

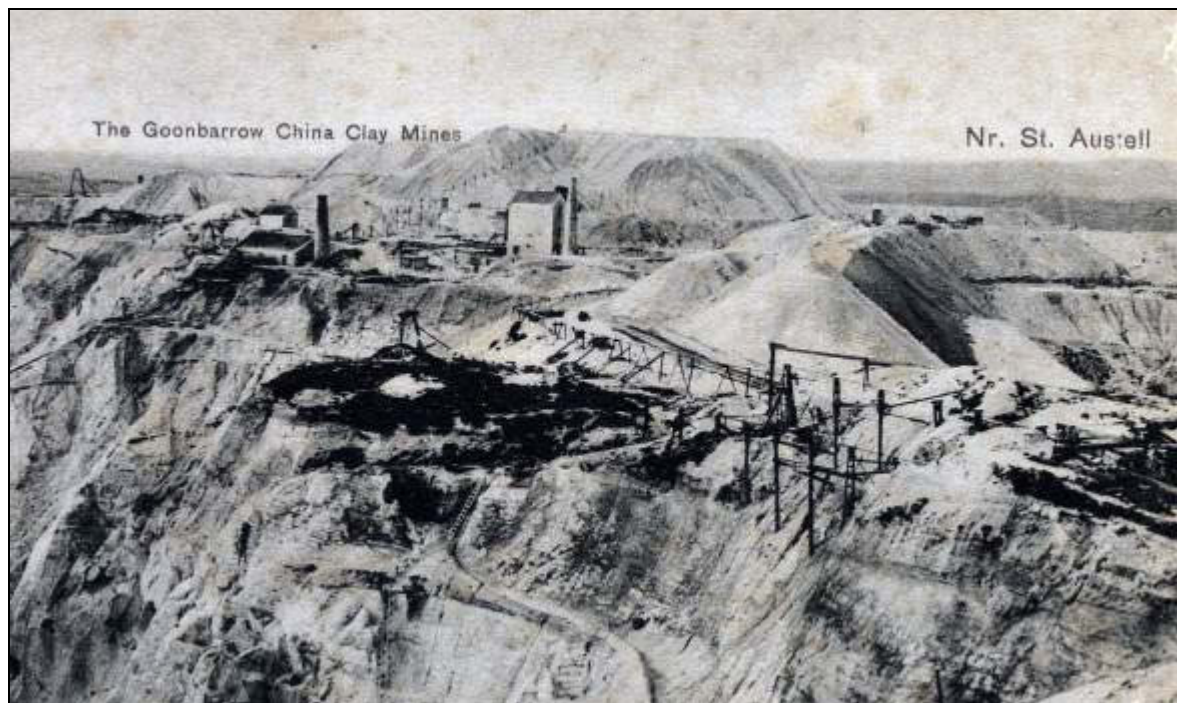


Figure 17 The distinctive new industrial landscape created by the rapidly developing clay industry of the pre-World War I period, shown on a postcard of Goonbarrow clay works. (Photograph: Steve Hebdige Collection.)

The resulting areas of industrial landscape were extensive (Figs 16, 17). In the course of less than 4 km along the valley of the River Fal, for example, between Gaverigan and Meledor Mill, the 1st edition Ordnance Survey 25in: 1 mile map of c 1880 depicted nine named clay operations: Hit-or-Miss, Retew, Wheal Remfry, Wheal Benallack, Mellangoose, Great Halwyn, Burngotha, Great Treviscoe and Virginia; other workings depicted on the map were not named and yet others were already disused at this date. Over a comparable transect across the uplands between St Dennis and St Stephen's, a short distance to the east, the map similarly showed nine clay and china stone operations – Parkandillack, Hendra Downs, Restowrick Downs, Little Treviscoe, Gonnammarris, Bloomdale, Trethosa, Goonvean, Wheal Arthur – plus a cluster of china stone quarries and mills in the Tregargus valley. Other tracts such as that between Bugle and Carclaze were even more densely worked (Fig 16).

There were periods of severe market depression and industrial conflict in the clay industry during the later 1870s but the new working methods and rapid increase in the number of operations meant that overall output increased substantially between the 1860s and the end of the century. Barton (1966, 144) estimated that production of clay and china stone during the decade of the 1860s totalled roughly 1,000,000 tons, doubling during the 1870s and doubling again to a total of 4,000,000 tons for the decade 1890-99.

2.3 The nineteenth-century industry away from the St Austell granite

2.3.1 Mid-Cornwall

This period of rapidly rising demand and improving technologies in the second half of the nineteenth century also saw the opening of numerous clay enterprises outside the Hensbarrow region. One of these, not far from Hensbarrow but located on the granite outcropping to the north of Goss Moor, was a small operation close to Belowda Beacon which Tonkin (1994) has termed the Belovely clayworks. This was in operation by 1858 and continued in operation until about 1876. It was shown on the 1st edition Ordnance Survey 25in: 1 mile map of c 1880 with a pit, spoil heaps, engine house, settling tanks, a mica drag and a pan-kiln. Open 'sun pans' and an air dry were mapped a short distance to the north and there were other pits away from the main operation, some of which may represent unsuccessful trials (Tonkin 1994).

There were also some downstream works on rivers running off the St Austell granite which recovered china clay from run-off from processing. One such operated on the site of a former tin streamworks at Carlyon Bay (Taylor 2003a) and an operation at Ardevora Veor, opposite the Trelonk brickworks on Tuckingmill Creek, near Ruan Lanihorne on the River Fal, also appears to have been of this kind (Ferguson and Thurlow 2005, 95). It was shown on the 2nd edition Ordnance Survey 25in map of c 1907 and labelled as 'Brick Works (Disused)' but is shown with settling pits and a mica drag and dry, adjacent to a landing stage.

Further away, the St Day area saw exploitation of impure china clay to produce fireclay for smelting furnaces from at least the early part of the eighteenth century. Josiah Wedgwood is reputed to have rejected the St Day deposits for potting in 1749 but took out a lease in 1775 on a pit known as Wheal Amelia, which worked until the 1790s (Ferguson and Thurlow 2005, 102). The area was subsequently important for brickmaking (below).

Tregonning Hill, the scene of Cookworthy's original discoveries of china-clay deposits, saw a few years of activity in the 1830s but had been abandoned for a long period before that (Barton 1966, 108, 125-6; Henwood 1839). A small number of new operations were established in the 1850-70s but these appear to have been on a small scale, restricted by the limited quantity and quality of the clay resources. Brickmaking was established successfully on a number of the china-clay setts in the area in the 1870-80s.

A small china-clay operation, some distance from any other, was depicted on Porkellis Moor, Wendron, by the 1st edition Ordnance Survey 25in map of 1879 (Cornwall HER MCO 28810). The map showed settling tanks, pits and pans, a mica drag, a small rectangular building and leats located approximately 180m east of an extraction pit. There is no indication of a dry forming part of the operation (Sharpe 1997). Mapping of archaeological features from air photographs shows a very disturbed landscape in the vicinity, with a complex of linear workings, prospecting pits and spoil heaps. This site may represent the operations of the Wendron United China-Clay, Peat Works, Tin Mining & Streaming Company, for which a prospectus was issued in 1855 (Jenkin 1978, 3; Brooke 1994, 48). The working appears to have been abandoned by the time of the 2nd edition 25in map of c 1907.

2.3.2 West Cornwall

In west Cornwall there may have been some early working in the area around what was later known as Baker's Pit. William Borlase, rector of Ludgvan, noted in 1755 that 'we have a very fine white clay about 3 miles from us that was used in the pottery manufacture that was intended to have been carried on at Calstock but that scheme failed there' (quoted in Ferguson and Thurlow 2005, 63). In his *Natural History of Cornwall*, Borlase (1758, 63-4) referred to a white clay discovered at Amalebra, Towednack, and speculated that it could be useful in porcelain manufacture, although noting that 'at present, in its natural state, it serves only to make bricks for smelting-houses, enduring the most intense fire of the furnace better than any other within equal reach of the workmen'.



Figure 18 A pit (bottom left) and clay works with probable sun pans and air dries (lower right) at Bedlam Green, shown on the Towednack tithe map of 1839. The operation is known to have produced at least 500 tons of china clay in the previous year. (© Cornwall Record Office.)

The Towednack tithe map of 1839 showed a 'clay works' east of Bedlam Green, Towednack, on a 3-acre holding forming part of Georgia; the map showed two long buildings – probably air dries – and a series of open rectangles which are likely to represent sun pans (Fig 18). The site lay on enclosed former rough ground adjoining a

stream running east towards Nancledra and forming the boundary between Ludgvan and Towednack parishes. William Jory Henwood (1839) noted that in 1838 500 tons of china clay from Bedlam Green had shipped via Penzance and St Michael's Mount. This may have been the clay pit in Towednack which Balchin (1983, 160) refers to as opening in 1830. Approximately 500m south south west of this site the 1839 tithe survey for Ludgvan recorded 'Clay Pit Field' immediately to the east of the farm place of Polhiggy; Taylor (2002, 22) identified traces of two shallow workings in this area which may represent the oldest surviving clay industry features in the immediate area of the later Baker's Pit.



Figure 19 The flooded pit of a late nineteenth-century clay works on Tredinney Common, in west Cornwall. Although the area is now overgrown, field survey in the 1990s identified the remains of many elements of the operation, including engine and boiler houses, settling tanks, mica drags, finger dumps, prospecting pits and leat systems (Herring 1995) (cf Fig 46). (Photograph: Graeme Kirkham.)

The 1st edition Ordnance Survey 25in map published roughly four decades after the tithe surveys shows a china clay works on both sides of the stream close to the site of the earlier Bedlam Green operation and extending over a substantial area. A complex of settling pits and dries lay at the downstream end of the site, with an engine house 300m to the south west adjacent to an area of workings and spoil heaps; hints of complex earthworks and abandoned or truncated clay streams or leats in this area suggest earlier phases of working. The 2nd edition 25in map (1908) showed two very substantial clay pits north of Polhiggy with a new processing complex adjacent to the engine house. The works was taken over in 1910 by the Lovering family, major entrepreneurs in the St Austell district.

A china-clay working at Tregonoe (Treganhoe), Sancreed was referred to in 1839 (Henwood 1839) but the Sancreed tithe survey of the same year shows no indications of a working in this area. However, it recorded two adjacent fields at Sellan, 650m to the north, as 'Clay Pits' and 'Clay Field'. The 1st edition Ordnance Survey 25in map of

c 1880 showed an irregular pool coinciding with the first of these two parcels but nothing more is known of this operation.

Sharpe (1992, II, 24-7) has described the physical remains of the china-clay industry at Leswidden and Bostraze, east of St Just, but the history of clay winning in this area has not been documented in detail. No china-clay working is shown on the 1st edition Ordnance Survey 25in: 1 mile map sheet of c 1888; the 2nd edition of 1908 shows pits and a series of tanks, all labelled 'disused', to the east of the former Balleswidden mine and also shows disused clay dries to the south of the mine site. This operation was subsequently restarted (below) and it is clear that most of the currently visible remains of the industry in this area date to these later workings.

A further china-clay operation in west Cornwall, at Tredinney, St Buryan, was working in 1893 (*Royal Cornwall Gazette*, 25 May 1893), but was probably of relatively recent origin (Figs 19, 46). The 1st edition Ordnance Survey 25in map of c 1876 showed no apparent industrial activity in the area; the 2nd edition of 1908 depicted two extraction pits and extensive waste dumps, but marked the works as disused. Air photographs and field survey have identified leats and prospecting pits extending over a considerably wider area. The mode of operation and surviving remains at the site have been described by Herring (1995). The dries for this operation were approximately 1.5 km south east at Lower Leha, adjacent to the main Land's End – Penzance road.



Figure 20 The well-preserved remains of the Burnt Heath china-clay works on Bodmin Moor, first worked in the 1870s, including features which suggest an early phase of working based on air-drying before construction of the pan kiln (Smith 2008b, 107-8). (Photograph: Historic Environment, Cornwall Council: F100-168; 16 October 2010.)

2.3.3 Bodmin Moor

Smith (2008b) notes evidence from the tithe surveys of about 1840 for small-scale extraction of china-clay in Blisland, St Breward and St Neot parishes on Bodmin Moor. In general, however, poorer quality clays and inherent transport problems, particularly the distance from ports, hampered early development of the industry in this area. Nonetheless, a number of works were established on the Moor during the 1860-70s, almost all of which appear to have employed some elements of the new technologies of this period in the form of pan kilns; only two have evidence for the use of steam power, however, and all appear to have been on a relatively small scale (*ibid*, 106-7) (Figs 14, 20, 26, 35). Most ceased operation fairly quickly: all of the 18 works known to have

begun operations before the end of the nineteenth century were shown as disused on the Ordnance Survey 2nd edition 25in: 1 mile map sheets of c 1907 and some of these had closed prior to the 1st edition map of c 1880. Several of these older operations were re-worked subsequently (*ibid*, 107-16). Small-scale brickmaking using kaolinised clays took place at Carkeet on Bodmin Moor in the last decade of the nineteenth century (*ibid*, 116).

2.3.4 Dartmoor

Much the largest exploitation of china-clay deposits outside Hensbarrow took place on south-west Dartmoor. Harris (1992, 86-97), Wade (1982) and Dyer (2014) have briefly described the development of the clay industry in this area and the latter account provides a full synthesis of the development of workings around Hemerdon. Newman (2011, 214-22) has recently discussed the physical remains of the china-clay industry on Dartmoor.

Clay working began at Lee Moor in 1833, initially producing fire bricks and ceramic pipes, the early entrepreneurs being individuals who also had interests in china-clay operations in the St Austell area. There was also some early working at Headon (Exeter Archaeology 2009, 498; Dyer 2014). Murray's *Handbook for travellers in Devon and Cornwall* (Anon 1851, 62) referred to china-clay works at 'Heddon, Small Hanger, and Morley', and other pits were opened at Hemerdon and Broomage in the 1850s (Dyer 2014) and at Wigford Down around 1860 (Wade 1982, 13). Further pits were established at Cholvichtown and Whitehill Yeo and the three Lee Moor works were together producing 24,000 tons of clay annually by the early 1870s (Wade 1982, 13). Operations commenced at Wotter in the 1880s and at Shaugh Lake in the 1890s (*ibid*, 19). The opening of the productive site at Shaugh Lake enabled the closing of the Wigford Down and Wotter operations in about 1898 (*ibid*, 19).



Figure 21 Leftlake china-clay works on southern Dartmoor, first opened about 1850 and later worked in conjunction with the Redlake china-clay operation. The Redlake tramway can be seen following a sinuous route across the site. (Photograph: F M Griffith, Devon County Council, 20 March 1987.)

Other china-clay operations were set up at considerably more remote locations on the southern part of Dartmoor, well to the east of the Lee Moor area. A works was

established at Knattaburrow Pool on Brent Moor in 1836, approximately 9 km north of Ivybridge, with clay in suspension transported in channels to a processing site off the moor (Harris 1992, 95). Other workings in the same area included one at Leftlake (Fig 21), opened in about 1850, and another on Brent Moor (subsequently Petre's Pit) begun about 1872 (Wade 1982, 12-13). This latter operation re-used a tramway which had been established in 1847 to transport peat off the moor. New clay dries were built on the site of an earlier naphtha works at the lower end of the tramway at Shipley Bridge, north of South Brent, to which clay was brought by a ceramic pipeline (*ibid*, 17). The clay was of poor quality, however, and the operation ceased working in 1880. Further working in this area took place in the early twentieth century (below).

Methods in the Dartmoor industry appear to have been similar to those in the Hensbarrow area (Dyer 2014, *passim*). Much of the technology used derived from the Cornish industry and technical innovation appears to have broadly paralleled developments on the St Austell granite. Certainly, a processing complex at Shaugh Bridge with a pan-kiln and a series of settling pits and tanks, probably established c 1870-80, is very similar to those built in the Hensbarrow area at about the same time (Smith and RCHME 1996, 12). In certain aspects, such as the use of pipelines to transport clay slurry, the Devon industry may have led the way (Dyer 2014, 30).

As in Hensbarrow, the development of a transport structure was a crucial element of the expansion of the industry. The Lee Moor Tramway opened in 1854 – effectively from 1858 – to transport clay from this area (including Cholvichtown and Wotter) to Laira Wharf, Plymouth, for shipment (Taylor 1999). The tramway was horse-drawn over much of its length but with two inclines on which loaded descending trains hauled up ascending trains which were either unloaded or carried loads of coal (*ibid*, 44). Locomotives were introduced on the non-incline lengths in 1899.

2.4 Brick and tile making

The earliest use of china clay for brickmaking was at Lee Moor (Harris 1992, 87) but a variety of other sites around the china-clay deposit areas had brickworks in the later nineteenth century. Many of these used contaminated clay which was unsuitable for exploitation by the primary industry.

Among these later operations were Carloggas, which began operations in 1860, Carbis, built around 1883 using bricks from Lee Moor for its kilns and which itself specialised in producing kiln bricks for the clay industry, Burthy (started 1880s), Chytane (c 1875) and Wheal Remfry and Gaverigan, which both opened in the 1890s (Ferguson and Thurlow 2005, *passim*). At Carkeet, on Bodmin Moor, suitable clay for brickmaking was discovered while prospecting for china clay. The brickworks started operation in 1885-6 but closed during the 1890s (*ibid*, 89-90).

A brickworks was established at St Day about 1860 and is said to have produced 1.5 million bricks in 1867. By 1874 a large hexagonal kiln with a central stack had been erected and the works was linked to the Redruth and Chasewater Railway. Late nineteenth century advertisements refer to the operation as the St Day Firebrick and China Clay Manufacturing Co. It closed in 1912, subsequently working sporadically until final demise in the late 1920s (*ibid*, 43, 102-3).

Brickmaking operations using china clay in west Cornwall include a 'China Clay and Brick Works' shown to the east of Castle an Dinas hillfort in Ludgvan on the 1st edition Ordnance Survey 25 in map of 1878. Little is known about this operation (Ferguson and Thurlow 2005, 111-2); the map showed a clay pit, an engine house, kilns, and two rectangular ponds, but it is not clear whether it produced china clay as well as bricks. The 2nd edition map of 1908 depicted the site as disused and with no remaining structures. Brickmaking also took place at the historic-china clay pits on Tregonning Hill from 1871 until about 1900 (*ibid*, 114-5). The surviving brick kiln on the site has been the subject of a recent recording project (Sturgess 2014). Brickmaking at the nearby Wheal Grey China Clay & Tin Co, at Tresowes Green, near Germoe, began in 1878 but it also closed about 1900 (Ferguson and Thurlow 2005, 112-3).

On Dartmoor a late nineteenth-century brick and tile works formed part of a short-lived industrial complex at Shaugh Bridge; the remains of a tunnel brick kiln more than 50m long and other structures survive on the site, together with traces of the associated iron mine (Fletcher 1999).

2.5 The twentieth century

Continued technical advances, investment in infrastructure (not least numbers of new and larger dries, new pipelines and extensions to the rail network), and the opening up of new operations, coupled with expanding demand, particularly for rapidly developing export markets, stimulated the further rise of the clay industry in the first decade of the twentieth century. Production during this period totalled some 6,000,000 tons, half as much again as in the 1890s, and output reached an annual peak of more than 860,000 tons in 1912 (Barton 1966, 144, 152). A bitter labour dispute in the St Austell clay district during the following year temporarily limited output but the outbreak of World War I in 1914 had a more serious effect, reducing the workforce and severing links with overseas export markets; total production in 1917 was 400,000 tons less than in 1912 (*ibid*, 162). A significant number of clay enterprises ceased operation. The number of producers reduced considerably and a major new company emerged through amalgamation in the form of English China Clays (ECC).



Figure 22 A 1930s view over Wheal Remfry pit, one of the clay operations which formed the newly amalgamated ECLP (Photograph: China Clay History Society archive, 45663.)

Despite recovering overseas demand (Giles 2013), clay production did not return to pre-War levels until 1924. The period saw further technical advances, not least the expanding use of electricity, the introduction of centrifugal pumps and widening use of filter presses to improve efficiency in the drying process (Herring and Smith 1991, 52; Bowditch 2013). Control of production through trade associations also achieved improved prices for the industry. There was also considerable new investment: a new pan kiln constructed in 1921 at Carlyon Farm in the Trenance valley, near St Austell,

was the largest ever constructed (Figs 37, 78); a new Great Western branch line up the valley to serve clay operations there opened the previous year (Taylor 2008; St John Thomas 1988, 176). New facilities also eased the export of clay through Fowey, which at this date carried more than 75 per cent of output from the St Austell clay district and almost 90 per cent of shipments by sea (Giles 2013). Nonetheless, the 1920s, although production levels appear to have remained above 800,000 tons annually, was a difficult period (Barton 1966, ch 4; Hudson nd, ch 3).

The major world trade recession which began in 1929-30 had a catastrophic impact; many small clay companies went out of business in the early 1930s and up to half of working pits closed (Barton 1966, 189). There was further amalgamation of companies, including the creation in 1932 of English Clays Lovering Pochin (ECLP) which controlled a potential total output of up to 1,000,000 tons annually and represented approximately 75 per cent of the industry (Fig 22). This enabled significant cost reductions and modernisation and also supported research into new production techniques and products (*ibid*, 190-2; Hudson nd, ch 4). Acquisition of the Super Clay Co in the mid 1930s gave access to innovative bleaching technology which enabled processing of even poor-quality clays to produce a superior product (Ivor Bowditch, pers comm; Hudson nd, 64n, 163). By the end of the decade, therefore, the industry was in a better position for efficient production but overseas markets remained weak and variable. World War II again drastically reduced demand: by 1944 home demand was only half of the 1939 level and export trade less than 20 per cent (Hudson nd, 77-8).



Figure 23 Post-World War II 'Cornish units' at Chegwyns, Foxhole, including an unusual single-storey type. The 'units' were prefabricated using china-clay waste. (Photograph: Graeme Kirkham.)

In the immediate post-War period the china-clay industry faced shortages of both coal and labour in attempting to increase production and there was further consolidation and reorganisation of the enterprises making up the industry. (The difficulties and technology of this period are both well illustrated in a short British Pathé newsreel film from 1948: www.britishpathe.com/video/china-clay-3.) These issues prompted

significant research and technical development and, in response to rapidly expanding demand, considerable investment in new plant and infrastructure, not least in mechanising previously labour-intensive aspects of clay working. Steam power was progressively replaced by electricity, much of it generated by the industry itself, and oil rather than coal was increasingly used to heat clay kilns; the demise of coal-fired pan kilns meant that there was no further demand for the special firebricks produced by some of the brickworks using china clay and these too closed (Smith 1992a). Chemical dispersants were introduced to aid the separation of clay from contaminants and bleaching became commonplace to improve the quality of the clay product. 'Continuous refining' using Dorr Oliver units was adopted, initially at Lee Moor, to replace the former batch system of production.

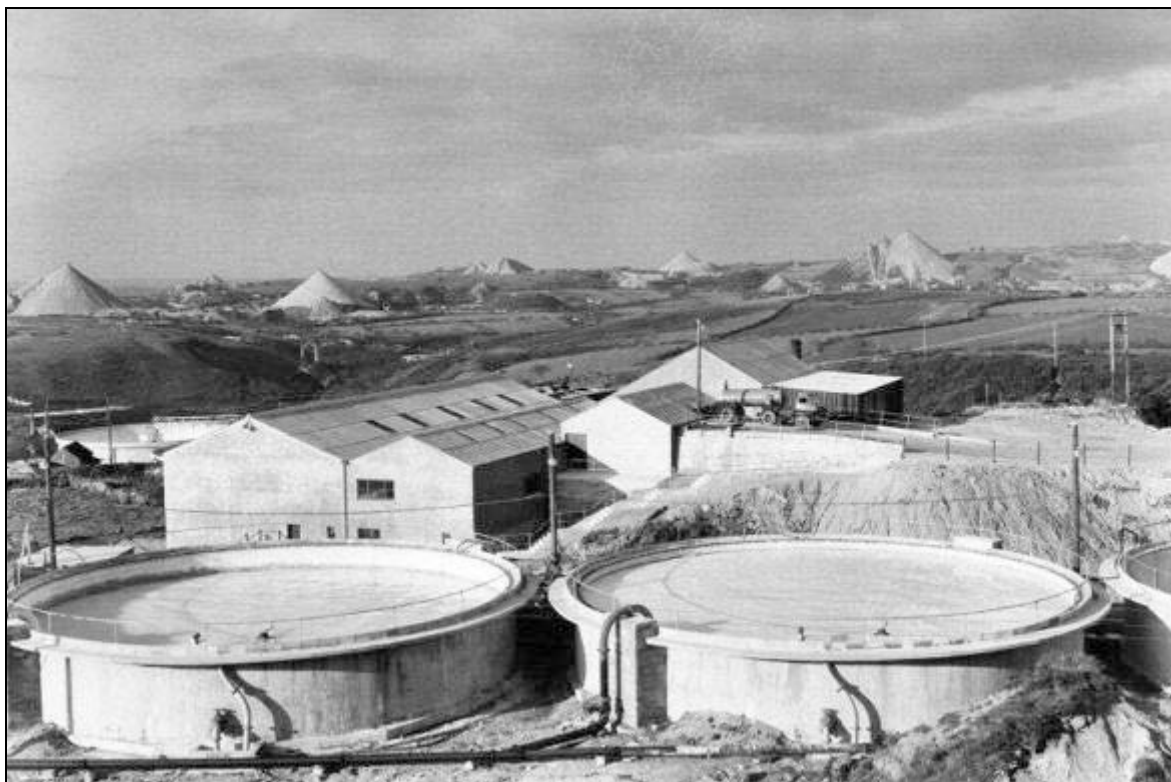


Figure 24 Treviscoe blending plant, photographed in 1957, with a view towards the Melbur, Wheal Remfry and Virginia clay works. The New Halwyn sky-tip is prominent, second from left of the nearer tips. (China Clay History Society archive; ref 507.)

There was also a move in the post-War period to diversification through exploitation of the vast reserves of sand and other waste created by the industry. Products included blocks and bricks, artificial facing stone and, most notably, prefabricated 'Cornish Unit' houses, first produced using secondary aggregates from the sand burrows at Gothers pit (Barton 1966, 202; Bowditch 2013) (Fig 23). More than 50,000 of these were produced in the late 1940s and early 1950s; profits from their manufacture were for a time greater than those from clay production but were used to invest in new technology (Bowditch 2013).

The 1950s became 'a period of previously untasted prosperity' for the china-clay industry (Hudson nd, 110) and, by the end of the 1960s, English China Clays, the dominant enterprise in the industry, was producing 2.5 million tonnes of clay annually (*ibid*, 112).

Large-scale investment in technological innovation and new infrastructure also continued. The first automated blending plant in the industry opened at Treviscoe in 1957 (Fig 24) and the new Blackpool dryers complex at Burngullow, developed during

the 1950-60s, at its production peak in the 1960s, could produce 10,000 tons of clay per week and had a storage capacity of more than 20,000 tons (Bowditch 2013) (Fig 33). Between 1968 and 1974 a substantial new drying complex was built at Par docks, primarily to serve European markets. A clay slurry plant was added in the 1980s (*ibid*).

One result of the changes was a further shortening of the period required to refine clay to a marketable state. Barton noted in 1966 that from the eight months required to produce clay in the industry of the early nineteenth century, 'today eight hours suffices between monitor and quayside' (Barton 1966, 206). (Production times can now be even shorter.)



Figure 25 The Melbur, Wheal Remfry and Virginia clay operations from the air in 2008. The differences between modern working and that of even the relatively recent past are highlighted by the contrast in scale and form between the modern Virginia and Melbur clay works (centre and left) and the vegetation-cloaked sky-tip and flooded pit of New Halwyn clay works at right (cf Fig 24). (Photograph: Historic Environment, Cornwall Council: F82-013; 16 April 2008.)

New working methods and the much increased scale of production altered the clay industry's physical presence in the landscape. This included development of larger, more centralised processing complexes (Figs 12, 33, 52), rather than the dispersed pattern which had characterised the industry previously. Even more prominent were the results of a rapid change in the methods of disposing of waste from the industry. The use of inclined skip-roads, which between about 1900 and 1970 created the distinctive steep-sided 'sky-tips' or 'burrows' (below) and flat-topped ridges across the clay working areas (Figs 4, 22, 24, 26, 29, 36, 110, 114), was progressively abandoned, in favour of using heavy machinery to carry material and transport it to much higher and more extensive stepped pyramids, with each 'step' or 'bench' up to 25m in height and resting wholly inside the layer below (Herring and Smith 1991, 50;) (Figs 11, 25, 73). This change is often said to have been prompted by fears about the stability of steep-sided waste tips in the aftermath of the Aberfan disaster of 1966, but it is probable that the rapidly expanding requirement of the industry for disposal of waste and the increasing availability of large plant for transporting overburden and other material

within clay working areas would in any case have resulted in new tipping methods and consequent new landforms.

Increased environmental awareness also had an impact. The mica component of clay waste had previously been discharged into adjacent streams and rivers, but from the early 1970s it was diverted into large mica dams, immediately reducing pollution in rivers but also creating a further distinctive new element in the industrial landscape. The planting of screening belts around processing sites in the St Austell clay district began at about the same time (Bowditch 2013) (Figs 11, 33, 52, 70).

2.5.1 The twentieth-century industry away from the St Austell clay district

Developing demand for china clay in the later nineteenth and early twentieth centuries also stimulated expansion of the industry outside the core on the St Austell granite. Operations on Bodmin Moor saw some growth in the first decade of the twentieth century. Some of these operations closed again during World War I but most of the larger workings appear to have developed or re-started on a larger scale in the post-War period. The difficulties of transport which had hampered earlier operations were substantially reduced by the construction of pipelines to new drying complexes located on the rail network: clay from both the Northwood works, operational from 1908 until 1921, and from Parsons Park, went to Moorswater, near Liskeard, from the Glynn valley operation (Fig 26) to Bodmin Road station (now Bodmin Parkway) and from Hawkstor to Newbridge, east of Bodmin Road, all on the Great Western Railway main line; clay from Stannon was piped to Penpont on an extension to the London South Western Railway branch line from Boscarne Junction, on which there was also a clay works at Stump Oak siding near Tresarrett (Smith 2008b, 113-5, fig 83; Whetmath 1994, 28).

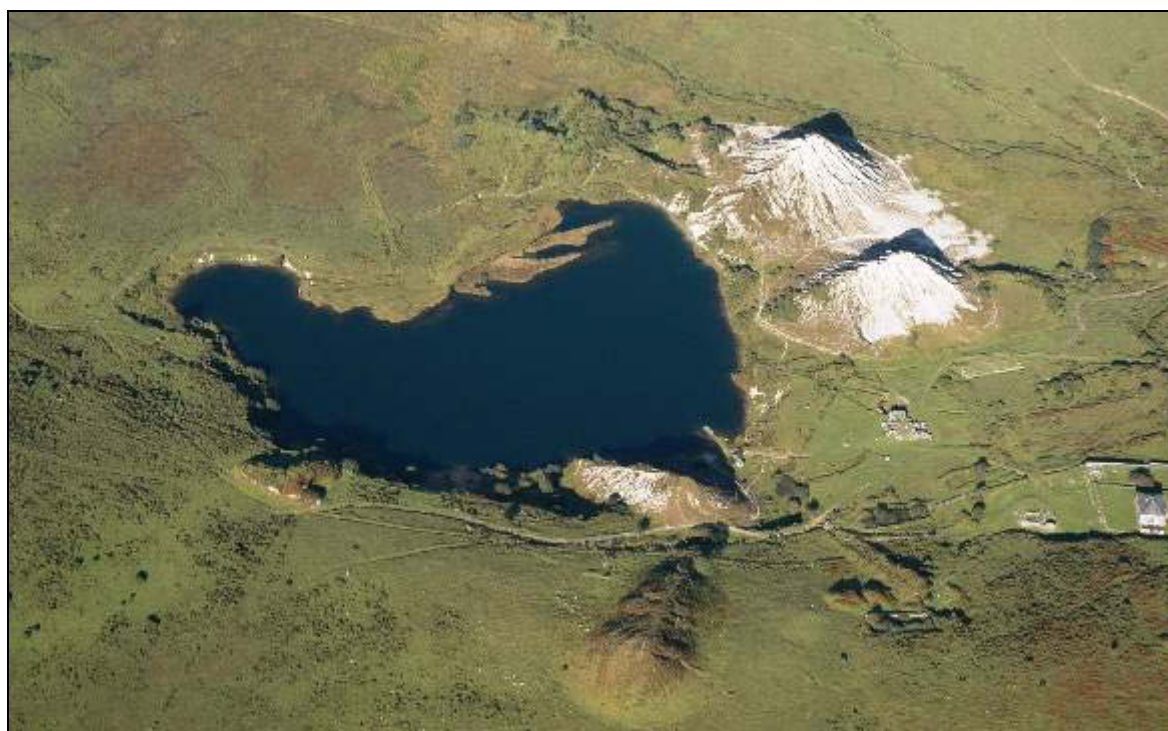


Figure 26 The pit and sky-tips of the Glynn Valley clayworks on Bodmin Moor, which first opened in 1875 and worked sporadically until 1942. The remains here provide an almost complete record of the development of a small pre-modern clay operation (Smith 2008b, 113-4). (Photograph: Historic Environment, Cornwall Council: F66-136; 31 August 2004.)

By contrast with the Hensbarrow area, limited use was made of steam engines for pumping; only Northwood and Temple appear to have used steam power (Smith 2008b, 103). Again, this may be attributable to the costs of transporting coal to these

remote sites but there were also good sources of water power locally, sometimes linked to the clay works by extensive flat-rod systems, as at the Hawkstoe (Cole 1997) and Temple clay-works, the latter powered by the large Gawns waterwheel more than 2 km to the west (MCO23950). Later, power was provided by electricity either produced on site or brought from a remote water-powered generator. In the 1930s, for example, the Gawns wheel was used to generate electricity which was carried to the Temple works by overhead lines (Smith 2008b, 115; Leigh 1937, 171).

Some of the Bodmin Moor works closed during World War II but others continued well into the second half of the twentieth century, including Park, or Parsons Park, which closed in 1997, and which had shipped at least some of its clay via the Looe branch line; St John Thomas (1988, 183) noted two trains per day carrying clay from the Moorswater dries to the quays at Looe until at least the early 1980s. The largest of the Bodmin Moor operations, Stannon, finally closed in 2000 (Figs 27, 75).

Away from Bodmin Moor, a new operation started about 1909 close to the former Belovely clayworks site near Belowda Beacon. This was highly innovative in its processing technology, with, for example, early instances of the use of centrifuges and chemical separation methods, and of concrete for the principal structures (Tonkin 1994). The operation closed in about 1924.



Figure 27 The Stannon china clay works on Bodmin Moor, photographed from Rough Tor in 1972 (cf Fig 75). (Photograph: China Clay History Society archive, HS 534.)

Two twentieth-century workings in the far west of Cornwall also show hints of technological innovation. Balleswidden clay works restarted in 1913 on the site of the earlier Leswidden workings (above) and expanded considerably during the 1920s. Remains include two concrete pan-kilns sited alongside the Penzance to St Just road; the later of the two kilns on the north side of the road was purpose-built in a style that has no direct counterpart in the St Austell clay district (Fig 28). Balleswidden closed in 1942 but the dumps have been reworked for the manufacture of concrete blocks (Cornwall and Scilly HER MCO 24562, MCO 55816; Sharpe 1992, II, 26).

The last works in this area to close was that at Bostraze, to the north west of the Leswidden operations. The origins of this site postdate the 2nd edition Ordnance Survey 25in map of c 1907 but are not more closely dated. It had an oil-fired dry, small by

comparison with coal-fired dries, and small tanks and mica drags; transport access was to the main Penzance-St Just road (Sharpe 1992, II, 27). The Bostraze clay works was closed by ECCI in 1991 (Scrivener *et al* 1997, 11).



Figure 28 The early twentieth-century china-clay works at Balleswidden, near St Just in west Cornwall. (Photograph: Historic Environment, Cornwall Council: F87-001; 31 October 2008.)

Elsewhere in west Cornwall, Baker's Pit (above) closed during World War I and worked only sporadically subsequently, finally closing in 1942 (Taylor 2002, 11). Another operation, the Porthia china-clay works, commenced in 1923 near Penderleth, Towednack, about 2.5 km to the north east of Baker's Pit. It closed in the 1930s and the surviving remains include a long, narrow openwork, spoil dumps, a mica-drag, settling pits and a pan-kiln with a stack in brick and granite (HER MCO 50785). Clay from this operation was sent by pipeline to a dry 5 km to the south east, adjacent to the Great Western Railway main line at St Erth (Ivor Bowditch, pers comm).

On Dartmoor, the operation at Wotter, which had closed in 1898, re-opened before World War I (Wade 1982, 19). The most ambitious development of the early part of the century, however, was the establishment of substantial new workings on the higher part of the southern moor at Redlake (Fig 29). The remote location, 11 km north of Ivybridge at an altitude of 450m OD, necessitated substantial investment in infrastructure, including the building of a tramway to the workings with a parallel conduit for transporting liquid china clay to settling tanks and dries adjacent to new sidings on the Great Western main line. The complex, which began operation in 1913, also included two steam engines for pumping, a barracks to accommodate the clay workers and a cottage for the works captain (Wade 1982, ch 3). The operation was hit almost immediately by the major slump in export demand which resulted from World War I and worked only sporadically for several years. It re-opened in the early 1920s, adding the nearby smaller Leftlake works (Fig 21) to the operation at the same time, and the two workings continued until they were closed in 1932 by the reduction in demand resulting from the Depression (*ibid*, 40).

Redlake and Leftlake appear to have been the only Devon pits to close during the Depression but several others were ordered to cease working by the Board of Trade during World War II, including Cholwichtown, Whitehill Yeo, Hemerdon, Wotter and Olvers / Smallhanger (Wade 1982, 81). There was some consolidation in the industry, with only two works left outside ECLP ownership by the early 1950s (*ibid*). The Cholwichtown operation restarted in 1959 and Lee Moor expanded to take in the

Whitehill Yeo works; clay from Lee Moor was from 1947 sent by pipeline to a drying works at Marsh Mills, Plymouth. Some of the finished clay was shipped from Plymouth, most from Fowey (Harris 1992, 90-1, 94). By the 1960-70s the three operations – Lee Moor, Cholwichtown and Whitehill Yeo – were being worked in a closely integrated system with new investment in infrastructure (*ibid*, 88) (Figs 30, 68).



Figure 29 The remote Redlake china-clay works on southern Dartmoor opened in 1913 with total initial investment exceeding £100,000. The site was served by a 13 km tramway and liquid clay produced there was shipped by gravity to settling tanks and kilns off the moor at Cantrell, on the Great Western Railway main line. The operation closed in 1932. (Photograph F M Griffith, Devon County Council, 16 February 1988.)

2.6 Recent history

[Part of the content of the following section has been compiled from press reports from the past decade or so currently available online, plus material from company websites. These sources have not been individually referenced.]

Substantial reserves of china clay remain in the south west: production in 2008 totalled 1.36 million tonnes and the British Geological Survey estimated that the then current rates of production, using existing technology, could be sustained for 50 years (BGS 2009). Recent decades have seen continuing major changes in the technological elements of the industry (Thurlow 1992; 2001), not least the introduction of centrifuges which have aided the recovery of much higher proportions of kaolin from the material worked. The entry of Imerys into the south-western industry brought advances through the application of modern mining methods; this has resulted in significant improvements in the management of the development of extraction sites (Richard Bown, pers comm). The relatively recent introduction of dry mining, initiated at Lee Moor in 2001, represents a particularly important innovation in working methods (Devon County Council 2004a, 107; 2004b, 181; DKG 2008).

There has also been significant change in the broader economic context for the industry. Major shifts in patterns of world trade, together with fluctuating currencies and rising energy prices have been paralleled by the emergence of new clay sources

overseas and growing multi-national interest in production of key raw materials. China-clay sales from the south west peaked in the late 1980s at around 2.75 million tonnes annually and have declined subsequently. Overall, the primary focus of production of clay for world markets has now shifted to Brazil.

These trends have been accompanied by increasing concentration of ownership. A key change was the takeover in 1999 of English China Clays International, successor to ECLP, by the French company Imetal, subsequently Imerys. Imerys acquired Goonvean, the only surviving independent operator in the St Austell clay district, in 2012. In the Lee Moor area, which represented 12 per cent of the total production output for the south west in 2008, production was divided between two producers, Imerys and another multi-national, Sibelco (formerly WBB), until Imerys finally ended its Lee Moor operations and those at the associated processing complex at Coypool, Marsh Mills, Plymouth, in 2008. Sibelco took over part of the former Imerys Lee Moor working and its operation at Headon, Cornwood, continues.



Figure 30 Whitehill Yeo pit, on south-west Dartmoor, from the north, with a double incline mounting a waste tip; July 1971. (China Clay History Society archive, 17218.)

The modern industry has progressively worked to concentrate production on very large-scale operations; smaller, isolated and more remote operations have been abandoned. Stannon, the last remaining clay working on Bodmin Moor, ceased operation in 2000-1 and many workings within the core St Austell region have also closed. Par harbour closed in 2007, with the bulk of exports subsequently going via Fowey (78 per cent) and Plymouth (18 per cent) (BGS 2009) (Fig 31). Only a relatively small proportion of clay is now shipped by rail and road. Overall, there has been a substantial reduction in the clay workforce in the south west.

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Some new operations have opened, however, and there is also a growing although predominantly regional market in the secondary aggregates and sands produced as 'arisings' from the industry. BGS (2009) noted sales of 3.5 million tonnes in 2008, almost all in the south west. Transport costs have limited the market for these aggregates outside the south west but this may be changing: secondary aggregates from the St Austell clay district were shipped by rail for use in construction of facilities for the 2012 London Olympics complex (Bowditch 2013).



Figure 31 China-clay wharves and jetties at Fowey. A large proportion of clay production is now shipped by this route. (Photograph: Historic Environment, Cornwall Council: F67-059; 8 June 2005.)



Figure 32 The Eden Project, now a major tourist attraction, is the most obvious example of new uses for former industrial sites within the clay area. The main complex occupies the former Wheal Carlyon, Carvear and Bodelva clay works. Clay working began here in the 1820s (Johns 1996). (Photograph: Historic Environment, Cornwall Council: F67-034; 8 June 2005.)

As the industry has abandoned worked out or unprofitable operations there has been a continuing process of backfilling disused pits with waste and major programmes of re-profiling old tips and re-vegetating them through tree planting and heathland restoration (Thurlow 1992, 13; 2001, 60-1; section 3.3.6, below) (Figs 73, 74, 76, 111). This has been particularly prominent in the St Austell china-clay district but similar 'landscape restoration' measures have taken place on former tips around Stannon and Park on Bodmin Moor (Figs 6, 75) and in the area around Lee Moor in Devon.

Also prominent has been a trend towards seeking new uses for land within the clay areas. Stannon pit has found a new function as a reservoir but in the St Austell clay district there has been a focus on increasing the amenity value of areas of landscape which have effectively been abandoned by the industry. Prominent examples of this have been the Eden Project (Fig 32) and the creation of a china-clay industry museum and country park at Wheal Martyn. A network of leisure trails has been created through areas which were formerly largely inaccessible to the public (Fig 53). In the recent past the margins of the Hensbarrow upland have also become a focus for renewable energy developments.



Figure 33 Blackpool dryers, refinery and pit at Burngullow, the site of a proposed 'eco-community'. The first phase of the processing complex, located alongside the Great Western main line, adjacent to the junction with the important mineral branch line to St Dennis, dates to the late nineteenth century. The site was the focus for major investment in new clay processing technology in the 1960s and 1970s, at which time the distinctive belts of evergreens screening the site from view from the St Austell – Newquay road were also planted (Bowditch 2013). The Blackpool complex lies over the sites of the former manorial centre of the manor of Burngullow and the medieval farm settlement of Methroes in an area of Anciently Enclosed Land. The potential for buried archaeology around the site is likely to be high. Beyond the St Austell – Newquay road to the north is an area of Recently Enclosed Land taken in from rough ground in the post-medieval period. (Photograph: Historic Environment, Cornwall Council: F82-075; 16 April 2008.)

Much the largest potential impact in terms of new uses, however, is represented by a proposal launched in 2008 for a series of 'eco-communities' on former clay industry sites across the St Austell clay district, including 5,000 new houses and 25 ha of employment land. The proposed sites are:

- West Carclaze and Baal, with an adjacent technology park development and new road link around the base of Carluddon (Great Treverbyn) sky-tip (Figs 106, 115).
- Goonbarrow refinery, effectively extending the existing settlement of Bugle.
- Blackpool dryers refinery and pit, near Trewoon (Fig 33).
- Drinnick and Nanpean (Fig 12).
- Par Docks, with a focus on housing and a marina (Fig 5).

2.7 Historic extraction and processing methods

(This section is closely based on Herring and Smith 1991, 49-52.)

2.7.1 Methods of extraction

The extraction of china-clay has always been a hydraulic process. The extent and nature of the clay deposit was first determined by sinking a series of shallow excavations or **prospecting pits**, in the same manner as for any other mineral. From the area of the **sett** the surface soil or **overburden** was removed to reveal the kaolinised granite; the top layer of which, discoloured by leached minerals, would also be discarded.

2.7.2 Stream and strake

The original method of extraction was by **stream and strake**: a stream of water was directed over the exposed clay ground, washing the kaolinised material away from the unaltered rocks or **stent**. Workers using shovels and short picks known as **dubbers** stood in the clay stream and broke up the material; as the stream deepened the channel thus formed in the working face was termed a gully or **strake**. In the early phase of extraction hillside sites were chosen for preference and the clay flowed by gravity to the process area; as the pit deepened and this was no longer possible, it was necessary to either drive an **adit** from the bottom of the pit or sink a **shaft** from the top through which the clay was pumped to surface.

The first pumps used were simple plunger devices made from hollowed logs and operated by hand; while the depth of the openwork was shallow this sufficed, but as the works deepened and expanded a water wheel would be installed to drive a series of lift pumps similar to those used in underground tin and copper mines.

A shaft was sunk on the edge of the clay ground, and a level or adit driven from the bottom of this to a point below the centre of the intended work area. A **rise** was then driven up to the surface, by now stripped of overburden, and a **button-hole launder** placed in this shaft. This device was in essence a vertical wooden pipe of square section, having a series of holes bored in one face throughout its length; the holes were normally plugged by a series of wooden pegs. The top plug was removed to allow the clay stream to flow through the adit to the pumping shaft, and as the pit deepened so further pegs were removed.

If water was unavailable in sufficient quantity on site to drive a wheel for pumping, this could be sited some distance away and the drive transmitted via a series of reciprocating iron rods, or **flat rods**. Failing this, a steam engine would be installed for the same purpose.

In 1927 the first centrifugal electric pumps were installed on Hensbarrow, and this method of pumping direct from the **sump** or lowest part of the openwork is now universal.

2.7.3 Pressure hose

The first use of a high-pressure hose to wash the clay from the working face was at Blackpool Pit in 1890, using a steam fire-engine as the source of power. Special high-speed pumps were developed to perform the same role, often fed from older flooded workings. By the mid-1920s this method was accepted practice in the Hensbarrow area (Fig 34). Modern development of this concept has resulted in the **monitor**, a high-pressure jet directed by remote control from a weatherproof cabin.



Figure 34 High-pressure water power in use to remove clay at Great Beam clay works (undated). (Photograph: China Clay History Society archive, 45658.)

2.7.4 Gravel and stent

Primary separation of the heavier waste elements took place in the strake itself, the **dubbers** removing the stent as they worked. The coarse gravel and sand was eliminated from the clay stream before pumping to surface by running the stream through a series of pits, the gravel depositing in them and the clay running off the top. At intervals the stream would be diverted to another pit and the waste material dug out. These **gravel pits** in time became more sophisticated and incorporated a certain amount of mechanisation to speed emptying, but the basic principle remained unchanged until recent years.

Disposal of these wastes from shallow workings was originally performed by **shammelling**, the material being dug by hand and thrown back up a series of stepped excavation platforms. This back-breaking labour was replaced by mechanical haulage up a tramway incline or **skip-road**, power for this being provided by a horse-whim, water-wheel, or steam engine.

The dispersal of the sand, gravel and stent at surface displays an evolution through two distinct forms. Initially the wastes were barrowed out along flat topped dumps which spread, fan-like, from the margins of the excavation to cover the nearby moor. Barrows were in time replaced by tramways and hand-pushed skips to speed this process. These **finger dumps** were a notable feature of many of the Hensbarrow works, but very few survive to the present day in that area (Fig 35). Well-preserved examples of finger

dumps, together with other associated features of nineteenth-century working, have recently been recorded at Hemerdon, on Dartmoor (Dyer 2014, 33).



Figure 35 Finger dumps at Blacktor Downs, near Colquite, on Bodmin Moor, formed of spoil barrowed or trammed from an unsuccessful trial working for china clay which took place in the early 1870s (HER MCO 23814). An extensive Scheduled prehistoric roundhouse settlement can be seen immediately adjacent to the dumps. (Photograph: Historic Environment, Cornwall Council: F96-93; 11 March 2010.)

As the bounds of the sett became pressured by the expansion of the excavations and increasing amounts of dump material, so it became necessary to rationalise the methods of waste disposal. In an effort to conserve available land, the skip road from the pit was extended upwards and the material dumped directly off the top; as the mound of materials grew, so the skip road was extended, resulting in the characteristic conical mound of white sand, or **sky-tip** (Fig 36). This also eliminated the labour of intensive tramping of material by hand along the flat-topped dumps.

Modern practice is to remove coarse wastes by large diesel trucks to flat-topped dumps, arranged in the manner of a stepped pyramid (Figs 11, 25, 58, 73, 95, 111-114).

2.7.5 Sand and mica

The clay stream arriving at surface, although purified to some extent, still contained large quantities of waste materials. These consisted of fine quartz sand and even finer mica. The original method of separation involved the use of three rectangular pits, stepped one below the other; as the stream flowed through the pits the waste was deposited in each, sand in the first, fine sand and some mica in the second, and mica only in the third. The stream was then allowed to flow to settling pans for thickening.

As the clay stream slowed so the fine mica was deposited in these **mica drags**, and the pure product was then run through mesh screens to remove humic material. In later years these mica drags were considerably expanded in size and complexity, often covering large areas of ground.

The current technique employed in handling these wastes involves the pumping of the clay stream through **hydrocyclones** which separate the material in a series of cuts.

The disposal of the sand was to the dumps or **burrows** as for the coarser material from the bottom of the pit. Mica from the drags is a very fluid material, and on Hensbarrow was normally directed to the nearest convenient watercourse and allowed to find its own way to the sea. This had three immediate results: the destruction of all aquatic life

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in the stream, the silting of ports and harbours, and the establishment of numerous small **mica works** downstream of the large producers. Mica lagoons are the current method of dealing with this material.

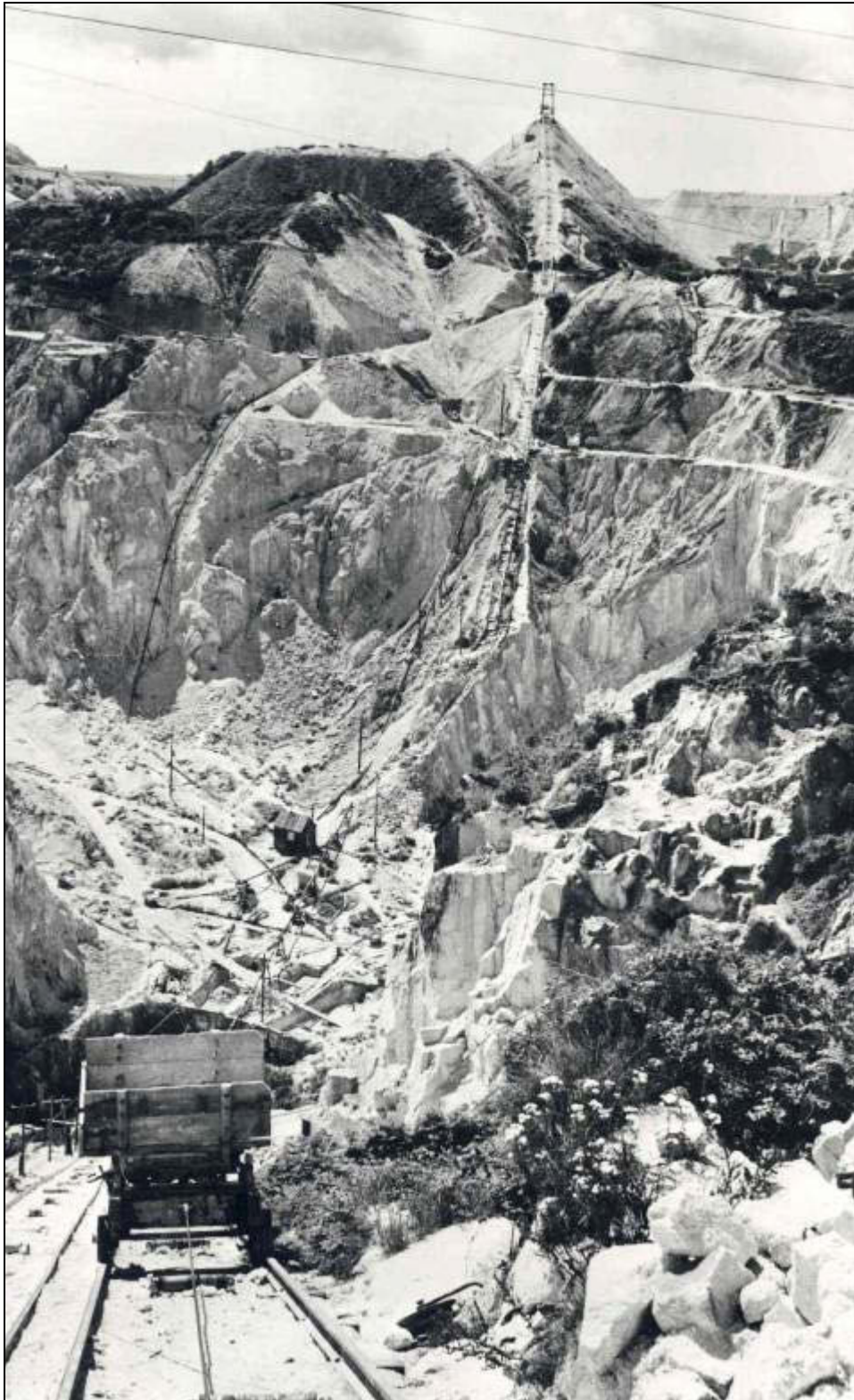


Figure 36 A wooden sand wagon on an incline, hauling spoil from the base of a pit to a sky-tip; a second incline and sky-tip can be seen on the far side of the pit (undated). (Photograph: China Clay History Society archive, 27733.)



Figure 37 The drying floor and travelling bridge (used for distributing semi-liquid clay across the drying floor) at the derelict Carlyon Farm china-clay dry in the Trenance valley, near St Austell. It was completed in 1921 and was reputedly the largest pan kiln ever built. The photograph dates to between 1968 and 1984. (Photograph: ECC archive, held by the China Clay History Society.)

2.7.6 Water removal and drying

Before the clay could be presented for sale it had to be dried. Initially it was run into stone-lined **settling pits**; these might be rectangular or circular in shape. Here the clay was allowed to settle and the clear top water run off via **pin-hole launders** (similar to button-hole launders but with smaller holes). When the clay had thickened by the required amount it was **landed** or run off via a sluice in the base of the tank to the next stage in the process. The earliest settling pits were of relatively shallow section, and these led in turn to **clay pans** where the clay was allowed to dry gradually in the open air. When sufficiently de-watered to be cut into blocks, it was removed and stacked in open-sided sheds or **air dries** till ready for sale.

This method of working, used in places until the 1920s, was inherently slow and labour intensive. In the 1850s **pan kilns** were introduced to the industry. Usually built into a

slope to take advantage of a natural gravitational feed through the building, the kiln had as its lower front portion a **linhay** or storage area for the clay. The raised portion at the rear formed the **pan**; here a series of brick flues connecting a furnace at one end of the kiln with a chimney or **stack** at the other were covered with semi-porous earthenware tiles. These formed a heated floor onto which the semi-fluid clay was run, the moisture being driven from the clay by means of the hot gases circulating beneath. At the rear of the kiln were **settling tanks** into which the clay was landed from the settling pits and further thickened before being run on to the pan.

To further speed the de-watering process, **filter-presses** were introduced in the 1920s as an intermediate stage between the settling tanks and the pan kiln. These removed water content by subjecting the clay slurry to hydraulic pressure, the resultant **press-cake** being dried on the pan in the usual fashion.

Present-day practice is to thicken the clay slurry in large (140-foot diameter) settling tanks, and then to dry the material in **rotary** or **Buell** driers. A certain proportion is also delivered to consumers in slurry form.

2.7.7 Packing and distribution

Until recent years, china clay was always delivered to the consumer in bulk form. The blocks of clay were loaded from the linhay into carts or directly into railway wagons and transported to the nearest harbour, there to be loaded into the holds of ships destined for the Potteries and paper-makers. Some clay intended for shipment overseas was packed into 5 cwt casks, and this mode of transport was increasingly used for markets where contamination of the clay had to be avoided. Only since 1945 have these methods of packing and shipment been radically altered, as the clay products themselves have become more specialised and highly refined. Clay slurry for papermaking is transported in tank wagons or lorries, and bagged clay in plastic sacks is now preferred by many consumers.

3. Historic Landscape Character

This section examines the Historic Landscape Character of the present project area, part of which may potentially be subject to future china-clay industry development but which also includes the area covered by the St Austell, St Blazey and China Clay Area Regeneration Plan, subject to a wider range of potential development. It assesses the extent to which future china-clay extraction, infrastructure development or restoration could impact on present historic landscape character, with a summary of potential impacts and a statement of significance for each historic landscape character Type.

The fundamental principle underlying the concept of historic landscape character is that

'all parts of the landscape are 'historic' in the sense that they are the direct product of past human activity interacting with geology, natural landforms, climate and the consequent vegetation and fauna; there is no part of the landscape which has not been subject to some human influence' (Herring 2011a, 72).

Across an area, a district a region or a land-mass, present landscapes can be divided into a patchwork of pre-determined Types, further subdivided into sub-Types, based on attributes which derive substantially from their past 'biographies': that is, the forms of human activity which have shaped them (for example, areas dominated by field systems based on agricultural patterns established in the medieval period; upland moors used for grazing since the prehistoric period; former rough ground enclosed to create new farms and smallholdings in the eighteenth and nineteenth centuries). Understanding of these Types offers powerful tools both for predicting archaeological potential (in the widest sense) and for managing change within landscapes. Historic landscape characterisation has a large and growing literature. The key texts for Cornwall and Devon are Cornwall County Council (1996), Herring (1998a), Turner (2007) and the relevant pages on the Devon County Council website (Devon County Council, HLC). For Dartmoor the National Park's *Landscape Character Assessment* (Land Use Consultants 2010) is also strongly relevant.

3.1 Assessing significance

One of the principles of HLC is that all areas have historic landscape character and all such character has value and can be managed or curated in ways appropriate to that character (Cornwall County Council 1996; revised historic landscape characterisation texts 1998 and 2009 held by Historic Environment, Cornwall Council). The characterisation process does not ascribe absolute or inherent values to any HLC type: such value-ascription will vary with the purpose and context of any application and is most appropriately made at the time of such application. It is useful, however, to anticipate various applications of the characterisation by considering some of the ways in which each HLC Type relates to the four main forms of heritage values (evidential, historical, aesthetic and communal), as set out in English Heritage's *Conservation principles* guidance (English Heritage 2008b). The following are brief introductions to each of these values.

3.1.1 Evidential value

Evidential value derives from the potential of a place, or a type of place, to yield evidence about past human activity. Physical remains of past human activity are the primary source of evidence about the substance and evolution of places, and of the people and cultures that made them. These remains are part of a record of the past that begins with traces of early humans and continues to be created and destroyed today. Their evidential value is proportionate to their potential to contribute to people's understanding of the past.

In the absence of written records, the material record, particularly archaeological deposits, provides the only source of evidence about the distant past. Age is therefore one indicator of relative evidential value, but is not paramount, since the material

record is the primary source of evidence about poorly-documented aspects of any period, including the very recent.

3.1.2 Historical value

Historical value derives from the ways in which past people, events and aspects of life can be connected through a place, or a type of place, to the present. It tends to be illustrative or associative. The idea of illustrating aspects of history or prehistory – the perception of a place as a link between past and present people – is different from purely evidential value (above). Illustration depends on visibility in a way that evidential value (for example, of buried remains) does not. Places with illustrative value will normally also have evidential value, but it may be of a different order of importance.

Illustrative value has the power to aid interpretation of the past through making connections with, and providing insights into, past communities and their activities through shared experience of a place.

The historical value of places depends upon both sound identification and direct experience of fabric or landscape that has survived from the past, but is not as easily diminished by change or partial replacement as evidential value. The authenticity of a place indeed often lies in visible evidence of change as a result of people responding to changing circumstances. Historical values are harmed only to the extent that adaptation has obliterated or concealed them, made them illegible, although completeness does tend to strengthen illustrative value.

3.1.3 Communal value

Communal value derives from the meanings of a place, or a type of place, for the people who relate to it, or for whom it figures in their collective experience or memory. Communal values are closely bound up with historical (particularly associative) and aesthetic values, but tend to have additional and specific aspects.

Commemorative and *symbolic* values reflect the meanings of a place for those who draw part of their identity from it, or have emotional links to it (Figs 38, 110, 115). Such values tend to change over time, and are not always affirmative. Some places may be important for reminding us of uncomfortable events, attitudes or periods in our history. They are important aspects of collective memory and identity, places of remembrance whose meanings should not be forgotten. In some cases, that meaning can only be understood through information and interpretation, whereas, in others, the character of the place itself tells most of the story.

Social value is associated with places that people perceive as a source of identity, distinctiveness, social interaction and coherence. Some may be comparatively modest, acquiring communal significance through the passage of time as a result of a collective memory of stories linked to them. They tend to gain value through the resonance of past events in the present, providing reference points for a community's identity or sense of itself. They may have fulfilled a community function that has generated a deeper attachment, or shaped some aspect of community behaviour or attitudes. Social value can also be expressed on a large scale, with great time-depth, through regional and national identity.

The social values of places are not always clearly recognised by those who share them, and may only be articulated when the future of a place is threatened. They may relate to an activity that is associated with the place, rather than with its physical fabric.

In the following texts describing HLC Types the notes on communal value concentrate on the range of perceptions that communities and individuals typically have of the HLC Type under consideration.

3.1.4 Aesthetic value

Aesthetic value derives from the ways in which people draw sensory and intellectual stimulation from a place, or a type of place. Aesthetic values can be the result of the

conscious design of a place, including artistic endeavour. Some aesthetic values are not substantially the product of formal design, but develop more or less fortuitously over time, as the result of a succession of responses within a particular cultural framework. They include, for example, the seemingly organic form of an urban or rural landscape; the relationship of vernacular buildings and structures and their materials to their setting; or a harmonious, expressive or dramatic quality in the juxtaposition of vernacular or industrial buildings and spaces (Fig 72; Appendix 1). Many places combine these two aspects – for example, where the qualities of an already attractive landscape have been reinforced by artifice – while others may inspire awe or fear. Aesthetic values tend to be specific to a time and cultural context, but appreciation of them is not culturally exclusive.

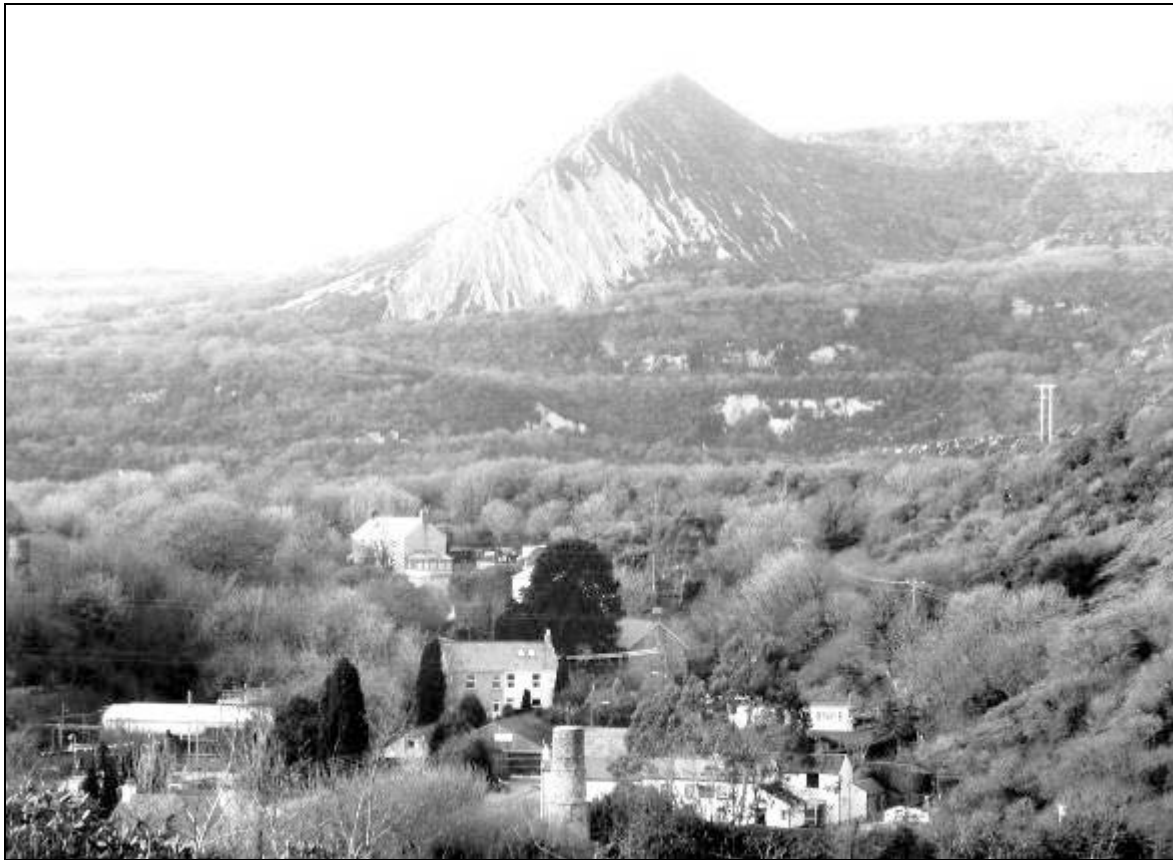


Figure 38 A misty view north over the settlement at Carthew and Carbean at the upper end of the Trenance valley, looking towards the twentieth-century pit and sky-tip of Gunheath. The stack in the foreground formed part of the later nineteenth-century Lower Ninestones clay dries. Although relatively recent, industrial features such as these have clear evidential and historic value, and are also likely to have significant communal value because of their high visibility and strong contribution to the locality's unique sense of place. (Photograph: Graeme Kirkham.)

3.2 Historic Landscape Character Types

The Cornwall and Devon Historic Landscape Characterisation datasets differ from each other in the degree to which Types are subdivided but are otherwise broadly comparable for the landscape Types relevant to the current study. Table 1 notes briefly the attributes which have been identified for the various Types within each of the historic landscape character datasets and the equivalences between Types which have been assumed in the assessment. Historic landscape character Types in the Cornwall HLC are defined in Cornwall County Council (1996), Herring (1998a), with subsequent

revisions (texts held by Historic Environment, Cornwall Council). Those for Devon have been derived from the brief historic landscape character descriptions presented at www.devon.gov.uk/index/environmentplanning/historic_environment/landscape-characterisation/historiclandscapecharacterisationmaps.htm, amplified by material in Turner (2007).

Table 1 Historic Landscape Character Types for Cornwall and Devon

Cornwall HLC	Devon HLC
<p>Upland Rough Ground</p> <p>Mostly found on granite or poorly drained and particularly exposed downland. Now distinguished mainly by habitat/ecology from surrounding enclosed or improved ground. The impact of human action is often underestimated and the Type is regularly regarded as largely 'natural' or 'wild'. In fact, it usually has the longest history of human interference/utilisation with its principal attribute, impoverished soil supporting essentially heath/scrub vegetation communities, usually being a product of prehistoric human intervention, which was maintained through medieval and early modern land use systems.</p>	<p>Rough ground</p> <p>Rough grazing ground, heathland or moorland</p> <p>Rough ground</p> <p>Rough grazing ground, heathland or moorland that shows signs of earlier historical use as agricultural land</p> <p>Rough ground with prehistoric remains</p> <p>Earthworks in this rough grazing ground, heathland or moorland preserve the remains of a prehistoric landscape.</p> <p>Rough ground with mining remains</p> <p>Earthworks in this rough grazing ground, heathland or moorland show areas of historic mining activity.</p>
<p>Anciently Enclosed Land (also Farmland: Medieval)</p> <p>The agricultural heartland, with farming settlements documented before the seventeenth century AD (source, Institute of Cornish Studies place-names index) and whose field patterns are morphologically distinct from the generally straight-sided fields of later enclosure. Either medieval or prehistoric origins. Tends to be on relatively sheltered land, not too steep and not too poorly drained, but can extend onto the edges of high downs. Networks of winding lanes and roads, often deeply cut by the passage of people, animals and vehicles over centuries or thousands of years. These connect farming settlements whose layouts are typically irregular, often clearly shrunken from hamlets; some are still hamlets. Churchtowns and a few larger villages are scattered through the Type which also contains, or surrounds, most of the county's ancient towns.</p> <p>NB. The following sub-Types of Anciently Enclosed Land have been identified during subsequent work in specific areas in Cornwall:</p>	<p>Medieval enclosures</p> <p>Fields first enclosed with hedge-banks during the Middle Ages</p> <p>Medieval enclosures based on strip fields</p> <p>Probably first enclosed with hedge-banks during the later middle ages. The curving form of the hedge-banks suggests that earlier it may have been farmed as open strip-fields.</p> <p>Strip fields</p> <p>Surviving unenclosed strip field systems.</p> <p>Barton fields</p> <p>Relatively large, regular enclosures likely to have been laid out between the fifteenth and eighteenth centuries. Some curving boundaries may follow divisions in pre-existing medieval fields.</p> <p>Post-medieval strip-enclosures</p> <p>Unusual long narrow enclosures, probably of the post-medieval period, whose boundaries follow divisions in the earlier medieval open field</p> <p>Post-medieval enclosures with medieval elements</p> <p>These enclosures are probably based on</p>

Cornwall HLC	Devon HLC
<ul style="list-style-type: none"> • Medieval strip fields (unenclosed) • Derived from medieval strip fields (enclosed) • Derived from medieval cropping units • Barton farm field patterns • Irregular field patterns • Irregular peripheral fields. <p>Anciently Enclosed Land in West Penwith has been generically classified as Farmland: prehistoric.</p>	<p>medieval fields, but the many straight field boundaries suggest they were substantially re-organised in the post-medieval period.</p>
<p>Recently Enclosed Land (also Post-medieval Enclosed Land, Farmland: Post-Medieval)</p> <p>Land enclosed in the 17th, 18th and 19th centuries, usually from land that was previously Upland Rough Ground and often medieval commons. Generally in relatively high, exposed or poorly-drained parts of the county.</p> <p>Fields in Post-Medieval Enclosed Land normally have perfectly straight sides and boundaries have less mature or varied vegetation cover than in Anciently Enclosed Land. Many are drystone walls. Being exposed, there is relatively little woodland compared with Anciently Enclosed Land, but more evidence of its previous vegetation in gorse, heather, bracken, etc, on hedges and in corners of fields. Land is now usually pasture, with little arable, this being essentially marginal land.</p>	<p>Post-medieval enclosures</p> <p>Enclosures of post-medieval date. Fields laid out in the eighteenth and nineteenth centuries commonly have many surveyed dead-straight field boundaries.</p>
<p>Modern Enclosed Land</p> <p>Mainly Anciently Enclosed Land or Post-Medieval Enclosed Land in which field systems have been substantially altered by large-scale hedge removal in the 20th century. It also includes, however, 20th century intakes from rough ground, woodland and marsh.</p>	<p>Modern enclosures</p> <p>Modern enclosures that have been created by adapting earlier field systems.</p>
<p>Ornamental</p> <p>Deliberately and carefully created landscapes, parklands and gardens surrounding large country houses, normally of eighteenth and nineteenth century origin (not including urban parks).</p>	<p>Park/garden</p> <p>A park planted with ornamental trees or a garden round a house. Also includes allotments and public parks.</p>

Cornwall HLC	Devon HLC
<p>Industrial</p> <p>Only extensive areas of industrialised land are placed in this Type. Most will be the sites of extractive industry (mining and quarrying) and only a few will still be active. Where relict industrial landscapes have been overwhelmed by woodland or become absorbed into Upland Rough Ground, they are usually included in other relevant Types. The effect of these decisions is to significantly under-represent industry as most industrial sites are fairly confined and so too small to be included. Many derelict sites have been classified in other Types.</p>	<p>Quarries</p> <p>This character type represents extractive industries including quarries and clay pits.</p> <p>Mining</p> <p>Mines and associated features (NB. Some of the remains of china-clay working on the southern portion of Dartmoor have been characterised under this heading.)</p> <p>Industrial complex</p> <p>Industrial complex (for example, factory, mill, warehouses, retail centre, rail terminal).</p>
<p>Settlement</p> <p>Settled areas from larger farming settlements upwards.</p>	<p>Historic settlements</p> <p>The core area of a historic settlement, based on the late nineteenth century 1st edition (25inch) Ordnance Survey maps.</p> <p>Modern settlement</p> <p>Areas of modern settlement developed during the twentieth century.</p>

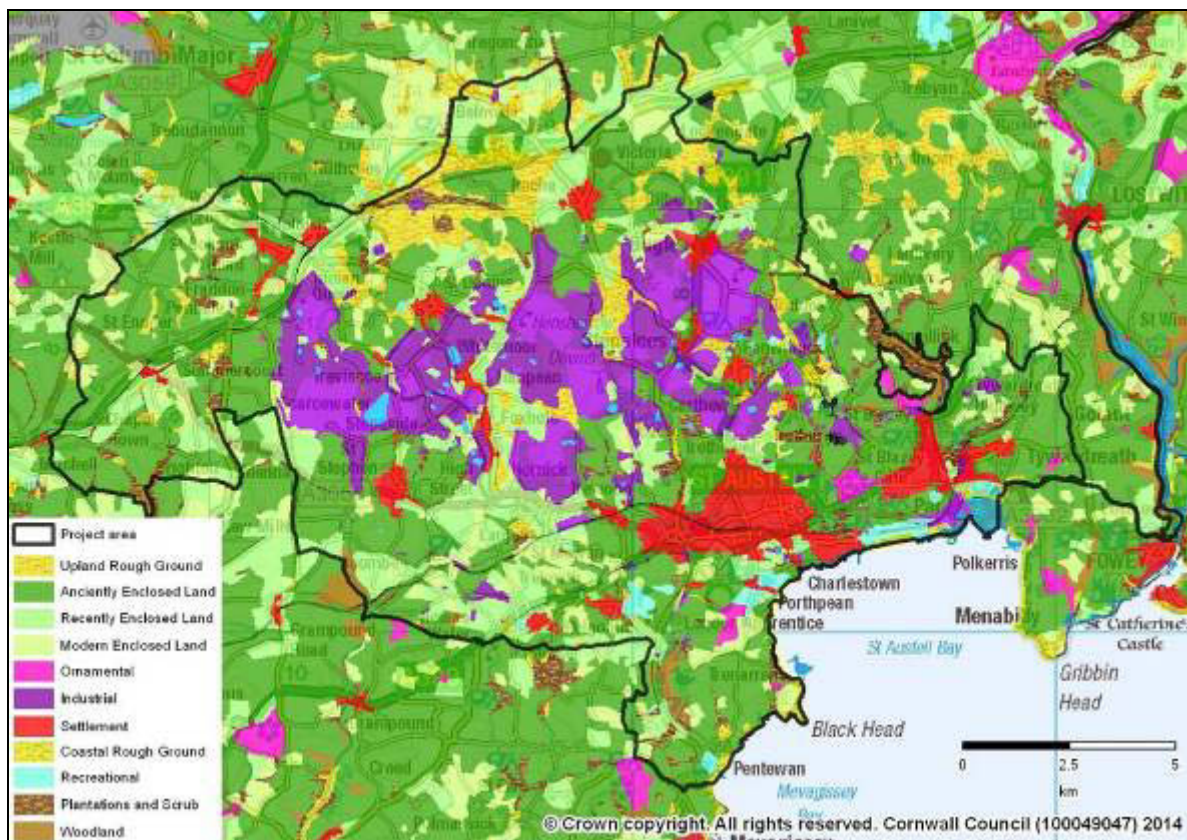


Figure 39 Historic Landscape Character in the St Austell china-clay district (based on mapping from Cornwall County Council 1996).

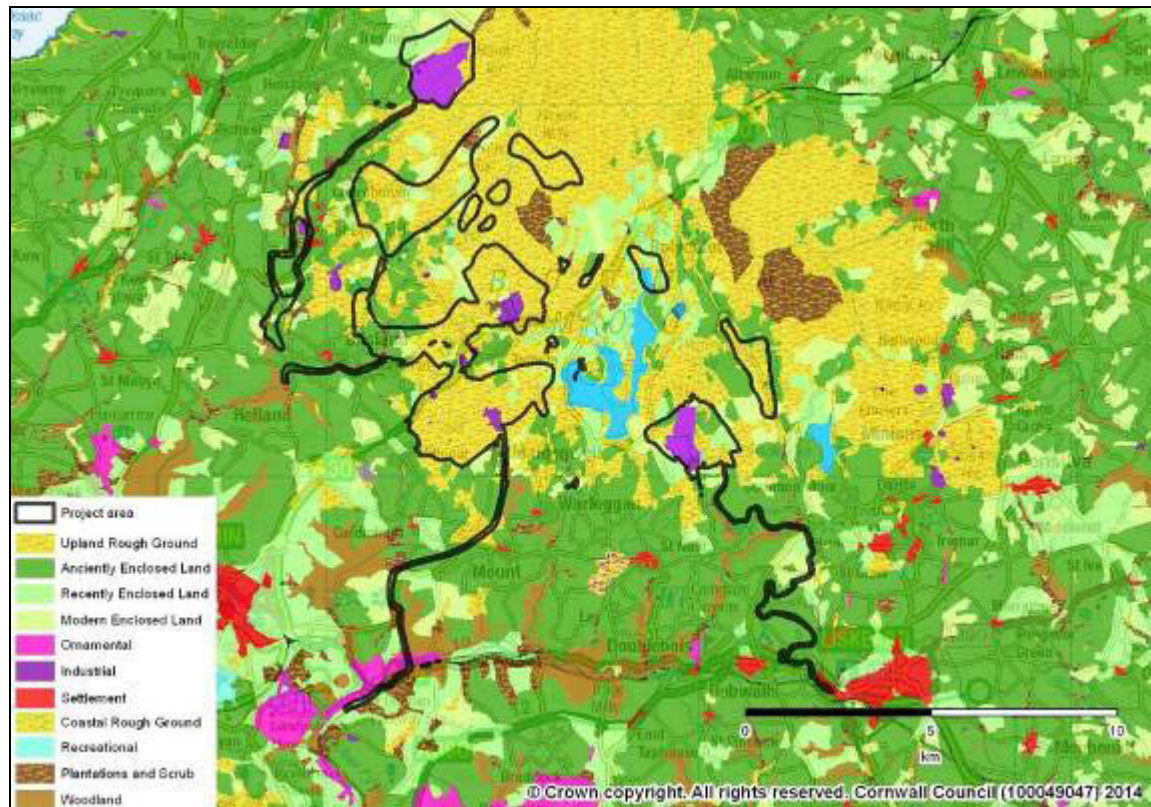


Figure 40 Historic Landscape Character on Bodmin Moor and environs (based on mapping from Cornwall County Council 1996).

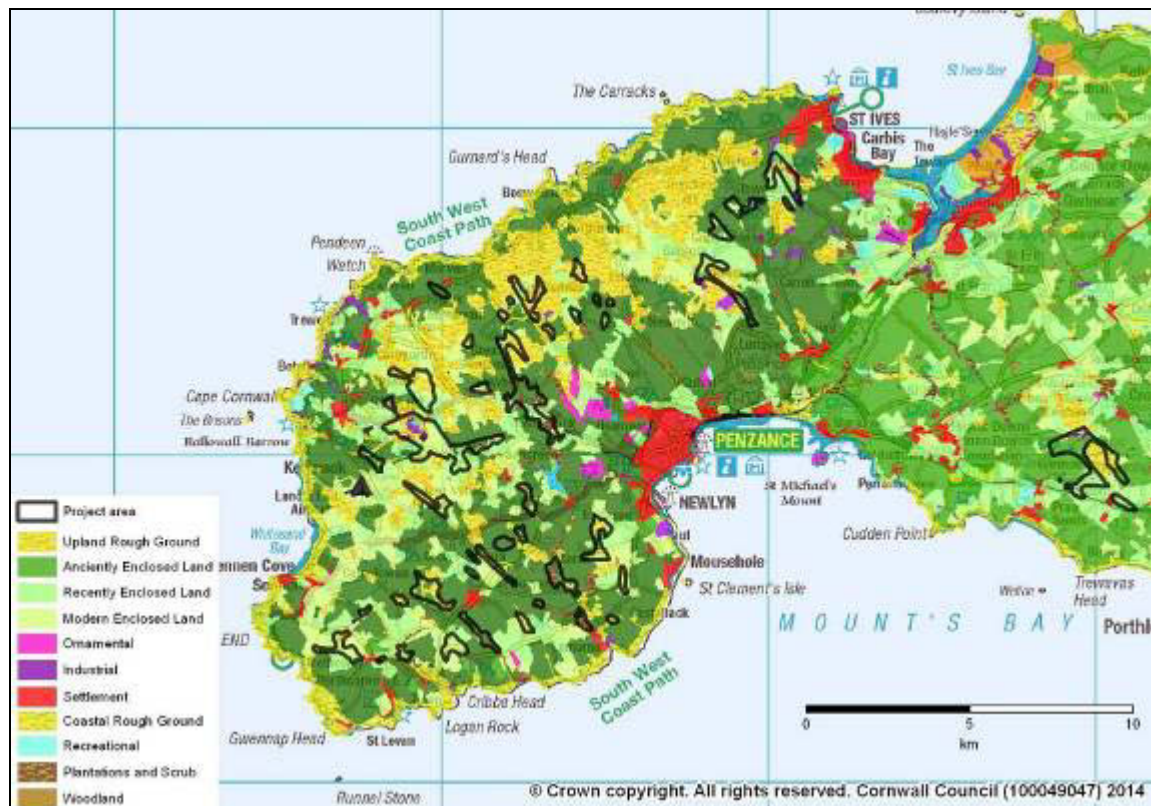


Figure 41 Historic Landscape Character in west Cornwall (based on mapping from Cornwall County Council 1996).

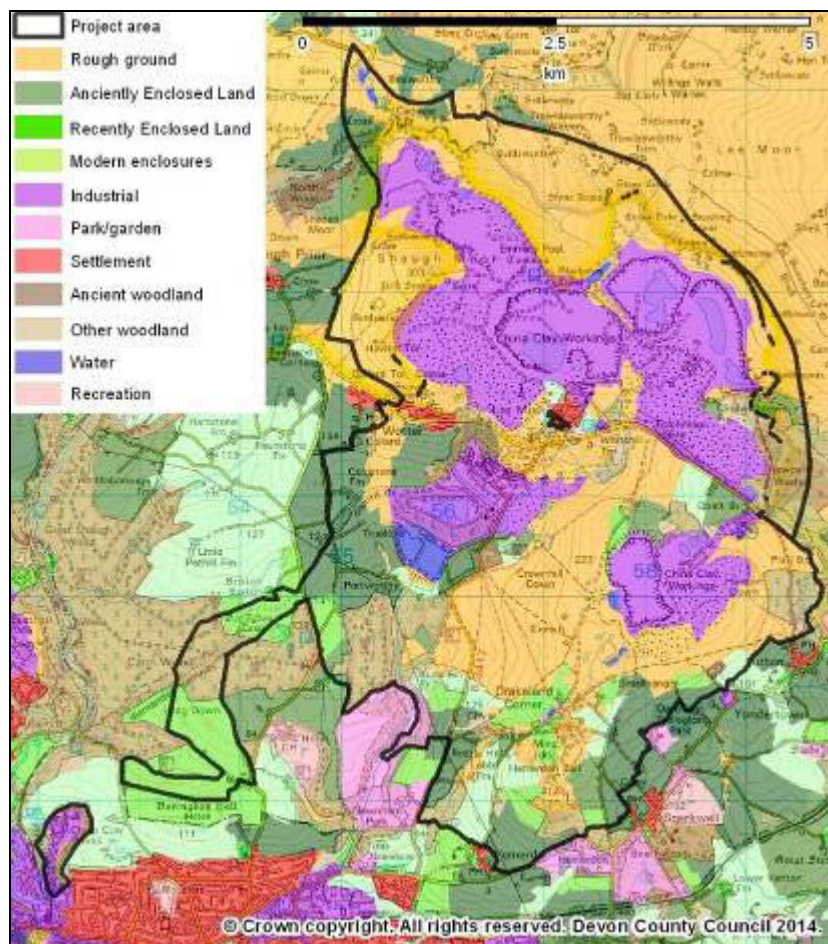


Figure 42 The Lee Moor (south-west Dartmoor) portion of the project area, based on Devon Historic Landscape Character mapping, simplified to parallel the range of historic landscape Types in the Cornwall HLC (cf Table 1). Historic china-clay working on south Dartmoor, outside the area shown, is almost wholly on rough ground landscape character Types.

3.3 The principal Historic Landscape Character (HLC) Types within the project area

This section presents in turn the key historic landscape character Types occurring within the project area and outlines their key character attributes. For each Type potential impacts on historic landscape character are examined, together with a discussion of mitigation and a statement of significance in the particular context of the project area.

The initial summaries of character Type attributes here have been developed from the HLC texts prepared in 1994 by Peter Herring for the Cornwall Landscape Character Assessment (Cornwall County Council 1996), with subsequent revision in 1998 and 2009 (texts held by Historic Environment, Cornwall Council). For Devon the relevant HLC components are discussed in Turner (2007). (The relevant Landscape Character Types recognised within the Dartmoor National Park (Land Use Consultants 2010) coincide reasonably well with those defined by HLC within the project area.) The texts have been amended and enhanced to reflect the particular requirements and themes of the current project. Consideration of the Types has been aided by brief discussion with Peter Herring of recent work on assessing sensitivity in historic landscape character.

3.3.1 Upland Rough Ground

*'Soon they were climbing up a rocky slope overhung by gorse,
emerging onto open downland. The path here was rutted, narrow,
edged by a linked succession of pulley-rods that creaked over tarred
wheels, turned by the big water-wheel down by the wood'*

Jack Clemo (2000, 52).



Figure 43 The enigmatic Scheduled enclosure of probable Neolithic date on St Stephen's Beacon, near Foxhole, viewed from the north east. The monument, which includes a large embanked annexe to the north, lies on a surviving block of what was formerly a much larger area of rough ground, indicated by place-names in the vicinity such as Gonnabarn and Gonnamarris (both incorporating the Cornish element, *gun*, meaning downland rough grazing) and Carloggas Moor. The former Penbough and Carpalla china-clay works lie just to the south of the hill on which the enclosure lies, Beacon clay works to the west, Foxhole works to the east and Carloggas to the north: the North Carloggas mica dam is visible in the foreground of the photograph. (Photograph: Historic Environment, Cornwall Council: F82-065; 16 April 2008.)

This historic landscape character Type is mostly found on granite or poorly drained and particularly exposed downland. It is now distinguished mainly by habitat and ecology from surrounding enclosed or improved ground. The impact of human action is often underestimated and the Type is regularly regarded as largely 'natural' or 'wild'. In fact, it usually has the longest history of human activity and utilisation, with its principal attribute – impoverished soil supporting essentially heath and scrub vegetation communities – usually a product of prehistoric human intervention, maintained through medieval and early modern land use systems. Other key attributes of rough ground include the extensiveness and open landscapes of the larger blocks such as Dartmoor, Bodmin Moor and the West Penwith moors, with wide views in which natural features such as tors and carns, streams and bodies of open water, form important landmarks.

Rough ground is the focus for much of the most significant surviving above-ground archaeology in the south west, accommodating extensive landscapes of prehistoric ceremonial monuments, settlements and field systems, and evidence of past industrial activities including tin streaming, moorstone working, mining, quarrying and, of course,

china-clay working (Figs 35, 43, 46-9, 77, 91, 107). Mitigation in advance of expansion of the clay industry has provided some of the most significant excavated evidence of rough ground archaeology to date (below).

Much the largest part of the china-clay industry in both Cornwall and Devon developed initially on Upland Rough Ground and many of the smaller historic clay sites are incorporated within mapped blocks of this historic landscape character Type. The corollary is that the china-clay industry, because of its extensive nature, has had a substantial impact in reducing the area of upland rough ground within the project area. Herring and Smith (1991, 57) estimated that only 12 per cent of the moorland extant on the St Austell granite in the early post-medieval period now survives, and there have also been significant although smaller reductions around Stannon and Park on Bodmin Moor and in the Lee Moor area of Dartmoor (Fig 44).

In addition to the overall reduction of rough ground, there has also been considerable fragmentation, with surviving pockets isolated from each other by intervening workings, haul roads and waste tipping (for example, Fig 4). This is significant not only in terms of the reduction in extent and the decontextualisation of the remaining parcels of the historic landscape character Type, and of the standing and buried archaeology they are likely to contain, but also for natural habitats. This latter point was noted some 20 years ago (Department of the Environment and Wardell Armstrong 1993, 5), with the comment added that the 'remaining areas [of rough ground in the clay districts] are worthy of protection'. The 6.6 sq km occupied by the china-clay industry on Dartmoor in 2004 was estimated to represent 5.5 per cent of the historic area of heath habitat type on the moor (Dartmoor Society 2004).



Figure 44 Clay working extending over unenclosed rough ground at Shaugh Lake, south-west Dartmoor, in July 1971. (Photograph: China Clay History Society archive, 17228.)

The clay industry has not, of course, been the only factor working to reduce and fragment the area of historic upland rough ground in the south west. Since at least the later seventeenth century there has been very substantial enclosure of rough ground for new farms and smallholdings and in the twentieth century large areas were improved and enclosed through agricultural expansion (Dudley 2011, 47-55; Johnson *et al* 1983), creating the Recently Enclosed Land historic landscape character Type (below, section 3.3.3; Figs 58-61). In the late medieval period rough ground covered approximately 40 per cent of western Cornwall; the current surviving area is approximately 11 per cent (Dudley 2011, 3). In Devon as a whole, including Dartmoor, rough ground has decreased very substantially over the past 100 years, from more than 1100 sq km in the early twentieth century to the current total of about 685 sq km (Turner 2007, 104).

In the longer view, therefore, the Upland Rough Ground historic landscape character Type is a much diminished resource, effectively to be regarded as 'at risk'.

The present project area in Devon includes just under 1100 ha (11 sq km) of rough ground. This is a relatively small proportion – less than two per cent – of the whole area of rough ground in the county. In Cornwall, however, more than 36 sq km (3653 ha) of the project area is characterised as Upland Rough Ground, out of a total of 265 sq km (26,546 ha) within the county as a whole. In Cornwall, therefore, approximately 14 per cent of the surviving Upland Rough Ground could potentially be directly affected by future development if all clay-bearing grounds could be exploited and no constraints were in place. In both counties a much wider area is potentially subject to visual impacts from development taking place within the Type (*cf* Land Use Consultants 2010, 47, 65).

3.3.1.1 Potential impacts

New china-clay development and infrastructure, particularly on the scale achieved by the modern industry, is likely to be highly visible in the context of the open, upland rough ground landscapes of this historic landscape character Type. There is therefore a very high probability of major impacts on visual amenity and historic landscape character where new industrial development takes place on this historic landscape character Type. The need to restrict open public access in proximity to modern industrial working would create new physical barriers to movement over what are otherwise typically open landscapes. The presence of industrial activity with associated movement, dust and noise would also have a substantial impact on the sense of isolation and, in the modern period, near absence of human activity other than leisure and low-intensity grazing, from these areas.

Encroachment onto extensive areas of semi-natural vegetation is likely to be substantial, with consequent impacts on a habitat which itself testifies to the extent of past human activity in creating these areas. The rich historic environment resource which characterises rough ground, extending across all periods from prehistoric to modern, not least that derived from the historic clay industry, and incorporating both standing and buried remains, would also be at risk, as would the very significant palaeoenvironmental resource. Even where direct impacts on the historic environment resource are avoided there is potential for the settings of heritage assets to be affected and for otherwise coherent historic landscapes and complexes and groupings of associated sites and features to be divided and rendered less legible (Figs 47-8).

These potential effects can be demonstrated in terms of the historic impact of the clay industry on the rough ground historic environment. Most obviously there has been a substantial reduction in the historic extent of the upland rough ground landscape character Type and its associated pre-clay industry archaeological assets; large areas of former rough ground have been transformed into the Industrial historic landscape character Type (section 3.3.6). This is most marked in the Hensbarrow district. More than 20 years ago Herring and Smith mapped the substantial historic decline in the

extent of rough ground on the St Austell granite and the associated impact on the historic environment resource (1991, map 10). They noted that in the early post-medieval period approximately 34 sq km of 'undamaged upland' survived in this area, but that in the

'... last 250 years these upland reserves of prehistoric archaeology have been decimated, first by small china-clay and china-stone works with their attendant settlements and farms and now, in the second half of the 20th century, by the vast pits and dumps of the modern industry. Only small patches of undamaged heathland or relict moorland survive (the northern slopes of Hensbarrow Downs, St Stephen's Beacon, and small patches of Caerloggas Downs, Carn Grey, Burngullow Common, Trenance Downs, Trelavour Downs and Longstone Downs), barely 4 square kilometres in total. This represents just 12% of the moorland extant in the early post-medieval period; it is not surprising, therefore, that the archaeological resource is now limited. The fragmentary nature of the extant moorland means that only glimpses of the once coherent prehistoric and medieval landscapes ... can now be obtained' (Herring and Smith 1991, 57).

An example of this latter point is offered by a north-south tract almost 5 km long on the western side of the St Austell granite massif, between Gaverigan to the north and the new Scarcewater tip to the south. Much of this area was formerly Upland Rough Ground but now shows few surviving traces of the pre-industry landscape Type (Fig 25). Few extensive areas of rough ground now remain in the Hensbarrow clay district and the surviving pockets are often divided by haul roads and the ubiquitous networks of overhead power lines and, latterly, communications masts (Fig 45); the sense of extended space and openness which are key elements of this historic landscape Type elsewhere are substantially diminished.



Figure 45 The view north from West Gunheath towards the Littlejohns clay workings is dominated by power lines and communications masts, a frequent attribute of surviving blocks of rough ground on the St Austell granite. (Photograph: Graeme Kirkham.)

There have also been reductions of Upland Rough Ground (although not comparably large in percentage terms) and associated archaeology elsewhere, at Stannon, on Bodmin Moor, for example, and more extensively on south-west Dartmoor (Figs 27, 44, 48-9).

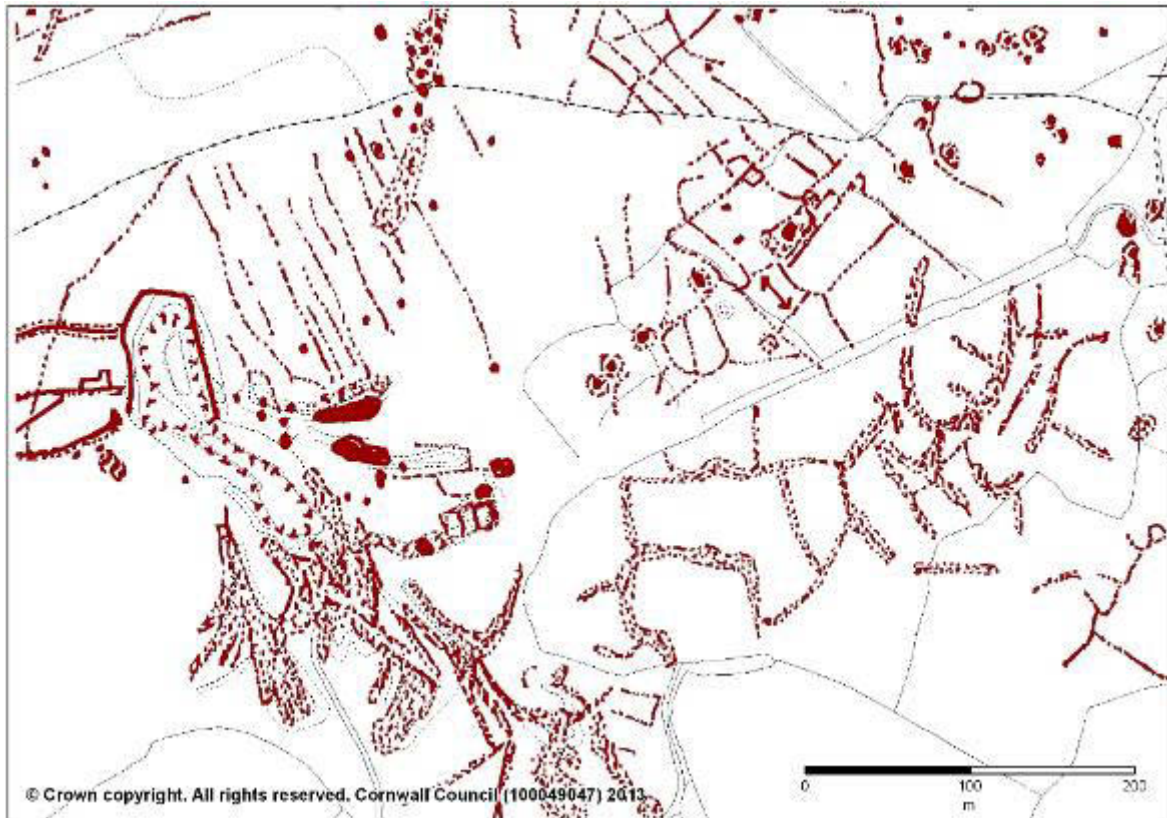


Figure 46 Field survey and transcription of air photographs reveal a long history for the rough ground landscape around the complex remains of the Tredinney china-clay workings in west Cornwall (the former pit lies diagonally on the west (left-hand) side of the map: Fig 19). Features include prehistoric settlement and several phases of prehistoric field systems, traces of medieval or post-medieval cultivation of rough ground and medieval and post-medieval grazing boundaries dividing the heathland landscape. (Air photograph transcription by the Cornwall and Scilly section of the National Mapping Programme.)

In addition to potential loss of or damage to archaeological features on rough ground, the significance of some surviving archaeological features may be affected by transformations of their settings brought about by industrial activity. The Bronze Age barrow known as Hensbarrow, for example, formerly stood on the highest point of the St Austell granite and formed a landmark over a wide area of mid-Cornwall; visibility and dominance were clearly key elements of the original function of the monument. The barrow is now overtopped and masked from view by adjacent spoil heaps (Fig 47). The 3m high Bronze Age standing stone known as the Long Stone, formerly on the boundary between St Mewan and St Stephen-in-Brannel and recorded in the late seventeenth-century *Lanhydrock Atlas* as one of the bound points for the Manor of Burngullow, was, after excavation, removed and re-erected on a housing estate in Roche (Holden *et al* 2010, 244; Miles and Miles 1971; HER PRN 21505). St Mewan Beacon, a natural feature and landmark also incorporated in the bounds of the Manor of Burngullow (Holden *et al* 2010, 244), survives as a physical feature, but is now encroached on by processing facilities associated with Blackpool china-clay works and considerably diminished in terms of its 'presence' in the landscape.

A further potential impact is the masking of visual relationships between ceremonial monuments within prehistoric landscapes by spoil arising from clay operations (Fig 48). The recognition and analysis of such visual links in recent decades has represented a major advance in approaches to interpreting the selection of locations for prehistoric structures and potentially to understanding the cosmologies underpinning their

construction and use (Tilley 1994; 1995; 1996; Herring 2008a; Jones 2004-5; 2005; 2006).

Of course, the historic remains of the china-clay industry itself have clearly added significantly to the range, distinctiveness and chronological diversity of archaeological landscapes on rough ground (for example, Figs 19, 20, 21, 26, 28, 29, 35, 46, 98, 102). It is also important to remember that, even though there has clearly been substantial loss of and damage to heritage assets of all periods within this historic landscape character Type, much remains or is likely to remain, the importance and significance of which is enhanced by the fact that it now represents the surviving element of a formerly larger resource.

There have been substantial efforts towards 'restoration' of landscapes partly falling within this historic landscape Type; these are discussed further under the 'Industrial' Type below (section 3.3.6).

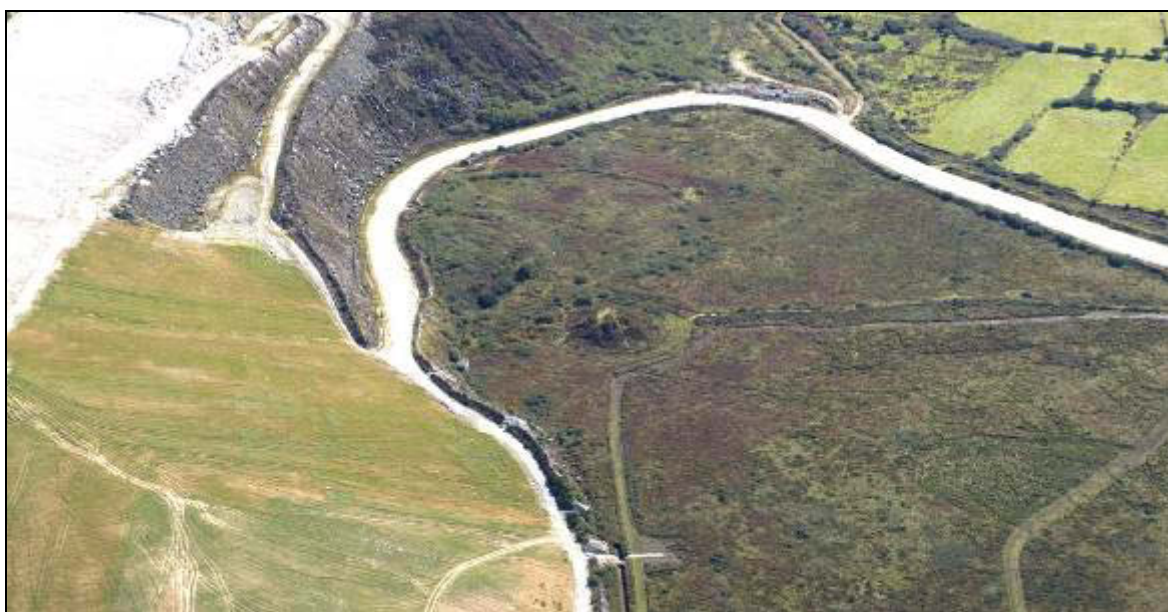


Figure 47 Looking south across the Bronze Age barrow at Hensbarrow Beacon, one of the few remaining large prehistoric features on the St Austell granite. Sited at 312m above sea level, the barrow was formerly the highest point of the Hensbarrow upland and formed a landmark visible over a wide area. It is now both dwarfed and masked from distant views by a large spoil dump to the east – in the process of being re-profiled at the time the photograph was taken – which is at least 50m higher, and another to the north west approximately 20m higher. (Photograph: Historic Environment, Cornwall Council: F95-023; 10 September 2009.)

3.3.1.2 Mitigation

Potential impacts on the historic environment resource can to some extent be mitigated by comprehensive recording (usually survey and excavation) of the resource to be lost. The resulting increase in knowledge is clearly to be understood as a public good: archaeological investigation undertaken in mitigation of past expansion of china-clay operations on rough ground has added very substantially to our knowledge of upland archaeology in south-west Britain, with particularly important examples including work at Shaugh Moor and Cholvichtown on Dartmoor (Fig 77) (Wainwright *et al* 1979; Wainwright and Smith 1980; Smith *et al* 1981; Balaam *et al* 1982; Collis 1983; Eogan 1964), at Stannon on Bodmin Moor (Mercer 1970; Mercer and Dimbleby 1978; Johnson and Rose 1994; Herring 1998b; Jones 2004-5; 2006) (Figs 49, 107), and in the Hensbarrow district (Miles 1975; Miles and Miles 1971; Jones and Quinnell 2006;

2012). Archaeological recording on rough ground sites has also added significantly to understanding of the history of the china-clay industry itself (for example, Herring 1995; Smith 2008b; Taylor 2002; Dyer 2014).

However, the results of mitigation, in the form of archaeological records and archives, analyses, drawings, photographs and publications, no matter how detailed and comprehensive, do not compensate for the loss of the actual physical above-ground remains of the past and particularly will not stand instead of the potential human experience of moving through rough ground landscapes bearing such remains as visible and tangible entities. This is as true for the traces of post-medieval industry as it is for prehistoric ceremonial complexes or settlements and field systems, for example, or for medieval outfields and streamworks.

Further, the scale of modern industrial operations by the clay industry is likely to bring about near total effacement of landscape and archaeological features over very substantial areas, either by excavation of overburden and the underlying clay deposits or by burial under waste, without the prospect of retention of an archaeological 'reserve'. This means that the knowledge which can be garnered through mitigation is limited to that which can be acquired by *current* methods: these areas and the heritage assets they contain are effectively lost to future advances in archaeological techniques and technologies and the new questions accompanying them.



Figure 48 The important view from Stannon stone circle, on Bodmin Moor, to the distinctive profile of Roughtor, partly blocked by the re-profiled tips of Stannon clay works. Intervisibility with major natural features and with other contemporary monuments is a regularly occurring association of prehistoric ceremonial sites on upland rough ground, and the implied relationships and links between them offer key insights for understanding and interpretation. (Photograph: Graeme Kirkham.)

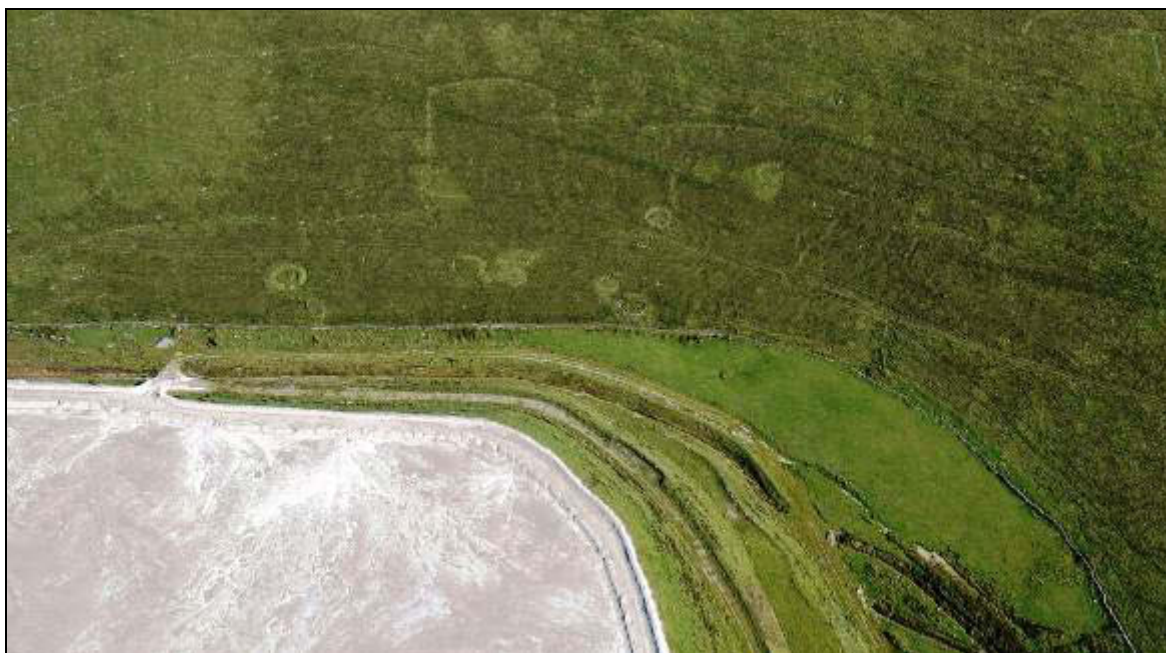


Figure 49 Roundhouses, cairns and enclosures on upland rough ground at Stannon Down, Bodmin Moor, encroached upon by expansion of the tip and mica dam at Stannon clay works. Several prehistoric dwellings and a number of ritual and ceremonial monuments were surveyed and excavated in advance of the expansion of tipping during the period 1968-2000. The features outside the Stannon works boundary now fall within both a large Scheduled Area and an area designated for management as a Premier Archaeological Landscape (PAL) (this report, section 5.4). (Photograph: Historic Environment, Cornwall Council: F66-080; 31 August 2004.)

3.3.1.3 Statement of significance

(after Kirkham 2011a, 137, with additions and amendments)

- Rough ground contains well-preserved and coherent complexes of prehistoric, medieval and industrial archaeological remains and is generally considered to be of high archaeological potential.
- Upland rough ground areas in Cornwall and on Dartmoor are among the handful of places in Europe where clearly visible prehistoric settlements, fields and pasture boundaries survive alongside ceremonial and ritual monuments.
- These remains can often be related to topographical features such as tors, hills, marshes and downlands and to the views that their creators also experienced.
- Rough ground contains important palaeoenvironmental resources, otherwise scarce in south-west Britain, and is thus a key resource for understanding past landscape and environmental change, as well as the influence and impact of human activity.
- The rough ground historic environment lies within a broadly open landscape in which features are often 'legible' as extended systems and complexes and are easy to locate and move through. Many upland rough ground areas are well visited, enjoyed by both local people and visitors.
- Rough ground offers evidence of the survival since the prehistoric period of a mosaic of distinctive and largely unchanged and stable semi-natural vegetation communities, created and modified by past human activity.
- Rough ground holds evidence of clear functional relationships between the archaeological remains, semi-natural communities and past and present-day farming.

- It is a valuable educational resource, of importance for showing children (and adults) how people lived in and responded to a landscape at different periods, from at least six thousand years ago to the mid-twentieth century, and for showing how those people created and maintained the historic environment and semi-natural habitat that we now manage.
- It is the target of numerous statutory and non-statutory designations, reflecting the interests and assessments of historic environment, natural environment and landscape authorities. (For example, 30 Scheduled Monuments with a total extent of more than 44 ha lie within rough ground within the portion of the project area in Cornwall.)
- Surviving areas of rough ground in Cornwall and Devon, not least those in china-clay areas, gain additional significance because of the scale of reduction in the historic extent of the Type.

3.3.2 Anciently Enclosed Land

Anciently Enclosed Land is the largest individual component of the countryside in both Cornwall and Devon; it represents the essential character of lowland rural areas in these counties. This is the agricultural heartland of the south west, with farming settlements documented before the seventeenth century and field patterns frequently derived from enclosure of medieval cultivation strips, morphologically distinct from the generally straight-sided fields of later enclosure (Fig 50).



Figure 50 Anciently Enclosed Land north west of St Austell, with Goonamarth sky-tip and waste tips on Longstone Downs beyond. The medieval settlement of Penisker, in the middle ground, was first recorded in the fourteenth century. (Photograph: Graeme Kirkham.)

This historic landscape character Type incorporates networks of winding lanes and roads, often deeply cut by the passage of people, animals and vehicles over centuries or thousands of years. These connect farming settlements whose layouts are typically irregular, often clearly shrunken from hamlets; some are still hamlets. Churchtowns and a few larger villages are scattered through the Type which also contains, or surrounds, most of both Cornwall and Devon's ancient towns.

Much, probably most, of this Type has been enclosed and farmed since later prehistory, from the Middle Bronze Age (c 1500 BC) onwards. Archaeological potential for buried remains of past settlement and cultivation is therefore high. There is also substantial evidence for earlier occupation of these areas, in the form of Neolithic and Early Bronze Age ceremonial monuments. Notable demonstrations of this potential in Anciently Enclosed Land in proximity to clay operations include excavations in the St Austell area at Trethurgy (Quinnell 2004) (Figs 57, 108) and Trenowah (Johns 2008) (Fig 51), and near St Stephen-in-Brannel at Pennance (Scarcewater Tip) (Jones and Taylor 2010; 2013; this report, section 5.5.1) (Figs 97, 103-5). Anciently Enclosed Land also accommodates substantial numbers of historic rural settlements and standing structures.

The extent to which the historic china-clay industry has worked in or adjacent to Anciently Enclosed Land is suggested by the many clay operations with names which derive from early medieval and medieval settlements. Examples in west Cornwall include Leswidden, first documented in 1245, Tredinney (1296) and Bostraze (1300); Porthia clay works lay adjacent to the lands of Penderleath (1499). On south-west Dartmoor the medieval settlements of Cholwichtown and Wotter lie immediately adjacent to clay operations (Fig 68) and there and in the St Austell clay district a substantial number of medieval farm settlements and their land have been absorbed by or now lie within clay processing complexes (Exeter Archaeology 2009, 497-9; Herring and Smith 1991, 49). Examples in the St Austell clay district include Burngullow (1296) (Fig 33), Meledor (1201) (Fig 70), Burgotha (1250), Higher Coldvreath (1281), Knightor (1305) and Penhedra (1414).

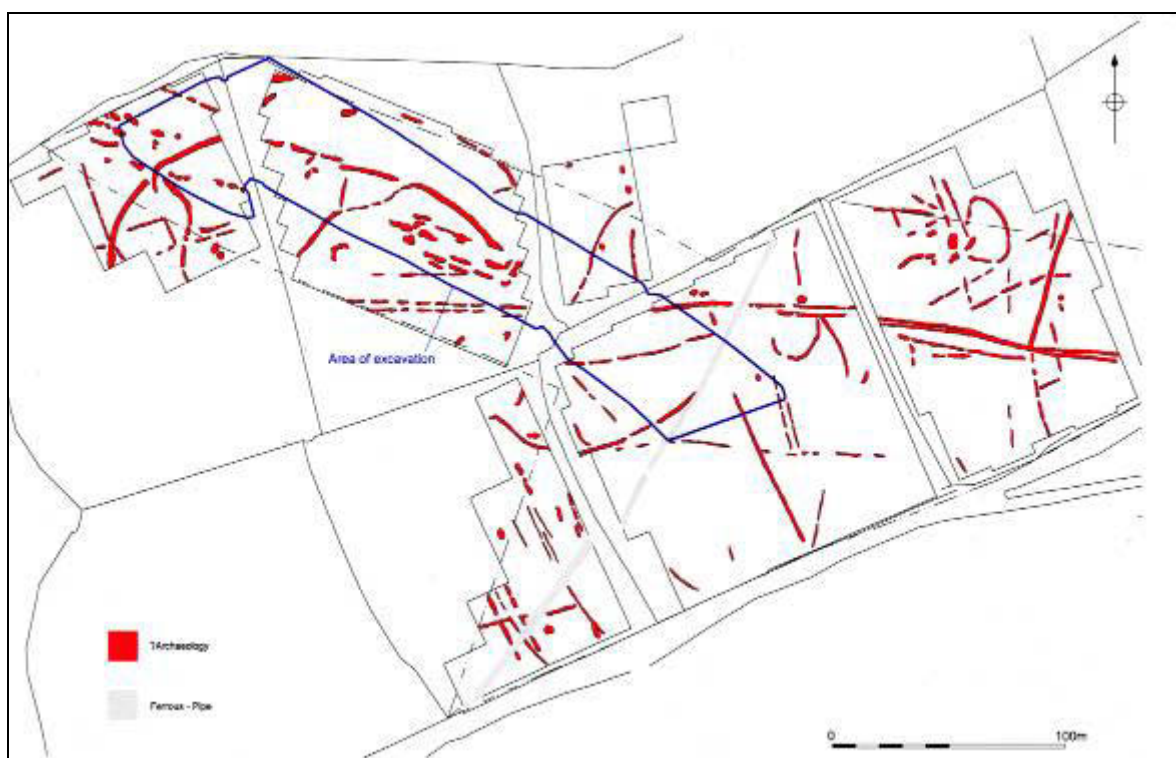


Figure 51 The interpreted geophysics plot (Geophysical Surveys of Bradford) for part of the St Austell North-East Distributor Road, showing a complex buried landscape of enclosures and field boundaries underlying the current landscape of Anciently Enclosed Land. Excavations on the route in 1977 [area outlined in blue] identified features and finds of the Early Neolithic, the Middle and Late Bronze Age and Early Iron Age, with several phases of field systems and enclosures dating from the Early Iron Age to the Roman period (Johns 2008). None of these features were visible prior to the archaeological investigations carried out in advance of road construction.

*United Kingdom china-clay bearing grounds: mineral resource
archaeological assessment*

The Cornish author Jack Clemo, born at Goonamarris in 1916, referred in his poem *Private Pompeii* (Clema 1986, 32-3) to the cottage close to Trethosa tip in which he had lived as a child, now

'. . . gone from sight
Beyond hope of excavation . . .'

In another poem in the same collection (*ibid*, 30-1), *Salvaged*, Clema noted the fate of the farm formerly occupied by his grandfather (*cf* Herring and Smith 1991, 44-5; Mansfield 2012, 155-8):

'As a young schoolboy I scanned the farmhouse
With mild curiosity – then it vanished,
Swallowed by a clay-pit; and for thirty years
I saw the whole farm eaten away.
Dynamite, tip-waggons, scoops – they all combined
To rip and crush my parents' lost green world
Till not a post or grass-clump was left behind.'

Infrastructure and communications elements of the china-clay industry – refineries, pipelines, roads, railways – often lie within or run through Anciently Enclosed Land (Fig 52). The Blackpool dryers complex lies within Anciently Enclosed Land off the southern edge of the St Austell granite, alongside the main rail line through Cornwall (Fig 33), and Cantrell dries, which served the former Redlake and Leftlake workings on southern Dartmoor, similarly sit within a well-preserved system of enclosed medieval strips just off the moorland edge.

In Cornwall a total of 91 sq km of Anciently Enclosed Land lies within the current project area. Much of this – more than 73 sq km – is included in the assessment because it falls within the zone defined for the St Austell, St Blazey and China Clay Area Regeneration Plan. This is the case for large tracts between St Austell and Pentewan, for example, and for areas around St Stephen-in-Brannel, Summercourt, Fraddon, Indian Queens, Tywardreath and Luxulyan. Within the regeneration area only 190 ha of Anciently Enclosed Land overlies kaolin deposits and is consequently potentially at *direct* risk from future china-clay extraction. However, areas of Anciently Enclosed Land lying adjacent to clay resources may also be required for future infrastructure development (Figs 33, 52), or for waste tipping, as with the current development at Scarcewater Tip (this report, section 5.5.1), near St Stephen-in-Brannel, and, somewhat earlier, near Trethurgy, over the sites of the Roman-period Trethurgy round and the medieval settlement of Penhedra (Fig 52).

In West Penwith a substantial proportion of the project area defined by mapped kaolin deposits coincides with Anciently Enclosed Land. In this area much of this Type is characterised by field systems with prehistoric origins, underlining its high archaeological potential. Most of the Tregonning Hill project area also coincides with Anciently Enclosed Land, as do some small parcels around the western and southern fringes of Bodmin Moor.

The Lee Moor portion of the project area in Devon includes 351 ha of historic landscape character Types comparable with Anciently Enclosed Land. Only 29 ha of this overlies mapped kaolin deposits. Again, however, adjacent areas may be at risk from associated waste and infrastructure. (**NB.** A substantial proportion of the Anciently Enclosed Land within the wider Lee Moor project area is likely to be affected to some extent by the current development of tungsten mining in the Hemerdon area.)



Figure 52 Trebal refinery, on the eastern edge of the St Austell china-clay area. The site lies within Anciently Enclosed Land, overlying the fields historically associated with the medieval farm settlements of Knightor and Trethurgy. Extensive planting and landscaping around the margin of the site soften its visual impact from the ground. Nonetheless, its industrial function and the sheer scale of the complex (by comparison with other components of the otherwise predominantly agricultural landscape) produce a significant impact on historic landscape character. The road which skirts the site cuts through the historic field pattern and thus reduces its 'legibility'. A further planted screen in the right background masks Alseveor clay tip from the modern settlement of Trethurgy. The Roman-period round or enclosed settlement excavated in the 1970s (Figs 57, 108) lay approximately where this shelter belt meets the edge of the tip. The site of the medieval farm settlement of Penhedra also lies beneath this tip. (Photograph: Historic Environment, Cornwall Council: F95-031; 10 September 2009.)

3.3.2.1 Potential impacts

Large-scale change within Anciently Enclosed Land, particularly in the highly visible forms taken by an extractive industry with a very large arisings product, is likely to have a very substantial impact on historic landscape character. New elements such as roads, waste dumps and clay processing complexes and the associated landscaping, for example, are considerably larger and different in form from other components of the Type (Figs 33, 52). They reduce the legibility and coherence of key components such as field patterns, networks of minor roads, and settlement distribution, blurring patterns which are otherwise essentially early medieval and medieval in origin or, in the case of west Cornwall, at least partly late prehistoric.

This impact on character can extend beyond the immediate environs of any particular development because of the long-term visibility of such activity (Fig 53). Waste tipping in Anciently Enclosed Land, even where landscaping and re-vegetation are subsequently undertaken, produces substantial changes to long-established landforms and vegetation cover. It can also significantly alter the setting of historic features nearby.



Figure 53 Ruddle tip, above the Trenance valley in the St Austell clay district, is an example of a china-clay operation almost wholly set within Anciently Enclosed Land. The works last operated in 1935 and the complex is now one of the features to be viewed from the leisure trail network between Wheal Martyn and the Eden Project. Smith (2008a) described the group value of the complex at Ruddle as an 'exceptional assemblage of small tips surrounding the pit, including a horizontal engine house'; he assessed the sky-tips as 'worthy of preservation in the landscape', scoring them highly for condition, completeness and group value. Part of the complex, however, is mapped as an 'opportunity site' on a 2011 Cornwall Council 'Regeneration Opportunities Map' (Photograph: Graeme Kirkham.)

Even where development is not itself located within Anciently Enclosed Land, impacts may still occur because of the high visibility of clay working outside the immediate area in which it occurs. The fine grain, visual quality and amenity of Anciently Enclosed Land make it potentially susceptible to this kind of impact, even when this is at some distance. The St Austell granite upland, much of which is dominated by clay waste tips, is prominent in views from a wide area of Anciently Enclosed Land in mid Cornwall, including the Roseland to the south and south west, from the areas noted above within the St Austell, St Blazey and China Clay Area Regeneration Plan area, and from a large swathe of land to the north and north east, extending to at least the southern fringes of Bodmin Moor around Warleggan and St Neot, more than 20 km distant (Figs 54, 55). From these areas the substantially altered profile of the high ground in the Hensbarrow area is clearly visible; new tipping is prominent over considerable distances. The Lee Moor workings are similarly visible from substantial blocks of medieval enclosed landscape in the adjacent area (Fig 56) (*cf* Land Use Consultants 2010, 63).

Such visual impacts are not necessarily entirely negative – distinctive and easily identifiable clay-industry features such as Carluddon Tip (Figs 82, 115) are noted landmarks over wide areas – but are likely to be on a potential scale to require that account is taken of them in advance of any proposed development.

The substantial archaeological potential in the Anciently Enclosed Land Type means that most forms of development may be considered likely to have an impact in terms of either buried remains or of standing structures, in some instances both.



Figure 54 The view across Anciently Enclosed Land from Dowgas, near Coombe, towards the south side of the St Austell granite upland. The nearest clay workings are 3-4 km to the north but infrastructure, working areas and historic and current tips are clearly visible. (Photograph: Graeme Kirkham.)



Figure 55 The altered skyline of the north-eastern block of the Hensbarrow upland, viewed from Helman Tor, 5-6 km distant. (Photograph: Graeme Kirkham.)



Figure 56 A view from Cann Wood towards Lee Moor, showing the visibility in distant views of the large china-clay spoil tips. This is one of a number of landscape images of this area dating from 1971, probably intended to inform the major planning inquiry held in that year on proposals for further expansion of clay operations on the south-west margins of Dartmoor. (China Clay History Society archive, 17394.)

3.3.2.2 Mitigation

Methods for identifying the archaeological resource in lowland Cornwall are well established, typically including documentary and map research, interpretation of place-names, geophysical survey, air photo transcription and walkover surveys, together with evaluation trenching. Work in 2002-4 following this approach in advance of proposed tip expansion at Goonamarth and Higher Biscovillack, St Mewan, for example, identified 65 possible features within an approximately 100 ha survey area (Exeter Archaeology 2002; Cole 2004). These included possible barrow sites suggested by antiquarian accounts, a possible late prehistoric or Roman-period enclosure indicated by a field name, extant medieval field systems, a variety of post-medieval mining and china-clay associated features captured from documents and historic mapping and a number of standing buildings within medieval and post-medieval farmsteads and former china-clay processing complexes. Geophysical surveys (GSB 2004a; 2004b) were carried out over approximately 25 ha, with the results used to target evaluation trenching. This identified a probable Bronze Age roundhouse (Cole 2004). The assessment report (*ibid*) reviewed the significance of the range of features located and made recommendations for further mitigation. In the event the tip expansion did not proceed and no further archaeological work was carried out.

Large-area excavations have taken place on a number of sites in Anciently Enclosed Land around the St Austell granite, confirming the high archaeological potential associated with this historic landscape character Type. Examples include work at Penhale and Penhale Moor, St Enoder, which revealed a Middle Bronze Age farmstead, a later prehistoric and Roman-period 'round and an early medieval holloway (Nowakowski 1994; Nowakowski and Johns, forthcoming; Johnston *et al* 1998-9); excavation of Neolithic pits at Tregarrick Farm, Roche (Cole and Jones 2002-3); full excavation of a round-type enclosure and internal features at Trethurgy, St Austell (Quinnell 2004) (Figs 57, 108); investigation of Neolithic pits, Bronze Age deposits and field systems and enclosures of the Early Iron Age to the Roman period at Trenowah, St Austell (Johns 2008) (Fig 51); and excavation of a Middle Bronze Age settlement, an Iron Age ritual feature, Roman-period burials and field systems of various periods at

Scarcewater, St Stephen-in-Brannel (Jones and Taylor 2010; 2013; this report, section 5.5.1) (Figs 103-5). Archaeological work on pipelines passing through Anciently Enclosed Land in the project area has also revealed significant archaeology (for example, Lawson-Jones 2012).

The large scale on which clay-working, tipping and infrastructure development typically occur makes it difficult to mitigate the impact of such activities on historic landscape character. The 'grain' of Anciently Enclosed Land is typically fine, with few large components; the highest vertical element has historically been church towers (although latterly wind turbines and grain stores have been added); the largest horizontal elements are generally individual fields. Modern china-clay-related developments typically spread over extensive areas of fields or cut through the existing pattern, thus rendering the historic landscape less legible. Attempts to mitigate the impact of new clay-related components through landscaping and visual screening themselves often introduce 'out-of-character' elements to the Type (Fig 52).



Figure 57 The paved entrance to the Roman-period enclosed settlement or 'round' at Trethurgy, excavated in advance of tip expansion in 1972-3. It remains the only site of this type in Cornwall to have been fully excavated (Quinnell 2004). (Photograph: Trethurgy archive, Historic Environment, Cornwall Council.)

3.3.2.3 Statement of significance

- Anciently Enclosed Land is the typical and iconic landscape of lowland Cornwall and Devon, with its origins in the medieval period evident in the form of fields, lanes, settlements (for the most part with early medieval place-names) and ancillary features such as churches and mills.
- The long history of occupation and settlement in this landscape Type means that it has substantial archaeological potential and chronological depth. Surviving blocks of Anciently Enclosed Land within the china-clay areas, where much of the archaeological resource has been removed or made inaccessible by the scale of extensive working past and current working, are therefore of particular importance. In essence, surviving pockets of Anciently Enclosed Land in clay areas gain additional significance because of the loss of a large proportion of the Type in the immediate area.

- More than 200 Listed Buildings and 18 Scheduled Monuments with a total extent of 7.7 ha lie within Anciently Enclosed Land within the Cornish part of the project area. Anciently Enclosed Land generally holds a higher proportion of designated built features – churches, dwellings, farmsteads, bridges and mills, for example – than other rural historic landscape Types.
- The Type is typically better-quality agricultural land.
- Until the recent explosion in the numbers of wind turbines across lowland Cornwall, this historic landscape Type was relatively less impacted by prominent modern features than other landscape Types. As such it is highly valued in public perceptions as of high visual quality.

3.3.3 Recently Enclosed Land

This is land enclosed in the post-medieval period, usually from Upland Rough Ground, often the former commons of medieval farms. Much of the land enclosed in this period formed new farms of around 12 ha (30 acres), with large, regular straight-sided fields (Figs 58, 60), or smallholdings of 2 ha (5 acres) and less, often occupied by families involved in extractive industries (Fig 59); again, field boundaries are often straight.



Figure 58 Ruler-straight boundaries on Recently Enclosed Land at Whitemoor, near St Dennis. A small area at bottom right of the photograph was recorded as enclosed before 1842 by the St Dennis tithe survey, but the fields in the centre foreground were created at the end of the nineteenth century by subdividing earlier crofts and grazing blocks on rough ground. Partly visible in the foreground is Gothers clay works, which as it developed during the twentieth century cut through the field system. The area occupied by the large Dorothy clay works beyond the settlement was formerly also an area of smallholdings and Recently Enclosed Land. (Photograph: Historic Environment, Cornwall Council: F95-013; 10 September 2009.)

Enclosures in Recently Enclosed Land are often bounded by dry stone walls; buildings in farmsteads and smallholdings tend to be standardised to a two up-two down vernacular in their design and are relatively small and poorly constructed compared with those in

Anciently Enclosed Land. There is much use of corrugated iron and asbestos for roofs, and concrete block for walls. Most settlement is dispersed, but there are sometimes small nucleations, especially where associated with extractive industry (Fig 59).



Figure 59 Nineteenth-century smallholdings on former rough ground at Gunheath, on the north-west margin of St Austell parish. Such features are now a relatively rare survival on the St Austell granite. In 1841 the house with the rendered gable was occupied by an agricultural labourer, Henry Pinch, and family. His second son, Luke, aged 11 at the time of the census, was recorded as a 'clay labourer'. The small 'one-up, one down' dwelling to the left with an external buttress chimney was added to the 3 ha holding at some point between 1840 and 1880. Two more houses, only partly visible behind trees towards the right of the image, were also extant by c 1840, part of a smallholding made up of 1 ha of arable, 2 ha of pasture and approximately 7.5 ha of enclosed rough ground. Many of the families occupying these and other upland smallholdings in the immediate area worked in the clay industry. (Photograph: Graeme Kirkham.)

Because of its relatively recent enclosure and improvement (by comparison with Anciently Enclosed Land), there is potential within Recently Enclosed Land for significant standing archaeology as well as buried remains. Examples from within the china-clay project area include the small hillfort within which St Dennis church stands (Fig 60), Stripple Stones henge on Bodmin Moor and Grumbla Quoit chambered tomb, Sancreed.

In Cornwall 3100 ha (31 sq km) of Recently Enclosed Land lie within the project area. This is mostly in the Hensbarrow area but there are also parcels in west Cornwall and in the vicinity of historic clay workings on Bodmin Moor (Fig 61) and south-west Dartmoor.

A little over 500 ha (5 sq km) of this area of Recently Enclosed Land overlies mapped kaolin deposits and could therefore be vulnerable to future extraction; much of the remainder lies adjacent to current and historic clay operations and could also be affected by future expansion. In Devon 148 ha of post-medieval enclosures fall within the project area, only a small proportion of which lies over or adjacent to kaolin

deposits. Several parcels lie in the Hemerdon area, however, and may be at risk from future tungsten mining.



Figure 60 Recently Enclosed Land around the small hillfort in which St Dennis church is located. Most of the strongly rectilinear stone-walled boundaries here were created during the middle decades of the nineteenth century. (Photograph: Historic Environment, Cornwall Council: F19-49; 20 June 1989.)

3.3.3.1 Potential impacts

Recently Enclosed Land has, in historic terms, already undergone substantial change. It could, therefore, be regarded as less sensitive to impacts on historic character and significance than Types with longer histories in their current form, particularly Anciently Enclosed Land and Upland Rough Ground. However, while often undervalued, the Type nonetheless has a distinct historic character and represents a key element of the south-west's post-medieval landscape history. Industrial activity in or near the Type, particularly large-scale extractive working which results in alteration or loss of its historic character, would therefore represent a significant impact. Such activity potentially reduces the legibility of historically significant field systems and settlement forms, as well as creating visual elements which are on a scale significantly larger than those characteristic of the Type.

Recently Enclosed Land can contain important standing monuments (above) and also potentially includes buried remains of features and deposits partly removed or reduced during the process of enclosure and improvement. A striking example is a complex of earlier prehistoric ceremonial sites recorded within Recently Enclosed Land during work in advance of construction of the A30 bypass of Indian Queens. A walkover survey identified a Bronze Age barrow at Little Gaverigan (Fig 62) and a watching brief on road construction works located the Highgate 'ritual enclosure' closely adjacent (Nowakowski 1994; Nowakowski and Johns, forthcoming). Large-area excavations on the portion of the Scarcewater Tip site characterised as Recently Enclosed Land revealed traces of

field systems of probable later prehistoric date and a Roman-period trackway (Jones and Taylor 2010; this report, section 5.5.1).

3.3.3.2 Mitigation

As indicated for Anciently Enclosed Land (above), methods for identifying the archaeological resource in this historic landscape character Type are well established, typically including documentary and map research, geophysical survey, air photo transcription, walkover surveys and ground-truthing, together with evaluation trenching.

The large scale on which modern clay working is carried on – both in terms of extraction and in dumping waste – means that it is likely to be difficult to maintain a meaningful archaeological reserve for future investigation within areas targeted for development. For this reason mitigation measures need to be on a large scale, comprehensive in scope and backed by as extensive a range of investigation techniques as can be mustered in order to obtain the maximum of useful information.

3.3.3.3 Statement of significance

- Recently Enclosed Land is historically significant as a landscape formed during a relatively short time (by comparison with other extensive landscape types such as Upland Rough Ground and Anciently Enclosed Land) in association with key economic and social changes in the region.
- The Type is often undervalued in terms of visual amenity and for the paucity of prominent historic environment assets when compared with Anciently Enclosed Land or Upland Rough Ground.
- The potential for both standing and buried archaeology is high.
- 11 Scheduled Monuments covering a total of 2.5 ha and 40 Listed Buildings occur within Recently Enclosed land in the Cornish part of the project area.

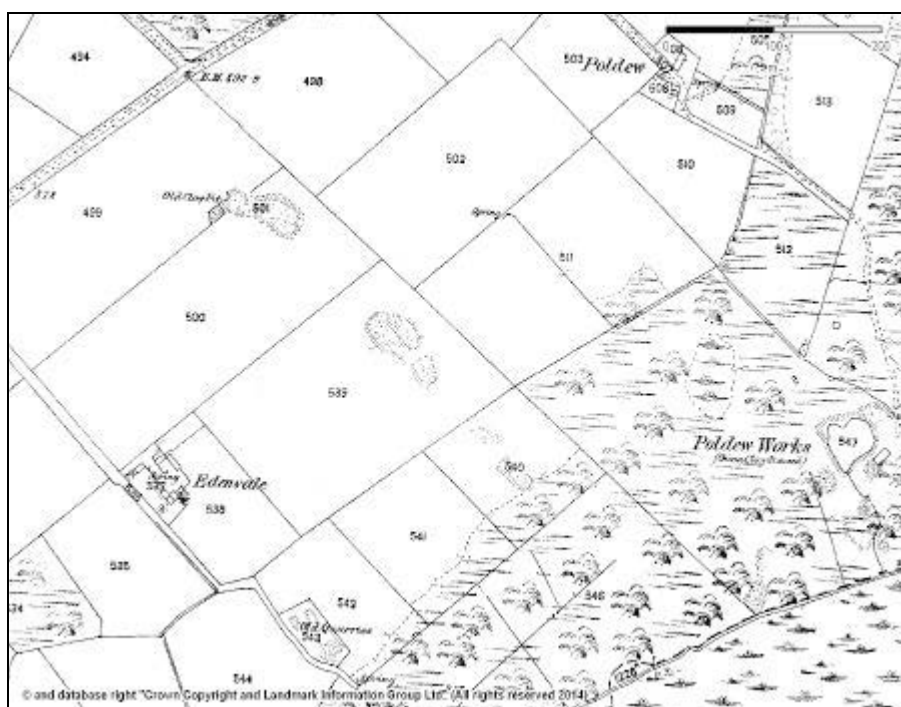


Figure 61 Trial clay pits at Edensville, near Stannon, Bodmin Moor, lying across the rectilinear fields of the farm of that name (1st edition Ordnance Survey 25in: 1 mile map, c 1880). The farm was laid out on the former Poldew Downs at some point after the tithe survey of 1841.

3.3.4 Modern Enclosed Land

This Type is principally derived from Anciently Enclosed Land or Recently Enclosed Land in which field systems have been substantially altered to accommodate modern agricultural methods by large-scale hedge removal in the twentieth century. It also includes, however, twentieth-century intakes from rough ground, woodland and marsh.

Fields are often very large, but when derived from Anciently Enclosed Land may have some sinuous boundaries where ancient hedges have been retained (Fig 63).

Settlements and most of the other surviving historic components of Modern Enclosed Land usually retain features of Anciently Enclosed Land, although farmsteads are often also altered, with new modern components and few surviving historic farm buildings. Occasionally whole farmsteads have been removed.



Figure 62 Excavations by Cornwall Archaeological Unit on Little Gaverigan barrow in 1992-3, in advance of construction of the A30 Indian Queens bypass. The site, on the northern edge of the St Austell granite, lay in Recently Enclosed Land and was first identified only during a pre-construction walkover survey of the road route. (Photograph: Historic Environment, Cornwall Council.)

The use of heavier agricultural machinery means that there are likely to be fewer prehistoric features visible at surface than in Anciently Enclosed Land and also that sub-surface remains have potentially been damaged or destroyed.

More than 2050 ha (20.5 sq km) of this Type falls within the Cornwall project area, much of it within the wider St Austell, St Blazey and China Clay Area Regeneration Plan area around the periphery of the current area of clay exploitation in the Hensbarrow district, and deriving for the most part from Anciently Enclosed Land. A further 107 ha lies within the Devon part of the project area.

3.3.4.1 Potential impacts

The impact of extractive industry within and in proximity to this historic landscape Type will be less than in Anciently Enclosed Land because much of what creates the latter's

intricate grain has been eroded or removed. Further, the scale of the landscape has been increased through the creation of large fields and thus the visual impact of large-scale components of industrial activity may be somewhat reduced. At the same time, however, pits, waste dumps and infrastructure, are likely to be visually intrusive in an otherwise rural setting. Modern Enclosed Land is also typically intermixed with Anciently Enclosed Land, meaning that industrial development in the first is likely to have an impact on the second through proximity.

While buried archaeology in this historic landscape Type may have been damaged by the use of large machinery and damaging cultivation methods, there remains potential for survival of a similar range of remains of past human activity to that which exists in Anciently Enclosed Land. Recent archaeological work by Cornwall Council Historic Environment Projects (now Cornwall Archaeological Unit) within Modern Enclosed Land at Victoria, north of the St Austell clay district, identified Middle Bronze Age field ditches and a probable contemporary roundhouse with evidence for metalworking, a Romano-British enclosure with indications of industrial activity and a medieval deer park boundary (Sean Taylor, pers comm).



Figure 63 Lantern clay works, Carloggas, St Austell, from the north. The pit was first opened in the later nineteenth century, located on rough ground immediately outside the Anciently Enclosed Land associated with the medieval settlement of Resugga. To the right is Recently Enclosed Land, enclosed in the mid nineteenth century from Carloggas Downs and plausibly associated with the development of Treverbyn and Stenalees as a new industrial settlement. In the foreground is an area of the Modern Enclosed Land HLC Type, in this instance created through removal of historic field boundaries. Lantern Pit closed in 1938 and there is an evident softening of the historic landscape impact of smaller-scale industrial operations such as this once they are disused and become vegetated. (Photograph: Historic Environment, Cornwall Council: F95-030; 10 September 2009.)

3.3.4.2 Mitigation

As suggested for Anciently Enclosed Land (above), methods for identifying the archaeological resource in this historic landscape character Type are well established,

including documentary and map research, geophysical survey, air photo transcription, walkover surveys and ground-truthing, together with evaluation trenching.

In this Type, too, the large scale on which modern clay working is carried out means that within areas targeted for development it is likely to be difficult to maintain meaningful archaeological reserves for future investigation. Mitigation measures therefore need to be on a large scale, comprehensive in scope and backed by as extensive a range of investigation techniques as can be mustered in order to obtain the maximum of useful information.

3.3.4.3 Statement of significance

- Modern Enclosed Land created from Anciently Enclosed Land may retain significant elements of the latter in terms of historic routeways, settlements and surviving historic boundaries, together with components such as churches, bridges and mills. It is also often intermixed with Anciently Enclosed Land and thus may derive significance from proximity.
- There may also be survival of the substantial potential for buried archaeology associated with Anciently Enclosed Land.
- Where Modern Enclosed Land derives from rough ground there may be potential for survival of buried remains. Even where disturbed by deep ploughing some artefactual evidence and cut features may survive.
- Past loss of Anciently Enclosed Land and Upland Rough Ground to industrial activity means that, despite the possibility of damage from modern farming methods, Modern Enclosed Land within china-clay areas may represent an important surviving resource of buried archaeology within particular areas.
- 11 Listed Buildings and 11 Scheduled Monuments lie within Modern Enclosed Land within the Cornish part of the project area.
- The Type is often good agricultural land.

3.3.5 Ornamental

This historic landscape character Type covers designed landscapes, principally associated with and surrounding country houses and dating to the eighteenth and nineteenth centuries; the Devon HLC Parks/gardens Type additionally includes various planned spaces such as public parks and allotments.

In Devon, part of the Scheduled post-medieval deer park pale of Newnham Park, Sparkwell, and an associated rabbit warren fall within the project area. (Part of the former deer park of Boringdon Hall, also in Sparkwell, the boundary of which is Scheduled, also falls within the project area, but the Devon HLC 'modern' layer characterises the area as Post-Medieval Enclosures rather than Parks/gardens.) Blocks of Parks/gardens associated with Hemerdon House and Goodamoor Cottage, Sparkwell, adjoin the project area boundary.

In Cornwall most of the occurrences of the Ornamental Type found in proximity to the project area are located around the southern margins of the St Austell clay district, at some distance from current or historic clay working. Blocks of the Type associated with Penrice, Trenarren, Tregrehan and Trenyhton lie entirely within the project area, as does part of the Ornamental area for Prideaux, near Luxulyan (Fig 64). Ornamental areas linked to Garlenick and Heligan lie contiguous to the project area. An exception to the general distancing of large houses and associated designed landscapes from the clay area was Carthew House, in the Trenance valley, built by the wealthy St Austell clay merchant Elias Martyn in the 1840s (Hendy 2012). A block of woodland planting which formerly formed part of the approach to the house survives but is currently mapped as Plantation and Scrub landscape Type rather than Ornamental (Fig 113). The house itself was demolished in 1972 and the site, including the former gardens, now lies within Wheal Martyn pit.

Tregrehan (Grade II*) (Fig 65) and Heligan (II) are Registered Parks and Gardens; the former Tregrehan carriage drive runs adjacent to a former clay dry at Par Moor. At Lanhydrock, part of the Registered Park and Garden (Grade II*) coincident with the Ornamental landscape Type lies adjacent to the site of former clay dries and rail sidings near Bodmin Road (now Bodmin Parkway) station. The route of the historic pipeline to this complex from the Glynn Valley clay works on Bodmin Moor passes through the contiguous area of Ornamental landscape associated with Glynn.

At Godolphin, Breage, the area mapped as Ornamental is relatively small (it does not cover the whole of the area shown as formal gardens on the 1st edition Ordnance Survey 25in map of c 1880). Here, however, the Registered Park and Garden (Grade II*) extends over a much wider area, taking in the former deer park and warren. The southern edge of this block lies very close to mapped kaolin resources and historic clay workings around Tregonning Hill (Fig 66).



Figure 64 Prideaux, just north of St Blazey, has a designed landscape associated with the house (top right) built in the early nineteenth century by the Rashleigh family (Pett 1998, 162-3), and potentially traces of an earlier ornamental landscape accompanying its manorial predecessor at Great Prideaux (top centre). Part of Warren Wood in the lower left foreground falls within the project area but the house and open lawn fronting it lie just outside the boundary, which follows the hedge line to the left (west) of Prideaux hillfort and passes on the far side (north) of the house. It is clear that development within the project area could potentially have a significant impact on the setting of the Ornamental landscape, the house (Grade II Listed) and the Scheduled hillfort. (Photograph: Historic Environment, Cornwall Council: F82-156; 16 April 2008.)

Significant remains of earlier mining within the Godolphin deer park represent a relatively unusual example of industrial remains forming an element within an ornamental landscape. This may have been fortuitous but was perhaps intended as a reference to the source of the family's wealth in the early post-medieval period (Herring 1997).

A more overt instance of industrial features forming the focus for a designed 'landscape experience' occurs in the Luxulyan valley. There the Kendall family of Pelyn, near

Lostwithiel, from c 1845 created an 8-mile engineered carriage drive now known as the Velvet Path, which traversed the spectacular complex of leats, tramways, inclines and a viaduct constructed in the valley by Joseph Treffry. This drive was enhanced with planting of rhododendrons and beech trees and has been described as intended to present the 'sights and sounds of the new industrial landscape in a culturally significant attempt at displaying the sublime against the natural beauty of the valley' (Smith 1992b; Scott Wilson 2011, 1, 9-10, 15). From c 1875 the experience offered by the Path included new water-powered china stone mills and pan kilns.

3.3.5.1 Potential impacts

Ornamental landscapes were usually conceived and created as entities covering relatively substantial areas. They typically have important elements of character which derive from views and vistas within the 'designed' area but which may also extend outside. This makes them particularly vulnerable to visual disruption of their planned aesthetics by new landscape elements such as tipping or infrastructure elements. Such impacts on ornamental landscapes may occur even when development is at a distance. For example, the Grade II* Registered Park and Garden at Trewithen, near Probus, clearly falls within the wider zone of visual impact of the St Austell china-clay district (Fig 67), although the nearest clay workings are a little over 6 km distant from it.



Figure 65 The Grade II Registered Park and Garden of Tregrehan, viewed from the north. The route of the former carriage drive (part of the Registered area) extends past the industrial buildings at the top of the image (occupied by a retail complex) and its further extent adjoins Imerys' laboratories at Par Moor. (Photograph: Historic Environment, Cornwall Council: F82-135; 16 April 2008.)*

Within Ornamental areas there are also potential impacts on both key standing 'archaeological' elements of designed landscapes, such as planting schemes, earthworks and structures, often in several phases, but also on buried archaeology deriving from the associations of the historic landscape Types which preceded use as Ornamental land or which forms the immediate context. Most of the examples noted above lie within broader areas of Anciently Enclosed Land, and are likely to share the latter's significant potential for buried archaeology deriving from occupation and

settlement extending from prehistory to the medieval period and beyond. At Godolphin the Registered Park and Garden includes the rough ground of the former deer park and warren in which are located a prehistoric enclosure and field system and extensive evidence of medieval mining activity (Herring 1997).

3.3.5.2 Mitigation

The specific character of this historic landscape Type requires that approaches to mitigation include not only consideration of archaeological factors (below) but also projections of the potential visual impacts of any proposed development and of impacts on setting in terms of tranquillity.



Figure 66 The former Godolphin deer park and warren from the south, a Grade II Registered Park and Garden although not mapped in HLC as Ornamental. (Godolphin House itself lies to the right, outside the area shown.) Mapped kaolin deposits underlie the houses and Grade II Listed engine house of Great Work mine in the foreground, extending to within less than 100m of the boundary of the Registered area. The entire area also lies within the Cornish Mining World Heritage Site. (Photograph: Historic Environment, Cornwall Council: F85-134; 23 July 2008.)*

For mitigation of impacts on standing and buried archaeology approaches generally applied to designed landscapes and Anciently Enclosed Land are likely to be appropriate. These potentially include documentary research and air photograph interpretation, walkover survey, measured survey, geophysics, evaluation trenching and appropriate mitigation in the form of watching brief or full excavation. Construction of a china-clay pipeline from Trebal refinery to Par was preceded by an archaeological assessment (Lawson-Jones 2001) and was subsequently the subject of archaeological fieldwork (Lawson-Jones 2002). A controlled topsoil strip was carried out on a portion of a pipeline route which passed through part of the designed landscape at Tregrehan (outside the mapped area of Registered Park and Garden). This revealed, among other features, a flint scatter, elements of a field system of probable prehistoric date, an early medieval 'burnt pit' and post-medieval mining remains (Lawson-Jones 2012).

3.3.5.3 Statement of significance

- Ornamental landscapes were conceived and executed as expressions of contemporary ideals of aesthetic design and were intended to impress, to represent proprietorial power over the landscape and to give pleasure. It is unlikely that designed landscapes on comparable scales and conceived upon similar principles will be created in the future and the surviving examples are therefore particularly significant in terms of their aesthetic, historic and evidential value.
- Several areas of Ornamental historic landscape character Type lying within or adjacent to the project area in Cornwall are designated as Registered Parks and Gardens (Tregrehan, Godolphin, Lanhydrock and Trengwainton (all Grade II*) and Heligan (Grade II). Grade II* sites are regarded as 'particularly important, of more than special interest'; Grade II sites are of 'special interest, warranting every effort to preserve them' (English Heritage 2010).
- Scheduled features associated with Newnham Park, Sparkwell, fall within the Devon portion of the project area.



Figure 67 The view north towards the St Austell granite upland over ornamental woodland forming part of the Grade II Registered Park and Garden at Trewithen, near Probus. (Photograph: Graeme Kirkham.)*

3.3.6 Industrial

Only extensive and continuous areas of industrial land are placed in this Type and its use in characterisation in Cornwall and Devon has therefore been limited. However, much of the area of past and current china-clay exploitation in the St Austell and south-west Dartmoor clay districts fall within it.

The mapped polygons for the Cornwall HLC are noted as either Industrial Working or Industrial Disused. However, the characterisation exercise in Cornwall was carried out more than two decades ago and some areas, particularly in the regions of china-clay activity which were identified as 'working' by the sources used for the mapping, will now have become disused; equally, formerly disused areas may have been

reincorporated into the working area. The two sub-Types have therefore been taken together.

More than 40 sq km (4046 ha) of the mapped project area in Cornwall are characterised as Industrial, representing approximately 73 per cent of the total of 55 sq km (5514 ha) for this character Type within the county as a whole. A substantial proportion of the current extent of the Industrial landscape character Type in Cornwall could therefore be affected by future china-clay industry development. In Devon 807 ha (8 sq km) of 'industrial' historic landscape character Types fall within the project area.



Figure 68 A dynamic industrial landscape expanding across rough ground on south-west Dartmoor in 1971, looking east from Wotter (foreground) towards Lee Moor, Whitehill Yeo and Cholvichtown. Tipping from the modern Lee Moor clay working has subsequently expanded to cover the area between Wotter and Lee Moor and the road linking them visible in the middle ground no longer exists. (Photograph: English China Clays, by courtesy of Dartmoor National Park.)

Key elements of character are that the Type predominantly represents relatively recent activity, most of it dating from the twentieth century. The most substantial features have developed only during the past 40 years. These recent elements have been created by highly mechanised forms of operation, and this is evident in the landforms – very large and deep pits, extensive and highly visible stepped tips, mica dams, networks of haul roads – and other features associated with it, including conspicuous abandoned structures and machinery. The clay workings and spoil tips within the Type are often on a massive scale and highly dramatic in terms of their size, complexity and sheer 'presence' in the landscape (for example, Figs 4, 11, 106, 111-5).

Alongside these character elements of the recent and current industry, the historic landscape Type also includes extensive areas of former workings now abandoned and

typically densely overgrown with scrub and rhododendron (Fig 53). Such areas often hold significant remains of historic working, including important infrastructure elements such as engine houses, dries and generator houses (Bowditch 2013 presents several examples; also Sharpe 1991b).

Operational and recently redundant elements of infrastructure are dispersed widely through the Industrial landscape, buildings usually in the form of highly functional structures of concrete or of metal-frame, sheet-clad construction (Fig 69). Isolated groups of buildings and plant occur relatively frequently (Fig 70). Where these are sited in areas open to public view, primarily near settlements and along through routes, they are often screened by tree planting, including linear groups of evergreens, and these small blocks of visually prominent planting, frequently now grown to a significant height, form a distinctive element within the Type (Figs 33, 52, 70).

China-clay landscapes are highly fragmented. Active clay-winning areas and infrastructure complexes are often closely adjacent to and intermixed with abandoned workings, with settlements and small pockets of earlier land-use forms surviving as 'islands' within the broader Industrial landscape (for example, Figs 111, 113, 114).

The growth in the scale of operations in the industry in recent decades, evident in the greater depth and extent of pits and the height and mass of spoil tips, has been matched by the development of processing facilities on a much larger scale. The processing complex at Parkandillick, near St Dennis, covers more than 14 ha, Kernick and Treviscoe more than 15 ha and Trebal refinery more than 19 ha; Lee Moor extends over almost 30 ha, Par Docks almost 40 ha and the large Drinnick complex between Nanpean and Goverseth across more than 50 ha (Figs 5, 12, 52, 86).



*Figure 69 Industrial buildings and installations at the Greensplat pit complex.
(Photograph: Graeme Kirkham)*

It is an obvious point that the Industrial historic landscape Type developed from – and by the large-scale alteration of – other landscape Types, predominantly Upland Rough Ground and Anciently Enclosed Land. This 'transformative' aspect of the Type is captured in Goonamarris-born Jack Clemo's poem, *The clay-pit worker* (cf Fig 87):

'This sand-dump's base now licks a hedge
Whose snaky bramble-growths will bear
No flowers or fruit again; a few more days

*United Kingdom china-clay bearing grounds: mineral resource
archaeological assessment*

And they'll be buried 'neath the wedge
Of settling gravel, rotting where
No naturalist may pry to mark their sleep' (Clemo 1988, 25).

In *The flooded clay-pit* Clemo highlighted the secondary transformation resulting from subsequent abandonment of clay landscapes (cf Fig 43):

'What scenes far
Beneath those waters: chimney-pots
That used to smoke; brown rusty clots
Of wheels still oozing tar;
Lodge doors that rot ajar.
Those iron rails
Emerge like claws cut short on the dump,
Though once they bore the waggon's thump:
Now only toads and snails
Creep round their loosened nails' (Clemo 1988, 19).



Figure 70 Melbur refinery, set around the site of the medieval farm settlement of Meledor. The view from the air makes clear the extent of planting which has been carried out to produce visual screening. (Photograph: Historic Environment, Cornwall Council: F67-014; 8 June 2005.)

Public perceptions of the china-clay industry over the past century have almost entirely focused on features located within the Industrial landscape character Type. A guidebook of c 1931 noted that the 'first characteristic which strikes the traveller's eye is the succession of huge glistening white "burrows" rising to heights which render them conspicuous from all parts of the Duchy'; the guide also described clay dries and recommended that 'visitors wishing to view the clay area should take a motor-bus to such a place as St Stephens, St Dennis, or Bugle. The whole method of production may be seen' (Anon nd, 87). Daphne du Maurier, in *Vanishing Cornwall* (1972, 152), similarly highlighted the fascination which the landscape created by the clay industry has exercised on a wider public:

*United Kingdom china-clay bearing grounds: mineral resource
archaeological assessment*

'The interest to the layman, though, and to the casual wanderer who finds himself by chance or intention in the china-clay country, is the strange, almost fantastic beauty of the landscape, where spoil-heaps of waste matter shaped like pyramids point to the sky, great quarries formed about their base descending into pits filled with water, icy green like arctic pools. The pyramids are generally the highest, and the pools deepest, on land which is no longer used; the spoil heaps sprout grass-seed, even gorse, upon the pumice-stone quality of their surface . . .

Wild flowers straggle across the waste, seeds flourish into nameless plants, wandering birds from the moorland skim the lakes or dabble at the water's edge. Seagulls, flying inland, hover above the surface. There is nothing ugly here. Cornishmen are wresting a living from the granite as they have done through countless generations, leaving nature to deal in her own fashion with forgotten ground, which, being prodigal of hand, she has done with a lavish and careless grace.'

Mansfield (2012, 25) summarises divergent modern perceptions of the Industrial landscape Type:

'The white pyramids write an interesting signature on the local skyline, provoking mixed feelings amongst locals and visitors.

Some see them as a meaningful mark of a working landscape and its industrial heritage, some see them as offensive and ugly waste tips scarring the area's skyline and others see them as curious, abstract and exotic (we love 'em).'

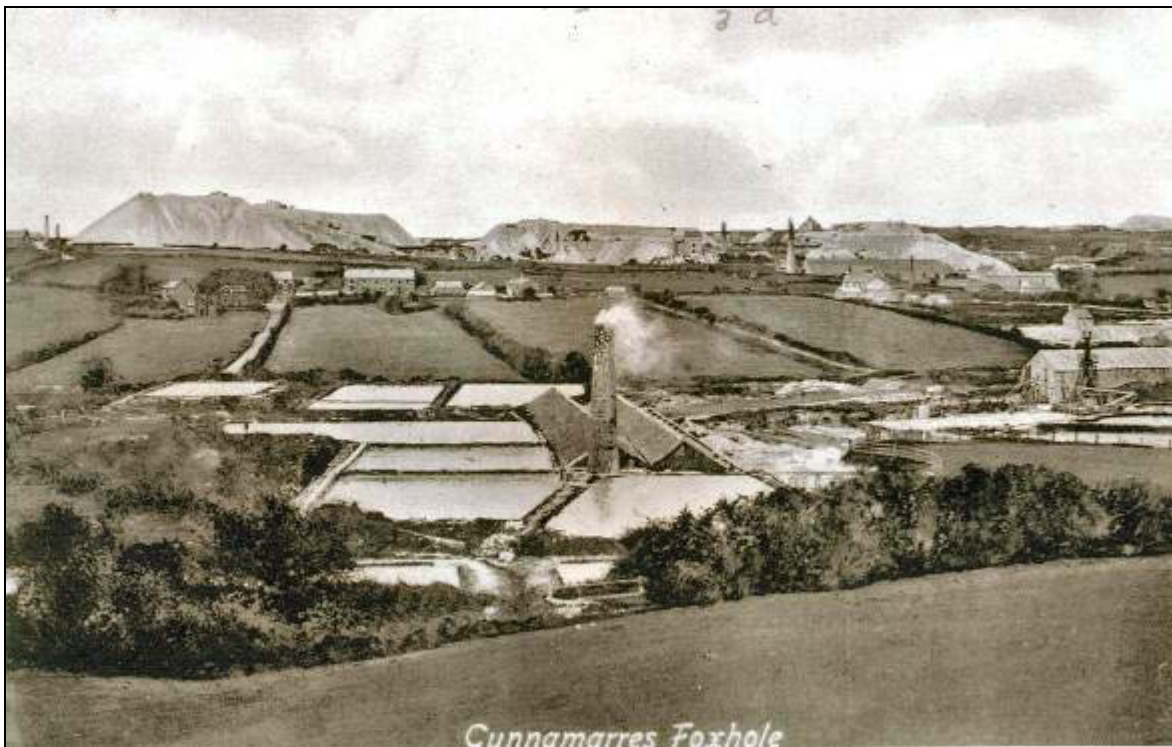


Figure 71 An early twentieth-century postcard view showing developing industrial activity within the essentially medieval agricultural landscape associated with the settlement of Goonamarris, first documented in 1290. East Carloggas china-clay dries are in the foreground, with Bloomdale and Goonamarris pits behind. (China Clay History Society archive, HS1162.)

The landscape Type has featured in a significant number of artworks (Appendix 1): Dame Laura Knight's *China Clay Pit* (1914) and *Men Working in a China Clay Pit* (c 1914), Harold Harvey's *Leswidden Pit* (c 1920-24) and *The Clay Pit* (1923), Samuel

Lamorna Birch's *Old China Clay Pit (Penwithack)* (recte Penwithick) (nd), Harold Truman's *The Quarry Pool* (1933) and *China Clay Pit, Lee Moor* (1937), Ruskin Spear's *China Clay Works, Great Wheal Prosper, Tresayes, Roche* (c 1940), *China Clay Pits, St Austell* (c 1939), and *Derelict China Clay Works, Belowda Beacon, Roche* (c 1940), and Ivy T Pearce's *Clay Pit* (nd) and *Clay District* (nd), for example, are all rich evocations of the clay industry and its associated landscapes in the first half of the twentieth century (Appendix 1). More recently, the artists Alan Arthurs, Roy Goodman, Stuart Thorn and Kevin Tole have produced portfolios of work derived from the china-clay industry and landscapes. A number of photographers have also explored clay landscapes, including Jem Southam (Daniel-McElroy *et al*, 2004) and Roy Goodman (2012) (Fig 72).

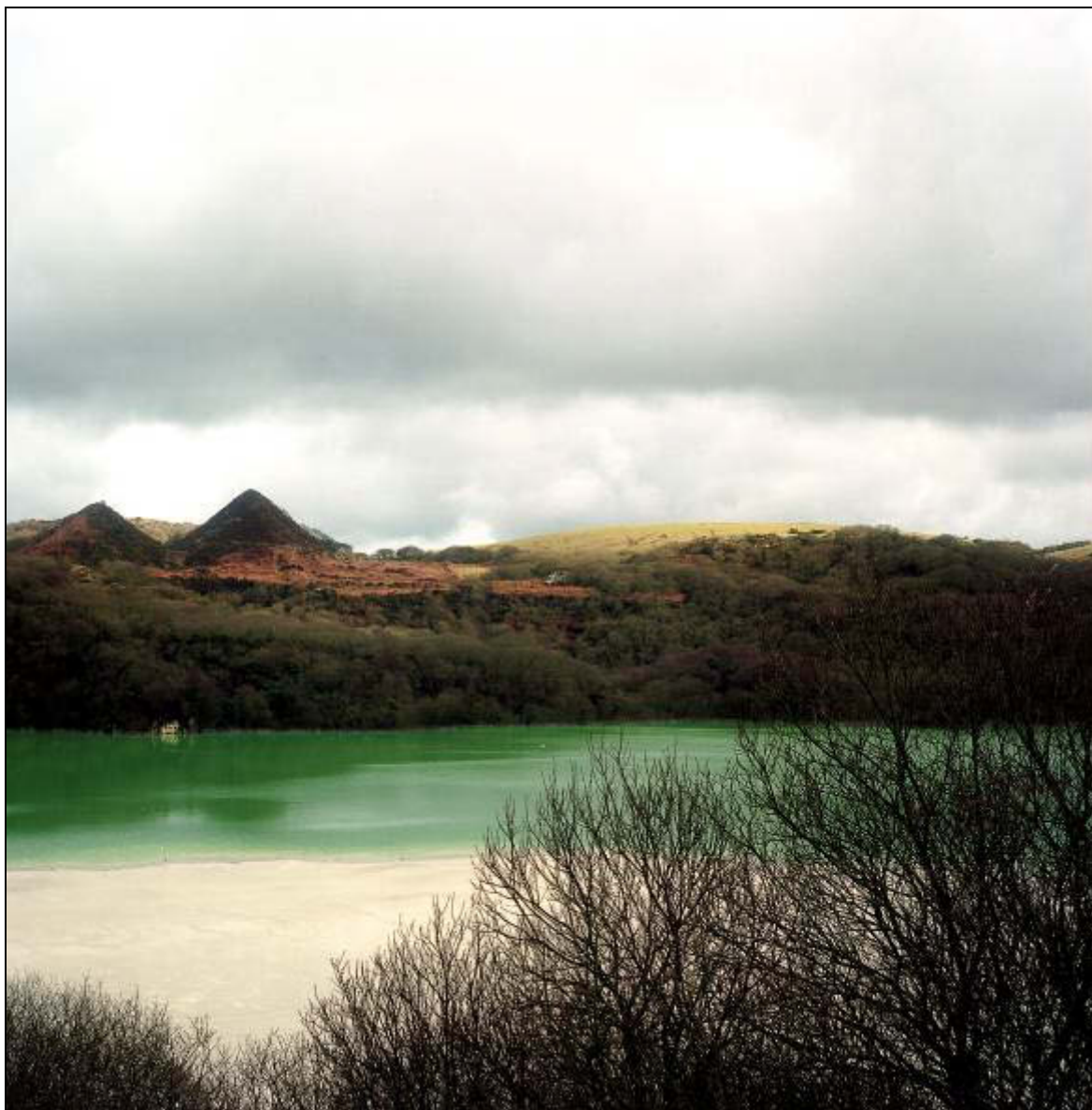


Fig 72 Hendra Pit. (Photograph: © Roy Goodman.)

In literature the clay industry and its landscapes have featured most prominently in the works of the Cornish writer Jack Clemo; examples include poetry collections titled *The Clay Verge* (1951), *The Map of Clay* (1961) and *The Echoing Tip* (1971) and a novel, *The Clay Kiln* (originally titled *The Dry Kiln*) (2000).

Elements of the historic Industrial landscape, particularly sky-tips (burrows), have achieved iconic status in self-identification by communities within the wider St Austell area, with images appearing on, for example, school badges and pub signs (Smith 2008a). The prominence of Industrial landforms as landmarks in views from most of the settlements within the clay district means that these features are particularly significant in perceptions of local distinctiveness and sense of place (Wildworks 2008; Mansfield 2012) (Figs 38, 60, 82, 90, 110).

NB. Some key features characteristic of this Type in fact lie outside areas mapped as Industrial at the county level of historic landscape characterisation. Examples include the railways and pipelines which carried clay to processing points and the various complexes of china-clay dries and stores which lay alongside railway lines and at ports (Figs 5, 33).

3.3.6.1 Potential impacts

Future clay working within this Type would, in principle, continue to reproduce some of the essential elements of the 'Industrial' landscape character Type; it could thus be seen as broadly continuing historic processes and therefore effectively 'neutral' in its impact. In practice, however, new working – typically on a larger scale than much of the activity which has preceded it – will be likely to mask or destroy the details and character reflecting the period of the industry during which much of the visible landscape was created. Not least, future working is likely to reduce visible evidence of time depth in the Type, in that older workings may be re-worked, buried or extensively altered by new activity.

At particular risk is the physical evidence of the modern large-scale industry as it has developed over the past 40 years; its vulnerability arises not solely from its dynamic quality and the changes arising from continuing working but also from modern perspectives which seek to cosmetically mask the physical remains of large-scale extractive industry (below) (Fig 73, 76, 111). This period has seen the clay industry achieve unprecedented peaks in output levels and economic returns, and, with new working methods and technological innovations, create extensive new landscapes with a unique range of characteristic elements. As with any historic process which has left an imprint in the present, these features represent a key source of information about the past; they are in themselves both the evidence of and a monument to the recent significance of the china-clay industry and can therefore be considered to be important heritage assets. Such features will often be affected by future working.

From an historic environment perspective, therefore, continuing development of the industry within the Industrial historic landscape character Type will almost inevitably have significant negative impacts at the same time that it creates new heritage assets for the future. This ongoing re-shaping of the landscape and physical evidence of the industry is itself a key element of the character of the Industrial historic landscape character Type.

3.3.6.1.1 Reworking of waste for secondary aggregates

Recent estimates indicate that the clay industry produces approximately 10 million tonnes of arisings a year, of which 4 million tonnes is sand (BGS 2009). The total industry stockpile of waste amounts to approximately 600 million tonnes, much of it in tips which have been landscaped and re-profiled; approximately 150 million tonnes are estimated to be 'possibly usable' (BGS 2009; 2013). In 2008 approximately 3.5 million tonnes of aggregate derived from china clay waste were sold. Much of the aggregate sold derives from current working although some past stockpiles have also been reworked (*ibid*). To place these figures in perspective, across Great Britain sales of aggregates in 2011 amounted to 55 million tonnes of sand and gravel, 91 million tonnes of crushed rock and another 60 million tonnes of recycled and secondary aggregates (BGS 2013).

The extent of future potential exploitation of china-clay arisings is difficult to predict. At current levels of the Aggregate Levy transport costs are seen as a significant barrier to substantial use of clay-industry derived aggregates outside the south west (BGS 2009; 2013). (The current suspension of the exemption from the Aggregates Levy for secondary aggregates represents a further barrier to their wider use beyond the areas of clay working.) Cost issues also arise when these secondary aggregates are used for concrete because of higher demand for cement and water resulting from the high surface area of the sand particles (BGS 2013).

Secondary use of china-clay waste may have benefits for the historic environment if this diverts material deriving from current working which would otherwise be tipped on other historic landscape Types or on historic areas within the Industrial landscape Type. In principle, removal of waste could potentially be targeted to reveal historic features and land surfaces buried by past dumping or to re-establish their presence in the landscape by taking away material which has blocked views to and from them. In practice, removal of waste from historic features and contexts would need to be undertaken very carefully in order not to damage what had previously been preserved.



Figure 73 Re-profiling and re-vegetation of modern stepped china-clay waste tips in progress on Hensbarrow Downs in 2009. The characteristic form of the tips created by the modern industry is almost entirely obliterated, leaving a smoothed and rounded landform which shows little of the topographical characteristics of south-western granite uplands. The Bronze Age Hensbarrow (top right), formerly the third highest point in Cornwall and a prominent landmark in the region, is now overtopped and dominated by the tip (cf Fig 47). (Photograph: Historic Environment, Cornwall Council: F95-025; 10 September 2009.)

Where waste is to be sourced from older tips there is an obvious potential risk to features which may themselves be significant components of the historic industrial landscape. This is particularly the case if the waste is to be taken from the iconic sky-tips (Smith 2008a) but may also have an impact in other contexts where tips form a legible element of historic clay working processes. On some smaller long-abandoned sites the surviving earthwork evidence of pits and tips provides direct testimony of chronological sequences and changing historic techniques of china-clay production. Examples include Glynn Valley works on Bodmin Moor, Baker's Pit in west Cornwall and

Redlake and Leftlake on southern Dartmoor (Figs 21, 26, 29, 102). Removal of waste from such sites, together with other disturbance, should be avoided.

3.3.6.1.2 Landscape 'restoration' and re-vegetation

The Industrial historic landscape Type has been and continues to be subject to programmes of landscape 'restoration' and 're-greening': tips are re-profiled and initiatives undertaken to proactively restore heathland vegetation and habitats and to plant trees over extensive areas. This has been most marked in the St Austell clay district (Figs 73-4) and on south-west Dartmoor but there have also been programmes elsewhere: the former sky-tips at Bostraze in west Cornwall, for example, were levelled after the operation ceased working and tips at Hawkstor on Bodmin Moor have also been partly re-profiled. Substantial re-profiling and re-vegetation programmes have taken place on the extensive tips at Parson's Park and Stannon, on Bodmin Moor (Smith 2008a, 7) (Figs 6, 75).

Programmes of restoration and re-vegetation were already in progress in the early 1990s but landscape problems arising from much increased production levels in the industry were noted in a report commissioned by the Department of Environment (Department of the Environment and Wardell Armstrong 1993). The report noted that in the St Austell uplands the total land area occupied by the china-clay industry had increased by more than 70 per cent since 1970, with substantial expansion also in the Lee Moor area in Devon. Increased production had had a 'marked detrimental effect on the local landscape' (*ibid*, 1). Tips in the clay areas, it observed, had thus far been 'designed and built to engineering criteria with few landscape and no landuse criteria. This approach has resulted in the construction of very uniform and steep tip profiles that are unnatural and incongruous in their landscape setting' (*ibid*, 3). The report also noted that tips had been 'located in very prominent and scenically valuable locations', including the Dartmoor National Park and, in the case of Bodmin Moor, within Areas of Outstanding Natural Beauty (AONB) or Areas of Great Landscape Value (AGLV) (*ibid*).



Figure 74 A re-profiled late twentieth-century tip on the former Burthy Downs, south of Fraddon on the western edge of the St Austell china-clay district. The rounded, smoothed and symmetrical form of the tip, which is visible over a wide area to the west, partly conceals its industrial origins but is uncharacteristic of the natural landforms of the St Austell granite. (Photograph: Historic Environment, Cornwall Council: F82-003; 16 April 2008.)



Figure 75 The partly re-profiled working at Stannon, on Bodmin Moor, four years after production ceased in 2000 (cf Fig 27). (Photograph: Historic Environment, Cornwall Council, F66-063; 31 August 2004.)

Unsurprisingly at this period, historic environment and historic landscape character issues were not prominent. The 1993 report noted that 'sites of archaeological interest' could represent potential environmental constraints to re-profiling tips and proposed as a possible mitigating measure the 'excavation and recording of site [*sic*] and possible reconstruction in new location' (*ibid*, 4). It also acknowledged that 'old conical tips' [sky-tips] had potential after-use as elements of 'industrial heritage' (*ibid*, 6). Options for landscape improvements on 'old and idle tips' acknowledged that where natural vegetation had re-established tips might be 'best left alone' on the grounds that 'they will probably have wildlife and perhaps historical interest' (*ibid*, 11). However, in discussing a general strategy for reclamation it was proposed that an underpinning philosophy should be adopted whereby land used for tipping should be regarded as 'borrowed, to be returned in the future in a form that is suitable for some beneficial and appropriate use. Tipping is thus only a temporary use of the land' (*ibid*, 9). Potential future uses for a variety of tip types were listed as agriculture, forestry, conservation, recreation and tourism and built development; conservation uses were noted as wildlife and, for 'old conical tips' alone, industrial heritage (*ibid*, 6).

Cornwall County Council's *St Austell China Clay Tipping and Restoration Strategy*, produced in 2000, included as objectives:

- To provide for the progressive restoration of china-clay waste to reflect the local landscape character of an upland moorland, with woodland, scrub and farmland on the lower slopes and in the valleys.
- To improve external and internal views of tips by developing enhanced tip profiles which have regard to natural contours and neighbouring tips, and which are capable of echoing indigenous vegetation patterns.
- To create improved tip profiles which are capable of supporting a wide range of after-uses.
- To maintain and promote biodiversity and corridors between habitats of high nature conservation interest.
- To safeguard examples of diverse archaeological and historical evidence of national importance as well as maintaining examples of the development of the Clay industry (Cornwall County Council 2000, 4).

The Strategy set out preferred options for the various areas within the St Austell granite upland and envisaged the establishment of new landform profiles and new 'edges' to the clay area on a substantial scale. For example, proposals for the Carthew district included linking tips at Littlejohns, Goonheath and Dorothy, noting that this

'represents a significant opportunity to provide an improved landform for the northern edge [of the clay area] which cohesively incorporates and absorbs existing tips providing substantial tipping capacity. Further careful investigation will need to be made into the diversion / closure of the Trenance to Tresaize road and the future of the Hensbarrow Beacon (a Scheduled Ancient Monument) through full investigation and possible reinstatement at a new high point. The present position of the barrow as a high point has been compromised by tipping on either side. It makes sense to link the two new landforms together to create an entire edge to this side of the clay area rather than leaving the barrow in a cleft between two tips' (*ibid*, 25).

More recently the *Tomorrow's Heathland Heritage* project (1998-2004) and *China Clay Woodland Project* (2005-8) have undertaken considerable works in the St Austell clay area to reinstate rough ground habitats and carry out tree planting. The more recent programme, led by Natural England with Imerys, the Forestry Commission, Cornwall County Council and Restormel Borough Council as partners, planted new native broadleaf woodland on 380 ha of non-agricultural land, restored 440 ha of existing woodland, converted 116 ha of non-native shelterbelts to broadleaf woodlands and created 11 km of new and improved footpaths and bridleways (www.naturalengland.org.uk/regions/south_west/ourwork/chinaclaywoodlandproject.aspx) (Fig 76). It is envisaged that the 'new woodland will become a rich eco-system and will allow the public to see the woodlands grow and develop, providing a valuable asset for local residents and visitors to the region. The project's contribution to BAP [Biodiversity Action Plan] targets will also be immense' (*ibid*).



Figure 76 Broadleaf tree planting on a re-profiled tip adjacent to a leisure trail at Ruddlemoor. Natural regeneration of furze (gorse) and scrub often appears to thrive better than the new planting. (Photograph: Graeme Kirkham.)

Devon County Council, in its guidance for the 'Southern Dartmoor and fringes' landscape character Type, proposes that a long-term strategy be developed 'to restore disused areas of china clay quarrying and tipping around Lee Moor; it should aim to filter views and sounds of current quarrying, and provide wildlife habitats and green infrastructure links' (www.devon.gov.uk/text/landscape).

Landscape 'restoration' and re-vegetation programmes such as these, in addition to meeting public sector objectives for re-use of derelict land, improvement of visual amenity and natural environment enhancement, also have benefits for the china-clay industry in terms of stabilisation of tip margins and dust control. Such measures are also likely to have a significant degree of public support in the extent to which they reduce the prominence of highly visible and overtly 'industrial' landforms, particularly the larger and more recent tips, and create 'green' places where formerly only waste and dereliction were apparent. Provision of new public access in such areas is also likely to be strongly welcomed.

However, it is also evident that the large-scale re-shaping of china-clay waste envisaged by these strategies, together with the reworking of waste for use as secondary aggregates (above), potentially places at risk a range of historic features associated with the clay industry, in essence sweeping away or substantially modifying potentially significant portions of the landscape which the industry has created during its two-and-a-half centuries of activity.

One element of this risk to historic features and landscape character was addressed by Smith (2008a), in a project commissioned by Cornwall County Council Spatial Planning, with an assessment of the archaeological significance of sky-tips in the St Austell clay area. He noted the relatively recent origins of this particular industrial feature – the methods of waste dumping which created sky-tips were probably first adopted around 1900 and continued until the 1970s – but also emphasised the visual prominence of these features within clay landscapes over the past century or so and their iconic status in perceptions of these areas (Figs 24, 38, 60, 110). John Betjeman called them the 'splendid white cones of the china clay pits' and they are prominent in historic guide books and other descriptions for visitors, in artworks and in public regard (*ibid*).

Of the 200 sky-tips estimated to have existed in the St Austell area c 1940, only a small proportion, probably less than 15 per cent, now remain. Smith (2008a) listed 15 sites on which 29 sky-tips have survived in good condition, many of which were assessed as having group value with adjacent associated features such as pits, engine houses, pan kilns, settling tanks, mica drags and mica lagoons. The extent to which these sites may now be regarded as 'protected' from restoration programmes, or from other potential risk elements, is unclear.

It is important to note that other landforms and landscapes created by china-clay working, both earlier and later than sky-tips, have not been similarly assessed for their historic significance, are less immediately spectacular and do not hold the same public regard, and are thus potentially at greater risk. It is likely that the awe-inspiring landscapes of tips, pits, mica lagoons and infrastructure elements produced on an enormous scale by the modern industry – Peter Herring has recently referred to modern clayworking on the St Austell granite, particularly referring to the wider area around Dubbers, as 'a sublime industrial landscape' (Herring 2011b, 320, fig 6) – will be particularly targeted and could, therefore, within a relatively short time be largely replaced by post-extraction cosmetic treatments of industrial landforms.

Current practice in the industry appears to include, at least in some locations, re-profiling and vegetation programmes routinely commencing immediately after or even during tip formation. At the active Scarcewater tip site, near St Stephen-in-Brannel, for example, the outer, lower portions of the tip are being profiled and vegetated as tipping proceeds on the upper portion. This in itself represents a significant new process with a distinctive, although unspectacular, resulting form in the field.

Photography and survey could provide some element of mitigation of the loss of iconic features of the modern industry, but the significance of the industry also merits

preservation for the future of at least a sample of the key elements which characterise it, including these modern landforms and associated infrastructure. From an historic environment perspective, such features represent a potential future resource for understanding the historic development and local progress of the china-clay industry, in some instances potentially the only record, and for appreciating its former scale and impact. Re-profiling without prior assessment of the potential significance of landforms and appropriate recording therefore represents a possible loss of data, as well as the loss of the features themselves. Additionally, it is clear from the growth of rhododendron and other scrub within abandoned and derelict portions of clay-working areas that historic features can be masked to a substantial extent, rendering them less legible for analysis and understanding of what they represent in terms of information on past processes and chronological sequences (for example, Sharpe 1991b). Planned tree planting is clearly likely to have the same result.

In addition to the potential loss which re-profiling represents in terms of the survival of the modern 'industrial archaeology' of china-clay tips, it is evident that the smoothed, 'designed' landforms produced by the process differ considerably from the characteristic natural forms seen in the granite uplands of the south west. The rounded profiles and steep sides are to an extent reminiscent of chalk downs (Figs 55, 74, 112). Planting broad-leafed woodlands on the steep sides of these new landforms could reinforce this impression, producing landscapes which in time would broadly resemble parts of the South Downs or Chilterns, albeit on a smaller scale.

In fact, dense and extensive broad-leaf tree cover is only found in Cornwall in the historic landscape character Type termed Steep-sided valleys, typically along the lower reaches of the larger rivers (Cornwall County Council 1994); it is not associated with any of the historic landscape Types typically found within and adjacent to clay areas. More specifically, extensive broadleaf woodlands are not found *on* the granite uplands in the south west. (They have existed around the margins, however. The presence of woodland on the fringes of the upland in West Penwith in the prehistoric period is suggested by palaeoenvironmental evidence from, for example, Chysauster and Carn Euny (Scaife 1996; Dimbleby 1978; Robinson *et al* 2011); documentary evidence and place-names around the southern and eastern margins of Bodmin Moor also indicate more extensive woodland in this area in the early medieval period (Johnson and Rose 1994, fig 51; Herring 2008b; Henderson 1935b). Broadleaf woodland survives to some extent around the southern, western and eastern fringes of Bodmin Moor and a small block of Ancient Woodland is mapped by Devon historic landscape characterisation in a stream valley at North Wood, just outside the current south-west Dartmoor project area, west of Shaugh Moor.) Modern coniferous plantations have been planted on upland rough ground to a limited extent, primarily on Bodmin Moor and parts of Dartmoor, but have themselves been highlighted as having a disproportionately large impact on the open character of this historic landscape Type (Herring 1998a, 85; 2008b, 132-3; Cornwall County Council 1996, 71, 74) and the settings of monuments in it, as well as being potentially damaging to both standing and buried archaeology.

Extensive tree planting on abandoned upland clay-working sites therefore has the potential to produce a significant dilution or muddying of the otherwise distinctive and well-defined historic landscape character of the china-clay Industrial landscape Type. This is a potential change which requires appropriate management. Many areas of former clay working which have been abandoned have been subject to natural regeneration of woodland and scrub. These are generally on a much smaller scale than those to which the extensive re-vegetation schemes have been applied.

It is also important to remember that while heathland habitats may be successfully reinstated or created *de novo*, there is self-evidently no possibility of re-creating the historic environment component of these, either as semi-natural habitats with origins in prehistory (as with other areas of rough ground in the south west) or as areas of landscape with high potential for standing and buried archaeology extending from prehistory to the modern period (*cf* Dudley 2011). In this respect the significance and overall value of the re-profiled landforms and re-created habitats is clearly distinct from

that of the industrial features modified in the process. In a longer perspective, however, the landforms and vegetation communities created by the aspirations and aesthetics of the later twentieth and early twenty-first centuries, will themselves in time acquire historic significance.

3.3.6.2 Mitigation

Key elements underpinning mitigation in the Industrial landscape Type in Cornwall in the recent past have been the report by Herring and Smith (1991), which included identifications of sites, indications of significance and recommendations for appropriate mitigation. In addition there have been a number of studies undertaken as part of the Review of Old Mineral Permissions (ROMP) process (for example, Cole 1999a; 1999b; 1999c; 2000; 2005; Roper and White 2005). The ROMP investigations have been aimed at obtaining a better understanding of the historical development of particular operational areas and identifying the extent and character of the archaeological resource within them. They have also provided recommendations on further recording of identified features if they are likely to be affected by mineral operations. These reports function as a primary aid to both the operators and the planning authority in developing a mitigation strategy for the historic environment of these areas.

In Devon the Lee Moor china-clay area was subject to an environmental statement in 2009 in advance of proposed further development of clay working (Sibelco UK and Imerys 2009). This provided an inventory of designations and known sites, a review of current understanding of the archaeology and historic development of the area, a synthesis and bibliography of past archaeological work and a summary of potential impacts from the proposed development and appropriate mitigation measures.



Figure 77 George Eogan's excavation of Cholwichtown stone row, Dartmoor, in 1961, an early instance of mitigation carried out in advance of the expansion of clay operations. (Photograph: Ted Birkett Dixon; courtesy of Dartmoor National Park.)

There have been numerous individual mitigation projects on clay industry features within the Industrial landscape Type. Examples in the St Austell clay district include a series of 'preservation by record' surveys in 1994-5 (Lawson-Jones *et al* 1995), a

photographic survey of West Gunheath clay works in advance of destruction (Cole 1999d), survey and watching brief in advance of pit extension at Greensplat and Carrancarrow (Taylor 2003b) and recording of an engine house at Greensplat prior to demolition (Thomas 2002). Carlyon Farm clay dry in the Trenance valley (Fig 78) and Wheal Rashleigh dry, St Blazey, were both recorded in advance of proposed conversions of the sites to other uses (Taylor 2008; Cole 2007). Extensive survey and excavation were undertaken at Stannon clay works on Bodmin Moor in advance of expansion of tipping (Jones 2004-5) (Fig 107). More recently, extensive recording of surviving historic china-clay industry features was carried out at Hemerdon, on south-west Dartmoor, prior to extension of quarrying activities (Dyer 2014). Recording has also taken place in mitigation of damage to monuments, as at Littlejohns barrow on the St Austell granite (Johns and Herring 1994) and Emmet's Post barrow on south-west Dartmoor (Bayer 2000).

In the wider sense mitigation also includes measures taken to ensure future preservation of heritage assets. This may include designation (section 5.3) and the identification of particular sites or areas as of particular significance. Herring and Smith (1991) proposed a number of individual sites and features within the St Austell clay area for protection on archaeological grounds, but also highlighted a number of wider areas characterised by good survival of significant complexes of remains. These are discussed in section 5.4 (Table 7).

The Alseveor and Ruddle clayworks in the St Austell district, located within an area surrendered by the clay industry, have recently been assessed to be of 'at least regional importance' (Environmental Dimension Partnership 2010, 5.83) and Smith (2008a) has identified 29 surviving sky-tips on 15 sites in this region which are recommended for retention. The Glynn Valley works on Bodmin Moor (Smith 2008b, 112-4) and Redlake on southern Dartmoor (Wade 1982) (Figs 26, 29, 102) offer comparably well-preserved examples of historic forms and phases of clay working and are also of high significance, meriting protection and proactive conservation management. The 10 ha Wheal Martyn Museum, including 1.2 ha with Scheduled Monument status, is a key site for presenting and interpreting historic forms of clay working in the heart of the St Austell clay area; it has recently been the subject of a management plan and a site inventory and condition survey (Laing-Trengove 2013).

The sites referred to in the paragraph above all represent phases of the industry based on working methods which developed from the substantial technological advances of the Victorian and Edwardian periods (Perry and Thurlow 2006). There is also a need to ensure conservation of surviving traces of early phases of the industry, as, for example, at Burnt Heath on Bodmin Moor (Smith 2008b) (Fig 20). (Dyer (2014, 33) notes the survival of features dating to the early phases of china-clay working on Dartmoor at Hemerdon; these have been recorded in advance of destruction by the expansion of quarry working.)

Clearly, these historic sites are important for the information they provide on the development of the china-clay industry, and all merit long-term conservation and protection. However, the modern china-clay industry is acknowledged as being of national and international importance (Devon County Council 2004a, 9.1.1; Cornwall Council 2013, 3.2.4) and in consequence it is logical that significant and characteristic features of its modern as well as its historic forms should also be considered either for protection or for appropriate mitigation. Following this principle, there is a case for urgent attention to the question of how representative examples of the principal elements of the modern industry, particularly the large-scale and spectacular landforms, the extensive working landscapes and the complex technology which characterise it, can be retained and presented for future generations. It is suggested that this would conform to Article 1 of the European Landscape Convention of 2000 (Council of Europe 2000), which defines 'landscape protection' as action to

'conserve and maintain the significant or characteristic features of a landscape, which is greatly valued on account of its distinctive natural or cultural

configuration. Such protection must be active and involve management measures for preservation of significance.'

In general, there is a clear need for further (and continuing) assessment of the significance of the diverse components of the china-clay industry within this landscape Type, and consequent framing of policies which ensure both appropriate future protection and management, and the mitigation of actions which may have an impact upon significance and character.



Figure 78 Carlyon Farm clay dry, in the Trenance valley, near St Austell, was constructed in 1921, soon after construction of a branch line up the valley from the Great Western main line. It was the largest dry ever built and combined two kilns in a single building. The structure is a Grade II Listed Building. It was recorded in advance of proposed conversion, with recommendations for further mitigation (Taylor 2008). (Photograph: Cornwall Archaeological Unit, Cornwall Council.)

3.3.6.3 Statement of significance

- This landscape character Type is the principal location of a large proportion of the most distinctive and iconic historic and landscape features associated with the china-clay industry, among them sky-tips, stepped waste dumps, worked-out pits, mica dams, residue lagoons and structures such as clay dries.
- Industrial activity is not always well documented. The surviving remains are therefore important as testimony of the past form, methods and scale of the china-clay industry.
- The Type accommodates the features which provide information on the developed, modern large-scale china-clay industry, itself recognised to be of national and international importance.
- The Industrial Type has, in principle, because of the historic character of the landscapes which preceded it, a high potential for buried archaeology for all periods from the prehistoric to modern. However, because of the extensive character of the activities which have created it, surviving remains are likely to be biased towards the more recent past. Much of this potential may, in practical terms, be inaccessible.

- The Type offers a prime example of extractive industry on a large scale; the decline of such industries in Britain during the twentieth century means that relatively few examples now survive. Those elements which do survive therefore acquire additional significance for the present and more particularly for the future.
- These landscapes are important as testaments to the historic regional, national and international significance of the china-clay industry, its contribution to the local and national economy and the development of specialised technologies.
- The highly visible and dynamic nature of the industry means that it continues to contribute significant new landmarks to the contemporary landscape of Cornwall.
- These landmarks and the extensive 'typical' clay-working landscapes which make up the Type are now themselves vulnerable to post-industrial environmental improvement, in the form of back-filling of pits, re-profiling of spoil heaps and re-use of arisings, together with the creation of new leisure resources.
- The St Austell clay district forms the key component in Natural England National Character Area (NCA) 154, and of the Hensbarrow Joint Character Area defined by the 1994 Cornwall landscape characterisation (Cornwall County Council 1996) and the 2006 Cornwall Landscape Assessment (Diacono Associates and White Consultants 2007).



Figure 79 A late nineteenth- or early twentieth-century roadside rural terrace of eight houses at Bojea Terrace, Trethowell, in the Trenance valley, close to the Bojea and Trethowell clay works. (Photograph: Graeme Kirkham.)

3.3.7 Settlement

The 1994 Cornwall HLC (Cornwall County Council 1996) mapped the historic cores of settlements (as shown on the 2nd edition Ordnance Survey 25in: 1 mile map of c 1907); subsequent work has produced additional polygons for areas of later settlement development. The Devon HLC similarly distinguishes between historic

settlement cores and twentieth-century development. Both have been taken together for the purposes of the current project.



Figure 80 The architecture of prosperity in the centre of St Austell: the 'Red Bank' (right), designed by Silvanus Trevail for the St Austell Bank in 1898, and (left) the former premises of the Devon and Cornwall Bank. New offices were built nearby for the West of England China Clay Company in 1908. These and other new buildings constructed in the period 1890-1914 transformed the centre of St Austell under the stimulus of profits derived from the rapid development of the clay industry. (Photograph: Graeme Kirkham.)

This section refers primarily to urban and village-scale settlements in the project area, but, as noted above in discussing Anciently Enclosed Land, one of the consequences of the spread of the clay industry beyond the rough ground and former rough ground of the uplands has been a decline in the number of surviving older rural settlements, particularly medieval farmsteads, in the major clay-working areas (Herring and Smith 1991, 49; Exeter Archaeology 2009, 497-9). In the St Austell clay district there has also been a decline in another settlement sub-type, in the form of rural industrial housing of the nineteenth and twentieth centuries. These dwellings accommodated families working in the clay industry and were typically set either along roads or on farmland adjacent to clay workings. Surviving examples include terraces and rows (Fig 79), cottage pairs and individual dwellings (Herring and Smith 1991, 40-1).

Historic maps show some clusters of post-medieval smallholdings on higher ground on the St Austell granite, typically in the form of one or two detached dwellings on 2-4 ha holdings enclosed from former rough ground (Fig 59). Many of these have also subsequently been lost to encroachment by clay working, and there is now little in this district which resembles the extensive smallholding landscapes which occur in other industrial zones in Cornwall (Dudley 2011, 49-55; Kirkham 2011b). Smallholding settlements do occur at Balwest and Tresowes Green close to Tregonning Hill but these were associated with nineteenth-century mining activity rather than with clay working.

Elsewhere, dispersed rural industrial settlement apparently directly associated with the china-clay industry is scarce if not absent.

The decline of rural settlement caused by expansion of the clay industry, particularly during the twentieth century, has been one of the factors underpinning growth of the 'island settlements' and of urban centres such as St Austell (*cf* Cahill Partnership and Historic Environment Service 2004a, 15).

A significant number of nucleated settlements are located within the current project area and thus would potentially be affected by future china-clay industry development (Appendix 2). Overall, these form a diverse group. The only large urban centre is St Austell but there are numerous small settlements within and close to the clay areas, many of which have been significantly shaped by the industry. Some of these had origins as medieval churchtowns (Roche, St Stephen-in-Brannel), others developed over what were previously agricultural landscapes as service centres for the clay industry and the associated working population (St Dennis, Nanpean, Foxhole, Stenalees); Lee Moor was a nineteenth-century planned industrial village (Figs 87-88). Charlestown and Pentewan were created as industrial ports and Bugle, Indian Queens and St Blazey had their origins in transportation and communications, growing subsequently as population and service centres for the clay industry.

Appendix 2 lists the settlements identified by HLC mapping, noting those which have been the subject of characterisation studies, Conservation Area plans or similar assessments. The table includes a number of settlements located within the St Austell, St Blazey and China Clay Area Regeneration Plan area but outside the immediate china-clay district and a small number which lie outside the defined project area but are situated closely adjacent to it and for which there could be potential impacts from future clay-related development.



Figure 81 Views north west from the centre of St Austell are dominated by the skyline created by waste tipping around the eastern side of the giant Blackpool clay works. (Photograph: Graeme Kirkham.)

3.3.7.1 St Austell

St Austell was a medieval churchtown, the centre of a large parish, which developed as a market centre for the surrounding mining area in the early post-medieval period (Newell 2002). Mining continued to be the dominant economic element until the mid-nineteenth century but the town's later development was strongly influenced by the china-clay industry. Banks and clay companies built architecturally impressive premises, matched by a variety of institutional buildings, many of them dating to the two decades after 1890 and coinciding with the meteoric rise of the local clay industry at this period (Fig 80).



Figure 82 Looking north along Porthpean Road, Mount Charles, St Austell, with Carluddon sky-tip dominating the skyline. Some historic elements of the clay industry form key components in local 'sense of place'. (Photograph: Graeme Kirkham.)

Unlike the tin industry, much of the investment in the nineteenth-century expansion of clay working came from the near locality: profits accruing to local investors saw expression in substantial numbers of large suburban villas. The *Mining Journal* (10 November 1866) referred to 'new mansions that have been lately built by persons who only a few years since were standing behind the counter or working at their trades and are now independent gentlemen'. Many of these houses survive and the gardens and ornamental planting around them still contribute a significant element to the historic character of St Austell (Newell 2002).

The town also served as a commercial, retail and entertainment centre for the clay area. 'The people here are said to be very rich in comparison with those in other towns, and they need three banks to take care of their cash', noted the writer J H Harris (1906, 250). 'The chief amusement at night is to walk around the banks, just to see that the doors are closed' (Fig 80). 'As a Cornish town, St Austell ranks high,' noted a visitor guidebook of c 1931:

'It is often spoken of as the richest in the county, and with its many important shops presents a smart appearance. By reason of its pre-eminence in the China-Clay industry it is frequently called "Clayopolis". The offices of clay-producing companies are on every hand . . . houses, villas and bungalows, all fresh from the trowel, spring up like mushrooms' (Anon nd, 85).

This history of prosperity derived from the clay industry has left a built legacy in St Austell which, although there have been some regrettable losses, offers some striking nineteenth- and early twentieth-century urban architecture: examples include the 'Red Bank', Liberal Club and Assembly Rooms, all designed by the Cornish architect Silvanus Trevail, several former china-clay company offices and a variety of nonconformist chapels (Fig 80). Historic accounts of the frequent passage of clay wagons through the town en route to Par and Fowey can be better appreciated when understood in the context of the topography of narrow curving streets which characterises the centre of the town. St Austell was also the northern terminal of the Pentewan tramway, constructed in 1829 to carry china clay to the port of Pentewan.

The historic influence of the clay industry on St Austell is underscored by the physical presence of remains of the industry in many views out from the town; the closest tips lie only a little more than 1 km from the historic centre (Figs 81-2). Satellite settlements such as Carclaze and Boscoppa, formerly separate but now incorporated into the St Austell built-up area by recent residential development, lie even closer to historic clay workings.

3.3.7.2 Other settlements

Other settlements on and around the St Austell granite – Bugle, Indian Queens, Fraddon, Roche, St Stephen-in-Brannel, St Dennis, Trewoon, Penwithick, Stenalees, Nanpean and Foxhole – although with differing origins, are now essentially service and residential centres which grew alongside the expanding china-clay industry during the later nineteenth and twentieth centuries (Appendix 2).



Figure 83 Terraced housing, semi-detached 'villas' and a modern insertion in Penwithick, in the St Austell clay district, an industrial settlement which developed almost entirely in the twentieth century. (Photograph: Graeme Kirkham.)



Figure 84 Granite and brick, the latter almost certainly from local brickworks, used on the elevations of late nineteenth-century houses in Fore Street, St Stephen-in-Brannel. (Photograph: Graeme Kirkham.)

Key character elements of these are the diverse mix of detached, semi-detached terrace and row housing, mostly on a relatively small scale: the clay area settlements differ from former mining areas in Cornwall in that there are few complete streets of terraces (Fig 83). There is considerable use of local granite (and in a few instances 'china stone' and killas) on older (nineteenth century) buildings, with a relatively high incidence of coursed and faced granite construction, at least on front elevations (Fig 84). Brick occurs frequently around openings; much of this likely to derive from local brickmaking in the china-clay area.

A substantial proportion of the housing and ancillary buildings in the St Austell clay district settlements dates from the earlier twentieth century, reflecting the major expansion of the industry in this period, and for much of this the architecture and fabric reflects the easy availability of locally produced blocks and bricks, often with plain rendered or pebble-dashed finishes (cf Cahill Partnership and Historic Environment Service 2005b, 29; 2005c, 24).

There is also a significant presence within and around the fringes of the St Austell area clay settlements of detached and semi-detached houses, villas and bungalows of some architectural pretensions (cf Cahill Partnership and Historic Environment Service 2005b, 29; 2005c, 24). These include many bungalows apparently dating to the 1920s and 1930s. Jack Clemo's novel *The clay kiln* (originally *The dry kiln*), drafted during the 1940s and set in 1938, described the bungalow occupied by the aspiring Creba family as a 'grey, solitary villa on the outskirts of Roche village' (Clema 2000, 25).

As with other post-medieval industrial settlements in Cornwall, the clay villages of the St Austell area incorporate a variety of nineteenth- and twentieth-century institutional

buildings, including nonconformist chapels, schools, institutes, reading rooms and band rooms (Fig 85). Where these have become redundant they have often been converted to other uses. Most settlements also have evidence of small-scale historic retail provision and the remnants of minor craft-based industrial activity such as blacksmith's and cooper's shops.

Several of these settlements – Bugle and Stenalees are examples – take their linear form from being set along through roads, or around cross roads (Fig 114). Many smaller settlements – Trethowell, Little Treviscoe, Penwithick, Kerrow Moor, Whitemoor and Ruddlemoor, for example – similarly straggle along through-routes immediately adjacent to china-clay workings (Figs 58, 86). Much of their development occurred after World War I. The proximity and visibility of industrial activity – pits, tips, dries, railway lines and other infrastructure elements – is a key element of character for almost all settlements in the St Austell clay area (Figs 38, 50, 58, 60, 79, 81-2, 86, 110, 114).



Figure 85 An early twentieth-century Methodist chapel in Penwithick, now converted for domestic use. (Photograph: Graeme Kirkham.)

This proximity of settlement to industry in the St Austell clay area and the resulting association of key aspects of Industrial landscape character with clay settlements are highlighted in part of James Goodman's poem *The White Hill* (Goodman 2011):

The spent village of Greensplat
on a slip of hard-edged land
between the pits of Great Longstone
and Wheal Martyn China Clay Works.

On the high hill by Carrancarrow
half a dozen squat homes
hedged up against the road
slack-leashed with telegraph lines,

a grey slate Methodist chapel,
clay-dust telephone box,

*United Kingdom china-clay bearing grounds: mineral resource
archaeological assessment*

steel-lattice transmission mast,
wide scandal of turned earth.

A shambling path through
a dock-and-daisy field
with goats and chicken wire
breaks the hedge and meets the pit-void.

By contrast, in west Cornwall and on Bodmin Moor there is no clear association between china-clay working and settlement; in both areas work on china clay was only one of a number of potential 'industrial' employments – others included mining, quarrying and moorstone working – together with agriculture and fishing. Without analysis of later nineteenth-century census returns (beyond the scope of the current project) there are no obvious indications of individual settlements having been a particular focus for clay workers. For the relatively small West Penwith sites of Leswidden and Bostraze it is probable that part of the workforce came from St Just, approximately 2 km to the west; settlement character there was essentially derived from the local dominance of mining during the nineteenth century (Cahill and Cornwall Archaeological Unit 2002). Again, the pattern of rural smallholdings which characterises the area adjacent to Tregonning Hill derives principally from the long dominance of mining in the area rather than the short episodes of clay working.



Figure 86 The clay settlement of Little Treviscoe, near the former Little Treviscoe and Kernick clay works. The 1838 tithe survey showed a handful of smallholdings here; the present settlement of terraces, cottage pairs and single cottages around a road junction was first shown on the 2nd edition Ordnance Survey 25in: 1 mile map of c 1907. Close proximity to clay working areas and infrastructure is a strong element of the historic character of many smaller settlements in the St Austell uplands. (Photograph: Historic Environment, Cornwall Council: F82-021; 16 April 2008.)

Similarly, on Bodmin Moor there are no settlements which appear to have been specifically influenced in character by association with the clay industry, as distinct from the wider range of rural industrial activities in the area, including moorstone working,

granite quarrying and dimension stone working (Herring *et al* 2008). Workers in all these industries were drawn from, or lodged with, farm families on and around the Moor: Margaret Leigh noted the problems created for Bodmin Moor farmers in the 1930s because 'the quarries and clay-works . . . draw so many men away from the land' (Leigh 1937, 3). Some clay workers came from St Breward and Camelford; during the later nineteenth and twentieth centuries both places saw the addition of distinctive attributes of Cornish industrial settlements in the form of terrace and row housing together with nonconformist chapels and buildings such as Sunday schools, as did some historic farm hamlets around the moorland edge such as Highertown and Watgate, close to the Stannon works (Conservation Studio and Cornwall Archaeological Unit 1999b; Herring and Newell 2005; Herring 2008c).

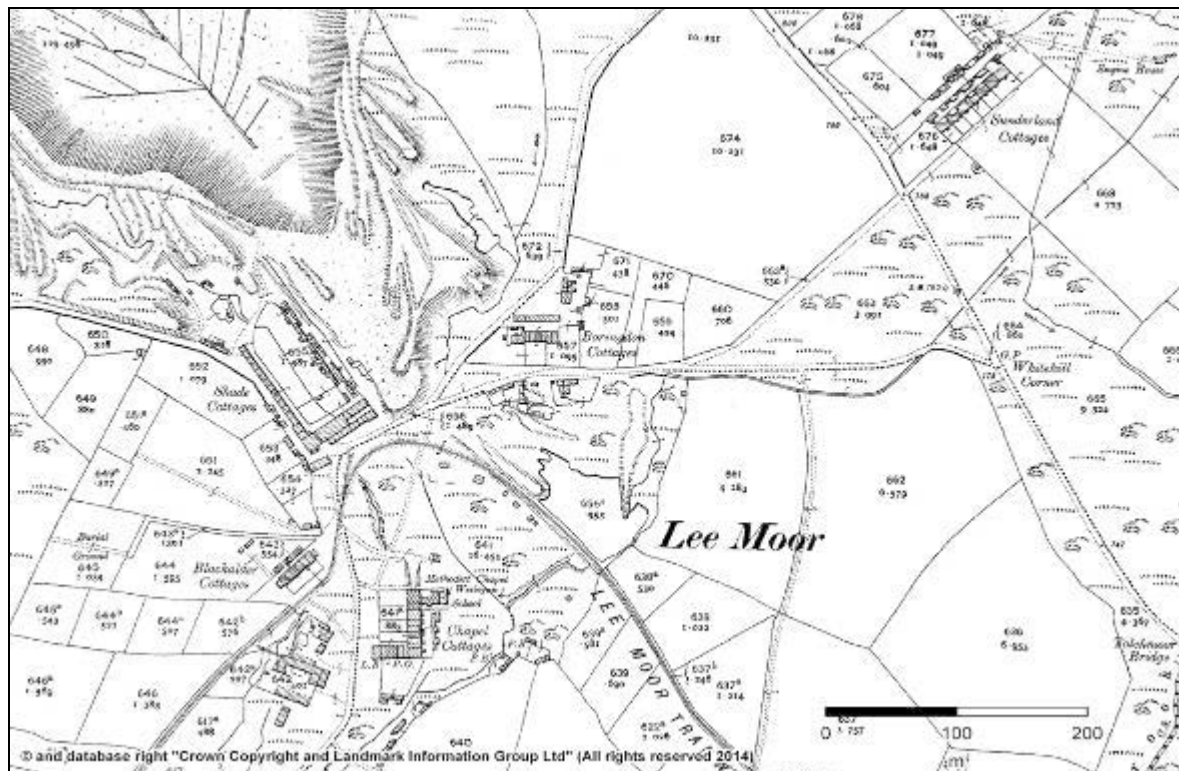


Figure 87 The small industrial settlement at Lee Moor as it stood in the first decade of the twentieth century, shown on the 2nd edition Ordnance Survey 25in: 1 mile map. The dispersed terraces and rows lay adjacent to active clay operations and were surrounded by rough ground and recently enclosed former rough ground.

Lee Moor, on south-west Dartmoor, stands out from contemporary clay settlements in Cornwall in that it was a planned industrial settlement; the first terrace was constructed in the mid-1830s soon after the initial development of the clay industry in the area (Devon HER MDV2522). In the later nineteenth century the principal china-clay employers were Martins, and about 1903 the Dartmoor writer William Crossing commented that there was

'no other community on Dartmoor better circumstanced . . . Entirely a settlement of labourers, there is yet an air of prosperity about Lee Moor . . . to the efforts of Messrs Martin it is mainly due. They have done much to foster a spirit of content among their employees by the interest they have shown in the village, which if not exactly of their creation, has been formed by them out of a very small beginning' (Crossing 1992, 80).

Lee Moor incorporated dispersed terraces originally of relatively formal design (Fig 88) (some now regrettably unsympathetically altered), with gardens and allotments, a

Methodist chapel, Anglican mission hall and a co-operative store but no pub (Crossing 1992, 80; Harris 1992, 94-5; Taylor 1999, 91-3). It was threaded by the Lee Moor tramway – the wagon repair shops lay within the settlement – but unlike many of the St Austell area settlements was not on a significant through route. As with the Hensbarrow clay settlements, however, clay working in the form of pits, tips and infrastructure has been and remains a strongly visible element in the vicinity of Lee Moor and of the other adjacent settlement in the area, Wotter (Fig 68).

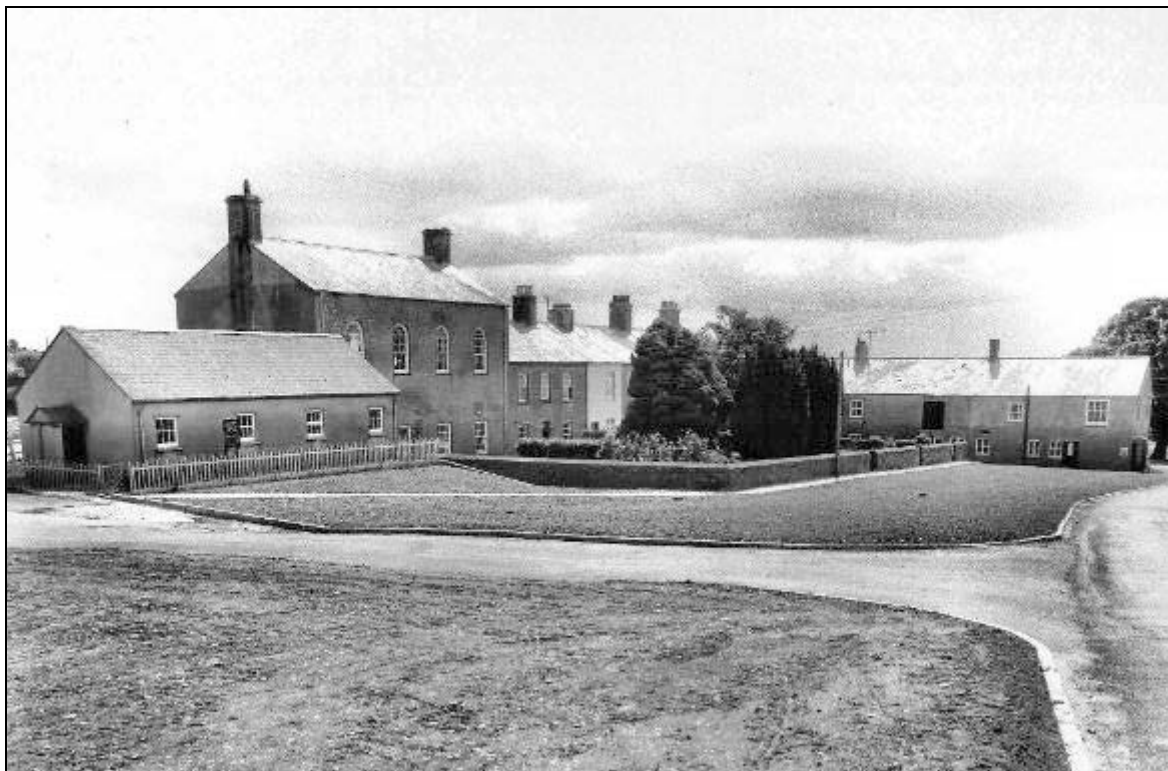


Figure 88 The Methodist chapel and Chapel Cottages at Lee Moor in 1971 (Photograph: China Clay History Society archive, 17377.)

There is little to indicate that clay companies were involved on a comparable scale in the early development of settlements in the Cornish clay districts, although the occurrence of late nineteenth – early twentieth century cottage pairs and small terraces to unified designs hints at some element of entrepreneurial investment at a later date. The most significant developments of this type were by the West of England clay company, which built Gracca Terrace, Bugle, in 1900 and three substantial terraces conveniently near to its Drinnick dries complex in Nanpean in 1907-1910 (Bowditch 2013; Ivor Bowditch, pers comm), expanding the historic settlements of Nanpean and Foxhole significantly. Fernleigh Terrace, Nanpean, consisted of two blocks of six single-fronted terraced houses; eight blocks of eight houses – 64 dwellings in all – were constructed to a closely similar if not identical design along Currian Road (Fig 89) and five blocks of eight houses at Goverseth Terrace, Foxhole, were added to the north of the former village. These dwellings represented a substantial investment in accommodation for the workforce of the company's expanding clay operations in the vicinity (*cf* Cahill Partnership and Historic Environment Service 2004a). Further research may identify other examples of such provision.

3.3.7.3 Potential impacts

Many individual farms and isolated cottages in the St Austell clay district have been absorbed by the expansion of china-clay operations (above), to the extent that there

has been a significant historic decline in rural settlement in the area. While some small rural settlements survive, the majority of the population now live in the various 'island settlements' – surrounded by industrial activity or closely adjacent to it – and in smaller roadside hamlets and aggregations. It seems improbable that future expansion of the clay industry would place at direct risk the core fabric of these historic settlements or the more recent development which surrounds them. In the St Austell clay district the 'island settlements' do not coincide with kaolin deposits and since the early 1950s they have been specifically excluded from china-clay working; more recently they have been nominated as the focus for future community growth (Herring and Smith 1991; Cornwall County Council 1998, 7.46-7.50, inset 1a; Cornwall Council 2012a, 5.2). The envelope around some of these is relatively small, however, and potential impacts on them and on other settlements, including St Austell, are probably most likely to occur in terms of changes to their settings brought about by expansion of pits, waste tips and china-clay infrastructure. There is also potential for alterations in key environmental factors such as traffic levels and exposure to the potential adjuncts of industrial activity in the form of noise, vibration, dust and dirt.



Figure 89 Terraces of 'company housing' (right centre) built by the West of England Co in 1908 at Currian Road, Nanpean, part of a substantial expansion of settlements in the St Austell clay district at this period. (Photograph: Historic Environment, Cornwall Council: F67-025; 8 June 2005.)

Historic settlements both within the clay district and in the St Austell, St Blazey and China Clay Area Regeneration Plan area are also likely to be the future focus for new development. To an extent this is already under way: the clay settlements are already notable for numerous small housing developments in progress or recently completed (Fig 90), presumably prompted by relatively low land prices and looser constraints on development in an area which is often viewed as without particular landscape merit and not acknowledged for its historic significance. Much of the new housing development is of regrettably poor or, at best, bland design quality. There has been little development which enhances the distinctiveness of these clay district settlements.

Much of the recent development in the St Austell clay district has been on greenfield sites adjacent to settlements, but studies of some historic centres by the Cornwall Industrial Settlements Initiative (CISI) identified a problem in terms of the potential

future loss of historic open spaces within them to infill development (*cf* Cahill Partnership and Historic Environment Service 2005a; 2005c). The historic significance of these industrial settlements has generally not been matched by the quality of recent additions and many are notable for under-use of historic buildings, poor quality alterations to historic structures and degraded streetscapes.

Potential impacts now and for the future are greater because there are few if any heritage designations in most of the clay area settlements. Bugle, Stenalees, Nanpean and Foxhole, for example, have no Listed Buildings (even St Austell has significant numbers of historic buildings of clear historic and architectural interest which are not Listed). For most of these settlements the statutory planning guidance on development which would be offered by Conservation Area status, Conservation Area Appraisals and Article 4 Directions is absent. St Austell, Charlestown and Pentewan, however, all have Conservation Areas and Conservation Area Management Plans (Appendix 2); Charlestown additionally falls within the Cornish Mining World Heritage Site and is subject to the associated management constraints.

Review of statutory listings and the establishment of Conservation Areas for all of the historic clay settlements in the St Austell district were strongly recommended by the CISI reports carried out a decade or so ago (listed in Appendix 2).



Figure 90 New development near Penwithick, in the St Austell clay area, with Carluddon sky-tip forming a dramatic backdrop. (Photograph: Graeme Kirkham.)

The historic settlement at Lee Moor overlies mapped kaolin deposits and despite its interest as a planned industrial settlement has no heritage designations. It is presumably effectively subject to *de facto* exclusion from future development of china-clay working and infrastructure development, comparable with the situation for the 'island settlements' of the St Austell clay district.

3.3.7.4 Mitigation

The key elements of mitigation proposed for historic settlements are:

- Appropriate levels of designation of historic structures; the CISI reports on historic industrial settlements in the vicinity of the Hensbarrow clay area provided lists of candidate buildings meriting statutory protection through designation. Use of 'local lists' could provide some additional indication of local significance for undesignated heritage assets.
- Speedy imposition of Conservation Areas and completion of Conservation Area Appraisals; again, the CISI reports offer substantial contributions to the process of compiling both the Conservation Areas and the Appraisals.
- A commitment by the relevant planning authorities to treat clay-area settlements as places of significance, meriting both appropriate protection for heritage features and a requirement for high-quality design and a concern for historic character in new development.
- Wherever possible, beneficial uses should be sought for historic structures in clay settlements. Where this is not feasible the planning system should require appropriate archaeological recording of buildings and structural remains at risk from development.
- A thematic assessment campaign aimed at greater and more appropriate levels of designation of significant buildings and structures in settlements in the project area, including distinctive components of relatively recent (twentieth century) origin.

3.3.7.5 Statement of significance

- Settlements in and close to Cornwall and Devon's clay areas are, to greater and lesser extents, products of one of the south west's major post-medieval and modern industries. Most show clear evidence of past prosperity and all have a distinct character and strong sense of place.
- Industrial settlements associated with the clay industry are different in character from those principally associated with historic mining, not least in terms of their chronology of development and the influence this has had on the use of materials and range of architectural styles. They represent a significant element among settlements in south-west Britain which have been shaped by later nineteenth and twentieth century extractive industry and thus have a wider significance than the merely local.
- Current levels of designation and protection of settlements within the clay areas do not reflect their significance. A relatively small number of buildings within settlements are the subject of designations; a minority of settlements have Conservation Areas and even fewer have appropriate management prescriptions (Appendix 2), despite past recommendations for their historic significance to be appropriately recognised.
- Surviving small rural settlements in the St Austell china clay district have additional significance because of the extent to which others in this area have been lost.

4. Results

The project design for the china-clay mineral assessment proposed the following broad quantitative outcomes from the analyses carried out on the historic environment datasets:

- To quantify the impact of past and present china-clay extraction on the historic environment of the china-clay bearing areas in the UK.
- To assess the potential impact of future china-clay extraction on the historic environment of the china-clay bearing areas.
- To quantify and analyse the heritage assets within the clay-bearing grounds to assess the potential impact of the processing of china-clay waste as secondary aggregates.

These themes are explored in the following sections.

4.1 The impact of the china-clay industry on the historic environment resource

One aim of the current project has been to assess the extent of the known historic environment resource across the project area and assess the degree to which it has been damaged or lost as a consequence of the past development and spread of the china-clay industry. A further aim was to provide an assessment of the extent to which the resource could be vulnerable to or at risk from future exploitation of the known kaolin resource in Cornwall and Devon, and from other china-clay related change such as infrastructure development, re-use of secondary aggregates or re-profiling and re-vegetation of areas of past waste tipping. Additionally, it aimed to assess the potential risks from development within the area covered by the St Austell, St Blazey and China Clay Area Regeneration Plan.

One element of this analysis is an assessment of the background levels of historic environment 'asset density' to be found across Cornwall and Devon, as represented by sites recorded on the respective county HERs (Devon data derived from Heritage Gateway). Table 2 presents asset density figures (sites per sq km) for the administrative areas of Cornwall and Devon arranged by period. Comparable asset density figures for the china-clay project area assessed by the project are provided in Table 3.

Overall asset density figures from the two administrative areas (derived from HER / Heritage Gateway data) are very closely comparable: a total of 20.12 asset records per sq km for Cornwall, 19.93 for Devon (the difference in densities is less than 1 per cent). There are greater differences between the asset densities for different periods, with those in Cornwall generally being greater. The exception is the modern period, for which Devon records an asset density almost 60 per cent higher than in Cornwall; this is perhaps more likely to reflect a policy decision influencing the content of one or other of the HERs than any real difference but it may hint that the Cornwall record is to some extent deficient in modern records. The apparent disparities in the densities of sites classified as early medieval and medieval in the two areas, perhaps reflecting different practices in attributing periods to records, almost disappears when the two classes are aggregated (Cornwall 6.33 sites / sq km; Devon 6.27 / sq km).

Figures for average densities of monuments included in the National Heritage List (Table 2) are also broadly similar across the two counties, with the slightly higher density of post-medieval monuments in Cornwall possibly reflecting the greater number of designated industrial monuments within the county. Overall, the density per square km of National Heritage List sites is around 20 per cent higher in Cornwall than in Devon.

Table 2 Historic environment asset densities for Cornwall and Devon

Period		Cornwall (3559 sq km)	Asset density / sq km	Devon (6700 sq km)	Asset density / sq km
Prehistoric	HER	11339	3.19	14457	2.16
	National Heritage List	811	0.23	1311	0.20
Roman	HER	1724	0.48	2867	0.43
	National Heritage List	112	0.03	35	0
Early medieval	HER	6404	1.80	18801	2.80
	National Heritage List	257	0.07	55	0
Medieval	HER	16139	4.53	23282	3.47
	National Heritage List	1212	0.34	2343	0.35
Post medieval	HER	26577	7.47	46087	6.88
	National Heritage List	12083	3.40	18314	2.73
Modern (20 th century)	HER	9437	2.65	28017	4.18
	National Heritage List	1092	0.31	2571	0.38
Total	HER	71620	20.12	133511	19.93
	National Heritage List	15567* 13944**	4.37 3.92	24629* 20812**	3.68 3.11

Note. Figures for Devon heritage assets are derived from Heritage Gateway, consulted online 24 September 2013; the totals combine data from Devon and Dartmoor HER, Exeter City HER and Exmoor National Park HER. Data for Cornwall derive from the Cornwall and Scilly HER for the administrative area of Cornwall (excluding Scilly); consulted 24 September 2013. Heritage Gateway data for Devon and Cornwall cannot be compared directly because the Cornwall returns include monuments on the Isles of Scilly.

National Heritage List data were obtained from the National Heritage List online database, consulted 6 January 2014. There are some inconsistencies in the totals by period from this source when compared with global totals for the administrative units. In the case of Devon, there are also inconsistencies in totals derived from data for the ten individual local authorities when compared with those for Devon as a whole. In terms of orders of magnitude the variations are relatively small. Results less than or equal to 0.01 are shown as 0.

* Totals obtained by summing period totals. ** Totals for the administrative units as a whole.

The densities of heritage assets recorded in HERs in the two counties as a whole may be compared with the equivalent figures for the current project area (Table 3). Asset densities in the Cornwall and Devon divisions of the project area are in fact closely similar to those in the wider administrative areas in which they lie. In Cornwall as a whole there are on average 20.12 HER records per sq km, compared with 20.4 per sq km in the project area, a difference of less than 2 per cent. The 'fit' is less close for Devon, with 19.93 records per sq km across the whole county compared with 25.9 per

sq km within the project area. This approximately 30 per cent higher asset density in the Devon part of the project area can most plausibly be identified as a consequence of its relatively small size (29 sq km) and the strong history of survey activity on rough ground on Dartmoor: the area around Lee Moor has been subject to substantial work by RCHME and English Heritage and by a number of academic projects, as well as more recent pre-development assessments of areas targeted by the clay industry (Sibelco UK and Imerys 2009, ch 12) (Fig 91).

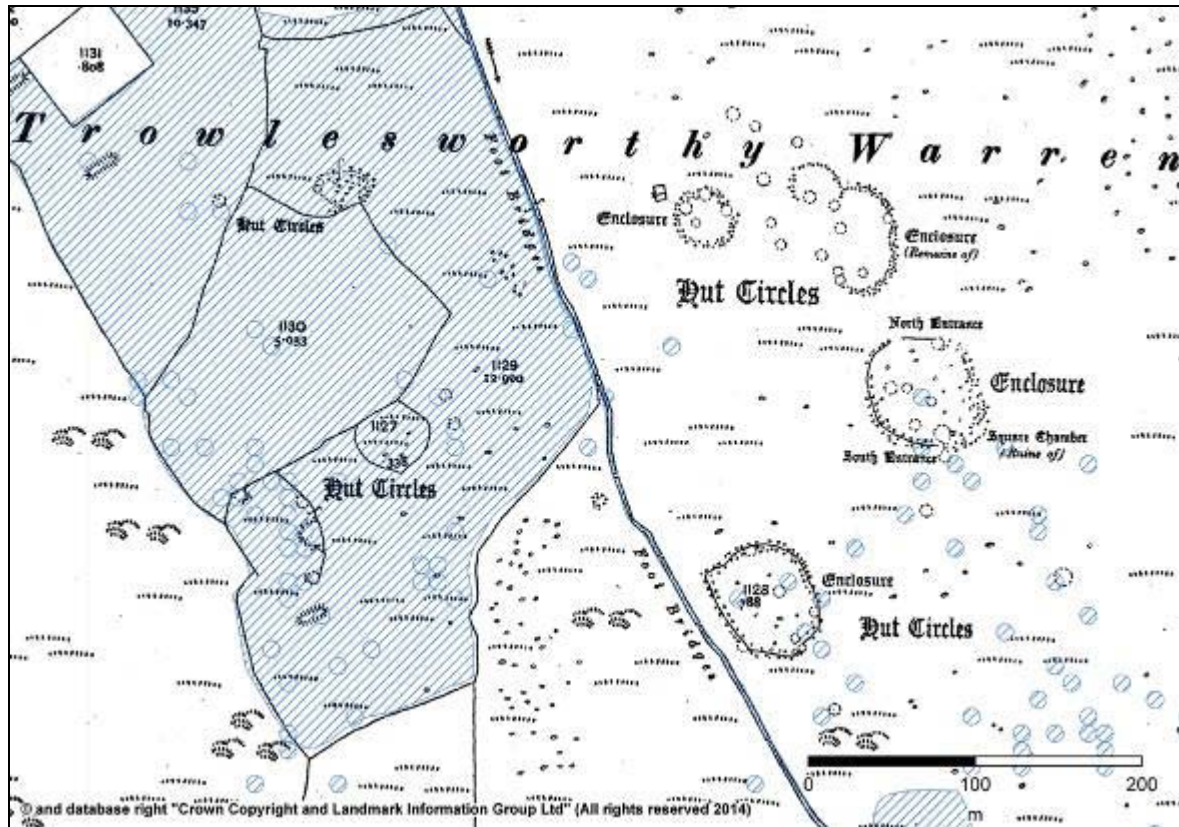


Figure 91 Prehistoric enclosures and roundhouses at Trowlesworthy Warren, south west Dartmoor, depicted on the 2nd edition Ordnance Survey 25in map of c 1905. The warren itself, as recorded in the Devon and Dartmoor HER, is represented by the large hatched polygon to the left. The hatched blue points which do not coincide with features on the map represent HER records of features identified by survey and other archaeological investigations in recent decades. The area without records in the top right hand portion of the map lies outside the current project area.

This conclusion is supported to some extent by comparison of the densities of heritage assets by period. The much higher figure for the prehistoric period – 11.59 recorded assets in the Devon project area compared with 2.9 in Cornwall – almost certainly reflects the greater density of visible prehistoric monuments on rough ground.

The average density of 25.9 heritage assets per sq km recorded for the Devon project area is about 25 per cent higher than the 20.4 in Cornwall. Again, it is likely that the differential can be accounted for, at least in part, by the large proportion of the Devon project area which has been subject to detailed survey (particularly the rough ground), creating a larger proportion of prehistoric and medieval site records.

Mapping created for this project to record the extent of past and present clay working – pits, tips and infrastructure – makes it possible to determine totals for the recorded heritage assets which survive within the project areas; that is, those which do not

coincide with areas mapped as clay extraction pits and infrastructure and which are not themselves records of such features. This comparison suggests a surviving asset density a little less than 7 per cent lower than the headline figure for all recorded assets in both areas; for Cornwall the average is 19.03 surviving heritage assets per sq km, for Devon 24.17. There must, however, be considerable doubt about the degree to which these figures can be regarded as accurate or even indicative indicators of the actual extent of past loss or damage of assets within the project area (below).

Table 3 Heritage asset densities in the project area (HER records)

Period	Cornwall project area (256.51 sq km)				Devon project area (29.00 sq km)			
	All records	Asset density/ sq km (all sites)	Records for surviving sites	Asset density/ sq km (surviving sites)	All records	Asset density/ sq km (all sites)	Records for surviving sites	Asset density/ sq km (surviving sites)
Prehistoric	744	2.90	718	2.80	336	11.59	324	11.17
Roman	20	0.08	20	0.08	-	-	-	
Early medieval	537	2.09	526	2.05	-	-	-	
Medieval	674	2.63	655	2.55	135	4.66	133	4.59
Post medieval	2845	11.09	2596	10.12	191	6.59	163	5.62
Modern	304	1.19	278	1.08	27	0.93	24	0.83
Unknown	95	0.37	89	0.35	62	2.14	57	1.97
Total	5219	20.40	4882	19.03	751	25.90	701	24.17

The figures for overall asset densities based on HER records in Tables 3 and 4 can be regarded as giving only a very broad basis for comparison and for understanding the overall 'presence' of heritage assets within the specified areas. Historic Environment Records are by their nature partial and variable (see discussion below) and, inevitably, in terms of the creation and verification of records, lag behind the current state of knowledge. Intensive fieldwork in particular geographical areas, or thematic projects to add specific types of site to the record, can produce substantial biases. The existence of such additional detail in particular areas is likely to be signposted only by the existence of an 'event record'; the absence of such efforts to enhance the record is less clearly in evidence. Similarly, as discussed below, HER data may provide an even poorer indication of the former extent and character of heritage assets within areas which have been subject to major extractive activity, and thus of the degree of loss and damage which has occurred (Table 3).

NB. The analysis is to some extent skewed by inclusion within the project area of the St Austell, St Blazey and China Clay Area Regeneration Plan area, which extends considerably beyond the mapped kaolin resource and the historic and current china-clay winning and working zone (Figs 1, 3). Thus, for example, the extent of Anciently Enclosed Land in the project area (Fig 39) is substantially increased, with proportionately higher numbers of, for example, Listed Buildings, historic settlements and crop-mark sites. Targeting of past surveys also distorts the picture. The status of Charlestown as a particularly significant and picturesque historic port within the Cornish Mining World Heritage Site, for example, has generated a high level of recording, reflected in more than 150 HER records. The port of Par, however, with its adjacent china-clay infrastructure (Fig 5), although historically considerably more important for the china-clay industry, has only around 30 records.

4.1.1 Designated assets

A further comparison may be made between the two areas in terms of the respective densities of designated assets (Table 4). The overall density of Scheduled Monuments, Listed Buildings, Registered Parks and Gardens and Registered Battlefields is remarkably similar in the Cornwall and Devon portions of the project area; less than 3 per cent higher in the Cornish part. The mix of designations, however, is rather different, with a significantly greater density of Scheduled Monuments in the Dartmoor area (more than five times higher than in Cornwall) and a four-times greater density of Listed Buildings in Cornwall. Two Registered Parks and Gardens occur within the project area in Cornwall, none in the Devon part (although others lie adjacent to it); no Registered Battlefields occur in either. Part of the disparity in the density of Scheduled Monuments may be due to the extensive Scheduling review undertaken on Dartmoor during the 1990s under the English Heritage Monuments Protection Programme; in Cornwall only Bodmin Moor was subject to a similar level of scrutiny. Additionally, the differing proportions of historic landscape character Types in the two areas are also likely to influence the relative densities: Scheduled Monuments are more prevalent on rough ground and Listed Buildings occur more frequently in Anciently Enclosed Land and settlements. The overall densities of designated assets determined in this way are rather lower than those for the counties as a whole obtained from National Heritage List data (Table 2).



Figure 92 Excavations by Oxford Archaeology on the Scheduled Emmet's Post barrow, September 2014, in advance of expansion of china-clay extraction on south-west Dartmoor. (Photograph: Steve Reed, Historic Environment Team, Devon County Council.)

The other relevant designation within the project area is the Cornish Mining World Heritage Site. None of the Devon china-clay industry assessment project area coincides with this (although the World Heritage Site does extend into Devon along the Tamar valley), but there is an overlap of 6.36 sq km between the designated World Heritage Site and the project area in Cornwall. Of this an area of 3.42 sq km overlies mapped kaolin deposits and might therefore in principle be at risk from future clay exploitation. The portions of the project area falling within the World Heritage Site include the historic port of Charlestown, the important area of early china-clay working around

Tregonning Hill, the Bostraze and Leswidden areas near St Just and the large nineteenth-century industrial complex in the Luxulyan valley.

Table 4 Comparative asset density: designated heritage assets

	Cornwall project area (256.51 sq km)		Devon project area (29.00 sq km)	
Designation	No of designated sites	Asset density/ sq km	No of designated sites	Asset density/ sq km
Scheduled Monuments	87	0.33	53	1.83
Listed Buildings	518	2.02	14	0.48
Registered Parks and Gardens	2	0	0	0
Registered Battlefields	0	0	0	0
Totals	607	2.37	67	2.31

4.1.2 The china-clay resource and the proportion extracted

The distribution of the kaolin resource across the south west is shown in Table 5 (*cf* Figs 1, 3, 7, 8, 9). The mapped extent (BGS) totals 6481 ha (approximately 65 sq km). Of this, 827 ha lies in Devon, the remainder in Cornwall (Fig 1). Unsurprisingly, much the largest proportion is located within the St Austell granite, with other large deposits on Bodmin Moor and Lee Moor. A perhaps surprisingly large kaolin resource – approximately 18 per cent of the total – is located in West Penwith, with only a small area located around the historically important Tregonning Hill deposits.

Of the total kaolin area, just over 2500 ha (39 per cent) has been mapped during the current project as occupied by china-clay industry features: pits, waste tips and infrastructure (Table 6). Of these features, pits occupy 1959 ha (roughly 30 per cent), infrastructure elements 107 ha (less than 3 per cent) and waste tips 446 ha (approximately 7 per cent). In principle, therefore, approximately 60 per cent of the kaolin resource remains to be exploited.

Table 5 Distribution of the kaolin resource

China-clay area	Area of mapped kaolin deposit (ha)	No of discrete mapped parcels	Largest kaolin parcel (ha)	Average kaolin parcel size (ha)
West Penwith	1166	48	149	24
Tregonning Hill	166	2	150	83
St Austell granite (incl Belowda)	2515	35	463	71
Bodmin Moor	1806	20	536	90
Lee Moor (Devon)	827	4	637	200
Totals	6481	109	637	59

Table 6 Extent (ha) of clay industry features, by area

	West Penwith		Tregonning Hill		St Austell granite		Bodmin Moor		Lee Moor (Devon)		Totals	
*	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Type of feature												
Pits	10	14	2	4	1334	1571	110	122	503	535	1959	2246
Waste tips	7	11	7	8	264	1526	52	352	116	367	446	2264
Infra-structure	1	3	1	2	65	334	6	22	34	96	107	457
Totals	18	28	10	14	1663	3431	168	196	653	998	2512	4967

* (1) Extent within area of mapped kaolin deposits (ha) (2) Total extent (ha)

Clearly the actual potential for future exploitation in any of the five areas of past and current extraction will rely on a variety of factors. Key among these are likely to be the overall scale of the deposits and thus the degree to which investment in exploitation may provide a return, proximity to existing processing infrastructure and to means of shipping finished clay products. The existing core areas for the industry in the St Austell clay district and around Lee Moor would score well on these criteria. The kaolin deposit around Tregonning Hill is relatively small by comparison with other areas (Table 5). In West Penwith, despite an apparently large kaolin resource, individual deposits are numerous and individually relatively small; re-establishment of the china-clay industry in this area would also require major investment in new processing and transport infrastructure.

There are also, of course, planning and environmental constraints on the potential for future exploitation. For West Penwith, as for Bodmin Moor, where there is also a substantial kaolin resource, modern perceptions of landscape amenity, expressed through designations such as Areas of Outstanding Natural Beauty and Areas of Great Landscape Value, and the particular significance of these areas from an historic environment perspective, would be likely to prove potential constraints to clay industry development (Fig 93). These factors suggest that in the current economic and development context (*cf* section 2.6), the china-clay industry is likely to be concentrated in the foreseeable future in its current principal locations on the St Austell granite and south-west Dartmoor.



Figure 93 Kaolin resources mapped over a total of 72 ha underlie the Lamorna valley and environs, on the south coast of West Penwith. There are a number of potential constraints on future exploitation, however. The valley falls within Area of Outstanding Natural Beauty (AONB) and Heritage Coast designations, and the former Area of Great Scientific Value. It contains a number of Listed Buildings and the remains of historic streamworking and granite quarrying; boundaries in the adjacent Anciently Enclosed Land are likely to be of later prehistoric origin. Lamorna is also strongly associated with an important artistic movement of the first half of the twentieth century. (Photograph: Historic Environment, Cornwall Council: F78-180; 9 August 2007.)

4.1.3 The impact on the historic environment

Taken together, Tables 5 and 6 indicate the proportion of mapped kaolin deposits which has been removed in the course of clay working; that is, in part, an indication of the area which is almost certainly 'sterile' in terms of surviving buried and standing archaeological remains (other than the 'archaeology' which the industrial features themselves represent). Pits, as mapped by this project, extend over a total area of 2246 ha, of which much the largest part – 1959 ha (87 per cent) – predictably falls within the kaolin resource area.

While the mapping of the extent of the various elements of the china-clay industry has been as precise as could be achieved, this extent is likely to be an underestimate, although not necessarily a large one. This is essentially a limitation of the data sources available for the project. Unless a pit is shown on an available historic map or air photograph it is not in practical terms always possible to tell from current mapping whether a particular area has been subject to disturbance below the historic ground surface; pits which have been worked in the past were and are often backfilled and subsequently covered by waste tipping (Figs 94-5, 111). Thus, if mapping or other sources are not available for the particular period during which a pit was open, its complete extent or even former existence may not be apparent.



Figure 94 A vertical air photograph of clay operations on the northern flank of the Hensbarrow Downs in April 1947; north to the top. At centre left the flooded pits of the former Great Wheal Prosper and West Goonbarrow clay works, both marked out as an earlier generation of working by well-defined fans of finger dumps, are in the process of being backfilled with waste from the operational North Goonbarrow pit to the south east. Much of the southern end of Great Wheal Prosper pit was infilled, although part survives; West Goonbarrow pit appears to have been completely backfilled. The workings and enclosed land across almost the whole of the right hand side of the image have subsequently been absorbed by the modern Goonbarrow pit and associated infrastructure. (Photograph: RAF CPE/UK 1999/B32/4135; 13 April 1947. Print held by Cornwall Council Technical Services.)

This is a particularly important limitation in view of the dynamic character of the industry during the twentieth century. For the current project no *universal* mapping sources were available for the period between the Ordnance Survey 2nd edition 25in: 1 mile map of c 1907 and current Ordnance Survey digital MasterMap resources. Limited areas have coverage from the 2nd revised edition 25in mapping of the 1930s and the National Mapping Programme has plotted features dating up to c 1945-7 from air photographs. However, china-clay workings developed during the period after World War II will not have been captured unless they are depicted on current Ordnance Survey digital mapping.

The consequence is that a new pit opened in, say, 1950, worked, abandoned and subsequently backfilled and covered by later waste tipping, would not be recorded as a pit. In this respect, therefore, the overall extent of the impact of the industry in terms of excavated features and consequent destruction of archaeology remains unquantified. (Sources within the clay industry will undoubtedly have a clearer picture of the overall extent of past working and of the potential survival of historic land surfaces. A request

was made to Imerys for data which might clarify the mapping produced for this project but this was not forthcoming (Sean Taylor, pers comm). It is possible that such data would be regarded as commercially sensitive.)

The overall extent of historic and current clay working and associated infrastructure is more easily determined, in that current and historic mapping, together with NMP data, are likely to have captured its greatest spread. Mapping for this project indicates a total area occupied by the industry of almost 5000 ha, of which a little over half falls within the mapped kaolin resource (Table 6).



Figure 95 Two of three former pits at Bloomdale, Goonamarris, in the St Austell clay area, have been backfilled with mica waste. (Photograph: Historic Environment, Cornwall Council: F82-009; 16 April 2008.)

An unknown element is the degree to which sites which have been buried by past tipping may survive with a good degree of preservation. Calculations for the current project have regarded sites known to be buried under waste as 'surviving', but in reality many may have been damaged in advance of tipping by the levelling of standing structures or by topsoil stripping and associated vehicle movements, or by vehicle movements during the early stages of tipping. Also unknown is the extent to which buried remains may be compromised by the weight of many metres of tipped material overlying them or by deposits leaching from the overburden. It may therefore be more realistic to view a significant proportion of features now under waste as substantially damaged; most are in any case unlikely to be accessible to archaeological investigation in the foreseeable future.

These qualifications mean that while in many cases the mapping undertaken for this project can be used to determine the probable survival or otherwise of historic features, there will be other instances where the archaeological potential of a particular site or area will need to be based on a detailed *ad hoc* assessment. At the same time, within the complex and extensive industrial landscapes of the clay areas, survival of pockets

of remains and of deposits deriving from pre-industry activity or from earlier stages of the industry itself must always be regarded as possible.

4.1.4 Secondary aggregate resources

Table 6 indicates a total of more than 2200 ha of waste tips within the project area, representing a very substantial resource of material for working as secondary aggregates. Two-thirds of this area, probably representing a considerably greater proportion by volume or weight, is located in the St Austell china-clay district.

Re-working of waste as secondary aggregates is clearly potentially beneficial in environmental terms, not least in reducing the potential impact of extraction of primary aggregate deposits on landscapes elsewhere. However, it is important that due regard is had for the extent to which clay industry waste tips may themselves represent heritage assets. This is clearly the case for the iconic 'burrows' or sky-tips created during the period between about 1900 and 1970 (Smith 2008a), but both earlier and later tips potentially have significance in terms of the information they offer on past ways of working and the phasing of different operations within the industry. The sheer scale, form and 'presence' of certain tips are also key components of particular historic clay landscapes.

Selection of waste tip resources for exploitation should therefore be subject to overview from an historic environment perspective, in order that activity may be directed towards those tips deemed least sensitive and, where this is not feasible, that key features may be recorded or conserved.

4.1.5 Quantifying heritage assets lost and damaged

Of the total of 5970 heritage assets recorded within the project area by Historic Environment Records (HERs) and added by the current project, 387 have been characterised as 'lost' or 'damaged' in that they fall within polygons mapped as pits or infrastructure but are not themselves the mapped feature (an HER record for a china-clay pit will fall within the mapped polygon for that pit but is evidently not 'lost'). This equates to 6.5 per cent of the currently recorded historic environment resource.

However, it is important to note that both the total number of features and the number of those probably lost are certainly gross underestimates: the 'real' extent of the potential historic environment resource within the project area and the number of heritage assets which have been lost or damaged are clearly much larger by orders of magnitude. This is a consequence of two limiting factors. One of these is the extent to which heritage assets have been subject to any form of recording in the past. In general, the areas affected by the china-clay industry were poorly covered by antiquarians and by archaeological research prior to the later twentieth century; this is certainly the case for the St Austell granite. Further, much ground had already been lost to clay working before the earliest maps with enough detail to show a significant proportion of historic features were produced in the late nineteenth century. The clay industry had expanded to cover an even larger area before the first comprehensive air photographic cover was achieved just after World War II. Clearly, unrecorded sites of archaeological interest which had been concealed or destroyed by clay exploitation prior to these horizons were 'lost' without record; the scale of this loss is unknown but current understanding of the archaeological potential of both rough ground and Anciently Enclosed Land suggests that it was probably very considerable (*cf* Herring and Smith 1991, 79). In addition to features pre-dating and unrelated to the clay industry, many sites associated with earlier phases of the industry itself will also have been lost to later activity.

The second limitation is the variable extent to which even relatively easily accessible data (from historic mapping, for example) has in fact been systematically and consistently incorporated into the record. This differs considerably from area to area and by theme and type of feature. In Cornwall, for example, many individual features associated with railways shown on historic mapping – for example, sidings, accommodation bridges and crossings – are recorded in the HER. Documented engine

houses have also generally been identified and added and the china-clay industry itself has been the focus of some systematic assessment, not least through the coverage of the St Austell clay district by Herring and Smith (1991). Comparable thematic enhancement exercises for individual monument types are not immediately evident in the Devon HER data. This is not to praise one and malign another, simply to recognise that there is no common horizon in the coverage which HERs offer.

Within the HERs there is also very substantial variation in the degree of detail with which features and groups of features have been recorded; this is perhaps an inevitable characteristic of datasets which have developed incrementally from widely differing sources of information over a period of time. (In Cornwall the earliest parish inventories, the initial source for data subsequently used to compile the HER, were produced in the late 1950s.) This variability can be illustrated with examples from within the current project area. Two roundhouses and an associated field system near Colvannick Tor on Bodmin Moor are represented in the Cornwall HER by four records, with a further single record for a separate group of four roundhouses, another for a medieval settlement and a further record for its associated enclosures. A settlement of 61 roundhouses on Brockabarrow Common, however, is represented by 62 individual records, with further entries for associated enclosures; a cluster of at least 12 roundhouses with associated enclosures at Louden, now partly covered by spoil from Stannon clay works, has a single HER record. Records in the Devon HER for prehistoric settlements on Lee Moor include a single entry for two enclosures with 13 roundhouses and 23 records for single or conjoined hut circles. The post-medieval hamlet of Old Pound in the St Austell clay district has 11 records for separate components; the nineteenth-century planned industrial village of Lee Moor on south-west Dartmoor has a single record for the terraced housing and another for a nonconformist chapel. A tight group of flooded pits created by twentieth century dredging of alluvial tin deposits on Goss Moor and mapped by the NMP is represented by ten separate HER records, whereas a linear series of at least 40 lodeback pits extending over almost 400m on Tregonning Hill has only a single record.

Several of the points outlined above can be demonstrated in the St Austell clay district. It was not an area which attracted the particular attention of antiquarians (Herring and Smith 1991, 5) and, while a few prehistoric monuments – Hensbarrow, the barrow known as Nine Lord's Land, Blue Barrow, Black Barrow and the Long Stone, for example – and medieval farms are referred to in historic accounts or appear on maps or in documentary sources (for instance, *West Briton*, 23 January 1852; Henderson 1935a; Holden *et al* 2010), the pre-clay industry archaeology of this upland area is generally not well documented. The parochial checklists compiled by Cornwall Archaeological Society (Beagrie 1972; Sheppard 1970a; 1970b; 1971; 1972; 1976) and the survey work across the area by Herring and Smith (1991) were carried out well after a substantial part of the area had already been lost to industrial activity. None of these initiatives was aimed at comprehensive recording of features already lost and only limited work has been undertaken subsequently to create HER records for such sites. Much of what has been added has been derived from features plotted by the NMP from air photographs taken in the immediate post-World War II period; historic mapping has generally not been used

To illustrate this point: the pit (now a mica dam) of Dubbers clay works, immediately east of Nanpean in the St Austell china-clay district, as mapped by the current project, covers an area of approximately 87 ha. The gazetteer and mapping accompanying Herring and Smith (1991) included no inventory points within this area but the Cornwall and Scilly HER currently records the following sites within it:

- Three extractive pits plotted from air photographs, one of which is shown on historic Ordnance Survey mapping as a shaft (Cornwall and Scilly HER MCO 48285).
- A general historical record for Dubbers clay works (MCO 25257).
- Two large cut features plotted from air photographs and interpreted as quarries (MCO 48271).

United Kingdom china-clay bearing grounds: mineral resource archaeological assessment

- Two extractive pits with associated spoil and a 'prospecting trench', identified from air photographs (MCO 48272).
- A post-medieval settlement recorded on the tithe map and noted as demolished during the 1990 survey work by Peter Herring but not included in the inventory in Herring and Smith (1991) (MCO 53569).

Additionally, NMP transcription of air photographs has been used to indicate the extent of past and current clay working as it existed in c 1946 (linked to the record noted above for Dubbers clay works) and to locate extensive traces of medieval or post-medieval tin streaming (MCO 48267). There are therefore six discrete HER records falling entirely or partly within this area, all referring to sites which are now 'lost'.

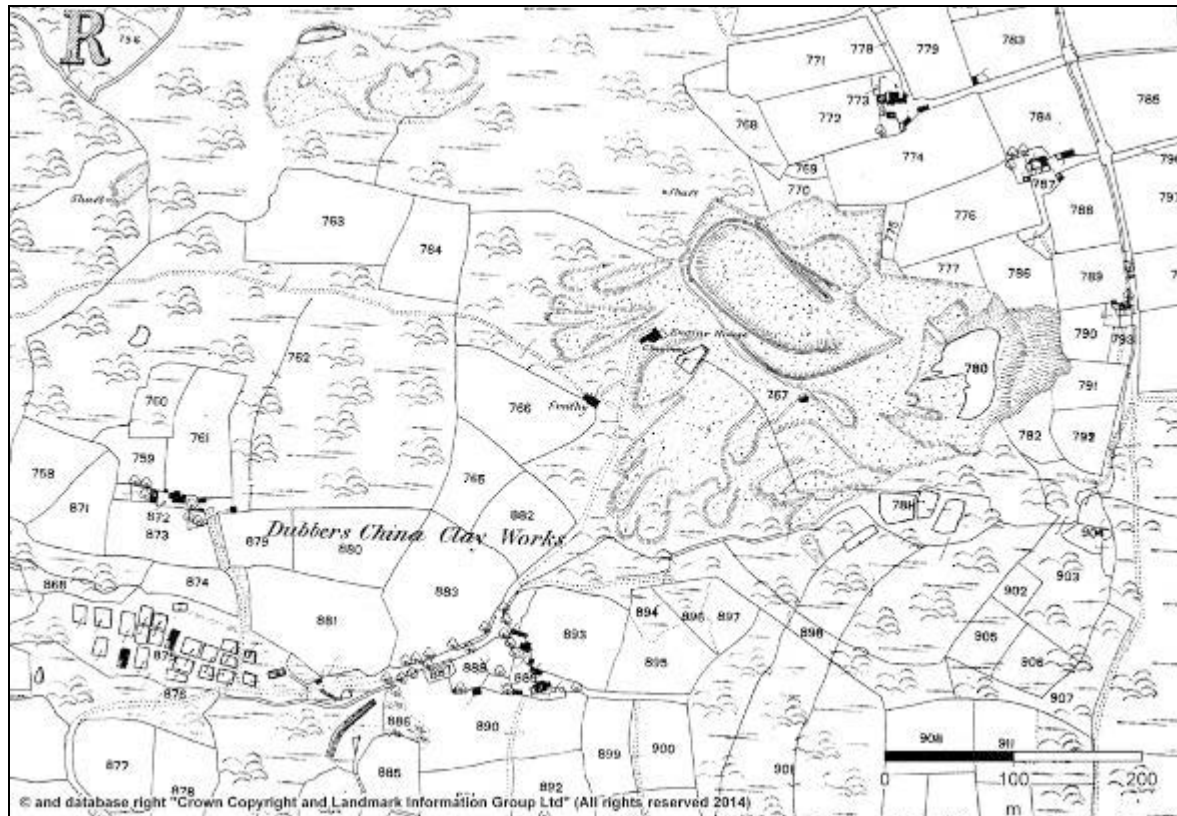


Figure 96 A late nineteenth-century upland rough ground landscape with post-medieval smallholdings, traces of earlier mineral working and expanding china-clay extraction and infrastructure, as recorded on the 1st edition Ordnance Survey 25in: 1 mile map of c 1880. Almost the whole of the area shown falls within the later Dubbers pit, itself now used as a mica dam.

However, a rapid review of the St Stephen-in-Brannel tithe map and 1st and 2nd edition Ordnance Survey 25in: 1 mile maps of c 1880 (Fig 96) and 1907 reveals a number of additional potential 'sites', all of which are of monument types frequently recorded by the HER in other locations and which therefore could well be the subjects of records here:

- The post-medieval settlement of Dubbers, comprising buildings and a field system.
- Five other unnamed settlements, all probably post-medieval smallholdings, with associated enclosures.
- An isolated shaft and spoil heap.

- An engine house with a chimney and shaft shown on the 1st edition Ordnance Survey 25in map, not apparently part of Dubbers clay works. Two further shafts are shown on the 2nd edition map.
- A pit and area of tipping shown as abandoned and therefore pre-dating the 1st edition Ordnance Survey 25in map (isolated from the Dubbers working).
- The developing Dubbers china-clay works. The 1st edition map shows an engine house, a smithy, a tramway and finger dumps, with a nearby shaft and a cluster of settling tanks and other clay-related features. The 2nd edition shows four engine houses, a smithy, processing facilities, a large pit with tramming to finger dumps, two skip-roads and a nascent sky-tip.
- A smallholding settlement with associated enclosures first shown on the 2nd edition 25in map.
- Two isolated shafts shown on the 2nd edition Ordnance Survey 25in map.
- An 'old clay pit' with associated spoil tipping first shown on the 2nd edition Ordnance Survey 25in map.
- Various leats associated with different phases of clay working.

The number of records for 'lost' sites within this one relatively small area, without extensive research beyond that of a brief interrogation of historic mapping, could therefore be at least quadrupled. Documentary sources and maps issued between the 2nd edition 25in map (c 1907) and current Ordnance Survey digital mapping (for example, the 1:10,560 and 1:10,000 Ordnance Survey mapping of the post-World War II period) are likely to have recorded significant later features relating to the clay industry and other sites may be apparent on more recent air photographs, making it probable that the number of records could be increased still further. Of course, no reckoning can be taken of standing and buried archaeology which was never recorded but which the former historic landscape character of the area as Upland Rough Ground suggests is likely to have been there.

4.1.6 Conclusion

The discussion and brief case studies above demonstrate that the total number of 'lost' heritage assets indicated by HER records across the project area is a gross underestimate of the real extent of loss. Beyond the question of the extent of loss, however, current perceptions of the historic environment also require that account is taken of the extent to which particular changes may impact or have impacted on the *settings* of significant features, even where these are not directly affected. This is clearly a substantial potential risk for a variety of monument types and features and has also very evidently already affected many surviving heritage assets (*cf.* for example, Figs 47-9). While much can be done using digital terrain modeling on GIS systems to assess potential impacts of proposed china-clay related development, recent experience with wind turbines and solar farms indicates that field assessment is also essential; vulnerability cannot be quantified simply from 'dots on maps'.

The limitations of HER data noted also make it clear that while HER records offer an indication of sites which may be at risk from future development, quantification alone does not provide a ready, reliable indicator of the overall density of monuments within areas: a roundhouse settlement, for example, may be represented by one record or sixty or more. This means that there is little solid foundation for comparison between areas. Again, quantification of the resource does not offer an indication of the potential impact of development on monuments through changes to their settings.

Given these limitations, understanding of the heritage resource potential of particular areas, both in terms of past loss and of the impact of future change, is almost certainly better derived from historic landscape characterisation (aided but not led by use of HER data) than from simple quantification of HER records.

5. Mitigation – past, present and future

5.1 Background

In the 1970s and 1980s a number of large archaeological fieldwork projects funded by the Department of the Environment (DoE) were carried out on sites that were threatened or about to be destroyed by china-clay extraction. These included a Middle Bronze Age settlement at Stannon, on Bodmin Moor (Mercer 1970), a standing stone and six barrows on the St Austell granite (Miles and Miles 1971; Miles 1975), a Romano-British enclosed settlement or 'round' at Trethurgy (Quinnell 2004) (Figs 57, 108), and a variety of prehistoric sites on Shaugh Moor, Dartmoor (Wainwright *et al* 1979; Wainwright and Smith 1980; Smith *et al* 1981; Balaam *et al* 1982). Excavation had previously been undertaken on a prehistoric stone row at risk from china-clay tipping at Cholwichtown, also on Dartmoor (Eogan 1964) (Fig 77). In all these cases, the loss of the sites was offset by a significant knowledge gain.

5.1.1 Cornwall

In Cornwall, in the period since the Herring and Smith (1991) survey was carried out, a key element of the context for mitigation of the archaeological resource has been the assumption that almost the whole of the 70 sq km of the Hensbarrow 'winning and working area' defined in 1974, other than the few 'island settlements' within it, was potentially at risk from future clay industry development (Herring and Smith 1991, 3, 4, 6). Herring and Smith (*ibid*, 82-4) highlighted 'preservation by record' (that is, excavation or other appropriate recording prior to destruction) as the key element of mitigation – there were few protective designations to direct potential alternative approaches – and recommended prescribed minimum mitigation measures for all sites potentially at risk.

In broad terms, the implementation of mitigation measures in the ensuing period was largely dependent on goodwill between those monitoring from CAU and its successors and the planning / operations managers on the clay companies' side. This arrangement became a little more formal following the 1995 Environment Act, which introduced the Review of Old Mineral Permissions (ROMP) procedures (Minerals Planning Guidance 14, 1995).

Prior to 1995 most of the clay companies had existing historic permissions to operate. The 1995 Act requires these old permissions to be periodically renewed and regularised. In 1998 what is often described as the 'overarching' ROMP was granted under decision 97/00965. This included a specifically worded condition for archaeology, requiring a 'code of practice' (CoP) to be developed between CAU and the Kaolin and Ball Clay Association (KABCA) and prescribed prior consultation between KABCA and CAU, procedures for agreeing assessment and evaluation, and the development and implementation of Written Schemes of Investigation (WSIs) for mitigation. This was finally agreed in 2010 (with the historic environment interest now represented by Historic Environment, Cornwall Council, following an update to accommodate PPS5 and inclusion of a requirement to be updated every two years. [PPS5 has now been supplanted by the National Planning Policy Framework (Department for Communities and Local Government 2012).]

The mitigation process has involved the submission of individual ROMP applications for each individual 'operational area'. In essence, the clay company produces a report detailing what they are planning to do in the area over a specified time period with an itemised list based on the 1991 Herring and Smith report and an undertaking to contact Historic Environment Planning Advice, Cornwall Council, to discuss mitigation as and when required. In some instances work has been commissioned by the operators to produce updated assessments of heritage assets within individual ROMP operating areas (for example, Cole 1999a; 1999b; 1999c; 2000; 2005; Roper and White 2005). Less certain are other operations undertaken by the companies which do not require specific applications and are sometimes outside the ROMP schemes. These are

technically covered by the CoP if they are within the relevant area but it tends to be a much more reactive process.



Figure 97 Part of the area of medieval farmland subject to controlled topsoil strip and recording at Pennance, near St Stephen-in-Brannel, in advance of tipping on the Scarcewater tip site. Two Middle Bronze Age roundhouses under excavation are visible, close to the top and right hand edge of the stripped area (cf Fig 103). (Photograph: Historic Environment, Cornwall Council: F65-025; 23 July 2004.)

Archaeological work in the post-1998 period has ranged from relatively small-scale building recording at a number of clay dry sites (for example, Berry 2003; Cole 2007; 2008; Taylor 2008; Bray 2011;), larger-scale recording of china-clay complexes – at Goonvean, for example (Deeks 2003; White 2005) – to extensive survey and excavation programmes on land to be impacted by expansion of clay operations. The most significant of these were a project including survey, excavation and environmental sampling on Stannon Down, Bodmin Moor (Jones 2004-5; 2006), including excavation of a number of Bronze Age ceremonial structures (Fig 107), and investigations over an area of 30 ha in advance of china-clay waste tipping at Scarcewater, near St Stephen-in-Brannel (Jones and Taylor 2010; 2013; this report, section 5.5.1) (Fig 97). The latter site revealed features dating from the Early Bronze Age to the post-medieval period, including several Middle Bronze Age roundhouses, an unusual Iron Age ceremonial site and Roman-period inhumations (Figs 103-5).

In Cornwall the overarching ROMP is currently under review. A request for an environmental impact scoping opinion was submitted by the clay operators in November 2012 with a subsequent continuing exchange of views between the operators on the one hand and Cornwall Council Historic Environment and English Heritage on the other over the degree to which the data presented by *The archaeology of the St Austell china clay area* (Herring and Smith 1991) continues to be an adequate basis for heritage protection in the china-clay working area. It has been emphasised that this report is now well over 20 years old and that the research on which it was

based was undertaken even longer ago. (The report itself made it clear that many aspects of the history and archaeology of the area remained obscure and that substantial future work was required (*ibid*, 77-8, 90-4).) The major changes which have occurred in information resources for the historic environment in the intervening period – important instances are historic landscape characterisation and comprehensive mapping of archaeological features from air photographs – together with fundamental shifts in understanding, methods of prospection and statutory and philosophical approaches to managing and conserving heritage, mean that there is a need for significant review of the baseline data on which future mitigation and management can be based (Dan Ratcliffe, Historic Environment, Cornwall Council, pers comm). Rapid technical change and the altered economic environment for the industry means that many significant sites for the modern industry have become obsolete or are no longer used; many of these could now potentially be regarded as heritage assets (Bowditch 2013). The broader context has also changed substantially through, for example, the provisions for heritage in the National Planning Policy Framework (NPPF) (Department for Communities and Local Government 2012). In this very different environment a full Environmental Impact Statement, including a comprehensive section on cultural heritage, is seen as an essential requirement for the overarching ROMP submission.

In this somewhat uncertain context there has been notably little historic environment mitigation work within the St Austell clay-working area in the recent past, the exception being some recording work carried out on disused clay dry chimneys prior to demolition in 2011-12 (for example, Stanier 2012).

5.1.2 Devon

Submissions were made in 1998 by the (then) two operating companies in respect of the three china-clay 'Mineral Sites' at Lee Moor, Shaugh Moor and Headon (Devon County Council 2004a, 9.3.3). The Devon Minerals Plan (*ibid*) noted that

'Whilst the submissions have been registered as being valid, the decision-making process is currently in abeyance pending the receipt of Environmental Statements. The operators are aware that the landscape, archaeology and nature conservation interests are particularly sensitive throughout the whole of the submission areas, not just within the National Park. After considering the detail of the environmental information to be submitted to the County Council, the operators have announced that they intend to voluntarily relinquish their rights to work minerals and tip quarry wastes on the three separate areas (known as Areas X, Y and Z) that remain within the Dartmoor National Park boundary. It is intended that the unconditional revocation will be formalised as part of the ROMP decision-making process.'

A closely similar summary of the position appears in an update to the Dartmoor National Park Minerals Local Plan (Dartmoor National Park Authority 2004).

Subsequently the Devon china-clay working area was the subject of an environmental statement (Sibelco UK and Imerys 2009) on proposals which included the merging of the major workings at Shaugh Lake and Lee Moor, requiring the destruction of an earlier prehistoric barrow known as Emmet's Post (Fig 92). The environmental statement provided an inventory of designations and known sites, a review of current understanding of the archaeology and historic development of the area, a synthesis and bibliography of past archaeological work and a summary of potential impacts from the proposed development, with recommendations for appropriate mitigation measures (*ibid*).

As a result of negotiations between Sibelco, Dartmoor National Park and Devon County Council (as the mineral planning authority) a single evaluation trench was opened on the Emmet's Post barrow in 2011 to gain an understanding of the monument; this revealed a carefully constructed prehistoric barrow (Hughes 2011). The barrow was fully excavated by Oxford Archaeology in September 2014 (Steve Reed, pers comm) (Fig 92). Other recent mitigation work on Dartmoor has included extensive survey and

targeted excavation of historic china-clay working features at Headon West Quarry, Sparkwell (Dyer 2014), recording on the line of the Lee Moor (Ridding Down) china-clay pipeline (Farnell 2009), which clarified the extent of Bronze Age and medieval field systems, and excavation of several Bronze Age ceremonial features on Headon Down (Dyer and Quinnell 2013).

5.1.3 Current mitigation policy and legislation

Current national planning legislation – the *National Planning Policy Framework* (Department for Communities and Local Government 2012) – provides the underpinning for mitigation through the planning system (section 1.4). The principles for mitigation methodology for mineral extraction are set out in *Mineral extraction and the historic environment* (English Heritage 2008a) and in *Mineral extraction and archaeology: a practice guide* (Mineral and Historic Environment Forum 2008). If planning permission for a proposed minerals development is granted, this may be subject to archaeological work being undertaken or a requirement to preserve *in situ* remains identified during pre-determination evaluation. Permission mitigation measures may include watching brief, excavation or 'strip, map and sample', followed by an archive stage, assessment, analysis and publication (English Heritage 2008a, 17-28).

5.2 The knowledge base

A key element in achieving appropriate approaches to mitigation is possession or acquisition of adequate information on the extent and character of the historic environment resource, a fundamental evidence base. This provides an underpinning for subsequent assessments of significance and the framing of policies for protection and future curation and management (*cf* PPS 5 policy HE2 (Department for Communities and Local Government 2010); National Heritage Protection Plan Framework measures 3-7 (English Heritage 2013)). In this context, the project which culminated in publication of *The archaeology of the St Austell china-clay area* (Herring and Smith 1991) itself represented a significant advance, providing both a much improved information base for the project area and a framework within which significance could be assessed, as well as outlining appropriate forms of mitigation.

Other projects have also produced substantial advances in understanding the historic environment within the present project area. Key among these have been the transcription of archaeological features from air photographs, carried out in Cornwall by the National Mapping Programme (NMP) (Young 2006) and for Dartmoor as part of the extensive survey work carried out by the Royal Commission for Historic Monuments England (RCHME) and subsequently by English Heritage. Historic Landscape Characterisation (HLC) in both Cornwall and Devon has also substantially added to understanding of historic landscape change and archaeological potential within the project area (Cornwall County Council 1996; Herring 1998a; Turner 2007).



Figure 98 A complex of settling tanks and leats or liquid clay channels on Greenbarrow Downs, near Temple, on Bodmin Moor. These were shown as 'disused' on the 1st edition Ordnance Survey 25in map of c 1880 and represent an early phase of china-clay working in the Temple area (Smith 2008b, 115). (Photograph: Historic Environment, Cornwall Council, F100-164; 16 October 2010.)

Extensive field survey projects carried out by the RCHME and subsequently English Heritage on Dartmoor, by Cornwall Archaeological Unit and RCHME on Bodmin Moor (Fig 98) and by Cornwall Archaeological Unit and the National Trust in West Penwith (Fig 46) all generated very substantial additions to previous knowledge of the historic environment resource in those areas, together with interpretations which substantially enhance understanding of significance. These projects are the subject of publications (Johnson and Rose 1994; Herring *et al* 2008; Newman 2011; Rose *et al*, in prep). Their archives have also been used to enhance the relevant Historic Environment Records, although incorporation of detailed survey data into HERs has not necessarily been complete.

Other survey initiatives have provided information on other parts of the project area. Early instances include work carried out on south-west Dartmoor by staff and students of the Department of Prehistory and Archaeology at the University of Sheffield in the 1970-80s (Fleming and Collis 1973; Gilbertson and Collis 1982; Collis 1983; Collis *et al* 1984). A full list of investigations carried out around the Lee Moor clay area is included in Sibelco UK and Imerys (2009) and extensive recording of the remains of the historic clay industry around Hemerdon is reported by Dyer (2014). On Bodmin Moor further survey work was carried out on Stannon Down as part of mitigation work in advance of the expansion of china-clay operations and subsequent re-profiling of tips (Herring 1998b; Jones 1998; 2001; 2004-5; 2006; Jones and Nowakowski 2000).

Examples of surveys in West Penwith which captured information on past china-clay working and the wider historic environment include archaeological assessments of Bartinney and Tredinney Common (Herring 1995), Baker's Pit (Taylor 2002) and Noon Digery (Rose 2008). Many other areas in West Penwith mapped with kaolin deposits but not subject to past china-clay exploitation have been covered by surveys (Rose *et al*, in prep).

Little work has been carried out in the Tregonning Hill area: only a single site-specific intervention is recorded, a Level 2 building survey, archaeological excavation and watching brief on a surviving brick kiln in the former Tregonning Hill brickworks (Sturgess 2014).

The St Austell china-clay district, in addition to the pioneering work carried out by Herring and Smith (1991), has seen a number of projects which have developed a more detailed and comprehensive understanding of the historic environment resource. These include surveys of the complex industrial remains in the Luxulyan valley (Smith 1988), of the china stone mills and other features in the Tregargus valley (Cole and Smith 2002), and of the Goonvean china-clay ROMPS area (Roper and White 2005). The proposal for a number of 'eco-communities' in the wider St Austell area prompted assessment of six substantial sites (Chandler *et al* 2008), all of which are significant in the history of the china-clay industry (Bowditch 2013).

A number of characterisation and historic building surveys have been carried out in settlements in the wider St Austell area, including assessments of Charlestown (Berry *et al* 1998), St Austell (Newell 2002) and a number of the smaller industrial settlements (Appendix 2).

The wider area around the St Austell granite, essentially that defined by the St Austell, St Blazey and China Clay Area Regeneration Plan outside the principal china-clay working area, has not been subject to any extensive assessment aimed at enhancing what is known of the historic environment resource, beyond the county-wide coverage provided by the National Mapping Programme and Historic Landscape Characterisation. There have been assessments of some specific sites in advance of proposed developments and renewable energy installations. Extensive investigations were also carried out on several phases of improvement to the A30 route running along the northern edge of the Hensbarrow clay district (Nowakowski 1994; Nowakowski and Johns, forthcoming; Johnston *et al* 1998-9; Clark and Foreman 2009) (Fig 62).

There have also been assessments within the wider project area around the St Austell clay area, covering wildlife reserves, a designed landscape and farms (for example, Herring 2000a; 2000b; Barnes *et al* nd). Overall, however, the significant potential which is implied by the Anciently Enclosed and Recently Enclosed Land historic landscape characterisations which cover much of this area is not matched in current levels of knowledge of the historic environment resource. A programme of research aimed at substantive enhancement of the HER would therefore be beneficial and timely in advance of the future development which the regeneration area status of the area implies. Such work would also have significant value in the 'place-making' element of planning such development.

5.3 Designations

A substantial number of heritage designations lie within the project area, including a total of 140 Scheduled Monuments, more than 530 Listed Buildings and two Registered Parks and Gardens (Table 4). A significant proportion of the Schedulings were made in the 1990s under the Monuments Protection Programme. These included prehistoric and medieval features within the china-clay project area on Bodmin Moor, principally along the Fowey valley, on western Craddock Moor and around Siblyback reservoir, and immediately beside the project area to the north west at Stannon and Loudon. Extensive Scheduling also took place on Dartmoor at this time. However, no features or landscapes associated with the china-clay industry in the Dartmoor National Park are currently designated (Jane Marchand, pers comm).

Historically, designation has not provided complete protection to heritage assets in china-clay areas but has underpinned some significant mitigation episodes. The Scheduled Cholwichtown stone row on Dartmoor, for example, was excavated prior to burial of the site under clay waste (Eogan 1964) (Fig 77), as was the Longstone on the St Austell granite (Miles and Miles 1971). The Scheduled Littlejohns Barrow was recorded and to some extent reinstated after being damaged (Johns and Herring 1994),

as was Emmet's Post barrow (Bayer 2000). Recording was required prior to demolition of the Grade II Listed Belowda engine house at Goonvean (Deeks 2003).

Proposed removal of the Scheduled Emmet's Post barrow and part of Crownhill Down barrow group has been a significant factor in the process of determining further development of the Shaugh Lake and Lee Moor clay workings on south-west Dartmoor (Jon Humble, pers comm; Devon County Council, Development Committee Report PTE 13/27, 17 April 2013). The barrow was finally excavated in September 2014 (Fig 92).



Figure 99 The remains of an overshot water wheel and launder at Big Wheel china stone mill in the Tregargus valley, photographed in 2006. The complex, built about 1898, is a Scheduled Monument and a Grade II Listed Building (Cole and Smith 2002). (Photograph: Historic Environment, Cornwall Council.)

Herring and Smith (1991) proposed a number of buildings, industrial complexes and historic and archaeological features in the St Austell clay area for protection through designation (*ibid*, 85-6, Appendix 6.5). Some of those on this list were subsequently designated. The hillfort known as Prideaux Camp (Fig 64), for example, is now a Scheduled Monument (National Heritage List no 1006663), as is St Michael's chapel on Roche Rock (National Heritage List no 1006664). Three round barrows and a holy well located north of Roche churchtown and now Scheduled (National Heritage List nos 1004231, 1004342) lie within the current project area but were outside the boundary of the Herring and Smith (1991) study.

Several sites recommended for designation by Herring and Smith (1991) have not been designated; examples include the hillfort in which St Dennis church is located (Fig 60) and rounds at Restineas and Rosemellyn. Belowda engine house, Goonvean, was Listed Grade II but has subsequently been demolished (Deeks 2003).

Significant designations for the china-clay industry itself include a 1.2 ha Scheduled area at Wheal Martyn china-clay museum (National Heritage List 1003265); this was included on the Heritage at Risk Register for 2013, with its condition described as generally satisfactory but with significant localised problems and the principal vulnerability being to development. A china-stone mill in the Tregargus valley near St

Stephen-in-Brannel is Scheduled (National Heritage List 1003101) and also Grade II Listed (National Heritage List 1327465) (Fig 99). In west Cornwall the Tredinney clayworks, in St Buryan, forms part of a Scheduled area which also includes a barrow, prehistoric settlement remains and prehistoric and medieval field systems (National Heritage List 1007271) (Fig 46).



Figure 100 The Grade II Listed Goonvean engine house (centre right), built in 1910, in its wider setting of the modern china-clay working landscape. (Photograph: Historic Environment, Cornwall Council, F82-023; 16 April 2008.)*

Several pan kilns and other clay industry features are Listed. These include Wenford dries at Wenfordbridge, on the edge of Bodmin Moor (National Heritage List 1391566), Wheal Rose clay works near Bugle (National Heritage List 1311331), Great Wheal Prosper clay works at Carbis, near Roche (National Heritage List 1158679), a china-clay works near Luxulyan station (National Heritage List 1144211) and Carlyon Farm dry (National Heritage List 1391523; Taylor 2008) (Fig 78), notable as the largest dry ever built, all of which are Listed Grade II. Rosemellyn china-clay works engine house near Carbis is Listed Grade II (National Heritage List 1311353). The important early twentieth-century engine house at Goonvean is Listed Grade II* (National Heritage List 1136944) (Fig 100).

A well-preserved and visually spectacular small kiln complex including a surviving stack at Heneward, on the edge of Bodmin Moor, was considered for designation in 2011 (National Heritage List 1541559) (Fig 101). It was not recommended for designation on the grounds that the visible remains are primarily of twentieth-century date 'and would therefore be expected to offer very considerable qualities of architectural, technological, or historical interest if it were to be recommended for listing, and a high level of intactness would usually be expected' (www.pastscape.org.uk/hob.aspx?hob_id=1541559#aRt).

A number of other features closely associated with the clay industry are Listed, including the quays and inner basin at the historic Charlestown harbour (National Heritage List 1327290) (Fig 13) and the engine sheds, stack and turntable of the Cornwall Minerals Railway at St Blazey (National Heritage List 1289905) (Fig 15), both

of which are Grade II*. The beehive kilns and stack of Carbis Brick and Tile works, immediately adjacent to Great Wheal Prosper clay works (National Heritage List 1158648), are Listed Grade II.



Fig 101 The surviving clay kiln and stack at Heneward, Bodmin Moor, part of a small working begun in the 1870s but substantially redeveloped during subsequent phases in 1913 and then during the 1920s and 1930s. The remains were assessed for Listing in 2011 but 'failed to meet the required criteria' (Pastscape record: Heneward china-clay works). (Photograph: Graeme Kirkham.)

The National Planning Policy Framework (Department for Communities and Local Government 2012) introduced a significant change in the degree to which designation is perceived as the primary indicator of significance for heritage assets, stating that 'non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets.' In this context the principal requirement is appropriate assessment of sites and features, particularly those regarded as at risk, to assess their significance.

5.4 Approaches to protecting wider archaeological landscapes

Herring and Smith (1991) proposed several blocks of 'archaeologically or historically very important landscape' for protection (Table 7). These areas were formerly designated as Areas of Great Historic Value and shown on the map of the St Austell china-clay area accompanying the 1998 Minerals Local Plan (Cornwall County Council 1998, inset 1a).

The principle of indicating substantial areas as meriting protection has been followed in the creation of Premier Archaeological Landscapes (PALs) on Bodmin Moor and within the Dartmoor National Park, primarily as a means of prioritising the historic environment in consideration of land management measures. On Bodmin Moor the

whole of the Glyn Valley clay complex falls within a PAL, as do the Burnt Heath works and the finger dumps and part of the clay pit at Blacktor Downs, the latter almost certainly included because of proximity to the large group of Scheduled prehistoric roundhouses immediately adjacent (Figs 20, 26, 35, 102). The total extent of the PALs incorporating these monuments is 224 ha, although the actual area occupied by clay-working features is considerably smaller. The large area of tipping at Stannon clay works lies immediately adjacent to a PAL (Fig 49). In Devon more than 120 ha of Shaugh Moor and Wotter Common has been designated as a PAL by the Dartmoor National Park Authority (Dartmoor National Park Authority website: PALs). The area lies adjacent to china-clay working on its north and eastern sides. However, Wigford Down is the only Dartmoor PAL to include clay workings within its boundary (Jane Marchand, pers comm).

Table 7 Archaeologically or historically very important landscape areas (Herring and Smith 1991)

Area proposed for protection	Principal archaeological and historic features	Extent of change since 1991
St Stephen's Beacon (Herring and Smith 1991, map 15)	Prehistoric (possibly Neolithic) defended enclosure; flint scatter; a round; round cairn; medieval pasture boundary; two buildings; a beacon site; disused china-clay workings; tin mine; surface mining remains; roadstone quarry.	No known impact from clay working since 1991.
Hensbarrow Downs (Herring and Smith 1991, map 16)	Hensbarrow and two other barrows; probable prehistoric pasture boundary; surface mining remains (including the 'best preserved eluvial streamworks in the ancient Blackmore stannary'; leats and reservoirs; an early clay working; medieval holloways; medieval hedge; boundstones; three nineteenth-century cottages.	Of the area of approximately 80.5 ha proposed by Herring and Smith, approximately 13 ha has been lost to clay operations (predominantly waste tipping) (Fig 47, 55, 59) and a further 3.7 ha to clay infrastructure and communications masts, representing approximately 21 per cent loss of the defined area of archaeological and historic interest. The settings of the Scheduled Hensbarrow Bronze Age cairn and other features have been substantially compromised.
Gover valley (Herring and Smith 1991, map 17)	Historic china-clay workings; four medieval hamlets; a medieval farm; medieval fields systems including a block of ridge and furrow; several cottages; a blowing house site; a mine site	A strip at the northern end covering less than 2 ha of the area of 245 ha has been affected by tipping, representing less than one per cent of the whole.
Goonabarn / Tregargus Valley (Herring and Smith 1991, map 18)	Historically important china-stone mills with associated quarries and leat systems.	No known impact from clay working since 1991.

*United Kingdom china-clay bearing grounds: mineral resource
archaeological assessment*

Area proposed for protection	Principal archaeological and historic features	Extent of change since 1991
Trethowel Valley (Herring and Smith 1991, map 19)	Historic china-clay workings; route of former railway; medieval hamlets; mills and medieval field systems.	Site of former Bojea pan kiln complex has been redeveloped as industrial estate.
St Dennis Consols and Gothers (Herring and Smith 1991, map 20)	Area of upland china-clay working, including engine houses and pan kiln complex	No known impact from clay working since 1991.
Carn Grey (Herring and Smith 1991, map 21)	Partly historic rough ground; possible Bronze Age barrow; prehistoric field system; possible prehistoric roundhouse and enclosure; medieval pasture boundaries; stone-splitting; granite quarries; historic china-clay works.	No known impact from clay working since 1991.
Treskilling, Lestoon and Tretharrup (Herring and Smith 1991, map 22)	Block of medieval agricultural landscape with two, possibly three, settlements with fossilized stripfield systems; 'best preserved relict medieval stripfield system in central southern Cornwall' on Treskilling Downs; probable medieval alluvial streamworks.	No known impact from clay working since 1991.
Bodwen, Higher Menadew and Lower Menadue (Herring and Smith 1991, map 23)	Medieval agricultural landscape including three farm hamlets with fossilised stripfield systems; possible prehistoric roundhouse; possible round site; indications of sites of a standing stone, barrow and medieval crosses; medieval eluvial streamworks; bone mill; various small features.	No known impact from clay working since 1991.
Trerice Bridge (Herring and Smith 1991, map 24)	A small area (approximately 2.5 ha) including Wheal Remfry brickworks; stamping mill; ruined small farm; fragments of two medieval field systems.	Much of the area has been affected by construction of a new road and regrading, with a large portion of the brickworks site buried in sand.



Figure 102 The Glynn Valley china-clay works falls within an area of Bodmin Moor mapped as a 'Premier Archaeological Landscape' (PAL), in which the historic environment is prioritised in considerations of land use and management. (Photograph: Graeme Kirkham.)

5.5 Current mitigation

Current approaches to mitigation are outlined in section 5.1 above. In practice these range from relatively small projects to record historic features such as clay dries, engine houses or stacks in advance of development or demolition (for example, Taylor 2008; Deeks 2003; Stanier 2012), to large excavation projects.

5.5.1 Scarcewater tip: a case study

Of the latter, the most substantial in the recent past was that carried out at Pennance, St Stephen-in-Brannel, in advance of development of the new Scarcewater pit (Jones and Taylor 2010; 2013) (Figs 97, 103-5). During this work, undertaken between 2000 and 2004, 16 ha of geophysical survey were carried out followed by excavation of 18 evaluation trenches. All 30 ha of the tip area were subject to controlled topsoil stripping and excavation of significant features.

The work identified the following significant features:

- A Beaker-period pit containing sherds of Beaker pottery, flint and macrofossil evidence, with a radiocarbon determination on charcoal of 2310-2130 cal BC (Wk-21486). Further Beaker material was recovered nearby.
- A pit group containing Early Bronze Age pottery and worked flint.
- A Middle Bronze Age settlement with three roundhouses and a number of pit groups dating to the period 1500-1100 BC (Fig 103). The roundhouses provided evidence of construction and occupation but also of complex processes of renewal and of final abandonment, together with some environmental evidence. The pit groups incorporated substantial quantities of artefacts and some at least may represent additional structures.
- A probable barrow containing a structured deposit of a pot with charcoal and visually distinctive stones. A radiocarbon date of 1510-1390 cal BC (Wk-21460) is unusually late for a barrow in Cornwall.

*United Kingdom china-clay bearing grounds: mineral resource
archaeological assessment*

- A Late Bronze Age roundhouse set within a palisaded enclosure with associated field boundaries. The enclosure provided a radiocarbon date of 1090-890 cal BC (Wk-21465).
- A D-shaped enclosure with an Early Iron Age date.
- An unusual ditched cairn structure with finds dated to the Middle Iron Age (Fig 104).
- A Romano-British settlement and field system, the latter extending over at least 9 ha and with several phases.
- Two, possibly three, burials dated to the Roman period close to the settlement, one of them in a stone-lined cist grave (Fig 105) and another a possible decapitation inhumation with hobnails. These are the first Roman-period inhumations identified in Cornwall.
- Medieval and post-medieval field systems.
- Post-medieval mining remains.
- A circular post-medieval structure, possibly a windmill base or a powder house.
- A variety of unphased features.

Additionally, the excavations recovered a substantial assemblage of prehistoric and Roman period pottery, lithics (including a collection of Middle Bronze Age domestic stonework), metalwork and a significant palaeoenvironmental dataset.



Figure 103 Middle Bronze Age roundhouses 1500 (foreground) and 1250 at Pennance, St Stephen-in-Brannel, excavated in advance of the creation of a new tip at Scarcewater. Projects such as this offer important opportunities to examine buried archaeology over substantial areas. This major excavation confirmed the high potential of Anciently Enclosed Land for the survival of well-preserved prehistoric settlement remains. (Photograph: Cornwall Archaeological Unit, Cornwall Council.)



Figure 104 Post-excavation view of a highly unusual cairn enclosed by a penannular ditch. A pot of the South West Decorated style was recovered from the ditch, which also produced a radiocarbon date of 410-350 cal BC (Jones and Taylor 2010, 40). (Photograph: Cornwall Archaeological Unit, Cornwall Council.)

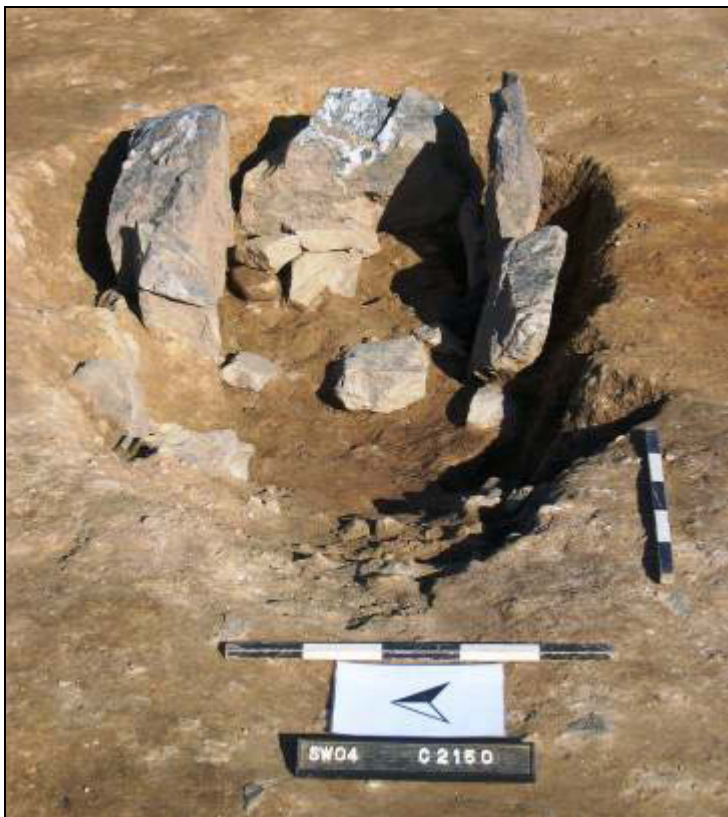


Figure 105 A Roman-period cist grave excavated during archaeological work at Scarcewater tip. The two inhumations from the site are the first recorded for the Romano-British period in Cornwall (Jones and Taylor 2010, 88). (Photograph: Cornwall Archaeological Unit, Cornwall Council.)

The knowledge gain from the Scarcewater tip excavations was substantial, and more particularly significant because it derived from an extensive lowland context in Cornwall. In addition to the very important gains which were achieved in understanding of the occupation and exploitation of the landscape from the Early Bronze Age to the post-medieval and modern periods, the work provided an important further demonstration of the high archaeological potential of Cornwall's Anciently Enclosed Land historic landscape character Type.

5.6 Future mitigation

The practical aspects of mitigation in the near future are likely to depend to a great extent on the further progress of the planning process concerning ROMPs. In Cornwall a key determinant is likely to be the extent to which a full assessment of cultural heritage is incorporated into an associated Environmental Impact Statement; in Devon the process is considerably further advanced but detailed aspects of plans for further china-clay development at Lee Moor are still to be resolved (Jon Humble, pers comm).

The wider context for mitigation has been substantially altered by changes introduced by the National Planning Policy Framework (NPPF) (Department for Communities and Local Government 2012). This is particularly evident in key conceptual elements of the framework including re-statement of a presumption for conservation of heritage assets (para 132), consideration of the impact of proposed changes on non-designated assets (135) and the principle that non-designated assets which are of equivalent significance to Scheduled Monuments should be considered subject to the same policies as designated heritage assets (139).



Figure 106 Great Carclaze (Baal) pit. The site was renowned in the eighteenth and nineteenth centuries as an unusual open-cast tin working on a vast scale and subsequently became a major china-clay operation. It is currently one of the six proposed 'eco-community' sites in the St Austell china-clay area, with proposals for significant housing and industrial development in and around the pit. Some development (foreground) has already taken place on the former Carclaze Downs, alongside the enhanced through route of the St Austell North-East Distributor Road. (Photograph: Historic Environment, Cornwall Council, F82-079; 16 April 2008.)

These principles will support continuing mitigation through the planning process and much of the activity which takes place in the foreseeable future is likely to be similar to what occurs now, with a mix of, for example, recording of historic structures, assessment and appropriate recording of standing and buried remains, agreed exclusion of certain sites from development and designation of key assets.

Less clear, however, is how the modern china-clay industry may be assessed. This is acknowledged to be of national and international importance (Devon County Council 2004, 9.1.1; Cornwall Council 2013, 3.2.4) and it is and has been of very substantial economic and social importance in the south-west region, particularly in Cornwall. Given this importance it is clear that the physical evidence of the modern industry – deep pits, extensive tip complexes, developed infrastructure and complex technology – already has cultural significance and should be recognised henceforth as representing important ‘heritage assets’.

A concern is that modern china-clay complexes recently abandoned or to become so in the future may be at risk of being stripped, dismantled and / or demolished as a matter of operational policy, not least for health and safety reasons and to reduce potential maintenance costs. Such actions would in one sense simply represent operational processes within the industry but from a historic environment perspective could potentially see the loss of very significant features without appropriate mitigation. Important characterising features of clay areas such as the very large modern pits and tip complexes in any case exist within the context of a dynamic industry in which normal operations include the backfilling of pits and secondary working of tipped aggregates. Re-profiling and re-vegetation of industrial areas are now part of the industrial process (above).

This point about the vulnerability of significant features of the modern industry was highlighted in a 2008 assessment of the six sites proposed for ‘eco-communities in the St Austell china-clay district (Chandler *et al* 2008) (Figs 5, 12, 33, 106). This acknowledged the widespread remains of historic features around the proposed development sites, but observed that

‘[U]pon reflection, however, the greatest industrial archaeological potential lies in the modern industry. Once an industrial site has closed it becomes ‘archaeology’ which should be recorded before equipment and structures are removed or demolished. With the exception of West Carclaze and perhaps Drinnick / Nanpean, the sites are on a huge scale. There are impressively large structures either still partly in use or recently redundant at Par Harbour, Blackpool Refinery and Dryers, and at Goonbarrow Refinery. The archaeology of the modern industry therefore poses considerable problems’ (Chandler *et al* 2008, 17).

Appropriate future mitigation, therefore, requires development of a strategy which gives significance to features associated with the modern china-clay industry and provides a basis for appropriate measures to record, and in particular cases to conserve, the more important of the heritage assets associated with it.

6. Discussion

The analyses presented in section 4 of this report attempted to generate statistical indications of the past and potential future impacts of the china-clay industry on the historic environment. It is clear from the examination made there of the datasets on which the calculations were based, however, that such approaches do not provide an adequate basis for such assessments. In particular, the data are not comprehensive or consistent enough for coherent and reliable conclusions to be derived. This is particularly the case in areas which have been extensively exploited over a long period: a brief case study on the present site of Dubbers pit in the St Austell clay district suggested that the numbers of 'lost' sites indicated by the HER could realistically be increased by several orders of magnitude. The actual extent of past loss is almost certainly unknowable but it is important that HER data are not used in a simplistic manner to attempt a proxy measurement. Without an appreciation of the implications of the limitations of these data there is a real risk of underestimating the extent of past loss and damage to the historic environment and thus potentially of underplaying its vulnerability to future development.

It is also clear that HER data, as they exist, provide only a limited capability for predicting in quantitative terms the extent and significance of heritage assets which may be at risk within any specified area. Distributions of 'dots on the map' are not an adequate indicator of the extent or importance of what is present, besides which, in many areas, what is present is not currently adequately represented in the record.

6.1 Using historic landscape characterisation (HLC)

The qualitative and attribute-based approach offered by historic landscape characterisation presents a complementary perspective to attempts at quantitative analysis of past harm or future risk. Historic landscape characterisation does not offer any notionally precise statistical conclusions but is solidly based in current understanding of the broader historic environment of Cornwall and Devon. It is also comprehensive in its coverage in a way that datasets dealing with specific heritage assets are unlikely to be.

Thus, for example, data on the extent and range of the heritage assets which formerly existed on the substantial area of Upland Rough Ground on the St Austell granite prior to the development of the china-clay industry are extremely limited. Some indication of what may have existed is given by the few important survivals of prehistoric features such as St Stephen's Beacon, Hensbarrow and St Dennis hillfort (Figs 43, 47, 60), evidence from sites excavated in advance of destruction such as the barrows at Watch Hill and Caerloggas (Miles and Miles 1971; Miles 1975; Jones and Quinnell 2012) and the range of sites of all periods identified by survey (Herring and Smith 1991). Identification of this area as formerly of the upland rough ground historic landscape character Type, however, enables a much richer perspective to be gained. Work on areas of rough ground elsewhere in Cornwall – Bodmin Moor, West Penwith – and on Dartmoor indicates the wealth of the characteristic historic environment resource on this historic landscape Type (Johnson and Rose 1994; Herring *et al* 2008; Rose *et al*, in prep; Newman 2011); this may include important remains of earlier phases of the china-clay industry itself (for example, Taylor 2002; Smith 2008b; Dyer 2014). Both the degree to which there have been almost certain past losses on a very substantial scale, and the potential for the survival of significant but currently unidentified assets, are readily apparent. This approach – using understanding gained from other areas to illuminate the otherwise truncated perception available – was strongly in evidence in *The archaeology of the St Austell china clay area* (Herring and Smith 1991), well before the first Cornwall-wide historic landscape characterisation was carried out in 1994 (Cornwall County Council 1996), with evidence derived from other parts of Cornwall used both to enable an historic narrative for landscape change and to delineate the characteristic historic environment of the study area.



Fig 107 Stannon site 11, a Bronze Age cairn on Bodmin Moor with an unusual stony 'tail' oriented towards Rough Tor (cf Fig 48), partly damaged before excavation by expansion of the Stannon clay works mica dam. Information from interventions such as this indicates the extent to which comparably rich sites may have been lost elsewhere on rough ground subject to china-clay operations, or which may potentially survive in operational areas which have not been subject to archaeological scrutiny. (Photograph: Cornwall Archaeological Unit, Cornwall Council.)

Similarly, historic mapping indicates the considerable extent to which medieval farm settlements (*inter alia*) have been lost to past expansion of the clay industry. In most instances, however, little more is known of the former historic environment resource in such areas. Characterisation as former Anciently Enclosed Land, however, considerably enhances perceptions of the probable impact of development on this historic landscape Type because of understanding gained of its archaeological potential through

investigations on Anciently Enclosed Land elsewhere in lowland Cornwall. This includes, for example, very substantial numbers of later prehistoric and Roman-period enclosures identified from air photographs (Young 2012) and a variety of other features located through walkover surveys, geophysics (Fig 51) and historic building analysis and recording. Excavations of sites at Trethurgy (Quinnell 2004), Scarcewater (Jones and Taylor 2010; this report, section 5.5.1) and the St Austell North-East Distributor Road (Johns 2008), all on Anciently Enclosed Land within the immediate vicinity of the St Austell granite, give an indication of the potential for significant buried archaeology in this historic landscape Type. This is an important consideration not only in areas immediately adjacent to clay districts but also over much of the extent of the area covered by the St Austell, St Blazey and China Clay Area Regeneration Plan (*cf* Fig 33).

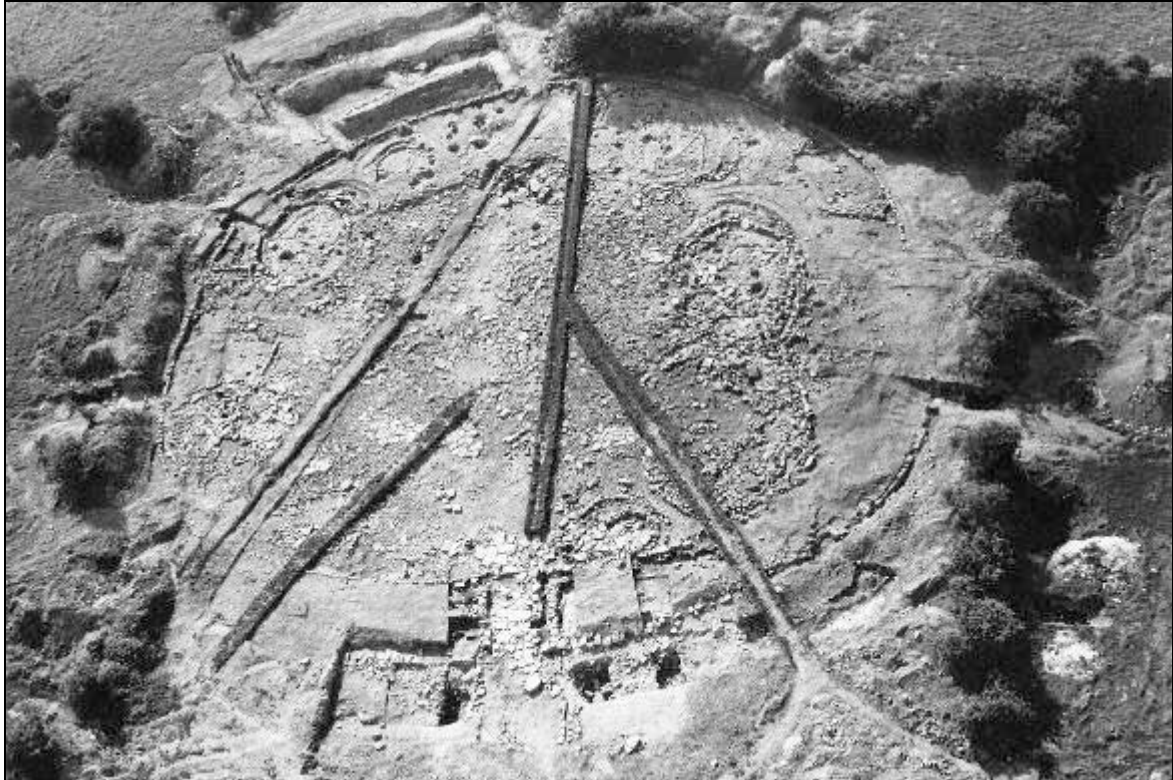


Fig 108 Excavation of the Roman-period enclosed settlement at Trethurgy in 1973, in advance of development of a china-clay waste tip. It remains the only full excavation of an enclosed settlement site of this period to have taken place in Cornwall. (Photograph: Royal Naval Air Station Culdrose; originally published in Quinnell (2004).)

The characterisation approach is also useful in addressing other historic landscape Types where the historic environment record may be deficient in indicating the real extent of heritage assets. Particular examples include the Settlement and Industrial Types.

A number of settlements in the St Austell china-clay area are acknowledged to be deficient in terms of levels of formal designation of the built environment and the presence of Conservation Areas and associated planning guidance. Lee Moor in Devon, despite its significance as an early nineteenth-century planned industrial settlement, is similarly lacking.

Characterisation studies which have been undertaken in the St Austell region on settlements such as St Dennis, Stenalees, Bugle, Roche, Foxhole and Nanpean, make it clear that they are highly distinctive and that there is much of quality and significance within them (Gillard and Cahill Partnership 2004a; Cahill Partnership and Historic Environment Service 2004a; 2004b; 2005a; 2005b; 2005c) (Figs 83-5, 109). A key

component of their character is the degree to which their development as industrial settlements occurred during the twentieth century. Approaching these settlements as a discrete subset of the broader Settlement character Type in Cornwall and recognising their close association with the historic china-clay industry offers a perspective for assessing their significance as elements of the wider historic environment in the project area, as well as emphasising the need for reappraisal of levels of designation and planning protection within them.



Fig 109 The former Stenalees Institute was highlighted in the Cornwall Industrial Settlement Initiative (CISI) report on Stenalees: '... one of the most interesting buildings in the whole area. It is a neat, well-designed little building standing in a prominent position at the central junction in the village, made of concrete blocks, but richly decorated with cast patterns of rustication, fleur-de-lys, and lettering – an example of what could be achieved with what is usually considered a poor-quality facing material' (Cahill Partnership and Historic Environment Service 2005, 21-2). The building has subsequently been altered for domestic use. (Photograph: Graeme Kirkham.)

The Industrial historic landscape character Type, particularly those areas which were active until comparatively recently, typically has relatively few historic environment records or designations attached to it. It is frequently described as 'despoiled and degraded' (for example, Cornwall Council 2012b) and is the focus of major initiatives to reshape and re-vegetate areas no longer in use and potentially to dispose of waste as secondary aggregates (above, sections 2.6, 3.3.6.1.1). At the same time, the Industrial Type carries high evidential and historical value for past ways of working in the china-clay industry; again, it is worth pointing out that this is acknowledged to be of national and international importance (Devon County Council 2004, 9.1.1; Cornwall Council 2013, 3.2.4). The attention given to Industrial landscapes by a significant number of artists and photographers also emphasises their cultural and aesthetic value

(Appendix 1; Fig 72) and there is clear pride in and affection for the visual iconography and monuments of the industry in local communities in clay areas (Smith 2008a; Mansfield 2012; Wildworks 2008) (Fig 110).

These latter qualities can be seen to have particular significance in the context of the European Landscape Convention (Council of Europe 2000) in relation to protected sites and landscapes. These may include 'everyday or degraded landscapes'. The Convention includes, *inter alia*, definitions of 'landscape quality objective' as

'the formulation by the competent public authorities of the aspirations of the public with regard to the landscape features of their surroundings' (Article 1c),

and of 'landscape protection' as

'actions to conserve and maintain the significant or characteristic features of a landscape, justified by its heritage value derived from its natural configuration and/or from human activity' (Article 1d).

Article 5 of the Convention commits member states to 'establish and implement landscape policies aimed at landscape protection, management and planning' (Article 5b). The Article also provides for parties to the convention to

'establish procedures for the participation of the general public, local and regional authorities, and other parties with an interest in the definition and implementation of the landscape policies mentioned in paragraph b above' (Article 5c) ; and

'integrate landscape into its regional and town planning policies and in its cultural, environmental, agricultural, social and economic policies, as well as in any other policies with possible direct or indirect impact on landscape' (Article 5d).

Article 6 lays out specific measures to be undertaken. These include awareness raising 'among the civil society, private organisations, and public authorities of the value of landscapes, their role and changes to them (Article 6A). Further, there is provision for processes of identification and assessment of landscapes. Article 6C.1 states that:

'With the active participation of the interested parties, as stipulated in Article 5.c, and with a view to improving knowledge of its landscapes, each Party undertakes:

- a
 - i to identify its own landscapes throughout its territory;
 - ii to analyse their characteristics and the forces and pressures transforming them;
 - iii to take note of changes;
- b to assess the landscapes thus identified, taking into account the particular values assigned to them by the interested parties and the population concerned.'

In this context it is evident that the china-clay Industrial historic landscape character Type has a developed iconography in terms of social representations (art, literature, popular culture) and is also an important component of the 'minor heritage' of local communities. The Council of Europe policy objectives which accompany the European Landscape Convention note that a factor which may need to be taken account of in the process of assessing landscapes is the 'current cultural values that are described by specialists, but not yet integrated by populations', noting industrial archaeology as a specific example (Council of Europe 2000, 67).

6.1.1 Conclusion

Examples of the insights provided by historic landscape characterisation could be multiplied from other Types but the principle is clear: understanding of both the historic environment which has been lost and the significance of that which may be at risk is made considerably clearer by an analysis based on historic landscape character. The approach also has the merit of assessing an industry which exists on a landscape scale with a landscape-derived tool, using units of analysis based on historically coherent areas rather than numerous individual points.

Historic landscape character therefore offers a particularly useful starting point in considering future development and the overall management of change. It provides a reliable guide to archaeological potential, otherwise problematic because of the limitations of the data resource, and recent developments have enhanced its value in considering the sensitivity of various historic landscape character Types to change (Peter Herring, pers comm). It also offers a useful perspective on the forms of mitigation which may be most appropriate in managing such change.



Fig 110 Two sky-tips on Trelavour Downs viewed from St Dennis church. The evaluation report on a community arts project in St Dennis in 2008 observed that there is 'an intense love of the landscape as shaped by industry. The two clay tips that stand above St Dennis, affectionately known as "Flatty and Pointy", are seen as a meaningful landmark. There is a real fear they might disappear. . .' (Wildworks 2008, 16). (Photograph: Graeme Kirkham.)

6.2 Mitigation

Three aspects of mitigation are discussed here: the knowledge base, designation and the challenges of mitigation for the modern china-clay industry.

6.2.1 Improving the knowledge base

The knowledge base provides the essential foundation for mitigation: without information on the historic environment resource which may be present in an area, and insights into its possible significance, it is difficult if not impossible to frame appropriate strategies and resource adequate interventions. It has been proposed above that historic landscape characterisation offers a particularly useful approach to understanding the potential extent and form of heritage assets, past and present, not least because of the limitations of HER site- and feature-specific data. This is not to deride or malign HERs: they represent an enormous and continuing achievement in capturing substantial quantities of information from diverse sources, information which itself underpins and puts flesh on the bones of characterisation.

As has been demonstrated, the data held by HERs could be substantially expanded through, for example, consistent capture of information from historic mapping or – particularly in the present case of the china-clay industry – through plotting and recording post-World War II industrial features from air photographs. Existing data could be amended so that individual records more closely mirror the extent of the heritage asset or assets they represent; representation of records as polygons rather than points on GIS mapping would offer a much improved indicator of the extent of assets. There is also much potential in consistently incorporating into HERs datasets from 'grey literature'. (Grey literature data are often incorporated only in the form of an 'event record', which notes that a particular area has been the subject of an investigation but does not detail what was identified.)



Fig 111 The dynamic character of the clay industry landscape is evident in the backfilling with waste of the former Lower Ninestones (left) and Penhale pits, the re-profiling and re-vegetation of former tips in the foreground and active working at Gunheath and other sites in the distance. (Photograph: Historic Environment, Cornwall Council: F67-029; 8 June 2005.)

While there have been significant advances in understanding the resource in particular areas through more or less detailed survey processes (section 5.2), there are important omissions in coverage, remediation of which would improve understanding and provide a better basis for future management and decision-making. The Tregonning Hill area, for example, despite its importance as the location of the earliest china-clay working in Cornwall, has not been subject to survey. The wider area of lowland Cornwall falling within the St Austell, St Blazey and China Clay Area Regeneration Plan, despite being the focus for future regeneration effort, has not been subject to any form of additional investigation aimed at enhancing understanding of the heritage resource.

In the St Austell china-clay district, Herring and Smith (1991, 9, 64, 66) emphasised that their rapid survey only inspected previously known sites, 'and then fleetingly' (only about 20 minutes, on average, was available for visits to each pre-1880 settlement, for example), and was limited to features dating to before World War II. The programme of

additional investigation they recommended makes clear the scale of the further potential for enquiry even in an apparently reasonably well understood area such as this.



Figure 112 The complex industrial landscape of pits, tips and infrastructure at Melbur china-clay works, on the western flank of the St Austell granite. The overgrown pit and sky-tips of New Halwyn can be seen in the middle distance with Wheal Remfry beyond. (Photograph: Historic Environment, Cornwall Council: F67-013; 8 June 2005.)

The Code of Practice agreed with the china-clay industry in 2010 for future archaeological mitigation acknowledged that the 1991 St Austell clay district survey was not an

'exhaustive account of the historic environment and will not reflect changes in the landscape or industry since 1991. Few sites could be visited during the fieldwork phase and their true extent and importance could rarely be established. For these reasons operational areas will require a more thorough and intensive investigation when schemes of working are being devised in order to provide a consistent basis for the assessment of the impact of the proposals on the historic environment and for the formulation of the mitigation strategy.'

A key priority is assessment of the modern china-clay industry itself to develop an understanding of the variety of components within it and of their significance. This is essential to inform future consideration of how the industry should be adequately recorded and to determine the potential for more important features to be conserved. The fundamentally dynamic character of the industry – modern methods create substantial changes to landscape and technology over relatively short periods of time (Fig 68, 111) – may mean that such assessment and recording would need to be repeated at regular intervals.

Finally, there is significant potential for further refinement of historic landscape characterisation. The existing mapping for Cornwall (Cornwall County Council 1996) was done at a fairly coarse grain when originally carried out and could usefully be amended in places. There is also potential to undertake finer grain HLC, perhaps for the whole of Cornwall, but certainly of specific areas in both Cornwall and Devon to inform particular initiatives, projects and proposals for change; such finer grain HLC has

already been done in a few cases (for example, Herring and Tapper 2002; Val Baker 2003; Dudley 2012). There is particular scope to develop further sub-divisions of the historic landscape character Types and to enhance the descriptive texts and management prescriptions which accompany them (Peter Dudley, pers comm).

6.2.1.1 Synthesis, publication and interpretation

Herring and Smith (1991, 65) pointed out the potential of the historic industrial resource in the St Austell clay district as an opportunity for study of considerably more than local significance:

'The range and number of sites within the study area represents a unique opportunity to study a 19th century industrial landscape of a particularly intensive type, which is found nowhere else in the British Isles. It is essential that the chance should not be missed to understand the mechanisms whereby an essentially small-scale, rural activity becomes a highly mechanised and technologically advanced industry.'

A small-scale study of the china-clay industry on Bodmin Moor has been produced (Smith 2008b) but there has been no overall synthesis of the industry's archaeology in the south west, and notably no account of the progress of technological change based on recording and analysis of its field remains.

Such a synthetic study would provide a baseline against which the significance and management priorities of surviving sites might be tested, an indication of key sites and features for designation and further recording, together with a solid foundation for future interpretation and educational provision.

6.2.2 Designation

A small number of clay-industry features are designated (section 5.3) but there are clearly many others which are of significant interest and potentially candidates for recognition. Where relatively complete and coherent complexes survive there is a need for designations appropriate to their scale as a basis for future management and presentation of more than individual structures.

Designation levels in the settlements associated with the clay industry are notably low (section 3.3.7). These settlements are often undervalued and subject to poor quality interventions and need levels of designation which reflect their historic importance and their significance as components of the wider china-clay associated historical resource.

In both these cases the limited extent of current designation is in part a consequence of the relatively recent origins of many of the heritage assets present: the physical historic remains of the clay industry and the built structures of its settlement date from the later nineteenth and twentieth centuries. Current principles underlying designation require substantially higher levels of architectural and historic significance and of completeness for such relatively 'recent' structures. A visually spectacular small pan kiln complex including a surviving stack at Heneward, on the edge of Bodmin Moor, was considered for designation in 2011 (Fig 101) but was not recommended for designation on the grounds that the visible remains are primarily of twentieth-century date 'and would therefore be expected to offer very considerable qualities of architectural, technological, or historical interest if it were to be recommended for listing, and a high level of intactness would usually be expected' (www.pastscape.org.uk/hob.aspx?hob_id=1541559#aRt). Arguably, for an industry with its most historically expansive phases during the later nineteenth and twentieth centuries there is a need for designation criteria to be sufficiently flexible to acknowledge appropriately the importance of its historic components.



Fig 113 Carthew Farm lies in the centre foreground, with the working areas of Wheal Martyn pit and a processing complex behind having absorbed much of its former extent. The view makes clear the extreme fragmentation of historic landscapes in china-clay areas as well as the creation of distinctive new landscape elements. Woodland in the centre foreground formerly formed part of the ornamental landscape associated with Carthew House (section 3.3.5). (Photograph: Historic Environment, Cornwall Council: F67-028; 8 June 2005.)

6.3 The challenge of the modern industry

It is self-evident that the modern china-clay industry operates on a large scale and is extremely complex in the detail of its working areas and the landscapes it creates. Both scale and complexity are often difficult to appreciate at ground level, outside the operational areas (Figs 112-13).

It is also an industry in which 'obsolescence' is part of its normal operation: new technology replaces former methods; pits, tips and infrastructure pass out of use because reserves are exhausted, market conditions change or a policy decision is made to concentrate production on larger sites. Some elements may be re-used: disused pits function as reservoirs or for disposing of new arisings; tips may be worked for secondary aggregates. However, the transition of facilities from state-of-the-art and intensive activity to out-of-use and obsolete can be rapid (Bowditch 2013).

The significance of the industry to the south west in economic and social terms, together with its role in shaping substantial areas of landscape and its influence on associated elements such as settlements and popular culture, mean that there is a very strong argument that modern industrial features, once they are no longer part of active production, should be regarded as 'heritage assets' (section 3.3.6.2). It is important that their values and significance as assets are assessed as a prerequisite for defining their status within the planning process framed by the National Planning Policy Framework (NPPF), for designation considerations, and to meet the obligations of the European Landscape Convention in respect of their landscape contributions. Such assessment and appropriate recording may need to be undertaken rapidly: new operations and uses may efface the evidence of earlier phases; disused structures and plant may be quickly demolished or scrapped and sites redeveloped.



Fig 114 The settlement of Bugle (right), set around a crossroads on the former turnpike road between St Austell and Bodmin, with Rocks china-clay pit in the foreground and Goonbarrow clayworks (upper left). The scale of change in the landscape in a period of little over a century is clear from comparison of the portion of road in the left foreground of the image with the historic mapping shown in Figure 16. (Photograph: Historic Environment, Cornwall Council: F88-184; 16 April 2008.)

The risk posed is that the physical evidence on which an appropriately detailed and comprehensive archaeological and historic record of an important modern industry should be based could vanish or be significantly damaged before it receives the attention which future archaeologists, historians and societies might require. Current policies of re-profiling and re-vegetating tips on a large scale have already brought about significant loss of historic landforms and the blurring or masking of historic landscape character. There is a potential risk that authentic features of the modern and historic industry, with the particular historic, evidential, communal and aesthetic values attached to them, will be progressively erased.

There are potential tensions, of course, between perceptions of china-clay landscapes as rich testimonies to one of Cornwall's most important historic industries and others which regard them as 'degraded and despoiled', demanding cosmetic improvement and offering significant opportunities for development. Acknowledgement by a wider public of the significance of 'modern' industrial heritage assets may also be potentially limited. Clay communities, however, clearly do place high value on the iconic elements of the industry, physical representations of the achievements of the local workforce over generations and a key factor in the distinctive character of those communities.

The very large scale on which modern clay working is carried on poses evident problems for meaningful future 'preservation' of a significant proportion of its key components, most obviously in terms of management and health and safety but also in order to avoid 'sterilising' remaining kaolin deposits and blocking appropriate and beneficial development. However, there is a need for active consideration of what levels and forms of mitigation are most appropriate and for a dynamic programme of assessment and recording to provide adequate support for decision making.

7. Recommendations

This section brings together a set of recommended actions, all of which are implicit or explicit in the preceding material and discussions. The actions are all to a significant extent inter-dependent.

7.1 Develop policies and strategies to inform decisions on future extraction / appropriate mitigation

- There is a need for a rapid resolution to the current delayed renewal of ROMPs in Cornwall, a resolution which includes an appropriate and adequate profile for cultural heritage within the china-clay area. This should be accompanied by a new Code of Practice which reflects this profile and provides for robust mitigation strategies based on modern understanding of the significance of both the china-clay industry and the wider historic environment in the context of broad principles of sustainability.
- Future consideration of china-clay industry development proposals should include cumulative impact assessments for extractive industries.
- A flexible approach is required in cases where potential sacrifice of a designated heritage asset can result in preservation or protection of other heritage assets.

7.2 Develop procedures which offer more comprehensive recognition and protection of heritage assets

- It is strongly urged that historic landscape character and associated assessments of significance and archaeological potential should form part of the 'trigger' process for referral of proposed china-clay development for historic environment scrutiny, rather than simple reliance on previously agreed registers of heritage assets.
- Particularly careful consideration should be given to future development proposed for the Upland Rough Ground character type, because of the large area which has already been lost in the south west (particularly on the St Austell granite); the Anciently Enclosed Land Type, because of its high archaeological potential, the impact on the historic character of the Type and the extent of past reduction of the Type in china-clay working areas; and the Industrial Type, because of the potential significance of remains of the modern industry there.
- Urgent reconsideration is required of the procedures for assessing proposals for secondary aggregates working and programmes of re-profiling and re-vegetating abandoned working areas to ensure appropriate historic environment input, aimed at appropriate recording or retention of significant features of the china-clay landscape and an assessment of the impact of these measures on the established historic landscape character.
- In view of the strong visual presence of the china-clay industry, future development proposals should be assessed in terms of their potential impact on the setting of heritage assets as well as direct physical impacts.
- Ensure mitigation measures include consideration of the palaeoenvironmental resource, particularly on rough ground.

7.3 Develop and enhance the knowledge base

- There is a general need for enhancement to HERs, aimed at making them more comprehensive and consistent, in order to make them more directly indicative of the extent and significance of the historic environment resource. Technical enhancement could be achieved by moving further to representation of individual sites by appropriate polygons rather than points.
- Herring and Smith (1991) acknowledged that their gazetteer of archaeological sites and areas in the St Austell clay district was incomplete and recommended further

survey work across the area. Similar survey programmes and / or enhancements are required in other areas potentially impacted by future china-clay development.

- Herring and Smith (1991) did not record features dated after 1939 or those in operational areas; the National Mapping Programme did not record features dated after 1946-7. There is potential for considerable enhancement of the record of 'modern' heritage assets, which could be supported by use of post-World War II air photographs and Ordnance Survey 1:10,560 and 1:10,000 mapping.
- Smith (2008a) carried out a thematic study of sky-tips on the St Austell granite as particularly prominent and significant features in china-clay landscapes, possessed of marked public appreciation as iconic symbols of the clay industry and of local identity and pride (Figs 38, 50, 82, 90, 110, 115). Again, there is a need for similar assessments to be carried out more widely and for them to include other prominent visual and physical elements of the industry; Smith (2008c), for example, recommended further detailed recording of the clay industry on Bodmin Moor. Features of particular significance to local communities and interest groups should be prioritised for consideration for designation or inclusion on 'local lists'.
- The St Austell, St Blazey and China Clay Area Regeneration Plan area outside the historic and current clay working zone will potentially be the subject of significant development proposals. As a predominantly agricultural area away from the clay district relatively little archaeological work has been carried out within this zone and there is a need for substantive enhancement of current levels of knowledge of the historic environment resource and potential. This could include (*inter alia*) investigation of historic mapping and documentary sources, examination of air photographs post-dating those used when National Mapping Project work was carried out for the area, together with interrogation and ground-truthing of newly-available LIDAR resources.



Fig 115 Carluddon sky-tip, a landmark over a very wide area of Cornwall, well beyond the immediate environs of the St Austell clay district, and an important icon of the historic significance of the china-clay industry. Industrial and business development and a new road route are planned in the area in the foreground adjacent to the base of the tip. (Photograph: Historic Environment, Cornwall Council, F82-081; 16 April 2008.)

7.3.1 Ensure appropriate recording of the modern industry

- In the short-term there is an urgent need to initiate a programme of recording on key technological sites and modern extraction areas, particularly those recently abandoned and potentially at risk but also including recording of active operational processes (*cf* Chandler *et al* 2008, 17). This should include not just technical recording of structures and a process record but also an element of capturing the 'look and feel' of the modern industry through photographic and video recording and interviews with those involved. A possible model for such work on a modern industry is the project carried out at the South Crofty tin mining and processing complex by the Royal Commission for Historic Monuments England in 1995 (Stoyel 1999; archive at National Record for the Historic Environment). Similar work has been carried out nationally on a variety of other modern industrial remains (Peter Herring and Dan Ratcliffe, pers comm).
- Assessment is required to identify the most significant, representative and 'legible' sites, structures and landforms for recording and for consideration for further protection. (A significant first step in this direction is represented by the DVD produced by John Potter and Ivor Bowditch (Bowditch 2013), highlighting the major importance in the recent history of the china-clay industry of a number of key sites, including Blackpool, Drinnick and Par Docks.) To develop a comprehensive understanding of what is required, a partnership approach would be beneficial, bringing together parties with expertise in modern industrial history and archaeology, particularly of the china-clay industry, those with national and regional interests and responsibilities in the appropriate conservation of significant heritage assets and the china-clay industry itself.

7.4 Designation

- Consideration should be given to assessing well-preserved historic china-clay complexes for designation; examples include Glynn valley on Bodmin Moor, Redlake and Leftlake on southern Dartmoor, Ruddle pit and others in the St Austell area; Smith (2008a; 2008b) provides a convenient starting point for consideration of sites in Cornwall. Designation would offer a basis for appropriate future management and long-term conservation on these particularly significant sites.
- The Dartmoor china-clay industry has not been subject to detailed assessment and evaluation over its full extent and this is reflected in the absence of any form of designation for any element of the historic industry within the Dartmoor National Park. There is a need to prioritise the area for consideration of potential designations.
- Other areas with significant clay industry remains could be considered for nomination as Premier Archaeological Landscapes in order to prioritise the historic environment in future land use and management discussions.
- There is a need to initiate and pursue a debate aimed at achieving considerably more extensive designation of later nineteenth- and twentieth-century heritage assets within the wider china-clay area. Most of the surviving industry remains are of this period (*cf* Herring and Smith 1991, 66) and this is also the case for much of the fabric of the associated settlements. It is asserted that the significance of the industry merits greater flexibility in the time-period criteria applied to designation of associated heritage assets.
- China-clay settlements currently have low levels of designation and of constraints under the planning system, notably Conservation Areas and accompanying Conservation Area Appraisals. There is an urgent need for re-assessment of these settlements, with a potential lead for those in Cornwall being provided by the CISI surveys and recommendations noted in Appendix 2.
- Take steps to ensure that heritage assets currently known and those recorded in the future have robust indications of significance. This will facilitate application of the National Planning Policy Framework guidance that assets of equivalent significance

to designated features should be treated as though designated.

- Give appropriate weight to community perceptions of the significance of china clay-derived landforms and other features associated with the industry (for instance, sky-tips). Assess the potential for formal designation or inclusion on, for example, 'local lists'. (**NB.** Current historic environment policy in Cornwall is that the Historic Environment Record constitutes an informal 'local list' (Dan Ratcliffe, pers comm).)



Fig 116 The distinctive stack on disused clay dries at Blackpool, near Burngallow. The letters 'FP' are for Frank Parkyn, a major figure in the historic development of the china-clay industry. (Photograph: Graeme Kirkham.)

7.5 Recognise the potential for place-making

- Adopt the principle that iconic features of the china-clay industry should as far as possible be retained as key elements of future place-making (Figs 110, 115-116). It is strongly asserted that the significance of the historic and modern industries means that they merit being commemorated and celebrated in place-making more appropriately and with considerably greater respect for their significance and integrity than is often accorded to industrial heritage.

7.6 Develop programmes to encourage public understanding and appreciation

- There is a pressing need to develop, encourage and promote programmes of outreach, improved intellectual and physical access and interpretation for the historic and modern clay industry, aimed at offering the wider public opportunities to experience and be impressed by the scale of past and present activity and the human achievement it represents.
- There has been no overall synthesis of the china-clay industry's archaeology in the south west, and notably no account of the progress of technological change and operating methods based on recording of its field remains. Such a work would provide a source of material for promoting public understanding at a variety of levels as well as a benchmark for future assessment of the remains of the industry.

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9. Project archive

The HE project number is **146135**

The project archive is housed at the offices of Cornwall Archaeological Unit, Cornwall Council, Fal Building, New County Hall, Truro, TR1 3AY. The contents of this archive are as listed below:

1. A project file containing records and notes, project correspondence and administration.
2. GIS digital mapping is stored in the folder L:\Historic Environment (Data)\HE_Projects\Sites_C\China_clay_industry_assessment_146135
3. English Heritage/ADS OASIS online reference: cornwall2-191800

This report text is held in digital form as: G:\TWE\Waste & Env\Strat Waste & Land\Historic Environment\Projects\Sites\Sites C\China-clay industry assessment 2012032\final report\United Kingdom China Clay Bearing Grounds – 146135.docx

10. Appendices

10.1 Appendix 1: A selection of china-clay associated artworks accessible online

Lamorna Birch

Old China Clay Pit (Penwithack) (nd)

<http://www.aucklandartgallery.com/the-collection/browse-artwork/11270/old-china-clay-pit-penwithack>

China Clay Pit (nd)

<http://artsalesindex.artinfo.com/asi/lots/214539>

St Austell, China Clay (nd)

<http://artsalesindex.artinfo.com/asi/lots/4387963>

Harold Harvey

A China Clay Pit, Leswidden (1920-24)

<http://www.bbc.co.uk/arts/yourpaintings/paintings/a-china-clay-pit-leswidden-13947>

The Clay Pit (1923)

<http://www.bbc.co.uk/arts/yourpaintings/paintings/the-clay-pit-13944>

Laura Knight

Men working in a China-Clay Pit (c 1914)

http://www.penleehouse.org.uk/artists/laura-knight.htm#23_quarrya.jpg

China Clay Pit (1914)

<http://www.penleehouse.org.uk/artists/laura-knight.htm>

Ivy T Pearce

Clay Pit (nd)

<http://www.bbc.co.uk/arts/yourpaintings/paintings/clay-pit-14979>

Clay District (nd)

<http://www.bbc.co.uk/arts/yourpaintings/paintings/clay-district-13911>

Ruskin Spear

Derelict china clay works, Belowda Beacon, Roche (c 1940)

<http://collections.vam.ac.uk/item/O1105370/derelict-china-clay-works-belowda-bodycolour-spear/>

China Clay Pits, St Austell (1939)

<http://www.bbc.co.uk/arts/yourpaintings/paintings/china-clay-pits-st-austell>

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China Clay Works, Great Wheal Prosper, Tresayes, Roche (c 1940)

<http://collections.vam.ac.uk/item/O17227/china-clay-works-great-wheal-watercolour-spear-ruskin/>

Herbert Truman

China Clay Pit, Lee Moor (1937)

<http://www.bbc.co.uk/arts/yourpaintings/paintings/china-clay-pit-lee-moor>

Kevin Tole

China clay (portfolio)

<http://www.kevintole.com/index.aspx?sectionid=1204045>

10.2 Appendix 2: Settlements in the project area, characterisation and planning guidance

Abbreviations: CSUS – Cornwall and Scilly Urban Survey; CISI – Cornwall Industrial Settlements Initiative

Settlements	Characterisation studies and planning guidance documents
St Austell china-clay district	
St Austell (including Holmbush, Mount Charles, Bethel, Boscoppa, Carclaze)	CSUS (Newell 2002); <i>St Austell Conservation Area Character Appraisal and Management Plan</i> (Le Page Architects 2013)
Bugle	CISI (Cahill Partnership and Historic Environment Service 2005a)
Roche	CISI (Cahill Partnership and Historic Environment Service 2005b)
Stenalees	CISI (Cahill Partnership and Historic Environment Service 2005c)
Nanpean	CISI (Cahill Partnership and Historic Environment Service 2004a)
Foxhole and Carpalla	CISI (Cahill Partnership and Historic Environment Service 2004b)
St Dennis	CISI (Gillard and Cahill Partnership 2004a)
St Blazey, St Blazey Gate and West Par	CISI (Conservation Studio and Cornwall Archaeological Unit 1999)
St Stephen-in-Brannel	
Trethowell, Ruddlemoor, Carthew	
Penwithick	
Treviscoe	
Whitemoor	
Trethurgy	
Par	
Trewoon	
Charlestown	<i>Charlestown: historical and archaeological assessment</i> (Berry et al 1998); <i>Charlestown Conservation Area Character Appraisal and Management Plan</i> (Historic Environment Service 2013)
St Austell, St Blazey and China Clay Area Regeneration Plan area (outside the clay district)	
Polgooth	CISI (Gillard and Cahill Partnership 2004c)
Duport	<i>Duport Village Development Brief</i> (2006)
Pentewan	CISI (Cahill Partnership and Cornwall Archaeological Unit 2002); <i>Pentewan Conservation Area Character Appraisal and Management Proposals</i> (Historic Environment Service 2010)
Fraddon / Blue Anchor	<i>St Enoder Parish Plan</i> (2008)

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Settlements	Characterisation studies and planning guidance documents
Indian Queens / Toldish	<i>St Enoder Parish Plan</i> (2008)
St Columb Road	<i>St Enoder Parish Plan</i> (2008)
Summercourt	<i>St Enoder Parish Plan</i> (2008)
Tywardreath	<i>Tywardreath Conservation Area Character Appraisal & Management Proposals</i> (2010)
Penrice	
Sticker	
Carlyon Bay	
Tregrehan Mills	
Tregorrick	
Luxulyan (close proximity)	CISI (Gillard and Cahill Partnership 2004b); <i>Luxulyan Valley Conservation Management Plan</i> (2011)
Mitchell (close proximity)	<i>St Enoder Parish Plan</i> (2008)
West Cornwall	
Halsetown	Conservation Area Statement / Appraisal
Newbridge	
Grumbla	
Trethewey	
Polgigga	
Morvah (close proximity)	
St Buryan (close proximity)	Conservation Area Appraisal
Sheffield (close proximity)	
Tregonning Hill	
Balwest	These settlements fall within the Cornish Mining World Heritage Site management plan area: Tregonning and Gwinear Mining District
Tresowes Green	
Ashton	
Bodmin Moor	
St Breward (pipeline)	CISI (Conservation Studio and Cornwall Archaeological Unit 1999b)
Blisland (close to pipeline)	Conservation Area Appraisal / Management Plan
Dartmoor	
Lee Moor	
Wotter	
Cornwood	
Sparkwell (close proximity)	
Lutton (close proximity)	
Hemerdon (close proximity)	