



# **Tolgus Arsenic Works, Cornwall**

## **Report of archaeological management work**





## **Tolgus Arsenic Works, Cornwall**

### **Report of management work: roof repairs, scrub clearance and recording**

<b>Client</b>	<b>English Heritage, Cornwall Heritage Trust</b>
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<b>Report author(s)</b>	<b>Ann Preston-Jones, Adam Sharpe</b>
<b>Checked by</b>	<b>Jacky Nowakowski</b>
<b>Approved by</b>	<b>Andrew Young</b>

Historic Environment Projects

Environment Directorate, Cornwall Council

Fal Building, County Hall, Treyew Road, Truro, Cornwall, TR1 3AY

Tel: (01872) 323603

Email: [hes@cornwall.gov.uk](mailto:hes@cornwall.gov.uk) Web: [www.cornwall.gov.uk](http://www.cornwall.gov.uk)



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The Project Manager was Ann Preston-Jones of Historic Environment Projects, Cornwall Council, with input from Ainsley Cocks of the World Heritage Site and Andrew Richards and Simon Thorpe of HE Advice. Adam Sharpe of HE Projects helped with recording the fuel store.

Melroy Youlton, owner of the site and his daughter, were supportive and helpful throughout.

The repairs to the roof were carried out by Jonathan Phaby and partner. Tom David, Claire North and Jenny Scriven of TCV (The Conservation Volunteers) organised scrub clearance on the site. Thanks to John Gander for photographs (Fig 13).

The views and recommendations expressed in this report are those of Historic Environment Projects and are presented in good faith on the basis of professional judgement and on information currently available.

## **Freedom of Information Act**

As Cornwall Council is a public authority it is subject to the terms of the Freedom of Information Act 2000, which came into effect from 1st January 2005.



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Institute for Archaeologists

## **Cover illustration**

Three pictures illustrate the sorry state of the calciner and fuel store. Above is the site from the NE in 2013; below are views of the damaged roofs of the fuel store (left) and the calciner (right).

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## Abbreviations

EH	English Heritage
HER	Cornwall and the Isles of Scilly Historic Environment Record
HE	Historic Environment, Cornwall Council
MCO	Monument number in Cornwall HER
NGR	National Grid Reference
OD	Ordnance Datum – height above mean sea level at Newlyn
OS	Ordnance Survey
TCV	The Conservation Volunteers





## **1 Summary**

This report describes work undertaken sporadically between January 2013 and March 2014 to carry out some small scale repairs and enhancement at the early 20<sup>th</sup> century Tolgus Arsenic Works, located on the outskirts of Redruth in Cornwall. The work focussed primarily on the Brunton calciner, the solidly built structure in which tin-bearing ores were roasted to drive off arsenic and sulphur contaminants.

The calciner's roof had been damaged as a result of vandalism. The work undertaken involved temporary repairs to waterproof the large hole in the roof. At the same time, gutters were cleaned and repaired. Conservation Volunteers cleared the inside of the building, which had been used for rough sleeping, of rubbish and the doorway was blocked to deter future access.

The fuel store at the side of the building, a collapsing and unsafe building of wood, metal and concrete, was recorded so that if it has to be taken down, it will be possible to rebuild it in a form as close as possible to the original.

The volunteers also cleared scrub from around the building and from the flues of the labyrinth in an effort to improve the presentation of the building.

Tolgus Arsenic Works is a Scheduled Monument, number 35822 (National Heritage List 1021240), and is 18039 in the Cornwall Historic Environment Record. It is located at SW 6901 4303.

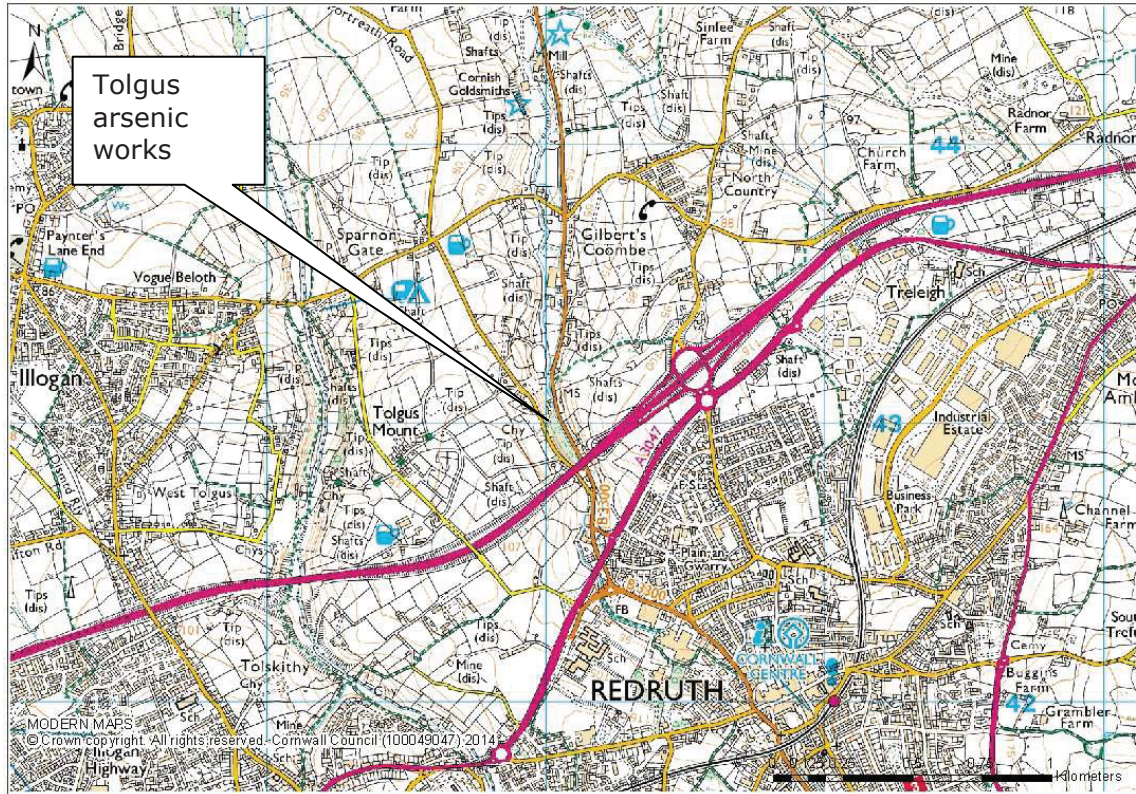


Fig 1 Location map

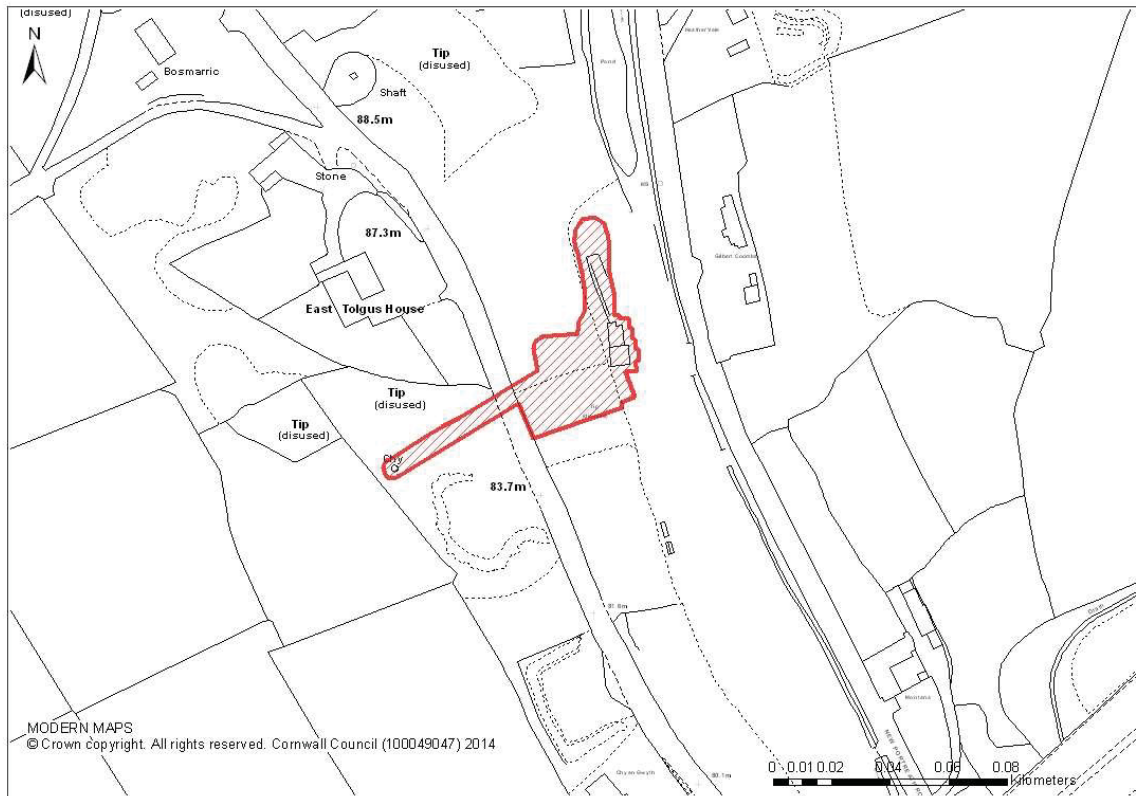


Fig 2 Site extent: the scheduled area at Tolgus, cross-hatched in red

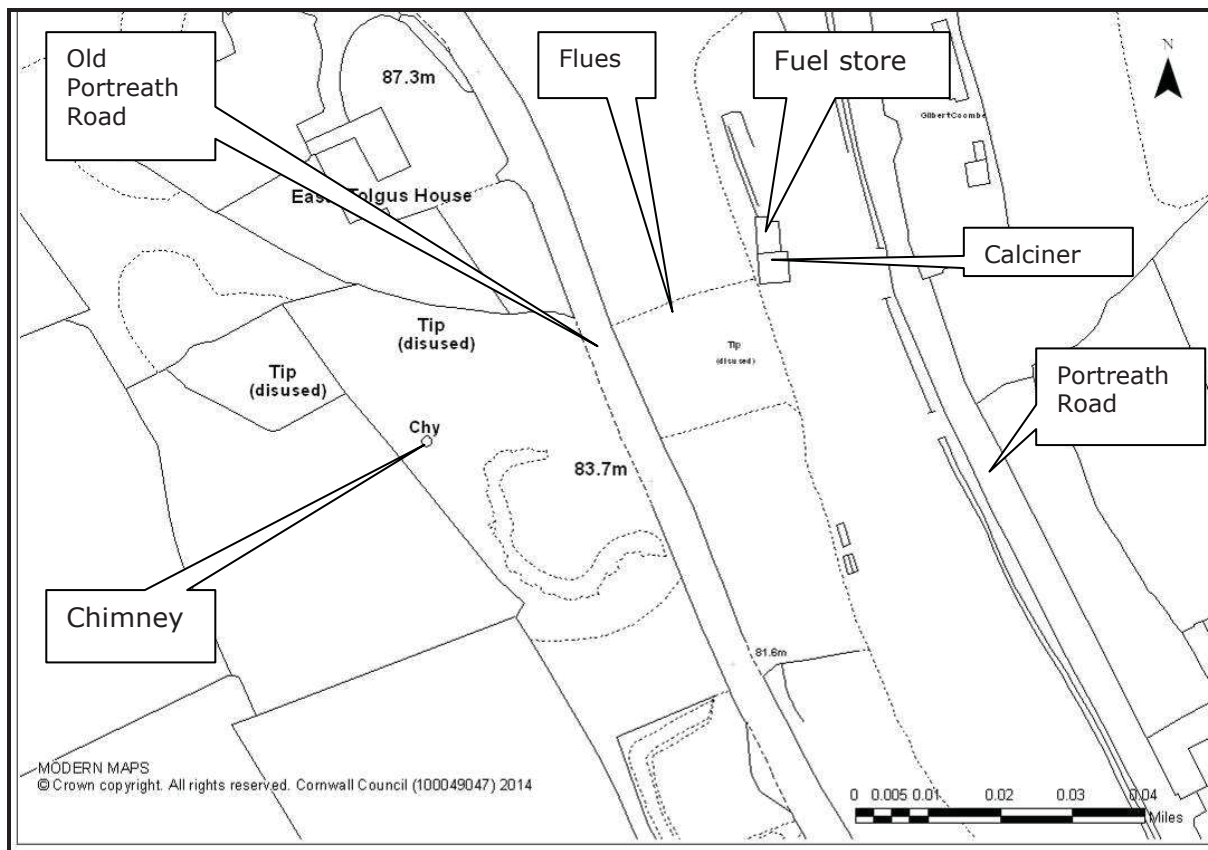


Fig 3 Ordnance Survey digital mapping showing the site and its environs (2014)

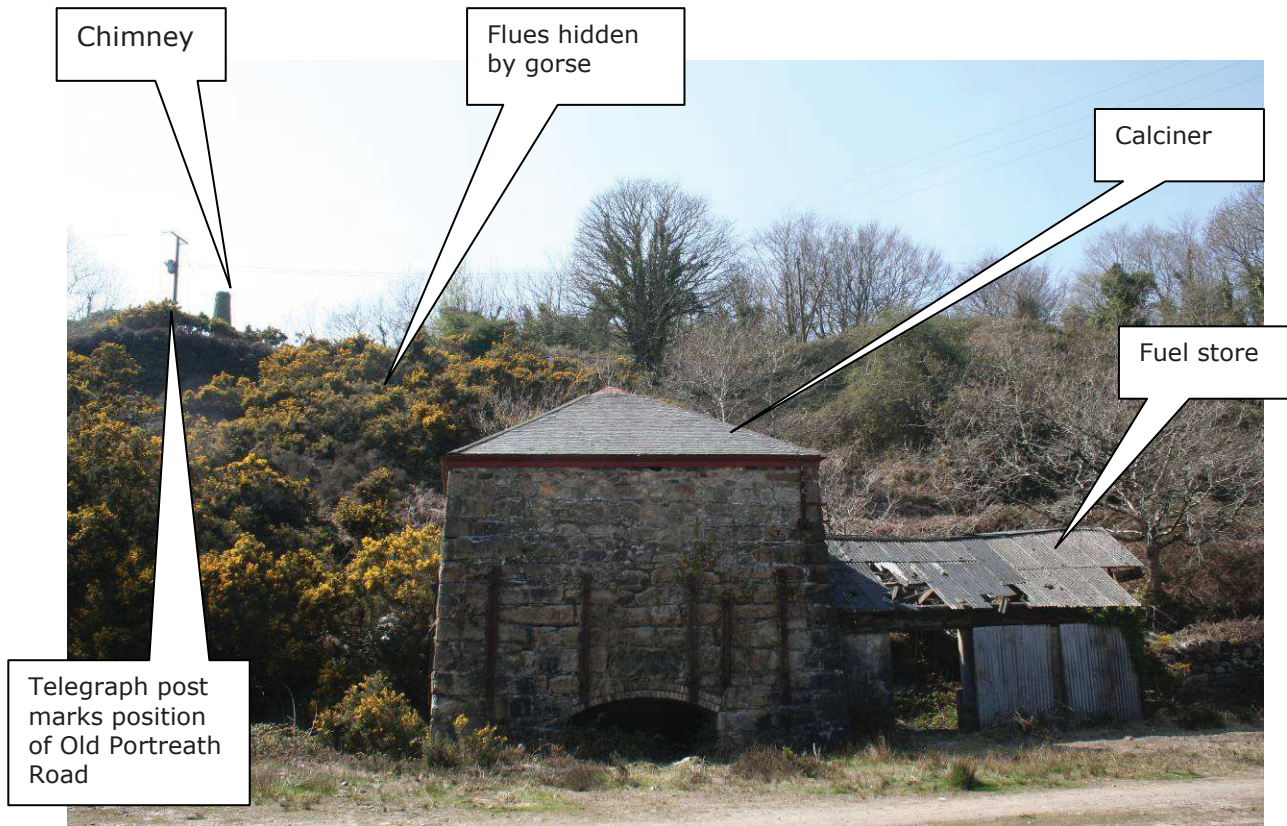


Fig 4 The arsenic works in 2010, showing the location of the separate components

## 2 Introduction

### 2.1 Project background

Located north of Redruth close to the Portreath Road, the early 20<sup>th</sup> century Tolgus Arsenic Works is one of the best preserved such sites in Cornwall (Fig 1). The site includes the solid square building of the furnace or calciner, designed for burning off arsenic from tin ores, with flues rising up the steep hillside behind to a tall chimney stack. The calciner is particularly notable for the fact that machinery survives intact inside the building. Because of its unusual completeness, the entire complex is protected as both a Listed Building and a Scheduled Monument, and lies within the Cornish Mining World Heritage Site.

Despite its importance, the site has suffered vandalism and neglect for many years and as a result is in poor, declining condition. Through the project described in this report, some basic repairs were carried out on the calciner roof, and a description made of the collapsing fuel store so that in the longer term it can be rebuilt. Simple tasks, like scrub clearance and the removal of fly tipping, were also carried out, to improve presentation of the site and help deter vandalism.

### 2.2 The monument

The following description is based on the Scheduling documentation. The Scheduled Monument is an early 20th century arsenic works which served the Tolgus tin stream works north of Redruth. It includes labyrinth, flue and a chimney and the most prominent feature, the works' Brunton calciner. This early 20th century calciner is understood to be the only surviving complete example of a type that was developed by the Scottish engineer William Brunton, so is of particular importance. It is this building, plus the adjacent fuel store, which were the focus of this project.

#### *The calciner*

Constructed on this site in about 1933, of re-used granite blocks with cream brick arches and a hipped slate roof, the calciner's function was to roast off sulphur and arsenical contaminants from tin-bearing ores. The calciner's ground floor walling is reinforced with vertical iron tie-bars to counter the thermal stresses when in use. It is the survival of machinery within the building which makes it of particular significance. In the eastern elevation, the calciner's power arch encloses the drive gearing for the rotating hearth which survives above. The calciner's exhaust opening and ore chute door are sited within the southern elevation. The first floor retains its original iron hopper to feed the rotating hearth, together with the floor's supporting beams and ties. The first floor also served as a storage space in which the ore was dried prior to being fed to the hearth below. Access to this floor is through a door on the west, opening to a sloping trackway beyond.

#### *The fuel store*

The fuel store attached to the north of the calciner is (or was) constructed from a mixture of materials including cement-rendered concrete blocks, ship-lap planking, and shuttered mass concrete; the roof is a mixture of cement-asbestos sheeting and felt-clad planks supported by wooden 'A' frames.

#### *The flues and stack*

Upslope from the calciner are the flues and condensers that connect with the calciner, rising to a circular chimney 87m to the south west (at SW 68942 43001). The flues are brick with coursed slate-stone rubble in places. A section of flue passes westwards under the Old Portreath Road and continues for a further 38m to join the circular chimney which bears the date 1933 and has a brick upper section. This is part of a separate property.

## 2.3 Monument details and constraints

Scheduled Monument 35822 / National Heritage List 1021240

Listed Building 66842 / National Heritage List 1328202

HER 18039

Location NGR SW 6901 4303

The monument also lies within the Cornish Mining World Heritage Site.

## 2.4 Condition of the monument

The monument as a whole, but the Brunton Calciner and flues in particular, suffer damage from neglect and vandalism. Being on the edge of the town of Redruth, the site is accessible yet not overlooked other than by one or two houses. The surrounding area is essentially unmanaged and used as a venue for trials bikes for both organised events and informal biking – a use which is relatively benign but does little to enhance its setting.

Some of the building's problems, like blocked and leaking gutters, and the cracked cement ridges of the hipped roof, were the result of natural deterioration and neglect. For the same reason, vegetation like Buddleia and gorse was growing from the walls, whose pointing was cracked or missing. But side by side with this, the calciner's roof had been a target for vandalism over the last few years, with bricks being picked off the flues above and thrown down onto the building. Inevitably, the damage to the roof allowed rain water in, threatening important internal fittings. In addition, there was open access to the upper floor, which was used as a den and focus for anti-social behaviour, with associated litter, graffiti, and fires being lit on the floor (Figs 5-10).

Following vandalism, the fuel store attached to the side of the building, a less solidly constructed structure of timber, concrete, galvanised iron and asbestos, was (and remains) in dangerous, half-collapsed condition (Figs 12 and 13), and as a result was subject to enforcement action. Because of its unsafe condition, temporary Heras fencing was erected some years ago; but this was stolen almost as soon as it had been put up (Melroy Youlton *pers comm*).

The calciner's flues, which rise up the slope behind the calciner, are in poor condition, the brick- and stone-work damaged and loose, the roofs of the flues collapsing in places (Fig 11). Although mainly covered in heathland-type vegetation, there was much invasive European Gorse and other scrub and fly-tipping from the Old Portreath Road. The flue runs under the road before heading for the chimney and some subsidence in the road at this point suggests that the flue beneath may be collapsing.

However, biking over the flues, which had occurred in the past, was no longer taking place in 2013, and the chimney is in a reasonable state.

### Risk

As a result of this continued deterioration, damage and abuse, the Scheduled Monument is considered to be at high risk of damage and in deteriorating condition. The calciner is also a Building at Risk.

## 3 Aims and objectives of conservation work

Given the relatively limited funding available through this project, the work undertaken in 2013-14 could hope to do no more than a few repairs and some tidying, as holding work to help deter vandalism and reduce further deterioration of the roof. The following aims and objectives are repeated from the project design (Preston-Jones 2013).

- To protect the damaged roof from further vandalism and deterioration it is proposed that a temporary covering is fixed.

- The fuel store on the side of the calciner will be fully recorded, enabling plans and a specification to be drawn up for the reconstruction of this element of the site. Following this, once a plan for rebuilding is agreed, but only with the further agreement of English Heritage, the structure may be demolished.
- To make the site appear more visited and cared for, scrub will be cleared from around the building and rubbish removed from inside.

However it was never anticipated that these measures will solve all of the site's problems and reduce the risk. This will depend on sorting out issues concerning access and the use of the surrounding land. A long-term solution to the problems of this site is likely to be expensive and complex, given its character and location. As well as a comprehensive repair scheme, a new approach to management of the setting, with solutions to deter the abuse and vandalism that have been a feature for decades will be required.

### **3.1 Objectives of proposed management work**

- Commission local Conservation Volunteers to carry out an initial clearance of litter and scrub from the site
- Protect the roof with a marine ply and bitumen covering on the west side, and replace the small number of slates that have gone missing on the south side
- Protect the door to the upper floor with 8 inch concrete block or cement-filled oil drums
- Install some form of barrier, possibly cement-filled oil drums, to prevent bikes accessing the labyrinth and the calciner
- Record the building as a whole, including the shed (fuel store) on the side, to enable a specification to be designed for the rebuilding of the structure in its original form
- Commission local Conservation Volunteers to visit the site periodically to clear scrub, tidy up fallen slates, remove litter and generally keep the site tidy.

The following aspects are still under consideration and may not be achieved as part of this project.

- Following recording, demolish the shed as this is in a dangerous state, and subject to enforcement action.
- Rebuild the shed as closely as possible to its existing form.

## **4 Results of the conservation work**

### **4.1 Scrub and rubbish clearance**

The aims of the initial scrub and rubbish clearance at Tolgus Arsenic Works were to

- Clear rubbish from inside the building
- Clear scrub from around the building
- Clear gorse from the labyrinth to prevent root damage to brickwork and help enhance the heathland vegetation growing on the flues and steep valley side

The purpose of this was not only to help improve the appearance, presentation, and management of the site but also, by making the monument appear managed and cared for, to help discourage the vandalism and misuse to which it had been subject.

The Conservation Volunteers (TCV) were commissioned to help with the initial scrub and rubbish clearing on the site because they are based nearby in premises in

Tuckingmill. They also work closely with local communities including local unemployed youths through their Youth Programme.

The initial work was undertaken by TCV on two days in January 2013. The inside of the calciner was cleared of all rubbish, which was put into a small skip for removal from site. Much tall gorse was cut from the labyrinth, and burnt on a site well away from the scheduled area. However, as well as opening up a view of the flues, the scrub clearance also had the effect of revealing fly tipping which has come over the wall from the Old Portreath Road over the years. This included two old freezers, a settee, a TV and a carpet which, without the use of lifting equipment, could not be as easily removed as the gorse.

TCV's Youth programme team subsequently visited on two further occasions to clear further scrub, including – where accessible – from the walls of the building.

## **4.2 Roof repairs**

For various reasons, including particularly dreadful weather in the winter of 2013-14, the repairs to the roof did not start until the end of January 2014.

The original specification had been for a marine ply covering over the damaged west side of the roof, to simply protect the interior of the building. Following discussion with English Heritage and potential contractors, this was modified to repairs to the scantle slates; but in the event, circumstances dictated a third approach to repairing the damage, which is outlined below.

Work began on 30<sup>th</sup> January, with the expectation of simply repairing the scantle roof. However, once work started on removing the slates, they were found to be in very poor condition; moreover, because they had been secured with a hard mortar, they could not be easily removed without damaging them, and would have been impossible to re-lay properly. Moreover, the roof as a whole was found to be in worse condition than originally thought, with the top of this side of the roof cracking and liable to slip. The cement ridges were also cracked and slipping and this was starting to affect slates in the adjoining roof elevations. There was also damage to the roof elevation to the right (S side), where more slates had been dislodged since the original specification was drawn up (Fig 8). Fortunately, the wall plate was found to be in reasonable condition, as were the rafters, for the most part.

Close inspection also showed up the poor condition of the old cast iron gutters. They were broken or missing in places and blocked with moss and pieces of slate. The problem this was causing is seen in stains on the stonework below, where water was overflowing or running down the walls where the gutters were missing (see Fig 7).

Appropriate and effective repair of all this would have sent the costs well above the existing budget, and so a new plan was devised and agreed, based on the need to protect the building and keep the walls and interior dry. The new plan involved:

- Removing all damaged and insecure slates
- Carrying out some small scale *ad hoc* repairs to rafters
- Covering with 2 x 3mm external ply, as this size could be slipped in under the edge of the slates at the edges of the roof which did not have to be removed. A double layer was used, siliconed together and with sheets overlapping so as to help with waterproofing.
- This was then finished with a heavy grade of shed felt, to ensure that it is fully water-proof. Being grey this also has the effect of making the repair less obvious.
- Expanding foam was squeezed in around the edges and then finished with cement to hold it all in place and make the joint secure and waterproof. The use

of these irreversible materials was considered acceptable since the slates are in poor condition and unlikely to be capable of re-use in the future.

- Where damaged or cracked, the cement hips on the W elevation were re-pointed.
- The time saved by employing this method was then spent on dealing with the rainwater goods and filling other holes in the roof, to keep the building dry and watertight.
- The gutters all around the building were cleaned out and the downpipe checked to ensure it was draining correctly.
- Much time was spent in trying to source either matching reclaimed cast iron gutter or something of similar style in plastic, to replace a missing section on the west side. As nothing suitable was easily available locally, a new metal gutter was ordered to replace the missing section.

As sourcing an appropriate new section of gutter took some time, work was not finally completed until March 2014.

### **4.3 Blocking the doorway**

Once all work was completed, Melroy Youlton blocked access to the interior of the calciner's upper floor with cement-filled oil drums, to prevent access and help protect the building until a permanent solution to its management can be agreed.

## **5 Results of the associated recording**

One aim of the archaeological input to the project was to make a comprehensive record of the fuel store to the side of the calciner, to enable a plan and specifications to be drawn up for its eventual reconstruction.

The second element of the archaeological input to the project was to liaise with all parties involved in the project, including English Heritage, the local authority conservation officer, the owner of the site, and the contractors; and to keep a close eye on the site as work was proceeding.

### **5.1 The record of the fuel store**

The north wall of the calciner contains doors or stoke-holes to the two fire-boxes within the furnace. Attached to the north wall of the calciner is a building constructed of less permanent and robust materials than the stone-walled furnace. This lean-to shed was used as a store for the fuel.

The building was recorded with photographs, sketches, measurements and notes, sufficient to produce a drawing, description and specification which, when circumstances allow, can be used to guide reconstruction of the building.

The shed was constructed from whatever materials were to hand when it was put up, and was designed to be functional rather than pretty. It has been repaired over time in *ad hoc* fashion, and so the recording reflected this by noting:

- Overall dimensions – length, width, height of walls, pitch and height of roof, as far as this can be ascertained; sizes of timbers used in construction of framework, walls, beams etc
- Details of the roof structure, including where beams are doubled up, how beams are put together, the location of notches, etc
- Materials used in the structure – concrete, timber, ironwork, corrugated asbestos roof sheeting, galvanised iron roofing, board and felt, old rail, etc, as well as wood preservative finishes (pitch)



- Details of doors and window openings, including detail of metal runners for sliding doors

### 5.1.1 Description of the fuel store

*"By 'shed', surely you mean incredibly interesting nationally important vestigial remains of the extraction industry, demonstrating the adaption and re-use of structural elements in response to procedural needs".*

Nick Russell, English Heritage

The following record of the building was made by Adam Sharpe of Historic Environment. See also Fig 16, a drawing made by sketching and measuring.

The fuel store at Tolgus Arsenic Works is a shed of vernacular construction built against the northern elevation of the calciner (National Monument No 1021240) at SW 69018 43046 within the Scheduled area and covered by the designation. The building served as a coal store and shelter for the calciner operative, is of unknown construction date, probably incorporating parts of a building dating from the period when the calciner was first erected on this site in 1933, though clearly much modified and patched during its lifetime. The works here operated until at least 1945, though was subsequently abandoned (the date when this occurred is not known). The building measures 7.95m long x 4.45m wide in plan, though its roof spanned an area 5.83m wide, extending to the west to cover part of the adjacent revetted bank next to the access track on this side. The roof is gabled and stands to 4.24m high, with an eaves height of 2.0m.

The eastern wall is of cement rendered blockwork and contains two door openings, each being 1.5m in width and full height. These were secured by sliding doors consisting of corrugated steel sheet on a 75mm x 50mm section timber frame – each door was suspended on a common U-section steel runner (now very much corroded) fixed with proprietary brackets to a half-sectioned railway sleeper serving as a wall plate. The function of a pair of rollers fixed to the wall plate above the southern opening is unknown. Two rows of 150mm wide ship-lap planking running horizontally above the blockwork covered the joist ends on this elevation. The functions of two cast concrete plinths adjacent to the external elevation of this wall and sited between the doors are uncertain.

The western wall was vestigial, but appears to have consisted of two rows of horizontal planks covering the joist ends and the timber blocks which lifted these off the wall plate (this was again made up of reused railway sleepers and measures 150mm x 160mm in section). All exposed timbers seem to have been treated with a bitumen-based black paint.

The southern wall of the building was formed by the arsenic calciner, against which the shed butted, apparently without any formalised flashing.

The northern wall of the building was formed from horizontal 150mm wide ship-lap planking on a 100mm x 50mm studwork frame – most of this cladding has recently been lost. It is understood from the present owner that the north eastern corner of this wall was 'open' to allow a draught into the building. This, however, seems unlikely, but cannot be confirmed or ruled out from available photographs.

The roof covering seems to have included some butted 230mm wide x 25mm thick timber planking (this is likely to have been the original roof covering, though it only survives in one area in the north western corner of the roof). It was possibly originally covered with a mineralised roofing felt, (or alternatively painted with liberal doses of tar-based paint), possibly some corrugated steel sheeting and (on the eastern elevation), asbestos-reinforced cement corrugated sheeting with one modern corrugated plastic roof light sheet. The hip was formed of two wide planks covered with roofing felt. The trusses, of which there were originally four are of simple braced form with half depth crossed top joints and measure 180mm wide x 50mm thick. These supported four purlins measuring 80mm x 60mm in section set at approximately 1.0m spacings.

The roof structure also appears to have included some other 57mm x 50mm timbers, at least one of which was topped with a narrow U-section steel channel. However, all of these timber components have collapsed and it is no longer possible to identify their original locations and functions. It should also be noted that almost all of the purlins on the western side of the roof have been lost and their arrangement lost.

The floor of the building is rendered poured cement and incorporates two bays or bins. Both are on the western side of the building, one adjacent to the calciner, the other towards the northern end of the shed. Their functions are unknown, though the larger one would have been likely to have been a coal store. These concrete features are likely to represent late modifications to the building, though ones contemporary with the operation of the calciner rather than the period after which it became redundant.

### **5.1.2 Guidelines for replacement of the shed**

The survey of the remains of the building indicates that the majority of its superstructure has deteriorated to the point where it is incapable of salvage or repair. As this structure is an integral element of the Tolgus Calciner Scheduled Monument, its replacement has been proposed. However it should be noted that any work to remove the existing structure and build a replacement would require agreement with English Heritage and Scheduled Monument Consent.

#### **5.1.2.1 Removing the existing structure**

The timber elements of the building should be carefully dismantled, preferably using a small crane to avoid damage to the floor and blockwork walls, or to the calciner structure. Any surviving ironwork attached to the timbers should be recovered for reuse and its original locations noted and photographed. The corrugated steel sheet doors should be recovered and inspected to determine whether they are capable of re-use. No demolition should take place to the concrete walls forming the eastern elevation of the building, nor to the concrete base, stub walls and containment bins within the building.

The concrete floor should be cleaned of rubble and brambles, gorse and other vegetation in and adjacent to the building should be cut back and treated to prevent regrowth. All rubbish, unusable timberwork and other materials in and adjacent to the building should be appropriately disposed of.

#### **5.1.2.2 Rebuilding**

The building should be re-constructed on a like-for-like basis using new or salvaged materials, the northern end of the building being reconstructed using appropriately-sized ship-lap timberwork on a studwork frame (as also the closer boards on the eastern and western elevations below the rooflines). Halved railway sleepers should be used for wallplates, and trusses and purlins should be fashioned from tanalised timber. Thought may need to be given to limiting the potential for the decay of the new western wallplate (the current example consists of a halved sleeper part buried in the ground surface) and a cast concrete strip may be an appropriate alternative at this location.

The roof should be covered in galvanised steel sheeting and flashed to the northern wall of the calciner using a methodology to be agreed with English Heritage. If capable of re-use, the existing sliding doors on the eastern elevation should be re-hung on new rollers and new channels fixed to the wallplate as previously. The doors should be capable of being secured using unobtrusive locks. The existing window in the northern elevation may be capable of being refurbished and re-glazed. In order to resist vandalism to the glazing, clear polycarbonate sheet should be secured to the outer face of the window frame. If this window frame cannot be refurbished, a like-for-like replacement should be sourced and installed.

In order to reduce the new appearance of the roof and walls, these should be painted in a bitumen-based black paint or other suitable weather-resistant coating.

## 6 Conclusions/discussion

The work described in this report has successfully helped to protect the roof of the calciner building and, for the time being, halt deterioration of the structure due to rainwater penetration. Some slight improvement to the setting and a reduction in levels of vandalism has also taken place.

However, this work can only be seen as a temporary measure. Many problems remains to be addressed before the building can be fully secured. If the structure is to be conserved in the long term, and removed from the Heritage at Risk register, a major project will be needed.

## 7 References

Preston-Jones, A, 2013. *Monument Management Scheme 2012-13: Proposal and Written Scheme of Investigation for roof repairs, scrub clearance and recording at Tolgus Arsenic Works.*

### 7.1 Websites

<http://www.heritagegateway.org.uk/gateway/> English Heritage's online database of Sites and Monuments Records, and Listed Buildings

## 8 Project archive

The HE project number is **146209**

The project's documentary, photographic and drawn archive is housed at the offices of Historic Environment, Cornwall Council, Fal Building, County Hall, Treyew Road, Truro, TR1 3AY. The contents of this archive are as listed below:

1. A project file containing site records and notes, project correspondence and administration.
2. Electronic drawings stored in the directory [Z:\Projects\Sites\Sites T\Tolgus calciner outbuildingrecord 2013](#).
3. Digital photographs stored in the directory [R:\Historic Environment \(Images\)\SITES.Q-T\Tolgus Calciner](#)
4. English Heritage/ADS OASIS online reference: cornwall2-184269

This report text is held in digital form as: `..\HE Projects\Sites T\TOLGUS\Tolgus 2012-13\Tolgus calciner conservation report 2014.doc`





*Fig 5 Tolgus arsenic works: the damaged west face of the calciner roof in January 2014: the lower, more detailed, image shows a brick from the flues lodged on the roof*



*Fig 6 Tolgus arsenic works: vegetation growing from cracks in the stonework*



*Fig 7 Tolgus arsenic works: missing gutter at NW corner. Water running down the stonework has caused the staining seen on the wall*



*Fig 8 Tolgus arsenic works: missing slates on south face of roof, blocked and broken gutter*



*Fig 9 Tolgus arsenic works: cracked cement hip*



*Fig 10 Tolgus arsenic works: rubbish resulting from rough sleeping in the calciner's upper room*



*Fig 11 Tolgus arsenic works: the damaged and collapsed brickwork of the flues*





*Fig 12 Tolgus arsenic works: the collapsing fuel store beside the calciner in 2011 (above) and 2013 (below)*



Fig 13 Tolgus arsenic works: the damaged roof of the fuel store (photos: John Gander)



*Fig 14 Above: The Conservation Volunteers (TCV) clear rubbish from the upper room of the calciner. Litter picking devices were used and protective suits and gloves worn for Health and Safety. Below: starting to clear vegetation from the flues of the labyrinth*



Fig 15 The calciner's roof after completion of temporary repair

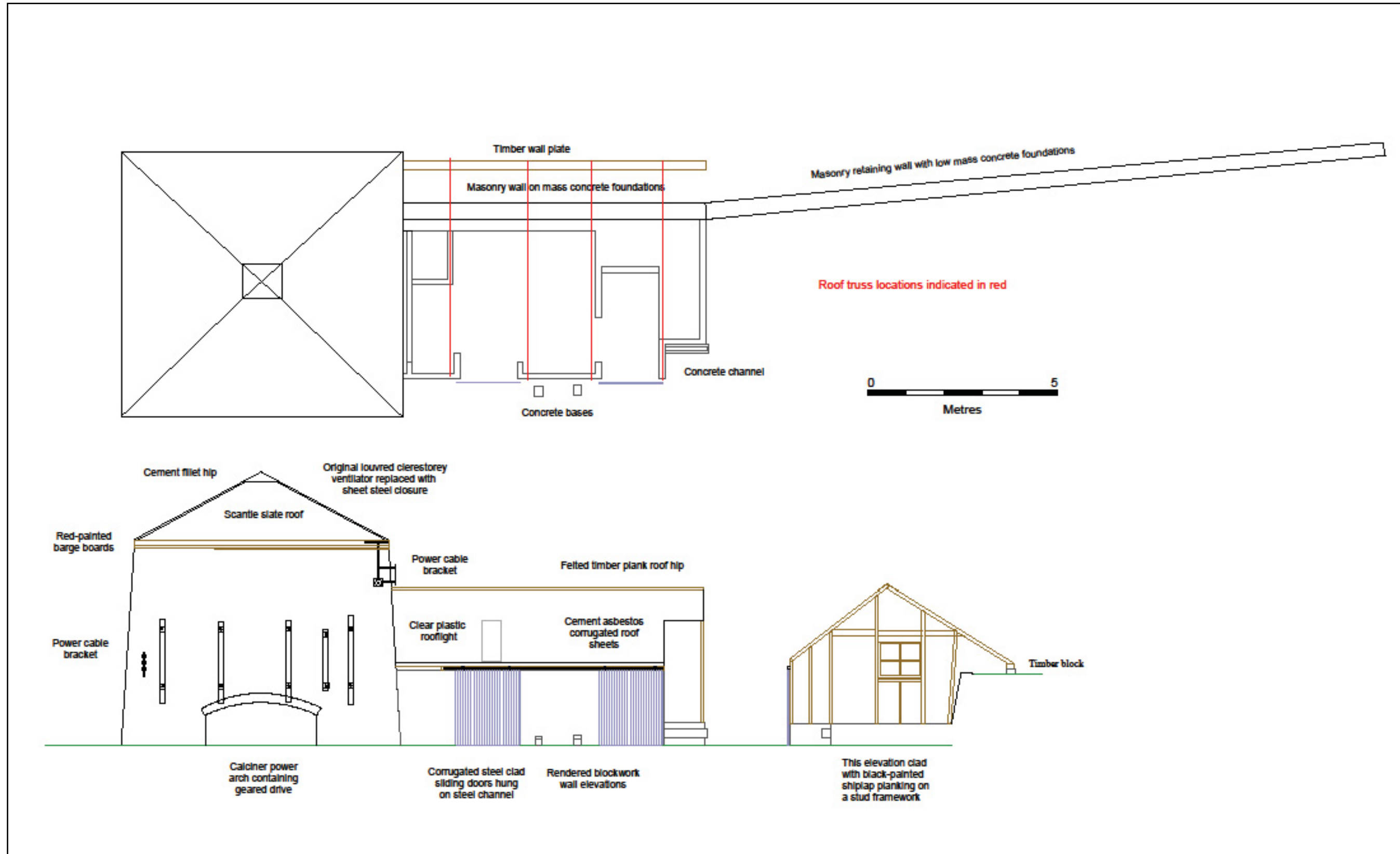


Fig 16 Plan of the calciner and shed/ fuel store, to aid reconstruction of the shed