

Safeguarding safety and significance – Saving an historic village in Bath

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ABSTRACT: Twenty-one hectares of unstable mines threaten the future of the village of Combe Down. This is an integral part of the World Heritage Site of Bath. Economists used the technique of contingent valuation to value the continued existences of the village. Government funding was provided to stabilise the mines to save the village.

1 INTRODUCTION

1.1 *The City of Bath World Heritage Site*

The City of Bath was inscribed as a World Heritage Site in 1987. It was recognised as a place of outstanding universal value for its architecture, town-planning, landscape, archaeological remains and its role as a setting for social history. Amongst the key features that are identified in the management plan (1) as contributing to its universal value are:

- the Georgian city and associated villages with their dwellings, social and civic buildings, parks and gardens, streets and public open spaces;
- the stone mines and associated works, transport systems and communities;
- the natural landscape setting.

Today Bath is a city of c.84,000 inhabitants with two universities and a role as a regional shopping centre. It attracts over 4 million tourists annually.

The historic buildings of Bath are almost all built of Bath stone which is an oolitic limestone of yellowy cream stone which in polite buildings is worked as ashlar fronted facades (see Fig. 1).

1.2 *The building of Bath*

In the 18th and early 19th centuries, this limestone came from quarries and mines beneath the hills around Bath, mainly Combe Down. This is an area to the south of Bath on a plateau above the centre of the city. In the early 1720's, existing small scale quarrying works were bought up by Ralph Allen who developed an integrated system of mining that included the extraction,



Figure 1. The Circus, Bath – Bath Stone Georgian architecture.

transport, delivery and working of the stone. Working began as open cast quarrying and as the overburden became too difficult to remove, the 'old men' tunneled into the hillside. Mining was done by 'pillar and stall' method, leaving 'rooms'. The stone blocks were cut to size and dressed underground within the mine. This is because the stone 'in-situ' is relatively soft and easy to work. When the stone becomes exposed to the atmosphere it hardens considerably. Discards were stored underground in worked areas. In some places, these discards are piled up to 5 meters deep.

Ralph Allen installed a railway (see Fig. 2) to take the stone down to his yard at the bottom of the hill, from where it was taken across the river Avon to building sites in Bath or shipped to wider areas such as Bristol and London. Bath stone became a fashionable building

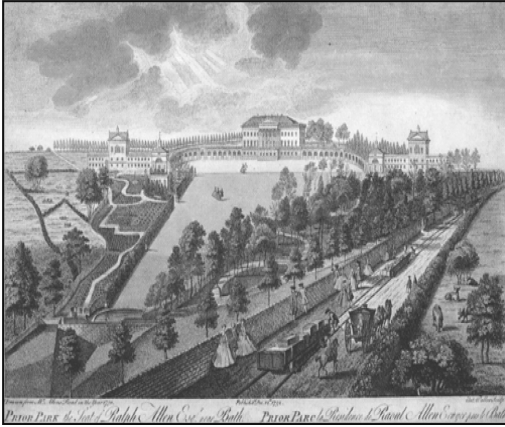


Figure 2. Prior Park, Bath. Ralph Allen's grand house. A railway was installed to transport the stone from the mine to his yard. (Walker, A: 1752).

material and there are buildings made of Bath stone in England and abroad – e.g. South Africa and the southern hemisphere.

Allen built himself a grand house, Prior Park, on the hillside overlooking Bath which served as a showcase for Bath stone (Fig. 2). This house has a commanding setting overlooking the city, and he landscaped the grounds in the manner befitting a ‘gentleman’. This park is now in the care of the National Trust and open to the public.

When Allen began his operation, Combe Down was open land with only scattered agricultural buildings and few inhabitants. The area became developed with the paraphernalia of mining such as quarries, the railway, cranes, stone yards etc. Ralph Allen built houses for his workers, both on Combe Down and at the bottom of the hill. The houses were built of Bath stone and were early workers housing of high standard with ashlar facades (Fig. 3).

During the eighteenth century further quarryman's cottages were built, mainly small vernacular buildings of rubble stone (see Fig. 4). A village grew up in Combe Down and chapels and pubs were established. The village is built of Bath stone with little drungs (stonelined paths) and detached gardens, which combine to create a pleasant and attractive environment.

During the nineteenth century, the area became popular with the middle classes, especially because of its clean fresh air and wonderful views to the south. Villas were built in the village and these are often large detached buildings, of ashlar stone (Fig. 5). The village today is densely inhabited with schools and churches, and shops as well as dwellings.

After the Great Western Railway constructed Box tunnel in the 1830's, a new source of oolitic limestone



Figure 3. A typical example of workers housing which were built to a high standard in Combe Down. (Webb, O: 2007).



Figure 4. Quarryman's Cottage built during the 18th century in Combe Down. (Webb, O: 2007).

was found in nearby Wiltshire. This stone was used in Bath and the Combe Down Stone mines were gradually abandoned. Since then the condition of the mines has deteriorated. Pillars were robbed (see Fig. 6) and the roof has become fractured.



Figure 5. Example of a 19th century Villa in Combe Down. (Webb, O: 2007).



Figure 6. The mine roof has become fractured as the stone pillars have been robbed of stone.

1.3 *The legacy of the mining*

There is now c.25 ha of disused, unstable mine below the village in which over 85% of the stone has been quarried away. The mines are very shallow, in some cases less than 3 m below ground. Geotechnical advice is that the mines have failed and that a sudden collapse could occur at any time, similar to that which occurred in the limestone mines in Gilmerton (Edinburgh, UK) in 2000, where there was damage to a number of properties which resulted in them needing to be demolished.

Above the Combe Down mines complex are c.700 dwellings (including a number of listed buildings), highways, businesses and schools. There are no registered mine owners because the mines were closed

before the system for registering owners was developed. As such the owners of properties above the mine are deemed to own the mine beneath their property. However it is impracticable for owners to consolidate their individual part of the mines.

2 A PROJECT TO STABILIZE THE VILLAGE OF COMBE DOWN

A Government fund, the Land Stabilisation Programme, was established in 1999 to fund local authorities to carry out stabilisation of unstable and abandoned non-coal mining workings. This is administered by English Partnerships and Bath & North East Somerset applied for funding under this programme.

Applications for large scale funding from central Government go through an appraisal process following the 'Green Book' process ("Appraisal and Evaluation in Central Government"). (2) This requires the establishment of a base case and options, identifying financial and non-financial issues. A number of options were developed and assessed, including the option of demolishing the whole village.

An economic appraisal was carried out to evaluate the application and each option. This included valuing non-market impacts. The methodology for the appraisal included applying techniques for valuing the preservation of archaeological remains, built heritage, townscape and bats. Although this technique has been applied regularly to the natural environment, it has more rarely been used in the heritage field. (2)

The assessors concluded that because of 'the fact that the character of Combe Down would be lost forever and with it a significant part of Britain's history', the demolition option should **not** be taken forward. This assessment took into account the historic significance of the village as a whole, and not only the listed buildings as individual structures. It was considered that the contribution the whole village makes to the story of stone and Bath was so important that the village should be saved and stabilized.

The next step in the appraisal was to work out how much government funding could be justified for the project. For this the assessors needed to use comparative case studies for valuation of the historic environment. No example of a relevant contingent valuation could be found locally. (This is a questionnaire based method of estimating an individual's value of some un-priced (non-market) good or service.) So the assessors used a piece of work done in the medina (old town) of Fes, Morocco (see Fig. 7).

Fes, like Bath, is a World Heritage Site and work had been done here in the 1990's by Navrud (4) to value the heritage of the city prior to funding a conservation project. This was to find out the value that visitors and non-visitors would place on the existence of the



Figure 7. The Medina in Fes, Morocco was the subject of a valuation prior to investment in conservation. (Iles:2007)

city. This survey concluded that non-visitors would pay approximately \$30 per person towards the continued existence of the medina because of its special qualities and on the grounds that they might go there one day.

The assessors of the Combe Down Project then used another study which had been done to work out how many residents would pay for the continued existence of the mines and the village. This study was done in Newcastle (UK) (3), and looked at residents' willingness to pay for the restoration of historic buildings in Grainger Town.

From this the assessors concluded that approximately 53% of households in Bath & North East Somerset would be willing to pay extra council tax for the continued existence of the mines and the village.

This appraisal was the basis for a calculation of what government funding would be justified to safeguard the village. (Other factors such as water protection and protection of bats were also included.) The council was awarded up to £154 million to fund the scheme (this included for ecological and environmental mitigation as well as heritage and archaeology).

The method that was chosen was to infill the mines from underground with foam concrete, with protection of bat habitats and water systems as well as archaeological recording. The archaeology of the mine is being recorded in advance of the works and this has enabled the archaeologists to investigate the mines and understand the techniques used and the development of the mining.

2.1 *The impact of the project on the buildings in the village.*

White Young Green was commissioned to undertake pre-works condition surveys on all properties within and just outside the footprint of the old mine workings. WYG were appointed because they (formerly



Figure 8. Protective roadways (Hydrock:2004).

called IMC Consulting Ltd), have undertaken in excess of 25,000 property damage claims relating to ground subsidence throughout the coalfield areas of the UK on behalf of the Coal Authority, who held the legal responsibility on behalf of the Government to manage the repair of these properties.

In Combe Down the surveys were completed before the onset of any underground activity and benchmarked the condition of each property. A copy of the report was forwarded to each relevant property owner.

The surveys indicated that most of the properties in the village which are over the mine area itself displayed little or no signs of distress. Many of the properties are old, some built 150 to 200 years ago. All of these were constructed using the stone extracted from the mine. Although many of the houses displayed minor historical distortion consistent with age, there was little evidence of any recent settlement.

The stabilisation works to the mine have been designed and supervised by Scott Wilson and were planned to cause no damage to surface property and to date, it has to be said, with success. The Team addressed the most dangerous areas initially to ensure that these areas are now stable. The Project then concentrated on the filling of the stone mine caverns to ensure that the final situation achieves the full stability situation which the rock would have exhibited prior to mining.

Minor damage was caused to a dozen properties just outside the mine margin along North Road. These properties lie in an area where the stone had been quarried using open cast methods. When the Project was attempting to prove the limits of the old mine, surface bore holes were drilled in close proximity to these houses. It was proven that the mine margin ran through the gardens of properties along North Road and that the houses were actually sited on unconsolidated backfill material used to fill the old quarry. Unfortunately the drilling operation caused minor settlement of the fill material and consequently minor cosmetic cracking to some of the properties (see Fig. 8).

3 STABILISING THE VILLAGE FROM UNDERGROUND

Because the mines are unsafe, engineers are not able to carry out surveys or design stabilisation areas until protective roadways have been built (see Fig. 9). These underground roadways are built by miners from steel and provide a protective 'cage' for engineers to survey the mine extent and mine condition and develop engineering design. The roadways are also used to support the shuttering to contain the foam concrete which is poured in lifts and allowed to set.

In areas where aboveground movement is detected, strain gauges are placed on the roadways and monitoring 'tell-tales' on the buildings above, and these are checked daily for movement. However in some cases, there is no detectable underground movement related to above ground movement.

If movement and cracking is detected, the surveyor visits the property, records the damage and assesses it against the original baseline survey. A monitoring system is set up to enable the surveyor to establish when the movement is stopped. Repairs are not undertaken until the area is stable and movement has stopped.

Most of the repairs have involved redecorating and can be done while the resident is still living in the property. If there is considerable repair work, the owner is found alternative accommodation whilst the work is done.

There are some 750 properties above the mine, there have been fewer than 20 reporting cracking in association with the works, and most of these have not had structural damage.

4 SETTLEMENT OF SOME BUILDINGS

There has been noticeable settlement to two properties situated on Combe Road above the mine itself. A new access tunnel was being driven to access this part of the mine when localised settlement of the surface occurred, causing damage to adjacent properties. Tunnelling was ceased immediately and investigations commenced to determine the cause of the damage. There had been no sympathetic movement in the mine itself that might have been the cause of the problem. The investigations proved the existence of a large void situated above the mine roof and below the foundations of the houses probably caused by washout following years and years of surface water discharge. The voiding was subsequently filled with concrete and no further settlement has taken place.

In carrying out plaster repairs to several properties the construction of the older houses has been revealed. The external walls are constructed of two skins. There is an outer leaf constructed of ashlar stone blocks and an inner leaf constructed of rubble. There are no ties or bonding between the two skins. This may have been



Figure 9. Noticeable fractures appear on a number of the houses in the Combe Down Stone Mines Area. Here a crack can be seen to the left hand side of the window. (McCabe:2007).

the cause of accentuated cracking internally with little evidence of movement externally.

5 CONCLUSION

The village of Combe Down has an historic significance of such importance that the UK government has provided funding to stabilise the mines that lie underneath it and which if left untreated would threaten the survival of the village.

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FIGURES

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