Area	Designation and description	Impacts and monitoring	Mitigation of impacts
Heritage	World Heritage Site (WHS), Area of Outstanding Natural Beauty, listed garden at Prior Park.	Subsidence and collapse pose a risk to the stability of features in the area; reported by structural survey before the EIA.	Infill underground mines with foam concrete, following a design solution to last at least 100 years.
Ecology and designated nature conservation sites	Sites of Nature Conservation Interest (SNCI), Site of Special Scientific Interest (SSSI), candidate Special Area of Conservation (SAC). A wide variety of bats present including greater and lesser horseshoe bats and vespertilionid bats. Listed in the top ten of bat hibernation sites in the UK. Greater horseshoe is rare and endangered.	Comprehensive baseline data on the designated habitats. Bat population surveys using mist netting, radio collars and bat detectors. Temperature variations in the mines monitored using data loggers. Circulation and access routes kept open.	-Timing of works to avoid seasonal roosting (e.g. summer roosts treated in winter) and carried out in daylight. -Preserve and improve airflow and access to key roosts. - Use absorbent shredded rubber to cushion noise and vibrations. -Screening to prevent disturbance to roosting bats from lights.
Hydrology	The mine complex is above a Grade 1 aquifer, supplying water for public and private use. Drainage through the rocks and the mines is important in recharging that aquifer.	Drainage problems may occur above the foam concrete infill and water quality issues arising from construction. Monitoring of ground water levels in boreholes and turbidity at key ground water spring lines.	-Divert contaminated water away from clean water during works. - Promote natural drainage through all concrete infill.
Archaeology	The mines are of significant archaeological interest, with some areas designated Archaeological Importance Grade 1. These include preserved tramways, crane bases and graffiti detailing aspects of the miner's lives. The mines are an important element of the WHS designation.	Extensive survey, including scanning and video in selected archaeologically sensitive sites.	-Sand infilling is to be used instead of foam concrete infill. This is easily reversible should future generations wish to excavate.

Table 2.11 Summary of some of the potential environmental impacts and mitigations at Combe Down (Parsons Brinckerhoff Ltd. , 2002)

Environmental impact assessment (EIA)

EIAs are procedures required by the planning processes of most countries. They are produced alongside a development proposal. The steps in an EIA include a baseline study of all relevant aspects of the environment (biotic and abiotic). These could be similar to the methods described previously. The purpose of the EIA is to assess the likely impacts before the development and suggest alterations to mitigate these. The EIA also includes a monitoring programme to take place during and after construction and operations.

Combe Down mines case study

LOCATION Lat: 51°21'37.22"N Long: 2°20'46.86"W

These shallow stone mines were dug near the city of Bath in England in the 18th and 19th century for Bath Stone used in the construction of many famous buildings, including Buckingham Palace. They are reported to be the largest and shallowest mine complex in Europe, covering around 25 hectares with only around 6m down to as little as 2m of cover of rock above. Surveys carried out in 1989 found that the mines posed a hazard to local residents through subsidence or collapse.

Initial proposals were made to fill the mines with pulverised fuel ash (PFA) at an estimated cost of around 26 million pounds. There was wide spread opposition to this proposal due to perceived environmental concerns and the possible impact on the aquifer (water-bearing rock) below.

A team involving the council and the community produced a proposal to strengthen the mines, in order to protect the 760 buildings and around 1660 people living above. This proposal included a comprehensive EIA produced by an independent consultant.

The process followed these three steps:

1.Preparation	Screening – is an EIA needed?
	Scoping - what are the significant impacts and issues?
	Description of development and alternatives
	Baseline survey
	Key Impacts
2.Assessment	Impact prediction
	Impact evaluation and assessment
	Identification of mitigation
3. Presentation	Presentation of findings
	Review of the process
	Decision making

Table 2.10 Steps in EIA procedures

Impacts considered in the process include the impact on traffic, vegetation and ecology, groundwater and drainage, sewers, local amenities, accidents, noise and vibrations, radon levels, air quality, archaeology and cultural heritage, as well as listed buildings and designations in the area.

At all steps in the EIA a range of alternatives had to be considered, including the option of doing nothing, installing a variety of supporting structures, evacuation and controlled collapse. Estimations of the final cost of the project using foam concrete* (see table 2.11 for details), came to over 140 million pounds, an increase of over 400% on the original PFA option. This was due to the cost of the environmental consultancy, engineering compliance with EIA requirements and the time extension of the project due to the environmental requirements.

*low density concrete with air bubbles