APPENDIX 5
CASE STUDY DETAILS: NOSTERFIELD

Name: Nosterfield Quarry

Site location: 6.5 km east of Masham, 7.5 km southeast of Bedale (Hambleton district)

Elevation: c 40 mAOD

Natural area: Southern Magnesian Limestone

Abiotic characteristics

Nosterfield Quarry is a large operational aggregate quarry on former agricultural land within the Swale and Ure Washlands. The quarry site comprises a partly restored area and active area of sand and gravel extraction operated by Tarmac. Nosterfield Nature Reserve comprises 57 Ha of former sand and gravel workings adjacent to Nosterfield Quarry (***Figure N^{os} 1 to 3***). The reserve is managed by the Lower Ure Conservation Trust primarily for birds (see www.luct.org.uk).

Geology

The landform in the vicinity of the site is of fairly low relief, with a significant slope to the west rising some 40 m. The area is underlain by the Lower Magnesian Limestone to the west and mudstones with interbedded evaporates in the east. Superficial geology comprises fluvioglacial sands and gravels, which forms the economic mineral, glacial lake deposits, clays, till, peat and alluvium. The peat appears to have formed in depressions potentially associated with gypsum dissolution and/or very probably the historical actions of European Beaver (Castor fiber). Upper and lower sand and gravel units, each of some 3.5 m thickness, are separated by approximately 1 m of clay interburden.

Hydrology

The quarry and nature reserve lie across the groundwater and surface water divide between the catchment of the River Ure to the south and Ings Goit, a canalised watercourse, to the north.

In general groundwater and surface discharge from the nature reserve and quarry is southwards and northwards respectively. The majority of waterbodies in the vicinity of the Application Area are located in areas of current and former mineral extraction which have been worked dry in the shallower areas and via dredging over much of the site.

A floating pontoon is used within Lingham Water to move the discharge point of silt from mineral processing operations. Deposition of material leads to creation of deltas and areas of shallow water. The elevation of Lingham Water is controlled by an adjustable weir which is generally maintained at 39.4 mAOD. Excess water discharges to Ings Goit. There are no outfalls from the other lakes, which are in continuity with the remaining sand and gravel deposits and permeable backfill connecting to Lingham Water. Changes in water levels at Lingham Water have an effect on adjacent lake levels and the surrounding groundwater levels.

Groundwater occurs within two distinct units of the Magnesian Limestones separated by a mudstone unit and within the shallow sand and gravel deposits. Hydraulic connectivity between the aquifers may be restricted by the occurrence of low permeability clay. However, groundwater levels are generally similar and in some areas the limestone is exposed or in direct continuity with the sand and gravel in which case discharge from the deeper aquifer may occur. The discharge from Lingham Water represents a combination of groundwater and rainfall run-off. Groundwater levels are typically within 4 m of the original ground surface.

Including the quarry discharge, flow in the Ings Goit increases by some 200 to 300% in the 2.4 km reach adjacent to the northern section of the quarry, with downstream discharges recorded in the range 50-300 l/s.

Water Quality
Groundwater from the magnesian limestone aquifer is an important water source, containing high levels of dissolved minerals. The following water chemistry data has been recorded:

Variable/Location	Date	pH	Electrical conductivity
Near reedbed	20/9/2006	7.4	810
Near reedbed	2000	7.9	1350

Table A5.1: Water chemistry data at Nosterfield

Historical and landscape context

Nosterfield Quarry is set within a highly sensitive historic landscape including a nationally-important Mesolithic henge complex to the south-east of the quarry. A current phase of quarrying extends into an area known as the Flasks which had significant peat deposits. In recent decades this had been under improved pasture but was presumably an area of plateau fen or wet grassland in the past. Palaeoenvironmental evidence from a sink-hole within the main quarry indicated the presence of extensive fen with sedges, common reed and reedmace in prehistoric times, along with open calcareous pools containing fen pondweed (*Potamogeton coloratus*).

Fragments of fen vegetation occur in adjoining ditches and in a small woodland (Fox Covert) to the north of the quarry.

Two km. north of Nosterfield Quarry, the magnesian limestone escarpment descends into the low-lying basin of Snape Mires. Although cartographic evidence is contradictory, Snape Mires was probably an extensive wetland site in the Middle Ages with substantial areas of floodable peatland remaining into the 18th century, when a major drainage scheme was initiated. There is a clear reference to the extensive ‘swamp’ that existed in the Medieval era (early 13c.), with references to extensive peat digging and aftermath grazing rights – indicating this was a large and extensive wetland habitat. Nowadays Snape Mires is predominantly improved pasture with some arable, with pump drainage used to lower the water table. Extensive fringes of common reed (*Phragmites australis*) along drainage dykes suggest that reedbeds could have been a feature of the Mires prior to agricultural reclamation. This validates the decision to choose Nosterfield Quarry as a trial site for re-establishing reedbed habitat in the Swale and Ure Washlands.

Ownership and management arrangements

The northern part of Nosterfield Quarry is scheduled for nature conservation afteruse. This will include a combination of open water, reedbed, magnesian limestone grassland and scrub. – ha of reedbed have already been established successfully since 2003.

Staveley Quarry is an operative Tarmac Northern site. The Lower Ure Conservation Trust (LUCT) has played a leading role in managing the reedbed-establishment trial but long-term management arrangements for the wider nature conservation restoration area have yet to be resolved. North Yorkshire County Council is involved in discussions on a regular basis as this is seen as a leading site for habitat re-creation in the Swale and Ure Washlands. There is a Quarry After-use Committee which includes Tarmac, NYCC, LUCT, and Nosterfield Parish Council.

The original concept restoration was developed in 1996 and has been re-examined on an annual basis by a steering committee including local interest groups and the County Council. A flexible approach has been taken so that over time the design has evolved and opportunities have been taken to enhance the restoration where possible. The restoration is designed to meet a number of end uses including nature conservation, public access and recreation (sailing). The site is owned by a number of landowners who may wish to maintain a long-term interest in the site. The final management mechanism for the site is under review.

Ecological objectives of site restoration and management

The reedbed has been designed around the needs of Bittern, a UKBAP Priority Species. It is designed around four cells planted with reeds, a central trench and a small lake. The reedbed cells are designed to hold an average of 22.5 cm depth of water in the summer months. A network of 1.2 to 1.5 metre deep dykes runs through the reedbed. The cells are interconnected by 300 mm. pipe sluices. A total of 24,000 *Phragmites* plants were planted in 2003-2004, all grown from local-origin seed.

Elsewhere within the nature conservation after-use zone, a small fen re-creation trial plot has recently been established.

A small lagoon has recently been infilled with peat transferred from the Flasks, to provide a trial site for establishing fen/sedge swamp vegetation. At the time of writing this trial site is heavily flooded and no further work has been undertaken.

Objectives for nature conservation after-use have changed in recent years, and this has presented challenges for quarry managers. In addition, the sensitive location of the quarry and controversy attached to future expansion plans has meant that restoration schemes are perceived to be under intense scrutiny and need to meet amenity as well as ecological requirements.

Biodiversity interest

The reedbed contains open pools and trenches which support a range of aquatic species. Flora includes charophytes (stoneworts) and the nationally scarce mudwort (*Limosella aquatica*). Invertebrates recorded from the reedbed include a scarce species of lesser water-boatman and nine species of dragonfly. The reedbed also attracts good numbers of Snipe outside the breeding season.

The following habitats are identified as priorities for conservation in the UK or Local (Hambleton district) Biodiversity Action Plans:

Feature	UKBAP Priority	Hambleton BAP Priority
Reedbed	●	
Lakes and ponds		●

Table A5.2: Habitats supported

The wider quarry site includes several lagoons which attract large numbers of water birds, with waders gathering to roost on spits and shorelines.

Potential for wetland restoration

In addition to the reedbed, a small trial plot has been established as an experiment in re-creating fen habitat. This is a hollow bunded off from the main lake in the nature conservation area and backfilled with peat taken from one of the current working areas. However, further plans have yet to be agreed at the time of writing. Lingham Lake currently supports impressive roosts of Lapwing and Golden Plover, however these may be lost once proposed tree planting takes place. Both this waterbody and Flasks Lake support very large roosts of gulls (>40,000 Black-headed Gulls and Nationally Important numbers of Lesser Black-backed Gulls, in season) – although Bird Strike may be an issue. These waterbodies have a few Red Buntings - a BAP and 'Red List' species however they do not provide large amounts of priority habitat from the BAP list. As such the potential of gaining Stewardship income is limited and subsequently the site's sustainability under management for nature conservation is reduced. Potential exists to modify existing plans to increase the long-term scope for nature conservation benefit although this is subject to the interests of the other stakeholders.

Nosterfield Nature Reserve

Separate from the operational quarry, a principal feature of the nature reserve is the frequent inundation of the site during the spring due to winter rainfall and as water levels in the underlying limestone rise.

The average depth of water during inundation is c1 m, in accordance with the High Level Stewardship definition for 'wet grassland' of "up to knee deep". Because of the subdued landform within the reserve, quite a lot of the land above 39.6 mAOD is likely to have grassland that exactly fits this description as the water level rises. Water depths of 2 m or even 3 m may be desirable for some species (ie diving duck); however, not generally as an 'average'. Diving ducks will feed at greater depths but it is generally accepted that they use more energy than they gain, by going to greater depths.

Nosterfield Nature Reserve has been landscaped to provide optimal conditions for wetland birds, with overburden and silt used to create shallows and large water edge lengths around two main waterbodies in the north and south of the site. The LUCT have pioneered the development of seasonally flooded wetland-grassland scrapes. These shallow scrapes are formed in tiers, so that they fill as the water level rises and form valuable muddy areas as the water recedes, before naturally returning to grassland. This practice of using tiered scrapes on inundation sites is now promoted as good practice and the RSPB use the Reserve as a case study in various documents, ie *Habitat Creation Handbook for the Minerals Industry*, RSPB (2003) and *Nature After minerals*, RSPB/MIRO (2006), also on their mineral after-use web site (www.afterminerals.com).

Two small historic silt lagoons are located in the southeastern corner of the site and are isolated from the surrounding groundwater system. The main lakes are fed by a combination of surface run-off and groundwater from the underlying limestone and surrounding sand and gravel.