

APPENDIX 6 CASE STUDY DETAILS: SCORTON

Name:	<u>Scorton Quarry</u>
Site location:	1.7 km northeast of Catterick Bridge (Richmondshire district)
Elevation:	c 55 mAOD
Natural area:	Vales of York and Mowbray

Abiotic characteristics

This site covers a significant area (160 Ha) near the River Swale and Tarmac is still in the initial phase of sand and gravel extraction. Restoration proposals to open waterbodies will include provision to discourage large bird flocks due to the proximity of a major airfield. Potential may exist for the creation of a series of linked waterbodies with an outfall to the Swale. This is dependent on a number of factors including the accurate prediction of final water levels.

The quarry adjoins the River Swale at the southern end and good potential exists for habitat creation keeping in context with the setting of the Swale Valley (**Figures SCR1 and 2**).

Geology

The area comprises a sequence of relatively coarse glacial sands and gravels with interbedded clay. Much of the sand and gravel may have been deposited at the mouth of a channel which was discharging into a large lake. The base of the workable mineral is predominantly formed by a thick sequence of clay, the depth of which generally increases south-westwards. The underlying bedrock comprises Triassic Sandstone in the east and interbedded mudstone and Dolomite to the west.

The mineral forms a vertically limited but laterally extensive aquifer which is situated above clay. It is assumed that the clay possesses low hydraulic conductivity and forms the base to the shallow surface aquifer system in the vicinity of the quarry. The presence of several large waterbodies in the vicinity of the quarry, which are all situated within former areas of mineral extraction, and the River Swale to the south of the site, are considered highly likely to exert significant control upon the groundwater regime within the sand and gravel aquifer. Interaction between the bedrock aquifers and the overlying sand and gravel is thought to be limited by intervening clay although there is some similarity in water level response (Figure SCR3).

A ridge of clay is observed to outcrop ~200 m to the west of the site and this is considered likely to form a hydraulic barrier between sand and gravel to the west, adjacent to the plant and Scorton Lake, and the mineral to the east within future extraction areas.

The degree of hydraulic connection between the river and the gravels is unknown, but may be limited by the presence of low permeability alluvium in the riverbed. This may explain the relatively large water level difference between piezometer W9 (50.77 mAOD) and the adjacent river level of 52.06 mAOD, which suggests groundwater flow from the river into the gravels.

Hydrology

Scorton Lake lies immediately to the north of the current plant site within a previously worked area. The lake is used within the current water management system, receiving discharge from the silt settlement lagoons and the quarry void. Water is abstracted from the lake via a gravity feed to a freshwater lagoon which supplies water to the mineral processing plant.

A stream discharges into Scorton Lake which originally discharged into the River Swale, but was diverted to permit landfilling to take place within its valley. The total stream catchment area is c 400 ha. (The landfill is operated by North Yorkshire County Council (NYCC)). The lake does not have a natural outlet and NYCC currently regulates its level by pumping to a drainage ditch running to the east of the site access road. The ditch is estimated to be carrying 75-100 l/s. Water levels within Scorton Lake are generally much higher than in the adjacent workings. The hydraulic connection between Scorton Lake and the groundwater system is thought to be restricted due to the presence of low permeability silt on its base. Scope exists to incorporate discharge from the lake within the final restoration design.

The original approved restoration scheme includes a large lake and two smaller waterbodies which will be naturally regulated, with no outfalls between the lakes or to the River Swale and no inflow from Scorton Lake.

The restored lakes are designed to be in continuity with groundwater within adjacent areas of unworked mineral and their levels will be controlled to some extent by the local watertable. However it is recognised that the hydraulic continuity may decrease over time due to siltation on the lake floor.

The northern lake covers ~2.4 Ha and spans a length of ~1 km perpendicular to the groundwater contours. The prediction of final water levels is therefore complex with a potential range in groundwater levels across the area of 50-54 mAOD.

Observed groundwater levels are lower than the immediately adjacent river levels in the Swale. Should an outfall be considered it would need to operate at a considerable distance downstream to achieve the required elevation. As the site lies within the floodplain of the Swale, inundation of the site will require discharge of flood waters to the groundwater system, if there is no outfall in place.

Water quality

The following water chemistry data were obtained from samples collected on 29/11/2006.

Variable/ Location	pH	Electrical conductivity $\mu\text{S}/\text{cm}^{-1}$	Ortho- phosphate mg/l P	Nitrate mg/l N	Sulphate mg/l	Magnesium mg/l	Calcium mg/l	Alkalinity mg/l CaCO_3
Quarry lake	7.93	621	<0.1	6.38	60.3	28.5	105	251
North lake	8.19	498	<0.1	3.09	56.0	48.9	179	159

Table A6.1: Water chemistry data at Scorton Quarry

This data suggests mildly alkaline, base-rich conditions.

Historical and landscape context

There do not appear to be any historic wildlife records for this site and it is not associated with any former wetland.

Ownership and management arrangements

Scorton Quarry is operated by Tarmac. It is a large, operative site being worked in phases. The landowners retain the freehold.

Ecological objectives of site restoration and management

This site is not currently zoned for nature conservation after use. Reduction of bird-strike hazards is a priority due to the proximity of RAF Leeming.

Biodiversity interest

Scorton Quarry attracts significant numbers of dabbling and diving duck; bird counts have been undertaken under the auspices of the Swale and Ure Washlands Project but data are not presently available.

Standing water is identified as a Priority Habitat for conservation management in the Richmondshire BAP.

Potential for wetland restoration

The layout of water bodies on this large site is constrained by the need to minimize bird-strike risks due to its proximity to RAF Leeming. Combined with the depth of high quality aggregate deposits, this will result in a series of relatively linear, steep-sided lakes which have limited potential for the creation of adjacent wetland habitats.

However, the southern sector of the quarry (south of Tancred Grange) is within the floodplain of the River Swale. This has been partly quarried for surface deposits in the past and will be re-worked for deeper material in the near future. This area is zoned for nature conservation after-use, although management will eventually revert from Tarmac to the private land owners.

From a landscape ecology perspective, this sector has considerable potential if habitat creation relates strongly to the river corridor. Although this section of the Swale experiences some pollution from waste water inputs, the river corridor contains important habitat features such as permanently- and seasonally- exposed shingle banks, gravel deposits on the floodplain surface and riparian woodland. This reflects the relatively dynamic character of the middle reaches of the Swale.

The middle reaches of the Swale and Ure are amongst the few large rivers in lowland eastern England where dynamic natural processes of erosion and deposition still occur extensively; most lowland rivers have been more intensively canalized and regulated to meet the needs of agriculture, land drainage and urban development.

An important feature of dynamic river systems is the occurrence of exposed riverine sediments such as shingle, gravel and sand banks. These vary from large islands around which the river eventually migrates (known in North Yorkshire as Batts) through to small, transient bars of sand and gravel exposed only during low flows. Recent surveys of exposed riverine sediments on the Ure and Swale have demonstrated their importance for

biodiversity, providing habitats for rare and specialized insects such as the stiletto fly *Spiriverpa lunulata* (a UKBAP Priority Species) and the click beetle *Negastrius sabulicola* (Godfrey, 2006). Exposed sediments are also used as nesting and foraging habitats for birds such as Oystercatcher and Common Sandpiper. They support a range of plant communities from sparse pioneer vegetation to mature riparian scrub. Some Batts on the River Ure have a distinctive woodland flora including plants such as giant bellflower (*Campanula latifolia*) and yellow star-of-Bethlehem (*Gagea lutea*).

Ideally, habitat creation in the southern sector of Scorton Quarry should incorporate areas of exposed mineral substrate, sandy and gravelly banks and some wet woodland adjoining the Swale. The feasibility of using controlled flooding from the Swale should be considered, since this could replicate natural disturbance associated with fluvial processes.

The creation of a large reedbed taking in part of an adjoining landfill site has been mooted but this would require the commitment of a number of land owners and has not been progressed.



◀ Exposed riverine sediments are an important feature of the Swale corridor

Restoration Design Options

Bird strike

The presence of a major airfield in the vicinity with the attendant risk of bird strike is such that the restoration is to be designed to discourage congregation of large flocks of birds. Measures will include:

- Planting of trees right up to the shoreline
- Having a steep (~1:4) gradient to ensure areas of shallow water are not created
- Installing fences between the lake shoreline and the surrounding land

Tree species will be selected which are capable of withstanding short-term inundation and the planting may be adjusted as actual lake levels become apparent. During the first few years after completion of the final restoration it may be prudent to provide pumping capacity in case water levels are not as expected.

Incorporation of flexibility into the restoration design

Final rest lake levels are difficult to predict due to the current lack of long-term monitoring data. Therefore some flexibility in the design is recommended, particularly if there is to be no outfall from the lake. Based on the available data natural levels in the northern lake are estimated to lie in the range 50-52 mAOD. To avoid the formation of shallows it would

No	Option	Advantages	Disadvantages
1	Three self-regulating lakes (original scheme)	Follows approved scheme	Uncertainty in final lake levels
2	Outfall from N Lake to S Lake	Set maximum level of North Lake	Requires outfall construction beneath road. Uncertainty in ability of S.Lake to accommodate the additional inflow.
3	Outfall from N Lake to S Lake to river	Set maximum levels in each lake	Lake levels and outfall operations subject to river level and potential flooding. Requires outfall construction beneath road and engineering within the river
4	Outfall from N Lake to river	Set maximum level of N Lake	Lake levels and outfall operations subject to river level and potential flooding. Requires outfall construction beneath road and engineering within the river bank
5	As for No 1 but also receives discharge from Scorton Lake to N Lake	Less drawdown from original surrounding groundwater levels	Uncertainty as to final N Lake level and whether discharge to groundwater can accommodate inflow without flooding the N lake
6	As for No 2 but also receives discharge from Scorton Lake to N Lake	Increased area for discharge to groundwater system. Increased time N Lake is at maximum level with less fluctuation.	Uncertainty as to final S Lake levels and whether discharge to groundwater can accommodate inflow without flooding the S lakes
7	As for No 3 but also receives discharge from Scorton Lake to N Lake	Less drawdown from original surrounding groundwater levels. Increased time N Lake is at maximum level with less fluctuation.	Lake levels and outfall operations subject to river level and potential flooding. Requires outfall construction beneath road and engineering within the river
8	As for No 4 but also receives discharge from Scorton Lake to N Lake	Increased time N Lake is at maximum level with less fluctuation.	Lake levels and outfall operations subject to river level and potential flooding. Requires outfall construction beneath road and engineering within the river
9	As the above options but N Lake subdivided into a series of cascading cells	Increased confidence in final lake levels. Potential to raise N.Lake level to 53 mAOD and ensure operation of outfall to river.	More construction and material required

Table A6.2: Restoration options

be prudent to design the lake shore at a gradient of ~1:4 over this entire range (and potentially ± 1 m more). This would involve a horizontal width of 8-16 m over which uncertainty on rest water levels exists.

Outfall from the lakes

A series of options has been examined should a variation in the original restoration be considered and are presented in the table overleaf. Several of these options will allow the greater control of final water levels via the use of outfalls between the lakes and/or to the River Swale. Based upon the available data it is considered that the average groundwater-supported lake levels are likely to vary between approximately 50 and 52 mAOD in the northern lake and between 48 to 50 mAOD across the southern lakes. Lake levels will be subject to short-term increases due to run-off from rainfall events, and reductions due to relatively high rates of potential evaporation during the summer.

The provision of an outfall from the lakes would allow the maximum level to be set slightly below the predicted natural level. An outfall would limit the uncertainty involved in the design of the upper elevation of the 1:4 slope. Also setting the outfall level close to the natural summer low in groundwater level may reduce the likely fluctuation in Lake levels, although it would also lower the surrounding water table. Flexibility in the restored lake levels could be achieved by installing an adjustable sluice gate (or similar) at the lake outfall.

Accepting discharge from Scorton Lake through the restoration and/or the construction of an outfall to the river may require considerable changes (increases) to the currently proposed restoration levels. For example based on a slight alteration of the original design concept the northern lake level could be regulated to 51 mAOD with an outfall to the southern lakes. Discharge from the southern lakes could then be made via natural groundwater egress (Option 2 in table 3.1). However an outfall over the shortest distance directly from the Northern Lake to the River Swale would require a Northern Lake Level of > 52 mAOD. The implications are considered below.

Discharge from Scorton Lake

Routing of outflow from Scorton Lake through the restoration will add further complexities to the system, in terms of flow balancing within the lakes and the required storage capacities. Scorton Lake is fed by a large catchment and it is estimated that average flows in excess of 100 l/s may discharge into the northern lake during the winter months. Whether the outflow from Scorton Lake could be accommodated by natural evaporative losses and discharge to the groundwater system without an unacceptable rise in lake levels is dependent on the hydraulic conductivity of the intervening material between the lake bed and the remaining aquifer. The lakes cover a large area and would likely accommodate this discharge should good connection ($k > 1$ m/d) be maintained with the sand and gravel. However, siltation of the lake bed is likely to occur and there is considerable uncertainty in the prediction of final rest water levels, plus fluctuations in water levels are anticipated to be significant. Therefore it is likely that an outfall to the Swale will be required. A potential benefit of accepting the inflow from Scorton Lake would be the ability to maintain lake levels at or very close to the outfall level which would then not have to be too far below the natural pre-extraction groundwater level.

Impact of the Swale outfall being inoperative

During times of high river level, which are likely to coincide with periods of high rainfall, the river level may be higher than that of the lake and discharge from the lakes will not be possible. Consequently water will accumulate within the lakes and their levels will increase. A 'worst case' scenario may be assumed where maximum rainfall run-off coincides with maximum river stage which could result in some short-term flooding of adjacent land.

Subdivision of the Northern Lake

Greater confidence in final water levels could be achieved by sub-dividing the Northern Lake so that each segment does not span such a large range in groundwater levels. Out falls between these lakes may be used to effectively fix maximum levels and reduce fluctuations. This approach is also likely to fit well with the progressive nature of the restoration. For example a lake may potentially be created within phase 2 with natural levels of 51 to 53 mAOD. An outfall in combination with inflow from Scorton Lake may be used to maintain lake levels at 53 mAOD giving sufficient head to allow discharge via a ditch running directly to the closest point on the Swale. The outfall to the Swale could be maintained separately to the other lakes with potential to discharge to them if required.

Sustainable development

Upon completion of extraction at Scorton, several large waterbodies will be created at different elevations, supported by both groundwater and surface water inflows. Restoration proposals include return to agricultural usage, wildlife habitat creation and potentially recreational or residential usage.

A considerable amount of energy is stored within the lakes of the system, both in terms of thermal energy and potential energy (Scorton Lake level lies at 58 m Above Ordnance Datum (mAOD), ~6 m above the River Swale). It may be possible to utilise some of this energy as part of the proposed restoration. Of particular interest may be the use of heat pump system(s) to provide heating for residential, aquaculture or agricultural (greenhouse) purposes and micro hydro-electric generation. The water itself is also a useful resource for agriculture and perhaps residential supply, either for non-potable use or as potable after treatment.

Sufficient land is available for the construction of an ecological waste water treatment system, such as that employed to serve the village of Scaryingham, Yorkshire, which has won several awards. The availability of these sustainable resources may complement the creation of an ecologically friendly development or 'eco park' such as the very successful Cotswold Water Park. Short rotation willow coppicing to feed a micro power plant might also be considered. This has been discussed in further detail under the section dealing with sustainable energy production within the main report.