The construction and renovation OF stillwater coarse fisheries

ENVIRONMENT AGENCY

Written by:

Dr Bruno Broughton
Trenchard
Lower Bromstead Road
Moreton
Newport
Shropshire
TF10 9DQ

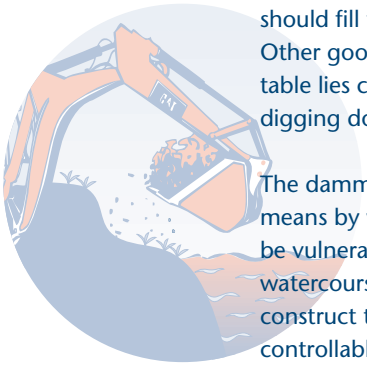
For more copies of this booklet
please contact:

National Coarse Fisheries Centre
Environment Agency
Arthur Drive
Hoo Farm Industrial Estate
Worcester Road
Kidderminster
Worcs DY11 7RA
Tel: 01562 68975
Fax: 01562 69477

Site selection and appraisal

The success of a lake construction project depends on a suitable, accessible site and the presence of a reliable, unpolluted supply of water. If excavation machinery cannot easily gain access to the land, or if the removed material (spoil) cannot be retained on site, costs will escalate.

The best sites are damp or marshy sections of farmland overlying clay. A lake formed in clay at the foot of a hillside should fill through surface drainage during wet weather. Other good sites include those where the subterranean water table lies close to the land surface; construction work entails digging down to the underground water.



The damming of a stream or river can be a relatively cheap means by which a lake can be formed. However, the lake will be vulnerable to siltation and possible water pollution if the watercourse flows directly into it ("on-line"); it is preferable to construct the lake to one side of the watercourse, with controllable inflow and outflow channels ("off-line").

TEST HOLES

Unless a full geological survey is commissioned, it is prudent to dig test holes across the site to determine the underlying substrate and to assess water supplies. Each hole need be no larger than two metres square and three metres deep. The spoil should be stored next to each hole, so it can be refilled.

Each hole should be covered temporarily - for obvious safety reasons - and marked with standard red-and-white barred plastic "hazard warning" tape.

PLANNING MATTERS

It is a legal requirement that planning permission is granted before the onset of any engineering work to create or enlarge a lake which is for non-agricultural use, within 25 metres of a

road, or where material is to be exported from the site.

The written consent of the Environment Agency is required if the excavation is within the flood plain of a river. The Agency's consent may be withheld if the position of a lake is immediately alongside a watercourse which could breach the intervening bank, or if spoil is to be stored in the flood plain. Contact your local Environment Agency Flood Defence Office for advice.

Before planning consent is sought, a land survey will be necessary to map the existing levels and contours. Special attention should be paid to the presence of constraining features (for example underground services, rock outcrops, mature trees). Detailed plans will then have to be drawn up for the lake creation and any ancillary work.

Design & construction

SIZE AND SHAPE

It is usually possible to create a lake that covers about 60-65 per cent of the available space; the remaining land is for access and car parks, paths, spoil disposal and tree planting.

Most stillwater fisheries are easier to manage if they are of uniform shape, since this will simplify fish removal which may become necessary in future. The value of a lake for angling will be enhanced if its outline is convoluted, with promontories and bays. This increases the length of fishable banks, is more interesting and can provide benefits to other wildlife.

ISLANDS

Islands add value to a lake, increasing the attractiveness of a fishery, enhancing its value to waterside wildlife and shielding one bank from another. Large islands are not recommended because of the "iceberg effect" (see Figure 1).

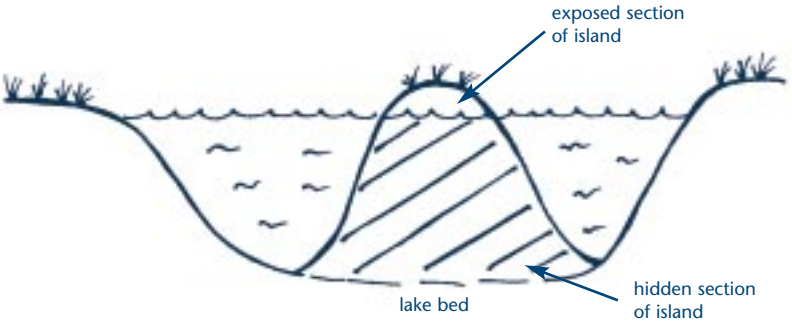


Figure 1: Iceberg effect

DEPTHS AND OTHER FEATURES

The average water depth in most coarse fisheries should not be more than about two metres. Shallower water warms more quickly than deeper water, encouraging water plants and invertebrate animals, the food of coarse fish. Fish life may be placed at risk if most of the water is shallower than one metre, although limited areas of shallows are important for the growth of marginal plants and to provide shelter and breeding habitat for fish.

These figures reflect the depths of water; the depth of the excavation is governed by the projected final water level in the lake and - if appropriate - the seasonal change in the height of the water table.

BOTTOM CONTOURS

The "batter" (or slope) of the banks in the margins of a fishing lake should be between 1:1.5 and 1:2.5. An underwater ledge or "berm" will (i) allow the rapid establishment of a fringe of marginal plants but prevent their encroachment into the water offshore, and (ii) provide a safety feature for anyone who may slip or fall into the water (see Figure 2).

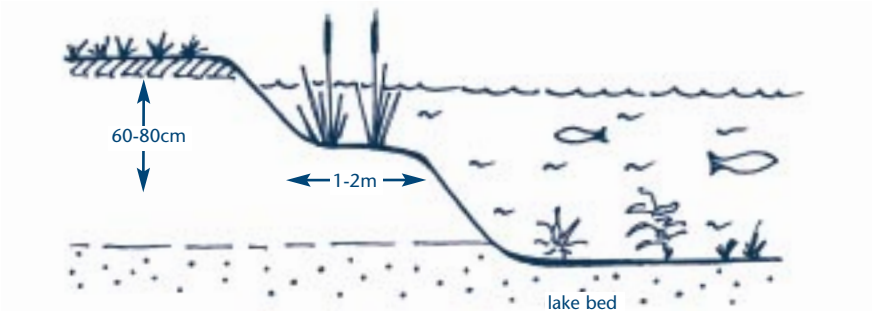


Figure 2: Bankside berm

CONSTRUCTION METHOD

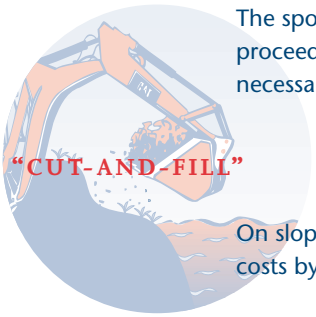
Detailed advice on the construction of the lake is outside the remit of this booklet, and technical advice should be sought from a qualified civil engineer.

MACHINERY

A drott or bulldozer could be used for the excavation. Generally, a drott is more useful as it can not only move soil but also lift and dump it, providing there is a base from which it can work; a bulldozer can only push soil, which will reduce its ability to landscape the banks.

Alternatively, some form of hydraulic excavator could be employed for the lake construction, especially if water will rapidly enter the newly excavated area. The machine could begin working towards the centre of the site, thereafter gradually removing spoil as it moves towards the edge.

The spoil will have to be removed as the excavation proceeds, and one or more earth-moving vehicles will be necessary for this purpose.



"CUT-AND-FILL"

On sloping sites overlying clay it may be possible to reduce costs by employing the "cut-and-fill" method. Clay which is

removed at the "uphill" side is used to raise the height of the banks along the "downhill" side.

Because the embanked section will help retain water in the lake it must be impermeable to water, with a clay core which is "keyed" into the underlying clay (see Figure 3).

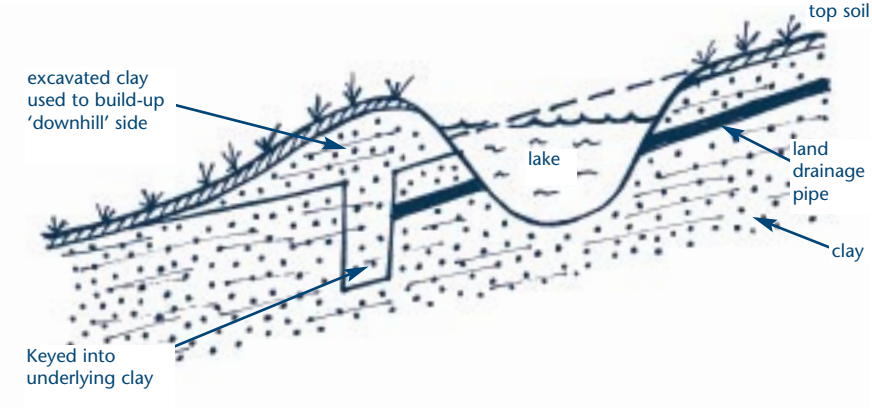


Figure 3: 'Cut-and-fill'

DAMS

The creation of an on-line or off-line lake necessitates the erection of a stable dam to retain the impounded water. Such lakes should never be constructed without consulting a fully qualified engineer and the Environment Agency. A licence may have to be obtained from the Agency for the abstraction, impoundment and/or discharge of water. Under the provisions of the Reservoirs Act there are special legal requirements if the dam is to retain more than 25 million litres of water.

Provision should be made for the overflow of excess water and, if possible, the drainage of the lake via a sluice or monk. It is essential that an on-line lake be protected against siltation by forming one or more silt traps on the feeder stream(s). Typically, a trap consists of a low weir - with a deepened area immediately upstream - which reduces water velocities and encourages silt settlement. Silt traps should be subject to routine cleansing to retain their effectiveness.

PREVENTION OF WATER OUTFLOW

On lakes formed in the underlying clay it will be necessary to cover any permeable material or fissures with a layer of clay, compressed into place ("puddled") when wet, to prevent water outflow.

It is important that the water cannot drain away through any land drainage pipes which might underlie the land surface. This could be accomplished by digging a so-called "key trench" close to the banks on the downhill side, then infilling it with clay.

SPOIL DISPOSAL

The material which is not used in any water-retaining embankment could be "bladed" into the slope of the adjoining land or used to form low embankments around the site.

Once construction work is complete, topsoil should be retained to be respread over the disturbed land flanking the lake. Thereafter, it should be sown with a low-maintenance, coarse grass seed, perhaps incorporating a commercially available amenity or wild flower mixture.

If the bed of the lake appears to comprise infertile substrates, a shallow layer of the topsoil could be distributed over it to provide a good growing medium for water plants.

Post-construction work

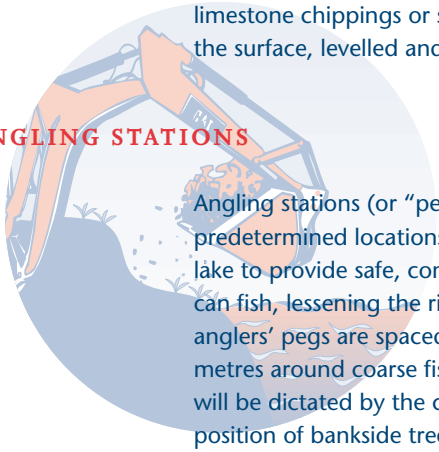
PREVENTION OF BANK EROSION

The banks of a newly created lake and any islands within it are liable to wind-induced wave erosion, especially along downwind shores. The most convenient way to prevent this is to plant the edges of the banks and islands with marginal

plants to act as absorbent wave buffers. If erosion is (or could become) severe, some form of armouring of the margins would be appropriate. This can be achieved with large boulders of stone-filled cribs - known as gabions - set into the banks at the water's edge.

ACCESS ARRANGEMENTS

It is sensible to retain a border of at least three or four metres wide as a fringe around the banks of the lake, close to the water's edge, to serve as access for maintenance vehicles and a route for bankside paths. These surfaces and any car parking areas should be firm. If either is likely to become muddy or unstable during wet weather, a layer of hardcore, limestone chippings or similar material should be spread over the surface, levelled and compressed into place.



ANGLING STATIONS

Angling stations (or "pegs") should be formed at predetermined locations around the banks of a coarse fishing lake to provide safe, comfortable areas from which anglers can fish, lessening the risk of damage to the margins. Usually, anglers' pegs are spaced at intervals of between 10 and 20 metres around coarse fisheries, although their exact positions will be dictated by the contours of the banks and the position of bankside trees.

The land surface at the water's edge should be levelled and the bank strengthened at the land/water interface using stout, weathered timber (for example disused railway sleepers) or other materials. Any soft or new wood should be pressure-treated with a non-toxic preservative.

These facilities will be especially useful to wheelchair users' providing there is easy access to them. Additional information is given in the booklet "The Creation of Angling Facilities for Disabled People".

Lake development

AQUATIC PLANTS

The lake will begin to establish its own community of aquatic plants by natural means. Colonisation will be assisted by the small-scale introduction of suitable native plants obtained from other fisheries in the vicinity (although there is a slight risk of introducing unwanted fish parasites and diseases). The owners' consent is a legal requirement under the provisions of the Wildlife & Countryside Act 1981.

SUBMERGED PLANTS

Submerged plant species with finely divided leaves are appropriate in coarse fisheries, although it would be prudent to exclude Canadian pondweed (*Elodea canadensis*) because it can grow too profusely in shallow lakes. Planting is best accomplished by introducing loosely tied, weighted bundles of the plants.

FLOATING LEAVED PLANTS

Most species are useful, including water-lilies, but fringed water-lily (*Nymphoides peltata*) should be excluded because of its invasive properties. Introductions can be accomplished with weighted sections of rhizomes, by direct planting of whole plants or by placing plant-filled containers on the lake bed. Lilies should be placed in water less than 1.25 metres deep, in full sunlight.

BANKSIDE TREES AND SHRUBS

The design of the lake should incorporate trees and shrubs around the periphery and on the adjacent land. If trees are to be introduced close to the margins, they should be grouped

in copses so that they do not restrict angling. Native species which flourish in damp conditions are best; these include alder, various willow species, poplar, hawthorn and dog rose. Contact your local Environment Agency Conservation section for more information.

Establishing the fishery

GENERAL PRINCIPLES

Most productive, stillwater coarse fisheries in Britain have a weight of fish per unit area (or fish standing crop) of between 350-600 kilograms per hectare (kg/ha). In those where carp are present in large numbers the standing crop can exceed 700 or 800 kg/ha, although the carp will tend to out-compete other coarse fish, which may decline in numbers and weight.

FISH STOCKING

In newly created lakes an initial stocking at about 250-300 kg/ha is appropriate, although this could be through a phased stocking programme. This should provide scope for stocked individuals and their offspring to grow to larger sizes.

Species selection will be influenced by the intended use of the fishery. Where a general mixed fishery is to be developed, it is sensible to avoid the introduction of large numbers of two or more species known to compete vigorously for food (such as common or mirror carp, bream and tench); perch, and roach or rudd, would be more appropriate.

SIZES

In general, fish of about 15cm and longer have a far greater rate of survival than smaller but cheaper fish. It is important

that the stock fish are young, so that they can grow larger. If fish are obtained from commercial sources, the introduction of two or more size groups helps ensure that fish of different ages are stocked.

TIMING

It is sensible to let a new fishery mature for the minimum period of one summer before fish are released. This should ensure the adequate development of the aquatic *flora* and *fauna* on which fish will rely for food, spawning and shelter. Fish should not be introduced in the warmer months, and most stocking should take place between October and April.

LEGAL MATTERS

The prior written consent of the Environment Agency is required before any fish can be introduced legally. It is essential that the source of these fish is investigated rigorously and that a sample of the fish is subjected to pathological examination, to prevent the introduction of disease and undesirable parasites.

See the Agency's leaflet "Buyer Beware" and the Agency Guide to Stocking Fish in England and Wales for more information.

The restoration of stillwater fisheries

When lakes are not maintained adequately or become neglected, their value as fisheries often diminishes. Each neglected water body will require a specific restoration plan based on the most cost-effective resolution of its particular problems. Typically, these include silt, excessive plant growth both beside and in the water, and leaks.

SILT

Siltation occurs because of the deposition of stream-borne

material, the build-up of dead water plants and leaf litter, and erosion of the banks. (The methods available to remove silt are examined in detail in another booklet in this series, "Desilting Stillwaters").

Preventing further siltation may require:

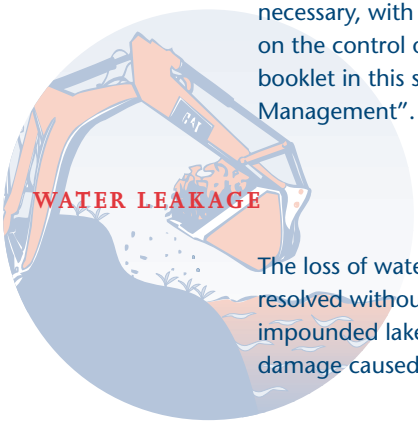
- **the installation of silt traps on feeder stream(s)**
- **the annual removal of floating leaves**
- **the use of lime or chalk products where siltation occurs**
- **measures to combat bank erosion.**

OVERGROWN BANKS

For wildlife conservation reasons, the clearance of overgrown banks should usually be restricted to the formation of bankside paths and anglers' pegs, as well as the removal of dangerous or poorly positioned trees and shrubs. Bankside alder and willow trees are suitable for pollarding, especially if they are tall and spindly, to create a new, lower crown of branches.

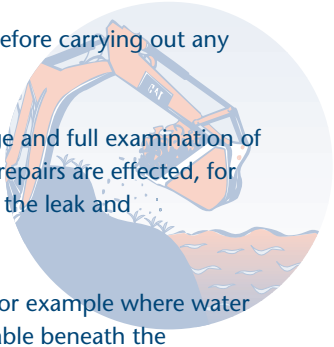
CONTROL OF EXCESSIVE PLANT GROWTH

Where submerged and floating-leaved plants have grown to an invasive extent, or marginal plants have encroached far into the open water, their control is desirable. Manual methods (raking, cutting and harvesting) should be considered first, although applications of herbicides may be necessary, with Environment Agency consent. More details on the control of water plants are included in another booklet in this series, "Water Plants, their Function and Management".



WATER LEAKAGE

The loss of water may pose difficulties which cannot be resolved without considerable financial expenditure. On impounded lakes the problem can often be traced to damage caused to the dam core by the roots of mature trees.



Specialist advice should be sought before carrying out any tree-felling.

In clay-lined lakes, complete drainage and full examination of the damage will be required before repairs are effected, for example by spreading wet clay over the leak and compressing it into place.

Some problems cannot be solved; for example where water abstraction has lowered the water table beneath the permeable bed of a lake, or when long periods of low rainfall mean that a lake is not refilled naturally.

MANIPULATION OF THE FISH COMMUNITY

Unless information is available on the size and nature of the fish community, some form of survey will be required. Thereafter, the fish populations may have to be adjusted through removals and/or introductions.

Further reading

"Buyer Beware - A Guide to Fish Stocking". Published by the Environment Agency, 1996. Free from Environment Agency regional offices.

"Freshwater Fisheries and Wildlife Conservation, a good practice guide". Published by the Environment Agency, 1998. Free from Environment Agency regional offices.

"Freshwater Fisheries Management", edited by R. Templeton. Published by Fishing News Books Limited, 1995.

'The Creation of Angling Facilities for Disabled People", produced by the Angling Foundation, 1994. Free from Convenience Marketing, Regency Business Centre, 26 Queens Road, Kenilworth, Warks CV8 1JQ.

"The New Rivers and Wildlife Handbook" by the RSPB, NRA and RSNC. Published by the RSPB, The Lodge, Sandy, Beds SG19 2DL.

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD
Tel: 01454 624 400 Fax: 01454 624 409

Internet World Wide Web www.environment-agency.gov.uk
www.environment-agency.wales.gov.uk

ENVIRONMENT AGENCY REGIONAL OFFICES

ANGLIAN
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811
Fax: 01733 231 840

MIDLANDS
Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: 0121 711 2324
Fax: 0121 711 5824

NORTH EAST
Rivers House
21 Park Square South
Leeds LS1 2QG
Tel: 0113 244 0191
Fax: 0113 246 1889

NORTH WEST
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

SOUTHERN
Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: 01903 832 000
Fax: 01903 821 832

SOUTH WEST
Manley House
Kestrel Way
Exeter EX2 7LQ
Tel: 01392 444 000
Fax: 01392 444 238

THAMES
Kings Meadow House
Kings Meadow Road
Reading RG1 8DQ
Tel: 0118 953 5000
Fax: 0118 950 0388

WALES
Rivers House/Plas-yr-Afon
St Mellons Business Park
St Mellons
Cardiff CF3 0LT
Tel: 01222 770 088
Fax: 01222 798 555

For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY GENERAL ENQUIRY LINE

0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY EMERGENCY HOTLINE

0800 80 70 60

ENVIRONMENT AGENCY

HO-3/99-10K-C-BEDF Printed on Cyclus Print, a 100% recycled totally chlorine free paper