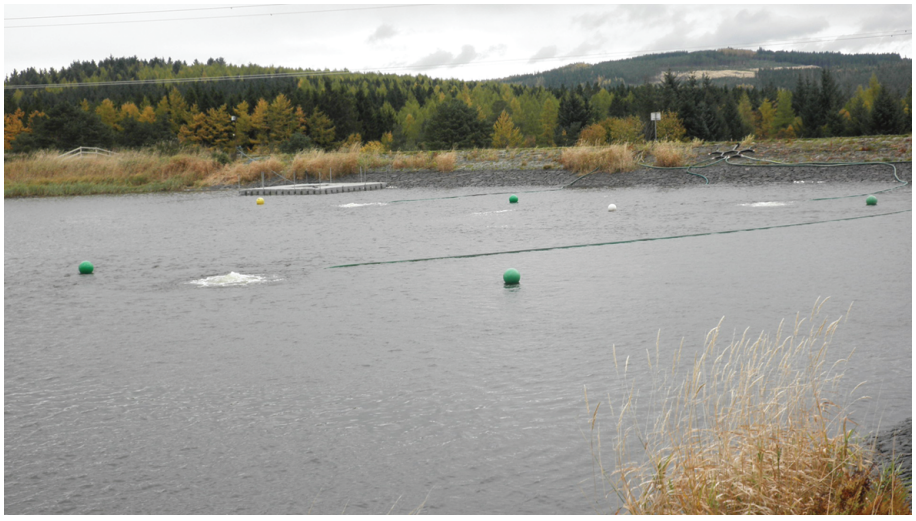
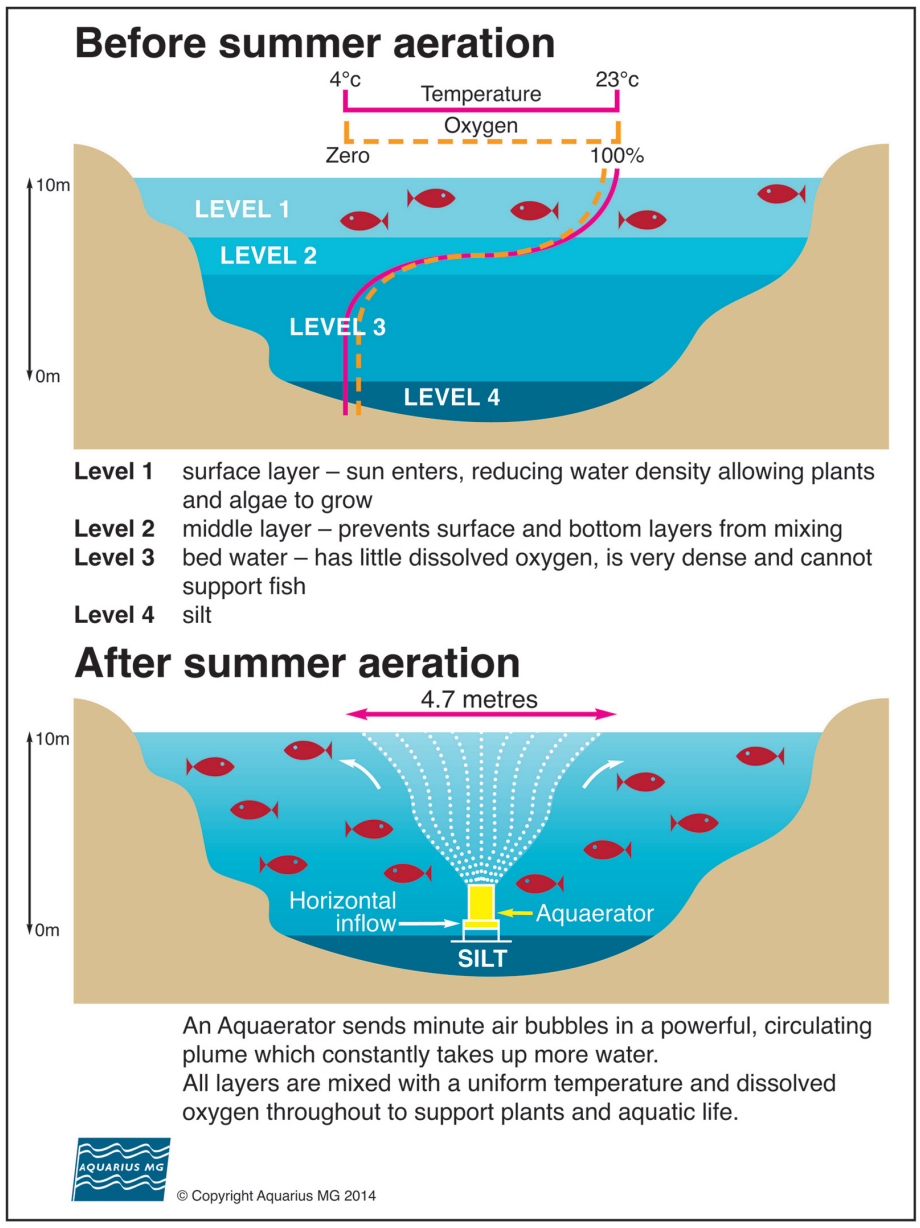
The best way to clean up flooded lakes and reservoirs?

Tony Wynes, Managing Director of Aquarius Marine Group

Agricultural run-off, sewage discharge and, more recently, floodwater are all compromising water quality in lakes, rivers, reservoirs and coastal waters. High concentrations of manganese, iron, aluminium and phosphates, which contribute to algal bloom and noxious gases, are affecting our aquatic animals and flora. Unhealthy, polluted water limits leisure activities and expensive chemical treatments are required to treat reservoir water – neither scenario is desirable, or even necessary. Tony Wynes, Managing Director of Aquarius Marine Group and developer of the Aquaerator,discusses the various options available today



Craigshead Reservoir with Aquaerators in Action



Lake and Reservoir Aeration - Before and After

Floodwater has been running off the land into rivers and lakes, carrying with it all sorts of waste, including raw sewage. Tests from Reading University recently showed floodwater contained 60-70 times the amount of bacteria recommended by the World Health Organisation.

But this is only compounding a growing problem. A lack of both management and investment, together with an increase in agricultural chemicals, has seen a steady decline in the health and ecology of many lakes and reservoirs.

One of the causes is thermal stratification, a common condition affecting bodies of water with little or no flow in the summer months - the result of heating by the sun. The result is layers of unmixed water at different temperatures with extremely poor levels of dissolved oxygen in the deeper water and a consequent disruption to the normal water ecology. This anoxic layer is bad for fish and the other organisms, which normally break down organics deposited in the lake. Studies also show that low levels of dissolved oxygen in deeper waters is linked to the development of toxic blue green algal blooms and increased concentrations of manganese and iron.

The Environment Agency is trying to improve lake water with the 2015 Water Framework Directive, which will make county councils responsible for improving the ecological status of 'water bodies' and 'protected areas' within each of the UK's River Basin Districts. Achieving this, however, could be challenging, given financial constraints and the additional complications of recent flooding. Proven, low cost solutions, requiring little energy or maintenance, are urgently needed.

Current Aeration Solutions for Water Improvements

Aeration has long been the solution of choice to maintain good water quality. Implemented effectively, it will solve all these problems. It enables oxygen exchange at the surface and releases noxious gasses such as carbon dioxide, methane and hydrogen sulphide from the various layers of water. Reservoir aeration has the added benefit of naturally improving water quality and reducing the necessity of expensive chemical interventions at the treatment works.

However, choosing the right solution can be problematic, partly as there are a raft of products all claiming to offer similar health benefits. Nor is it a matter of simply installing your chosen device and sitting back. As a first step, you really need to understand what is going on in the water, and use accurate sampling and analysis, before any solution is deployed.

Surface Aeration

The use of fountains to aerate the surface waters is a traditional method to improve conditions and these can also be attractive, an important consideration for urban lakes and water bodies. But, as they only pull the first 0.3 - 0.6 metres of water up to oxygenate it, they cannot handle large areas and require constant amounts of energy.

Floating surface aerators, which disrupt the first 0.6 metres of water, are also powered by on-shore electricity and are limited to adding oxygen to much more than a 3-metre diameter, often leaving the bed water unaffected. Paddles work in a similar fashion, agitating the water to add oxygen, but again they use lots of energy, there are moving parts to maintain, and above all they cannot aerate an entire water column. None of these resolve the low dissolved oxygen depletion problem at depth - which is the underlying issue.

Subsurface Aeration

Subsurface aeration devices seek to release bubbles at the bottom of the water body. Diffuser aeration systems use multiple diffuser discs to produce fine bubbles. These are generally used to maximise oxygen discharge in tanks and small ponds.

Many of these devices, however, due to their design, are only able to affect a relatively small cubic volume of water, so large numbers of them must be deployed to aerate a lake adequately. Initial capital costs to cover purchase and installation are therefore high, and ongoing energy costs can be significant. Also, the size of the air bubbles rising to the surface is critical and often quite large and less effective, depending on the depth.

Bed View 2 of Aquaerators at Craigshead

A Low Carbon Solution

A new, low energy solution, scientifically proven to mix and aerate bed water with powerful plumes spreading out to 9 metres surface diameter (depending on the water depth) is generating significant interest in Scotland and China. This "*Aquaerator*" mixes air and near-bed water together to form a buoyant plume which has enough vertical momentum to expand and rotate while bubbles rise to maximise the rate of entrainment of near-bed water immediately above the device. The device differs from others on the market as its 40 small air jets release tiny bubbles at high pressure,engulfing we believe the largest amount of water, while requiringless power than other sub surface solutions. The ability to mix and aerate a large volume of water from a single device, namely 4.5 tonnes per second from 10m depth and increasing to 13.4 tonnes per second from 20m, offers advantages over solutions that mix the water column just above the device.

Benefits to the Environment

With any subsurface solution, it is also very important that the silt bed, which normally traps unwanted heavy metals, remains undisturbed. A solution, which takes the water horizontally from near the bottom, thus without disturbing the silt, ensures the ecology of the lake or reservoir bed is not disturbed and that silt is not drawn up into the water column.

Reducing Costs for the Water Industry

Cost of course is a fundamental issue. Understanding the capital cost as well as the ongoing energy consumption and likely maintenance issues is another aspect that you will need to look at. A sub surface solution with no moving parts, which is easy to maintain and has no stainless steel manifold to attract the build-up of heavy metals such as manganese and which can entrain large volumes of mixed air and water to reduce bed water density, will be more economical than surface solutions.

Aquarius Marine is a founder member of the Environmental Industries Commission at the House of Lords in 1995 and a member of British Water.