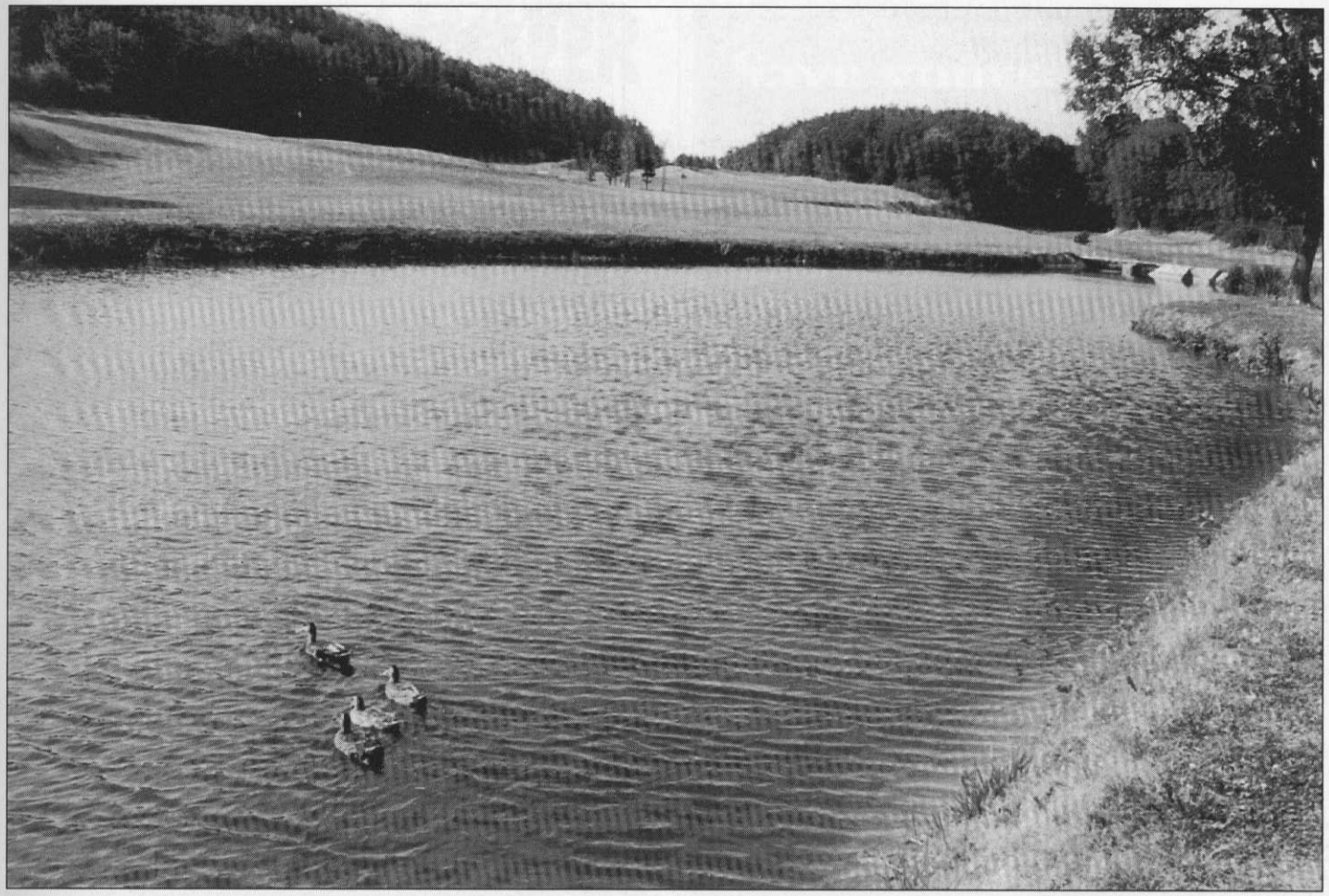

IRRIGATION WATER

Finding a suitable source of irrigation water for golf courses is becoming an increasing headache with heavy water charges, stringent abstraction limits and unreliable rainfall. Although automated irrigation systems are helping to maximise the efficient timing and use of irrigation water, these systems can still be limited by a poor quality water source. As a result, existing water features are being used to supply irrigation water together with an increasing number of specially constructed reservoirs.

The final quality of irrigation water is very much dependent upon the management of these water features and the quality of their original source water. The following is an overview of typical irrigation water sources, some problems inherent in them and how these problems can be managed to maximise irrigation water quality.

Borehole and Mains Water

A readily accessible underground water supply can provide a cheap source of high quality water. If drawn off chalk, however, there can be problems with high alkalinity and some groundwaters contain high metal levels such as iron. Groundwater supplies are also becoming universally nutrient enriched, as a long term result of agriculture – this becomes a particular problem when water is used to maintain lake and reservoir levels.

Mains water varies greatly in its suitability for irrigation, depending upon the area of the country and the original source of supply. Water drawn from an aquifer is typically of the highest quality, whereas river extracted water, that may have passed through several treatment processes in its lifetime, can have a high level of dissolved nutrients and minerals. Chlorine levels can also vary considerably, both from region to region and from day to day within the same region. Holding mains water in a tank before use, allows any residual chlorine to dissipate.

Local water companies will supply a detailed breakdown of the mains water quality in your area. This information can be used to determine whether water can be used directly or would benefit from blending with another available source.

Lakes & Reservoirs

Golf course water features have long been used as a source of irrigation water. As a greater understanding of how the natural ecosystems of these features work however, we are becoming better able to manage these features to maximise their irrigation water quality. A well managed water feature can improve the quality of an initially poor water source, whereas a poorly managed one will have the opposite effect.

Eutrophication

Eutrophication, or nutrient enrichment, is an almost universal problem in lakes and reservoirs. Nutrient rich ground and mains water sources, combined with surface fertiliser run off, means that excessive inorganic nutrients readily find their way into water courses. The most visible effects of this are heavy filamentous algal growth (blanket weed) and unicellular algal growth (pea-soup water). As well as generating complaints from members, the effects of heavy algal growth in an irrigation lake range from the constant blocking of pump filters, to an accumulation of decaying algae in the sward.

Contaminated Water Sources

Lakes and reservoirs fed by stream or surface run off, are prone to a wide range of contaminants. The origin of a stream may be many miles from the lake it feeds and in the interim can become contaminated with a variety of industrial pollutants affecting pH, salinity, nutrient and cation levels.

Any water sources originating in urban areas have been shown to be universally contaminated with lead and zinc, together with hydrocarbons from fuel and mineral oils. All these pollutants will accumulate in the sediment of a lake, ultimately accumulating in the rootzone through irrigation.

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On Site Waste Treatment

The distance of some courses form mains drainage means that sewage emuent may be treated on site by systems ranging from a septic tank, to a full biological waste treatment plant. This treated waste is typically discharged to a water course feeding an irrigation source.

When working efficiently, a waste treatment plant produces large quantities of inorganic nutrients, nitrates, phosphates and minerals, as a result of organic degradation. These nutrients will accelerate lake eutrophication and reduce water quality. When working inefficiently, which they do for a number of common reasons, a treatment plant will discharge undegraded organic solids, together with high levels of ammonia and nitrites and other ecotoxic compounds. Unless heavily diluted, these pollutants will seriously damage a lake or reservoir and will have a similarly damaging effect on fine turf and soil microflora. The problems associated with irrigating with treated effluent are becoming common in southern Europe where water restrictions demand more recycling. It is important to be aware of the downstream effects of inefficient effluent treatment so remedial action can be taken before long-term damage is caused.

Many fine turf problems resulting from poor water quality are cumulative, with the cause being masked as a result. Most irrigation water related problems can be determined however, through analysis of water sources and a survey of the lake or reservoir.

pH Fluctuation

In trying to maintain acid conditions on greens, the use of high pH water presents the most obvious problems. Most lakes are naturally slightly alkaline but degrees of alkalinity vary greatly throughout the country. Alkalinity is typically countered with acid dosing direct to water or by the use of acid releasing fertilisers.

A heavy algal bloom in a lake or reservoir will also significantly raise the pH of the water due to the photosynthetic process. The pH rises through the day reaching a maximum in the evening and then lowers through the night to reach its lowest point in the early morning. If algal growth is heavy, irrigation can be timed accord-

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ingly to reduce the effect of alkalinity.

Abstraction

Abstraction methods can be tailored to minimise some of the problems inherent in a water feature. Where there is a contaminating water source, water should be drawn off at the furthest point to take advantage of the natural purifying capacity of the ecosystem.

In shallower lakes, where there is a problem of accumulating silt, pump inlets should ideally be floated on the surface to avoid the uptake of any bottom sediments, as these have been identified as one of the causes of anaerobic 'black layer' on greens.

Deeper lakes, especially reservoirs, are prone to seasonal stratification. In some cases, this results in algal growth being limited to the surface layer, making a deeper abstraction point beneficial. Stratification problems can be prevented through effective aeration, which will also help to oxidise pollutants in the water and reduce the accumulation of organic sludge.

'Modern biotechnologies are being used to combat the problems of eutrophying water bodies with applications in the control of algae, the reduction of silt and the improvement of water quality'

Ecosystem Management

Effective management of a water body can reduce the occurrence of irrigation water problems as well as limiting the impact of a polluted water source. Combating heavy algal growth is a priority which can be achieved in several ways. Planting a range of marginal submerged and floating plants is an effective means of long term management however, the nature of the water body and its seasonal fluctuations in water levels will determine the most suitable plant types.

The prudent use of herbicides; triazines for blanket weed and glyphosates for floating plants can help to restore a highly eutrophied lake. These products should always be applied by qualified personnel and the timing of application is also critical. The algicidal effect of decomposing barley straw has long been used for algal control with the latest research indicating that the production of the chemical requires light and aerobic conditions. Floating the straw loosely packed in netting therefore, is recommended over sinking whole bales. Certain plants such as the milfoils have also shown algicidal effects and can be encouraged in shallower water

Modern biotechnologies are being successfully used to combat the problems of eutrophying water bodies with applications in the control of algae, the reduction of silt and the improvement of water quality. Unicellular algae can also be temporarily controlled by the use of environmentally safe flocculants.

The fish population of an irrigation lake should also be monitored and managed. Ideally, planktiverous fish numbers should be limited as they graze on the invertebrates that graze on the algae. Bottom feeding fish should also be restricted in new or developing lakes as they prevent plant growth. Large resident and visiting waterfowl populations should be discouraged, where possible, as their polluting effect on water quality is becoming an increasing problem.

■ *David Ward is Senior Biochemist at Symbio.*