


During the period 2004–2006, the water quality status of 449 lakes was examined, representing over 1014 km² of lake surface water. The majority (383 or 85.3%) of lakes were of satisfactory water quality. These accounted for 91.9 per cent or 931.8 km² of the lake surface area examined and were predominantly located in the west and north-west. The water quality of 66 lakes, representing 14.7 per cent of lakes examined and constituting an area of 79.2 km², was less than satisfactory, i.e. eutrophic or hypertrophic in status. Most of these lakes were in Counties Monaghan, Cavan and Leitrim. In the recent past, few of these lakes had satisfactory water quality.



There has been no major change in the water quality status of lakes in terms of both numbers and surface area in recent years. The acid-sensitive lakes – Maumwee and Veagh – and their tributaries have not changed since the previous period and a slight improvement was noted in the status of the acid-sensitive Lugduff River at Glendalough.

The main pressure impacting on the water quality of lakes in Ireland is inputs of the nutrients phosphorus and nitrogen, at concentrations in excess of natural levels, resulting in over-enrichment or eutrophication. This process commonly results in increased planktonic algal and higher plant biomass creating an undesirable disturbance to the balance of organisms in a lake and thus to its water quality.

WATER QUALITY OF LAKES

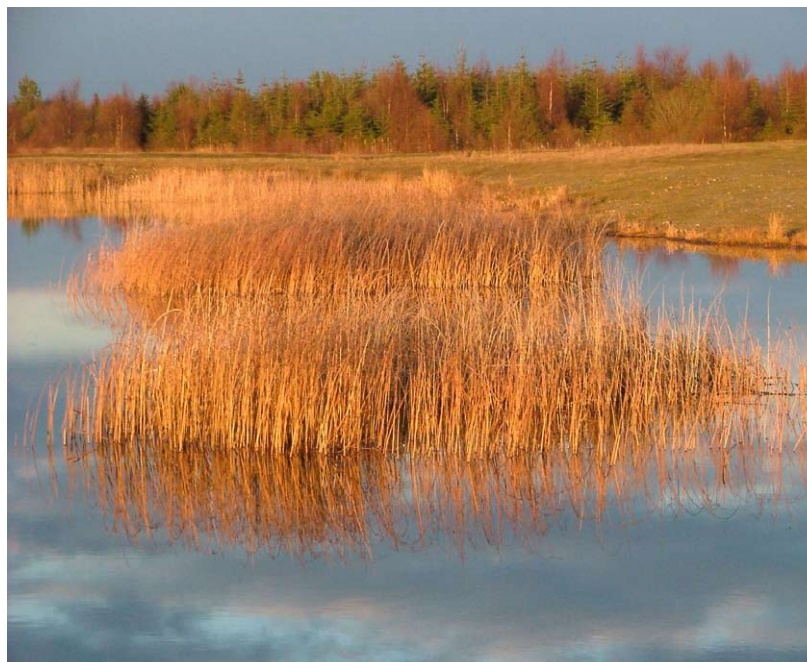


Introduction

The main pressure impacting on lakes in Ireland is elevated inputs of phosphorus and nitrogen. These nutrients occur naturally in the environment, and their presence at background levels in rivers and lakes is necessary to sustain plant and animal communities. However, increased inputs of phosphorus and nitrogen arising from human activity, either directly to the lake or more commonly through its inflowing streams, can give rise to over-enrichment – eutrophication. This form of pollution is characterised in lakes by increased phytoplankton growth and more intensive algal blooms, increased rooted plant growth, declining transparency, deoxygenation of the deeper layers and an overall reduced amenity value. The principal sources of these nutrients are losses from agricultural activities and municipal and industrial waste discharges.

Assessment of Eutrophication and Lake Classification

The degree of enrichment in lakes is assessed by reference to a scheme



proposed by the OECD (1982), which sets boundaries defining the different trophic categories. This scheme is based on consideration of three key parameters: total phosphorus as a measure of the availability of the essential 'growth-limiting' nutrients, chlorophyll as a measure of the biomass of the resulting planktonic algae and cyanobacterial growth in the water, and water transparency as a measure of the impact of the planktonic growths.

The frequency of sampling of lakes in Ireland usually does not generate sufficient data to permit the calculation of the annual mean values as specified in the OECD scheme. To allow classification of these lakes, a modified version of the OECD scheme is used, based on the annual maximum chlorophyll concentration. Because of the wide limits set for the eutrophic category in the original OECD scheme, this category was subdivided. The lakes are classified, therefore, into six water quality

Table 8.1 Modified Version of the OECD Scheme Based on Annual Values of Maximum Chlorophyll Concentration (Indicators Related to Water Quality and the Probability of Pollution are also shown)

Classification Scheme			Category Description			
Lake Trophic Category		Annual Maximum Chlorophyll, mg/m ³	Algal Growth	Deoxygenation in Hypolimnion	Level of Pollution	Impairment of Use of Lake
Oligotrophic (O)		<8	Low	Low	Very low	Probably none
Mesotrophic (M)		8–25	Moderate	Moderate	Low	Very little
	Moderately (m-E)	25–35	Substantial	May be high	Significant	May be appreciable
Eutrophic	Strongly (s-E)	35–55	High	High	Strong	Appreciable
	Highly (h-E)	55–75	High	Probably total	High	High
Hypertrophic (H)		55–75	Very high	Probably total	Very high	Very high

categories based on maximum levels of planktonic algae, i.e. chlorophyll measured during the period. This modification of the scheme is set out in Table 8.1, together with other indicators related to water quality and the probability of pollution.

Where it was possible to carry out only a limited number of measurements on lakes, these measurements were made during the summer and autumn months – periods when the maximum planktonic algal growth is likely to occur. The highest chlorophyll concentrations recorded during these months are taken as approximations of the annual maximum concentration.

Selected acid-sensitive lake systems in Ireland were monitored regularly during the period. Such waters occur in areas with slowly weathering bedrock formations, e.g. granite, shale, gneiss and sandstone, and associated soils. They are located predominantly along the western seaboard and in Co. Wicklow, where the surface waters are characterised by their low alkalinity and consequently poor capacity to neutralise acid inputs. The chemical and biological characteristics of three lakes and their inflowing streams – Loughs Veagh (Donegal) and Maumwee (Galway), and Glendalough Lake Upper (Wicklow), representative of these larger acid-sensitive areas – were examined. In addition, a physico-chemical examination of a number of other

lakes in the same areas was carried out.

The levels of acidity in the three lakes and their feeder streams was described by reference to Raddum index (NIVA, 1987). This index is based on the sensitivity of the macroinvertebrate fauna to reduced pH and is used widely to describe the acid status of surface waters. Species are assigned an 'acidification score' or index in accordance with the scheme of sensitivity or tolerance to acidity given in Table 8.2.

Recent Assessment of Lake Water Quality

Current Trophic Status

Information on the water quality of 449 lakes was assessed for the period 2004–2006. The assessment data were derived from monitoring carried out by the local authorities, Central and Regional Fisheries Boards and the Environmental Protection Agency. The majority (383 or 85.3%) of the lakes examined in this period were of satisfactory water quality, i.e. oligotrophic or mesotrophic in status (Figure 8.1), suggesting a low probability of pollution.

The water quality of 66 lakes was less than satisfactory. Fifty-one were classified as eutrophic in varying degrees. Of these, 21 were classified as moderately eutrophic and 30 as strongly or highly eutrophic compatible with a strong to high level of pollution and a marked

Figure 8.1 Percentage of Lakes in Each Trophic Category Reviewed in 2004–2006 (Source: Clabby *et al.*, 2008)

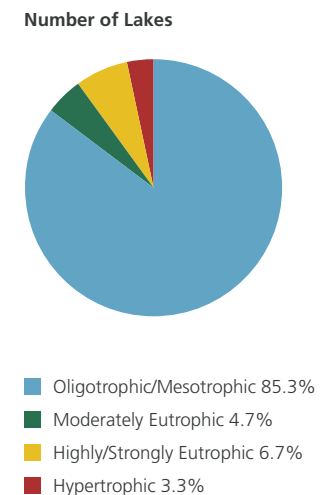


Figure 8.2 Trophic Status of 449 Lakes Reviewed in 2004–2006 expressed as a Percentage of Lake Surface Area (Source: Clabby *et al.*, 2008)

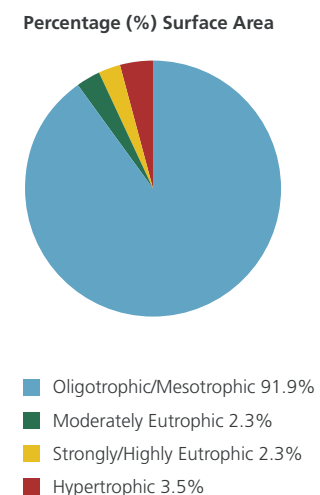
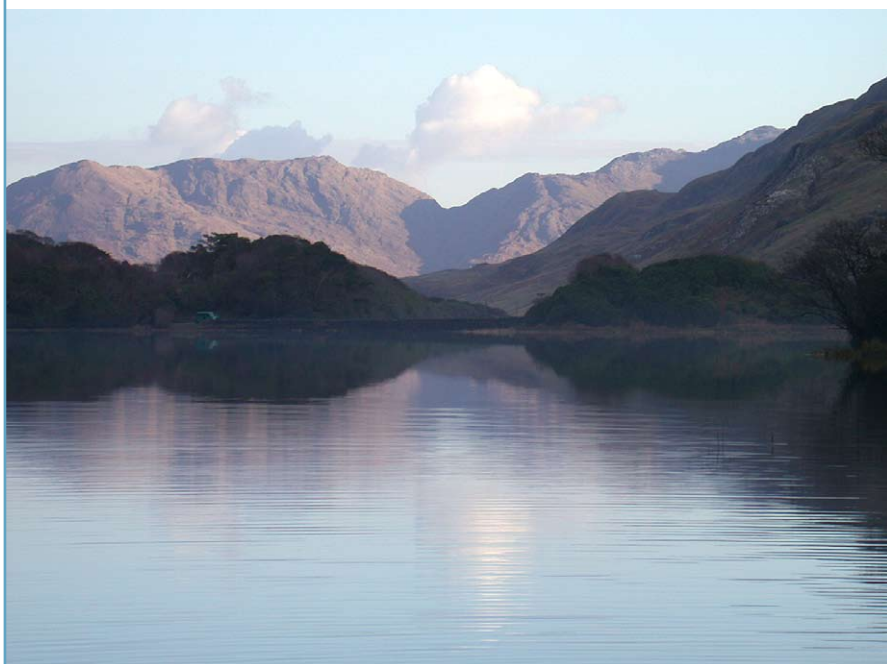


Table 8.2 Sensitivity or Tolerance of Macroinvertebrate Fauna to Acidity in Surface Waters

Category	Minimum pH Tolerated by Species	Score	Inferred Acidification Impact by Presence
A	5.5–6.0	1.0	None
B	5.0–5.5	0.5	Moderate
C	4.7	0.25	Serious
D	<4.7	0	Severe



degree of impairment of beneficial use. The remaining 15 lakes were classified as hypertrophic, i.e. the most enriched status.

The status history of these 66 lakes was reviewed. Twelve had shown no improvement in status since first reviewed. Thirty-eight had deteriorated in status, while 14 had improved. Two lakes had not been sampled previously. Four of the 66 lakes are colonised by zebra mussels (*Dreissana polymorpha*). Surprisingly, only one showed reduced planktonic algal growth and, thus, an improvement in status from strongly to moderately eutrophic, two deteriorated in status and one remained the same. A review of the status history of the 15 hypertrophic lakes showed that all except three had previously been at the 'higher' status, albeit still an unsatisfactory condition.

The surface area of the 449 lakes examined amounted to 1014 km². Lakes accounting for 931.8 km² (91.9%) were in the unenriched oligotrophic/mesotrophic categories. a further 46.8 km² (4.6%) were

classified as eutrophic and 35.4 km² (3.5%) were assigned to the hypertrophic category (Figure 8.2).

The proportion of lakes with an overall satisfactory water quality status has increased in the latest period (85.3%) compared to the previous period (2001–2003) of assessment (82%). Likewise, the proportion of lake surface area (Figure 8.2) categorised as satisfactory for the period 2004–2006 (91.9%)

is slightly higher than that for the period 2001–2003 (91%).

Water quality data for 24 of the 27 large lakes with surface areas exceeding 7.5 km² was available. Twenty lakes were in the satisfactory oligotrophic (8) or mesotrophic (12) categories. The remaining four – Sheelin, Ramor, Oughter and Gowna – exhibited a high degree of enrichment.

Zebra mussels are known to be present in 33 of the lakes sampled during the 2004–2006 period, including all the River Shannon lakes and nine other large lakes. Reduced levels of algal development were measured in 13 of these 33 lakes compared with that measured in 2001–2003, while that in five lakes increased. The trophic status of 15 lakes remained unchanged. The majority of these lakes were already in the satisfactory oligotrophic and mesotrophic categories.

The continued spread of zebra mussels and of other invasive alien species is a cause for concern. Zebra mussels are known to impact on other biological elements, and not always favourably.

Figure 8.3 Distribution of Lakes by River Basin District (Source: Clabby *et al.*, 2008)

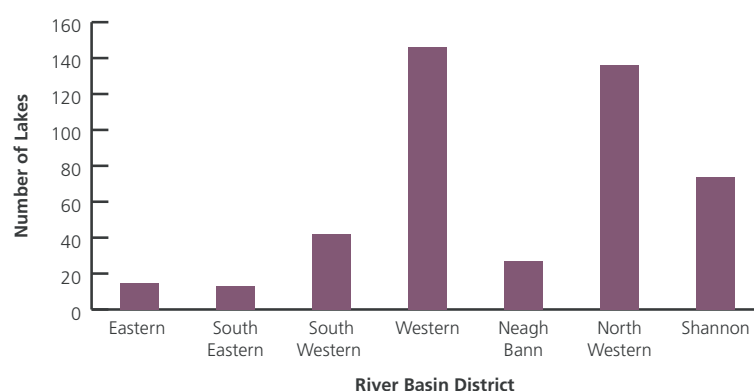
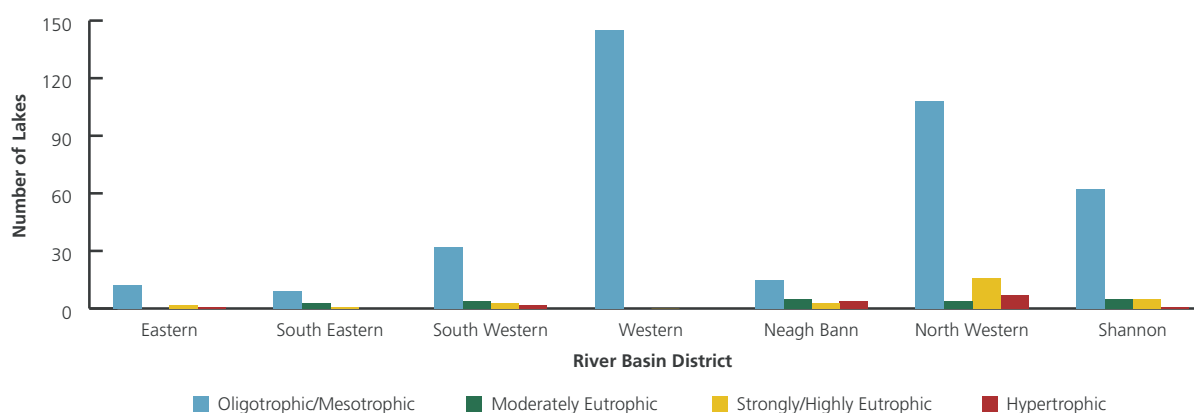


Figure 8.4 Distribution of Lakes in Each Status Category by RBD (Source: Clabby *et al.*, 2008)

Lake Assessment by RBD

The distribution of lakes by River Basin District (RBD) is presented in Figure 8.3. Over half of the lakes (282) examined were in the Western and North Western RBDs (WRBD and NWRBD). The Shannon RBD had the next highest number of lakes at 74. The breakdown of lakes into status category for each RBD is presented in Figure 8.4. In most RBDs, the majority of lakes are in satisfactory condition (Figure 8.4). All lakes in the WRBD are unenriched, being either oligotrophic or mesotrophic. Although the majority of lakes in the NWRBD are unenriched (108), the highest

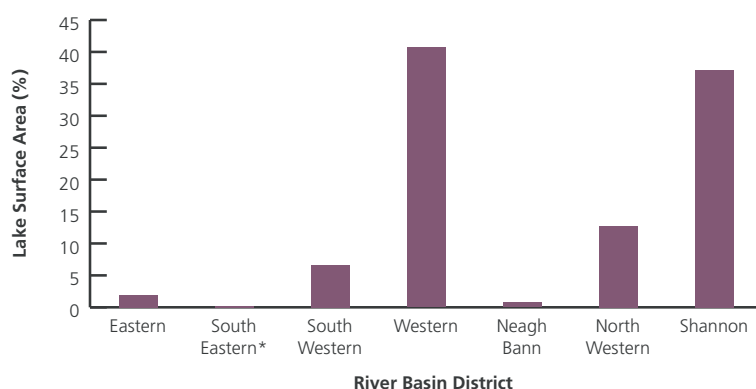
concentration of enriched lakes (27) is also in this region. The latter are located predominantly in Monaghan, but also in Cavan and Leitrim.

The percentage of lake area examined in each River Basin District is shown in Figure 8.5; percentage of lake surface area by trophic category in each RBD is shown in Figure 8.6. Overall, eutrophic and hypertrophic lakes accounted for a small proportion of the total lake surface area examined (8.1%). However, examination of these lakes at the RBD level revealed quite different scenarios. In some RBDs eutrophic

and hypertrophic lakes accounted for a high percentage of the total lake surface area (Figure 8.6).

Long-Term Trends in Lakes' Water Quality

The trends in the trophic status of Irish lakes in the past 15 years are shown in Figure 8.7. The percentage lake surface area categorised as satisfactory, i.e. oligotrophic/mesotrophic, has remained stable since 1998–2000. The most significant changes have been the reduction in the moderately eutrophic and highly/strongly eutrophic categories in 1998–2000. There has been a small rise in the percentage area assessed as hypertrophic in the current sampling period.

Figure 8.5 Lake Surface Area Examined in each River Basin District shown as a Percentage of the Total Area Surveyed Nationally. (Source: Clabby *et al.*, 2008)

* Thirteen lakes accounting for 0.16% of the total area surveyed were examined in the South-Eastern River Basin District.

Acid-Sensitive Waters

The presence of acid-sensitive fauna at Loughs Maumwee and Veagh (excepting the lakeshore site) and their inflows indicates that there is no evidence of artificial acidification at these sites. The suggested impact for the Veagh shore site is not supported by the pH data and can only be attributed to sampling conditions at the time.

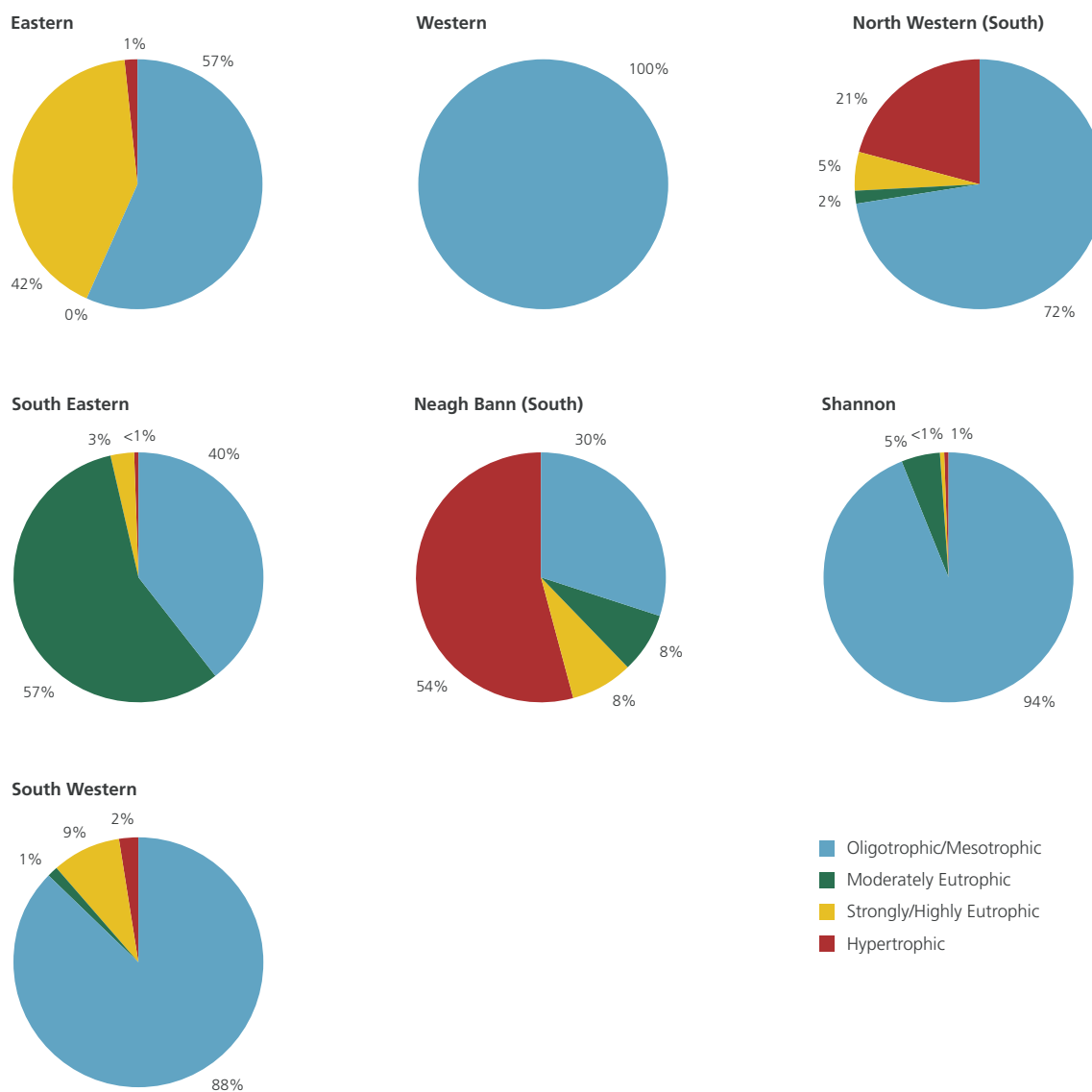
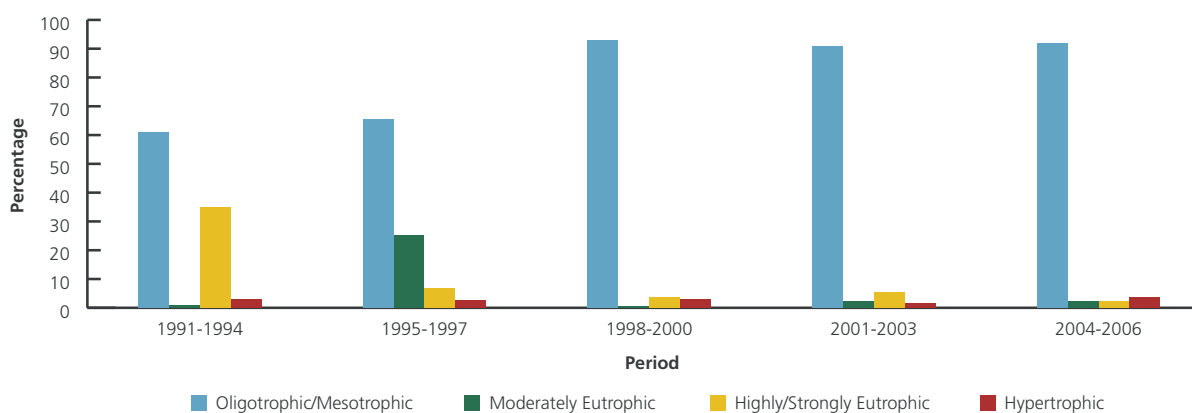
Figure 8.6 Percentage of Lake Area in Each Status Category by River Basin District (Source: Clabby *et al.*, 2008)

Figure 8.7 Recent Changes in Trophic Status Expressed as Percentage of Total Lake Area Surveyed (Source: Clabby *et al.*, 2008)



The Lugduff River, an inflowing stream to Glendalough Lake Upper, is showing signs of improvement having gone from severely impacted on all sampling occasions in the period 1985–2003 to moderate (two sampling occasions) and no impact (single occasion) in the current period. This was reminiscent of its status in the period 1991–1994, when it fluctuated between being severely and moderately impacted.

The minimum and median pH values recorded for Lough Maumwee and Glendalough Lake Upper and their inflows, with the exception of the Lugduff River and the Derrybeg River (L. Veagh), are not indicative of acid input. This is supported by the recorded non-marine sulphate and total oxidised nitrates levels. These have remained relatively unchanged.

The afforested catchment of the Lugduff River continues to be a cause of acid inputs through scavenging of air pollutants by the trees. The Derrybeg River has previously been noted as being more acidic (Bowman, 1991), but the reason remains unclear. However, this does not appear to affect the macroinvertebrate community.

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