Urban Waste Water Treatment Directive

How effective are it's measures?

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1. Background

The Urban Waste Water Treatment Directive (91/271/EEC) is a key directive for water management in the EU. The Directive sets minimum standards for the collection, treatment and disposal of waste water dependent upon the size of the discharge, and the type and sensitivity of the receiving waters. The major requirements of the Directive are given in Tables 1 and 2.

For discharges to areas ‘sensitive’ to contamination from nitrogen and/or phosphorus, secondary treatment with more stringent treatment must be installed. Sensitive areas are broadly described as:

- surface waters (inland, estuaries and coastal waters) subject to eutrophication;
- fresh surface waters, intended for abstraction of drinking water, having, or likely to have a nitrate concentration of >50 mg l^{-1}; and,
- areas where further treatment is necessary to fulfil the requirements of other Directives.

The Directive defines common standards for treatment focusing on the control of nitrogen and/or phosphorus inputs from larger discharges to areas more sensitive to pollution. Member States must designate sensitive waters and the impact of the Directive will depend to a large extent on the extent of designation within each Member State. Thus, for example, Denmark, Finland, Sweden, Luxembourg and the Netherlands are not obliged to identify sensitive areas as they apply more stringent treatment (than required) throughout their territory (CEC, 1999). In contrast, Belgium, Germany, Spain, France, Ireland, Portugal, and the UK have designated a ‘patchwork’ of water bodies as sensitive areas, requiring treatment more stringent than secondary treatment only within these defined areas. Thus in effect nutrient removal will be required in all plants with a capacity above 10 000 PE, or an overall reduction of 75 % for total nitrogen and phosphorus load must be reached. Austria has stated that there are no sensitive areas in its territory, and Greece and Italy had made no formal designations by October 1998. The UK and Portugal have also designated ‘less-sensitive’ areas allowing less stringent treatment in areas with high natural dispersion characteristics, and where there is low risk of eutrophication effects occurring. The Commission is in the process of verifying whether or not the criteria for the identification of sensitive and less sensitive areas have been respected by Member States. There is also some indication that Greece might designate sensitive areas, and Italy sensitive and less sensitive areas (EWWG, 1997).

Table 1 Typical requirements for controlling discharges from Urban Waste Water Treatment Plants

The Urban Waste Water Treatment Directive- sets emission limits for discharges to sensitive areas subject to eutrophication (one or both parameters - N and/or P - may be applied depending on the local situation).		
	Annual average concentration	Or % reduction in relation to the load of the influent
Total P	2 mg P l^{-1} (10 000 - 100 000 PE)	80
	1 mg P l^{-1} (>100 000 PE)	
Total N	15 mg N l^{-1} (10 000 - 100 000 PE)	70-80
	10 mg N l^{-1} (>100 000 PE)	

Notes: PE= Population equivalent

Table 2 **Levels of treatment required by the Urban Waste Water Treatment Directive**

Agglomeration size (1,000's Population equivalent)	Nature of receiving water		Treatment level required		
	Type	Sensitivity	31 Dec. 1998	31 Dec. 2000	31 Dec. 2005
<2	All waters	All	-	-	Appropriate treatment
2-10	Coastal waters	Standard	-	-	Appropriate treatment
	Estuaries	Less sensitive	-	-	Primary treatment
	Freshwater estuaries	Standard	-	-	Secondary treatment
10-15	Coastal waters	Less sensitive	-	-	Primary treatment
	All waters	Standard	-	-	Secondary treatment
	All waters	Sensitive	Tertiary treatment	-	-
>15	Coastal waters	Less sensitive	-	Primary treatment	-
	All waters	Standard	-	Secondary treatment	-
	All waters	Sensitive	Tertiary treatment	-	-

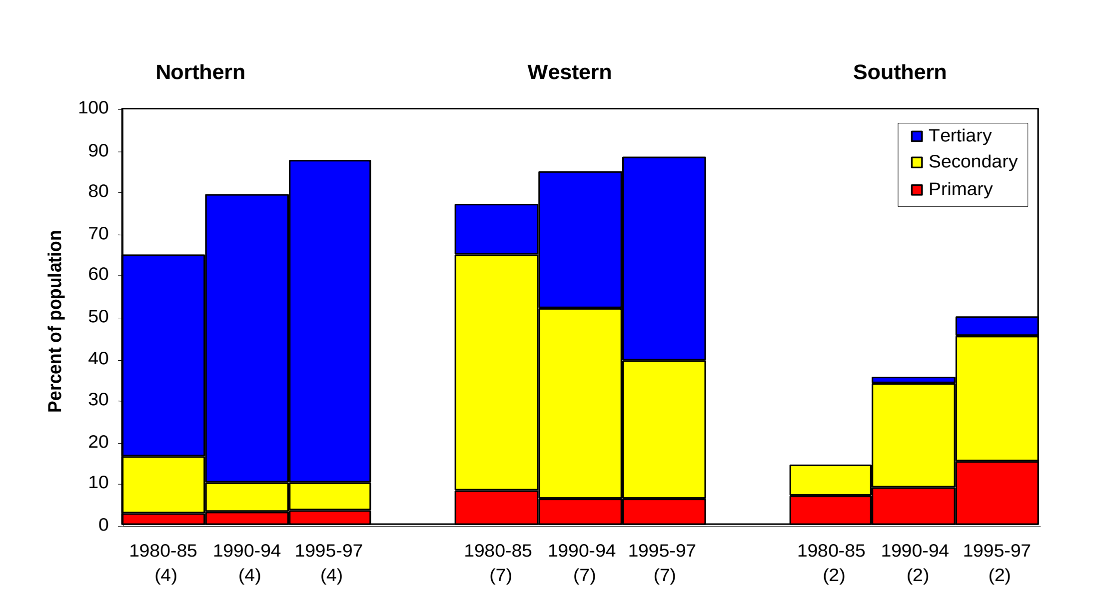
The Urban Waste Water Treatment Directive came into force in 1991. As indicated above it contains a phased timetable as to when measures required to improve urban waste water treatment should be implemented. The timetable and measures are dependent on the 'sensitivity' of the waters receiving the treated effluent and on the size of agglomeration from which waste water is collected. Thus tertiary treatment with nutrient removal was required for agglomerations greater than 10,000 pe discharging into all sensitive waters by 31 December 1998. Therefore, if the Directive is being implemented by Member States correctly and the measures required are effective then some changes (improvements) in Europe's surface waters would be expected to be detectable by 2001.

2. Changes in Urban Waste Water Treatment

2.1 Current situation

Over the last 17 years, marked changes have occurred in the proportion of the population connected to waste water treatment as well as in the waste water treatment technology involved. (Figure 1). The percentage of the population connected to tertiary treatment has increased since 1980 in all European regions. In Northern countries such as Finland and Sweden, the majority of the population was connected to sewers with waste water treatment early in the 1980s, while in many of the other countries a marked increase in the population connected to sewers has occurred over the last 10-17 years. In Austria and Spain, the proportion of the population connected to sewers and waste water treatment has more than doubled over the last 17 years. In Spain, however, only around 50 % of the population had their waste water treated in treatment plants by 1995, some of the waste water to sewers was discharged untreated.

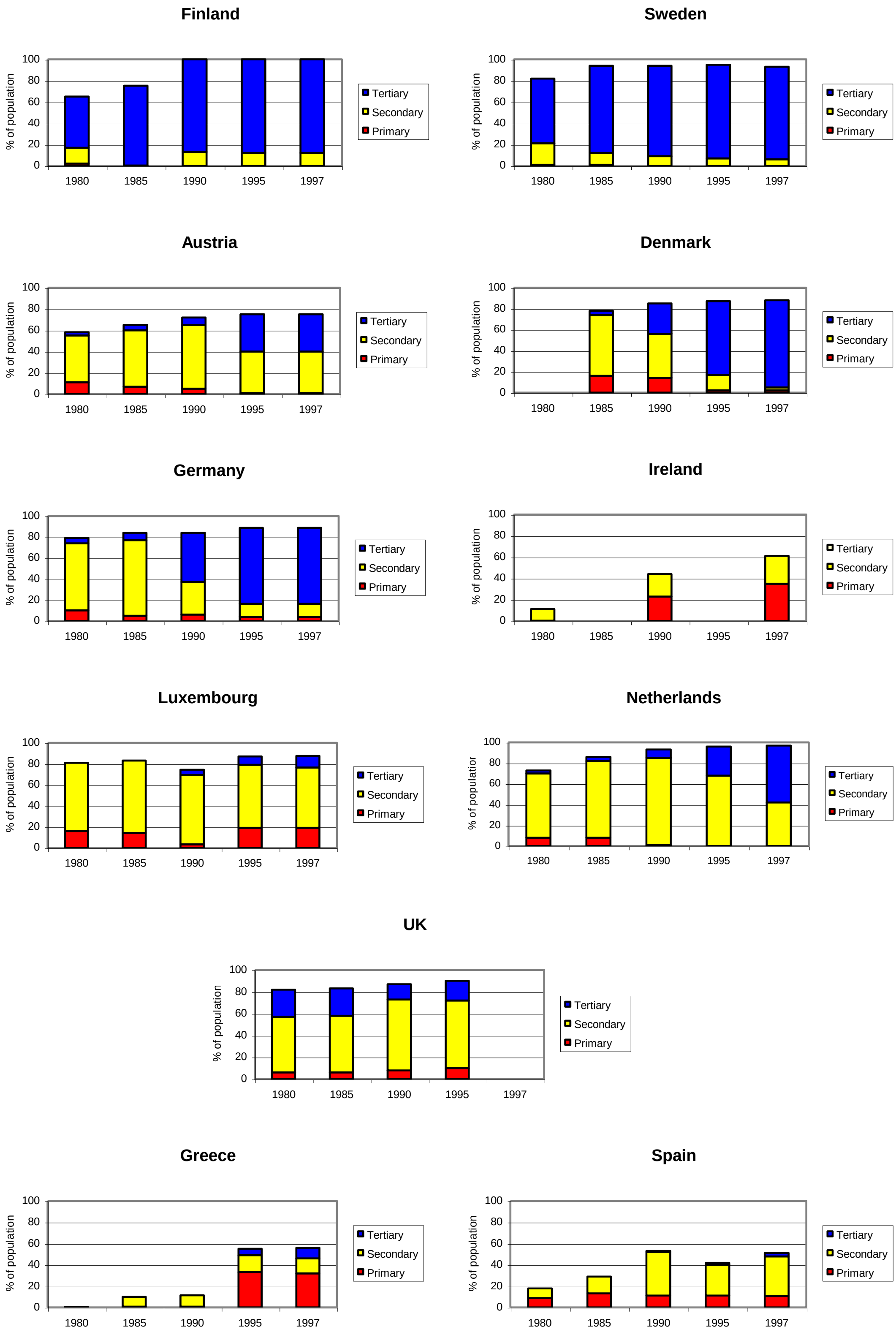
Figure 1 Changes in waste water treatment in regions of Europe between 1980/85, 1990/94 and 1995/97.



Notes: Only countries with data from all periods included, the number of countries in parentheses.
Northern: Iceland, Norway, Sweden, Finland.
Western: Austria, Ireland, United Kingdom, Luxembourg, Netherlands, Germany, Denmark.
Southern: Greece, Spain.
Missing data from: Liechtenstein, Belgium, Italy, France, Portugal.
Source: OECD/Eurostat

In the 1980s many western countries, such as the Netherlands and Austria, secondarily treated most of the waste water, however, in countries like Finland and Sweden most of the waste water was already treated in plants with tertiary treatment (Figure 2). In the late 1980s and 1990s, many of the western countries constructed treatment plants with nutrient removal (e.g. the marked increase in tertiary treatment in Austria and the Netherlands from 1990 to the mid-1990s). In Germany the majority of waste water treatment plants with phosphorus elimination (tertiary treatment) are also run with nitrification/denitrification.

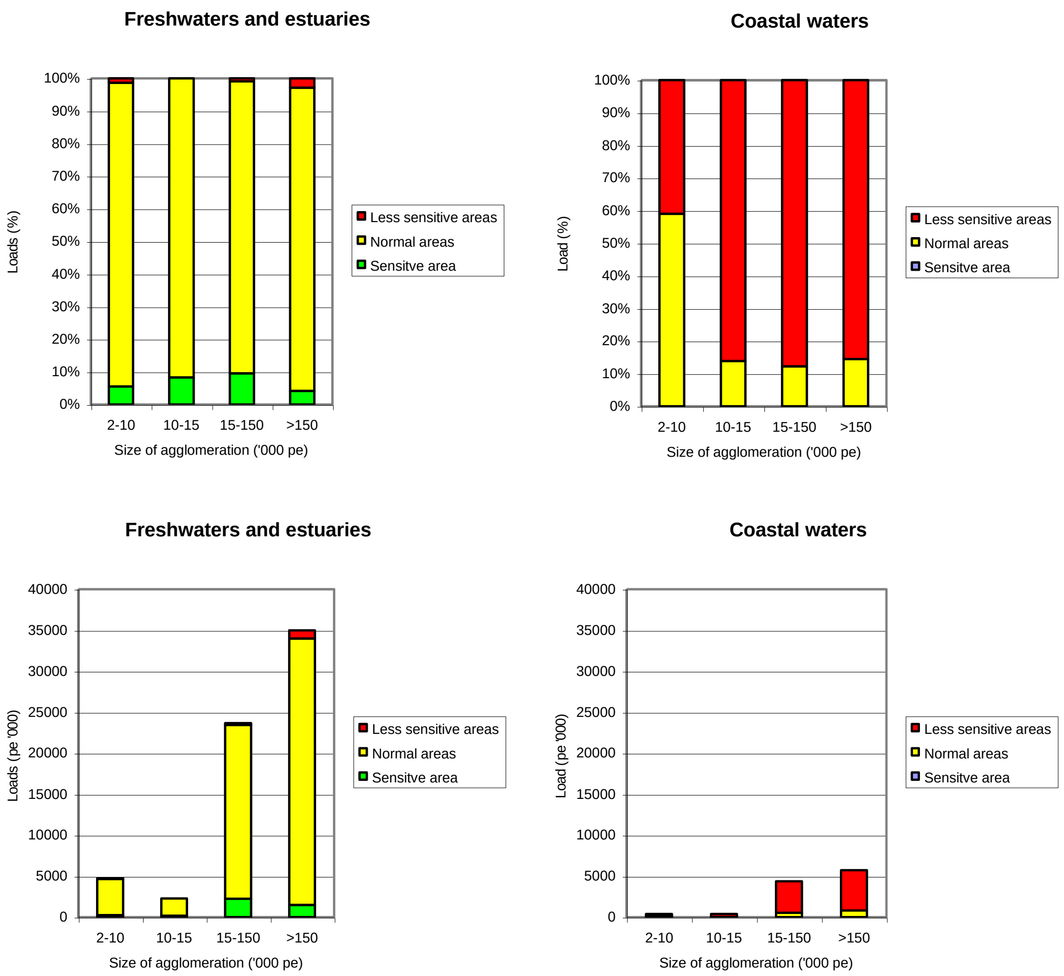
Figure 2 **Changes in urban waste water treatment in EU countries, 1980 to 1997**
Source: OECD/Eurostat



In Greece there has been a marked increase in sewage treatment from 11.4 % of the population connected in 1990 to 56 % in 1997. Tertiary treatment in Greece has also increased from 0 to 10 % of the population in the last 7 years. In Spain there was a relatively large increase in the percentage of population connected to waste water treatment works between 1985 (29 %) and 1990 (53 %). Since then there appears to have been only small changes though the proportion of tertiary treatment has increased over the more recent years.

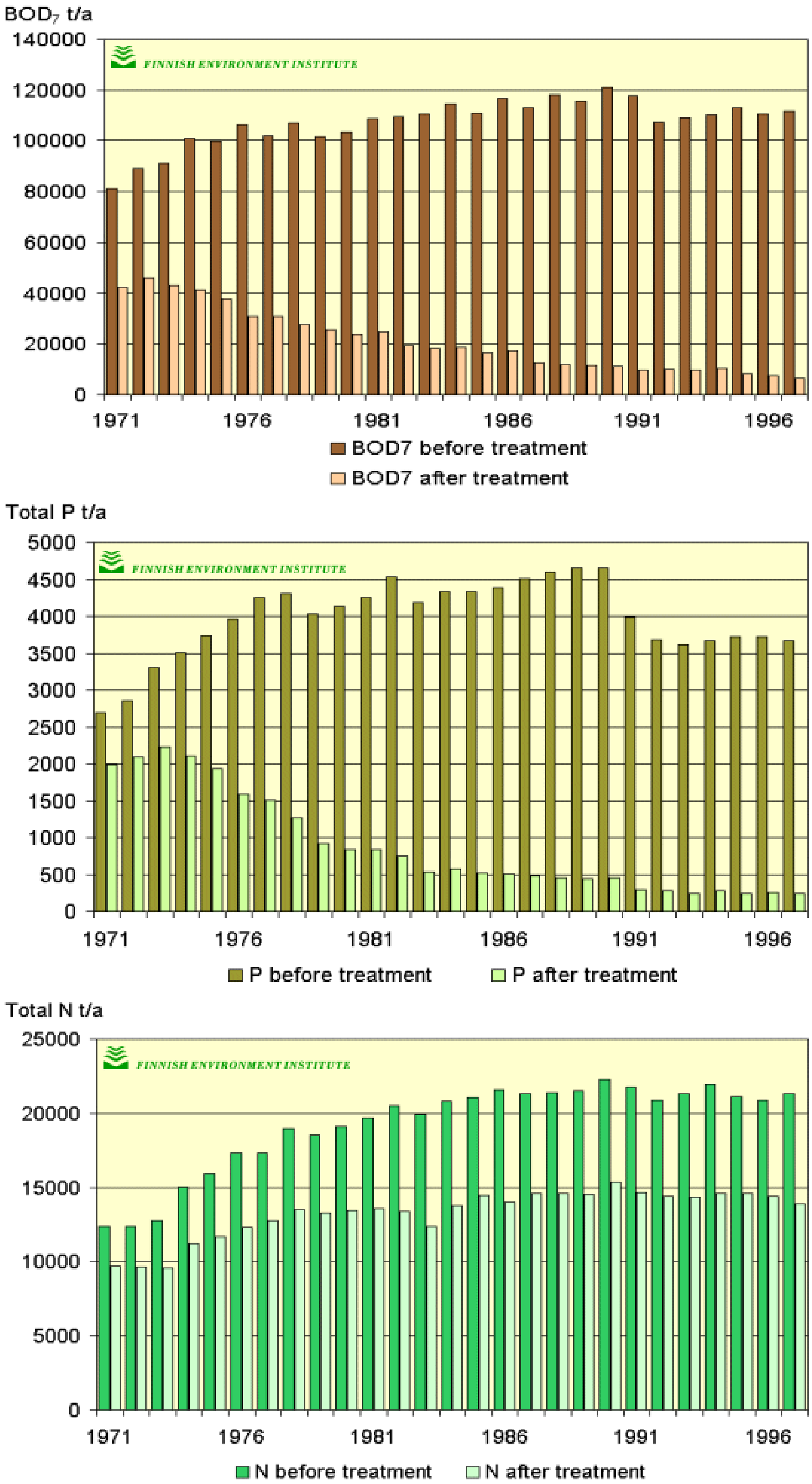
As described above the UK has designated both sensitive and less sensitive areas (high natural dispersion areas) in its waters. Figure 3 illustrates the proportion of, and total population equivalent load arising from, different sized agglomerations discharging into river and estuaries and into coastal water. It can be seen there are significant differences between the two broad types of receiving water and the designations given to them. For example, the total load equivalent in 1992 was considerably greater to coastal waters than to rivers and estuaries. In rivers the predominant designation is normal where secondary treatment is considered to be the minimum required for agglomerations greater than 2000 pe. In contrast in coastal waters most of the load would be discharged to less sensitive waters where primary treatment is considered to be the minimum required for agglomerations greater than 2000 pe.

Figure 3 Percentage of total load, and total loads (‘000s population equivalents) from different sized agglomerations discharging into different 'types' of water in freshwaters and estuaries, and coastal waters of the UK in 1992 (source: DETR, 1998)



The performance of municipal wastewater treatment plants has continuously improved in Finland (Figure 4). By 1996 the average degree of organic matter (BOD_7) removal and phosphorus removal had risen to 93 %. However, the average degree of nitrogen removal has remained at only 30 %. As a result the total load of organic matter from public wastewater plants into lakes, rivers and sea areas has fallen by 82 % since the early 1970s, and the load of total phosphorus by 88 %.

Figure 4 Finland: BOD_7 phosphorus and nitrogen loads before and after treatment in municipal sewage works, 1971-1997



2.2 Future developments

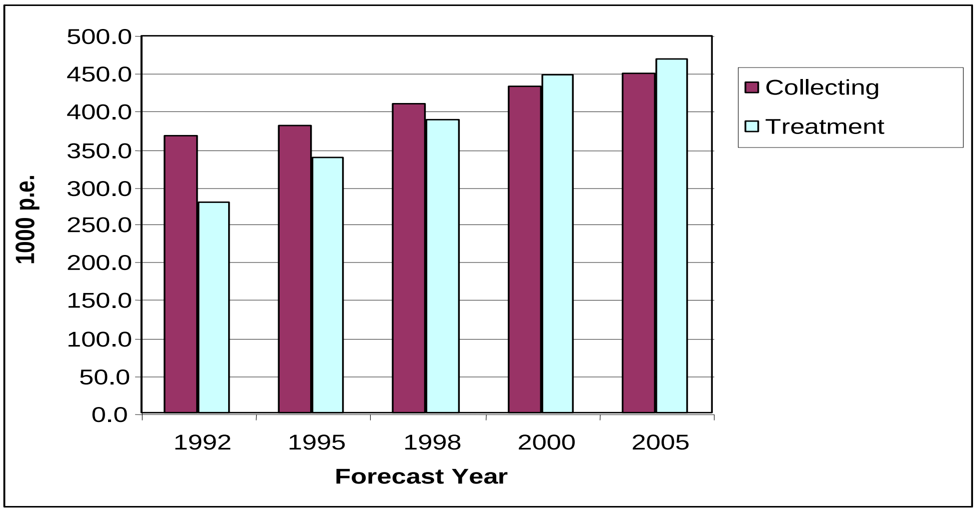
Figure 5 shows that the capacities (in organic load) of collecting systems and treatment plants in EU Member States have increased since 1992 following the coming into force of the Directive, and forecasts show that these capacities will increase even further until 2005.

Southern countries, such as Portugal and Spain, have planned large increases in the capacity of collecting systems, whereas most Northern and Western countries have planned no increase or only a small increase since these countries already had a high capacity per pe before the implementation of the Directive.

The increase in the capacity of treatment works is significant for all Member States except for Sweden, Finland and the Netherlands as these countries' treatment works already had a very high capacity. The greatest increase is in Southern countries such as Spain, Portugal and Greece but a large increase is also planned in Ireland (see Figure 6).

In general, the planned developments are that collecting systems capacities should increase by 22 % over the 13 years of implementation of the UWWT Directive and that treatment capacity should increase by 69 %. It is projected that by 2005, the capacity of collecting systems and treatment works will be greater than or equal to the organic load in most Member States.

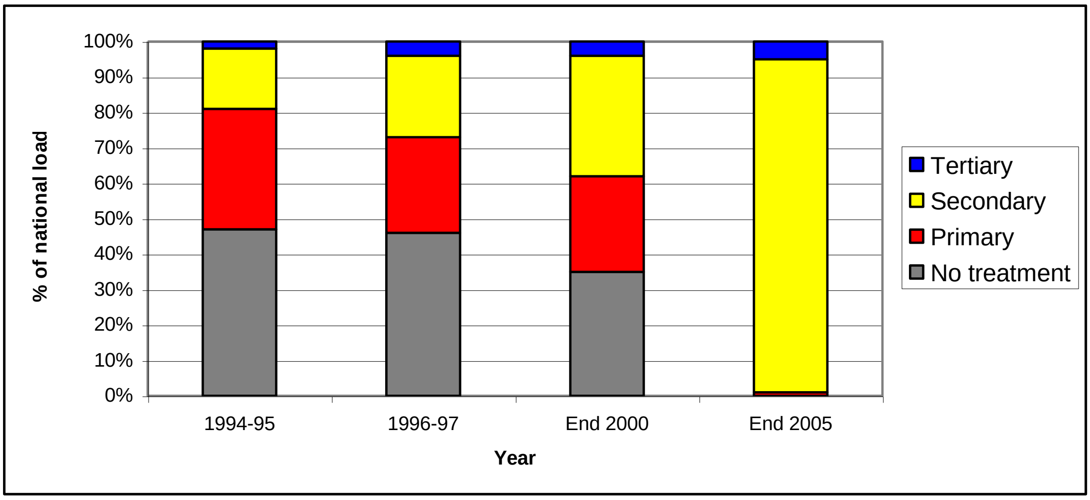
Figure 5 Planned development of collecting systems and treatment plants in EU Member States, 1992 - 2005



Note: Data excludes Italy. Data for Belgium for collecting systems relate to the Walloon region only.
Source: European Commission Report of 27 February 1998 on Council Directive 91/271/EEC.

Figure 6 shows the expected development of urban waste water treatment in Ireland as a result of implementing the Directive. The biggest change is expected to be a great increase in the proportion of the national load being secondarily treated by the end of 2005. This compares to the current situation where there are large proportions of untreated and primarily treated load. There will however only be a small increase in the proportion of tertiary treatment.

Figure 6 **Development of the treatment capacity in Ireland resulting from the implementation of the UWWT Directive (Source: EPA, 2000: Ireland's Environment – A Millennium Report**



3. Impact on receiving water quality

3.1 Indicators

Waste water treatment will remove certain contaminants in sewage. The proportion of any particular contaminant removed will depend on amongst other things the level of treatment applied. Thus typically primary treatment would remove 40 % of BOD load and secondary treatment 95 %. Little total ammonium would be removed by primary treatment whereas secondary treatment would reduce loads by 75 %. The Directive also specifies reductions for total nitrogen and total phosphorus in discharges to sensitive areas (see Table 1).

Thus any changes in water quality resulting from increased waste water treatment should be indicated by changes in measured determinands such as total phosphorus, orthophosphate, total ammonium and BOD. There should also be secondary changes resulting from decreases in the loads and concentrations of these determinands such as improvement in the quality of the aquatic ecosystems.

This section examines in detail changes in these determinands over recent years and how that might relate to the implementation of the Urban Waste Water Treatment Directive.

3.2 Total phosphorus and orthophosphate

Natural concentrations of total phosphorus and orthophosphate will vary from catchment to catchment depending upon factors such as geology and soil type. Natural ranges are considered to be approximately 0 to 10 µg P/l for orthophosphate and 5 to 50 µg P/l for total phosphorus in surface freshwaters. Waters containing concentrations above 500 µg P/l would be considered as being of bad quality as significant effects of eutrophication would be expected.

The following figures indicate that phosphorus concentrations have been generally decreasing in European rivers in the 1980s and 1990s (Figures 7 to 10). The data have been collected using EUROWATERNET-Basic for rivers which is designed to give a general overview of the quality of all sizes[1] and types[2] of river in a country.

There are clear differences in terms of orthophosphate between different sized rivers with medium rivers having higher orthophosphate concentrations than the others. There are also clear differences between the regions of Europe in terms of phosphorus concentrations with Finland having far lower and stable orthophosphate concentrations over the 9 year period compared to other countries (Figure 9). The Western countries appear to have similar median orthophosphate concentrations over this period. Figure 11 also indicates that Northern countries such as Finland have more river stations with low concentrations of orthophosphate, and Western and Southern countries fewer.

[1] River size refers to the surface area of the catchment upstream of the river monitoring station. Thus small = <50 km^2 catchment area: medium = 50 to <250 km^2: large = 250 to <1000 km^2: very large = 1000 to <2500 km^2: and largest ≥ 2500 km^2.

[2] Type relates to the predominant land use patterns in the catchment upstream of the river monitoring stations.

Figure 7 **Trends in the median of the stations' annual average total phosphorus concentrations (µg P/l) in different sized European rivers, 1990 to 1998**

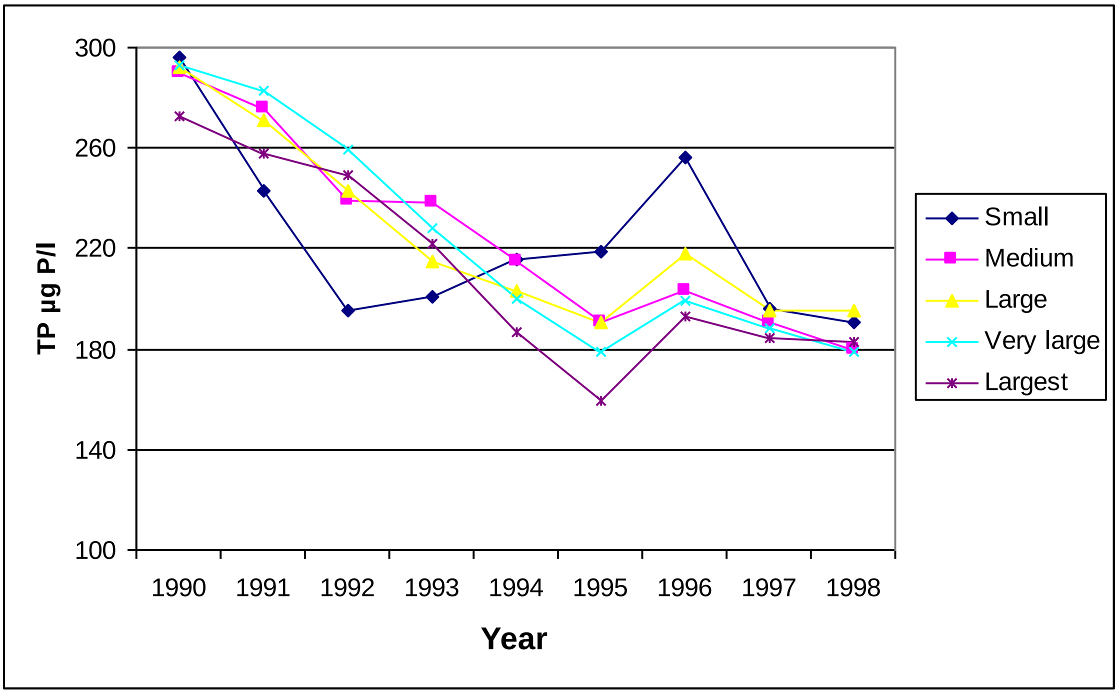


Figure 8 **Trends in the median of the stations' annual average orthophosphate concentrations (µg P/l) in different sized European rivers, 1990 to 1998**

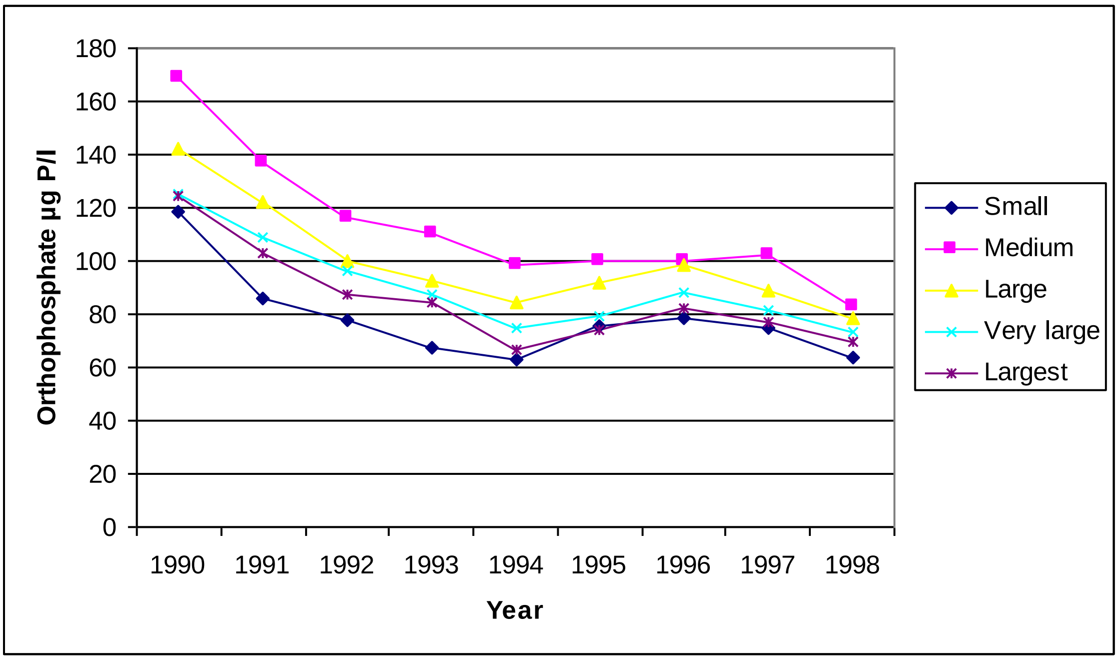


Figure 9 **Median of the stations' annual average orthophosphate concentrations (µg P/l) in aggregated (all sizes) river stations between 1990 and 1998. Number of stations in brackets**

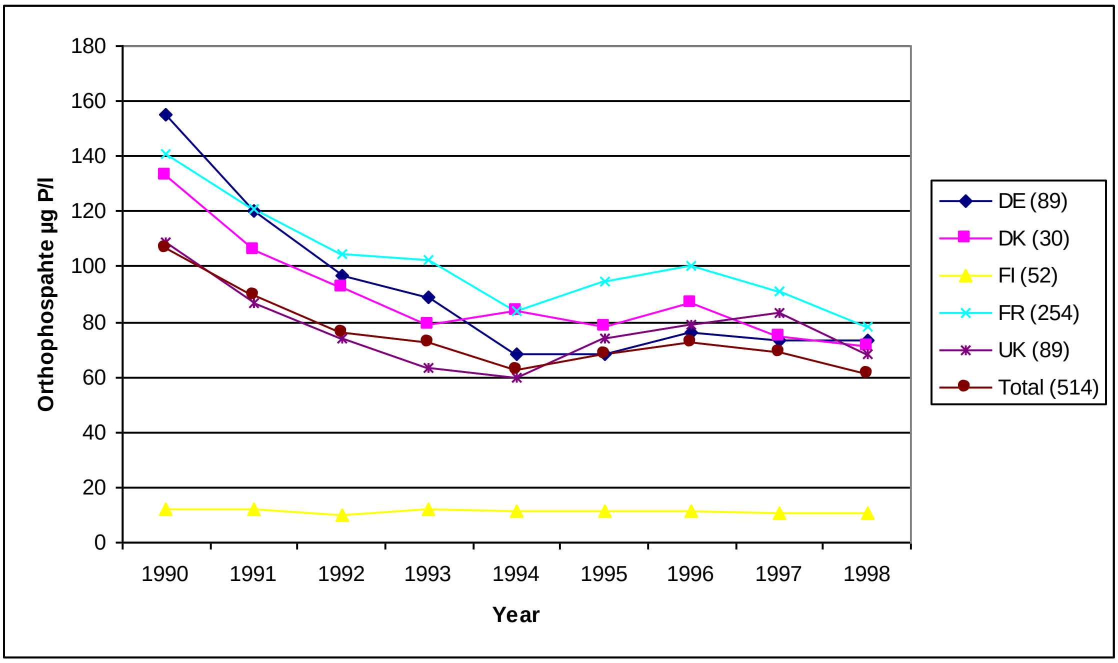


Figure 10 **Median of the stations' annual average orthophosphate concentrations (µg P/l) in aggregated (all sizes) river stations between 1985 and 1998. Number of stations in brackets**

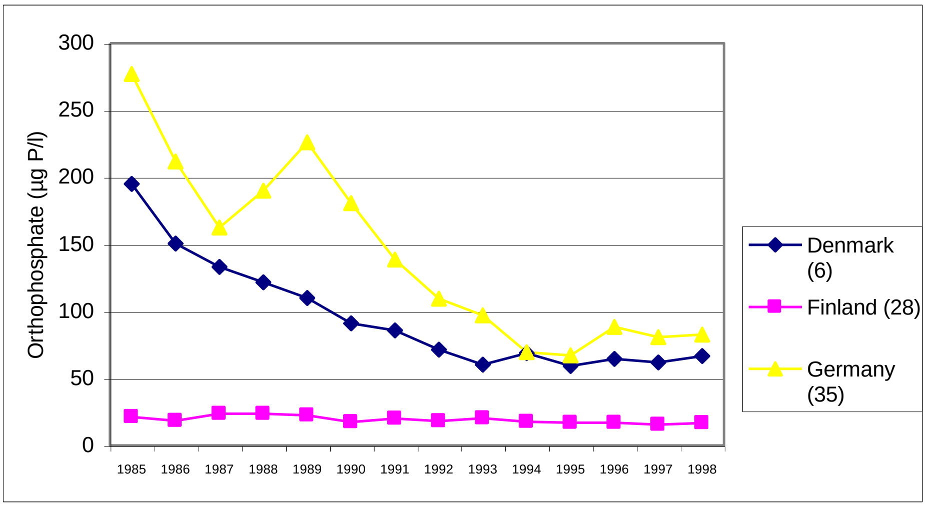
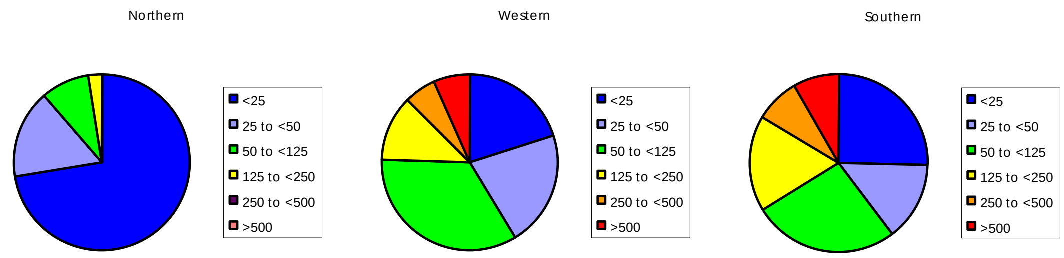


Figure 10 covers a longer time period than Figure 9 but for fewer countries and with fewer river stations per country. This means that it is probably less representative than Figure 9 in terms of general quality in those countries. Nevertheless it can be clearly seen that in Denmark and Germany orthophosphate levels have been decreasing for a number of years before the Directive came into force. As described in section 1, the first deadline for some measures to be completed is 31 December 1998. Obviously some of the required new treatment would have been operational before this deadline. It is likely that the decreasing orthophosphate concentration at the beginning of the 1990s and for a few years after that was due to national programmes of improvements that were already in place and were apart from those required under the Directive. It is thus difficult to separate the improvements in river water quality due to the Directive (and thus its effectiveness) from those arising from national programmes.

Figure 11 **Comparison of the distribution of medians of the stations' annual average orthophosphate concentrations (µg P/l) in aggregated (all sizes) river stations in different regions of Europe. Based on most recent data from each country.**

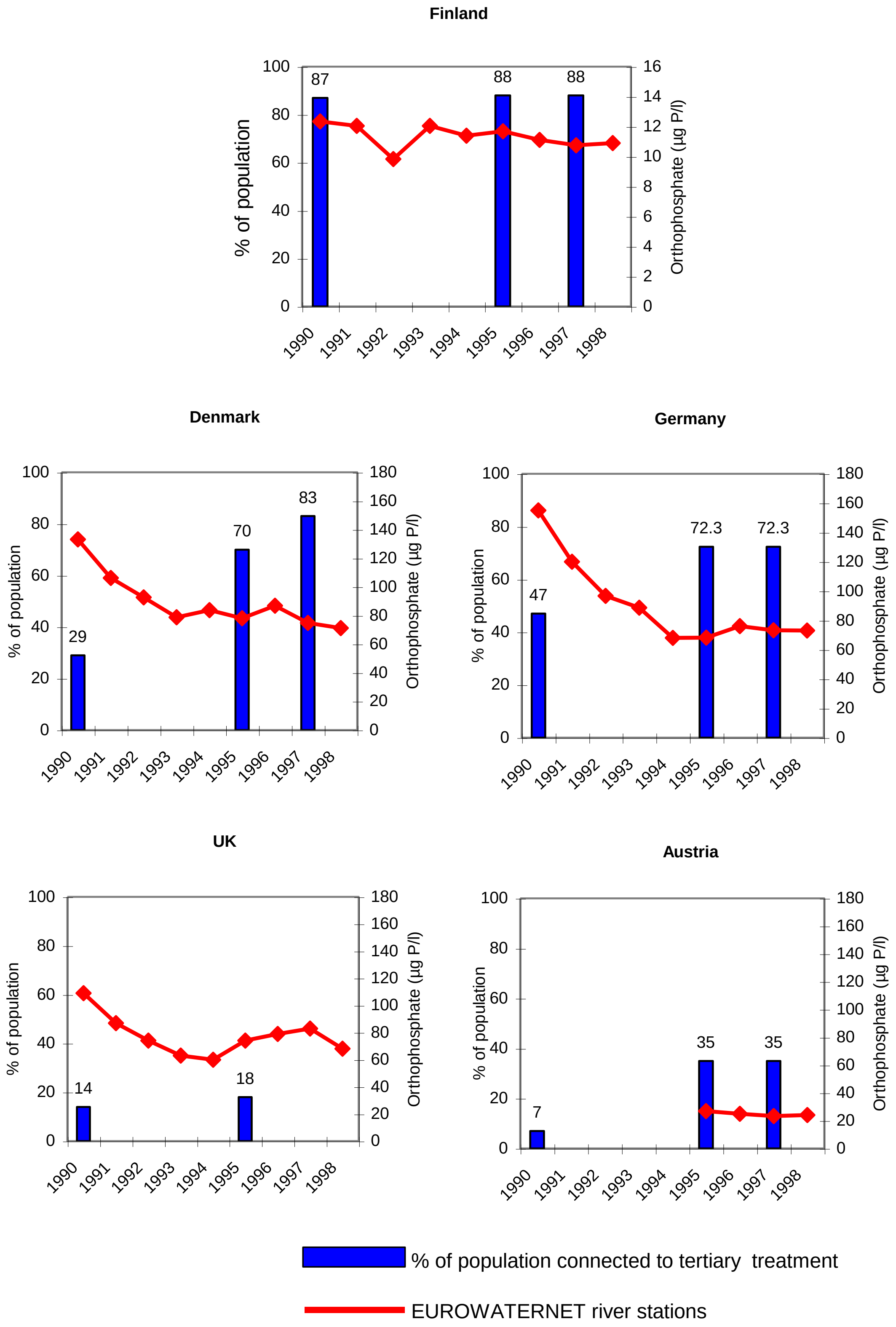


Northern (Finland)
Western (Austria, Belgium, Denmark, France, Germany, Ireland, Netherlands and UK
Southern (Greece, Italy, Portugal and Spain)

The identification of the improvements in river water quality arising from the Directive’s measures is further examined in Figure 12. Here river orthophosphate concentrations are plotted against the proportion of the population connected to tertiary treatment. Tertiary treatment is generally required to remove nutrients from sewage, and it was the discharges to sensitive waters from the largest agglomerations that required tertiary treatment or a specified reduction in nutrient loads by end of 1998. It should be noted that the proportions of tertiary treatment in Figure 12 are for the whole country and make no distinction between discharges to rivers, estuaries and other water body types.

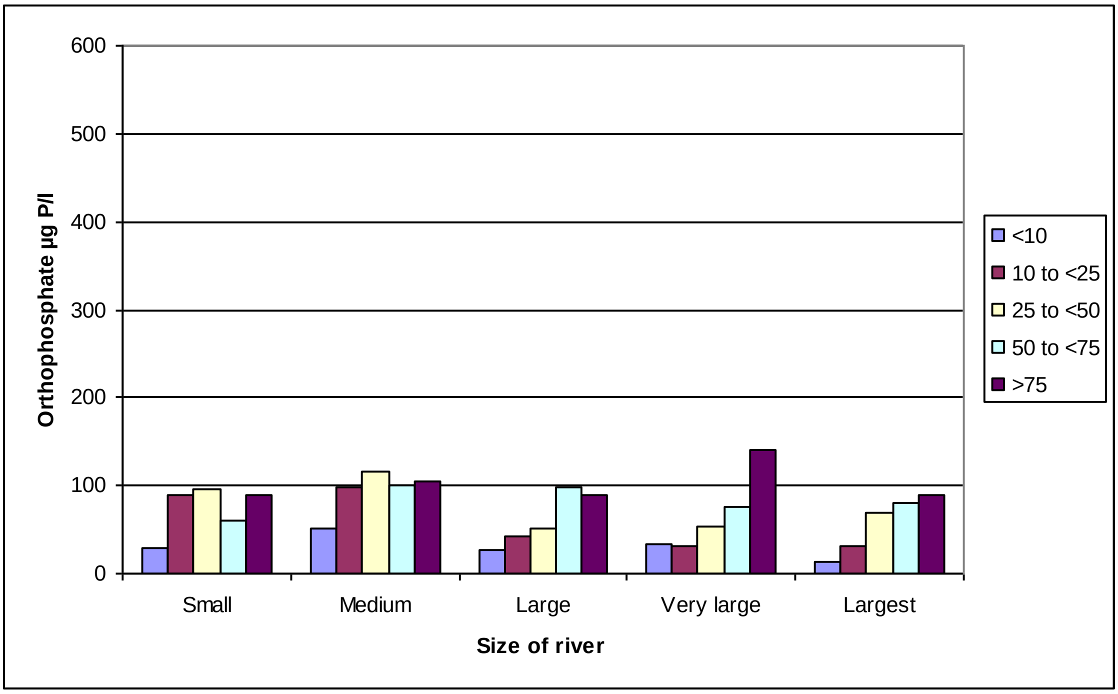
It can be seen that in Finland has a high proportion of its population connected to tertiary treatment. As a result, and as Figure 4 further illustrates, there has been a very large reduction of the phosphorus load arising from Finland’s treatment plants. This has probably contributed to the very low levels of orthophosphate in its rivers compared to the other countries in Figure 12. There has also been a marked increase in the levels of tertiary treatment in Austria, Germany and Denmark between 1990 and 1995/97. Over the same period the concentration of orthophosphate has also been decreasing in Denmark and Germany (there are no equivalent data available for Austria). However, there is no information available to differentiate between the increase in tertiary treatment due to the Directive and from previous national measures, and to relate that to the decrease in river orthophosphate concentrations. In the case of the UK there was a small increase in the proportion of the population connected to tertiary treatment between 1990 and 1995. Over the same period orthophosphate concentrations in UK rivers have also been decreasing but not to the same extent as in Denmark and Germany. As already illustrated in Figure 4 only a relatively small proportion of the UK load (in terms of pe) in the UK will be discharged into sensitive waters, and thus potentially require nutrient removal.

Figure 12 **Changes in river orthophosphate concentrations (µg P/l) in the 1990s in relation to the proportion of the population connected to tertiary treatment in a number of EU countries**



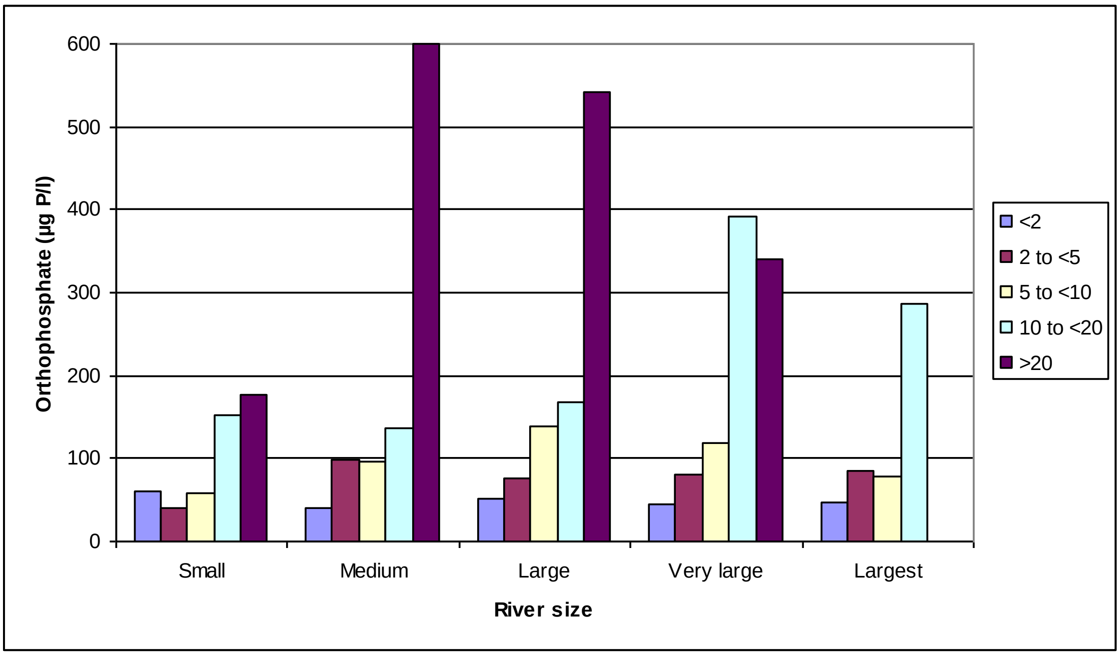
In many catchments the predominant source of orthophosphate in rivers will be from point sources such as discharges from urban waste water treatment works but in others agriculture will also be a significant source. Thus improvement of river water quality in terms of decreasing phosphorus loads will often require measures to control both point and diffuse sources. Figures 13 and 14 examine the relationship between the measured orthophosphate concentration at the river stations and the land use in the upstream catchment. It can be seen that there is an increase in orthophosphate concentrations with increasing total agricultural land use in the upstream catchment. There are not very marked differences between the different sizes of rivers though medium sized rivers generally have higher concentrations of orthophosphate than the other sized rivers. There is also an increase in orthophosphate concentrations with increase in percentage of urban land use in the upstream catchment particularly so in relatively highly urbanised catchments of medium, large and very large rivers (Figure 14). The concentrations of orthophosphate are also higher in urbanised catchments compared to mainly agricultural catchments probably reflecting the relative importance of both sources of orthophosphate.

Figure 13 **Median of the stations' annual average orthophosphate concentrations (µg P/l) in different sized rivers in relation to percentage <u>total agricultural</u> land use in upstream catchment. (Note same concentration scale as Figure 13).**



Data from Denmark, France, Germany, Portugal and UK

Figure 14 **Median of the stations' annual average orthophosphate concentrations (µg P/l) in different sized rivers in relation to percentage urban land use in upstream catchment**



Data from Denmark, France, Portugal and UK

3.3 Total ammonium

Concentrations of total ammonium below 0.015 mg N/l would be considered to be natural or background levels for most European rivers. Levels exceeding 9 mg N/l would be expected to have significant toxic effects on aquatic life. Total ammonium concentrations (Figure 15) have also decreased between 1990 and 1998 but this time in those countries for which there are data, the highest median concentrations have tended to be in the larger rivers and lowest in the smallest. Figure 16 indicates that generally the UK, Denmark, Finland and Austria had the lowest concentrations of total ammonium at the stations provided, and Netherlands and Belgium the highest.

Figure 15 **Trends in median of the stations' annual average total ammonium concentrations (µg N/l) in different sized European rivers, 1990 to 1998**

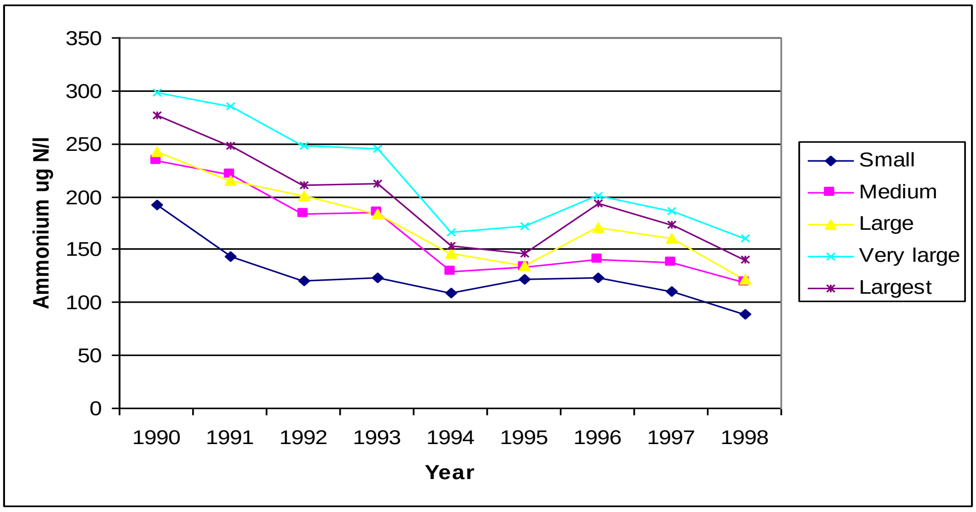
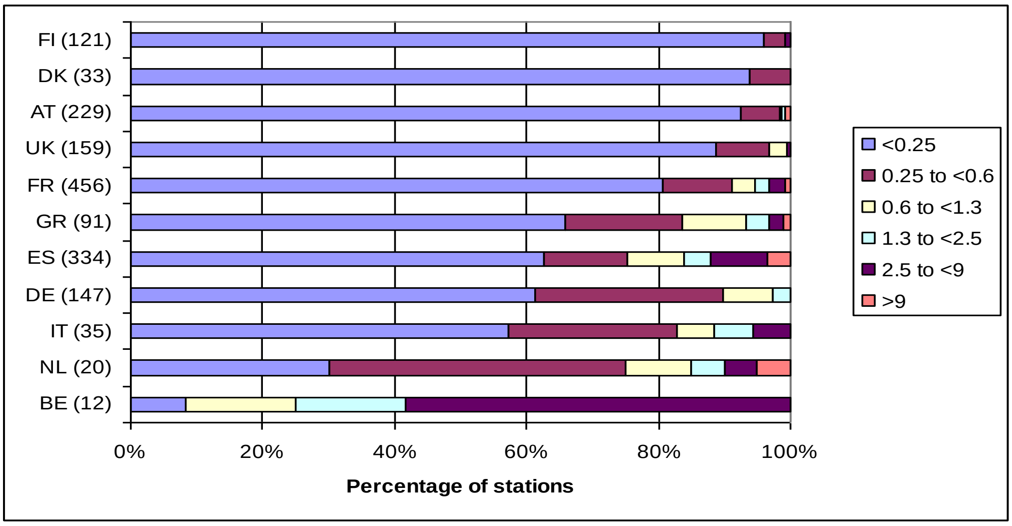


Figure 16 **Distribution of annual average total ammonium concentrations (mg N/l) in European countries for the most recent year for which data are available (aggregated data across all sizes of river. Number of stations per country in brackets)**



3.4 Biochemical oxygen demand

Biochemical oxygen demand (BOD) is a measure of the oxygen demand arising from the microbiological breakdown of organic matter in water. Changes in dissolved oxygen concentrations are measured under controlled laboratory conditions usually over 5 days but in Northern European countries over 7 days. BOD is increasingly being replaced by total organic carbon measurement in many European countries.

High biochemical oxygen demand (BOD) may indicate a potential for reduced oxygen levels in water thereby affecting the biodiversity of aquatic communities. It is one of the main parameters used in the Urban Wastewater Directive for controlling discharges. A BOD level of less than 2 mg O_2/l is indicative of a relatively clean, and more than 5 mg O_2/l of a relatively polluted river.

Figure 17 indicates that BOD levels have decreased during the 1990's in all sizes of river in the EU. Small rivers have the lowest concentrations of BOD and very large rivers have the highest concentrations probably reflecting the discharges from sewage treatment works and industry the largest of which tend to be on the larger rivers. In recent years, the majority of river stations in Western European countries had low levels of BOD with a large percentage with concentrations below 2 mg O_2/l indicating relatively clean water (Figure 18). Austria and Denmark had lowest levels of BOD at the stations provided (Figure 19). The decrease in BOD concentrations in rivers is at least in part due improved levels of sewage treatment part of which would result from the implementation of the Urban Waste Water Treatment Directive.

Figure 17 **Trends in the median of the stations' annual average concentration of BOD5 (mg O_2/l) in different sized rivers in Europe between 1990 and 1998**

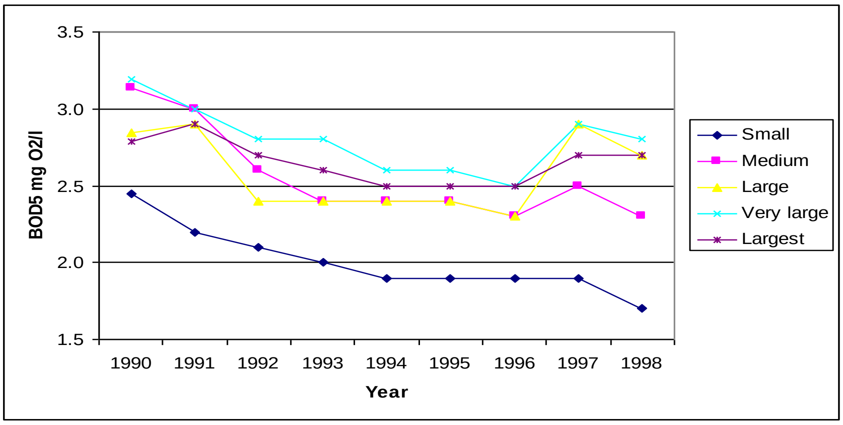


Figure 18 **Distribution of annual average BOD5 concentrations (mg O_2/l) in European countries for the most recent year for which data are available (aggregated data across all sizes of river). Number of stations per country in brackets.**

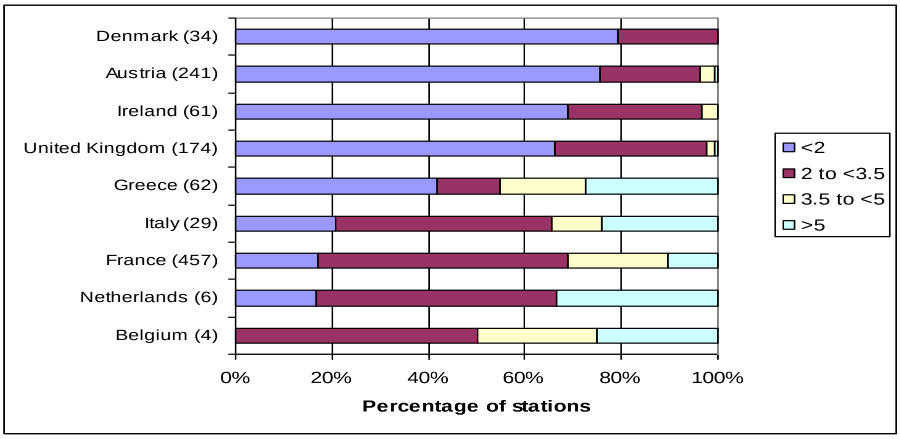
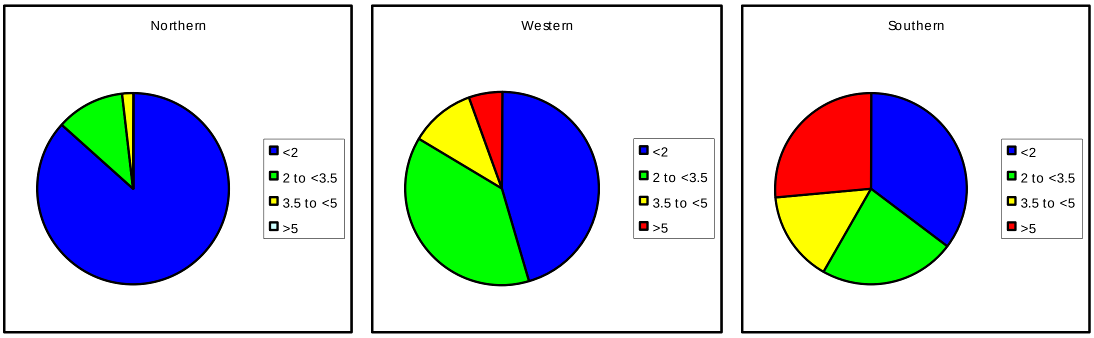


Figure 19 **Distribution of annual average BOD concentrations (mg O_2/l) in different parts of Europe for the most recent year for which data are available (aggregated data across all sizes of river). Number of stations per region in brackets.**



Northern: Finland (BOD7)
Southern: Greece and Italy (BOD5)
Western: Austria, Belgium, France, Ireland, Denmark, Netherlands and UK (BOD5)

3.5 Nitrate and/or total oxidised nitrogen

Concentrations of nitrate below 0.3 mg N/l would be considered to be natural or background levels for most European rivers though for some rivers levels of up to 1 mg N/l are reported. Concentrations of nitrate above 7.5 mg N/l would be considered to be of relatively poor quality and would exceed the guideline concentration for nitrate of 5.6 mg N/l as given in the Surface Water for Drinking Directive (75/440/EEC).

The data for nitrate or total oxidised nitrogen (TON) show no trend with time between 1990 and 1998 (Figure 20). Small rivers however have higher concentrations than the other size categories. Of the western European countries for which there are consistent time series it appears that France had the lowest median nitrate or TON concentration, and Denmark and the UK the highest (Figure 21). Figure 22 shows that the lowest concentrations of nitrate or TON are generally found in Norway, Portugal and Ireland, and the highest in Denmark, Belgium and Germany. It should however be noted that the number of stations provided by Norway, Portugal and Belgium is small and have not been provided through the EUROWATERNET process. The information for those countries may not therefore be representative of all rivers in those countries. In addition, the concentration of nitrate in rivers is significantly influenced by year-to-year variability in water run-off and river flow. Concentration data 'adjusted' for this variability would improve the information on trends of nitrate in rivers.

Figure 20 Trends in median of the stations' annual average nitrate or total oxidised nitrogen concentrations (mg N/l) in different sized European rivers, 1990 to 1998

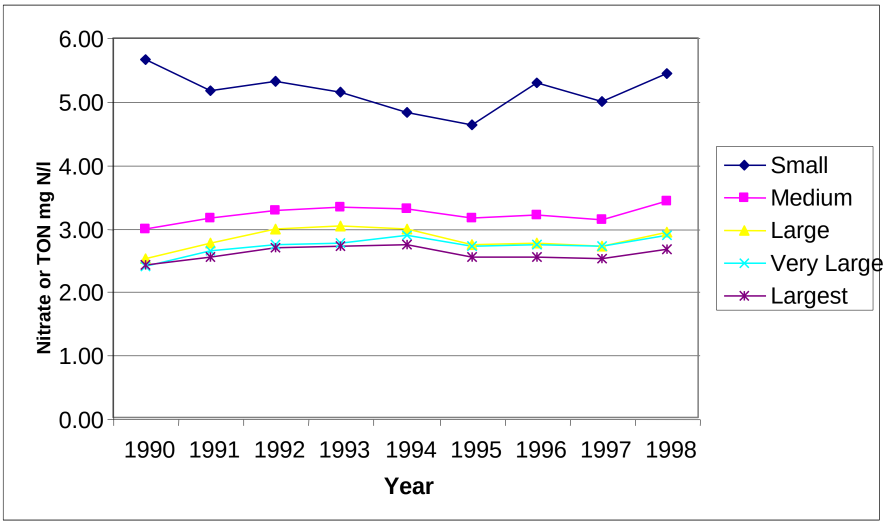


Figure 21 **Median of the stations' annual average nitrate or total oxidised nitrogen concentrations (mg N/l) in aggregated (all sizes) river stations between 1990 and 1998. Number of stations in brackets.**

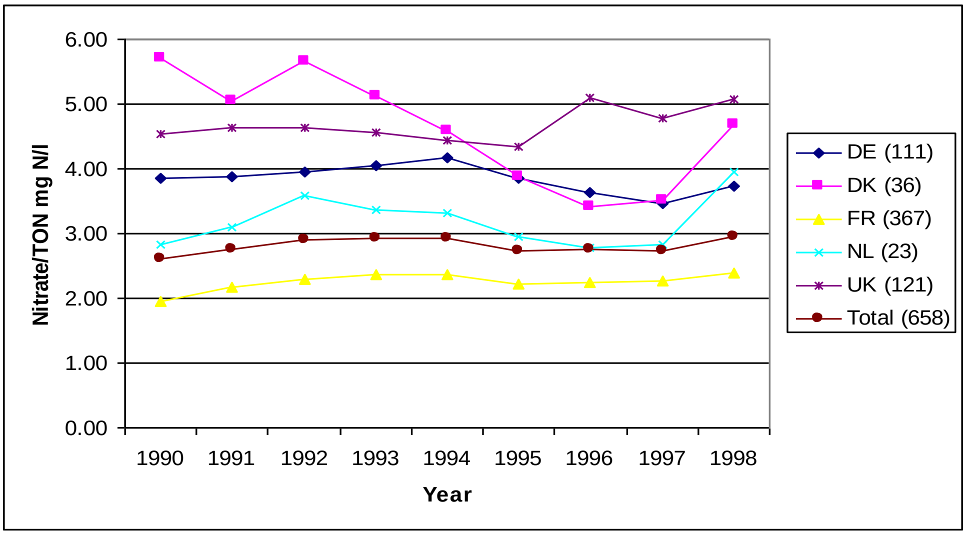
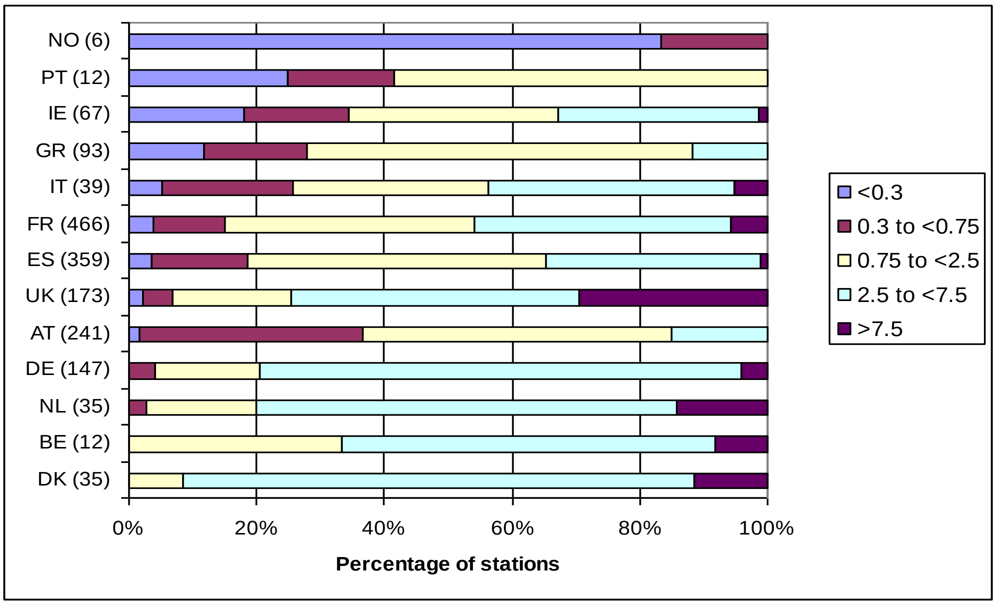


Figure 22 **Distribution of annual average nitrate or total oxidised nitrogen concentrations (mg N/l) in European countries for the most recent year for which data are available (aggregated data across all sizes of river. Numbers of stations per country in brackets)**



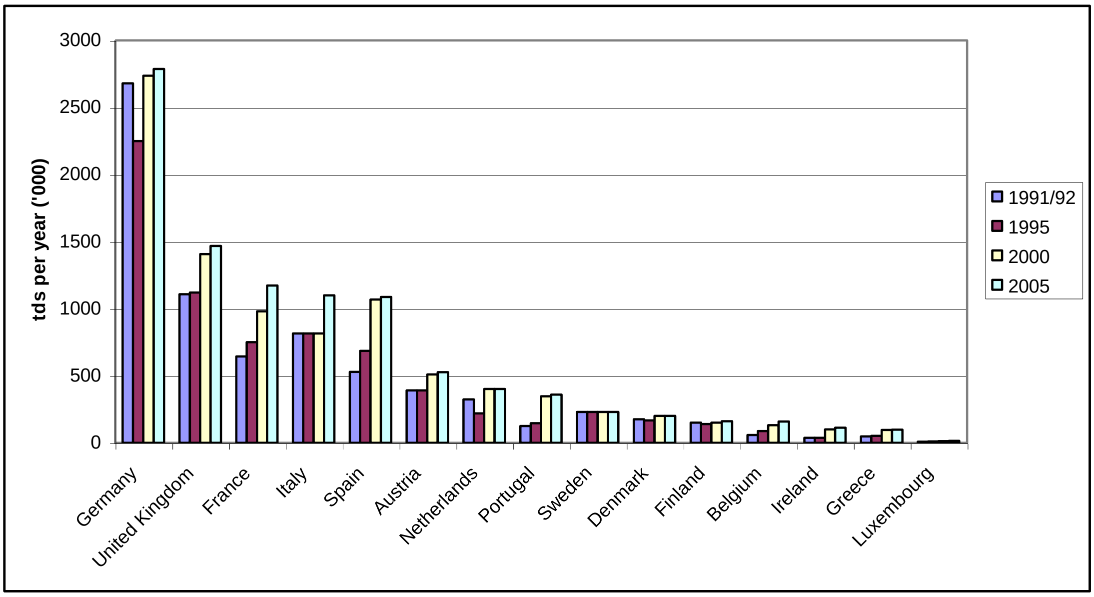
4. Production of sewage sludge

The Directive requires that collection and treatment systems be in place for all agglomerations of more than 2 000 pe from December 1998 and at the latest for December 2005 depending on the size of the agglomerations and the sensitivity of the receiving waters. That means that for all agglomerations of more than 2 000 pe, it can be assumed that all waste water will be treated by 2005 to an appropriate level of treatment and that sludge will be produced. A rough estimate for sludge production in 2005 (Figure 23) has been calculated based on either:

- the total population per country multiplied by a typical national coefficient for sludge production depending on the level of industrial connection and type of treatment; or
- the total treatment capacity as reported in the implementation report of the UWWT Directive and assuming a typical coefficient of sludge production according to country.

The information has been mainly extracted from existing reports of the Commission on the implementation of the Directive describing the position in 1998 (latest figures available), and on the implementation of Directive 86/278/EEC on Sewage Sludge with the latest updates of this report from personal contacts with co-workers. When the information was missing, for example for Italy, data were also extracted from a review carried out by WRc and SEDE and published in 1994 for the DG ENV on sewage sludge in the Member States.

Figure 23 Best estimates of sewage sludge production in the EU (total dry solids x 1000/annum)



All EU countries except Sweden expect to increase their sewage sludge production between 1991/92 (when the Directive came into force) and 2005 when all sewage treatment measures required by the Directive are due to be operational. Comparison of the proportion of types of sewage treatment in EU countries in the early 1990s (Figure 2) with the predicted sewage sludge production by 2005 (Figure 23) shows that the biggest increase in sludge production is expected in those countries with the lowest proportion of sewage treatment in 1990. For example, Ireland is expected to increase it s sewage sludge production 3 fold compared to 1991 production (see also

Figure 6). In contrast those countries with a high proportion of their population connected to sewage treatment before the implementation of the Directive only expect a relatively small increase in sewage sludge production by 2005, e.g. Denmark and Germany. Overall in the EU there is expected to be a 2.4 fold increase in sludge production between 1991 and 2005.

Once produced sewage sludge needs to be disposed of in environmentally acceptable ways, for example through agricultural use, landfilling or incineration. In the terms of agricultural use there is a Directive (86/278/EEC) which ensures that heavy metals arising from the sludge do not accumulate in the soil at levels that exceed specified limits. The incorrect application of sewage sludge onto agricultural land can in itself lead to the pollution of surface waters through run off during rainfall, for example.

5. Impact of the implementation of the UWWTD at the local scale -

The Ondaine Valley, France

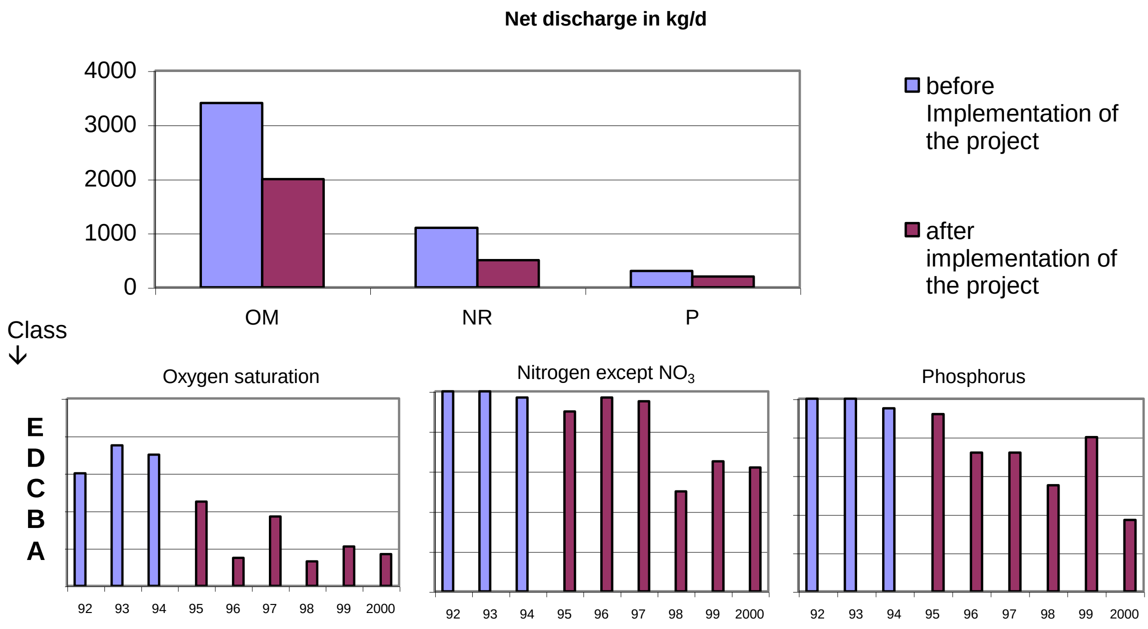
The project

Before June 1995, all the wastewater from collectives and industries located in the valley of the Ondaine were discharged directly into the river. In June 1995, a sewerage collection network was built that takes wastewater straight to the local wastewater treatment plant.

The results

Subsequent to the implementation of the collection network, there was a significant improvement in the physico-chemical and biological quality in the river Ondaine. Figure 24 below illustrate this trend.

Figure 24 Results from the Ondaine valley, France

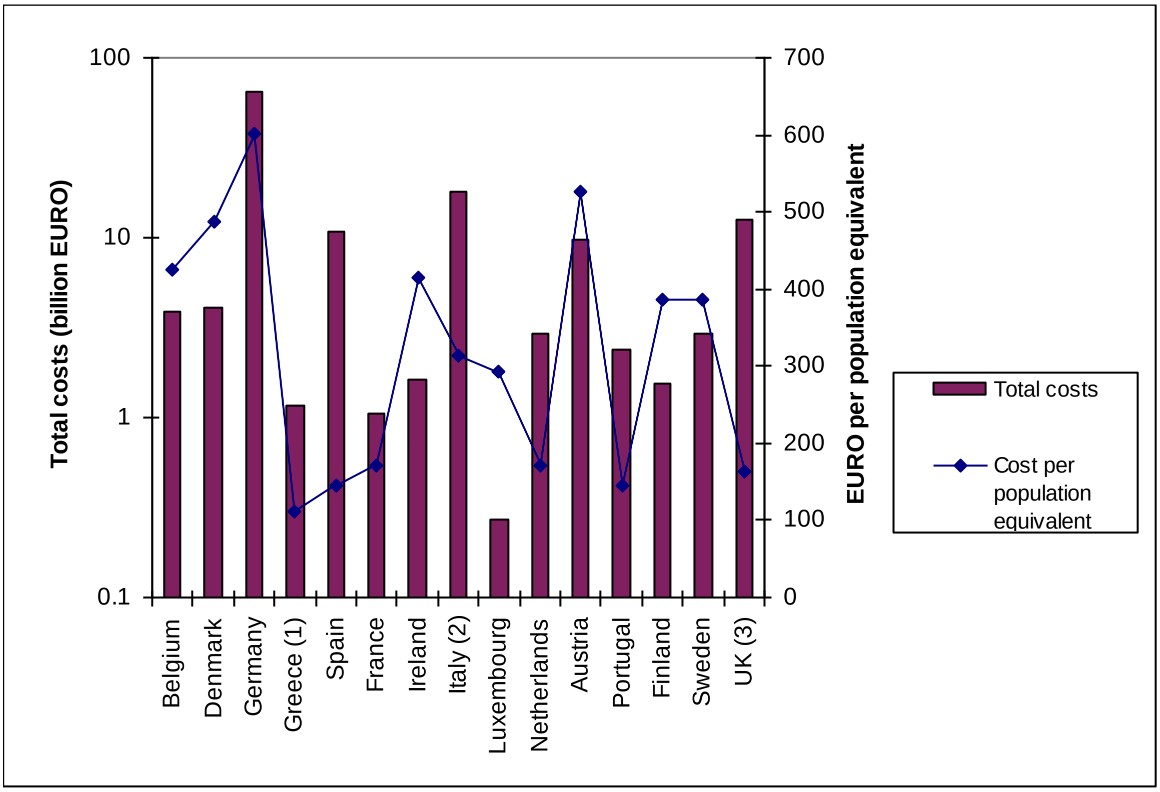


OM: Organic Matter P: Phosphorus NR: Nitrogen except nitrate
A: very good quality B: good quality C: average quality D: bad quality E: very bad

6. Costs

The costs of implementing the Directive are likely to be considerable particularly for countries such as Germany (due to the legacies of East Germany), Italy, Portugal, Spain, UK and France where major investment will be needed to build new infrastructure. This will result in higher water charges to users. The forecasted total investments in the 14 EU Member States, that provided information (Italy did not provide information) for a European Commission's report on progress with implementation of the Directive (CEC, 1999), amount to 130 billion EURO, 53 % of which is for collecting systems and 47 % for treatment plants. Figure 25 illustrates the total forecast costs and costs per population equivalent for each Member State. The forecasted costs per population equivalent (pe) varies between 112 EURO per pe in Greece and 602 EURO per pe in Germany, and equate to an average cost for the 14 Member States of 307 EURO per pe.

Figure 25 Forecast investment costs for the period 1993 to 2005 for implementing the requirements of the Urban Waste Water Treatment Directive in EU Member States (CEC, 1999, unless otherwise stated)



Notes:

Total costs for collecting systems and treatment plants at 1994/1995 values

1 1993 to 2000 only

2 Source: EWWG (1997). Costs are per person not population equivalent

3 Value 1996/1997 for UK

7. Conclusions

1. The Northern and Western European countries with the longest tradition for purification have a high proportion of treated wastewater, the development primarily being continual improvements in treatment level. Southern countries have also improved the level of treatment over the more recent years.
2. The capacities of collecting systems and treatment plants in EU Member States are forecasted to increase over the next five years.
3. The concentrations of both phosphorus and ammonium have been decreasing in EU rivers in the 1990's reflecting the general improvement in waste water treatment over this period. However, the rate of decrease appears to have slowed since 1994 in Western countries with relatively high levels of waste water treatment, for example in Denmark and Germany. Levels of orthophosphate in Finland have been stable and low for many years reflecting the high proportion of tertiary treatment in place.
4. However the current concentrations of orthophosphate in Western and Southern countries are still way above what might be considered to be 'background' or natural levels. Such background levels are found in parts of the Northern countries such as Finland. There is no information on what the impacts are of these elevated concentrations in terms of changes in trophic and ecological status of the affected rivers. Also nitrate or total oxidised nitrogen levels have not changed over this period. The relatively high concentrations of phosphorous compared to natural levels in all sizes of river is also of concern in terms of potential ecological impact. The levels of nitrogen in smaller rivers are also relatively high perhaps reflecting the impact of agriculture on smaller rivers.
5. Most reduction measures for phosphorus to date have focused on point sources such as discharges from urban waste water treatment works. As the loads from these sources decrease then measures will have to be focused on other sources such as agriculture if concentrations in surface waters are to be further reduced to levels at which no ecological impact would be expected. This will become particularly important in water bodies are to achieve good status as required by the Water Framework Directive.
6. The impact of human activities on small and medium sized rivers is particularly evident from the relatively high concentrations of orthophosphate, and of nitrate and total nitrogen found in catchments with high urban land use and high total agricultural activity, respectively. This reflects, respectively, the effects of discharges of orthophosphate from urban waste water treatment works and the emissions of nitrate (and other forms of nitrogen) from agriculture.
7. BOD levels generally decreased in the early 1990's in all river sizes. In more recent years levels appeared to have increased again in all but the smallest rivers. However recent data indicate that many European countries had a majority of river stations with low concentrations of BOD. The levels of BOD are generally lower in Northern countries than in Southern or Western Countries.
8. The Directive requires a 70 to 80 % reduction in total nitrogen loads being discharged into sensitive areas from large agglomerations. There was no available information as to whether this is generally being achieved. Experience in Finland indicates that this might be hard to achieve as only a 30 % reduction has been achieved in a country with high levels of tertiary treatment, and where high levels of phosphorus load reduction have been achieved. Data from EUROWATERNET also indicated that there has been no change in nitrate

concentrations in rivers in the 1990s. Even though point source discharges from urban waste water treatment works may not be the main source of nitrate in many catchments, the reduction of nitrate concentrations and loads may require more efficient removal of nitrogen from sewage.

9. All EU countries except Sweden expect to increase their sewage sludge production between 1991/92 (when the Directive came into force) and 2005 when all sewage treatment measures required by the Directive are due to be operational. Comparison of the proportion of types of sewage treatment in EU countries in the early 1990s with the predicted sewage sludge production by 2005 shows that the biggest increase in sludge production is expected in those countries with the lowest proportion of sewage treatment in 1990. For example, Ireland is expected to increase it s sewage sludge production 3 fold compared to 1991 production. In contrast those countries with a high proportion of their population connected to sewage treatment before the implementation of the Directive only expect a relatively small increase in sewage sludge production by 2005, e.g. Denmark and Germany. Overall in the EU there is expected to be a 2.4 fold increase in sludge production between 1991 and 2005.

10. The costs of implementing the Directive are likely to be considerable particularly for countries such as Germany (due to the legacies of East Germany), Italy, Portugal, Spain, UK and France where major investment will be needed to build new infrastructure. This will result in higher water charges to users. The forecasted total investments in the 14 EU Member States, that provided information (Italy did not provide information) for a European Commission’s report on progress with implementation of the Directive (CEC, 1999), amount to 130 billion EURO, 53 % of which is for collecting systems and 47 % for treatment plants. Figure 22 illustrates the total forecast costs and costs per population equivalent for each Member State. The forecasted costs per population equivalent (pe) varies between 112 EURO per PE in Greece and 602 EURO per pe in Germany, and equate to an average cost for the 14 Member States of 307 EURO per pe.

11. The costs of implementing the Directive are likely to be considerable particularly for countries such as Germany (due to the legacies of East Germany), Italy, Portugal, Spain, UK and France where major investment will be needed to build new infrastructure. This will result in higher water charges to users. The forecasted total investments in EU Member States (excluding Italy) amount to 130 billion EURO, 53 % of which is for collecting systems and 47 % for treatment plants. The forecasted costs per population equivalent (pe) varies between 112 EURO per pe in Greece and 602 EURO per pe in Germany, and equate to an average cost for the 14 Member States of 307 EURO per pe.

12. The available information and data indicates that there has been significant improvement in some indicators of water quality as a result of improvements in urban waste water treatment. However, it is not clear how much of the improvement is due to the implementation of the Directive or from previously planned national improvement measures. If more precise information is required to assess the effectiveness of the Directive then this could be obtained through the implementation of the EUROWATERNET-impact network.

References

To be completed