3. WATER QUALITY

3.1 Introduction

This chapter presents the latest available published baseline water quality for the GDSDS area at the time of writing and discusses the impact of current practices on receiving waterbodies. The principle issues of concern in relation to water quality are those of public health, environmental degradation and aesthetic quality.

The GDSDS area covers nearly 1900 km^2, encompassing all of County Dublin and parts of south-east County Meath, north-east County Kildare and north County Wicklow. The boundary is shown on **Figure 7** & **Figure 8** below. Since the activities in the wider region influence the water quality within the GDSDS area and Dublin Bay, the discussion of water quality extends to areas which are outside the GDSDS boundary. This includes river headwaters in Wicklow to the south and the Hurley, Nanny and Mosney Rivers to the north as shown on **Figure 7** & **Figure 8** below.

The water quality of the main rivers, estuaries and Dublin Bay is monitored using both biological and physico-chemical techniques. Biological monitoring enables assessment of the effects of pollution, if any, whereas physico-chemical monitoring measures the quantity/concentration of pollutants and is required in order to assess compliance with relevant standards. Water quality is best assessed using a combination of both methods and for this review, both sets of data were used where available at the time of writing. Subsequent data may show improvement or deterioration and it is up to the reader to take this new data into account.

Section 3.2 outlines the sources of data on water quality. Section 3.3 then describes the main sources and components of pollution while Section 3.4 briefly outlines the different landuses within the GDSDS and their potential as a pollution source. Section 35 summarises river water quality, Section 3.6 discusses water quality within Dublin Bay, including estuaries and offshore waters, while Section 3.7 discusses groundwater quality. The final section summarises the current status of water quality in the GDSDS study area and highlights requirements for improvement. Relevant references are provided in section nine. Supplementary information on water quality and standards for its protection can be found in **Appendix C.**

3.2 Water Quality Data Sources

The following data sources were used in the preparation of this chapter:

- EPA Water Quality in Ireland: Monitoring of the main rivers and streams in the Greater Dublin Area reported on a tri-annual basis. This data is reviewed for the latest monitoring period (1998-2000) and compared with data from the previous period (1995-1997) to identify trends.
- Three Rivers Project Data: Camac and Liffey.
- EPA/ coastal and offshore water monitoring data reported on a tri-annual basis.
- Dublin Bay Water Quality Monitoring Programme 2001 undertaken by the Central Laboratory on behalf of Dublin City Council, 2001.
- Dublin Bay Water Quality Management Plan, Environmental Research Unit, 1991.
- EPA canal waters monitoring data reported on a tri-annual basis.
- EPA groundwater quality monitoring data reported on a tri-annual basis.

The water quality data is assessed in relation to the existing standards and regulations introduced in **Chapter 2**.

3.3 Pollutants

Water quality within the GDSDS area is determined by a combination of natural processes and human activities. Pollution occurs when contaminant concentrations, nearly always derived from human activities, reach an objectionable level and harm either humans or the environment (e.g. flora and fauna).

3.3.1 Pollution Sources

The sources of pollution can be categorised as either point or diffuse.

- Point source pollution originates from identifiable smaller scale sources such as leaking storage tanks, combined sewerage overflows (CSOs), discharge from Wastewater Treatment Works (WwTW) and effluent discharges from industry.
- Diffuse source pollution is that which originates from a wide area of influence comprising many smaller sources. Diffuse source pollution occurs primarily from run-off and other discharges associated with land uses such as landspreading of agricultural wastes, pesticide application in farming practices and urban run-off.

Of particular importance is the first flush phenomenon, whereby pollutants which have built up on the land and in pipe networks during dry periods are washed off during the early stages of a storm event and contribute to poor water quality in receiving waters. This can happen before the river has responded to the rainfall event and is still at low flow. Section 5.8.4 further discusses the implications of managing first flush.

Significant pollution may occur also where stormwater drains are connected to the foul sewers and which hence cause overflow to receiving waters in periods of heavy rainfall. Infiltration to foul sewers is also a significant issue, the management of which is discussed fully in **Volume 4 on Inflow, Infiltration and Exfiltration**.

Pollution pathways are diverse but generally pollution of watercourses usually occurs directly via contaminated run-off and discharges and/or indirectly via groundwater baseflow contributions to rivers and streams.

3.3.2 Pollutant Types

Introduction
The constituents which give rise to pollution can be broadly categorised as organic, hydrocarbons, trace metals and other inorganics, and microbial. **Table 7** below summarises the common pollutants found in water and their likely sources. Many of these pollutants are “List I” substances under the Groundwater (80/68/EEC) and Dangerous Substances Directives (76/464/EEC).

Pollutant Type	Typical Components	Typical Source	Environmental Impact
Organic and inorganic	Nutrients: nitrogen[2] and phosphorus[2]	Waste water treatment discharges Sewer overflows Agricultural run-off (slurry/animal waste) Urban run-off (detergents, organic material) Septic tanks Industrial effluent Atmospheric deposition (N) Fertilisers & Pesticides: agricultural and municipal application	Eutrophication. Algal blooms. Ecological degradation. Contamination of potable surface and groundwater supplies.
Hydrocarbons	Petroleum Hydrocarbons[1] Monocyclic Aromatic Hydrocarbons e.g. benzene, toluene, ethylbenzene & xylene (BTEX). Polycyclic Aromatic Hydrocarbons (PAH)	Car Maintenance. Disposal of waste oils. Spillages. Road runoff. Industrial run off. Contaminated Sites	Toxicity. Contamination of stream sediments. Groundwater contamination. Nuisance (surface waters). Taste (potable supplies).
Trace Metals	Lead[2], zinc[2], cadmium[1], mercury[1], arsenic[2].	Urban run-off Sewer overflows Septic tanks leaks Landfill leachate Oil spillages Atmospheric deposition Car Parks and roads Industrial effluent	Toxicity. Bio-accumulation. Health effects//Death.
Chemicals	Phenols[1], Polychlorinated Biphenyls[1] (PCB's) Solvents[1]	Industry	Toxicity, endocrine disruption. Contamination of potable water supplies.
Sediment	Silt, sand, gravel, clays.	Urban Runoff Construction sites Land erosion Stream bank erosion	Muddy water Siltation Smothering of aquatic life
Litter	Paper, plastic, leaves, syringes	Commercial areas Fast food outlets Urban areas in general	Mainly visual Interferes with aquatic life
Microbial	Faecal Coliforms, other bacteria and viruses.	Waste water discharges Sewer overflows Leaking sewers Misconnections Septic Tanks Animal faeces	Human Infection, illness and disease Loss of bathing waters.
Flow	Volume, frequency, velocity	Increased stormwater runoff	Stream Bank Erosion Impact on estuarine and marine habitats.
Atmospheric Pollutants	Sulphur, nitrogen[2].	Car emissions (traffic) Industry	Low pH in sensitive catchments – acid rain.

Table 7: Common Water Pollutants

Notes [1] List 1 [2] List 2 Dangerous Substances (76/464/EEC) and Groundwater (80/68/EEC) Directives

3.4 Land Use

By examining landuse within the GDSDS area, some understanding of potential pollutant sources can be gained. To this end, a detailed thematic land use map of the study area has been generated from a CORINE (Co-ordinated Information on the European Environment) land cover database as Figure 7 below. The CORINE database consists of geographical datasets describing vegetation and landuse, from which 28 different landuse classes were identified.

An analysis of the Corine database, together with data from development plans, Ordnance Survey maps, house counts and aerial photography, was undertaken to derive the following percentages of landuse within the GDSDS area:

- 24% Urban: includes all impervious areas such as roads, roofs, carparks and paved areas;
- 8% Urban Green Space: includes recreational grounds and green spaces enclosed by urban areas; and
- 68% Rural: includes pasture / agricultural land and high amenity areas such as the Dublin Mountains.

Urban areas are obviously concentrated around Dublin City and include all residential, commercial and industrial landuses. As is shown below (refer **Figure 8**), pollution in these areas is more pronounced than elsewhere.

Landuse is more complex in the southern part of the study area, and includes a combination of agricultural, pasture, forest, peat bogs, moors, heathland and natural grassland. Pasture and non-irrigated arable land comprises the main landuse in the north GDSDS area where the land is much flatter.

The activities which have the potential to impact on water quality in the GDSDS area include agriculture, forestry and rural development, landfill, industry, mining, discharges from WwTW and urban development including urban runoff. The relative pollutant contributions of each type of landuse has been investigated in detail in the Camac River catchment, as discussed below and in **Appendix C.**

Figure 7: Corine Land Cover

INSERT FIGURE 7

Figure 8: GDSDS River Water Quality

INSERT FIGURE 8

3.5 River Water Quality

3.5.1 Introduction

This section reviews biological and chemical (phosphorus) water quality data for the main rivers and streams within the GDSDS area. The majority of data is derived from monitoring carried out by the EPA and Local Authorities, as described in **Section 3.2**. As mentioned above in **Section 3.1**, the data discussed is that of the rivers both within the GDSDS area and rivers outside that boundary which may affect water quality within the GDSDS. However, for the purposes of the discussion, and to avoid confusion, the terminology GDSDS is retained.

For biological surveys the EPA have adopted a method of water quality classification based on biotic indices or Q ratings. These indices are based on the composition and diversity of macro-invertebrate communities and have been developed in order to convey the significance of the biological changes caused by pollution. The index reflects the effects of organic pollution such as eutrophication and de-oxygenation, but can also reflect the impact of toxic pollution. The biotic index is shown in **Table 8** below. Further details on the characteristics of the biological quality classes can be found in **Appendix C**.

Biological surveys are undertaken at sampling stations once in the three year monitoring period. Unlike the physico-chemical surveys which extend through the year, the biological surveys are undertaken in the period June to October, when flows are likely to be relatively low and temperatures highest. Surveys are likely therefore to coincide with the worst conditions to be expected in those reaches affected by waste inputs (EPA, 1998).

Biotic Index (Q Value)	Quality Class	Pollution Status	Colour Code		Condition
Q5, Q4-5, Q4	Class A	Unpolluted	Blue		Satisfactory
Q3-4	Class B	Slightly Polluted	Green		Unsatisfactory
Q3, Q2-3	Class C	Moderately Polluted	Yellow		Unsatisfactory
Q2, Q1-2, Q1	Class D	Seriously Polluted	Red		Unsatisfactory

Table 8: EPA Biotic Index

The EPA also conducted a study of dangerous substances, comprising metals, pesticides and volatile organic compounds, endocrine disrupting chemicals (EDCs) e.g. polychlorinated biphenols (PCBs), in rivers throughout Ireland. The findings of these studies are included below.

3.5.2 Current Water Quality (1998-2000)

Overview

The EPA Biological Water Quality Classification for the GDSDS area is shown in **Figure 8**. This figure shows biological quality status for the period 1998 – 2000 and indicates any changes since the previous period. The EPA also include comments on the likely causes of pollution and these comments have been incorporated into the discussion.

The EPA 1998 to 2000 monitoring data indicates that of the 126 water quality stations sampled in the GDSDS area, 88 stations (70%) were polluted (refer **Figure 9**).

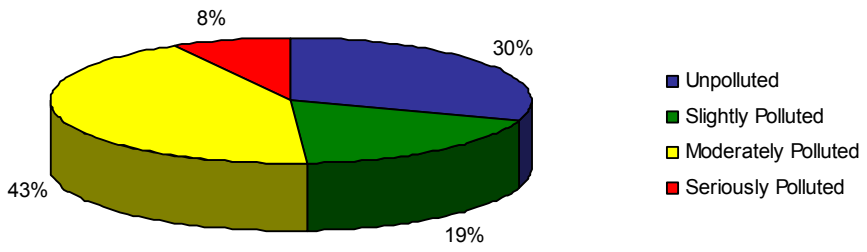

Figure 9: GDSDS Biological Water Quality 1998-2000 (Based on river stations)

These figures are comparable when the river quality data is analysed with respect to channel length (refer **Figure 10**) which indicates that approximately 64% of the rivers channel length monitored are polluted.

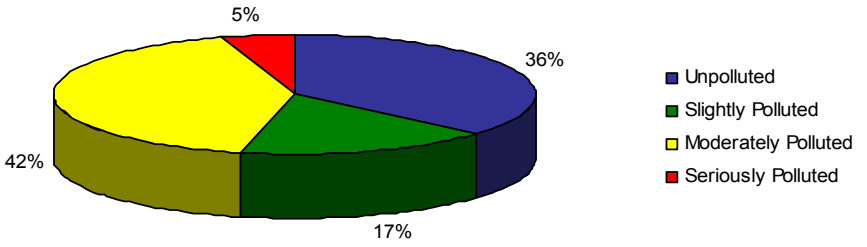

Figure 10: GDSDS Biological Water Quality 1998 – 2000 (Based on channel length)

South GDSDS Area

The South GDSDS area contains 79 of the total 126 stations within the GDSDS. A larger proportion of these 79 stations (43%) were unpolluted (refer **Figure 11** below), a reflection of the fact that the headwaters of these rivers occur in mountainous, relatively undeveloped areas. In general, water quality tends to deteriorate moving downstream as a result of agriculture, industry and urban development.

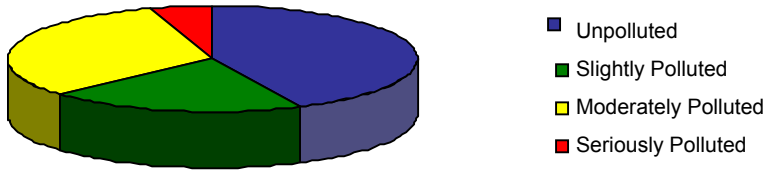

Figure 11: South GDSDS Area Rivers - Biological Water Quality 1998-2000 (Based on River Stations)

Incidents of serious pollution were recorded in the Camac, Liffey and the Owendoher Rivers as a result of WwTW discharges and urban runoff. The decommissioning of Saggart WwTW and the upgrading of Osberstown WwTW will however result in continued water quality improvements in the upper reaches of the Camac and Liffey Rivers respectively.

The Liffey is of only moderate status downstream of Leixlip WwTW, with recorded exceedances of DO, ammonia and Molybdate Reactive Phosphate (MRP) standards. Exceedances of discharge quality standards at Leixlip WwTW were also recorded, but the situation is improving. Serious pollution of the Camac occurs downstream in a heavily urbanised area of Dublin City.

The EPA indicate a variety of reasons for incidences of slight and moderate pollution. This includes runoff and siltation (resulting from quarrying, forestry and urban development), oil spills and sewage discharges. Further details of individual rivers and pollutant levels are given in **Appendix C**.

North GDSDS Area

The North GDSDS area contains 48 of the total 126 stations within the GDSDS, but only four (8%) of these were unpolluted (refer **Figure 12** below). These unpolluted stretches occur in the Nanny, the Delvin and the Hurley Rivers at the fringes of the GDSDS area, although some deterioration to moderate status has been recorded in the upper reaches due to industrial and agricultural influences.

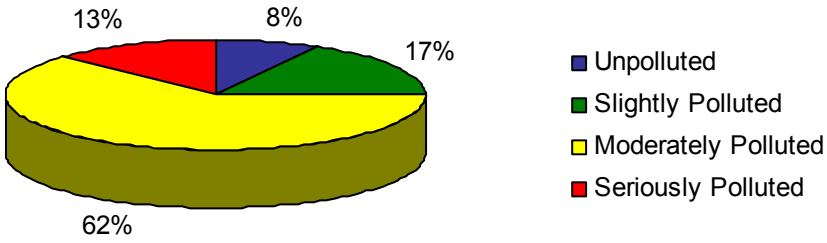

Figure 12: North GDSDS Area Rivers - Biological Water Quality 1998 – 2000 (Based on River Stations)

The North GDSDS area contains a high proportion (62%) of moderately polluted rivers. These rivers begin their lives in relatively low-lying, agricultural areas which are under greater pressure from nutrient inputs than the headwaters of South GDSDS rivers.

Stretches of serious pollution occur along the Santry, Tolka, Mayne and Broadmeadow Rivers. The serious pollution of the Santry River occurs in its middle and lower reaches, which may be due to local commercial/industrial activities. High levels of ammonia and MRP were recorded.

Serious pollution of the River Tolka was recorded in the Dunboyne Branch, mainly from agricultural runoff and possibly sewage treatment effluents. Median MRP levels and total ammonia were elevated.

Serious pollution of the Mayne River, which is suspected to be toxic, occurs in its downstream reaches, although no obvious source was identified. DO, maximum ammonia and median MRP levels all exceed given criteria.

The serious pollution of the Broadmeadow River occurs in the upper reaches in a largely agricultural area. The river reach where the Swords WwTW discharges is moderately polluted, with some breaches of BOD and TSS recorded. Ammonia and MRP levels exceeded recommended criteria at all sites monitored.

Further details of individual rivers and pollutant levels are given in **Appendix C**.

Comparison of Data with Previous Sampling Period (1995-1997)

Figure 13 below summarises the overall trend in water quality over the two monitoring periods based on sampling at river stations. Only 113 of the 126 stations were sampled in both periods, and have been assessed for the identification of trends.

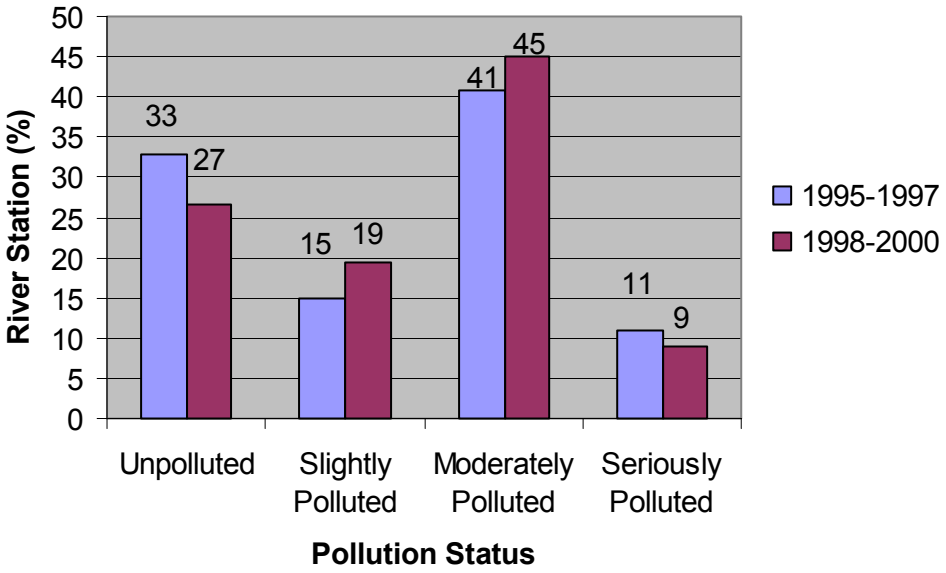

Figure 13: GDSDS Area Rivers - Comparison of Biological Water Quality ('95 - 97 & 98- '00)

Note: Only those river stations which were monitored in **both** years can be compared.

There has been a 6% increase in polluted waters over the two periods. The level of slight and moderate pollution has increased, however the level of serious pollution has declined.

The overall trend in water quality for the two monitoring periods for North and South Dublin are also summarised on **Figure 14** and **Figure 15**. Overall, the proportion of polluted rivers in the south has increased, unlike in the north which have improved or remained static. However, the northern GDSDS area's rivers still suffer from greater overall pollution.

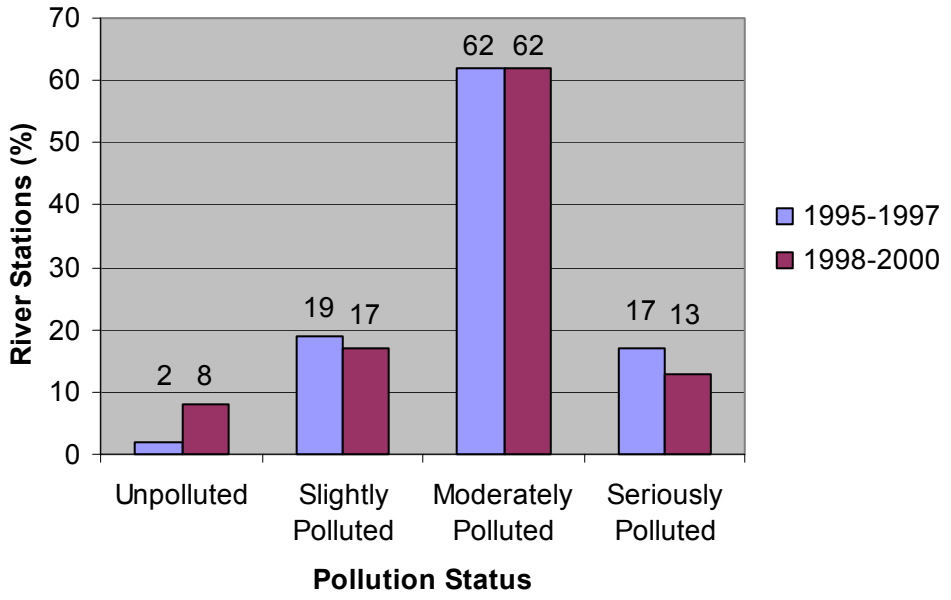

Figure 14: North GDSDS Area Rivers - Biological Water Quality ('95 – '97 & 98 -00)

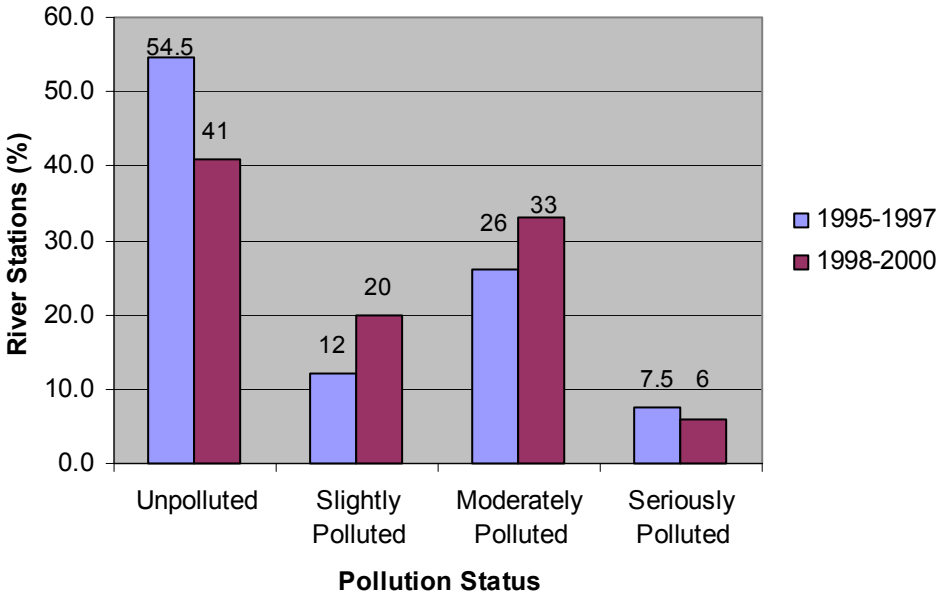

Figure 15: South GDSDS Area –Rivers - Biological Water Quality ('95 – 97 & '98 – 00)

Investigations into the Impacts of Urbanisation on Water Quality in the Camac River

Introduction

Investigations into the impact of urbanisation on water quality in the Camac were instigated as part of the Three Rivers Project, one of a series of Government initiatives to pilot the development of catchment based water quality monitoring and management systems.

The study area was established in a predominantly urban catchment to ascertain the effects that various sectors (residential, industrial, infrastructure (roads), and developing) may have on water quality. The catchment that was chosen was the Camac system that flows through a considerable area of South County Dublin. The catchment comprises:

- 3734 hectares – Rural
- 1144 hectares – Residential
- 883 hectares – Industrial
- 137 hectares – Developing
- 76 hectares – Naas Road and M50

The Camac is 24km in length, and has a catchment area of 59 km^2. The fall of the river from Mount Seskin to the Liffey outfall is approximately 330m. The population of the catchment was approximately 96,000 persons according to census of 1996, and has increased to approximately 108,000 in 2002.

Methodologies

Water quality in the river was monitored using three methods, weekly grab sampling, annual biological sampling and flow proportional automatic sampling. The autosampler was also used to monitor storm water systems.

Nutrient loads were estimated for five main sub-catchments of the Camac. These loads were estimated using instantaneous flows and nutrient concentrations from the weekly grab samples. Loads were also estimated for the sectoral landuses from auto sampler data at targeted sites and these were used to calculate nutrient export coefficients from the various landuses i.e. rural, residential, industrial, developing, and infrastructure. This information was to be used to help prioritise investigations into problem sub-catchments and landuses that had the greatest impact on those sub-catchments.

Results

Water quality results (physico/chemical and biological) showed that elevated nutrient concentrations and subsequent low biological status in the Camac occurred downstream of the outfall of Saggart WwTW. This poor water quality remained constant throughout the rest of the system further downstream.

Results from the autosampling showed that elevated nutrient concentrations in systems draining the monitored landuses (residential, industrial, developing, infrastructural) were all strongly event based.

When actual and estimated sub-catchment loads results were compared it was found that two sub-catchments were heavily influenced by nutrients originating from undefined sources (sources not originating from landuse). The undefined source in one of these sub-catchments was Saggart WwTW, which was estimated to be contributing 50% of the MRP load for the whole Camac catchment. Saggart WwTW has since been decommissioned. The other sub-catchment with an un-defined source is presently being investigated by the Local Authority concerned.

Discussion

Point sources are currently the most significant sources of nutrients in the Camac catchment. It was found in the study that sources such as these, once isolated to a smaller sub-catchment, are more swiftly identified, and suitable measures to control them, more easily implemented. The removal of the two most significant point sources will reduce the MRP load to river by 74%.

Results from the autosamplers monitoring the storm water systems from the different landuses have found that increased nutrient concentrations are event related and are considered diffuse. These diffuse sources are emanating from "minor misconnections", "first flushes" and "storm run off" from impermeable surfaces and gulley traps. Currently the Local Authorities are investigating misconnections in private households (washing machines, dish washers etc. connected to storm systems). These investigations are taking place in catchments other than the Camac in the Greater Dublin area and have achieved considerable success.

Recommendations

Short Term (0-2 years)

- Investigate and remove all foul mis-connections to the surface water sewer network.
- Encourage storm water management in all current and future developments (e.g. implement SuDS).
- Monitor licensed premises (Section 4 and 16) to ensure the license conditions are being adhered to.

Medium Term (2-5 years)

- Investigate and remove all storm water mis-connections to foul networks.
- Identify all combined sewer overflows and minimise impact through the development of drainage area plans and by upgrading sewerage infrastructure (holding tanks etc.)

Long Term (5-10 years)

- Investigate and remove all storm water mis-connections to foul networks.
- Consider retrofitting of SuDS in developed urban areas especially where redevelopment is occurring.

3.5.3 Compliance with Regulations

Phosphorus Regulations

The Local Government Water Quality Standards for Phosphorus Regulations 1998 attempt to address eutrophication through the setting of interim targets to be reached by 2007. (The requirements of the regulations are included in **Chapter 2**: Environmental Legislation).

The EPA report on the implementation of the Phosphorous Regulations, and at the time of writing the latest available report which was published in 2001. This report is based on surveys undertaken during the 1998-2000 period. A further report on more recent data (2000-2002) is expected to be published during 2003 which will document any improvements/changes since the last monitoring period.

For the purposes of this Study, the latest available published water quality status (1998-2000) was reviewed to determine progress in relation to interim targets, using data from the EPA's report "Water Quality in Ireland 1995-1997" as the baseline. As mentioned in section 3.5.2 above, a total of 113 river stations were monitored within the GDSDS area for both periods. Of the 113 monitoring sites, 79 sites have both current (1998-2000) Q ratings and median MRP data while the remaining sites had no MRP data (and therefore compliance with the Phosphorus regulations is based on equivalent Q rating as given in the regulations). Compliance with the Phosphorus Regulations is based on an ecological & physico-chemical approach, i.e. sites can comply with either the biological Q rating or the annual median MRP target, or both (refer section 2.6.3 or S.I. 258, 1998). **Table 9** below shows the percentage of sites in 1998 - 2000 complying with the Phosphorus Regulations, 1998 Interim targets set for 2007. Over half of the sites (57%) failed to meet their 2007 interim target as set out in the Phosphorus Regulations. The compliance with the Phosphorous Regulations for the period 1998-2000 is summarised on **Figure 16.**

Criteria	Compliance	% Of Sites
Pass MRP or Pass Q (Meet P Regulations)	Pass	35
Pass MRP and Q (Meet P Regulations and Water Framework Directive)	Pass	9
Pass neither MRP nor Q (Fail P Regulations)	Fail	57
Pass P Regulation Objective	43%	
Fail P Regulation Objective	57%	

Table 9: Percentage of Sites in Compliance with Phosphorus Regulations and WFD

Figure 16: Phosphorous Regulations and WFD Compliance

INSERT FIGURE 16

Water Framework Directive
The recently introduced Water Framework Directive (WFD) (2000/60/EC) requires the achievement of good status for all waters by 2015. This includes the prevention of deterioration of "present status".

Although the reference conditions have yet to be established for each water body within the GDSDS area, the WFD is likely to require the achievement of both the MRP and Q value targets set out in the Phosphorus regulations. Derogations may be given for example where the water body has been heavily modified or for reasons such as technical unfeasibility, or disproportionate expense. Within the GDSDS area the River Poddle is likely to fall into this category as it has been heavily culverted.

Using the above criteria only 9% of sites passed the interim targets for both MRP and Q ratings i.e. met the likely requirements of the WFD for achievement of good status.

Water Quality Standards for Specific Uses
Targets for water quality standards to protect beneficial uses, for example, fisheries or drinking water abstraction, are stipulated in legislation outlined in chapter 2. Within the GDSDS area, there is only one river, the Dargle, which is designated as a Salmonid Water under the Freshwater Fish Directive (78/659/EEC). The Dargle discharges to the sea at Bray Harbour, near the southern limit of the study area.

The EPA biological survey recorded a "marked deterioration" in the lower reaches of the Dargle since 1997 (down to Q3 at 2 downstream sites from Q4 and Q3-4) when it was surveyed in 2000. The physico-chemical results for the 1998-2000 period indicate elevated MRP levels in the lower reaches, with the national standard of 0.03mg/L (annual median) exceeded at both stations 0200 (0.05mg/L) and 0300 (0.04mg/L).

3.5.4 Dangerous Substances

The overall findings of the dangerous substances survey reported by the EPA (1998-2000) were that the concentrations of the dangerous substances sampled were very low and there was no evidence of any of the targeted pesticides and other organic substances. Metals, attributed to mining activities and geological features, were identified in some rivers, but these were outside of the GDSDS boundary.

However, the study concluded that, in relation to endocrine disrupting chemicals (EDCs), as many of these substances are being used in Ireland it is likely that they are reaching our freshwater environment through sewage discharges, landfill leachate infiltration and runoff, land runoff and atmospheric deposition.

Canal Waters
Although the Royal and Grand Canal are not receiving waters for GDSDS drainage they both discharge to Dublin Bay and so are relevant when discussing catchment water quality in Greater Dublin as a whole.

The results of the EPA 1998-2000 surveys were that water quality in both canals was good with low levels of conductivity and nutrients. MRP levels at all sites in the Grand Canal section within the GDSDS were well below 0.02 mg/L. Several Royal Canal feeders that previously exhibited raised phosphorus levels showed a marked improvement. Litter remains an aesthetic nuisance, particularly in urbanised areas.

Summary – GDSDS River Water Quality

The EPA biological water quality monitoring data for the period 1998-2000 indicates that 70% of river sites monitored are polluted. A comparison with data from the previous monitoring period indicates that while incidents of serious pollution have declined, overall the level of polluted waters has increased.

A Pilot study in the Camac catchment has shown that, when the contribution from point source pollution is removed, elevated nutrient concentrations for monitored landuses: residential, industrial, developing (construction sites) and infrastructure (roads), were strongly event based and considered diffuse. In other words, stormwater provides a significant source of aquatic pollution. Misconnections, combined sewer overflows, 'first flush' events and urban stormwater in general, were significant components of this type of pollution.

When assessed against the interim standards set in the National Phosphorous Regulations, of the latest published data (1998-2000 monitoring period), only 43% of GDSDS river monitoring sites have achieved the interim targets which must be achieved by 2007.

Based on biological and chemical (phosphorus) data from the 1998-2000 monitoring period, published by the EPA, it is estimated that only 9% of GDSDS river waters are currently likely to comply with the requirements of the Water Framework Directive.

3.6 GDSDS Coastal Water Quality

3.6.1 Introduction

The following water quality data exists for Dublin Bay and is reviewed in summary or referenced below.

Dublin Bay Water Quality Monitoring Programme, Dublin City Council 2001
The Dublin Bay Water Quality Monitoring Programme is carried out by Dublin City Council. This is a 5 year programme, which commenced in June 2000 and is being undertaken by the Central Laboratory of Dublin City Council. It will provide information on Ringsend effluent, the Liffey estuary, offshore waters and bathing waters, prior to, during and after the upgrading of the Ringsend Sewage Treatment Works. At the time of writing, data was available for June 2000 to June 2001. The nine major freshwaters flowing into Dublin Bay are also monitored (Liffey, Dodder, Tolka, Camac, Poddle, Santry, Naniken, Royal Canal and Grand Canal). Since writing this report, data for these freshwater inputs has been published.

A range of parameters were surveyed and included ammoniacal nitrogen, total oxidised nitrogen (TON: nitrate and nitrite), MRP, total phosphorus, chlorophyll, dissolved oxygen, biochemical oxygen demand (BOD), total and faecal coliforms and transparency. Sampling was undertaken throughout the year broadly on a monthly basis.

EPA Water Quality in Ireland Report 1998-2000
The EPA report "Water Quality in Ireland" includes data on general quality conditions in estuarine and coastal waters monitored by a number of agencies and reported on a tri-annual basis. This data is reviewed for the latest monitoring period (1998-2000) and compared with data from the previous period (1995-1997) to identify trends.

Within the GDSDS area the coastal waters monitored are those from Balbriggan to Bray Head. A range of survey parameters were monitored including ammoniacal nitrogen, free ammonia (toxic to fish), dissolved inorganic nitrogen (sum of ammoniacal nitrogen and TON), MRP, chlorophyll, dissolved oxygen, BOD, total and faecal coliforms, transparency, temperature, pH and salinity. Sampling was generally undertaken on a monthly basis between May and September. Some winter data is available from the Marine Institute, Fisheries Research Centre.

The EPA made an assessment on the trophic status of each estuary and bay on the basis of nutrient enrichment (dissolved inorganic nitrogen and MRP), accelerated growth of algae (chlorophyll) and undesirable disturbance to the oxygen regime (dissolved oxygen). The criteria for eutrophication in Irish Estuaries, Bays and Nearshore Coastal Waters as documented in the EPA Water Quality in Ireland report 1998-2000 are included in **Appendix C**.

Dublin Bay Water Quality Management Plan, Environmental Research Unit, 1991
The Dublin Bay Water Quality Management Studies were initiated in 1986 to develop a Water Quality Management Plan for Dublin Bay. The studies set water quality standards for Dublin Bay and the Liffey estuary largely based on parameters normally used to detect the presence of organic wastes. The standards set for the parameters of relevance to the assessment of water quality in Dublin Bay are shown in **Appendix C**. The Dublin Bay Water Quality Management Plan identified the Tolka and the Camac rivers to be the most markedly impaired of the freshwater inputs to Dublin Bay.

3.6.2 Estuaries

The EPA report "Water Quality in Ireland 1998-2000" identified eutrophic conditions in two estuaries within the GDSDS area, i.e. the Inner Broadmeadow estuary and the Liffey estuary. Both these estuaries have been designated as 'nitrate sensitive' (under the Urban Waste Water Treatment Regulations, 2001 (SI 524 of 2001) and as such require the provision of nutrient removal at WwTW discharges to these areas by May 2008. Refer to **Figure 5: Protected Areas** above for designated nitrate sensitive areas.

Summary statistics for the Broadmeadow and Liffey estuaries are found in **Appendix C**.

Broadmeadow Estuary
The Broadmeadow Estuary is "an impounded lagoon that consequently has a very low flushing rate which allows high plankton biomass to develop" (EPA, 2002). The findings of the EPA surveys are outlined below.

Significantly high photosynthetic activity was observed on most surveys throughout the impounded waterbody. Oxygen saturation was greatly disturbed and exhibited a large range (76-268% of normal). Saturation was generally highest close to the mouth of the Broadmeadow / Ward River. This area is also the discharge point for the Swords Waste Water Treatment Works (WwTW).

Elevated BOD levels were found (median summer concentration of 5.2mg/l) and are ascribed mainly to discharges from the WwTW.

Oxidised nitrogen in the fluvial inflow was moderate (0.009mg/l - 2.13mg/l). Inputs of ammonia from the WwTW provided the main nitrogen source on all surveys. Significant inputs of MRP were also found to be derived from the WwTW. The surveys indicated that potentially toxic levels of ammonia could have been present in the upper section of the estuary.

MRP concentrations in the fluvial inflow were very high (100-760μg/l P) with significant additional phosphate derived from the WwTW outfall.

Chlorophyll concentrations were very high during summer, particularly in the upper reaches, and the estuary was strongly eutrophic on all surveys. Similar conditions were reported in the previous review period and no improvement has occurred. On the contrary, the median chlorophyll value rose from 22μg/l in 1995-1997 to 37μg/l in 1998-2000 (the median criterion for eutrophication is 15μg/l), suggesting a worsening of the eutrophication status of the estuary.

The Outer Broadmeadow (Malahide) estuary (seawards of the railways embankment) showed few indications of impaired water quality. Oxygenation levels were generally close to normal levels and BOD and nutrient concentrations were generally low. Chlorophyll concentrations were largely consistent with those observed in the adjacent coastal waters. The Outer Broadmeadow is classified as non-eutrophic.

Liffey Estuary

The EPA data for 1998-2000 identified oxygen levels in the Liffey Estuary to be very similar to those for the previous review period with only a small proportion falling outside the normal range of 80-120% of normal saturation. Low levels were detected in the vicinity of the East Link Bridge. An improvement in oxygen levels was identified in the vicinity of Ringsend WwTW outfall. Excess oxygen saturation was also detected in the Dodder and Tolka estuaries and has been related to accelerated plant growth. The results of the Dublin Bay Water Quality Monitoring Programme for the period 2000-2001 generally had satisfactory dissolved oxygen (D.O.) levels.

The EPA (1998-2000) report identified generally low BOD concentrations in the estuary, however the Liffey Estuary was in breach of the 95%ile BOD standard of 4mg/l O_2 set out in the Dublin Bay Water Quality Management Plan. Limited information is available from the previous monitoring period therefore an examination of trends is not appropriate. The most recent data for 2000-2001 from the Dublin Bay Water Quality Monitoring Programme record BOD levels consistent with the EPA data with the median BOD concentrations less than 2mg/l at all sampling locations upstream of Ringsend WwTW. The maximum value recorded was 30mg/l at Ringsend WwTW outfall.

Summer oxidised nitrogen concentrations in the most recent EPA surveys were very similar to those recorded in the previous review period and were generally low relative to the estuaries of other major rivers. The 2000-2001 data recorded the highest levels of TON in the upper reaches of the estuary and in the vicinity of Ringsend WwTW with nitrogen concentrations decreasing seawards with increasing influence of seawaters. Median values ranged from 134μg/l (Poolbeg) to 275μg/l (Matt Talbot Bridge). No standard for TON was set within the Dublin Bay Water Quality Management Plan, as further research was required at the time on dissolved nutrients and their effect in the Bay.

Ammonia concentrations detected during the EPA 1998-2000 monitoring period were similar to the previous period with significantly higher concentrations recorded in the Outer Estuary adjacent to Ringsend WwTW outfall. The results from the Dublin Bay Water Quality Monitoring Programme 2000-2001 surveys are consistent with the maximum ammonium level (860μg/l) recorded at Ringsend WwTW outfall.

Phosphate concentrations were also highest at Ringsend WwTW outfall. Slightly elevated values were also detected in the vicinity of the East Link Bridge indicating that river inflow was a significant source of phosphorus as was evident in the previous monitoring period. The 2000-2001 Dublin Bay Water Quality Monitoring data recorded the highest levels of phosphate in the vicinity of Ringsend WwTW (363 μg/l). Upstream of the WwTW median values ranged from 34μg/l to 64μg/l and downstream median values ranged from 34μg/l to 215μg/l.

The EPA report chlorophyll concentrations in the estuary as mostly low and did not exhibit any significant changes since the 1995-1997 period. The results from the Dublin Bay Water Quality Monitoring Programme 2000-2001 were consistent with this data.

Bacteriological water quality monitored in the Dublin Bay Water Quality Monitoring Programme returned highest levels of coliform contamination in samples from the North Bull Wall, inside the estuary. As would be expected coliform contamination was highest in the vicinity of Ringsend WwTW (see below).

The Dublin Bay Water Quality Monitoring Programme reports samples from the Liffey estuary in the vicinity of Ringsend WwTW during 2000-2001 with concentrations as high as 1,892μg/l N as ammoniacal nitrogen, 363μg/l phosphate, 30mg/l BOD, 26,900,000 total coliforms per 100ml and 5,300,000 faecal coliforms per 100ml. All of these concentrations are higher than the maximum corresponding values recorded for samples taken during the 1986 to 1988 sampling for the Dublin Bay Water Quality Management Plan, which indicates deterioration in the quality of Liffey estuary water in this area since 1988. The recent commissioning of the new WwTW at Ringsend, which includes tertiary treatment during the bathing season, is expected to provide significant improvements to water quality in the Liffey estuary.

Figure 17: Bathing Water Quality (1998 - 2002)

INSERT FIGURE 17

3.6.3 Bathing Waters

The quality of designated bathing waters within the GDSDS area is monitored by the local authorities in accordance with the EU Bathing Water Directive (76/160/EEC). Sampling must be undertaken on a two weekly basis during the bathing season which extends from mid May until the end of August. Each sample is analysed for micro-biological and physico-chemical parameters as given in **Appendix B**. Over the bathing season water quality must comply with the mandatory standards specified in the Directive. Guide levels have also been set which are quality objectives which all bathing sites should endeavour to achieve.

In Ireland, the Quality of Bathing Water Regulations (Statutory Instrument No. 84, 1988) gave effect to the Bathing Water Directive. The Directive was transposed into Irish law such that additional national standards (National Limit Values) were established for a number of parameters (dissolved oxygen, total coliforms, faecal coliforms, and faecal streptococci) to enhance the protection of Ireland's waters. These standards are also included in **Appendix B**.

The EPA produce an annual report on the quality of bathing water for the whole of Ireland in which compliance is assessed against EU and National Guidelines. Blue Flag awards are also noted. At the time of writing, published Bathing Water Quality data was available up until 2002. Therefore, in this report an assessment is made for the most recent five years of available data reported by the EPA, i.e. 1998-2002.

There are 15 designated bathing waters reported by the EPA within the GDSDS area. These bathing waters are included on **Figure 17** and listed in **Table 10** together with compliance of the past five years published data with EU mandatory (I) and guideline (G) standards. Compliance with the additional national limit values where the detailed data was available and is indicated by symbols (#, ~, *) explained in the footnotes for **Table 10**.

Bathing water quality in the study area is generally very good, with all beaches achieving compliance with mandatory standards in 2002. This represents an improvement for Merrion Strand and Sandymount Strand which failed the mandatory values for total and faecal coliforms in the previous year but had complied with these standards in the previous three years.

Many also regularly achieve the much more stringent standard which is required for 'Blue Flag' status: Skerries, Portrane, Donabate, Malahide, Seapoint and Killiney have achieved guideline status at least three times in the five year period from 1998 – 2002 inclusive. Dollymount Strand achieved the guideline standard for the first time in 2000 but failed to regain it since then. Balbriggan, Sandymount Strand and Merrion Strand have never achieved guideline standard. It must be stated that although the water quality requirements for 'Blue Flag' may be achieved, this does not guarantee Blue Flag status as many other criteria are also required (refer **Appendix B**). Furthermore, An Taisce report that not every beach applies for Blue Flag, even though it may have met the water quality requirements.

Of the 15 beaches within the GDSDS area, the EPA report that 6 achieved the EU G value in the 2002 bathing season, and of these none achieved the National Limit values (NLV). The remaining beaches all achieved the mandatory EU (I) standard. This is an overall improvement since the previous year when only 2 beaches within the GDSDS area achieved the EU 'G' level and two failed the mandatory levels. It is worth noting that in 1999 and 2000, 9 beaches achieved the EU 'G' standard. Compliance with the BWD for the five year period 1998-2002 is shown on **Figure 17** for GDSDS area beaches.

The Blue Flag awards are summarised for the years 2000 to 2004 in **Table 11** below. Note that in terms of water quality, the awards are based on the previous years bathing season monitoring results.

Of the GDSDS beaches, only Seapoint was awarded Blue Flag Status in 2003 (in terms of water quality, based on the results from the 2002 bathing season). Portrane did not apply for the award. For the remaining 4 beaches that are reported to have achieved the EU 'G' limit, it is assumed that the failure to achieve Blue Flag is due to issues other than water quality.

There was a decline in Blue Flag awarded between the 2000 and 2003 (in terms of water quality awarded on the basis of 1999 and 2002 bathing season). The beaches at Killiney, Seapoint, Portrane and Bray were awarded Blue Flag status in 2000. In the following year Portrane and Seapoint retained their Blue Flag Status but both Killiney and Bray failed. This was due to failure to meet water quality compliance standards for faecal streptococci. Only one bathing beach was awarded Blue Flag Status in 2002 and 2003, Portrane in 2002 and Seapoint in 2003. At the time of writing the 2004 Blue Flag awards were announced. Three blue flags were awarded in the Greater Dublin area: to Killiney, Portrane and Seapoint. The results reflect an overall improvement in water quality since the previous year.

The full criteria for obtaining Blue Flag Status are given in **Appendix B**. For example, an agglomeration (as defined in the Urban Wastewater Treatment Directive (91/271/EC) and explained in the glossary in **Appendix A**) failing to put in place adequate sewage treatment infrastructure will not be eligible for the Blue Flag award.

	Bathing Season				
Bathing Water	**2002**	**2001**	**2000**	**1999**	**1998**
Balbriggan	I	I#	I	I*	I
Skerries	I	I#	G	G	G*
Loughshinny	G	I#	G	G*	I*
Rush, South Beach	I	I#	I	G*	I*
Portrane	G∞	G*	G*	G*	G*
Donabate	G	I#	G*	G*	I*
Malahide	I	I	G*	G*	I*
Portmarnock	I	G[1]	I*	I	I*
Sutton, Burrow Beach	I	I#	I	G	I*
Dollymount Strand	I	I#	G	I	I
Sandymount Strand	I	F#~	I	I	I
Merrion Strand	I	F#~	I	I	I
Seapoint	G	I#	G	G	G*
Killiney	G	I#	G*	G*	G*
Bray Beach	G	I#	G*	G	I*

Table 10: Bathing Water Compliance (1998 to 2002 Bathing Seasons) for GDSDS area

Source of Information: EPA Water Quality in Ireland Reports and Local Authority monitoring results.

Notes
G: Achieved EU Guide level
I: Achieved EU Mandatory level
F: Failed EU Mandatory level
* Achieved National Limit Value
~ Failed mandatory (I) level for total and faecal coliforms.
# Failed guide level for faecal streptococci
∞ Failed guide value for faecal streptococci - An Taisce press release 5/6/2003.

[1] EPA report indicates EU 'G' achieved, however local authority results indicated failure to achieve 'G' for faecal streptococci.

	Blue Flag Award				
Beach	2004	2003	2002	2001	2000
Portrane	✓	✓	✓	✓	✓
Seapoint	✓			✓	✓
Killiney	✓				✓
Bray					✓

Table 11: Blue Flag Awards (2000 to 2004) for GDSDS area

Note: Awards based on previous years bathing season results

Notes
- Blue Flag Status

3.6.4 Dublin Bay – Offshore Waters

The Dublin Bay Water Quality Monitoring Programme entails sampling in Dublin Bay at 28 locations. An emphasis was placed on the sub-littoral zone inside the 10 metre depth contour and on sampling from a depth of 2 metres. Additional samples were taken from near bottom (depth) and analysed for nutrients. The sampling stations are shown on **Figure 18**.

The dissolved oxygen results from the Dublin Bay Water Quality Monitoring Programme 2000-2001 identified only a small proportion of oxygen levels in Dublin Bay falling outside the normal range 80-120%. This data was consistent with the EPA data for 1998-2000 and the previous review period.

Transparency in the Bay was identified as being good in the surveys (Dublin Bay Water Quality Monitoring Programme 2000-2001). BOD results were generally satisfactory. This is consistent with the EPA (1998-2000) results which identified generally low BOD concentrations in Dublin Bay.

The EPA report ammonium and phosphate in the Bay at similar concentrations to the previous period with background coastal levels throughout the summer months, except in a few instances in the waters outside the Bull Walls. Summer phosphate levels in the bay ranged from 5μg/l to 40μg/l with a median of 11μg/l. Summer ammonia levels ranged from 9μg/l to 114μg/l with a median of 9μg/l. Winter nutrient concentrations (N and P) in the coastal waters adjacent to Dublin Bay were found to exceed the respective winter background concentrations of the North East Atlantic.

The results of the Dublin Bay Water Quality Monitoring Programme 2000-2001 surveys indicate a marked seasonal variation in the concentration of TON, ammoniacal nitrogen and phosphate with highest nutrient concentrations occurring in winter and reducing to close to or less than the limit of detection in spring blooms as nutrients were taken up by algae. Nutrient levels in the near bottom samples were less than the limit of detection. Chlorophyll levels in the bays were reported by the EPA at very low levels relative to those expected in enriched waters for both review periods.

Summary – GDSDS Coastal Water Quality

The EPA have classified the Broadmeadow and Liffey estuaries as eutrophic (nutrient enriched). Eutrophication has been linked to discharges from Waste Water Treatment plants at Swords and Ringsend respectively. Under the Urban Waste Water Treatment Regulations 2001 (SI 254 of 2001) both the Liffey and Broadmeadow Estuaries were designated as 'sensitive areas' for the purposes of wastewater treatment and as such required the provision of nutrient removal by May 2008. Recent upgrading at the Ringsend WwTW to tertiary level treatment and of Swords WwTW to secondary level treatment is expected to result in considerable water quality improvements.

Despite these problems, the outer Broadmeadow estuary shows little evidence of impaired water quality and Dublin Bay itself is classified as non eutrophic.

Although the quality of bathing waters is generally good with all GDSDS beaches achieving the mandatory standards, the introduction of stricter standards expected in the next revision of the Bathing Water Directive, is likely to result in a dramatic fall in compliance. In the last reported Bathing season (2002), six of the fifteen GDSDS area bathing beaches achieved the EU Guide standards, an improvement on the previous year when only two achieved the 'G' standard. Within the GDSDS area Seapoint was the only beach to be awarded Blue Flag status in 2003.

Despite eutrophication of estuaries mentioned above and the low level of compliance with the more stringent EU 'G' bathing water standards, the water quality in Dublin Bay remains high.

Figure 18: Dublin Bay Offshore Water Sampling

INSERT FIGURE 18

3.7 Groundwater Quality

3.7.1 Introduction

The prevention of groundwater pollution is important to overall water quality and the achievement of 'good status' for all waters as required by the WFD. In many rivers, more than 50% of the annual flow is groundwater fed and in periods of low flow it can be as much as 90%. Groundwater also provides a source of discharge to estuaries. Therefore surface water quality may be adversely affected if groundwater discharge is polluted.

Groundwater is also important for both public and private drinking water supplies. Groundwater provides about 20% of the public water supply in County Meath (Meath County Council, Groundwater Protection Scheme, 1998), and about 12% of the total water consumption for County Wicklow (Wicklow Groundwater Protection Scheme, 2001). In addition, the first public groundwater supply abstraction in Fingal County Council is currently being commissioned. Throughout Ireland, only a small proportion of the available groundwater resource is being used and therefore represents an important resource for future sustainable development.

This section provides a summary of the available groundwater quality data for the main aquifers in the Greater Dublin Area. The data review is limited to that reported in EPA, Water Quality in Ireland, 1998-2000 report and is compared with the Drinking Water Regulations (S.I. No. 439 of 2000).

3.7.2 Groundwater Occurrence and Classification

The occurrence of groundwater within the GDSDS area is controlled by the characteristic of underlying geology and subsoils. The main aquifers in the GDSDS area are within Lower Carboniferous limestone bedrock largely where significant solutional activity, faulting or fracturing has occurred or within Quaternary sand and gravel deposits. Further significant yields are common from wells in Lower Paleozoic metasediments and volcanics as well as from the Leinster Granite, within the south Dublin area. However these rock types are considered to be poor aquifers.

The Lower Carboniferous Limestone aquifers are located in areas of south Dublin, north Dublin and Meath, and are classified by the Geological Survey of Ireland (GSI) as being locally important or minor aquifers.

Significant sand and gravel deposits occur in the GDSDS in Dublin City (10-20m), the Dargle Valley (up to 45m), the Blessington area of Co. Wicklow (up to 100m) and Tallaght (35-42m) and are also classified as locally important or minor aquifers.

3.7.3 EPA Groundwater Quality Monitoring

The EPA commenced its groundwater monitoring programme in 1995. Groundwater samples were taken from 380 locations in Ireland. Of theses locations, five fall within the GDSDS area as shown in **Table 12** below. No data was reported for aquifers within Dublin City (south Dublin). In general there has been little work done to date on groundwater potential and vulnerability in the Dublin Area. This is because an adequate supply of water has been available from reservoirs in the Wicklow Mountains. The GSI (1994) report that many of the groundwaters in Dublin City are of poor quality as a result of the numerous activities associated with urban centres.

Location	Description
Rush, Co. Dublin	Aquifer type unconfirmed.
Newbridge, Co. Kildare	Mid Kildare Sand & Gravel Aquifer (Regionally Important)
Blessington, Co. Wicklow	Blessington Sand & Gravel Aquifer (Locally Important)

Table 12: EPA Groundwater Monitoring Locations

The data is for raw water prior to treatment. During the monitoring period the EPA sampled each location twice per year. The results were reported as the mean value for the three year period for the parameters ammonia, nitrate, chloride, phosphate, iron and manganese. Results for faecal coliforms were not presented due to a lack of the minimum number of sampling runs to present comparable mean concentrations. The results are presented in **Appendix C** as mean concentration values. The data from the previous sampling period is also presented along with drinking water guidelines (S.I. 439, 2000).

A public supply source also exists at Dunboyne, Co. Meath from which groundwater is abstracted from the Lower Carboniferous limestone.

A pilot public supply abstracts groundwater from a confined limestone aquifer adjacent to the North Dublin Fault at Bog of the Ring in Fingal County. Iron and managanese, believed to be naturally occurring, and turbidity, are a groundwater quality issue in this supply. This is dealt with by appropriate treatment (for example, oxidiation & filtration). Although no faecal coliforms were detected in the raw water, the source is also disinfected as a matter of principle.

3.7.4 Groundwater Quality

Introduction

The EPA Groundwater Quality Monitoring Data is reviewed in this section below in relation to the Drinking Water Regulations (S.I. 439, 2000). Further standards of relevance to include:

- the Phosphorus Regulations (S.I. 258 1988) which indicate that phosphorus in groundwater should not exceed 0.03 mg/l P when providing base flow to a river and 0.02 mg/l total phosphorus when providing base flow to a lake (EPA, 2002); and
- the Groundwater Directive (80/68/EEC) which define ammonia and phosphate as List II substances for which discharge to groundwater should be limited so as to prevent pollution.

Additional information on groundwater quality has been obtained from the Meath County Groundwater Protection Scheme as these sources were not monitored in the EPA report.

Results

Phosphate

MRP levels exceeded the drinking water standard (0.035mg/L) and national standard (0.03mg/L) in samples from Rush and are comparable to the previous sampling period. In the most recent sampling period, MRP at the Newbridge source has reduced from up to 0.6 mg/L (1995-1997) to below the maximum admissible concentration (MAC) in 1998-2000.

Ammonia

Mean ammonia concentrations were below the MAC for drinking water for all sources sampled. No change has occurred since the previous sampling period.

Nitrate

Mean nitrate concentrations were elevated (10-25mg/l) in the samples taken from the Kildare sand and gravel aquifer. There has been no change in these concentrations since the 1995-1997 monitoring period. Nitrate was found to be in the range of 25-50mg/l in the Blessington aquifer which means that some samples were at the limit of the MAC for drinking water. Nitrate levels have increased at this sampling location since the previous sampling period when lower concentrations (10-25mg/l) were recorded. High nitrate levels were reported in 20% of samples which have been attributed to poor control of animal wastes and poor siting and construction of septic tanks.

Chloride
Chloride concentrations are elevated in the groundwater sampled at Rush (50-100mg/L) and slightly elevated in one of the Newbridge sampling locations and at Blessington (both 30-50mg/L). However these levels were below the MAC for drinking water of 250 mg/L. No change in chloride concentrations were recorded, apart from at Blessington where a significant reduction has occurred since the previous sampling period when chloride concentrations in the range of 100-150mg/l were recorded.

Metals
Iron and manganese were found to exceed the drinking water standard of 0.2mg/L at Rush. However, the problems associated with high iron and manganese levels in groundwater are largely aesthetic and there is normally no harmful effect to people as a result of consuming significant amounts of iron and manganese.

Bacteria
Bacteriological sampling was also undertaken by the EPA on a nationwide basis, however the results were discussed in general i.e. specific details for the GDSDS area are not provided in their report. Countrywide, positive counts for E.Coli were obtained in 38% of the individual samples taken.

Meath County Council Groundwater Quality Monitoring
Historical data (Meath County Council Groundwater Protection Scheme) from the public supply wells at Dunboyne indicates that groundwater quality is generally good. Iron and managanese is high and is naturally occurring in the area. Elevated calcium and sulphate were reported but were not causing a major problem.

Summary

Although groundwater quality is in general reported to be good, rising nitrate levels are reported particularly in vulnerable aquifers where subsoils are thin.

Phosphate is also reported to be elevated at some sources.

Bacteriological contamination is a problem in a significant proportion of sources throughout Ireland and by inference in the GDSDS area.

In Dublin City itself groundwaters are reported to be of poor quality as a result of urban activities.

3.8 Summary and Discussion

As outlined in Chapter 2, one of the primary purposes of the WFD is to maintain an aquatic ecosystem as near as practicable to its natural condition, rather than ensuring its suitability for particular uses, as required under the existing water directives. Assessment of overall quality must be based, in the case of surface waters, on a combination of biological, chemical and hydromorphological criteria. In addition, the WFD requires that good groundwater status (both quantity and quality) be achieved for all groundwater bodies and that there be no significant and sustained deterioration in groundwater status.

The EPA biological water quality monitoring data for the period 1998-2000 indicates that currently 70% of river sites monitored are polluted. Currently, it is estimated that only 9% of GDSDS area river waters are likely to comply with the requirements of the Water Framework Directive.

Pollution is more widespread in the Northern GDSDS area with only 8% of river site samples being unpolluted whereas in the South 43% of river sites were unpolluted.

Moderate pollution is the most widespread class of pollution accounting for 69% of rivers in the Northern GDSDS area and 32% in the Southern GDSDS area. The causes of moderate pollution are attributed to agricultural practices and urban runoff.

Incidences of serious pollution are double in the northern GDSDS area (10% of river sites) relative to the southern GDSDS area (5% of river sites). The causes of serious pollution have been attributed to discharges from WwTWs, oil spillages and other point source discharges such as detergents discharges. However serious pollution was also recorded in largely agricultural areas. The causes of slight pollution are attributed to forestry, quarrying and urban development.

The overall trend from biological monitoring is that of a decline in the proportion of unpolluted waters when water quality for the period 1998-2000 is compared with the previous monitoring period (1995-1997). The data indicates that slight and moderate pollution have increased in this period with an overall reduction in the incidences of serious pollution.

It was found that dangerous substances are not yet a problem in GDSDS area river waters. EDC substances were found to be in widespread use and the conclusion is that they are likely to be reaching our freshwaters. However, the environmental consequences of these chemicals has yet to be studied.

The water quality of Canal Waters was found to be good, although litter remains an aesthetic nuisance.

The Broadmeadow and Liffey estuaries are classified as eutrophic. The eutrophication of the Broadmeadow had been linked to effluent discharge from the Swords WwTW which provides secondary treatment. Breaches of the UWWT standards for BOD and TSS are recorded for the period 1998-1999 and have been discussed above. Current upgrading at this plant is likely to provide considerable water quality improvements in this reach. Despite these problems the outer Broadmeadow estuary shows little evidence of impaired water quality. The eutrophication of the Liffey estuary is largely attributed to urban wastewater discharges from the Ringsend WwTW. Levels of nutrients and coliform bacteria which are extremely high in the estuary downstream of the plant are likely to reduce now that the new plant has been commissioned. Dublin Bay itself is classified as non eutrophic.

Although the quality of bathing waters is generally good with most beaches achieving the mandatory standards, the introduction of stricter standards expected in the current revision of the Bathing Water Directive, is likely to result in a fall in compliance.

The recent and ongoing upgrading of WwTWs is expected to partially improve water quality problems, after which the focus will shift to reducing other sources of pollution such as diffuse urban pollution and the problem of combined sewer overflows.

Good quality groundwater is of vital importance for the maintenance of groundwater dependent ecosystems, such as groundwater fed rivers and lakes and for human health. Many groundwaters in Dublin City are of poor quality as a result of the numerous activities associated with urban centres (GSI, 1994). Elsewhere groundwater quality problems are largely associated with organic and microbiological contamination from sources such as septic tanks, farmyards and agricultural activities. Naturally occurring ‘contaminants’, i.e. iron and manganese, are also present at some sources. There is also a strong potential to pollute groundwater from the leakage of sewer mains. Therefore, reductions in defects in the fabric of the sewerage systems are required. The threats to groundwater quality require addressing through consideration of groundwater vulnerability to pollution, groundwater resource and source protection and the use of groundwater protection scheme guidelines in land use planning and management.

The introduction and implementation of new policies for sustainable urban drainage is essential in order to reverse the trend of deterioration of water quality required by current legislation and which will result in a clean environment for current and future generations.

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