4 WATER STATUS

4.1 INTRODUCTION

Baseline water quality in the Boyne, Liffey and Suir catchments was established at the start of the Three Rivers Project (see Project Baseline Report) using biological and physico-chemical data from the period 1995-97 (EPA compiled tri-annual medians), with data from 1998 for the Liffey catchment biological data.

In this chapter the current status of water quality (up to December 2001/January 2002) in the three catchments is presented based on data collected from the Three Rivers Project monitoring network, which has been operational since January 2000. Changes in water quality over the Project period are identified and commented on.

Water quality was assessed at all sites in 2000 and 2001, using physio-chemical parameters based on threshold limits that the EPA have identified as being indicative of poor water quality (**Section 4.1.1**). Water quality was also assessed by biological survey (conducted by the EPA and the Project) at the majority of sites in the years 1999 to 2001. Unfortunately a biological survey of the Liffey was not conducted in 2001 due to Foot and Mouth Disease Restrictions.

The focus of Three Rivers Project monitoring network is on establishing nutrient budgets for catchment areas and for the different sectors contributing to that budget. The network is concentrated in the larger sub-catchments, in areas of poor water quality (as identified in by previous monitoring) and in the vicinity of major point sources. A number of smaller tributaries have only one project monitoring site at their d/s end. Where available and where the sampling frequency is sufficient to allow meaningful comparison with Project data, physico-chemical data from Local Authority monitoring has been consulted for u/s sites to augment project data in these catchments.

It should be noted that monitoring sites that were established in the Pilot Study Areas to investigate specific pressures were not included in this overall assessment, as their focus in areas of poor water quality might tend to skew the results. However, for information, the quality results for these sites are shown on the relevant maps.

4.1.1 Water Quality Criteria

Physico-chemical Parameters

The following physico-chemical parameters were used in the assessment of water quality:- Molybdate Reactive Phosphorus (MRP), Total Oxidised Nitrogen (TON), Dissolved Inorganic Nitrogen (DIN) (sites at freshwater limit and estuarine sites only), Ammonia (NH_3) and Dissolved Oxygen % Saturation (DO% Sat).

Phosphorus and nitrogen are the major nutrients that promote growth in aquatic systems; phosphorus being the limiting nutrient in freshwater systems while nitrogen is the limiting nutrient in estuarine and coastal systems. MRP is considered the most bio-available form of phosphorus. Ammonia can be toxic to fish at certain concentrations while dissolved oxygen must be present in water in sufficient concentrations in order to sustain aquatic life, especially salmonid fish species that are particularly sensitive to low oxygen concentrations.

The criteria used to determine quality are largely based on the “Threshold Limits” that the EPA have identified as being indicative of potentially poor water quality. These criteria are summarised in **Table 4.2**. *and monitoring sites are considered to have passed/achieved the Project quality criteria if they do not exceed the annual median concentrations specified in* ***Table 4.2***. Additional maximum and minimum concentrations that should not be exceeded in that year are also given for some parameters.

MRP

Monitoring sites are considered to have achieved/passed the Project MRP quality criteria if annual median concentrations are less than or equal to 0.03 mg/l[1]. In addition, maximum concentrations of MRP in that year should not exceed 0.15 mg/l while minimum concentrations should not exceed 0.02 mg/l.

Nitrogen

The nitrogenous parameters analysed by the Project included Total Oxidised Nitrogen (TON), Ammonia (NH_3), Nitrite (NO_2) and Dissolved Inorganic Nitrogen (DIN). *Monitoring sites are considered to have passed/achieved the Project TON quality criteria if the annual median concentration does not exceed 5.65 mg/l and the Ammonia quality criteria if the annual median concentration does not exceed 0.1 mg/l.* The Project DIN quality criterion of less than or equal to 2.6 *mg/l* based on the EPA publication "Eutrophication in Irish Estuaries and Coastal Waters" (2001) and is only applicable at the sites located at the freshwater limits of the 3 catchments and at estuarine sites.

Dissolved Oxygen (D.O) % Saturation

The usefulness of DO as a measure of water quality is limited unless monitoring is carried out on a continuous basis over a 24 hr period. This is due to the fact that reduced DO generally occurs during the hours of darkness. While diurnal DO monitoring (24 hour monitoring) was carried out at the auto-sampler locations, only daylight monitoring could be carried out at the majority of sites. *Monitoring sites are considered to have passed the Project quality criteria if the annual median is greater than or equal to 80% Saturation and less than or equal to 120% saturation.*

Biological Assessment – Q Ratings

The EPA's biotic (biological) indices or Q rating was also used to determine water quality. Using this index, monitoring sites were classed as "unpolluted" through to "seriously" polluted (**Table 4.1**). *Monitoring sites are considered to have achieved/passed the Project biological quality criteria if they achieve a Q rating of 4 or greater*. For the purpose of this report, changes in biological quality at monitoring sites are discussed in terms of a change in the "quality status" classification. Therefore a site improving its biotic index from Q4 to Q5 will be considered as "unchanged" in terms of quality class, whilst a site changing from Q3-4 to Q4 will have improved from "slightly polluted" to "unpolluted" class.

Based on a national data set the EPA has identified the average annual median MRP concentration one might expect to find at each quality class. Quality classes with the corresponding MRP concentrations and Q ratings are shown in **Table 4.1**. This table can be used to get an idea of the relative quality status of monitoring sites where MRP concentrations exceed the 0.03 mg/l quality criteria.

Table 4.1 – Water Quality Status Requirements for MRP and Biotic Index

Quality Status/Class	Biotic Index	Indicative Average Annual Median MRP (mg/l) associated with the quality classes
Unpolluted	Q5, 4-5,4	0.015 – 0.03
Slightly Polluted	Q3-4	0.045
Moderately Polluted	Q3, 2-3	0.07
Seriously Polluted	Q2, 1-2, 1	>0.1

Table 4.2 summarises the Three Rivers Water Quality Criteria. The EPA criteria upon which the table is based are included in **Appendix 4a**.

Table 4.2 – Three Rivers Project Water Quality Criteria

Determinand	*Min*	*Med*	*Max*
Dissolved Oxygen (%)*	≥80	≥80 or ≤120	≤120
Total Ammonia (mg N l^{-1})	< 0.1	< 0.1	< 0.3
Total Oxidised Nitrogen (mg N l^{-1})		≤ 5.65	
MRP (mg/l)	≤ 0.02	≤ 0.03	≤ 0.15
DIN (mg/l)**		≤ 2.6	
Q-value	***Biological Quality Index*** Q≥4		
Based on the most onerous of the EPA's threshold limits indicating potentially poor water quality (1999) and legislative requirements, (*) EPA "Characteristics of various biological quality classes" (1999), (**) DIN Freshwater Limit and estuarine sites ONLY			

4.1.2 Regulatory Compliance

Targets set for water quality improvements at monitoring sites under the Phosphorus Regulations were compared with current monitored quality.

These Regulations specify statutory targets for annual median MRP and Q Ratings, either of which should be met at the monitoring sites in order to comply with the Regulations. Although these targets do not have to be met until 2007, it is a useful exercise to see how near each catchment is to achieving its target quality.

Targets are based on maintaining OR improving water quality at monitoring sites using baseline data collected in 1997, or subsequent monitoring if no data is available for that year. The long-term target is to maintain all waters at a Q-Rating of 4 with equivalent MRP at ≤ 0.03 mg/l.

The Water Framework Directive (WFD) is likely to require that both the MRP target and the Q rating target be met at each sampling point. The WFD has the goal of returning all watercourses to "good" status by 2015.

The assessment of regulatory compliance made in this report used both the "either/or" scenario of the Phosphorus Regulations and the "both" scenario of the WFD.

4.1.3 Nutrient Budgets

Nutrient loads (MRP and TON) were estimated for key physico-chemical monitoring sites in the 3 catchments. **Appendices 4c, d, f, g, i & j** show the net loads calculated for each of the key sites and the nutrient loads per sub-catchment, in kg/ha. Data from the period April 2000 to April 2001 was used to calculate these loads. The calculation of loads was not possible at some water quality sites, as flows were not available.

Some data gaps exist, mainly during the period of February to April 2001 during the Foot and Mouth alert where sampling and/or staff gauge reading were curtailed.

Instantaneous flows, calculated from flow levels recorded at the nearest hydrometric station on each of the sampling occasions, were used to estimate loads at each site. Where physico-chemical monitoring sites and hydrological stations did not coincide, flows were factored to take account of the spatial difference between the 2 points.

4.2 BOYNE CATCHMENT

4.2.1 Current Water Quality - Biological

The quality class, calculated from the Q-Ratings (see **Table 4.1**), are shown for each monitoring site in the Boyne catchment in 2001 in **Figure 4.2.** Any change in class since the year 2000 is also indicated. **Appendix 4b** also shows the Q-Rating for each site sampled.

Excluding sites in the Pilot catchments, the 2001 data indicated, 22 sites (42%) were rated "unpolluted", 25 (45%) "slightly polluted", 6 (11%) "moderately polluted" and 1(2%) "seriously polluted". Water quality in 2001 was variable throughout the catchment, however the seriously and moderately polluted sites were confined to the **Boyne main channel, Blackwater (Kells), Moynalty, Knightsbrook** and **Tromann Stream.**

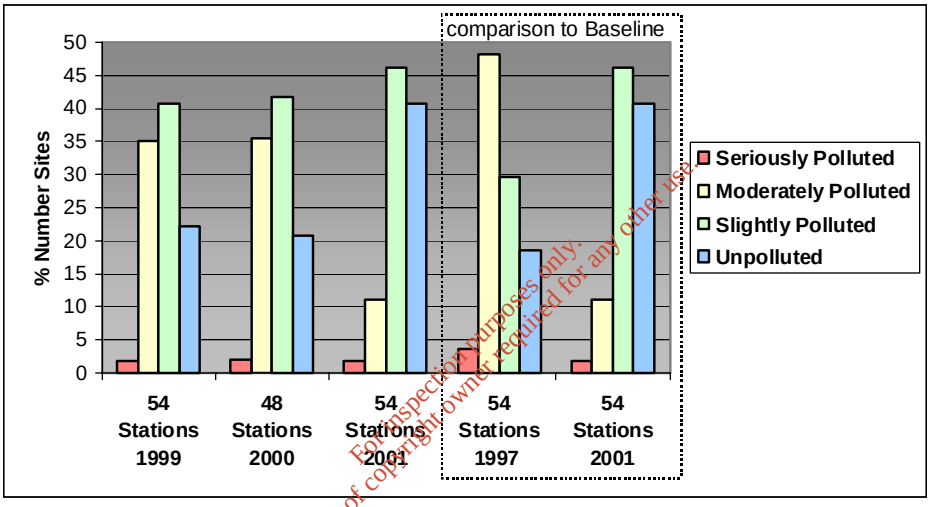


Figure 4.1 – Boyne Catchment Biological Status, Baseline to 2001

4.2.2 Quality Trends – Biological

Figure 4.1 shows the percentage of Project sites falling into each quality class over the last 3 years, and compares current the status (2001) with the Baseline.

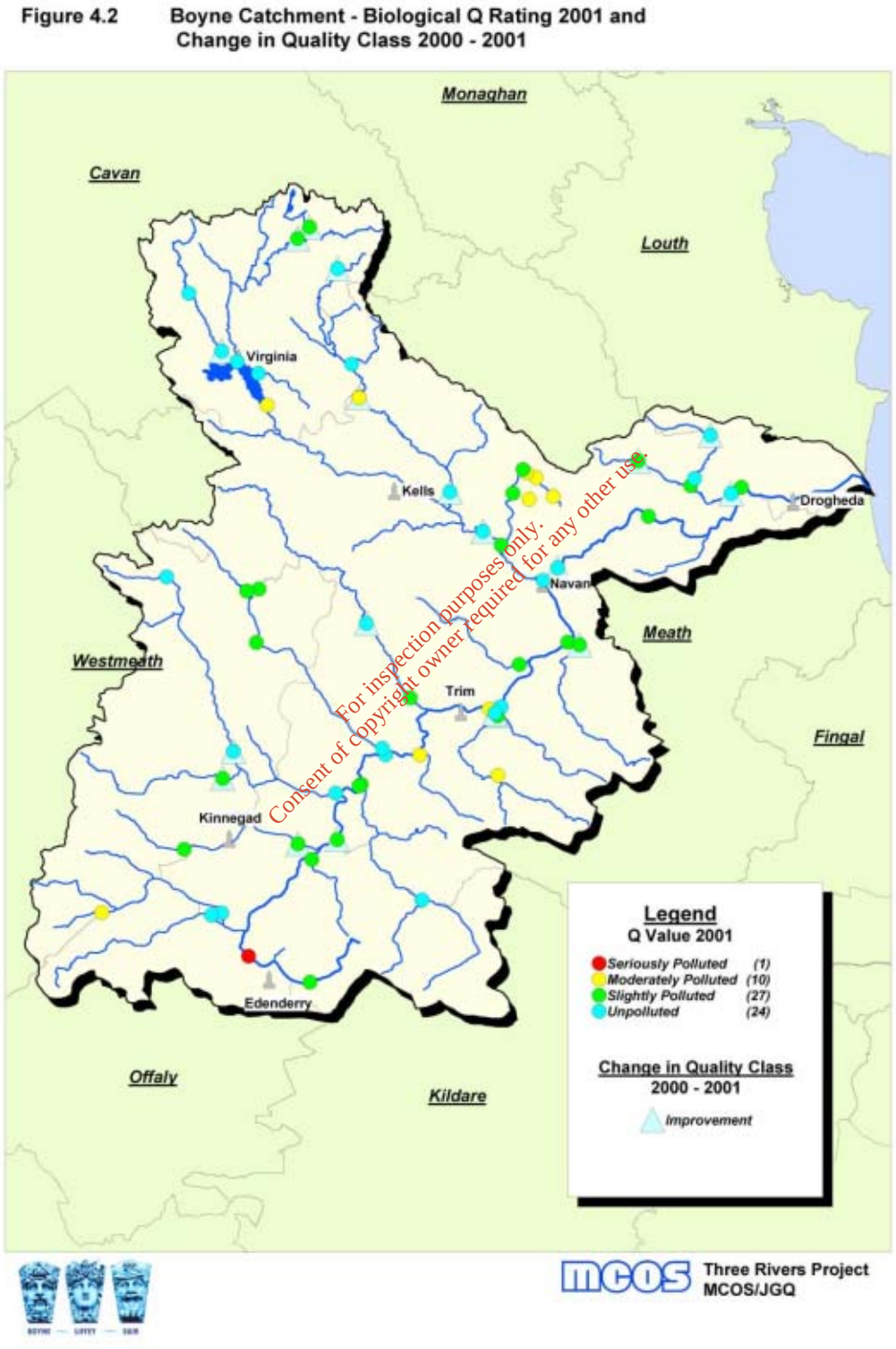
It can be seen that there has been a significant overall improvement in biological quality between 2000 and 2001. In this period, 45% of sites improved their quality classification and 55% of sites remained the same. No sites reduced in classification. The main improvements were on the **Boyne main channel**, the **Mattock, Knightsbrook, Deel** and the **Moynalty** rivers.

Comparing the 54 Project sites monitored both in 1997 and in 2001, 28 (52%) had improved in quality and 25 (46%) had remained stable. The watercourses that had shown significant improvement included the **Blackwater (Kells)**, **Mattock**, **Moynalty, Devlins**, **Deel**, **Nadreegeel**, **Kinnegad** and **Castlejordan**. The most improved site was on the Boyne main channel d/s of Navan MWWTP, which improved from Q 2-3 to Q4. This was due to the decommissioning of the MWWTP.

Only one site deteriorated since 1997, the **Boyne main channel** at Kinnafad Bridge. This site is located d/s of Edenderry MWWTP, and is rated as “seriously polluted”.

Figure 4.2 – Boyne Catchment, Biological Status

(This is a map of ALL the Boyne Bio-sites for 2001, showing change from 2000)



4.2.3 Current Water Quality - Physico-Chemical

MRP

In 2001 in the Boyne catchment more than two-thirds of sites (67%) were unsatisfactory in terms of MRP, with annual median concentrations of >0.03 mg/l. This includes all 12 sites on the main channel. The tributaries with the highest median MRP concentrations included the **Mattock, Devlins**, **Moynalty**, **Skane**, and **Knightsbrook**.

Figure 4.3 shows MRP concentrations for 2001 at all sites in relation to compliance with the ≤ 0.03 mg/l (annual median) Project water quality criterion, and any changes from the 2000 median. This information is also summarised in **Appendix 4b**.

Nitrogen

The median TON quality criterion was achieved at all sites in the Boyne catchment in 2001 (**Figure 4.5)**. The dissolved inorganic nitrogen (DIN) criterion of 2.6 mg/l was achieved at the freshwater limit and the estuarine site at St Mary's Bridge.

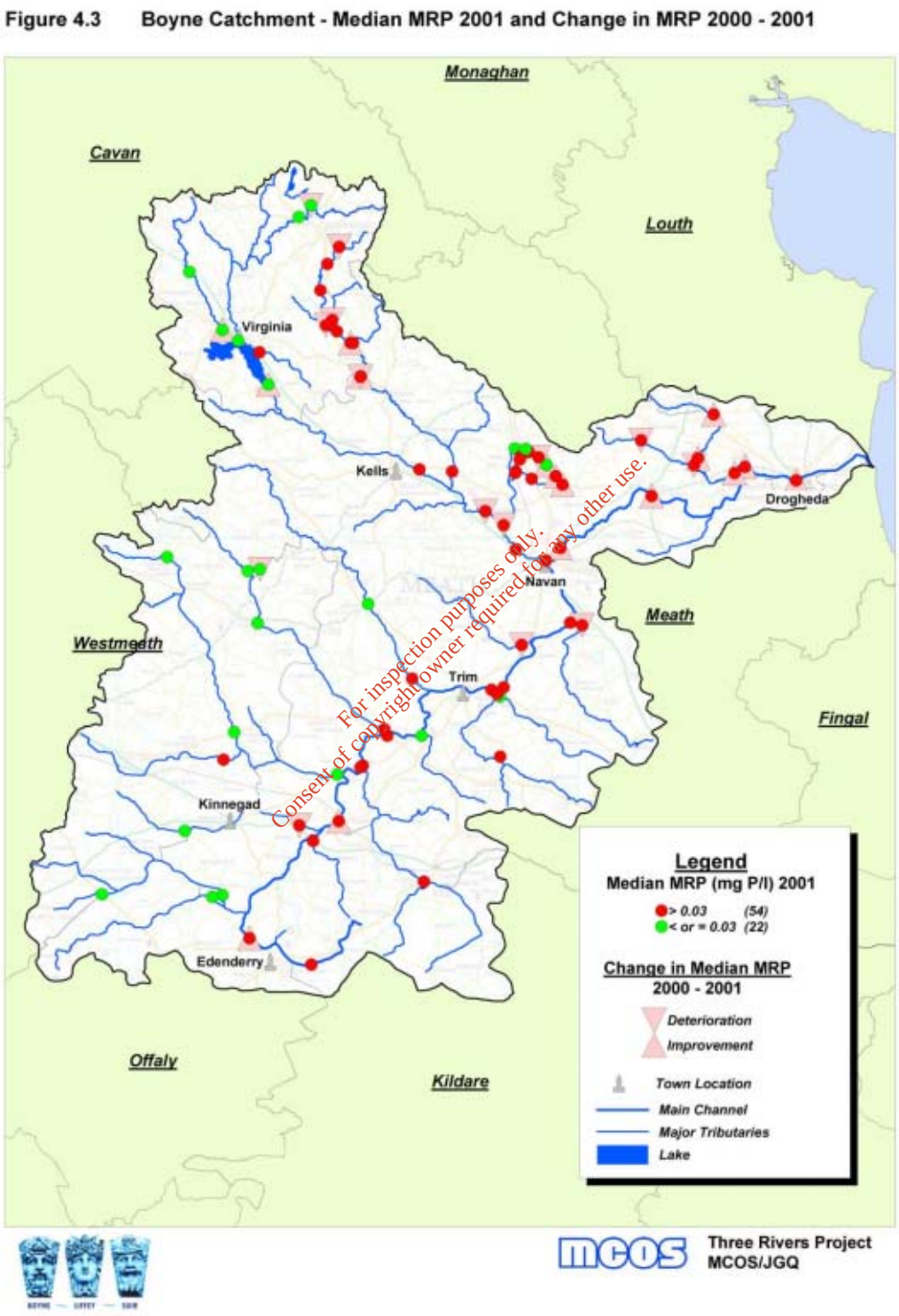
The median ammonia WQ Criteria was exceeded at 6 sites, with 2 sites d/s of MWWTPs (Mullagh and Edenderry MWWTP) and the remaining sites on the **Devlin's**, **Riverstown** and **Castlejordan**, while 39% of sites had excessive *maximum* ammonia concentrations (>0.3 mg/l N). These sites were located on the rivers **Mattock, Devlin's Moynalty, Skane, Knightsbrook, Castlejordan** and the **Boyne**.

Dissolved Oxygen

Maximum DO concentrations of >120% saturation were recorded at 53% of sites. Most of these were on the rivers **Moynalty, Blackwater (Kells), Mattock, Kinnegad** and **Boyne main channel** showing evidence of supersaturation. *Minimum* D.O. concentrations of < 80% saturation were also found at 61% of sites in 2001, indicating problems with night-time oxygen, particularly during summer months (**Figure 4.6**). The lowest DO of 10% saturation was at Kinnafad Br on the Boyne main channel. Other problem sites in relation to low DO were on the **Moynalty, Mattock, Kinnegad R.** and at Clonkeen Br on the **Boyne main channel**.

Figure 4.3 – Boyne Catchment, MRP 2001 and Change from 2000.

(This is a map of ALL the Boyne P/C for 2001, showing change from 2000)

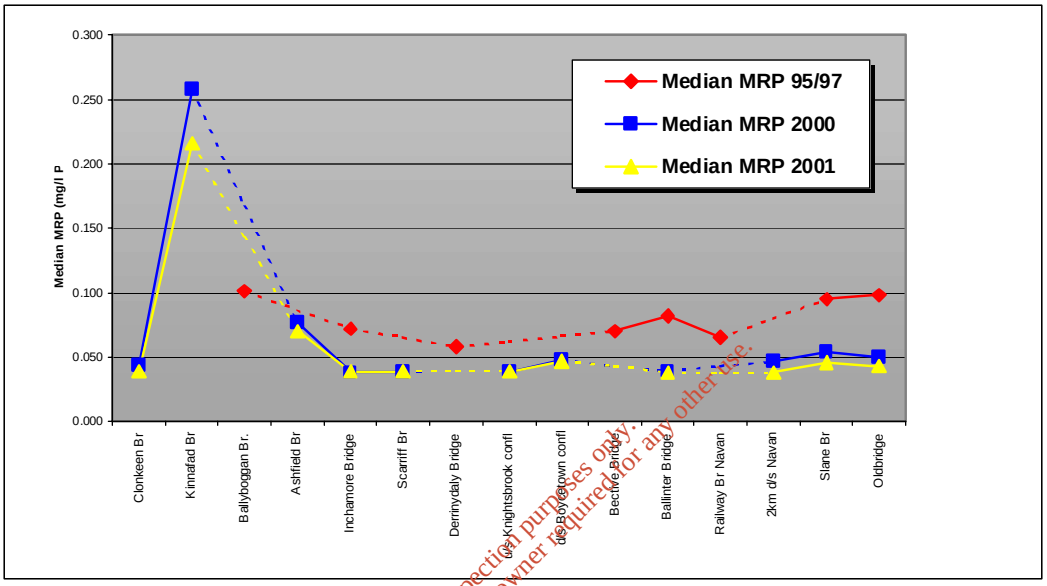


4.2.4 Quality Trends – Physico-chemical

MRP

Median MRP concentrations exceeded the Project criterion at 65% of sites in 2000, compared with 67% in 2001. However, more than half the sites surveyed showed lower median MRP concentrations in 2001 than 2000.

Figure 4.4 – Median MRP, Boyne Main Channel 1997-2001



Compared to the Baseline data of 1995-97, there was an improvement at 24 of 29 comparable sites, although of these sites, 23 still failed the Project quality criterion for MRP. There has been a general improvement on the **Boyne main channel**, particularly between Navan and St. Mary's Br, Drogheda. This trend is indicated in **Figure 4.4**. The **Mattock** and **Knightsbrook** did show an increase in median MRP concentrations since the Baseline year, however.

Nitrogen

The quality criterion for median TON of ≤5.65 mgN/l was met at all sites in 2000 and 2001, with 23% of sites improving in 2001 and 10% of sites deteriorating. There was also a substantial improvement in comparison to 1995-1997 data, with 86% of sites having lower TON concentrations. The most improved sites included the **Mattock**, the **Yellow** (Blackwater) **and u/s of Lough Ramor**.

Median ammonia concentrations decreased at 28% of sites in 2001 compared to 2000, with the other sites remaining largely constant. However, 39% of sites still failed the criterion for maximum ammonia concentrations in both years. Comparing with Baseline data, median ammonia concentration decreased at 17% of sites, whilst the maximum recorded concentrations fell at 55% of sites. This shows an improvement in the overall ammonia status of the Boyne, although some individual sites did deteriorate.

Dissolved Oxygen

The majority of sites (63% in 2000 and 54% in 2001) had minimum DO concentrations < 80% saturation on at least one sampling occasion indicating problems with night-time DO concentrations. Sites on the **Moynalty** and the **Boyne main channel** at Clonkeen Br showed most deterioration. Since 1997 there have been *no changes* in numbers of sites with DO problems although the problems are at *different sites* in 2001.

Figure 4.5 – Boyne Catchment TON 2001

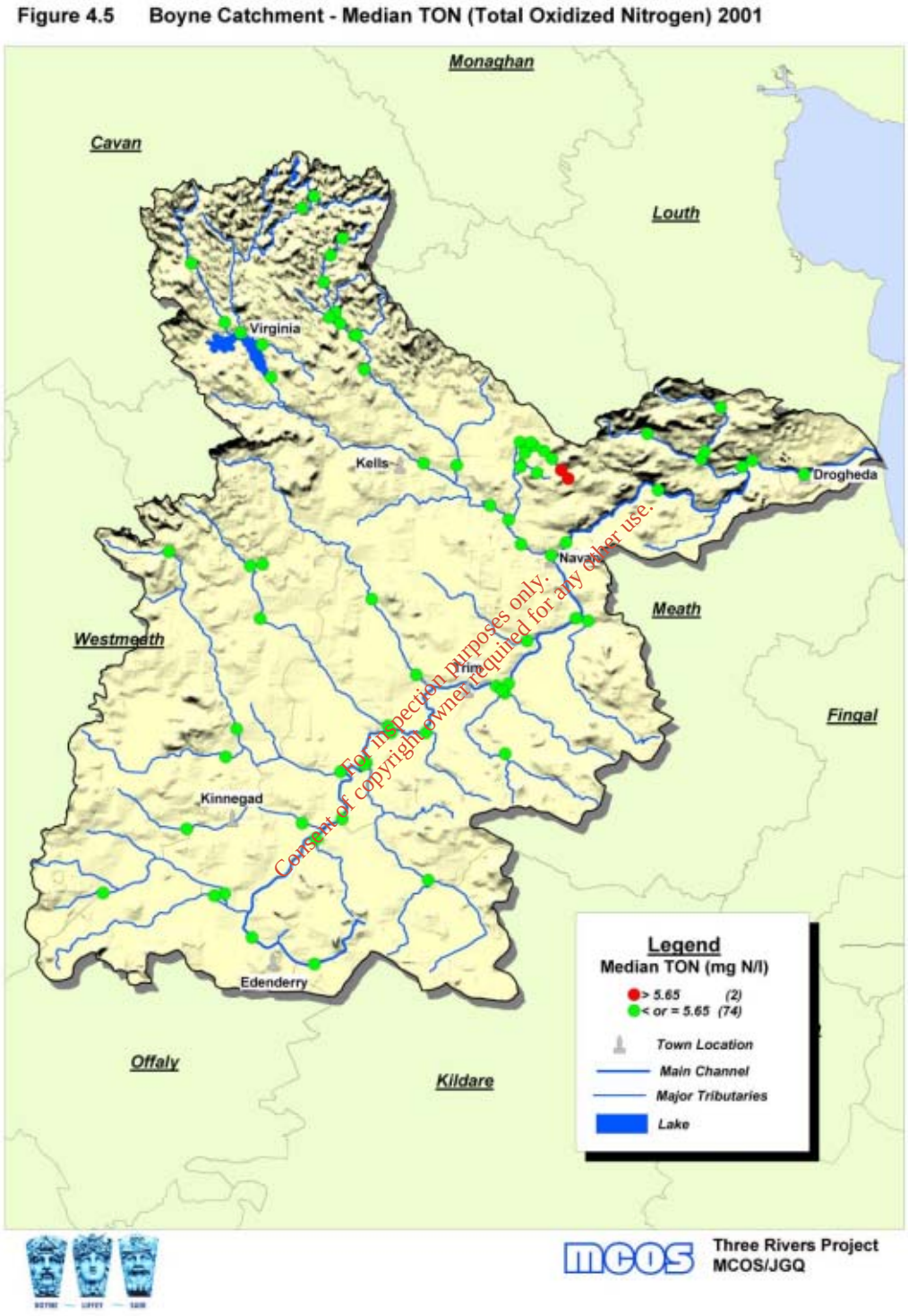
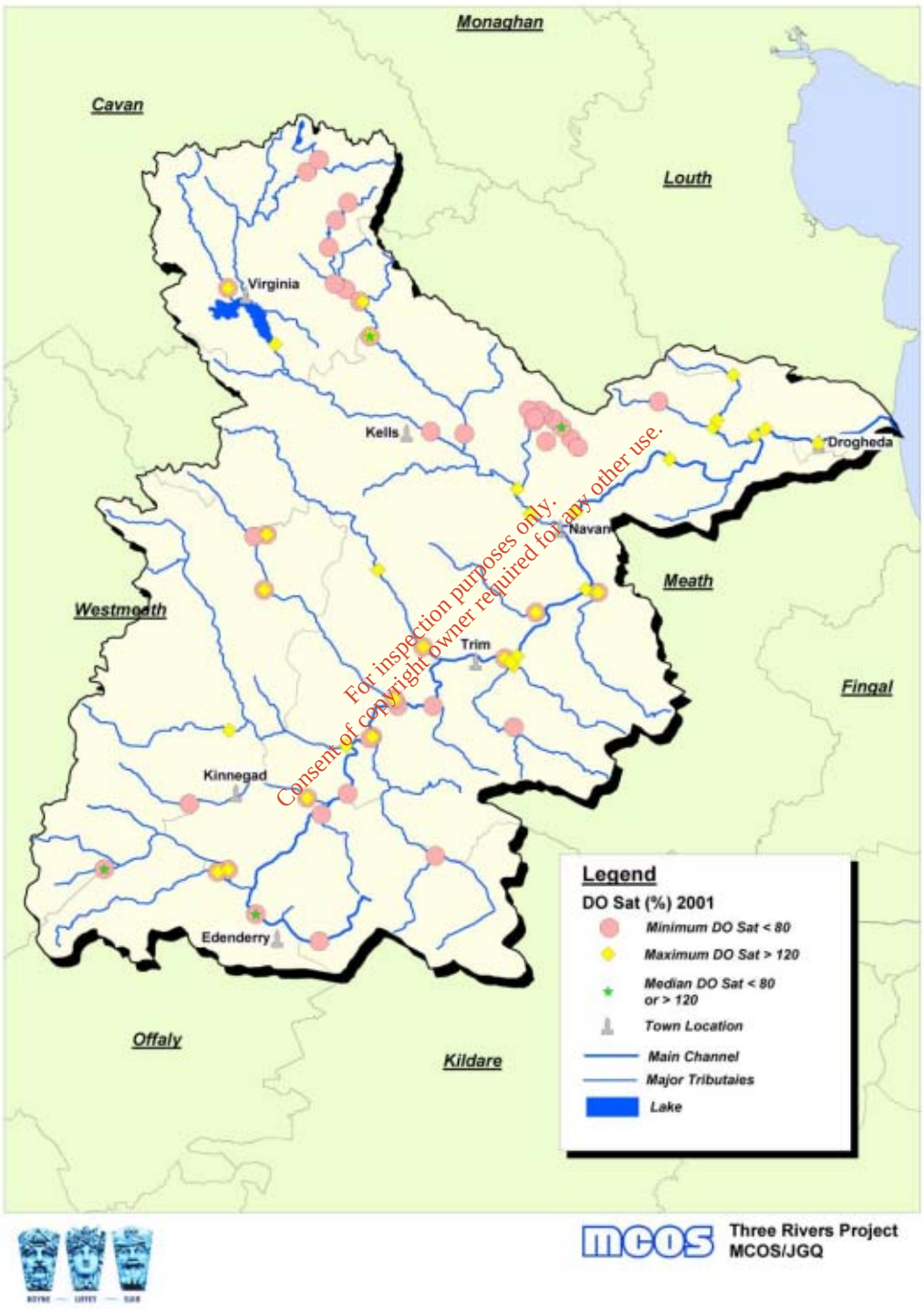


Figure 4.6 – Boyne Catchment Dissolved Oxygen Hotspots 2001



4.2.5 Phosphorus Regulations Compliance

Table 4.3 shows the percentage of Project monitoring sites in 2000 and 2001 that comply with the Phosphorus Regulations` interim targets set for 2007. The percentage of sites that would comply with the WFD requirements is also shown. The criteria used to assess the monitoring data are summarised in **Appendix 4b**.

Table 4.3 – Percentage of sites in compliance with Phosphorus Regulations and WFD

Criteria	Boyne	
	2000 (48 sites)	2001 (48 sites)
Pass Q criteria/ Fail MRP	23	27
Pass MRP criteria / Fail Q	25	6
Pass Both (WFD Compliant)	25	46
Pass P Regulation Objective (either/or)	73	79
Fail P Regulation Objective (both)	27	21

The Boyne catchment had 73% of sites complying with the Regulations in 2000 increasing to 79% in 2001. It had the lowest percentage (when compared with the Liffey and Suir catchments) of sites that passed both of the criteria in 2000, but the highest in 2001, with the number of WFD compliant sites doubling. The number of sites in the catchment passing both criteria increased sharply in 2001.

4.2.5 Nutrient Budgets

Catchment Loads - Phosphorus

Loads were calculated for 14 tributaries of the Boyne to ascertain the significance of each sub-catchment in terms of its nutrient contribution to the overall river system. Flows were not available for the Kinnegad, Glash and the Clady. For the Lisle a and Nadreegeel L. Stream entering Lough Ramor, flows were estimated using area proportioning from the next downstream site at 0900 Nine Eyes Br. No flows were available for the Mattock/ Devlin's system. The map in **Figure 4.7** illustrates the MRP loads from each catchment where data was available. The data is also shown in **Appendix 4c**.

The average annual MRP loading for the overall Boyne catchment was 0.29kg/ha, whilst the total annual load exported from the catchment at Obelisk Bridge (site code 2200) was 71.1 tonnes /yr. The amount of TP exported at the same point was measured at 161 tonnes/yr or 0.65 kg/ha. This figure calculated from Project weekly sample and flow data are comparable to the figure of 141 tonnes/yr calculated by the EPA for 1999, (the EPA figures corresponding to the Project sample period being unavailable) and may indicate a decrease in the annual TP load exported from the catchment since 1999 (**see Chapter 2, Table 2.6**).

On the **Boyne main channel** loads were calculated at four sites with the MRP load increasing u/s relative to d/s. The upper section from the source to Ashfield Br (0600) has an MRP load of 0.24 kg/ha/yr and this increases to 0.67 kg/ha/yr at Trim (1400). The only flows available d/s of Navan are at Slane Br. The net load at this site is 1.94 kg/ha/yr, however the MWWTP at Navan discharges d/s of Navan and is a contributor to that load.

The highest annual MRP load to the Boyne catchment was from its most significant tributary, the **Blackwater (Kells**) which contributed 18.6 tonnes/yr. (0.21 kg/ha/yr) representing 23% of the overall catchment load (**Figure 4.8**). The upper catchment to Lough Ramor including the **Drumkeery L. Stream** had an annual load of 4.8 tonnes/yr (0.40 kg/ha/yr). The **Lislea**, which flows in to L. Ramor, had a load of 0.9 tonnes/yr (0.32 kg/ha/yr). The highest individual MRP load from a tributary of the Boyne system is from the **Moynalty,** a tributary of the **Blackwater (Kells**), which contributes a total of 8.7 tonnes/yr or 0.50 kg/ha/yr.

Figure 4.7 – Boyne Catchment MRP Loads per Unit Area

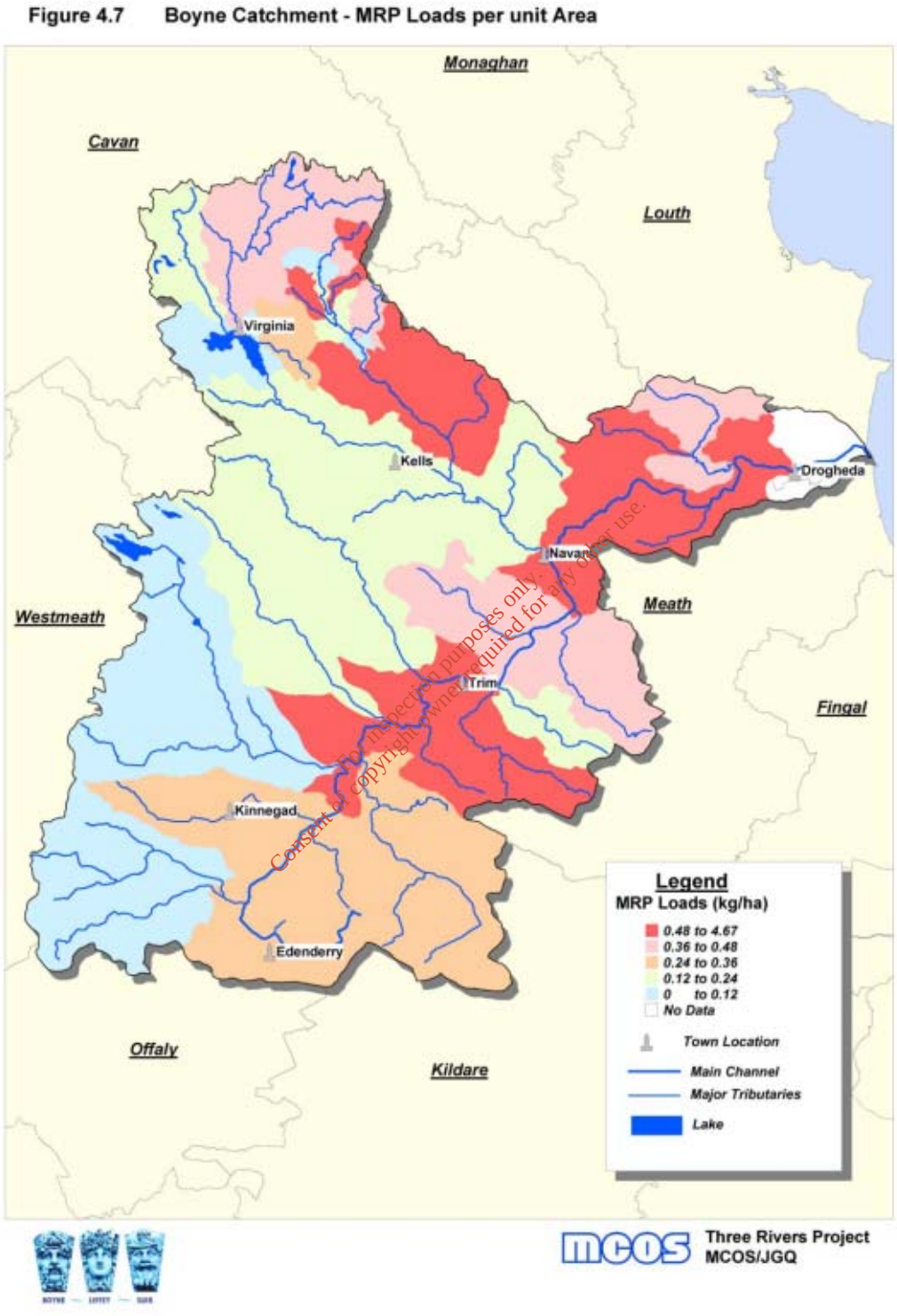


Figure 4.8 - MRP Loads from Boyne Sub-catchments in 2000/2001

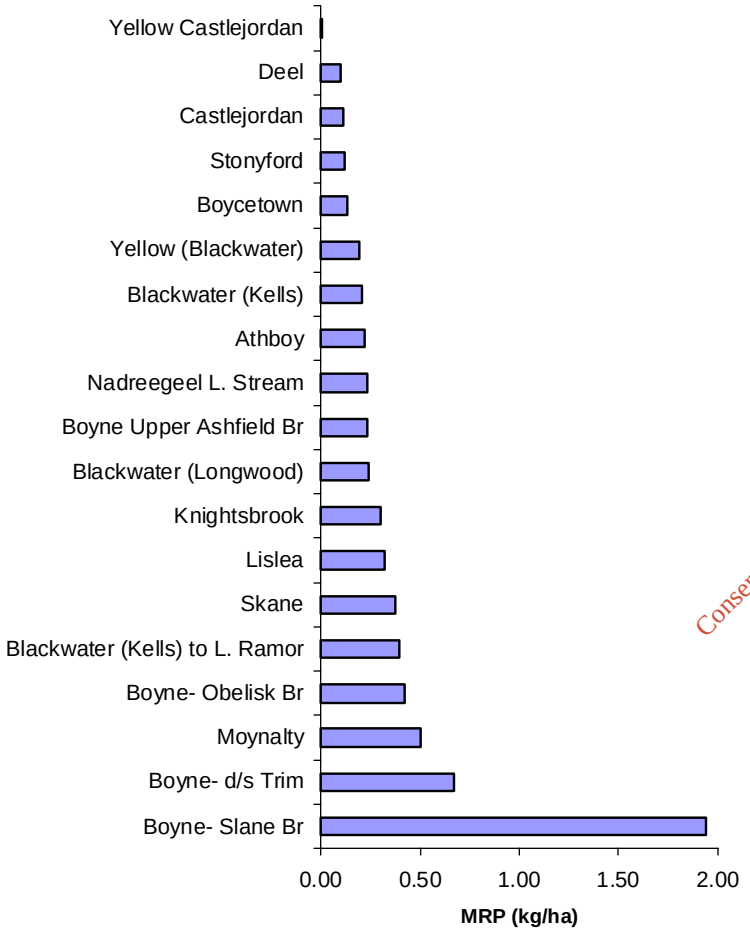
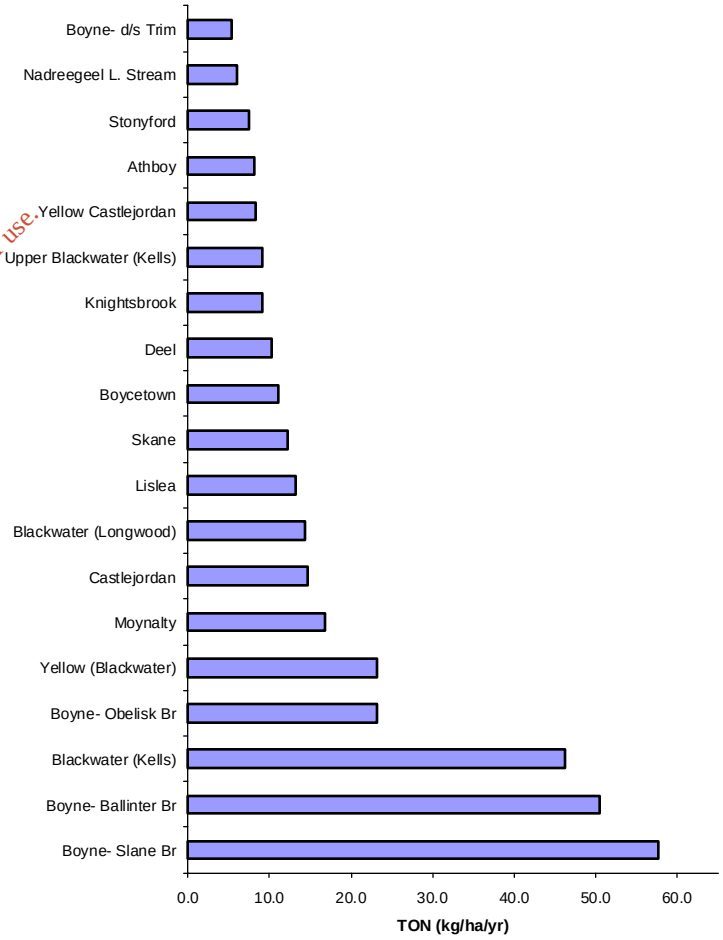


Figure 4.9 - TON Loads (Kg/ha/yr) from Boyne Sub-catchments in 2000/2001



During one flood event, the load from the Moynalty in one day in November was 2.9 tonnes, which is approximately one-third of its annual load.

The River **Skane** has an annual MRP load of 3.0 tonnes/yr. (0.37kg/ha/yr), which is 6% of the Boyne catchment MRP load. Two MWWTPs discharge to the Skane at Dunshaughlin (2,500 p.e.) and Kilmessan (400 p.e.). The Skane has had consistent water quality problems for a number of years ranging from slight to serious pollution with inputs from MWWTP suspected of being the cause.

Catchment Loads - TON

The average annual TON loading for the overall Boyne catchment was estimated at 12.9 kg/ha, whilst the total annual load exported from the catchment at Obelisk Bridge was 3245.3 tonnes/yr (**Appendix 4d**). All of the sites on the **Boyne main channel** exceed this average. TON loads are high at Trim (50.52 kg/ha/yr), Slane Br (57.68kg/ha/yr) and at Obelisk Br (23.25 kg/ha/yr).

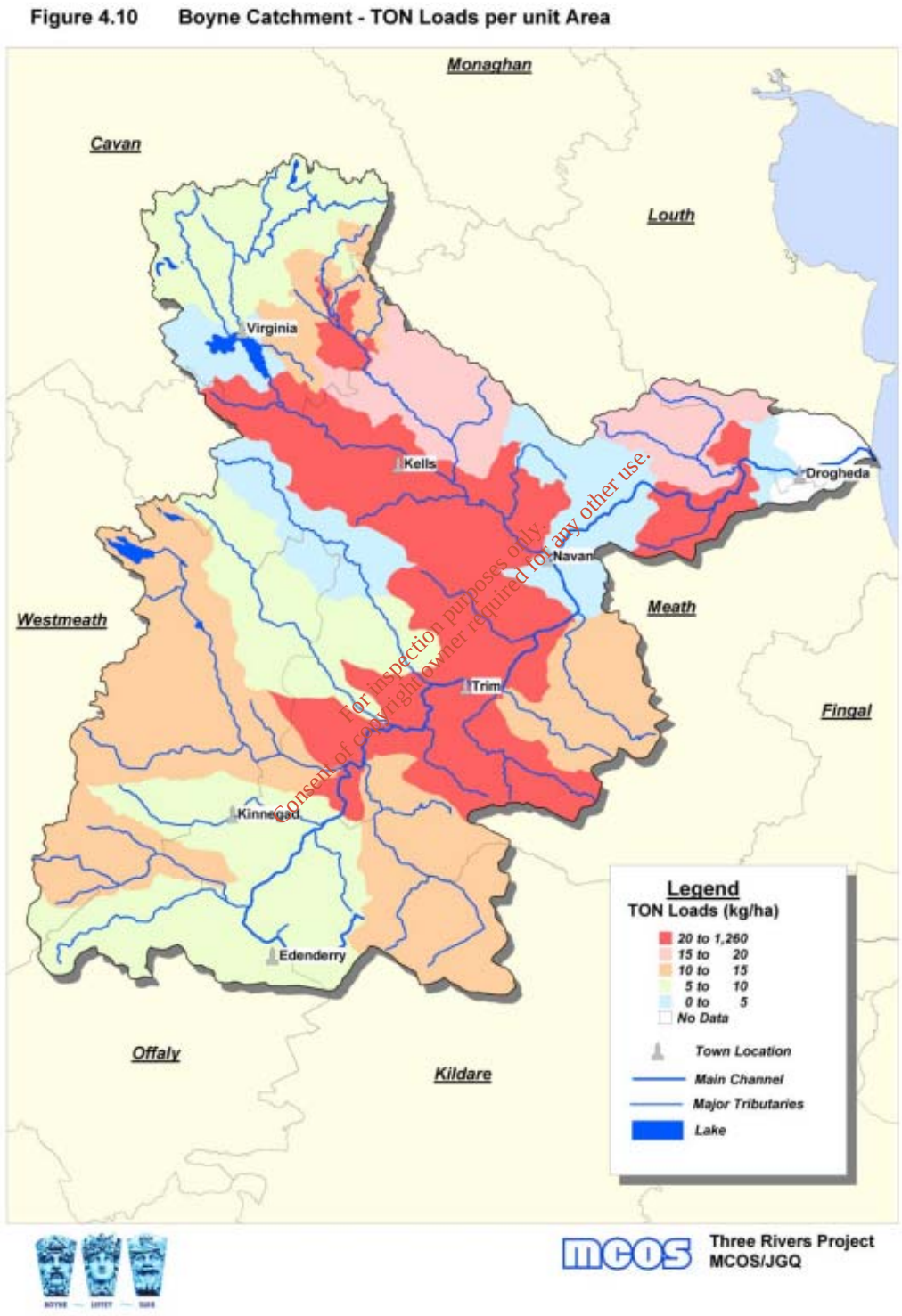
The most noticeable catchments exceeding this average are the rivers **Moynalty, Blackwater (Kells), Lislea, Castlejordan**, and **Blackwater (Longwood)** and the **Boyne main channel**. However, TON concentrations for these tributaries are within the Project water quality criteria.

The tributaries exporting TON loads below the catchment average were the **Nadreegeel L. Stream, Yellow (Castlejordan), Stonyford, Athboy and Knightsbrook** rivers (**Figures 4.9/4.10**).

A number of tributaries have no known point source influence and it is suspected that the predominant TON input is from agriculture. These catchments include the **Boycetown**, the upper **Moynalty** and its tributaries and **Yellow (Blackwater**). In the upper Moynalty, TON loads vary from 7.63 kg/ha/yr at Cloggagh Br to 65.44 kg/ha/yr at the EPA site 090 at Skearke Br.

There are also a number of tributaries that are receiving waters for MWWTPs and have higher than average annual TON loads. These include the **Moynalty (Mullagh) Branch** (Mullagh MWWTP) with an estimated load of 104 tonnes/yr (79.2 kg/ha/yr). Two MWWTPs at (Johnstown Bridge and Longwood) discharge to the **Blackwater (Longwood**) and the annual load is estimated at 283.9 tonnes/yr. (14.29 kg/ha/yr). The **Castlejordan** has a load of 139.9 tonnes/yr (14.64 kg/ha/yr), with 2 small MWWTPs discharging u/s at Ballinabrackey (100 p.e.) and Milltownpass (80 p.e.).

Figure 4.10 – Boyne Catchment – TON Loads per Unit area



4.2.6 Discussion

Both biological and physico-chemical monitoring indicate a general reduction in nutrient concentrations in the Boyne catchment since 1997 with the most dramatic improvement in biological quality occurring between 2000 and 2001. The general trend for lower MRP concentrations in 2001 than 2000 is also reflected in the concentrations of other determinands, with both TON and ammonia concentrations having decreased.

Annual nutrient loads can vary between catchments of similar areas, e.g. the **Moynalty** at Fyanstown has an ***annual MRP*** load of 8.7 tonnes/yr. (0.5 kg/ha/yr) compared to a load of 4.7 tonnes/yr (0.24 kg/ha/yr) from the **Blackwater (Longwood)** from a similar area, however ***annual TON*** loads are similar with loads of 307.1 and 283.9 tonnes/yr. (16.9 kg/ha/yr and 14.3 kg/ha/yr) respectively.

It is interesting to note that the catchments exporting elevated loads of MRP and TON are not always the same. Catchments with higher than average MRP loads (>0.29 kg/ha/yr) and lower than average TON loads (<12.9 kg/ha/yr) include the **Skane, Blackwater (Kells)** and the **Boyne estuary** site in Drogheda (2300). In addition there are a number of sites with low MRP loads per hectare but high TON loads, i.e. **Blackwater (Longwood)**, the **Blackwater (Kells)** at Liscarton, **Castlejordan**, and the **Yellow (Blackwater)**.

In summary, water quality appears to have improved on the Boyne catchment during the lifetime of the Project. While the trend is encouraging there is a significant amount of work needed to achieve the target of "good water status " by 2015. The majority of sites (67%) still exceed the target MRP criterion of ≤0.03 mg/l.

4.3 LIFFEY CATCHMENT

4.3.1 Current Water Quality - Biological

The quality class, calculated from the Q-Ratings is shown for each monitoring site in the Liffey catchment in 2000 in **Figure 4.12.** Any change in rating since the year 1999 is also indicated. **Appendix 4e** also shows the Q-ratings for each site monitored.

Unfortunately, due to operational difficulties caused by the Foot and Mouth Alert, the biological monitoring of Liffey catchment in 2001 to be carried out by the EPA had to be cancelled. Biological monitoring by “Conservation Services Ltd” was carried out at only eighteen sites on the Liffey in 2001 (17 on tributaries and 1 on the main channel). The majority of the sites monitored in 2001 were situated on the Camac and the Kings tributaries with one site monitored on the Brides Stream, a tributary of the Ryewater, one on the Upper Liffey, one on the Carragh, and one on the Naas Stream. A significant number of these sites remained unchanged (61%) from 2000 to 2001, 17% deteriorated and 22% showed improvement.

Excluding sites in the Pilot/Special Study catchments, the 2000 data indicated, 12 sites (29%) were classed as "unpolluted", 10 (24%) "slightly polluted", 16 (39%) "moderately polluted" and 3 (7%) "seriously polluted". Most of the unpolluted sites were situated in the upper reaches of the Liffey, with 4 sites being on the **Liffey main channel**. The seriously polluted sites were confined to the River **Camac** and the **Lyreen** d/s Maynooth.

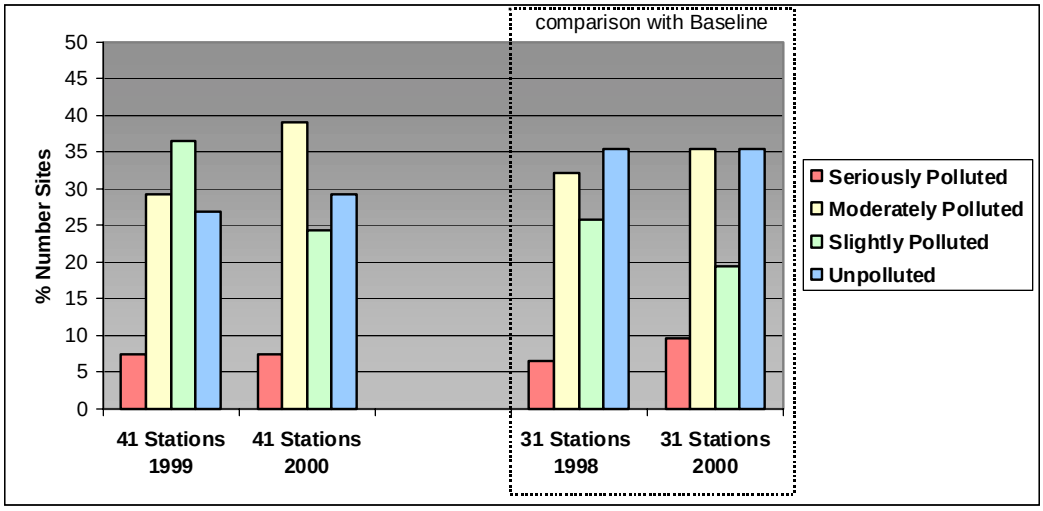


Figure 4.11 – Liffey Catchment Biological Status, Baseline to 2000

4.3.2 Quality Trends – Biological

Figure 4.11 shows the percentage of Project sites falling into each quality class over the last 2 years, and compares these with the Baseline year. A considerable reduction in the percentage of "slightly polluted" sites can be seen from 1999 to 2000 (13%) and from 1998 and 2000 (7%). However, this reduction has been at the expense of an increase of moderately and seriously polluted sites, whilst the number of unpolluted sites is unchanged. These results indicate a deterioration in biological quality from 1998 to 2000.

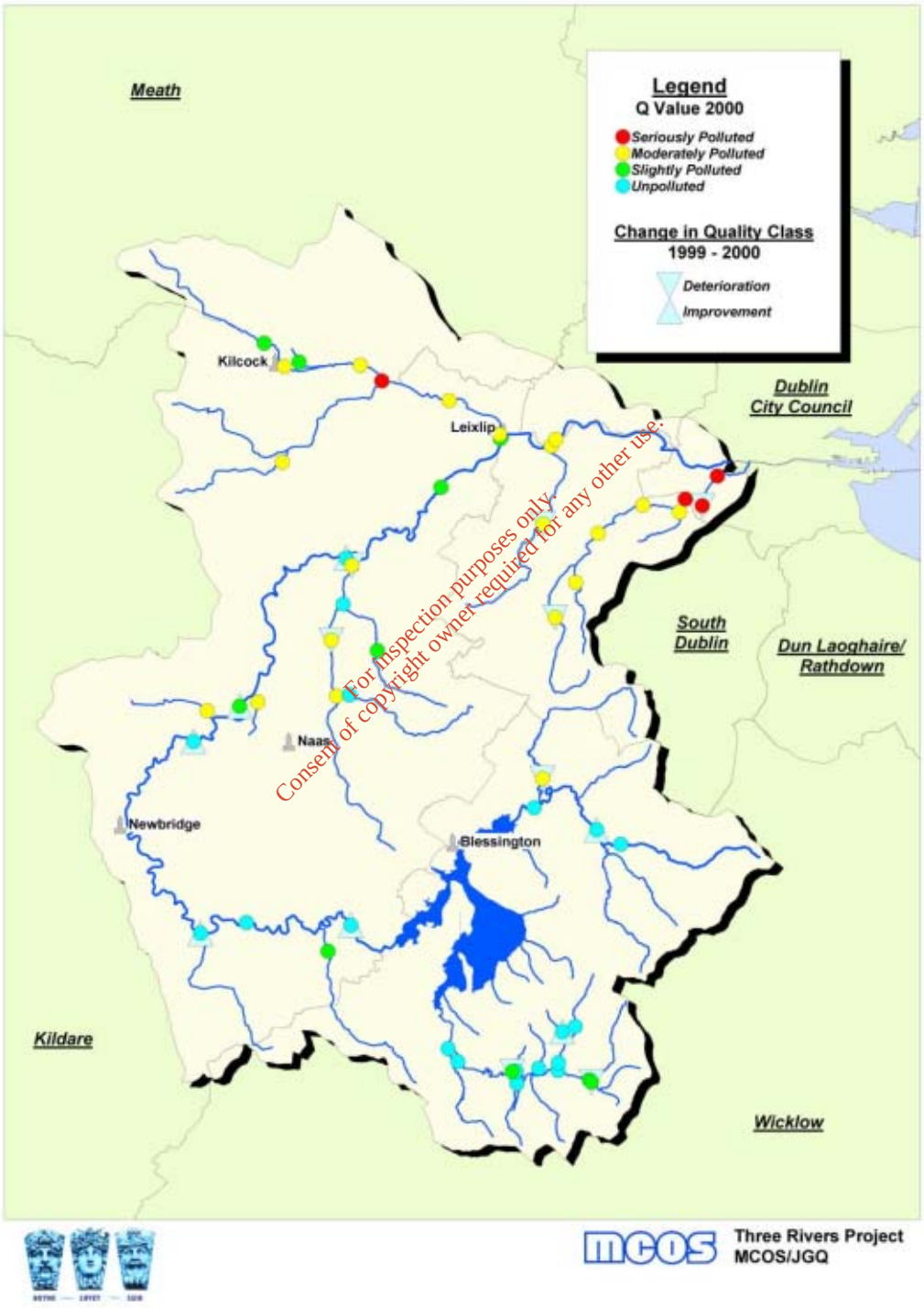
Deterioration was seen in biological status at 32% of sites in the Liffey catchment that were monitored in 1998 and 2000, an improvement was seen at 23% of the sites and 45% remained the same from 1998 to 2000. The majority of the deteriorated sites where situated on tributaries, however, on the main channel an improvement in biological status was seen at sites monitored from 1998 to 2000. This improvement was primarily due to the upgrading of the Leixlip and Osberstown wastewater treatment plants. No sites on the main channel had Q values indicative of serious pollution in 1999 or in 2000.

In most cases the changes in Q ratings are small (e.g. Q3-4 to Q3) but at a number of sites these changes have been significant. The most significant positive change in biological status from 1998 to 2000 occurred on the **Liffey main channel** downstream of the Osberstown wastewater treatment plant (MWWTP). This site improved from Q2 in 1998 to Q3-4 in 2000. The site with the most significant deterioration occurred on the **Camac River** upstream of Saggart Village situated in a predominantly rural setting, this site deteriorated from Q4-5 in 1998 to Q3 in 2000.

Figure 4.12 – Liffey Catchment, Biological Status

(This is a map of ALL the Liffey Bio-sites for 2000, showing change from 1999)

Figure 4.12 Liffey Catchment - Biological Q Rating 2000 and Change in Quality Class 1999 - 2000



4.3.3 Current Water Quality - Physico-Chemical

MRP

Annual median MRP concentrations exceeded the Project quality criterion at 56% of sites monitored in the Liffey catchment in 2001. All these sites are situated in the middle and lower catchment d/s of Victoria Bridge. The sites with the highest median MRP concentrations are on the tributary catchments, namely the Rivers **Camac, Griffeen, Lyreen, Carragh**, and **Rye Water,** with 1 station being on the **Liffey main channel,** and have MRP concentrations indicative of serious pollution. The site with the greatest median MRP for 2001 is on the upper **Lyreen** River. This site has consistently elevated concentrations of MRP over the Project monitoring period.

Figure 4.13 shows MRP concentrations at all sites in relation to compliance with the ≤ 0.03 mg/l Project water quality criterion, and any changes from 2000. This information is also shown in **Appendix 4e**.

Nitrogen

The median TON a quality criterion was achieved at all sites in the Liffey catchment in 2001(**Figure 4.15**).

The dissolved inorganic nitrogen (DIN) criterion of 2.6 mg/l was achieved at the site at Islandbridge.

Median ammonia concentrations were exceeded at 4 sites (9%). Three of these sites where situated downstream of MWWTPs, 2 on the **Griffeen** and one on the **Camac**. The fourth site was on the **Carragh Stream.** Reasons for the elevated median ammonia concentrations on this stream are not known. There was a MWWTP at Carragh but this has been decommissioned since August 2001 but may have influenced the ammonia concentrations prior to its closure.

Dissolved Oxygen

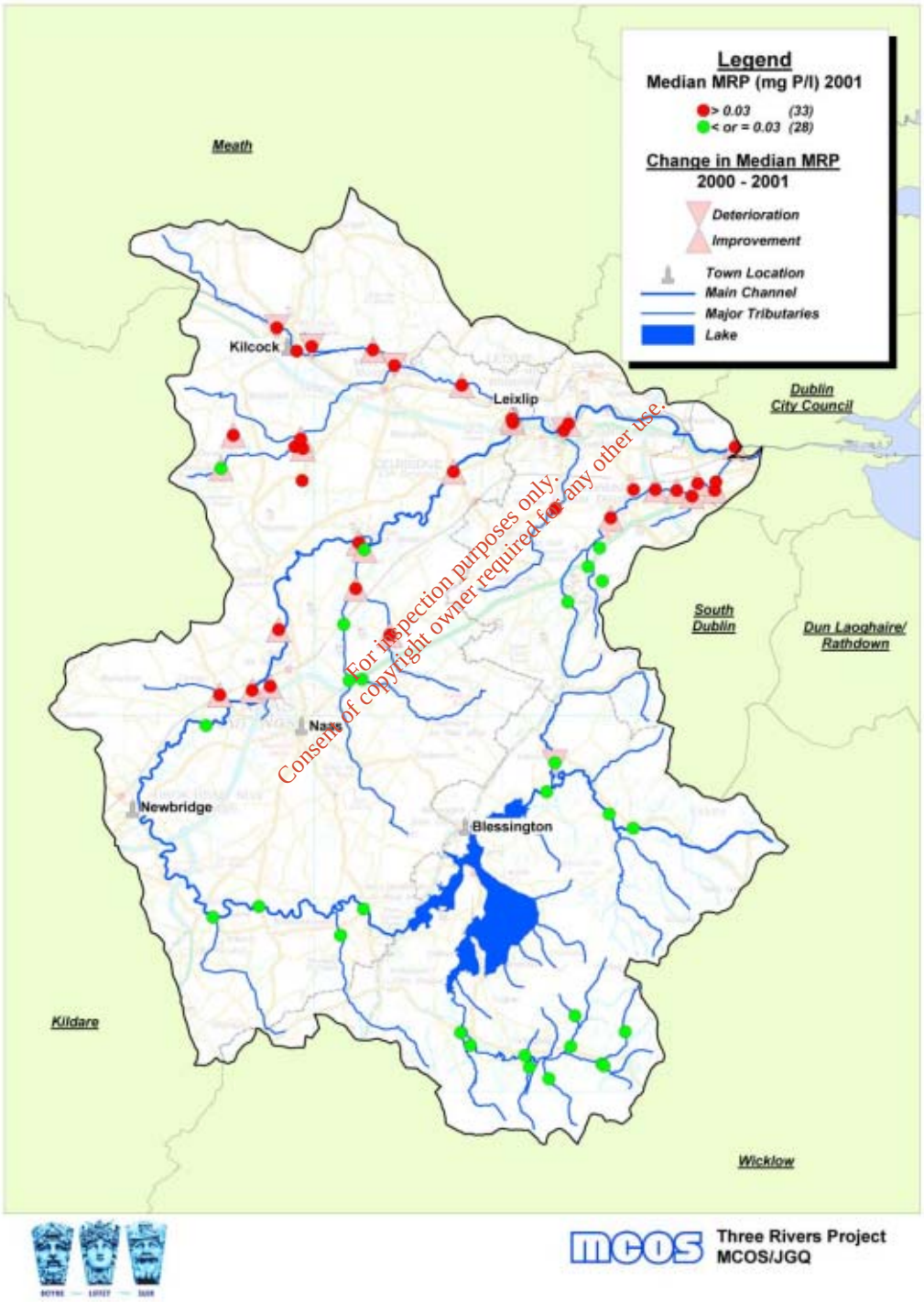
Only one site exceeded the criteria for *median* DO in the Liffey catchment in 2001. This site was on the **Carragh Stream**, a tributary of the Liffey west of Naas (**Figure 4.16**). The landuse in most of this catchment is medium intensity agriculture. There is also a small village (Carragh) through which the stream flows. This village is presently undergoing significant development, which may be influencing the water quality.

Minimum DO criteria were exceeded at 13 sites (29%). Five of those sites occurred on the **Rye Water** and it's tributary the **Lyreen**. *Maximum* DO criteria were also exceeded at thirteen sites (29%).

Figure 4.13 – Liffey Catchment, MRP 2001 and Change from 2000.

(This is a map of ALL the Liffey P/C for 2001, showing change from 2000)

Figure 4.13 Liffey Catchment - Median MRP 2001 and Change in MRP 2000 - 2001



4.3.4 Quality Trends – Physico-chemical

MRP

Median MRP concentrations exceeded the criterion limit at 58% of sites in 2000, compared with 56% in 2001. Overall there was a decrease in MRP concentrations at 20 (44%) of the sites monitored from 2000 to 2001. The number of sites with MRP concentrations indicative of serious pollution dropped from 17 (38%) in 2000 to 11 (24%) in 2001. The number of sites with MRP concentrations indicative of the unpolluted classification increased from 19 (42%) in 2000 to 20 (44%) in 2001. A total of 7 sites (16%) deteriorated in quality class in 2001.

There were only 11 directly comparable sites from 1995/97 (Baseline) data to 2001 data. Ten of these sites have shown an improvement and only one site, on the **Brittas River,** showed deterioration, although this site still remained below the ≤0.03 mg/l threshold. This site has also shown deterioration in biological status over the same period. **Figure 4.14** shows the indicative trend for median MRP in the **Liffey main channel** over the Project period.

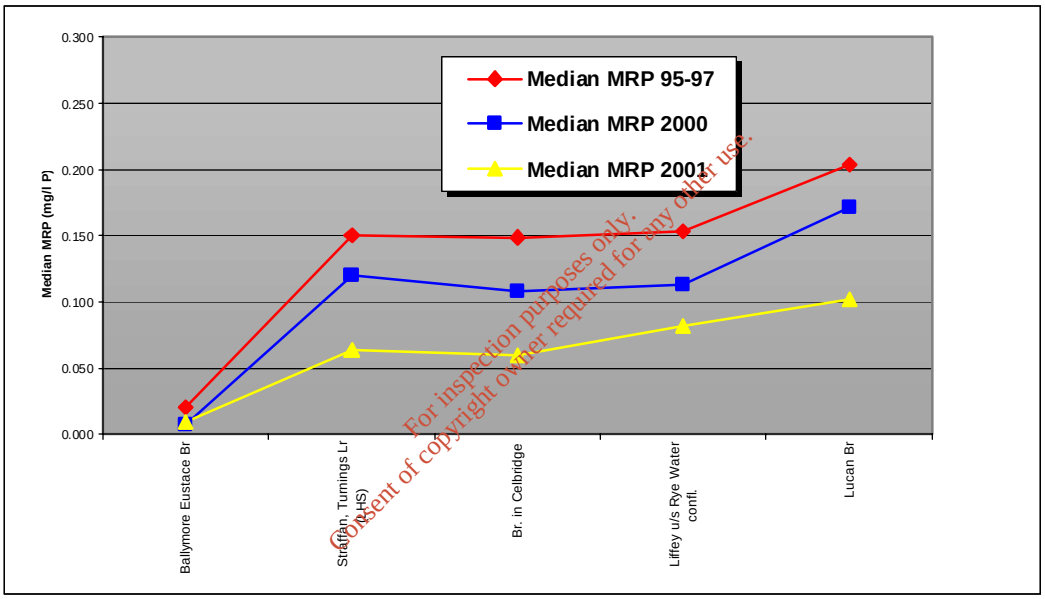


Figure 4.14 – Median MRP, Liffey Main Channel 1997-2001

The site with the greatest improvement in median MRP concentration (i.e. decrease in concentration) over the Project lifetime was on the **Griffeen** in Lucan Village. This site improved from 0.30 mg/l in 1995/97 to 0.20 mg /l in 2001. This site will continue to improve with the imminent closure of the Newcastle MWWTP. Other sites that are expected to show improvements in median MRP concentration with the closure of a MWWTP are the sites on the **Camac River** d/s of Saggart MWWTP, which was decommissioned in November 2001.

Nitrogen

None of the Liffey stations exceeded the median TON threshold of ≤5.65 mgN/l and 51% of stations have shown significantly lower (improvement) median TON concentrations from 2000 to 2001. All comparable sites on the Liffey showed an improvement in TON concentrations from 1997 to 2001 except for the site at Ballymore Eustace, which has shown a slight deterioration.

Most of the sites exhibited relatively small changes from 1997 to 2001 (i.e. less than 0.5 mgN/l) but 2 sites have shown considerable improvement, a site on the River **Ryewater** at Leixlip and the **Griffeen** at Lucan. Median concentrations of DIN at the Freshwater Limit site at Islandbridge did not exceed the quality criterion in 2000 or 2001.

Figure 4.15 – Liffey Catchment TON 2001

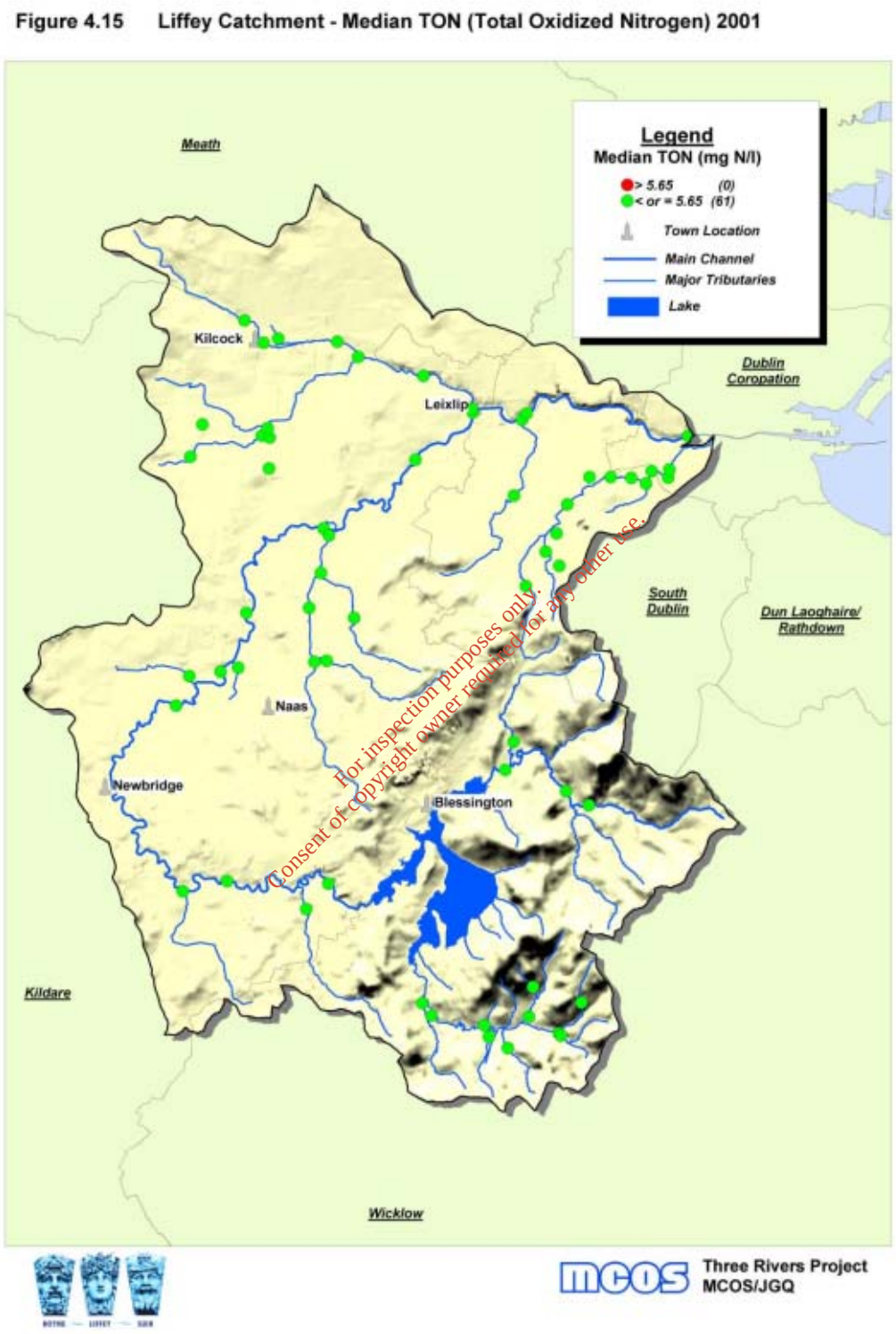
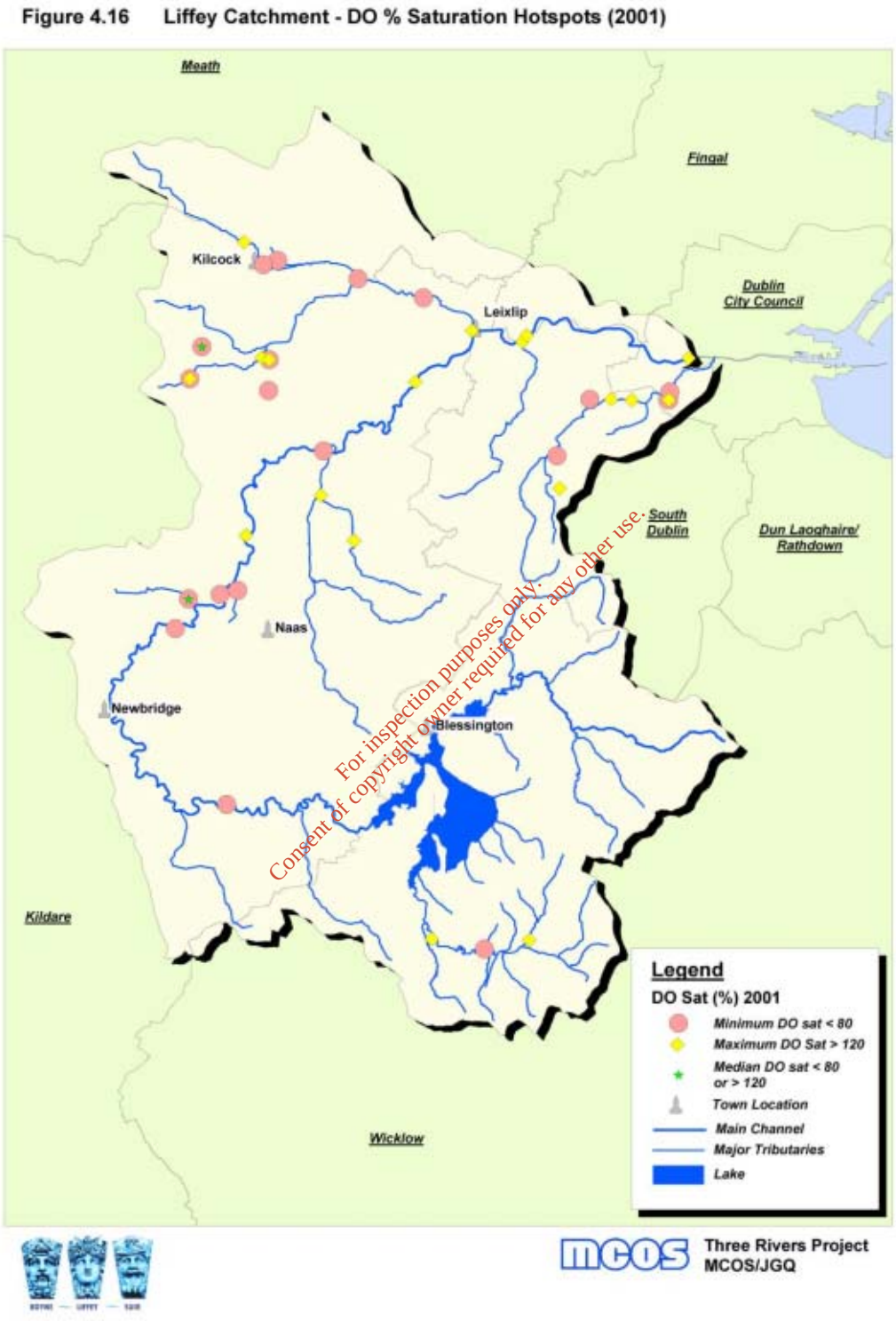


Figure 4.16 – Liffey Catchment Dissolved Oxygen Hotspots 2001



Five sites (11%) have shown significant improvement in *median* ammonia concentrations from 2000 to 2001. These improvements can be seen in the **Griffeen, Lyreen and Carragh** tributaries and on the **Liffey main channel** d/s of Osberstown at Castlekeely Ford and Straffan.

Eight sites (18%) have deteriorated in the Liffey catchment. A number of these sites are downstream of Leixlip on the **Liffey main channel** and the **Rye Water** and **Camac** rivers. Despite this deterioration, there was an improvement in ammonia concentrations at 55% of sites over the Project lifetime. Much of this improvement is on the **Liffey main channel** d/s of Osberstown MWWTP.

Dissolved Oxygen

Three sites showed a significant improvement in compliance with the *minimum* DO criterion from 2000 to 2001. There was an improvement in *maximum* DO criterion compliance at 8 sites (18%), 4 of these sites being located on the **Rye Water**. The site with the highest DO value recorded was the **Liffey** Islandbridge; this site recorded 225% saturation in 2001.

Of 11 sites comparable for both 1997 and 2001, 2 showed improvement with respect to the *minimum* DO criterion. Both of these sites were on the **Liffey main channel**, at Islandbridge and Celbridge. There were 2 sites that deteriorated in the **Kings River** and the **Rye Water**.

There were 2 sites that showed a decrease in the *maximum* DO. Both of these sites were on the **Liffey main channel** d/s of Osberstown MWWTP, at Straffen and Celbridge. Four of the 11 comparable sites increased the *maximum* DO sat recorded in 2001. These sites were on the **Griffeen River** and the **Liffey main channel.**

4.3.5 Phosphorus Regulations Compliance

Table 4.4 shows the percentage of Project monitoring sites in 2000 that comply with the Phosphorus Regulations` interim targets set for 2007. The percentage of sites that would comply with the WFD requirements is also shown. The criteria used to assess the monitoring data are summarised in **Appendix 4e**.

Table 4.4 – Percentage of sites in compliance with Phosphorus Regulations and WFD

Criteria	Liffey (% sites)	
	2000 (50 sites)	2001 (50 sites)
Pass Q criteria / Fail MRP	12	-
Pass MRP criteria / Fail Q	20	-
Pass Both (WFD Compliant)	28	-
Pass P Regulation Objective (either / or)	60	-
Fail P Regulation Objective (both)	40	-

Of the Three Rivers catchments, the Liffey had the lowest percentage (60%) of sites complying with the Regulations` target in 2000, although it had a higher number of WFD “compliant” sites than the Boyne. This was due to the high number of “un-polluted sites on the catchment u/s of Osberstown MWWTP. It was not possible to assess the 2001 compliance due to the lack of biological monitoring data.

4.3.6 Nutrient Budgets

Catchment Loads - Phosphorus

Loads were calculated at 34 monitoring sites on the Liffey. Eleven of these sites had no associated hydrometric stations, so flow was estimated from neighbouring sites. **Figure 4.17** illustrates the MRP loads from each catchment where data was available. The total MRP load discharged from the catchment, calculated at Island Bridge, was 51.9 tonnes/yr. (0.48 kg/ha/yr). This data is also shown in **Appendix 4f**.

Figure 4.17 – Liffey Catchment MRP Loads per Unit Area

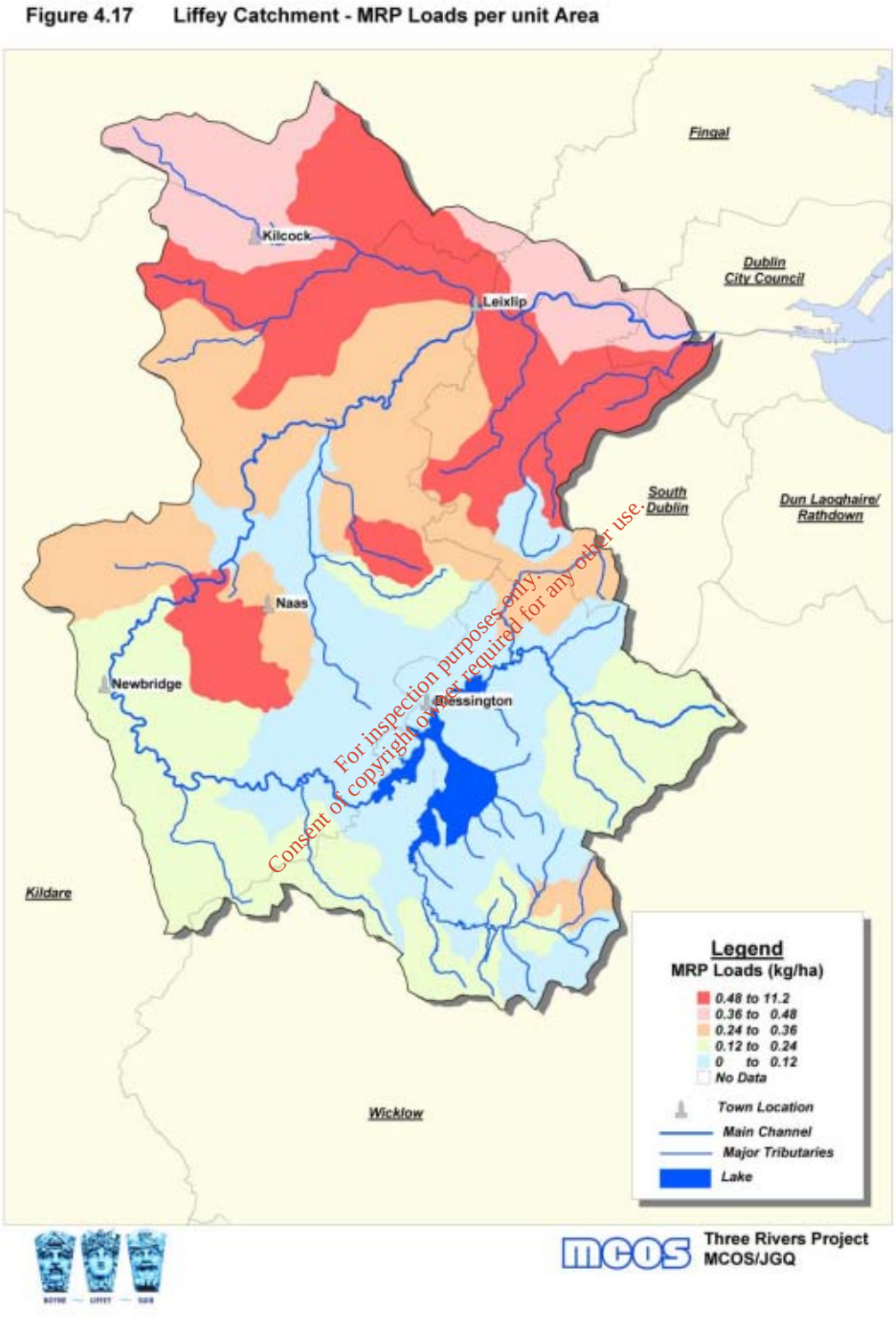


Figure 4.18 - MRP Loads - Liffey 2000 (kg/ha)

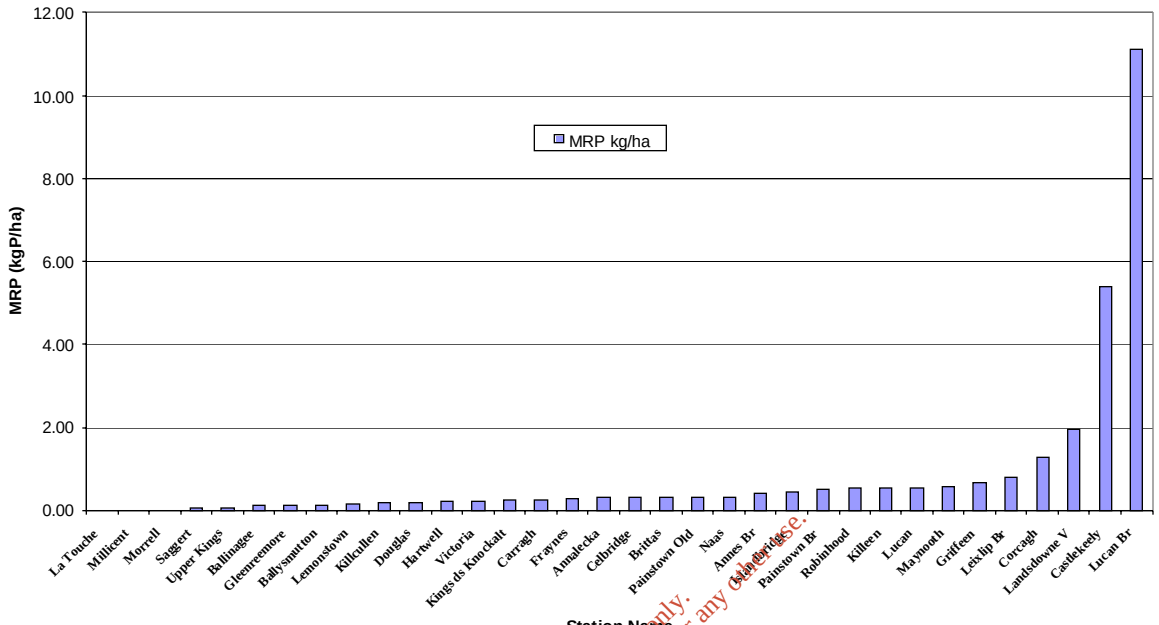
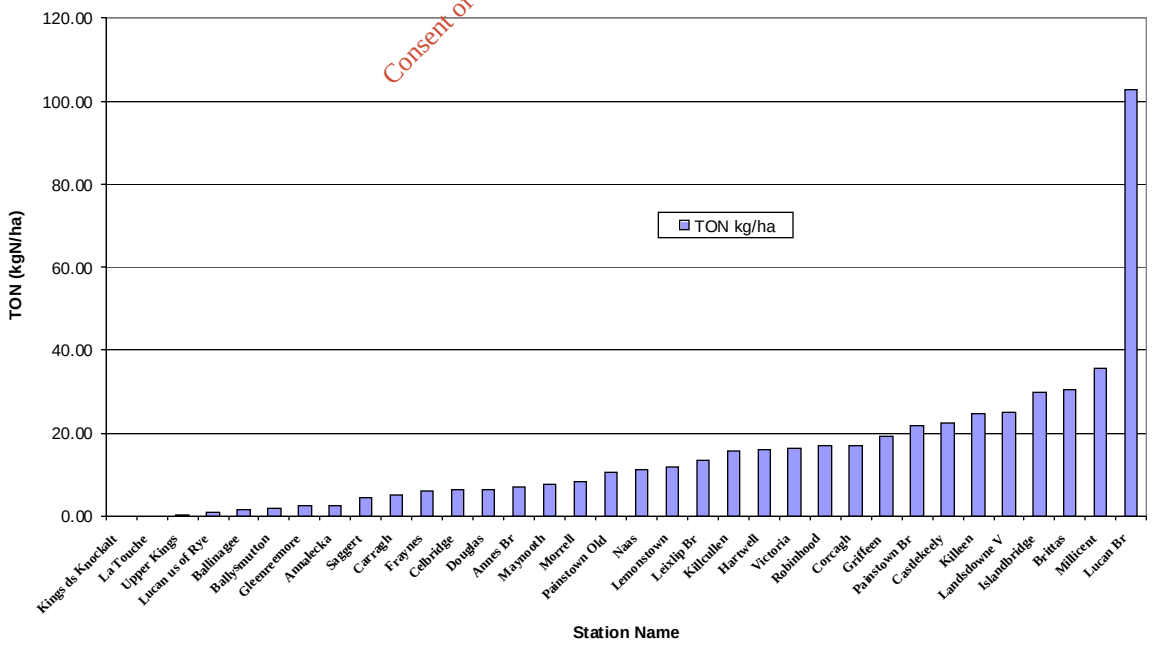


Figure 4.19 - TON Loads - Liffey 2000 (kgN/ha)



The TP load calculated at the same site was 78.8 tonnes/yr. (0.70 kg/ha), which rose to 86 tonnes when the contribution of the Camac catchment, which enters the Liffey just d/s of Islandbridge, was accounted for. This is comparable with the EPA calculated figure of 95 tones/yr for 1999 (**Table 2.6**) and may indicate a decrease in the TP load exported from the catchment since 1999.

Loads were calculated at 8 sites on the main Liffey Channel. There was a dramatic increase in the MRP load between Victoria Bridge (4.7 tonnes/yr) and **Castlekeely Ford** (22.5 tonnes/yr.) This increase was attributed to the Osberstown MWWTP. The load then remained relatively constant from Castlekeely down the main channel as a far as the site at **Lucan Bridge,** when another significant increase was observed, increasing from 27.5 tonnes/yr. u/s of Lucan Bridge to 50 tonnes/yr. at Lucan Bridge. Much of this increase was attributed to the MWWTP at Leixlip. The sub-catchment contributing to the site at Lucan Bridge also had the highest MRP load per hectare (11.11 kg/ha/yr) of any Liffey sub-catchment.

The tributary with the highest annual MRP load was the **River Rye (Figure 4.18)**. This river contributed more than 11 tonnes/yr (0.79 kg/ha/yr) to the Liffey catchment. There are 2 significant centres of population on this system (Maynooth and Kilcock) that may influence the MRP loading. Graphs of water quality results on a number of tributaries of the Rye (Lyreen upstream of Maynooth and the Brides Stream) would seem to suggest that point sources contribute significant nutrient loads in predominantly rural areas.

The tributary with the greatest MRP load per hectare was the **Camac**. The load for this tributary was 1.95 kg/ha/yr. The Saggart MWWTP that closed at the end of 2001 heavily influenced the Camac, and a significant reduction in the MRP load is expected following its closure.

The sites with the lowest MRP loads were situated mainly in the upper reaches of the **Liffey main channe**l and the **Kings River**. There are no major centres of population in these areas and farming practices tend to be less intensive, although, the **Brittas catchment** has very significant TON loads and MRP loads inconsistent with other tributaries in the area. Monitoring data showed an increase in the nutrient concentrations during the winter period suggesting a diffuse source that may originate from agriculture.

Catchment Loads – TON

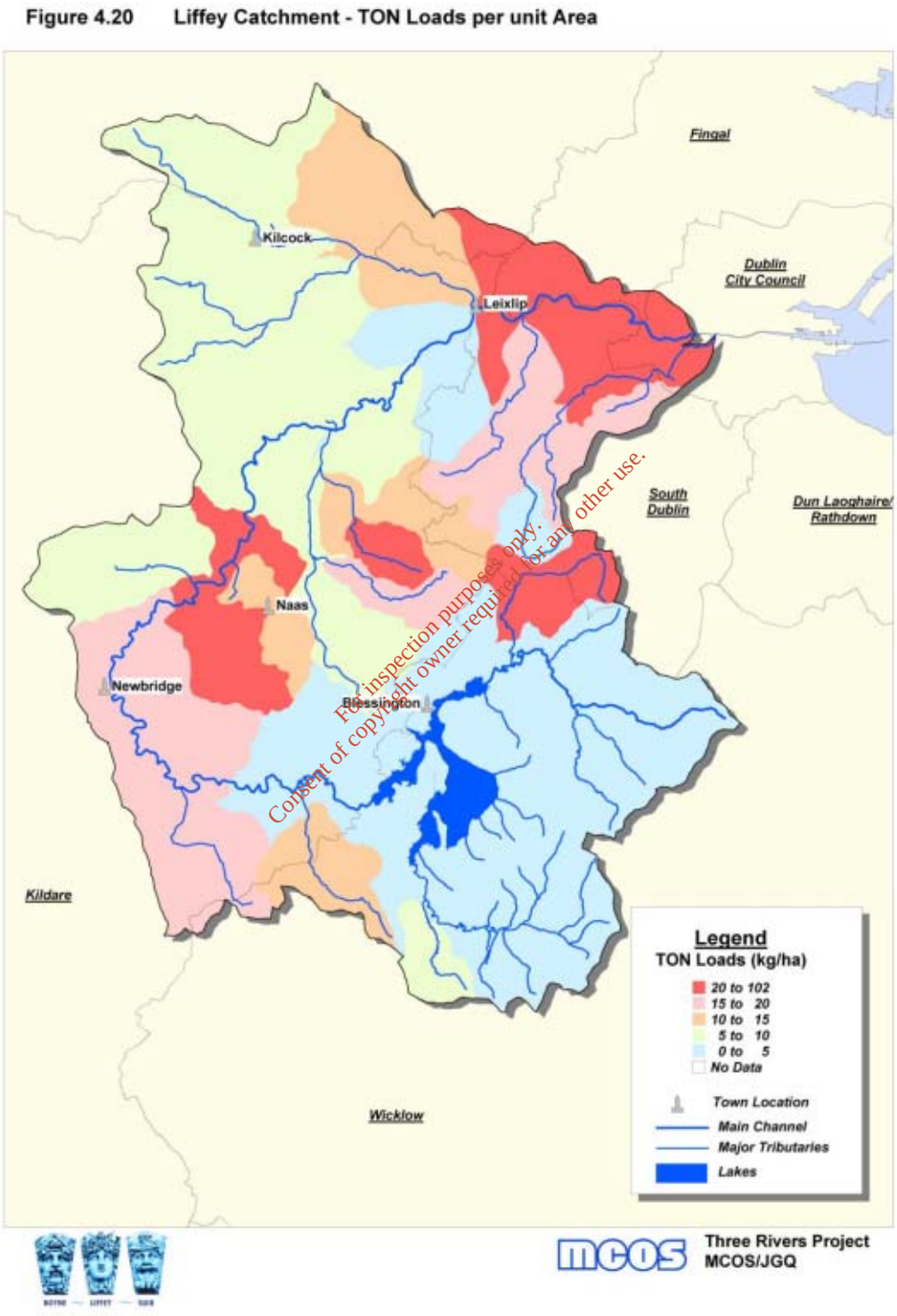
The annual total TON load discharged from the entire Liffey catchment, as measured at Island Bridge, was 1146 tonnes/yr (10.4 kg/ha/yr) (**Appendix 4g**). All of the main channel sites d/s of Pollaphuca exceeded this average except for the site at **Celbridge** and the site upstream of **Rye River** confluence (**Figure 4.19**).

The site with the highest annual TON load was **Lucan Bridge** (102.6 kg/ha). Other sites with significantly elevated TON loads were **Millicent Bridge** (35.5 kg/ha/yr), **Brittas** (30.4 kg/ha/yr) and Landsdowne Valley at the lower end of the **Camac** catchment (25 kg/ha/yr). Most of the sites with elevated TON loads were situated downstream of MWWTPs with the exception of the site on the Brittas River which has no major centre of population and is situated in a pre-dominantly rural setting.

Sites with the lowest TON loading were all situated in catchments with little or no influences from either intensive farming or urbanisation, the **Kings catchment** and upstream of Ballysmuttan Bridge on the **Liffey main channel** River. The loads for these catchments did not exceed 2.6 kg/ha/yr and many were below 1.0 kg/ha/yr (**Figure 4.20**).

The **Rye Water** catchment and its tributaries had TON loads consistently below the Liffey average with the exception of the most downstream site at **Leixlip Bridge** (13.5 kg/ha/yr). Although this river had below average loads per hectare it was the tributary that contributed the greatest annual load to the Liffey catchment (194.3 tonnes/yr) due to the large volumes of water it discharges. The sources of TON load in the Rye River are not easily identifiable and are most likely a combination of point and diffuse inputs emanating from both agriculture and urbanisation.

Figure 4.20 – Liffey Catchment TON Loads per Unit Area



4.3.7 Discussion

The biological monitoring of the Liffey from 1998 to 2000 has shown that there is a slight overall deterioration in the water quality of the Liffey. This deterioration is evident in the increase of the number of sites classed as “slightly” and “moderately” polluted. However, there has been an improvement in water quality at a number of sites on the main channel below Osberstown MWWTP. Unfortunately, due to circumstances beyond the control of the Project a very limited number of sites were monitored in 2001.

The physico-chemical data has shown general improvements in water quality throughout the lifetime of the Project with the most significant improvements being seen on the main channel. These improvements can be attributed to the up grading of the Osberstown and Leixlip MWWTPs. Even with these significant up-gradings the sites downstream of the Osberstown and Leixlip plants still contribute the largest nutrient loads to the catchment.

Discrepancies between the biological results and the physico-chemical results may show that there are factors other than nutrient concentrations affecting the biological status of a river.

4.4 SUIR CATCHMENT

4.4.1 Current Water Quality - Biological

The quality class at all sites in the Suir catchment in 2001 are shown in **Figure 4.22.** Any change in classification since the year 2000 is also indicated. **Appendix 4h** gives the Q-Rating for each site monitored.

Excluding sites in the Pilot catchments, the 2001 data indicated, 29 sites (49%) were classed "unpolluted", 18 (31%) "slightly polluted", 11 (19%) "moderately polluted" and 1 "seriously polluted". The **St. Johns River** has the only site in the Suir catchment that is classified as seriously polluted. The catchments with moderately polluted sites are the Rivers **Anner, Drish, Black (Cashel), Clodiagh** and the **Outeragh**. There are also 2 sites on the **Suir main channel** that are moderately polluted.

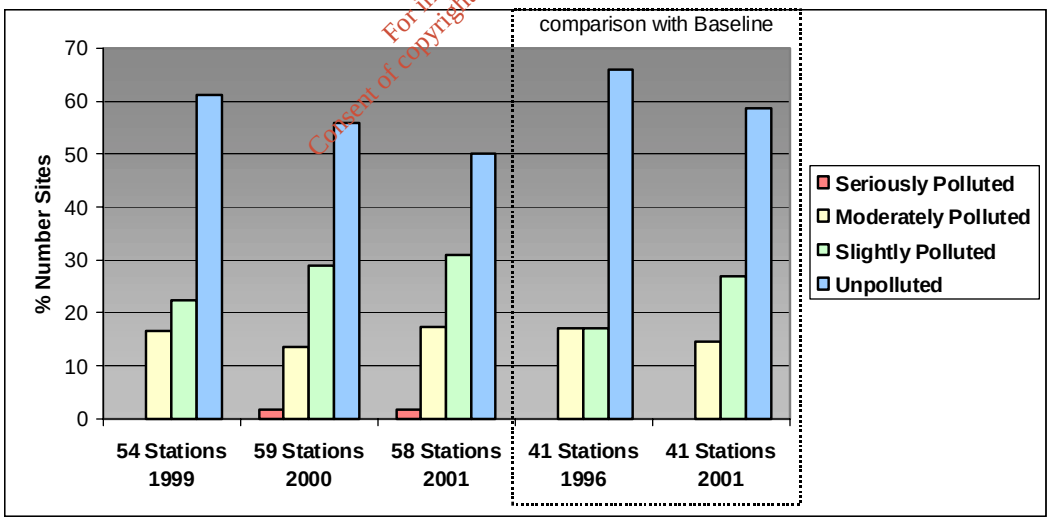


Figure 4.21 – Suir Catchment Biological Status, Baseline to 2001

4.4.2 Quality Trends – Biological

Figure 4.21 shows the percentage of Project sites falling into each quality class over the last 3 years, and compares these with the Baseline.

Q ratings were ascribed to 59 sites in both 2000 and 2001. There was no change in classification at 45 sites (76%), an improvement at 5 sites (8%) and there was deterioration at 9 sites (15%). Sites on the Rivers **Dawn, Glenbrook, Anner** and **Templetouthy Stream** all showed improvements.

The largest decrease in quality was on the **St Johns River**, whilst the largest increase was on the **Suir main channel** at New Bridge.

Comparing the 41 Project sites monitored both in 1996 and in 2001, 6 sites (15%) improved, 28 sites stayed the same (70%) and 6 sites (15%) declined in terms of quality class. The sites that have seen deterioration in water quality over this period are on the **Black Stream**, **Farneybridge**, **Drish, Nier** and **Clashawley** rivers. The site on the **Black Stream** deteriorated in quality from unpolluted to moderately polluted.

Watercourses that showed an improvement in classification over the Project lifetime were the **Suir main channel**, the Rivers **Fidaghta**, **Ara**, **Clodiagh** and the **Halfway House Stream**. The largest improvement was at the site on the River **Fidaghta**, which improved from "moderately" polluted to "unpolluted" status.

4.4.3 Current Water Quality - Physico-Chemical

Physico-chemical water quality was monitored at 64 sites within the Suir catchment in 2001. A further 20 sites were monitored in the in Pilot catchments but these sites are not included in the analysis below.

MRP

In 2001 almost half of sites (45%) monitored in the Suir catchment were unsatisfactory in terms of MRP, with annual median concentrations >0.03 mg/l. This includes all the sites on the **Suir main channel**. The tributaries with the highest median MRP concentrations included the Rivers **Anner, Outeragh, Ara, Moyle, St Johns** and **Clashawley**.

Figure 4.23 shows MRP concentrations at all sites in relation to compliance with the ≤ 0.03 mg/l Project water quality criterion, and any changes in median concentrations since 2000. This information is also shown in **Appendix 4h**.

Nitrogen

The median TON quality criterion was achieved at all sites in the Suir catchment in 2001, with the exception of the **Moyle** River (**Figure 4.25**).

The dissolved inorganic nitrogen (DIN) criterion of 2.6 mg/l was achieved at the freshwater limit at Sir Thomas' Bridge and the estuarine sites.

The median ammonia criterion was exceeded at 13% of sites, located on a small number of tributaries, these being the upper **Anner, Clashawley, Clover, Outeragh** and **St. Johns,** while 42% of sites had excessive *maximum* ammonia concentrations (>0.3 mg/l N). These sites were located throughout the catchment, with 2 sites located on the **Suir main channel**.

Dissolved Oxygen

Maximum DO concentrations of >120% saturation were recorded at 17% of sites. These were located on the Rivers **Ara, Anner, Outeragh, Moyle** and 4 sites on the **Suir main channel.** *Minimum* D.O. concentrations of < 80% saturation were also found at 43% of sites in 2001 (**Figure 4.26**). These were located on the Rivers **Moyle, Clashawley, St. Johns** and **Ara.** There were also 6 sites failing this criterion on the **Suir main channel**, although all of these sites recorded satisfactory *median* DO concentrations. Only 3 sites failed the median criterion, located on the **Moyle, St. Johns** and **Ara**.

Figure 4.22 – Suir Catchment, Biological Status

(This is a map of ALL the Suir Bio-sites for 2001, showing change from 2000)

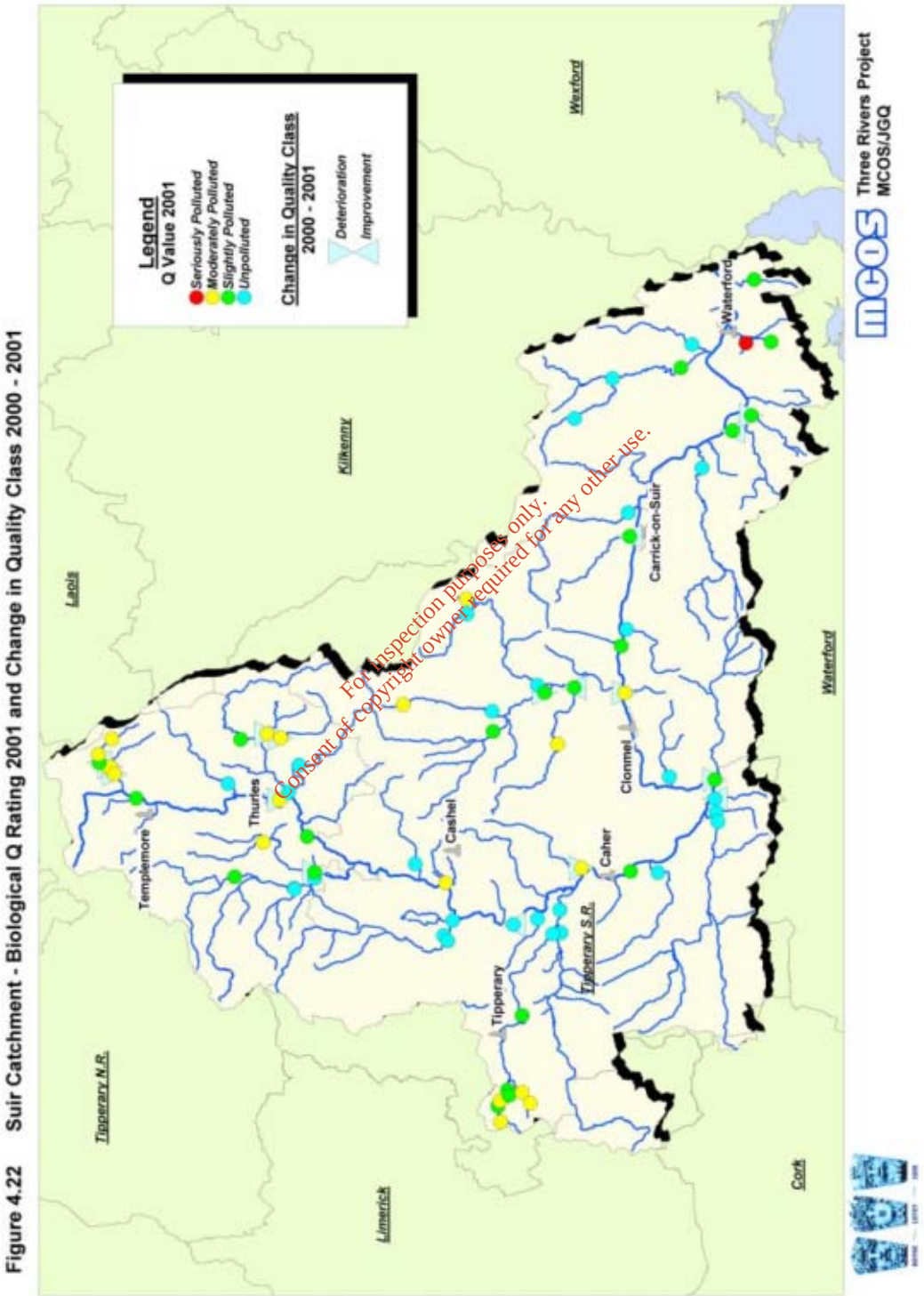
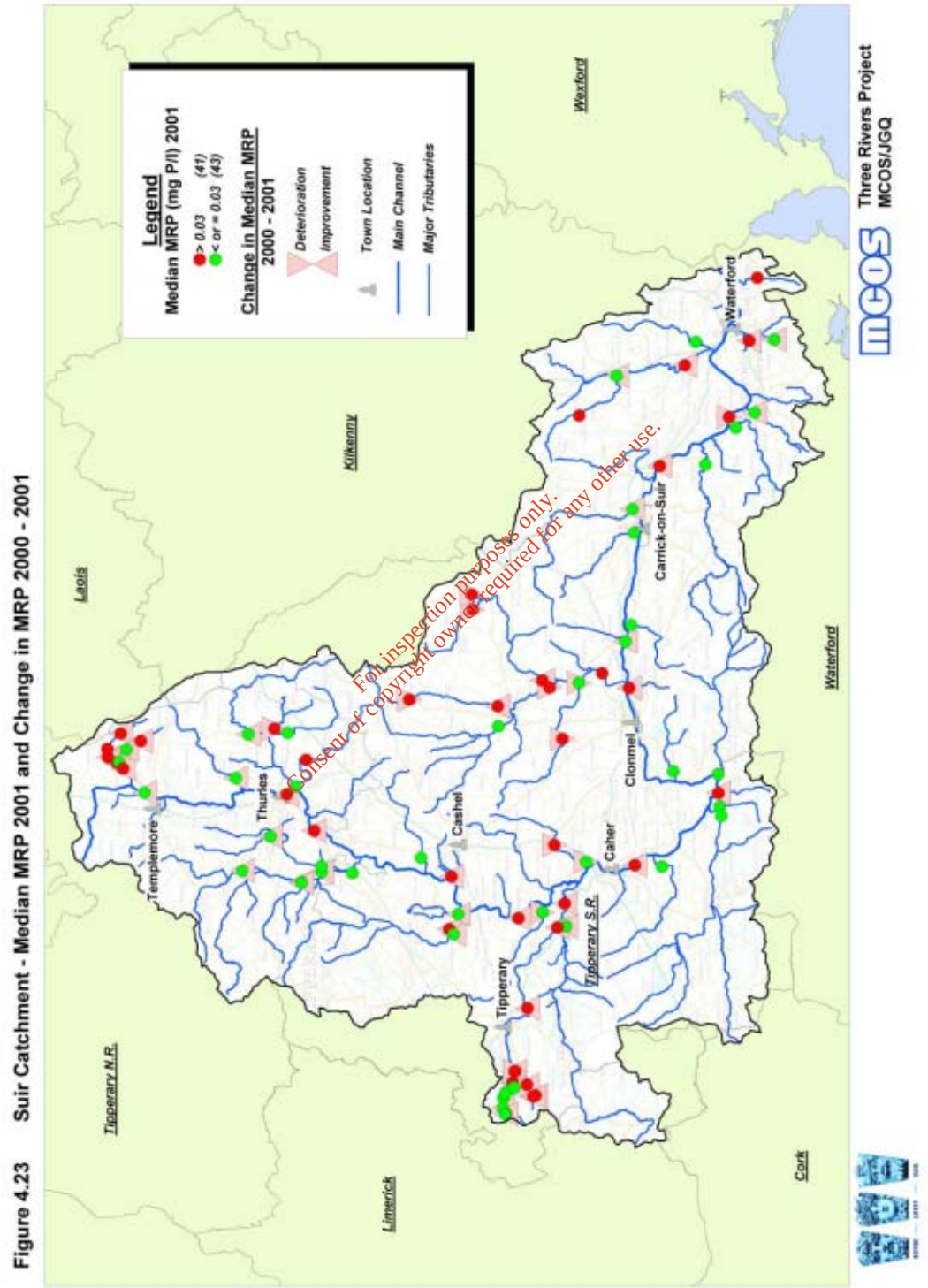


Figure 4.23 – Suir Catchment, MRP 2001 and Change from 2000.

(This is a map of ALL the Suir P/C for 2001, showing change from 2000)



4.4.4 Quality Trends – Physico-chemical

MRP

Comparing 2001 with 2000 median MRP concentrations, 39% of sites have improved in the Suir catchment whilst 18% of sites have deteriorated. There was no significant change for the remaining sites. The sites that have shown the largest improvement were on the **Ara** catchment d/s of Tipperary Town and the **Black Stream** d/s of Cashel. All sites on the **Suir main channel** have seen an improvement over this period, with the exception of the most d/s site, which is d/s of the freshwater limit and is affected by tidal influences (**Figure 4.24**). The site with the greatest deterioration is located on the upper **Anner**.

Compared to the Baseline data for comparable sites, 40% of sites have seen a significant improvement, with a further 49% of sites deteriorating over this period. Sites where improvements were recorded were located on the **Ara**, **Black** (Cashel), **Fishmoyne**, and the **Glenbrook**. Very significant deteriorations in MRP concentrations occurred on a number of sites in the **Anner, Moyle**, **Clashawley** and the **Outeragh.**

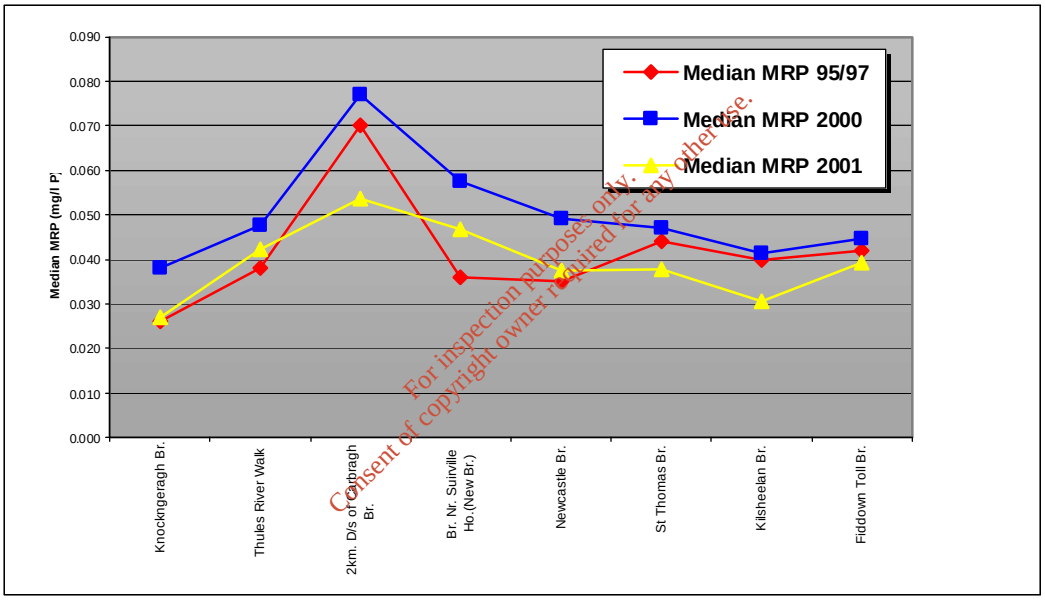


Figure 4.24 – Median MRP, Suir Main Channel 1997-2001

Nitrogen

The quality criterion for median TON of ≤5.65 mgN/l was met at all but 1 site (**Moyle** River) in 2000 and 2001, with 3% of sites improving in 2001 and 3% of sites deteriorating.

There was also a substantial improvement in TON concentrations (i.e. a decrease in concentration) in comparison to Baseline data, with 76% of sites where data is available having lower median TON concentrations in 2001. The largest improvement was at the **Rossestown River** monitoring site where the median fell from 3.5 mg/l to 2 mg/l.

Almost 15% of sites saw a decrease of more than 1 mg/l in TON concentration during this period, 2 of these sites being in the upper reaches of the **Suir main channel.** Ten (24%) stations experienced an increase in median TON concentrations. This deterioration was on average, by a factor of just 0.1 mg/l, with 3 of these stations being located in the lower reaches of the **Suir main channel**.

Median ammonia concentrations decreased at 16% of sites in 2001 compared to 2000, with 17% of sites showing increased concentrations of ammonia. The deterioration has been widespread throughout the catchment, with particularly poor sites being noted on the **Suir main channel** and the **Anner**. The most significant improvements were recorded on sites on the Rivers **Clashawley**, **Ara**, **Multeen, Outeragh** and the **Black (Drish)**.

From the Baseline to 2001, there was an increase in ammonia concentrations at twice as many sites (53%), as saw decreases (26%). The most significant decreases in concentrations occurred in the catchments, which had the poorest water quality such as, the Rivers **Moyle,** Black and Clashawley. Sites where concentrations increased in this period were on the **Suir main channel**, **Anner**, **Farneybridge, Clodiagh (Tipperary)** and **St. Johns**.

Dissolved Oxygen

There has been a significant improvement in *minimum* DO concentrations at 20% of sites in 2001 compared with 2000. In the same period, *median* DO concentrations at 27% of sites deteriorated. The sites that have exhibited the most significant deterioration were the Rivers **St Johns**, **Owenbeg**, and 1 site on the **Suir main channel**. *Maximum* DO concentrations throughout the catchment improved in 2001 with 52% of sites in the catchment exhibiting a significant improvement. Only 3% of sites deteriorated significantly from 2000 to 2001.

Minimum DO concentrations deteriorated between the Baseline and 2001 at 53% of sites with an improvement at only 14% of sites, whilst *maximum* DO (% Sat) concentrations improved at 30% of sites with 14% of sites deteriorating over the same period. Significant improvements in the DO status of sites occurred on the **Black Stream (Cashel)**, **Ara**, **Upper Anner**, **Multeen** and some sites on the **Suir main channel**. Deteriorations have occurred on the **Outeragh**, **Clodiagh, Moyle** and some sites on the **Suir main channel**.

The situation regarding oxygen concentrations in the Suir catchment is mixed, with some catchments having some sites that show improvements and some that show deterioration over the Project period, however, more sites have improved in terms of DO than have deteriorated over this time.

Figure 4.25 – Suir Catchment TON 2001 and Changes since 2000

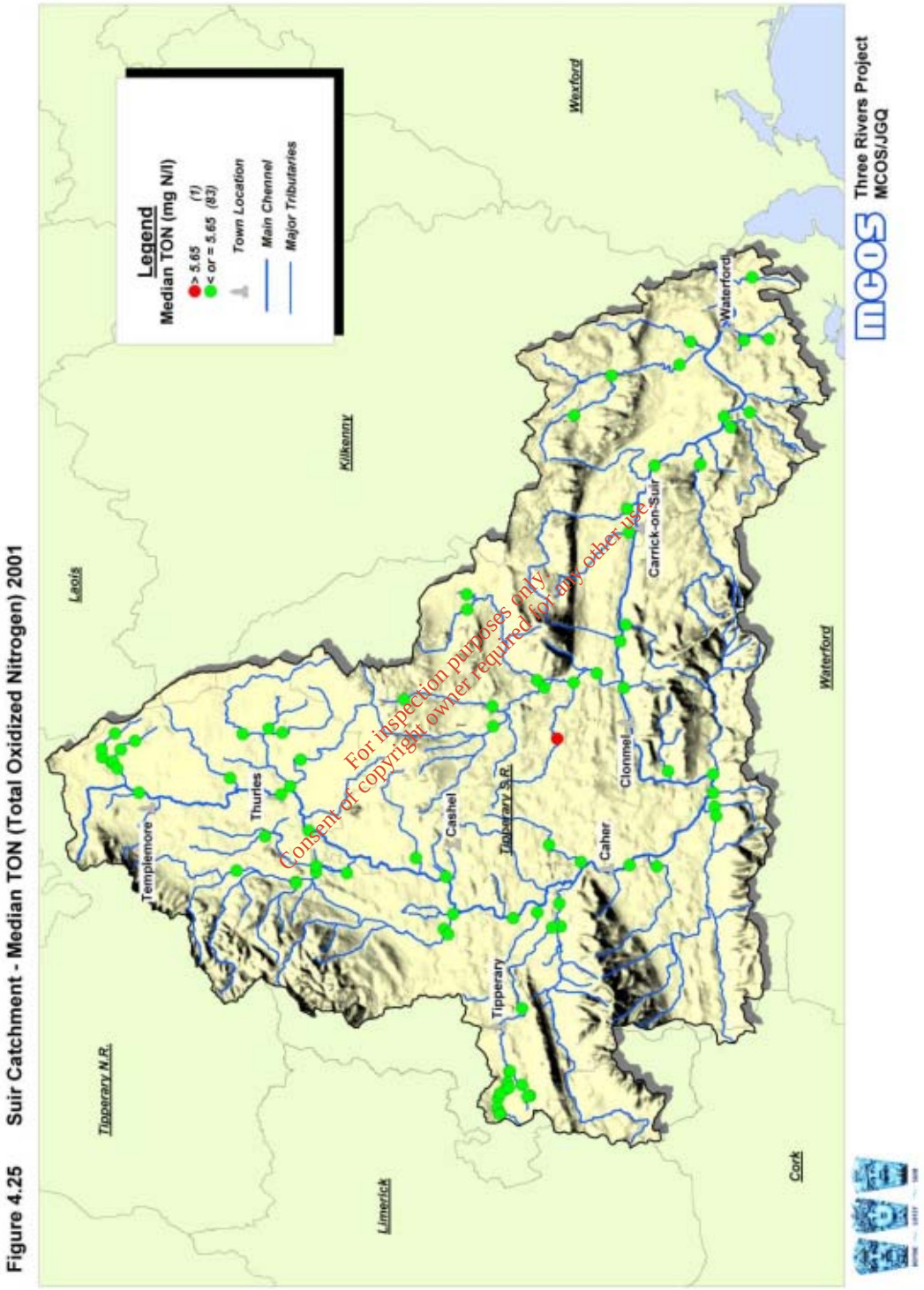
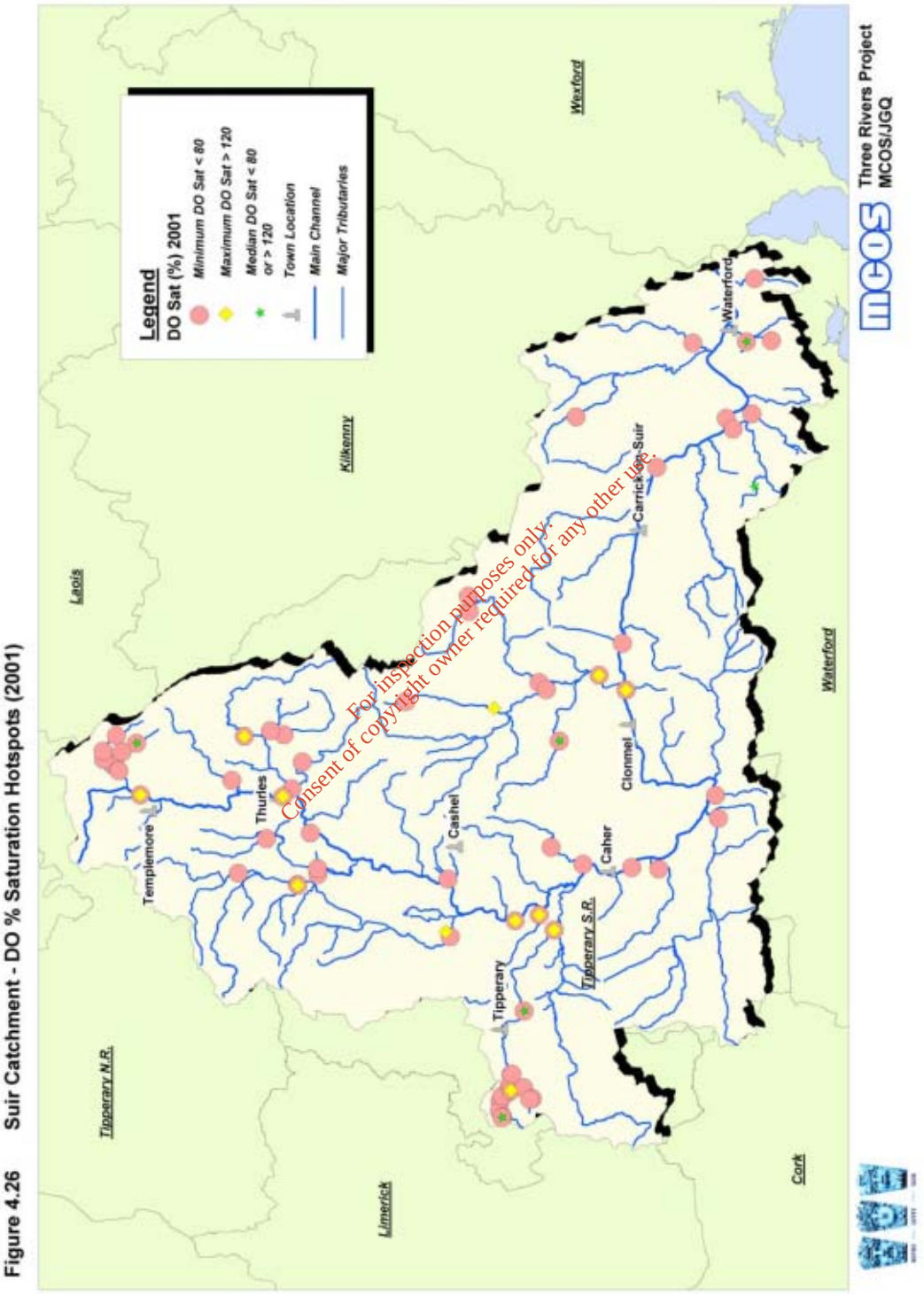


Figure 4.26 – Suir Catchment Dissolved Oxygen Hotspots 2001 and changes from 2000



4.4.5 Phosphorus Regulations Compliance

Table 4.5 shows the percentage of Project monitoring sites in 2000 and 2001 that comply with the Phosphorus Regulations` interim targets set for 2007. The percentage of sites that would comply with the WFD requirements is also shown. The criteria used to assess the monitoring data are summarised in **Appendix 4h**.

Table 4.5 – Percentage of sites in compliance with Phosphorus Regulations and WFD

Criteria	Suir	
	2000 (69 sites)	2001 (69 sites)
Pass Q criteria / Fail MRP	16	17
Pass MRP criteria / Fail Q	14	29
Pass Both (WFD Compliant)	35	34
Pass P Regulation Objective (either / or)	65	80
Fail P Regulation Objective (both)	35	20

Eighty percent of sites in the Suir catchment achieved the target quality set by the Phosphorus Regulations in 2001, an increase of 15% on the previous year. This was the highest level of compliance in the Three Rivers catchments. Thirty four percent (34%) to 35% of sites would comply with the WFD for the last 2 years, passing both the MRP and Q-rating criteria. The increase in sites passing the MRP criterion reflects the decrease in MRP concentrations noted at 39% of the sites between 2000 and 2001.

4.4.5 Nutrient Budgets

Catchment Loads - Phosphorus

The nutrient loads were calculated for 41 monitoring sites (**Appendices 4i & 4j)** in the Suir catchment, with loads calculated for all the major catchments and also for selected sub-catchments within these major catchments. **Figure 4.27** illustrates the MRP loads from each catchment where data was available, in terms of load/unit area.

The MRP load discharged from the Suir catchment, as calculated at Sir Thomas's Bridge (2600) was 79 tonnes/yr (0.37 kg/ha/yr). However, this site is located upstream of a number of important tributaries that discharge to the main channel such as the **Anner, Blackwater, Fidaghta, Clodiagh (Waterford), Dawn and St. Johns**. When the loads from these areas are considered, the total MRP load from the catchment is 147 tonnes/yr. The average MRP load per hectare for the entire Suir catchment therefore rises to 0.47kg/ha/yr, compared to 0.48 kg/ha/yr from the Liffey catchment, and 0.29 kg/ha/yr from the Boyne catchment.

The total calculated TP load at Sir Thomas's Bridge was 189 tonnes/yr (0.56 kg/ha/yr) compared to the 1999 EPA figure of 199 tonnes/yr. (**Chapter 2, Table 2.6**) possibly indicating a very slight decrease in TP exported from the catchment since 1999.

The MRP load in the **Suir main channel** increased from source to sea, as would be expected. Knocknageragh Bridge (2200), at the headwaters of the Suir had a MRP load of 1.8 tonnes/yr, which increased to 79 tonnes/yr d/s of Clonmel (22600). Annual MRP loads per hectare also increased from source down stream, ranging from 0.19 kg/ha/yr at Knocknageragh Bridge to 0.52 kg/ha/yr d/s of Cahir (1930), however, the MRP load per unit area reduced to 0.34 kg/ha/yr d/s of Clonmel. This could be due to settlement of solids in the slower moving reaches of the river causing a decrease in MRP values.

Figure 4.27 – Suir Catchment MRP Loads per Unit Area

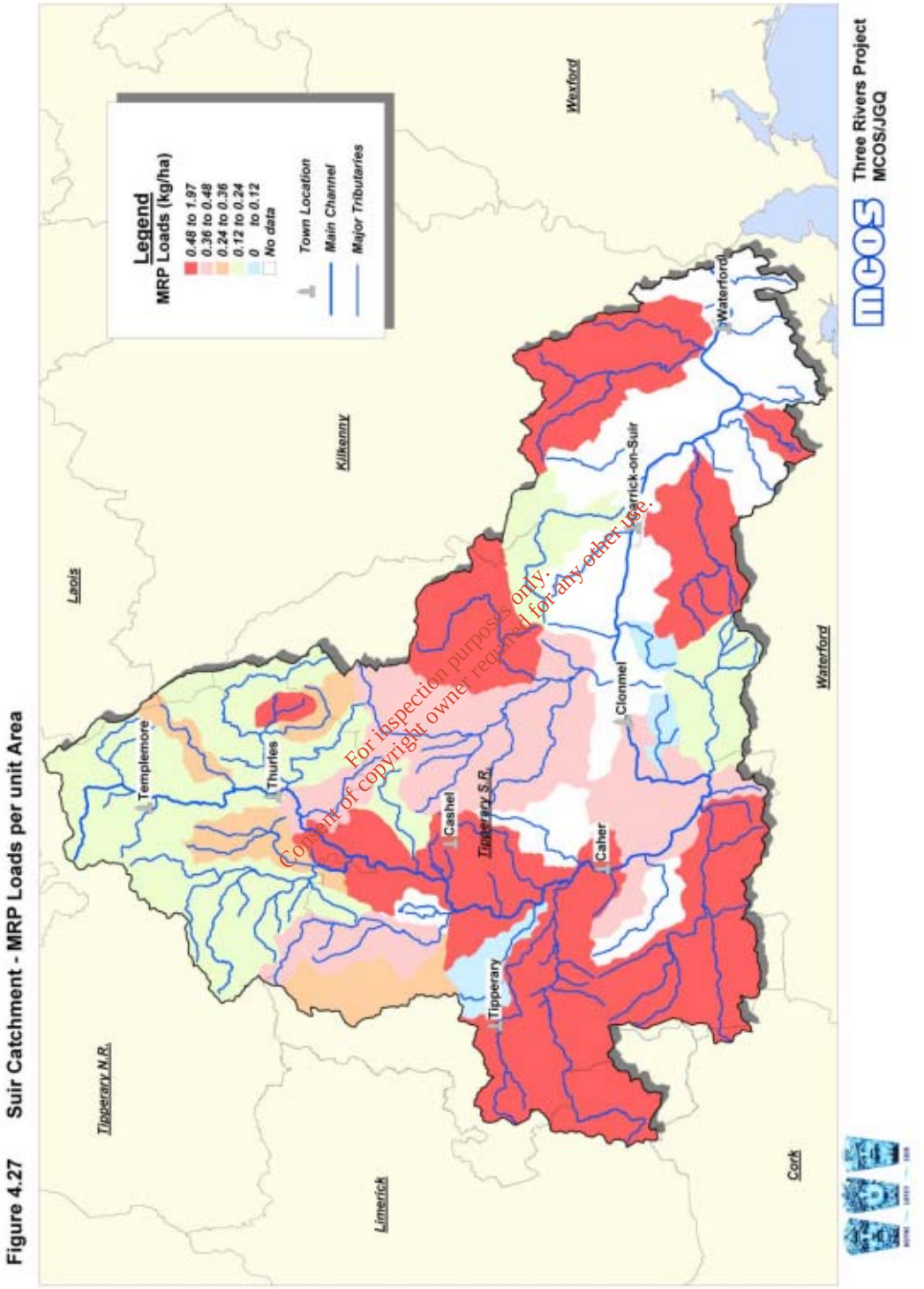


Figure 4.28 - MRP Loading for Main Catchments in Suir Catchment

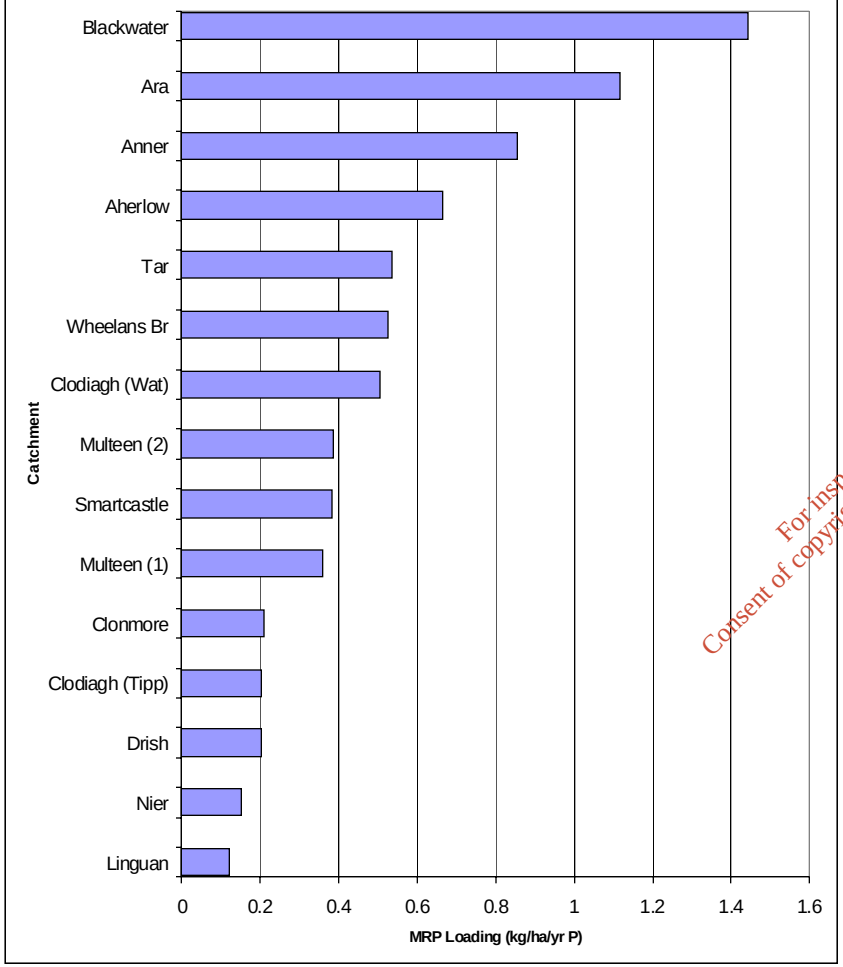
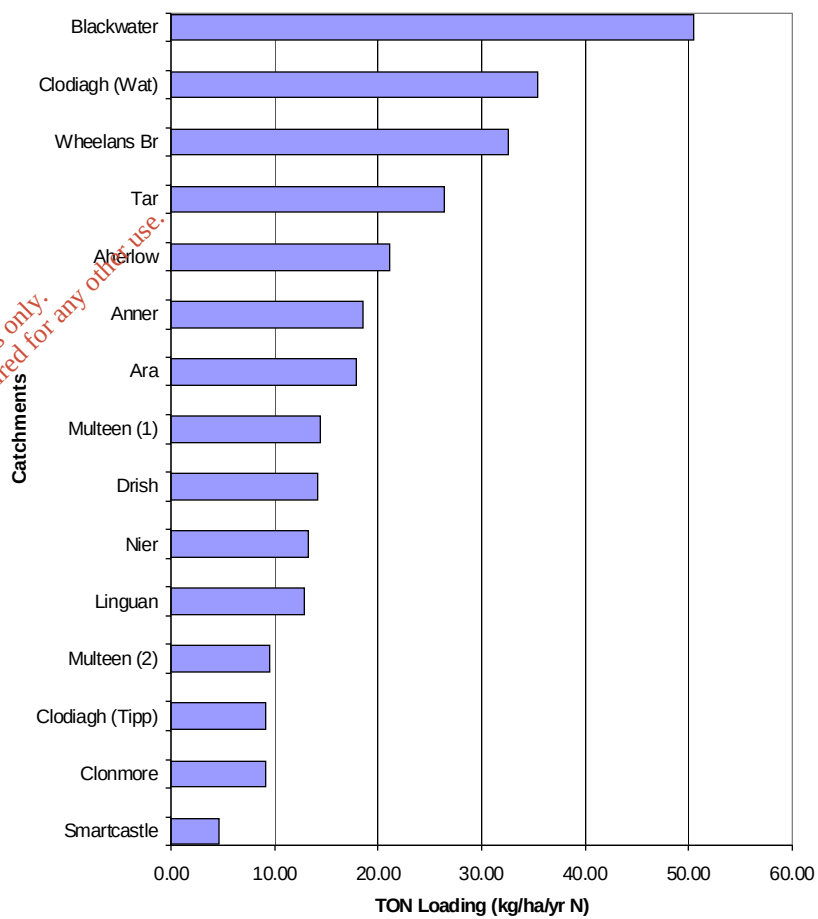


Figure 4.29 - TON Load (kg/ha/yr N) for the main catchments of the Suir



The highest annual MRP load per unit area discharging to the Suir catchment was from the **Blackwater,** which contributed 18.4 tonnes/yr (1.44 kg/ha/yr). The highest MRP load discharged was from the **Anner** discharging 37.7 tonnes/yr (0.85 kg/ha/yr). Other high contributors in terms of MRP load were the **Aherlow** discharging 11.8 tonnes/yr (0.67 kg/ha/yr) and the **Ara** 9.7 tonnes/yr (1.1 kg/ha/yr). The lowest contributors of MRP were the **Arglo** discharging 0.5 tonnes/yr (0.17 kg/ha/yr) and the **Fidaghta** discharging 0.2 tonnes/yr. (0.05 kg/ha/ha).

Figure 4.28 indicates the load per unit area to enable differently sized catchments to be compared. It can be seen that the **Blackwater, Ara, Anner** and **Aherlow** export the highest amount of MRP per hectare over a year.

The catchments, which are supplying the greatest phosphorus and nitrogen loads to the catchment, are not necessarily those with the poorest water quality. The catchments with the poorest water quality are often small streams that are not hydraulically as important as some of the larger rivers. One of the worst catchments in terms of MRP concentrations is the Moyle, although the MRP loading from this catchment is not very significant 2.3 tonnes/yr, in comparison to the Aherlow, for instance, which has an MRP loading of 11.8 tonnes/yr.

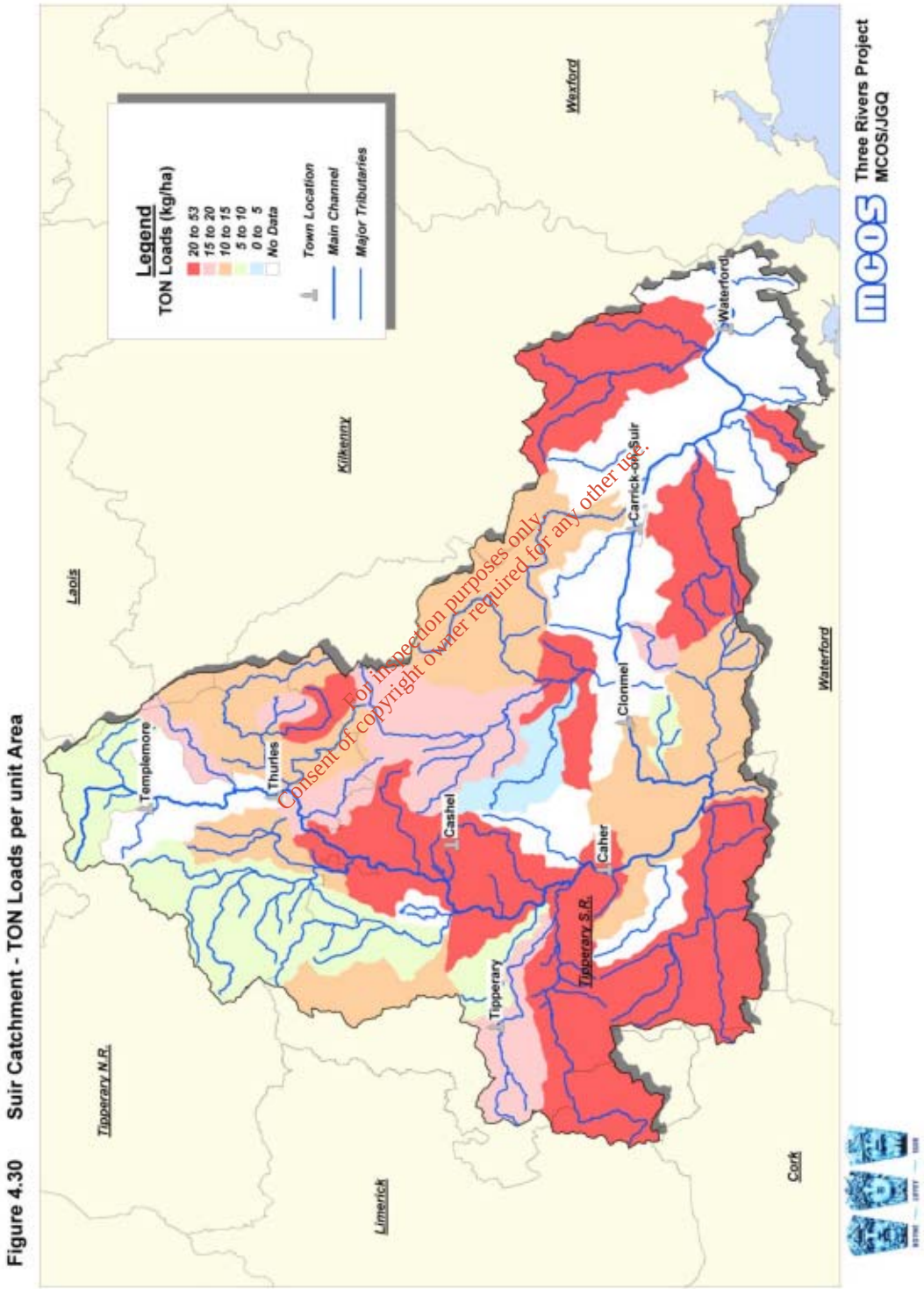
Catchment Loads - TON

The TON load exported for the Suir catchment, as calculated at Sir Thomas's Bridge, was 2887 tonnes/yr (13.4 kg/ha/yr). The TON loading follows a similar pattern as the MRP loading with an increase in TON loading from the source to sea within the catchment in the main channel. The TON load ranges from a loading of 69 tonnes/yr at Knockngeragh Bridge to 2887 tonnes/yr at Sir Thomas's Bridge d/s of Clonmel. When the load from the important tributaries d/s of this site are added, however, the total amount of TON generated by the catchment almost doubles to 5168 tonnes/yr (17.0 kg/ha/yr).

The highest exporters of TON load were the Rivers **Anner** (820 tonnes/yr), **Blackwater** (643 tonnes/yr) and **Aherlow** (376 tonnes/yr), whilst the **Arglo** (68 tonnes/yr) and **Fidaghta** (35 tonnes/yr) were the lowest, probably due to their small size. **Figure 4.29** shows that the **Blackwater** exports the highest average yearly load of TON per hectare (>40 Kg/ha/yr) but the **Clodiagh (Waterford)**, **Wheelans Bridge Stream** and **Tar** occupy the 3 next positions (**Figure 4.30**).

Unfortunately no flow data was available for the St Johns stream so it was not possible to calculate the nutrient load from this catchment. However, water quality in this catchment is very poor, and it could be expected to be a considerable contributor of nutrients to the Suir estuary.

Figure 4.30 – Suir Catchment – TON Loads per Unit area



4.4.6 Discussion

Comparison of biological monitoring data between the Baseline and 2001 indicates a slight decrease in water quality throughout the catchment with a reduction of 9% in the number of sites classed as "unpolluted". There was a decrease of 5% in the number of sites classified as "moderately" polluted with a corresponding increase in "slightly" polluted sites.

Water quality, in terms of MRP concentrations, improved at 40% of sites over the lifetime of the Project, but deteriorated at 49% of sites. There was a substantial improvement in 2001, compared to 2000. It is hoped that this improvement indicates a turning point in quality trends in the Suir catchment, which will be reflected in the biological classification in the coming years.

Median TON concentrations have decreased at 75% of sites during the Project lifetime indicating a major improvement in the nitrogen status of the river.

The causes of reduced water quality vary throughout the catchment. Diffuse agricultural sources have been identified as the main source of phosphorus loading in the catchment, with municipal wastewater treatment plants and industries also supplying a significant nutrient load to the catchment.

Generally, the **Blackwater, Ara, Aherlow and Anner** are the main exporters of nutrients to the catchment as a whole, even when the size of the catchment is accounted for.

In summary, water quality appears to have deteriorated on the Suir catchment during the lifetime of the Project although the number of sites complying with the Phosphorus Regulations targets for 2007 water quality is the highest of the 3 catchments. Whilst the number of unpolluted sites has decreased, some improvement is indicated in the increase in numbers of "slightly" polluted sites over that of "moderately" polluted sites. In addition, 54% of sites achieved the Project MRP quality criterion as against only 27% on the Boyne and 44% on the Liffey.

Effective implementation of the management strategies recommended in this report is likely to achieve a measurable response and increase the sites classed as "unpolluted" in the near future.