

1 Industrial and Municipal Effluents

1.1 Objectives

The objective of the activities related to point sources, i.e. industrial and municipal effluents are:

- to identify and quantify municipal wastewater pollution from the major cities and towns in the catchments and sub-catchments
- to identify and quantify the major pollution generating from industries in the catchments and sub-catchments

1.2 Methods

The determination of pollution loads from the point sources has been limited to the following parameters: BOD, Total-Nitrogen and Total-Phosphorus.

Identification of point sources

Two criteria have been used for selection of point sources for the assessment. Thus, only towns with more 10,000 inhabitants have been included, defining smaller town as rural settlements. For the selection of industries, only those which could be called "wet" industries (using water in the production) have been considered.

For each of the point sources the following information has been identified and assessed:

- Name of sub-catchment area for location of point source
- Town and/or province area for location of point source
- Co-ordinates
- Population figures for major cities and towns and year for determination of the population figures.

Based on assessments of population growth in the different cities and towns all population figures have been calculated to Year 2001 level.

The population growth for the different towns are assessed individually, but the following population growth figures are typically used:

(H) Highly expanding towns (typically larger towns): >4% growth

(N) "Normal" expanding towns (typically medium size towns): 3-4% growth

(R) "Rural expanding" towns (typically small towns): 2% growth

- Types and names of industries with significant wastewater production. Wastewater production from small scale industries and/or industries with very limited wastewater production are assessed to be included in the municipal wastewater production.

Calculation methods

The following methods have been used to quantify the industrial and municipal effluents:

1. Measurements

If measurements for industrial and/or municipal wastewater discharges have been available, these have been used to the extent possible.

For most industries and towns only limited measurements for wastewater pollution have, however, been available. Furthermore the data quality and reliability have in several cases been low.

2. Standard figures for municipal loads

If no measurements have been available the following standard figures have been used for municipal wastewater pollution loads:

BOD:	30-40 g/p.e./day
Total-nitrogen	5 g/p.e./day
Total-phosphorus	2 g/p.e./day

These values reflect the levels for populations in development countries with relatively low protein intake

3. Industrial pollution loads based on production figures

If no measurements have been available for industrial wastewater production, the assessment of wastewater pollution loads has been based on standard loads per production unit for the particular industry type and the actual production figures. The "World Bank Pollution Prevention and Abatement Handbook. Industry Sector Guidelines" has been used as the main reference for determination of industrial wastewater pollution based on production figures.

4. Rough estimates

If neither wastewater production nor industrial production figures have been available, rough estimates have been given based on either number of staff, local knowledge or similar.

Finally some industries have not been taken into account in the determina-

tion of wastewater pollution load to Lake Victoria as no information at all have been available.

Basic loads Based on the above calculation methods, basic loads for each of the point sources have been calculated. Basic loads are defined as the actual wastewater pollution production generated at the individual point source, i.e. total wastewater production from towns and industries.

Discharge methods The discharge methods from each of the point sources have been identified or assessed.

The following categories of discharge methods have been used:

- Direct discharge to Lake Victoria, a river or a stream
- Discharge to municipal sewer system
- Discharge to septic tanks or pit latrines
- No sewerage facilities
- Discharge to wastewater treatment facilities
- Discharge to wetlands

Where relevant, the fractions of wastewater discharged by different methods have been assessed. For larger towns the wastewater is typically discharged through a combination of more of the above options. As an example, the combination of discharge methods in Mwanza in Tanzania is assessed to be:

- | | |
|--|-----|
| • Direct discharge to Lake Victoria, a river or a stream | 35% |
| • Discharge to municipal sewer system | 5% |
| • Discharge to septic tanks or pit latrines | 60% |
| • Discharge to wastewater treatment facilities | 5% |
| • Discharge to wetlands | 5% |

The sum of the above figures for discharge methods shall not necessarily be 100%, since for example, wastewater discharged through the municipal sewer system is treated at the wastewater treatment facilities and part of the wastewater that is discharged directly to a stream flows through wetlands.

Reduction rates Based on the discharge methods the reduction of the basic wastewater loads before the wastewater pollution reaches the nearest recipient has been assessed.

The resulting load indicates the amount of pollutants reaching the nearest water course, i.e. stream, river or Lake Victoria. The reduction of pollutants through the river system before they reach Lake Victoria is hence not included in the reduction rates.

Using Mwanza again as an example, the following basic loads, reduction rates and resulting loads have been estimated based on an assessed population of 500,000 persons:

	Unit	Basic load	Reduction rate	Resulting load
BOD	kg/day	20,000	53%	9,400
Total-nitrogen	kg/day	2,500	50%	1,250
Total-phosphorus	kg/day	1,000	50%	500

1.3 Municipal Point Sources

In Table 1.1 below the estimate of the resulting municipal point sources from Kenya is shown. In total 51 larger towns have been identified in the Kenyan part of the Lake Victoria catchment area.

In the attachment to this chapter detailed figures for the assessment of the municipal point sources are given.

Table 1.1 *Municipal point sources, Kenya*

Catchment area	Town or province area	Population Persons (Year 2001)	Resulting load (kg/day)		
			BOD	Total-N	Total-P
North Awach	Kisumu	524,474	5920	1027	478
Yala	Siaya	11,640	89	15	14
South-Awach	Homa Bay	60,880	548	61	49
Gucha-Migori	Kisii	63,433	546	63	26
Gucha-Migori	Migori	63,624	189	268	63
Nzoia	Kakamega	80,206	550	92	51
Nzoia	Bungoma	79,009	711	102	36
Nzoia	Mumias	104,878	1001	185	72
Nzoia	Webuye	74,408	447	132	61
Nzoia	Kitale	91,572	742	185	74
Sondu	Kericho	98,677	834	162	52
Yala	Kapsabet	52,705	633	56	56
Nzoia	Eldoret	225,800	741	422	186
Sio	Busia	46,903	331	77	32
Mara	Bomet	89,457	805	134	54
Yala	Siaya	43,654	393	65	26
Yala	Yala	42,566	383	64	26
Gucha-Migori	Ogembo	45,934	413	69	28
Gucha-Migori	Suneka	33,672	303	51	20

Nyando	Muhoroni	33,042	297	50	20
Nyando	Ahero	32,174	290	48	19
Nzoia	Ugunja	31,310	282	47	19
Yala	Bondo	30,980	279	46	19
Nzoia	Funyula	30,834	278	46	19
Nyando	Kipkelion	28,417	256	43	17
Sio	Nambale	26,556	239	40	16
Gucha-Migori	Nyamache	25,955	234	39	16
Nzoia	Malava	25,725	232	39	15
Nzoia	Sirisia	24,952	225	37	15
Nzoia	Port Victoria	24,410	220	37	15
South-Awach	Kendu Bay	23,391	211	35	14
Nzoia	Moi's Bridge	23,174	209	35	14
Gucha-Migori	Masimba	22,511	203	34	14
Nzoia	Bumala	20,996	189	31	13
Nzoia	Matunda	11,897	107	18	7
Nyando	Londiani	36,266	326	54	22
Gucha-Migori	Kehancha	160,689	1446	241	96
Yala	Vihiga	116,177	1046	174	70
South-Awach	Nyamira	106,177	956	159	64
Gucha-Migori	Awendo	95,643	861	143	57
Gucha-Migori	Rongo	84,678	762	127	51
Yala	Nandi Hills	82,235	740	123	49
Nzoia	Kimilili	75,813	682	114	45
Gucha-Migori	Nyamarambe	70,637	636	106	42
Yala	Luanda	70,326	633	105	42
South-Awach	Oyugis	69,907	629	105	42
South-Awach	Mbita	49,038	441	74	29
Gucha-Migori	Keroka	42,785	385	64	26
Gucha-Migori	Nyansiongo	34,272	308	51	21
Nzoia	Lumakanda	12,079	109	18	7
Nzoia	Butere	10,366	93	16	6
TOTAL		3,366,907	29381	5532	2323

In Table 1.2 below the estimate of the resulting municipal point sources from Tanzania is shown. In total 30 larger towns have been identified in the Tanzanian part of the Lake Victoria catchment area.

In the attachment to this chapter detailed figures for the assessment of the municipal point sources are given.

Table 1.2 *Municipal point sources, Tanzania*

Catchment area	Town or province area	Population Persons (Year 2001)	Resulting load (kg/day)		
			BOD	Total-N	Total-P

Eastern Shore Streams	Musoma	120,025	1080	180	72
Grumeti	Bunda	15,190	137	23	9
Eastern Shore Streams	Tarime	22,079	199	33	13
Grumeti	Mugumu	9,879	89	15	6
Grumeti	Kyabakari	9,000	81	14	5
Mara	Butiama	10,918	98	16	7
Nyashishi	Mwanza	500,000	9400	1250	500
Southern Shore Streams	Geita	34,743	313	52	21
Isanga	Kharumwa	6,482	58	10	4
Southern Shore Streams	Kasamwa	9,814	88	15	6
Southern Shore Streams	Sengerema	36,893	332	55	22
Eastern Shore Streams	Nansio	33,038	297	50	20
Simiyu	Magu	17,470	157	26	10
Simiyu	Kisesa	9,901	89	15	6
Nyashishi	Nyanguge	5,726	52	9	3
Mbarageti	Ramadi	7,918	71	12	5
Magogo	Ngudu	11,461	103	17	7
Isanga	Malya	6,390	58	10	4
Magogo	Missungwi	10,718	96	16	6
Magogo	Misasi	10,387	93	16	6
Western Shore Streams	Bukoba	61,467	461	77	31
Ngono	Kamachumu	4,539	34	6	2
Ngono	Nshamba	8,338	63	10	4
Western Shore Streams	Muleba	9,595	72	12	5
Biharamulo	Biharamulo	8,048	60	10	4
Biharamulo	Chato	13,278	100	17	7
Kagera	Ngara	5,671	43	7	3
Kagera	Rulenge	7,146	54	9	4
Kagera	Kaisho	5,867	44	7	3
Kagera	Kayanga	8,631	65	11	4
TOTAL		1,020,613	13887	1998	799

In Table 1.3 below the estimate of the resulting municipal point sources from Uganda is shown. In total 6 larger towns have been identified in the Ugandan part of the Lake Victoria catchment area.

In the determination of the municipal wastewater pollution load from Uganda, it should be noted that only 50% of the population in Kampala is assumed to

discharge to the Lake Victoria catchment. Similar only 60% of the population in Jinja is assumed to discharge to the Lake Victoria catchment.

In the attachment to this chapter detailed figures for the assessment of the municipal point sources are given.

Table 1.3 *Municipal point sources, Uganda*

Catchment area	Town or province area	Population Persons (Year 2001)	Resulting load (kg/day)		
			BOD	Total-N	Total-P
Bukora	Mbarara	84,566	507	254	135
Northern Shore streams	Jinja	73,399	587	110	73
Northern Shore streams	Kampala	609,220	4143	1066	731
Northern Shore streams	Entebbe	72,852	291	146	87
Katonga	Masaka	73,398	294	147	88
Katonga	Nyendo	13,445	54	378	212
TOTAL		926,879	5876	2100	1327

Most of the wastewater discharge from Kampala to Lake Victoria drains towards Inner Murchison Bay through Nakivubo Channel, Kansaga and Kinawataka streams. The Nakivubo Channel drains through the centre of Kampala and the most industrialised areas of the city. It then flows through the Nakivubo/Luzira swamp before discharging into Inner Murchison Bay. The Kansaga Stream similarly flows through the Nakivubo/Luzira swamp and the Kinawataka Stream draining the new Kampala industrial area runs through the Kinawataka swamp before discharging into Inner Murchison Bay.

1.3.1 Fishing Villages

For Uganda a separate investigation of the fishing villages was conducted in September 2001 by National Water and Sewerage Corporation. It is estimated that there are between 600 and 1,000 fishing villages of various sizes on the shores and islands of Lake Victoria. The report concludes that the population of fishing villages along the lakeshore is at least 144,000 and possibly as high as 600,000. The lake pollution around the fishing villages chiefly represents a local public health issue and possibly not an overall pollution problem for Lake Victoria.

1.3.2 Rural Population

Wastewater pollution from the rural population is regarded as non-point pollution. There are no sewer installations and the wastes mostly infiltrate into the

soils . Thus the wastewater discharges to water recipients must be considered very limited.

1.4 Industrial Point Sources

In Table 1.4 below the estimate of the resulting industrial point sources from Kenya is shown.

In general only very limited data have been available for the industrial wastewater pollution in Kenya and therefore the determination of industrial load is very inadequate and uncertain. Especially figures for total-nitrogen and total-phosphorus are very uncertain.

In the attachment to this chapter detailed figures for the assessment of the industrial point sources are given.

Table 1.4 Industrial point sources, Kenya

Catchment area	District/ town	Name and type	Resulting load (kg/day)		
			BOD	Total-N	Total-P
South-Awach	Homa Bay	Homa Bay Slaughter House	3	0,5	-
North Awach	Nyanza Province	Kenya Breweries (KSM)	-	-	-
Nyando	Nyanza Province	A.C.F.C. (Muhoroni). Alcohol and yeast production	1224	-	-
South-Awach	Homa Bay	Homa Bay Capital fish processors	-	-	-
Gucha-Migori	Nyanza Province	Sony Sugar Co.	29	4	137
Gucha-Migori	Kisii	Kisii Bottlers Co. Soft drink bottling.	-	-	-
Nzoia	Mumias	Mumias Slaughter House	11	2	-
Nzoia	Webuye	Webuye Slaughter House	6	1	-
Nzoia	Webuye	Panpaper (EA) Mills Ltd. Pulp and paper	1750	31	38
Nzoia	Mumias	Mumias Sugar Co.	312	15	4
Nzoia	Western Province	Nzoia Sugar Co.	380	3	5
Nzoia	Eldoret	Highland Paper Mills Ltd.	3	-	-
Nzoia	Western Province	E.A. Heavy Chemicals.	-	-	-
Nzoia	Western Province	West Kenya Sugar Co.	87	2	-
Sondu	Kericho	Kericho Slaughter house	-	-	-
Nzoia	Eldoret	Eldoret slaughter house	2	1	-
Nzoia	Eldoret	Ken Knit. Textile production	3	-	-
Nzoia	Eldoret	C.P.C. Chemical Industry	14	-	-
Nzoia	Eldoret	Arkay. Food processing	1	-	-

Nzoia	Eldoret	Raiply. Wood products	-	-	-
Nzoia	Eldoret	Eldoret steel mills. Metallurgical	-	-	-
Nzoia	Eldoret	Premier Dairies	231	24	53
Nzoia	Eldoret	Eldoret oil industries. Corn oil production.	-	-	-
Nzoia	Eldoret	Doinyo Lessos Creameries. Dairy	-	-	-
South-Awach	Homa Bay	Prinsal Fish Processing treatment works	19	6	3
TOTAL			4074	89	241

In Table 1.5 below the estimate of the resulting industrial point sources from Tanzania is shown.

In general most of the figures for industrial wastewater pollution load in Tanzania are based on industrial production figures as only very limited reliable measurements have been available. The determination of the industrial wastewater pollution in Tanzania is therefore very uncertain.

In the attachment to this chapter detailed figures for the assessment of the industrial point sources are given.

Table 1.5 Industrial point sources, Tanzania

Catchment area	District/ town	Name and type	Resulting load (kg/day)		
			BOD	Total-N	Total-P
Eastern Shore Streams	Musoma / Mara	Fish Pack (T) Limited	55	1	1
Eastern Shore Streams	Musoma / Mara	Prime Catch Limited. Fish Filleting	69	2	1
Eastern Shore Streams	Musoma / Mara	Makilagi Maziwa Mara	1	0,1	0,04
Eastern Shore Streams	Musoma / Mara	Musoma Abattoir	15	3,3	1,3
Eastern Shore Streams	Musoma / Mara	Musoma Dairy	3	0,2	0,1
Eastern Shore Streams	Musoma / Mara	Musoma Bottlers	12	0,2	0,3
Eastern Shore Streams	Musoma / Mara	New Musoma Textile Limited (MUTEX)	210	51	34
Grumeti	Bunda / Mara	Bunda Oil Industries Ltd.	270	10	5
Eastern Shore Streams	Musoma / Mara	Mara Oil Limited	100	5	3
Grumeti	Bunda / Mara	Virian Tanzania Ltd.	120	7	4
Nyashishi	Mwanza / Mwanza	Vegetable Oil Industries Limited (VOIL)	63	13	6

Nyashishi	Mwanza / Mwanza	VIC FISH Limited	1000	15	8
Nyashishi	Mwanza / Mwanza	Tanzania Fish Processors	498	10	5
Nyashishi	Mwanza / Mwanza	Tanzania Breweries Limited (TBL)	693	93	30
Nyashishi	Mwanza / Mwanza	Tan Perch Limited	300	6	3
Nyashishi	Mwanza / Mwanza	Omega Fish Limited	86	1	1
Nyashishi	Mwanza / Mwanza	Nile Perch	309	5	3
Nyashishi	Mwanza / Mwanza	Dynamic Oil Mill Limited	150	7	5
Nyashishi	Mwanza / Mwanza	Mwanza Fishing Industries	180	4	2
Nyashishi	Mwanza / Mwanza	Mwanza Fish Meal	1854	391,4	197,6
Nyashishi	Mwanza / Mwanza	Birchand Oil Mill Limited	300	10	5
Simiyu	Magu / Mwanza	Chain Food International	2,01	0,09	0,036
Nyashishi	Mwanza / Mwanza	Bibiti Oil Limited	100	5	3
Nyashishi	Mwanza / Mwanza	Mwanza Abattoir	49	11	4,4
Nyashishi	Mwanza / Mwanza	Farai Oil Mills Limited	100	5	3
Nyashishi	Mwanza / Mwanza	New Era	192	50	24
Nyashishi	Mwanza / Mwanza	Regent Food and Drinks Limited	213,5	51,85	13,6
Nyashishi	Mwanza / Mwanza	Mwanza Dairy	-	-	-
Nyashishi	Mwanza / Mwanza	Lake Soap Industries Lim- ited	220	82	152
Nyashishi	Mwanza / Mwanza	African Tanneries Ltd.	38,4	9,4	4,3
Nyashishi	Mwanza /Mwanza	Nyanza Bottling Company Ltd.	1430	22	36
Western Shore Streams	Bukoba / Kagera	Fahari Beverages Limited	254	6	9
Western Shore Streams	Bukoba / Kagera	BUKOP Limited. Coffee Curing	-	-	-
Western Shore Streams	Bukoba / Kagera	Tanganyika Instant Coffee Company Limited	7,85	0,2	0,02
Western Shore Streams	Bukoba / Kagera	Bukoba Abattoir	10	2	1
Kagera	Kyaka / Kagera	Kagera Sugar Company Limited	24	10	5
			8930	887	569

In Table 1.6 below the estimate of the resulting industrial point sources from Uganda is shown.

In general most of the figures for industrial wastewater pollution load in Uganda are based on measurements. However some of the measured data seem to be incorrect and especially the values for total-nitrogen and total-phosphorus often seem to be unrealistically low. The determination of the industrial wastewater pollution in Uganda is therefore very uncertain.

In the attachment to this chapter detailed figures for the assessment of the industrial point sources are given.

Table 1.6 Industrial point sources, Uganda

Catchment area	District/ town	Name and type	Resulting load (kg/day)		
			BOD	Total-N	Total-P
Bukora	Mbarara	G. B. K. Dairy	59,0	2,90	1,70
Northern Shore streams	Jinja	Agro Processing Ltd.	27,9	0,59	0,30
Northern Shore streams	Jinja	Gomba Fishing Industries Ltd.	83,9	1,40	0,77
Northern Shore streams	Jinja	Jinja Cattle Trading & Butchers	16,4	3,7	1,50
Northern Shore streams	Entebbe	Greenfields	27,6	0,76	0,36
Northern Shore streams	Kampala	Britania Products	227,0	10,30	0,35
Northern Shore streams	Kampala	Century Bottling Co.Ltd, Coca Cola	178,5	2,55	4,13
Northern Shore streams	Kampala	City Abbatoir	154,0	34,50	13,80
Northern Shore streams	Kampala	Crown Bottlers (Pepsi cola)	177,0	2,50	4,10
Northern Shore streams	Kampala	Dairy Corporation Ltd.	70,0	3,50	2,10
Northern Shore streams	Kampala	Hwan Sung Ltd.	24,9	0,49	0,23
Northern Shore streams	Kampala	Kampala Bottlers	20,7	0,30	1,50
Northern Shore streams	Kampala	Mukwano Industries	154,9	11,97	0,55
Northern Shore streams	Kampala	Nakasero Soap works	40,9	3,20	0,15
Northern Shore streams	Kampala	Ngege Ltd.	163,4	2,47	1,33
Northern Shore streams	Kampala	Uganda Breweries Limited	835,0	57,50	86,30
Northern Shore streams	Kampala	Uganda Fish Packers	24,4	0,48	0,52
Northern Shore streams	Kampala	Uganda Meat Packers	69,7	15,70	6,30
TOTAL			2355	155	126

1.5 Summary of Point Source Loads

The total number of persons included in the municipal point source estimate is:

Kenya	3,367,000 persons
Tanzania	1,021,000 persons
<u>Uganda</u>	<u>927,000 persons</u>
<u>Total</u>	<u>5,315,000 persons</u>

These shall be compared with the total population in the Lake Victoria catchment of approx. 20 million persons.

The number of industries assessed to contribute with significant wastewater pollution loads on Lake Victoria for the individual countries were:

Kenya	16 industries
Tanzania	34 industries
<u>Uganda</u>	<u>18 industries</u>
<u>Total</u>	<u>68 industries</u>

In Table 1.7 a summary of the wastewater pollution from point sources for each of the sub-catchment areas are listed.

In general the assessment of the wastewater pollution from the industries is relatively uncertain, as the available data have been limited and some unreliable. However, the assessment indicates the order of magnitude of the pollution stemming from point sources around the lake as well as their relative importance. Thus, from a global lake point of view it is not believed that a more detailed assessment would give much additional information.

Such studies may, on the other hand, be highly valuable for assessment and management of local pollution problems in the near shore areas, especially "hot spots" such as Mwanza Gulf, Murchison Bay, Napoleon Gulf, and Kisumu Bay.

In Figure 5.1 - 5.3 the distribution of the wastewater pollution point sources is illustrated for BOD, total-nitrogen and total-phosphorus (it should be noted that the maps includes some rural towns which are not mentioned in the tables above).

As seen the main point sources are concentrated at a few major cities in Uganda and Tanzania, whereas the point sources are distributed at several larger towns in Kenya

Table 1.7 Summary of wastewater pollution from point sources, tons/year

Catchment	BOD	tons/year	
		Total-N	Total-P
Biharamulo	58	10	4
Bukora	306	130	69
Eastern Shore Streams	673	107	48
Grumeti	254	25	11
Gucha-Migori	2654	518	241
Isanga	80	13	5
Kagera	113	23	11
Magogo	69	12	5
Mara	402	67	27
Mbarageti	26	4	2
North Awach	2161	375	175
Northern Shore streams	3602	722	458
Nyando	873	71	28
Nyashishi	6269	745	367
Nzoia	3275	557	255
Sango Bay	403	137	74
Simiyu	109	18	7
Sio	290	57	24
Sondu	304	59	19
South-Awach	676	103	50
Southern Shore Streams	268	45	18
Ugandan Islands	139	17	9
Western Shore Streams	349	44	20
Yala	1766	277	131
TOTAL	25122	4135	2057

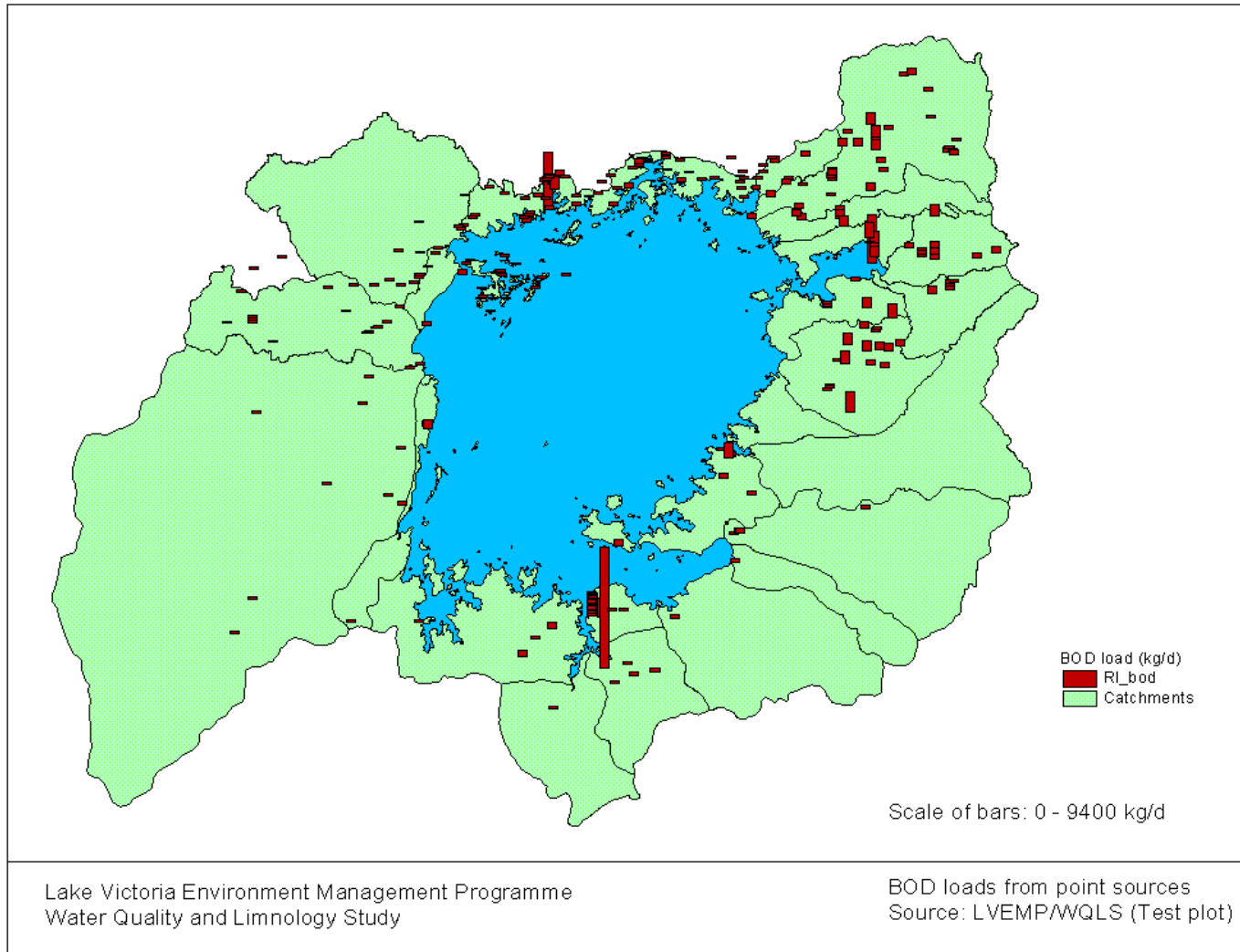


Figure 1.1 Distribution of point sources, BOD (kg/day)

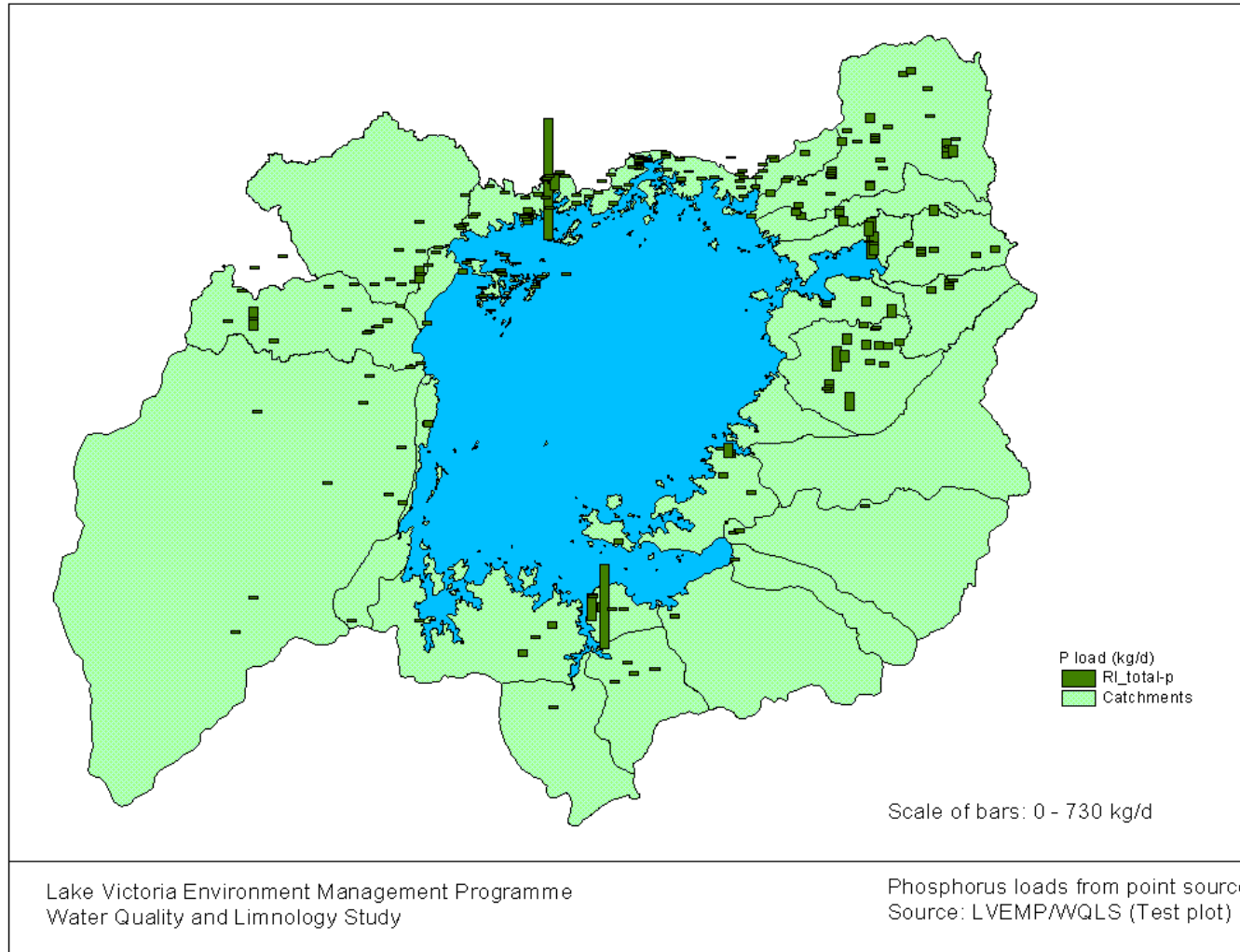


Figure 1.2 Distribution of point sources, Total-phosphorus (kg/day)

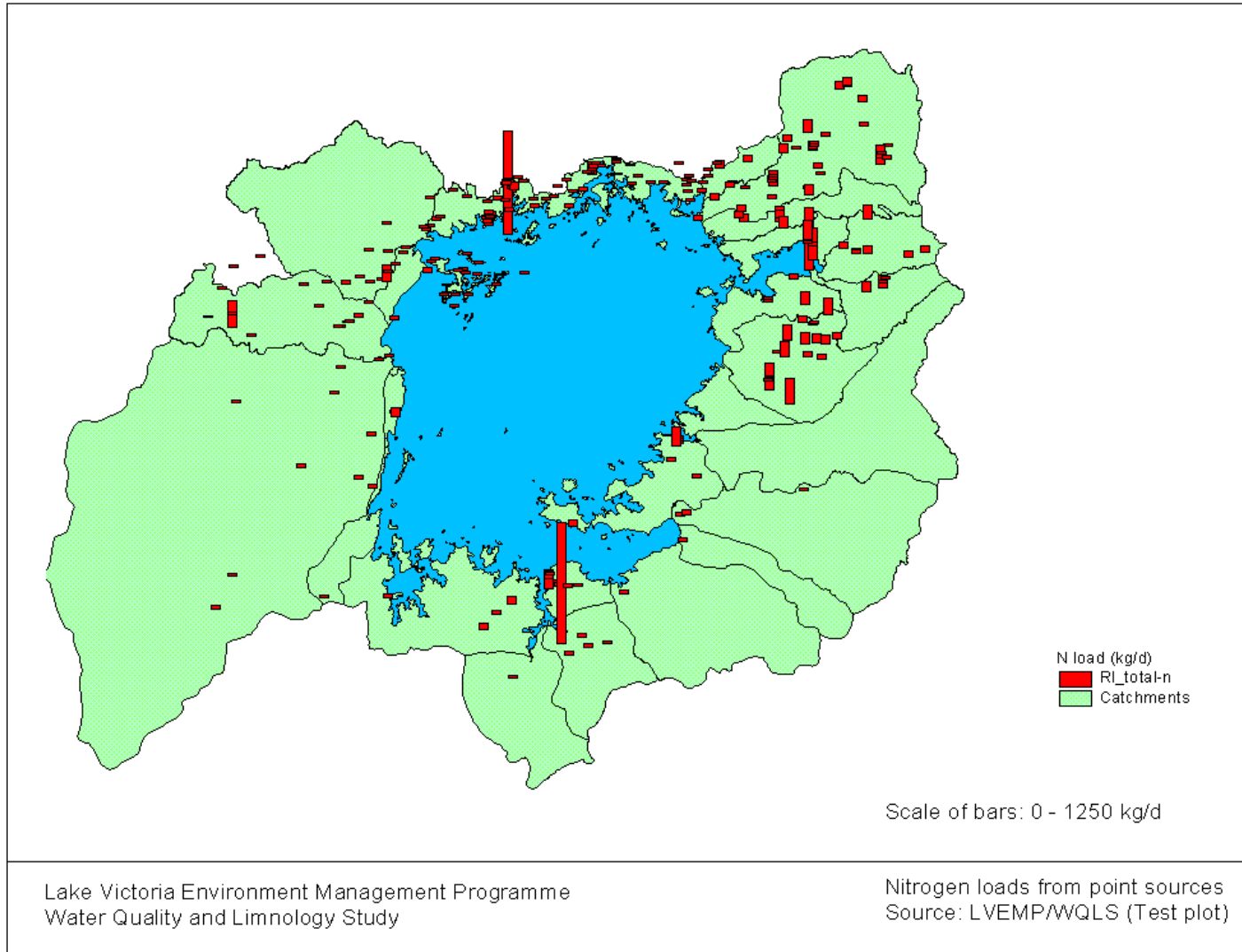


Figure 1.3 Distribution of point sources, Total-nitrogen (kg/day)

1.6 Recommendations

To support a future system for management of the water quality of the lake it is recommended to regularly repeat gross or "rapid" estimations of the urban and industrial pollution. This implies a regional updating of population data, industry data etc. For this purpose, it is recommended to improve on the data collection i.e establish more complete data sets bearing in mind that the "forcing" factors are the urban population, the industrial production and the discharge methods. Moreover, locally established (and verified) estimates of standard figures such as person equivalent loads, reduction efficiency of discharge system, industrial production related load figures etc. would improve the validity of the overall load estimates.

In the "rapid assessment" the determination of the wastewater pollution loads from municipal point sources, i.e. major cities and towns, is based on wastewater production standard figures per person equivalent and assessed reductions via the discharge methods. In order to improve and verify these estimates it is recommended to carry out measurements for some urban areas where it is possible to establish a well-defined relation between number of persons and actual pollution load. It is important to establish a measurement programme with several measurements over a longer period in order to establish well-documented figures. A possibility is to carry out programmes for selected towns located along a relatively small stream in order to determine the net pollution load.

The existing measurements from industrial point sources are often connected with the following errors and mistakes:

- Spots samples that are difficult to relate to the actual production (production of waste often varies considerably with time and all outlets may not always have been identified)
- Only concentrations are measured and not flows, which makes it impossible to establish the actual pollution loads quantitatively
- Analyses of several unimportant parameters
- Obviously wrong values
- Measurements carried out at industries which in reality do not discharge significant amounts of wastewater pollution

Due to the high resources input required for sampling and analyses, it is recommended to consider carefully the need for such studies and e.g. concentrate future measurements of industrial pollution loads on industries with significant wastewater production, sites with significant local problems, or studies necessary to determine production/load factors. For the selected industries overflow

weirs or similar devices should be established in order to determine the wastewater flows. Analyses should be based on flow-proportional samples. Analyses should be limited to a few central and important parameters which are relatively easy to analyse, for instance COD, suspended solids, ammonia, total-nitrogen, and total phosphorus. For specific industries it might, however, be necessary to supplement with additional parameters as pH, relevant heavy metals or specific hazardous chemicals.

Attachment to Chapter 5

Municipal and Industrial Wastewater loads