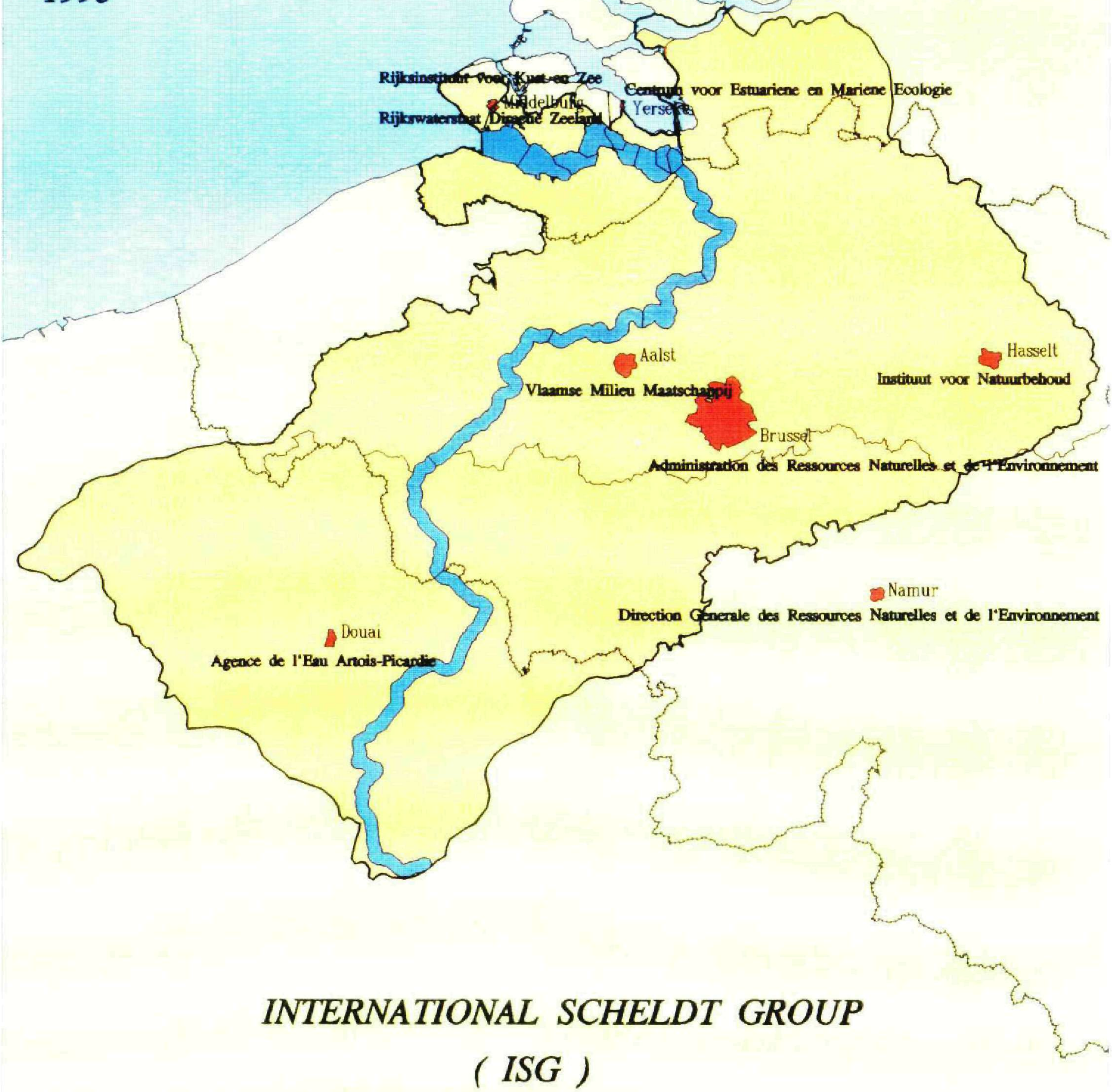
WATER QUALITY MANAGEMENT IN THE SCHELDT BASIN

INTERIM PROGRESS REPORT

1993



INTERNATIONAL SCHELDT GROUP

(ISG)

Water quality management in the Scheldt basin

(Interim progress report 1993)

International Scheldt Group (ISG)
Agence de l'Eau Artois-Picardie Ministère de la Région Wallonne Ministère de la Région de Bruxelles-capitale Vlaamse Milieumaatschappij Instituut voor Natuurbehoud Rijkswaterstaat Directie Zeeland Rijkswaterstaat, Rijksinstituut voor Kust en Zee Centrum voor Mariene en Estuariene Ecologie

Author: Ir. L.L.P.A. Santbergen (Rijkswaterstaat, Directie Zeeland)
GIS-maps: J.P. Vreeke (Rijkswaterstaat, Rijksinstituut voor Kust en Zee)

Citation: International Scheldt Group (ISG). Water quality management in the Scheldt basin (interim progress report 1993). March, 1994. Pages: 129. Report AX/94/013.

Summary

1 Introduction

In October 1991 the Conseil Interparlementaire Consultatif du Benelux/Raadgevende Interparlementaire Beneluxraad published a report on the river Scheldt (water policy, functions and water quality). In 1992 the member countries of the Economic Commission for Europe (ECE) signed the United Nations Helsinki convention on international water management of border crossing river systems. The Scheldt and Meuse riparian states started negotiations on a water treaty in 1993. The water management administrations have initiated the ***International Scheldt Group (ISG)***. This interim progress report is the account of the ISG activities in 1993.

The ISG objectives in 1993 were:

* A joint inventory of available data on water management organization, communal and industrial water pollution, water quality, waste water treatment efforts and investments in the Scheldt basin.
* The setup of an information database and presentation system for the Scheldt basin (Scheldt-GIS).
* The data collection and analysis to make recommendations on the establishment of an integrated management approach in the Scheldt basin.
* To build on the present working relationships between the water management administrations in the Scheldt basin.

The participating water management administrations are:
- Agence de l'Eau Artois-Picardie (North-France)
- Direction Générale des Ressources Naturelles et de l'Environnement (Wallonia)
- Administration des Ressources Naturelles et de l'Environnement (Brussels)
- Vlaamse Milieumaatschappij (Flanders)
- Instituut voor Natuurbehoud (Flanders)
- Rijkswaterstaat, Directie Zeeland (The Netherlands)
- Rijkswaterstaat, Rijksinstituut voor Kust en Zee (The Netherlands)
- Centrum voor Estuariene en Mariene Ecologie (CEMO)

2 Description of the study area

The river Scheldt takes its rise in North-France, nearby Gouy-le-Catelet, just north of Saint-Quentin. The river, which is about 350 km long, flows through France, Wallonia, Flanders and the Netherlands and debouches in the North Sea between Vlissingen and Breskens. Downstream of Gent the estuarine part is situated (length: 160 Km); this part consists of a fresh water, a brackish and a salt water zone.

The Scheldt basin, as studied in this project, has the following borders:
- the North Sea and the river Yser basin in the west;
- the coastal river basins in the southwest;
- the basins of the rivers Meuse and Rhine in the southwest, the east and the north.

The Scheldt and the tributaries are lowland river systems. Characteristics of these river systems are low current velocities and meandering. Water management administrations canalized large parts of the watercourses for shipping purposes and the surface water distribution. More than 250 locks and sluices form artificial junctions between water-courses. The river Scheldt basin includes several canals that flow in or out the basin.
The total surface of the Scheldt basin is 23,000 km^2 divided among France (33%, Wallonia (19%), Brussels (1%), Flanders (63%) and the Netherlands (4%). Eleven millions people live in the basin.
In the Scheldt basin the authorities and water management organizations use several hydrographic and administrative divisions. Within the division in hydrographic subbasins, as used by the Vlaamse Milieumaatschappij, the emphasis lies on the river Scheldt and her main tributaries:

- Haut-Escaut/Boven-Schelde
- Lys/Leie
- Dendre/Dender
- Senne/Zenne
- Dyle/Dijle
- Demer
- Nete
- Boven-Zeeschelde
- Beneden-Zeeschelde
- Kanaal Gent-Terneuzen
- Westerschelde

The authorities and water management organizations also use divisions in administrative area. These areas are:

- the zones E1, E2 and E3 (North-France);
- the Brussels Region (Brussels);
- the intercommunales IPALLE, IDEA and IBW (Wallonia);
- the AWP-II basins (Flanders);
- the waterschappen WS20 till WS25 (The Netherlands).

There is hardly any information available on the water distribution in the Scheldt basin. There is no or little communication between the administrations that collect hydrographic data of the river Scheldt and its tributaries. There are big differences between summer and winter periods. In dry, summer periods surface water of the rivers Lys and Scheldt is diverted to the coastal area since 1971. Consequently, the mean annual flow rates of the

Haut-Escaut and the Lys are lower since then. Approximately 65% of the surface water in the Scheldt basin upstream from Gent is diverted to the North Sea via canals. Fresh water is essential for the "survival" of the Scheldt estuary with the fresh- , brackish and salt intertidal areas. If more fresh water will be diverted, the Scheldt estuary will salt.
The high number of habitants, the high degree of industrialization and the agricultural use of a big part of the area mean a considerable burden to the aquatic ecosystems in the Scheldt basin. The water quality management problems are comparable in the different parts of the Scheldt basin:

* low groundwater and surface water levels
* pollution of ground- and surface water
* insufficient waste water treatment infrastructure
* the management of transboundary watercourses
* sediment contamination

Generally, from source to mouth the emphasis of the problems shifts from the surface water tot the bottom sediment. In the Scheldt estuary the main specific problems are:

* the physical-morphological disturbance because of the dredging activities
* the erosion of tidal flats and shores
* the reduction of the fresh water stream to the estuary

3 Water quality management organization

3.1 France

In France nine ministries carry out different aspects of environmental protection and management. The Ministry of Environmental Affairs coordinates the activities of the different ministries. This ministry has not a large decentralized apparatus. Therefore, it is partly dependant on the civil servants of the other ministries.
The regions, the departments and the municipalities play also roles in the water manage ment organization. Because the responsibilities on water management are divided over many administrations, the coordination of the activities is a complex matter.
The basin approach with the Basin Committees on the one hand (water policy) and the Basin Water Agencies (executive tasks) on the other hand is a good step in the direction of an integrated water management approach. Because all kinds of groups of interests participate in the river basin contracts, these contracts could also be a good basis for an integrated management approach.

The civil servants that are responsible for the environmental permitting, are also responsible for the control tasks. There are too less inspectors to control the discharge permit prescriptions. The administrations involved are responsible for both environmental permitting and the stimulation of the industrial and agricultural development.
The industrial water pollution tax rates are based on discharged amounts which are calculated (production processes).
Compared with the Fifth Action Programme, the Agence de l'Eau Artois-Picardie doubled its budget. Approximately 230 millions ECU's will be invested in the Scheldt basin between 1992 and 1996.

3.2 Brussels

The Administration des Ressources naturelles et de l'Environnement is responsible for the technical and administrative aspects of water management, including environmental permitting and monitoring of surface and groundwater quality. The Brussels Instituut voor Milieubeheer develops the water policiy for the Brussels Region.
Since the 1th of November a new integrated environmental permit system is in force, based on the Flemish VLAREM-regulation.
A tax system for industrial discharges is in force since the end of 1993. Due to the big number of small industries it is impossible for the Brussels water management administration to control these all regularly. The bigger companies have to monitor their own waste water streams: a system of self-control.
Between 1992 and two thousand, 500 millions ECU's will be invested in water quality management. The Brussels Region planned two waste water treatment plants, with a total design-capacity of 1,500,000 habitant-equivalents. This capacity will be sufficient for the communal waste water treatment of the one million habitants in the Brussels Region. The overcapacity will be used for the treatment of industrial waste water (500,000 pollution-equivalents).

3.3 Wallonia

In Wallonia one large ministry integrates different aspects of environmental management, including water quality policy and management. Until 1996 the Direction of Natural Sources and the Environment makes an annual report about the condition of the environment. The 1995 report will describe the water quality, the water management organization and the industrial sectors.
The "Decree concerning the protection of surface water against pollution" gives the regimentation on environmental permitting. This regimentation is based on the European Union guidelines and includes general and sectoral waste water discharge standards. The individual industrial discharge permits do not include technical prescriptions for pollution prevention and waste water treatment. There is no systematic organization of permit
control activities. The start of a new industry requires a discharge permit, including the strongest standards. Due to the bad social-economic circumstances, it is more difficult to change the discharge conditions for existing companies.
The present tax system for the discharges of communal and industrial waste water is based on BOD and COD.

In the period 1992-1996 the Wallonian Region will invest 239 millions ECU's in the building of waste water treatment plants and collector networks in the Scheldt basin.

3.4 Flanders

The Departement voor Leefmilieu en Infrastructuur (Department of Environmental Affairs and Infrastructure) of the Flemish Region, has the administrative and technical responsibility for the water quality management in Flanders. The Vlaamse Milieumaatschappij (VMM) is responsible for the waste water treatment policy in Flanders. AQUAFIN exploits and improves existing waste water treatment plants and collector networks. AQUAFIN also builds and exploits new waste water treatment infrastructure. The principle of the basin committees is a good example of the integrated water management approach.

The environmental permitting in Flanders is mainly based on the "Law on the protection of surface waters against pollution" and the Flemish Environmental Permitting Regimentation (VLAREM). There is an insufficient organization on the environmental permitting and control activities. Since 1991 there is publicity of environmental permits.

In Flanders all waste water discharge categories have to pay a tax. A distinguishment is made between citizens and industries that use small consumption water amounts (less than 500 m^3 a year), and citizens and industries that use large consumption water amounts (more than 500 m^3 a year). The tax rate for the "small users" is based on the measured water consumption. The tax rate for the "large users" is based on the discharged pollution amounts. Therefore, the Vlaamse Milieumaatschappij analyses the industrial waste water streams. In 1991 the VMM analysed the waste water streams of one thousand industries in Flanders. If analysis data are not available, the VMM estimates the number of pollution-equivalents, based on the production processes.

The Flemish Executive invests 1096 millions ECU's in new waste water treatment infrastructure in the period 1991-1999. In the period 1991-1994 the hydrographic subbasins of the Boven-Schelde, Dender, Leie, Nete and Demer have the highest priority.

3.5 The Netherlands

The water management (qualitatively and quantitatively) of the national watercourses like the Westerschelde is the task of the Rijkswaterstaat. The Third National Policies Document on Water Management (NW3; 1989) describes the guidelines of the Dutch water management. The Evaluation Document on Water Management (1993) shows the first results of the NW3, and includes additional measures and financial investments until 1998.

In the Netherlands the water management is based on an integrated approach to establish sustainable functioning water systems in a way that the interests of all the users of the water systems can be respected: today and tomorrow. Therefore, Rijkswaterstaat takes measures on:

* the pollution prevention and reduction
* the sanitation of contaminated sediments
* the management and development of intertidal areas and banks
* the general water systems restoration and the water distribution

One instrument is the ***target group policy***. This means that governmental administrations and industries can draw up convenants and intention declarations to tackle environmental problems by a joint, coordinated approach. Water quality and emission aspects are part of these agreements.
An example of the integrated water system approach is the Policy Document for the Westerschelde (1991). This document includes an integrated water management programme especially for the Westerschelde.
The Law on the Pollution of Surface Waters (WVO; 1970) contains the legislation framework on the environmental permitting. So-called General Governmental Measures (*Algemene Maatregelen van Bestuur; AMvB's) and ministerial regulations work out the* guidelines of this law. The Law Environmental Management (Wet Milieubeheer; 1992) is the new Dutch law that will integrate all environmental laws in future.
The civil servants of Rijkswaterstaat and the Inspectors of Environmental Hygiene and the Environmental Police control the WVO permit prescriptions. There is a WVO contact team that carries out routine control activities and an annual control action. The contact team inventories the number of offenders of the WVO. Between 10 and 20% of the industries offend the WVO.
Each person, organization or industry that discharge waste water to surface water or a sewage system has to pay a tax. The tax rate is based on the amounts of discharged oxygen substances and heavy metals in a management area and the costs that the managers have to make. The tax system includes two principles: "the polluter pays" and the "interest-payment-influence."
In the period 1993-1996 Rijkswaterstaat Division Zeeland will invest 19.8 millions ECU's in the Westerschelde. Until 1998 Rijkswaterstaat will evaluate and improve the financial water management organization in the Netherlands. Therefore in 1990 and 1991 the Research Committee Water Management Finance System (= Committee Zevenbergen) analysed the major bottle-necks and did proposals for the improvement of the financial organization.

4 Scheldt-GIS

In 1993 the National Institute for Coastal and Marine Management of the Dutch Rijkswaterstaat has setup the Scheldt-GIS. ISG uses the Scheldt-GIS as a medium for the data storage, linkage, analysis and presentation. The participants collect the data and decide which questions should be answered by means of the Scheldt-GIS.
The participants also will decide the future objectives and products of the Scheldt-GIS. If

the participants choose one option, the financial consequences have to be discussed. Each administration should think about the advantages of a Scheldt-GIS in relation with its activities and in relation with an integrated water management approach in the river Scheldt basin.

The possible 1994 options are:

1	One administration makes only a database and takes care of the updating of the database. The ISG participants get the database and will make their own products and applications.
2	The Scheldt-GIS is used as a database. The ISG participants define the products like reports, maps and tables. One administration manages the system and delivers the products.
3	The Scheldt-GIS is used as a database. The ISG participants define the products like reports, maps, tables and (pc-)applications. One administration manages the system and delivers the products and applications.
4	The Scheldt-GIS is introduced at the participating administrations. Each administration defines and makes its own products and applications, besides the joint products and applications. One administration takes care of the updating of the databases and the deliverance of joint products and applications.

5 Emissions in the Scheldt basin

5.1 Waste water treatment plants

If the Scheldt riparian states carry out their investments programmes, in 2000 the average available design-capacity in the whole Scheldt basin **could be sufficient** to treat the waste waters of the eleven millions habitants (biodegradable substances). This conclusion can only be drawn if no industries will be connected to the communal waste water treatment plants and if the total treatment infrastructure (including sewage systems and collector networks) will be sufficient. If some industries stay connected to the communal waste water treatment plants, the required design-capacity is much higher.
Until 1991 in all riparian states the emphasis lied on the treatment of biodegradable substances. Between 1992 and 2000 investments will also be made on denitriphication and dephosphatation.

5.1.1 North-France

In the French part of the Scheldt basin (area E1, E2 and E3) there are 136 waste water treatment plants available with a total design-capacity of 3,358,400 habitant-equivalents (situation 1991). This capacity could be sufficient to treat 88% of the communal waste water. Especially in area E3 (la Lys et la Deule) there is a lack of waste water treatment plants. Due to insufficient investments in the collector networks the equipment can not be used completely. As a result in 1990 only 46% of the communal pollution was eliminated.

In the period 1992-1996 the total design-capacity in the French part of the Scheldt basin will increase with approximately 900,000 habitant-equivalents. Until 1991 the emphasis has lied on the treatment of organic and suspended matter. Therefore the majority of the available waste water treatment plants has not the equipment for the elimination of nitrogen and phosphorus. One of the main problems is that some industries are also connected to the communal waste water treatment plants. Accidental discharges and strong fluctuations in the influent can cause damage and disfunctioning of treatment plants.

In the period 1985-1993 the mean treatment percentages for the parameters MO, MA an MeS (treatment plants with a design-capacity > 10,000 habitant-equivalents) were respectively 75%, 40% and 87%.

In the periods 1972-1981 and 1987-1991 the French government made large investments on waste water treatment infrastructure. In the period 1992-1996 the empasis lies on the development and exploitation of sewage systems, the connection of house-holdings to sewage systems, the expansion of the available design-capacity and denitriphication and dephosphatation.

5.1.2 Brussels

At this moment there are no communal waste water treatment plants in the Brussels Region. Therefore the waste waste water of the householdings is not treated, although more than 95% of the habitants have been connected to a sewage system. In 2000 two treatment plants will be operational with a total design-capacity of 1,500,000 habitant-equivalents. This capacity will be sufficient to treat both communal (1,000,000 habitant-equivalents) and industrial (± 500,000 pollution-equivalents) waste water.

5.1.3 Wallonia

In the Wallonian part of the Scheldt basin there are 57 waste water treatment plants available with a total design-capacity of 992,475 habitant-equivalents (situation 1991). This capacity could be sufficient for the treatment of 91.7% of the communal waste water.

In the period 1992-1996 the design-capacity will increase with 661,400 habitant-equivalents. The available design-capcity in 1996 in the area IBW and IDEA could be sufficient for the communal waste water treatment. In the IPALLE area more equipment will be required.

Until 1991 the emphasis has lied on the treatment of biodegradable substances. At none of the operational treatment plants the technical equipment is available for denitriphication and/or dephosphatation. One of the main problems is the connection of industries to communal waste water treatment plants.

In the periods 1972-1976 and 1982-1986 the Wallonian government made large investments in waste water treatment infrastructure. In the period 1992-1996 investments will be made in the building and adaptation of treatment plants and collector networks. A number of small plants will be replaced by bigger ones. At four plants the technical equipment will be installed for the denitriphication and/or dephosphatation.

5.1.4 Flanders

In the Flemish part of the Scheldt basin 87 communal waste water treatment plants are operational with a total design-capacity of 3,222,960 habitant-equivalents (situation 1991). This capacity could be sufficient for 62.6% of the required capacity. At 46 plants industrial waste water is also treated. The mean sewage percentage is 76%. Due to a lack of collector networks only 21% of the communal waste water is treated.
In the period 1991-1994 the design-capacity will increase with 976,635 habitant-equivalents. The availble capacity in 1995 could be sufficient for 81.3% of the required design-capacity. At 12 of the planned treatment plants denitriphication and/or dephosphatation equipment will be installed.
In the period 1989-1991 the mean treatment efficiencies of BOD, COD, NH4+, P-total, Cr, Cu, Pb, Ni, Ag, Zn, Hg and Cd respectively were 85%, 74%, 45%, 48%, 36%, 33%, 46%, 11%, 18%, 45%, 5% and 12%.

5.1.5 The Netherlands

In the Dutch part of the Scheldt basin there are 24 communal waste water treatment plants available with a total design-capacity of 966,600 habitant-equivalents (situation 1991). This capacity is sufficient to treat the waste water of the 598,935 habitant-equivalents. The mean sewage percentage is 93%. The over-capacity is sufficient to treat both communal and industrial waste water. There are no planned treatment plants in the Dutch part of the Scheldt basin.
The mean treatment percentages of the parameters BOD, N-total and P-total (period 1990-1992) of the treatment plants around the Westerschelde were respectively 95-98%, 26-79% and 44-86%.
In the periods 1967-1971 and 1982-1991 large investments were made on the waste water treatment infrastructure. Until 1998 the emphasis lies on the optimalization of the available plants and the denitriphication and dephosphatation activities.

5.2 Industrial emission sources

Within the inventory the emphasis lies on the industries that are responsible for 90% of the emissions in a management area. One of the objectives is to make a distinguishment between industrial and communal discharged amounts. The available information gives only a first, global impression. No information is available on the relations between emissions and water quality.

5.2.1 North-France

In North-France the discharged amounts are calculated, based on production process tables for the different industrial sectors.
The Agence de l'Eau provided data (1990) on the parameters MO (= (COD + 2BOD)/3)

and MA (= *organic nitrogen* + ammonia nitrogen). Respectively 166 and 108 industries cause 90% of the average discharged amounts of MA and MO (108,349 kg/day and 12,245 kg/day). Eighty percent of the amounts is discharged in area E3 (la Lys et la Deule). In this area cities like Tourcoing, Roubaix and Lille are situated.
No information is available on the discharged amounts by treatment plants.

5.2.2 Brussels
No information is available on the of the industrial emissions in the Brussels Region.

5.2.3 Wallonia
The Direction Générale des Ressources Naturelles et de l'Environnement makes an inventory of the main emission sources. This inventory includes the parameters of the black and grey European Union lists. Relations between discharges and water quality will also be studied. The DGRNE asked the industries to make a survey of the historical and present discharge situation. Prognoses until 1996 will be made. No information is available on the discharged amounts by communal waste water treatment plants.

5.2.4 Flanders
In 1991 the Vlaamse Milieumaatschappij started with the emission monitoring programme. At 1,225 of the 4,000 industries the VMM took waste water samples. The monitored parameters are: flow rate, COD, BOD, SM, N-total, P-total, Ag, As, Cd, Cr, Cu, Hg, Ni, Pb and Zn.
The 1991 inventory gives only a first global impression of the discharged amounts.
The VMM will improve the monitoring programme.

5.2.5 The Netherlands
The survey includes industries around the Westerschelde and the Kanaal Gent-Terneuzen that have to report discharge data to Rijkswaterstaat Division Zeeland. The data of these industries are stored in the WIER database. Rijkswaterstaat compares the provided data with the results of its own monitoring activities and makes an annual emission report. The data are used as input for the SAWES model (= System Analysis WESterschelde).
The Volkerak/Zoommeer and its catchment area are also part of the study area. The influence of the Volkerak/Zoommeer catchment area is monitored at the outlet of the Batshe Spuikanaal to the Westerschelde.

6. Water quality monitoring in the Scheldt basin
The basis water quality objectives of Flanders and the Netherlands and the category I objectives of France are the most severe water quality standards in the Scheldt basin. Therefore these will be used to describe the water quality. it should be emphasized that these objectives refer to a **minimum** ecological water quality level (!).
From the parameters which are part of the North Sea Action Programme, only phosphorus and nitrogen are monitored in **all** Scheldt riparian states (!). The parameters which are monitored in all Scheldt riparian states are: PO4-P, P-tot, SM, dissolved oxygen, BOD_5,

NH4-N, Kj-N, NO2-N, NO3-N and conductivity. No information is available about the monitoring programme in the Brussels Region.

In the French part of the Scheldt basin (area E1, E2 and E3) 87 water quality monitoring localities have been selected. Thirteen parameters were monitored regularly (6 or 12 times a year) in 1990 and 1991: pH, conductivity, SM, BOD, COD, dissolved oxygen, oxygen saturation percentage, NH4-N, NO2-N, NO3-N, Kj-N, PO4P and P-tot. Although toxic substances are part of the tax system, heavy metals and organic micropollutants have not been included in the water quality monitoring programme.

In the Wallonian part of the Scheldt basin 26 localities have been selected. The number of monitored parameters per locality depends on the water quality objectives of the monitored watercourse.
Generally the parameters are monitored five times a year. There are three stations at the Wallonian-French border: Haut-Escaut at Bléharies, l'Espierres at Leers-Nord and la Lys at Warneton. At these stations the parameters are monitored twelve times a year.
In la Haine an automatic monitoring station will be operational in 1994 (frequency: once per two months).

ISG selected 82 monitoring localities of the the physical-chemical monitoring programme of the Vlaamse Milieumaatschappij. At the majority of the localities the VMM monitors a set of basic (general) parameters with a frequency of 8-10 times a year: temperature, dissolved oxygen concentration, COD, NH3N, NO2N, NO3N, PO4P, chloride, conductivity, P-total and pH. For a selected number of localities the parameters BOD, Kj-N, sulphates and SM are added. The VMM monitors heavy metals only at localities in the vicinity of industrial discharges and in the vicinity of the country borders. The monitoring programme of the VMM is a relatively new one and still in development.

ISG selected 19 monitoring localities in the Dutch part of the Scheldt basin. The Dutch routine monitoring programme includes the PARCOM parameters. The monitoring frequency is twelve times a year at almost all localities. At the Dutch-Belgian border the monitoring frequency is 24 times a year. In general there is a shift from chemical to biological monitoring. Since January 1993 the activities of the physical-chemical and the biological monitoring programmes are fully integrated.

It would be a good thing to monitor continuously at the Dutch-Belgian border (Schaar van Ouden Doel). At this locality the improvement of the water quality as a result of the investments in waste water treatment infrastructure could possibly be monitored in the forthcoming years.

The average oxygen concentrations in the Lys, the Scheldt (from the French-Wallonian border to the Flemish-Dutch border), the Zenne and the Kanaal Gent-Terneuzen were very low (< 5 mg/l) both in 1990 and 1991. The situation in the Demer was better in 1991: at four localities (from Lessines to just downstream of Aalst) the oxygen concen tration changed from < 5 to > 5 mg/l. River Scheldt tributaries like the Scarpe, the Spiere, the Zwalm, the Dorpsloop, the Rupel, the Barbierbeek and the Grote Schijn have an average oxygen concentration below 5 mg/l.

In general the BOD contents in the Scheldt basin are very high. In the rivers Scheldt (from source to the Flemish-Dutch border), the Lys, the major parts of the Scarpe, the Dender, the Zenne, the Spiere, the Demer, the Dijle and the Nete localities are found where the BOD contents are between the 6 and 500 mg/l.

Except in the Scheldt estuary, almost no efforts are made on the inventory and sanitation of contaminated water bottoms. Prof. dr. Wollast provided information on the use of sediments as monitoring tool for studies of sediments.

7. ISG objectives and activities in 1994

During the last meeting of ISG in 1993 the participants agreed on the 1994 objectives and actions.

The ISG objectives in 1994 are:

1	The collection, analysis, presentation and distribution of information concerning water management, emissions, water quality, sediment quality, water distribution, ecology and investments.
2	The updating and expansion of the Scheldt-GIS: an information databank and presentation system for the Scheldt basin.
3	The collection of information that is needed for the both LIFE projects on the setup of a water management decision supporting system.
4	The advice of policy makers in the river Scheldt riparian states and the European Union. Advice: recommendations on the setup of an international cooperation of water management administrations based on the collected information.

In 1994 ISG will give the highest priority to the following activities:

1	The inventory of communal and industrial emission sources is continued. The inventory is extended with diffuse emission sources and extreme events. The emphasis will lie on the relations between emission sources and water quality. Recommendations will be made on the inventory methods and the analysis of the data.
2	A proposal is made on the setup of a small intercalibration programme and a joint water quality monitoring programme. Similarities and differences in the sampling and analysis methods are summarized. Monitoring localities are seleced and the monitored parameters and freqency are discussed.
3	The effects of investments and measures in the Scheldt basin will be studied more in detail. A comparison of instruments and tax systems wil be made. The environmental efficicency of investments, measures and instruments will be studied.
4	A workgroup of information specialists will inventory the possibilities for the implementation of a Scheldt-GIS at the water management administrations in the Scheldt riparian states. The advantages and disadvantages of the possible future objectives and activities (like the distribution of information) will be discussed.
5	The description of the water quality will be extended with maps of the parameters of the North Sea Actions Programme (1990, 1991 and 1992).
6	A inventory will be made ofthe quality, policy, management and sanitation efforts of contaminated sediments. A list is made of involved administrations and research institutes.
7	A special workgroup will make a Description of the Ecology of the Scheldt basin (DES).

Contents

1. Introduction

1.Introduction

1.1 Background

In October 1991 the Conseil Interparlementaire Consultatif du Benelux/Raadgevende Interparlementaire Beneluxraad has published a report on the river Scheldt. This report contains an evaluation of the water policy, the functions and the water quality.

The three main conclusions of the report are:

1	There is a comprehensive political apparatus of environmental affairs and laws and plans on water management in each of the river Scheldt riparian states. The differences in the organization and functioning of water management are considerable, especially among the Belgian regions (Wallonia, Brussels and Flanders).
2	The water quality of the river Scheldt and the main tributaries is very bad. Although the concentrations of several parameters decreased in the early eighties the water quality did not improve since then.
3	Speaking on ecological terms the river Scheldt is injured heavily. Only some upstream parts of the river and the western part of the estuary contain high ecological values.

One recommendation of the report is the setup of a public information network concerning water management and the effects of human interventions in the Scheldt basin. The first step should be the extension of contacts between Flanders and the Netherlands to France, Wallonia and Brussels. The second step should be the establishment of a connection among the water management organizations in the Scheldt basin, both on administrative and financial terms. Water management organizations should study the possibilities for the setup of an international Scheldt commission.

Since the last twenty years France, Belgium and the Netherlands are discussing the possibilities for international cooperation in cleaning up the rivers and canals in the Scheldt basin. In 1992 member countries of the Economic Commission for Europe (ECE) have signed the Helsinki convention of the United Nations. This treaty is a starting-point for closer contacts between the water management administrations in the Scheldt basin. It could be the basis for the setup of an international Scheldt commission. In 1993 the riparian states have started negotiations over water treaties for the rivers Scheldt and Meuse. Water management administrations have initiated the International Scheldt Group (ISG). This interim progress report is the account of the ISG activities in 1993.

1.2 ISG objectives 1993

The main ISG objectives of 1993 are:

1	A joint inventory of available data on water management organization, communal and industrial water pollution, water quality and waste water treatment efforts and investments in the Scheldt basin.
2	The setup of an information database and presentation system for the Scheldt basin (Scheldt-GIS).
3	The data collection and analysis in order to make recommendations on the establishment of an integrated water management approach in the Scheldt basin.
4	To build on the present working relationships between the water management administrations in the Scheldt basin.

1.3 Participating administrations

The chairman of the project is Prof. Dr. C.H.R. Heip, director of the Centrum voor Mariene en Estuariene Ecologie (CEMO; Centre for Estuarine and Marine Ecology). The CEMO is part of the Nederlands Instituut voor Oecologisch Onderzoek (NIOO; Netherlands Ecological Research Institute). Rijkswaterstaat directie Zeeland (the Division Zeeland of the Netherlands Directorate-General for Transport, Public Works and Water Management) runs the project management. In the first months of the project the Dienst Water (Water Division) of the Belgian federal Instituut voor Hygiëne en Epidemiologie (IHE; Institute of Hygiene and Epidemiology) in Brussels, participated. In 1993 the servants of this division have been divided between the Vlaamse Milieumaatschappij (VMM; Flemish Environmental Agency) and the Ministère de la Région Wallonne/Direction Générale des Ressources naturelles et de l'Environnement (Ministry of the Wallonian Region/Direction of Natural Sources and the Environment). Therefore, the IHE no longer participates. The present participating administrations of the three Scheldt riparian states are:

**** Agence de l'Eau Artois-Picardie (France)***

Based on the Water Act of 1964 France is divided into six hydrographic basins. In each basin there is a Comité de Bassin (Basin Committee) and a Agence de l'Eau de Bassin (Basin Water Agency). The Basin Commitee is responsible for the water policy strategy in the basin and the information of the ministers involved in water management. The Basin Water Agency is responsible for the execution of the water management in the basin. The French part of the Scheldt basin is totally situated in the basin Artois-Picardie. Therfore the Agence de l'Eau Artois-Picardie participates in ISG.

The Agence de l'Eau Artois-Picardie has four departmens:

* Ressources en Eau (Water Sources)
* Interventions Pollution (Pollution Reduction)
* Finances (Finances)
* Secretariat Général (General Secretariat)

The Water Sources Department is responsible for the drinking-water distribution strategy in the basin Artois-Picardie and the protection of water sources. The Pollution Reduction Department is responsible for the technical assistence and financement of investments in "the battle against pollution".

**** Ministère de la Région Wallonne (Wallonia)***

The Executif Régional Wallon (Cabinet of the Wallonian Region) has two large administrations: the Ministère de la Région Wallonne (Ministry of the Wallonian Region) and the Ministère Wallon de l'Equipment et du Transport (Ministry of Equipment and Transport). The Ministère de la Région Wallonne is divided into six general directions. The Direction Générale des Ressources Naturelles et de l'Environnement (the Direction of Natural Sources and the Environment; DGRNE) participates in ISG. The DGRNE has five divisions:

* la Division de la Nature et des Forêts (Nature and Forests Division)
* la Division de la Prévention des Pollutions et de la Gestion du Sous-Sol (Pollution Prevention and Bottom Management)
* la Division des Déchets (Discharges Division)
* la Division de l'Eau (Water Division)
* la Division des Pollutions Industrielles (Industrial Pollution Division)

The tasks of the Water Division are:

- Production, distribution and transport of water and water quality control.
- Waste water treatment and environmental permitting.
- Management of non-shippable watercourses and their banks.
- The establishment and collection of tax rates (industrial and communal waste water discharges).
- Protection and control of phreatic nappes and captures.

Within the Water Division the Surface Water Direction is one of the major departments. This department is responsible for the management of the water quality model PEGASE, the authorisation of waste water discharges, the adjudgement of water quality objectives and the appointment of sensible and vulnerable area (application of EC directive).

The tasks of the Industrial Pollution Division are:

- Monitoring and control of discharges and quality of surface waters, air and bottoms.
- The data management of control activities.
- The management of the service SOS Pollution.

Ministère de la Région de Bruxelles-capitale (Brussels)
The Administration des Ressources naturelles et de l'Environnement (Administration of Natural Sources and the Environment) is responsible for the technical and administrative aspects of water management, including discharge permits and the monitoring of surface and groundwater quality. This administration participates in ISG.

Vlaamse Milieumaatschappij (VMM, Flanders)
The Vlaamse Milieumaatschappij (VMM) participates in ISG. This administration has the following tasks:

* The setup and exploitation of monitoring programmes for industrial and communal discharges, surface water quality and the quality of the air.
* The setup of the General Waste Water Treatment Programmes (= Algemeen Waterzuiverings Programma's; AWP's).
* The setup of the investments programmes on the building and exploitation of waste water treatment works.
* The estimation of the tax rates and the collection of the water pollution taxes.
* The advisement of AMINAL with regards to the application of the Flemish Environmental Permitting Regulation (VLAREM).
* The annual publication of the results of the monitoring programmes.
* The setup of annual load balances per hydrographic subbasin.

Instituut voor Natuurbehoud (IN, Flanders)
The Instituut voor Natuurbehoud (Institute of Nature Conservation) is a scientific institute which carries out research on nature conservation and natural resources management and development, especially in the field of aquatic ecology. It also advises policy-making bodies in Flanders. This institute has two divisions: Landscape Ecology (Landschapsecologie) and Nature Development (Natuurontwikkeling).

The major research activities at the moment are:

- The monthly counting of waterfowl in the Zeeschelde.
- The inventory of breeding birds populations in the Zeeschelde.
- Vegetation monitoring in the Zeeschelde.
- Interpretation of ecological changes in the vegetation development.
- The modelling of the realations between hydrodynamic processes and vegetation development.
- The inventory of invertebrates in the Scheldt estuary.
- The study of eco-toxicologic effects of pollutants.

The IN participates in several Scheldt estuary management projects (OOSTWEST; ISG; Technical Scheldt Commission and so on) and gives advisement and education. The IN will setup the Description of the Ecology of the Scheldt basin (DES), a second ISG-project.

*** *Rijkswaterstaat, Division Zeeland (RWS-ZLD; the Netherlands)***
The Ministerie van Verkeer en Waterstaat (Ministry of Transport, Public Works and Water Management), just like any other Dutch ministry, has a minister and a secretary-general. The secretary-general is the chief-director of several directorates, services, directorate-generals and institutes. One directorate-general is the Rijkswaterstaat. The president of the Rijkswaterstaat is the directeur-generaal (director-general). The Rijkswaterstaat has eleven regional divisions, one for each province and one for the North-Sea. The Rijkswaterstaat also has six specialized services.
The Divison Zeeland manages the Westerschelde. Therefore the Afdeling Integraal Waterbeheer en Planvorming (AXW; Integrated Water Management and Planning Department) of this division participates in ISG.

*** *Rijkswaterstaat, Rijksinstituut voor Kust en Zee (RWS-RIKZ; the Netherlands)***
Two of the specialized services of Rijkswaterstaat are the RIZA and the RIKZ. The Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling (Institute for Inland Water Management and Waste Water Treatment; RIZA) is involved with the freshwater ecosystems and the waste water treatment technology.
The Rijksinstituut voor Kust en Zee (National Institute for Coastal and Marine Management; RIKZ) is responsible for the supplying of scientific knowledge and advisement in relation to a sustainable use of estuaries, coastal and marine ecosystems (1) and the protection against overflows by the North Sea (2). This institute develops and manages the transfer of know-how from scientific institutes to water management administrations. It organizes information systems and the water management data infrastructure. The knowledge is also available for other Dutch ministries. RIKZ is responsible for the setup of the Scheldt-GIS in the ISG project.

The appendix 1.1 is a list of addresses of the ISG participants and persons involved with the interim progress report 1993.

1.4 Reader

The chapter 2 gives a description of the study area including the river Scheldt, the main tributaries and canals. The paragraph 2.1 shows an overall description of the Scheldt basin (topography, hydrographic subbasins, administrative areas, population densities). The paragraph 2.2 contains an detailed overview of the hydrographic subbasins and the administrative area. The overview includes lists of tributaries and canals that debouch into these rivers. The paragraph 2.3 gives a list of the in- and outcoming canals in the Scheldt basin. The paragraph 2.4 describes the available information on water distribution.
The main water management problems in the Scheldt basin are described in the paragraph 2.5.
In the chapter three the water quality management organization, the environmental permitting the environmental tax systems and the investments in the period 1992-2000 of North-France, Wallonia, Brussels, Flanders and the Netherlands are compared and discussed.
The chapter 4 explains the Scheldt-GIS, a Geographical Information System (GIS), which is setup covering the whole Scheldt basin. The chapter gives the objectives and future possibilities.
The chapter 5 shows a first global inventory of communal and industrial emission sources. The emphasis lies on the waste water treatment infrastructure in the river Scheldt riparian states.
The chapter 6 compares the setup and the results of the water quality monitoring programmes. A start is made with the description of the water quality (O2 and BOD in 1990 and 1991).
In the chapter 7 the conclusions of the first project year are given and discussed. This chapter shows the 1994 objectives and activities.

2. Description of the study area

2. Description of the study area

2.1 The Scheldt basin

In fact there are five small sources of the river Scheldt. These sources flow together at the Mont Saint-Martin nearby Gouy-le-Catelet, just north of Saint-Quentin. The Mont Saint-Martin is part of the so-called "ridge of Artesia" (± 120 meters above sea-level). The ridge of Artesia is a geological formation which mainly consist of lime-stone rock. Infiltrating rain-water forms groundwater sources from which several brook sources spring.
At the source of the river Scheldt visiters can read the following poem:

Revivat Scaldis	*Revivat Scaldis*
Schelde,	Escaut, source limpide et critalline,
Kristalheldere bron.	Bénie dans ton destin.
Gezegend in uw bestemming,	Jaillisant d'une terre sainte.
Opborrelend uit een heilige grond.	Tu irrigues et enrichis la noble Belgique,
Bevloeit en verrijkt gij edele België.	Et embrassant nombre villes renommées.
En kussende vele en beroemde steden.	Tu entres à grandes enjambées.
Treedt gij met grootse tred.	Dans le domaine des nymphes.
In het rijk der waternimfen.	

The river, which is about 350 km long, flows through France, Wallonia, Flanders and the Netherlands and debouches in the North Sea between Vlissingen and Breskens. The fall between the source and the mouth is only 100 meters.
The Scheldt and her tributaries are lowland river systems. Characteristics of these river systems are low current velocities and meandering. Large parts of the watercourses have been canalized for shipping purposes and the distribution of surface water. More than 250 locks and sluices form artificial junctions between watercourses. Upstream from Gent 138 km of the river Scheldt has been canalized: 60 km of the French part, 78 km of the Belgian part.
The estuarine part, where either the river as the tidal influence is present, lies downstream of Gent. Over a length of 160 km this part of the Scheldt consists of a fresh water zone, a brackish water zone and a salt water zone. The Westerschelde is the part of the estuary between the Belgian-Dutch border and the mouth between Vlissingen and Breskens.
The figure 2.1 is a topographic map map of the Scheldt basin. It shows the river Scheldt, the tributaries and the main in- and outcoming canals.

The Scheldt basin, as studied in this project, is bordered as follows:
- in the west by the North-Sea and the catchment area of the river Yser;
- in the southwest by coastal river catchment area;
- in the southeast, the east and the north by the catchment area of the rivers Meuse and Rhine.

2.2 Hydrographic subbasins in the Scheldt basin
The authorities and water management administrations use several divisions of the Scheldt basin. Within the division in hydrographic subbasins, as made by the Vlaamse Milieu-maatschappij, the emphasis lies on the river Scheldt and her main tributaries. The hydrographic subbasins are:

- Haut-Escaut/Boven-Schelde;
- Lys/Leie;
- Dendre/Dender;
- Senne/Zenne;
- Dyle/Dijle;
- Demer;
- Nete;
- Boven-Zeeschelde;
- Beneden-Zeeschelde;
- Kanaal Gent-Terneuzen;
- Westerschelde.

The figure 2.2 is a map of the hydrographic subbasins in the Scheldt basin.
Authorities and water management administrations also use divisions in administrative areas. These areas are:

- North-France: the zones (les secteurs) E1, E2 and E3;
- The Brussels Region;
- Wallonia: the management area of the intercommunales IPALLE, IBW and IDEA;
- Flanders: the AWP-II basins;
- The Netherlands: the management area of the waterschappen.

The figure 2.3 is a map of the administrative area in the Scheldt basin.

The appendix 2.1 shows the surfaces of the hydrographic subbasins and the numbers of habitants in the Scheldt basin. The total surface of the Scheldt basin is 23,000 km^2. The Scheldt basin lies in France (33%), Belgium (63%) and the Netherlands (4%). In Belgium 43% out of the 63% lies in Flanders, 19% in Wallonia and 1% in Brussels. Eleven million people live in the catchment area. The appendix 2.2 gives the population densities in the administrative area of the Scheldt basin. The figure 2.4 is a map which shows the population densities in the administrative area.

2.2.1 Haut-Escaut/Boven-Schelde

The surface of the Upper-Scheldt subbasin is 6,088 km^2, divided among France (65%), Wallonia (25%) and Flanders (10%). This subbasin includes six administrative area:

E1 and E2	Haut-escaut and Scarpe
parts of IPALLE and IDEA	Haut-Escaut and Haine
AWP-II basin 22	Boven-Schelde
AWP-II basin 23	Zwalm

In the subbasin 1,906,193 habitants live. The table A of appendix 2.3 gives the tributaries/canals that debouche in the Upper-Scheldt. Although the tributaries le Rhieu de l'Haie and la Rhosnes debouche in the Upper-Scheldt in Flanders, the major parts of these watercourses lie in Wallonia. The main transboundary tributaries in this subbasin are la Haine and l'Espierre.

Big cities in this subbasin are Cambrai, Denain, Valenciennes, Arras and Douai (France), Mons and La Louvrière, Tournai and Mouscron (Wallonia), Oudenaarde (Flanders).

Due to canalization activities the connections of many meanders to the Upper Scheldt have been broken. Most of these old meanders are used as fish pounds.

TRANSBOUNDARY TRIBUTARIES: *LA HAINE* AND *L'ESPIERRE*

La Haine

The source of the river Haine lies in the management area of the intercommunale IDEA (Wallonia). The Nouvelle Haine, a canal, lies next to the river Haine and transports waste water from industrial area like Tertre and Ghlin-Badour. The Haine and the Nouvelle Haine debouche in the Haut-Escaut via le Canal du Mons.

The Haine subbasin includes cities like La Louvrière, Mons and St. Ghislain. Two hundred thousends inhabitants live in the Haine subbasin. The Canal Mons-Condé connects the Haine, via the Canal Péronnes and the Canal du Centre, to respectively the Dender subbasin and the Senne subbasin. The tributaries of the river Haine are, from source to mouth: *le Rieu de la Princesse, le Rieu des Estinnes, la Trouille* and *l'Anneau.*

L'Espierre

The source of the Spiere lies in North-France. Roubaix, Tourcoing and Lille form one industrial agglomeration; the waste water of this area is discharged to the Spiere. The Spiere is a small river (mean flow rate of 1-2 m^3/s). The waste water of Mouscron is also discharged to the Spiere. South of the Spiere the Canal de Roubaix is situated; the flow rate of this canal is very low. The Flemish part of the Canal de Roubaix is named as Spierekanaal.

2.2.2 Lys/Leie

The surface of this subbasin contains 4,305 km², divided among North-France (70%), Wallonia (1%) and Flanders (29%).

This subbasin includes five administrative area:

E3	la Lys et la Deule
a part of IPALLE	la Lys
AWP-II basin 10	Kluizen
AWP-II basin 16	Leie tot Afleidingskannaal
AWP-II basin 17	Leie/Afleidingskanaal/Ringvaart

In the subbasin 3,211,183 habitants live. The river head of the Lys is situated in Lisbourg (North-France) at a height of 100 m. The river follows her natural course until Aire-sur-la-Lys. Downstream this city the Lys is fully canalized. From Armentières to Wervik the Lys is the border between France and Belgium (over a length of 15 km). From Wervik to Gent the Lys flows through Flanders. A considerable part of the water of the Lys is diverted to the North Sea (le Canal Valenciennes-Dunkirk, Afleidingskanaal van de Leie naar Zeebrugge, Kanaal Gent-Oostende) and the Kanaal Gent-Terneuzen. In Gent the Ringvaart connects the canals and the Lys with eachother and the river Scheldt. The length of the Lys is 192 km; 84 km is situated in North-France, 108 km in Flanders. In the table B of appendix 2.3 the tributaries/canals that debouche in the river Lys are summarized.
Big cities in this basin are Lens, Béthune, Lille, Roubaix, Tourcoing, Hazebrouck, Kortrijk and Roeselare.

2.2.3 Dendre/Dender

The surface of this subbasin is 1,386 km², divided between Wallonia (49%) and Flanders (51%). This subbasin includes three administrative basins:

a part of IPALLE	Dender
AWP-II basin	Dender
AWP-II basin	Mark

The Dender is situated in the provinces of Henegouwen, East-Flanders and Brabant. In the Dender subbasin 443,996 habitants live.
The sources of la Dendre orientale and la Dendre occidentale lie in the Wallonian part of this subbasin. In Ath both rivers come together and flow further as the river Dender.

Besides the mouth of the Dender there is the Nieuwe Dender that debouches also in the Scheldt. In the table C of appendix 2.3 the tributaries/canals that debouche in the river Dender are summarized.
The source and the mouth of la Marcq (Mark) lie in Wallonia; the major parts of this watercourse lie in the Flemish Region.
Big cities in this subbasin are Ath, Lessines, Geraardsbergen, Ninove, Aalst and Dendermonde.

2.2.4 Senne/Zenne
The surface of this subbasin is 1,171 km^2, divided among Wallonia (49%), Brussels (14%) and Flanders (37%). This subbasin includes three administrative areas:

a part of IBW	la Senne
the Brussels Region	la Senne
AWP-II basin 30	la Senne

In the Zenne subbasin 1,512,402 habitants live. The Zenne starts in Wallonia, flows through the Brussels Region and debouches into the Dijle in the Flemish Region. The table D of appendix 2.3 shows the tributaries that debouche in the Zenne. La Hain, la Thines and la Samme debouche into la Senette before this river flows into the Zenne. Big cities in this basin are Soignies, Halle, the agglomeration Brussel and Mechelen.

2.2.5 Dyle/Dijle
The surface of this subbasin contains 1,265 km^2, divided between Wallonia (47%) and Flanders (53%). This subbasin includes three administrative area:

a part of IBW	la Dyle
AWP-II basin 31	Boven-Dijle
AWP-II basin 32	Beneden-Dijle

In the Dijle subbasin 502,435 habitants live. The source of the Dijle is situated in Houtain-Le-Val (in the Wallonian part of the province Brabant) at a height of 145 m above sea-level. The Dijle debouches into the Rupel in Flanders after collecting the water of the Demer and the Zenne. The length of the river is 90 km. The table E of appendix 2.3 gives the tributaries/canals that debouche in the Dijle.

2.2.6 Demer

The surface of this subbasin is 2,188 km^2, divided between Wallonia (17%) and Flanders (83%). The subbasin includes in five administrative basins:

a part of IBW	La Gette
AWP-II basin 26	Boven-Demer
AWP-II basin 27	Gete
AWP-II basin 28	Velp
AWP-II basin 29	Beneden-Demer

In the subbasin 712,655 habitants live. The Demer starts in Flanders (Tongeren) and debouches into the Dijle at Rotselaar. The total length of the Demer is 80 km. The fall between source and mouth is 30 m. The Demer and her tributaries lie in two provinces, the central and southern part of the Limburg and the eastern part of Brabant.
La Petite Gette and la Grande Gette start in Wallonia and come together in Flanders in the municipality of Zoutleeuw. The Gete collects water from the Velpe before debouching into the Demer. The Demer is a "rainriver" more than it is a "sourceriver". Due to the irregular flow rates the Demer is not very suitable for shipping. Big cities in this subbasin are Hasselt, Aarschot and Tongeren.
The table F of appendix 2.3 shows the tributaries/canals that debouche in the Demer.

2.2.7 Nete

The surface of this basin is 1,560 km^2, totally situated in Flanders. The subbasin includes two administrative area:

AWP-II basin 24	Kleine Nete
AWP-II basin 25	Grote Nete

In the Nete subbasin live 534,000 habitants. The source of the Kleine Nete lies in the municipality Mol, at the south-west side of the Kempense hills at a height of 25 meter. The hills form the natural border between basins of the Kleine Nete and the Grote Nete. The length of the Kleine Nete is 50.25 km.
The source of the Grote Nete is situated on the south-west side of the Kempense hills. Downstream of Berlaar the tidal influence is present. In Lier the Grote Nete and the Kleine Nete come together in the Beneden Nete. The Beneden Nete is the connection between the Grote Nete and the Kleine Nete and the Rupel. The Beneden Nete has a length of 13 km. The table G of appendix 2.3 gives the tributaries/canals that debouche in the Grote Nete and the Kleine Nete.

2.2.8 Boven-Zeeschelde
The surface of this subbasin is 1,007 km^2, totally situated in Flanders (between Gent and Rupelmonde). This subbasin includes seven administrative basins:

AWP-II basin 20	Boven-Zeeschelde/linkeroever
AWP-II basin 21	Boven-Zeeschelde/rechteroever
AWP-II basin 33	Vliet
AWP-II basin 34	Zeeschelde/middendeel/rechteroever
AWP-II basin 35	Rupel
AWP-II basin 36	Zeeschelde/middendeel/linkeroever
AWP-II basin 41	Durme

In the subbasin 475,000 habitants live. The table H of appendix 2.3 gives the tributaries/canals that debouche into the Upper Sea-Scheldt.

2.2.9 Beneden-Zeeschelde
This subbasin includes six administrative basins:

AWP-II basin 9	Polder ten noorden van de Moervaart
AWP-II basin 37	Beneden-Zeeschelde/linkeroever
AWP-II basin 38	Schijn
AWP-II basin 39	Barbierbeek
AWP-II basin 40	Polder ten noorden van de Barbierbeek
AWP-II basin 45	Mark en Kleine Aa

In this subbasin 878,300 habitants live. The table I of appendix 2.3 gives the tributaries/canals that debouche in the Beneden Zeeschelde.

2.2.10 Kanaal Gent-Terneuzen

This subbasin includes three administrative area:

AWP-II basin 8	Polder ten noorden van de Moervaart
AWP-II basin 12	Kanaal Gent-Terneuzen/exclusief kluizen
WS23	Waterschap De Drie Ambachten

The table J of appendix 2.3 gives the tributaries that debouche in the Kanaal Gent-Terneuzen.

2.2.11 Westerschelde subbasin

The surface of this subbasin is 2,871 km^2. The subbasin includes five administrative area, all in the Netherlands:

WS20	Waterschap Noord- en Zuid-Beveland
WS21	Waterschap Walcheren
WS22	Waterschap Het Vrije van Sluis
WS24	Waterschap 't Hulster Ambacht
WS25	Hoogheemraadschap West-Brabant

The Hoogheemraadschap West-Brabant includes several waterschappen. In this subbasin 428,235 habitants live. The table K of appendix 2.3 gives the canals that debouce in the Westerschelde.

2.3 Canals in the Scheldt basin

The appendix 2.4 gives an overview of the canals in the Scheldt basin. The canals that flow in the Scheldt basin are:

- Canal du Centre;
- Albertkanaal;
- Schelde-Rijn verbinding;
- Bathse Spuikanaal;
- Kanaal door Zuid-Beveland.

The canals that flow out the Scheldt basin are:

- Canal de St. Quentin;
- Canal du nord;
- Canal de Neuffossé;
- Kanaal Gent-Oostende;
- Afleidingskanaal van de Leie;

The Canal à Grand Gabarit connects the basins of the Haut-Escaut, the Lys, the Deule, the Scarpe and the Aa. The canals that are part of these canal network are:

- Canal de la Sensée;
- Canal de la Deule;
- Canal d'Aire;
- Canal de Neuffossé .

2.4 Water distribution in the Scheldt basin

The administrations which collect hydrographic data of the river Scheldt and her tributaries are:

- Central Hydrological Service (*Service Hydrologique Centralisateur; SHC*). This service monitors flow rates under the responsibility of the Regional Navigation Division (*Direction Régionale de la Navigation*).

- The Departemental Institute of Hygiène (*Provinciaal Instituut voor Hygiëne; PIH*).

- The Marine Navigation Service of Antwerp (*Antwerpse Zeediensten; AZ*).

There is no or little communication between these administrations about the monitoring activities and the used methods concerning flow rates. The appendix 2.5 gives an overview of the flow rates monitoring localities in the Scheldt basin in the period 1950-1992.
The fow rates of the watercourses in the French part of the Scheldt basin are not wellknown. In 1990 the SHC has started a study on the hydrographic situation of the French watercourses. The SHC also studies the effects of the Canal à Grand Gabarit.
In dry, summer periods surface water of the rivers Lys and Scheldt is diverted to the coastal area since 1971. Consequently the mean annual flow rates of the Upper-Scheldt and the Lys are lower since 1971. Compared to the period 1961-1970, the mean annual flow rate of the Upper-Scheldt at Condé in the period 1971-1980 decreased with 30%. In 1989 (extreme dry year) the mean annual flow rate of the Upper-Scheldt at Condé was extremely low (5.7 m^3/s).

As a result of the surface water divertation in summer periods, the mean annual flow rate in the Sea-Scheldt at Merelbeke fluctuated heavily between 1972 and 1986. River Scheldt water is also used to feed canals like the Kanaal Kortrijk-Bossuit and the Canal Péronnes. Downstream of Schelle water of the rivers Rhine and Meuse reaches the Sea-Scheldt via the Albertkanaal.
In the period 1949-1960 the Dender received rain water (91.5%) and sourcewater (8.5%). The flow rate of the Dender strongly depends on the atmospheric deposition and the groundwaterlevel. Water of the river Maas reaches the Demer via the Albertkanaal.
The water of the Zenne derives from natural sources (rainwater, groundwater, sources), waste water sources (industrial and communal) and canalwater.
In Charleroi the river Sambre feeds the Canal Charleroi-Bruxelles-Willebroek. Upstream of the Brussels agglomeration water from the Zenne is diverted to the Canal Charleroi-Bruxelles. Downstream of the Brussels agglomeration water from the Willebroekkanaal is diverted to the Zenne.
Real sources are lacking in the Kleine Nete subbasin and the Grote Nete subbasin. The watercourses receive most of their water from groundwater layers. The fluctuations in the groundwaterlevel (low in dry periods, high in moisty periods) cause large fluctuations of the flow rate of the Grote Nete. Especially the upper part of the river and the smaller brooks dry up in extremely dry summer seasons.
The figure 2.5 shows the flow rates in the river Scheldt in the period 1961-1990. As the figure shows the mean flow rate of the Rupel is bigger than the mean flow rate of the river Scheldt upstream from Rupelmonde, although the surface of the Scheldt catchment area upstream of Rupelmonde is twice as large as the surface of the Rupel catchment area. This is the consequence of the divertation of Scheldt and Lys water by canals to the North Sea: $\pm$ 65% of the Scheldt catchment area water upstream of Ghent (!). It should be emphasized that fresh water is essential for the "survival" of the Scheldt-estuary with her fresh water intertidal area. If more fresh water will be diverted, the Scheldt-estuary will salt.

2.5 Water management problems in the Scheldt basin

The high number of habitants, the high degree of industrialisation and the agricultural use of a big part of the area mean a considerable burden to the river ecosystem.

In the French part of the Scheldt basin the main problems are:

- low surface water levels (especially in Lys and Haut-Escaut) in dry, summer periods;
- low groundwater levels;
- pollution of ground- and surfacewater;
- insufficient waste water treatment infrastructure;
- management of transboundary watercourses (Haine, Spierre).

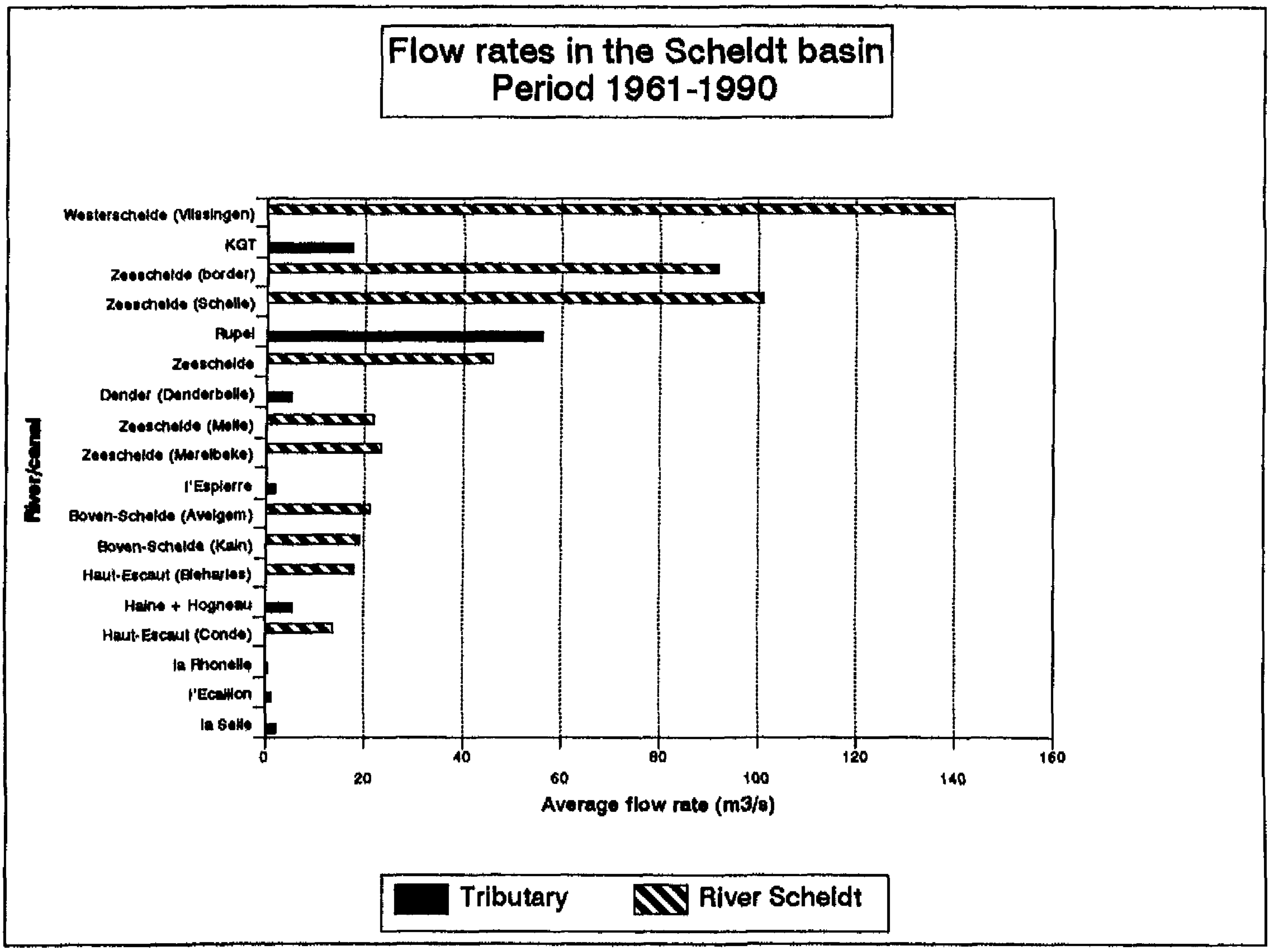


Figure 2.5 Flow rates in the Scheldt basin in the period 1961-1990.

In the Brussels Region the main problems are:
- pollution of surface water (especially the Senne);
- insufficient waste water treatment infrastructure;
- management of transboundary watercourses (Senne).

The main problems in Wallonia are:
- pollution of surface water;
- insufficient waste water treatment infrastructure;
- management of transboundary watercourses (Haine, Senne, Dyle, Demer).

The main problems in Flanders are:
- pollution of surface water;
- insufficient waste water treatment infrastructure;
- lack of knowledge (flow rates, relations between discharges and water quality, small watercourses);
- pollution of the harbour of Antwerpen;
- management of transboundary watercourses (Zenne, Zwarte Spierebeek, Kanaal Gent-Terneuzen, Dender en Dijle).

The main problems in the Netherlands are:
- transboundary water pollution (Schelde, Kanaal Gent-Terneuzen)
- sediment contamination;
- physical-morphologic disturbance (dredging activities);
- diminishment of fresh water stream to the estuary;
- erosion of tidal flats and shores.

Generally, from source to mouth the emphasis of the problems shifts from the surface water to the bottom sediment.

3. Water quality management organization

3. Water quality management organization

3.1 North-France

3.1.1 Organization

The Water Act of 1964 (Loi no. 64-1245 du 16 décembre 1964, rélative au régime et la répartition des eaux et à la lutte contre leur pollution) is the main basis of the water quality management organization in France. This act describes the organization and the competencies of the water management administrations (water quality and water quantity). The main objective is the pollution reduction of the French surface waters. The water quality objectives of the European Union have to be met.

According to this act the government has the following competencies:

The prohibition of waste water discharges (including poluting substances) by means of environmental permitting.
The adjudgement of water quality objectives to surface waters.
The setup of a tax system for extractions and pollution of ground- and surface water.
The regulation of the selling and distribution of products that can cause water and/or groundwater pollution.

The act also gives regulations on:
- the building and exploitation of locks and sluices;
- the division of watercourses in navigable and non-navigable, public and private;
- the appointment of investigation servants;
- the surface and groundwater extractions.

The other laws on which the water quality management is based are:

- Loi d'Orientation foncière (1967);
- Décret sur les rejets et déversements (1973);
- Loi relative à la récupération et à l'élimination des déchets (1975);
- Loi sur la protection de la nature (1976);
- Loi sur les installations classées (1976);
- Loi rélative à la décentralisation (1982);
- Loi sur la pêche (1984);
- Circulaires sur les contrats de rivière (1981; 1985).

The governmental organization includes six levels: the National Government (l'Etat), the Regions (les Régiones), the Departments (les Départements), the Districts (les Arrondissements), the Cantons (les Cantons) and the Municipals (les Communes). The districts and and the cantons have no water quality management competences.
Each ministry has a large network of civil servants at its disposal, spread over the whole country and divided among directions and services. The Ministry of Environmental Affairs (**le Ministère de l'Environnement**) collects data on the condition of the environment and carries out the legislation on the protection of the environment. This ministry has only a small number of civil servants. Civil servants of nine other ministries, that are also involved in water quality management work partially for this ministry. There is an Interministrial Water Mission (**Mission Interministérielle de l'Eau**) for the coordination of the measures taken by the different ministries and the development of the water policies. The Ministry of Environmental Affairs takes care of the secretariat of this mission.

Within the Ministry of Environmental Affairs, the Water and Pollution Prevention Direction (le Direction de l'Eau et de la Prévention des Pollutions) is responsible for the water quality management. This direction includes the Water Service (Service de l'Eau) and the Industrial Service (Service de l'Environnement Industriel). The Water Service manages the water quality knowledge. It advises the Interministrial Water Mission and coordinates the activities of the Basin Water Agencies (which will be discussed further on). The Industrial Service coordinates the activities related to the Environmental Permitting Act (see paragraph 3.1.2).
Finally there is a National Water Committee (**Comité National de l'Eau**) in which proportional delegations of users, departments, municipalities and the national government participate. This committee takes the most important decisions on water policy and advises national and regional governments.

Besides the deconcentrated national government the regions, the departments and the municipalities play roles in the water quality management organization. The Regional Parliament (**Conseil Régional**) develops the regional policies, including water management. The Regional Parliament supports river basin contract projects and can adjust regional nature areas like the "Parc Naturel Régional de la Plaine de la Scarpe et de l'Escaut".
The Departemental Parliament (**Conseil Général**) gives advise and/or money for water quality management projects. One of the priorities is the building of sewage systems in rural areas. This parliament also determines water quality objectives. The municipalities are responsible for the building and exploitation of the sewage systems and the management of non-navigable watercourses.
The regional prefect (Préfet de Région) and the departemental prefect (Préfet de Département) represent the national government respectively in the regions and departments. The regional prefet is chairman of the Technical Water Commission (Comité technique de l'Eau). The departemental prefect is responsible for the police-tasks related

to water management and several outdoor services of the national government. Both the regions and the departments participate in the river basin contracts.

The main important outdoor services of the region (responsible for operational aspects of water management) are:
- Regional water management service (Service Régional de l'Aménagement des Eaux; SRAE);
- Regional delegation on architecture and the environment (Délégation Régionale à l'Architecture et à l'Environnement; DRAE);
- Regional equipment direction (Direction Régionale de l'Equipment; DRE);
- Regional direction of hygiene and social affairs (Direction Régionale des Affaires Sanitaires et Sociales; DRASS);
- Regional direction of industry and research (Direction Régionale de l'Industrie et de la Recherge; DRIR).

Based on the Water Act of 1964 France is divided into six hydrographic basins. In each basin there is a Basin Committee (**Comité de Bassin**) and a Basin Water Agency (**Agence de l'Eau de Bassin**). The Basin Committees are responsible for the water policy strategy in the basin and the information to the ministers involved in water management. The Basin Water Agencies are responsible for the water quality management execution in the basin. It is a financial autonomous administration. The Agencies invest their receipts totally in water quality management. The committee boards of the Agencies include representatives of the central government, local authorities and users of water supplies. The Ministry of Environmental Affairs controlls functioning of the Agencies. In each basin there is a representative of this ministry (Déléque de Bassin).
The French part of the Scheldt basin lies totally in the basin Artois-Picardie. Therefore the Basin Water Agency Artois-Picardie participates in ISG. The Sixth Action Programme 1992-1996 (**le Sixième Programme d'Interventions 1992-1996**) gives the objectives and activities of this agency.

3.1.2 Environmental permitting

The Water Act and the Environmental Permitting Act of 1976 (Loi no. 76-663 du 19 juillet 1976, Rélative aux installations classées pour la protection de l'environnement) contain the waste water discharges permits regulation. The table 3.1 shows a comparison of this two acts.

Table 3.1 Water Act and Environmental Permitting Act.

Water Act	Environmental Permitting Act
1964	1976
Communal waste water discharges require a permit.	Industrial waste water discharges require an integrated environmental permit.
Division in small and big communal waste water discharges (for small discharges there is no permit required).	Division into "installations classées" (license required) and "installations à déclaration" (mentioning duty).
Criteria for permit issuing and control.	-
Discharge permit prescriptions are based on the water quality objectivess of the receiving watercourses.	Discharge permit prescriptions are based on the water quality objectives of the receiving watercourses.
Envrionmental permitting by the departemental prefect. Preparation by the "*Direction Départementale de l'Agriculture (DDA)*" of the Ministry of Agriculture and the "*Direction Départementale de l'Equipment et du Logement (DDE)*" of the Ministry of Transport.	Environmental permitting by the departemental prefect. Preparation by the "*Inspection des Installations Classées (IIC)*", part of the regional "*Direction de la Recherge, de l'Industrie et de l'Environnement (DRIRE)*" of the Ministry of Industry.
Environmental permit control by DDA and DDE.	Environmental permit control by IIC: 300 inspectors. System of selfcontrol: industries monitor their own waste water. Incidentally the inspectors monitor the industrial waste water to check the provided figures.
Publicity of permits, permit prescriptions and analysis figures.	Publicity of permits, permit prescriptions and analysis figures.

The outdoor control of watercourses (water police) is the task of several outdoor services that are under the jurisdiction of different ministries:

- Marine Service (Service Maritime; SM): river mouths (national watercourses);
- Service of navigable watercourses (Service des Voies Navigables): navigable, national watercourses;
- Direction Départementale de l'Equipment (DDE): non-navigable, national waters and regional waters in urban areas;
- Direction Départementale de l'Agriculture et de la Forêt (DDAF): regional watercourses in rural areas.

3.1.3 Environmental tax system

In the basin Artois-Picardie there are taxes on:

* The extraction of groundwater.
* The netto consumption of surface water.
* The extraction of surface water.
* The pollution of ground- and/or surface water.

In general the tax rates are the highest in geographical area where the extraction, consumption and pollution of water are the largest (= the area with the highest coefficients). In these area the water supplies are very vulnerable. That is why a substantial amount of the receipts of the taxes is invested in activities in these zones. The most vulnerable area are called the "champs captant irremplacable". The basin Artois-Picardie contains about 30 of these area.
The table 3.2 gives the geographical area and the coefficients for the different tax categories. There are no coefficients for the tax on surface water extractions because this is a relatively new tax and 96% of the water sources are groundwater supplies (!). The higher the coefficient the higher the rate of the tax will be.

Table 3.2 Geographical area and coefficients for the different tax categories.

Tax categorie	No extractions/consumption/pollution	Basis coefficient	Medium coefficient	High coefficient
Groundwater extraction		C (1.0) small extractions	B (1.5) area with vulnerable groundwater supplies	A (2.5) area with the "champs captant irremplacable"
Netto consumption of surface water	I (0.0) no or very little netto consumption	H (1.0) low degree of netto consumption		G (1.7) high degree of netto consumption
Water pollution		E (1.0) low degree of pollution		D (1.3) high degree of pollution

The tax rate on the (netto) consumption of surface water is based on the volumes of extractions between 1/6 and 31/10 ("drought period").
The surface water extraction tax is a relatively new one. The rate is based on the total

extracted amounts in the basin Artois-Picardie during one year. No distinghuisment in area is made.
The tax on the water pollution by householdings is based on the number of inhabitants in a municipality and the amounts of drinking-water consumption. The tax rate in Douai is about 4 French francs per m^3.
The tax on the water pollution by industries is based on the mean daily production in the month of maximum activity. The calculations are based on the production processes. In this tax-system the parameters suspended matter, oxidizable substances (MO), inhibitors (MI), reduced nitrogen-combinations (NR; organic and ammonia nitrogen), phosphorus (total: organic and mineral P), soluble salts, adsorbable organohalogenes (AOX), heavy metals and oxydized nitrogen-combinations (NO; nitrites and nitrates) are included.
MO is defined as $(COD + 2BOD_5)/3$. The soluble salts are calculated as (conductivity x flow rate). The included heavy metals are: As, Cd, Cr, Cu, Hg, Ni, Pb and Zn. The amounts are calculated as the weights of the metals x multiply coefficients: As (10), Cd (50), Cr (1), Cu (5), Hg (50), Ni (5), Pb (10), Zn (1).
The table 3.3 shows the basis rates of the different tax categories over the period 1992-1996.

Table 3.3 Basis rates of taxes in the French part of the Scheldt basin.

Basis rate	1992	1993	1994	1995	1996
Extractions (FF/m^3)					
Groundwater	0,107	0,112	0,118	0,124	0,130
Surface water	0,010	0,010	0,010	0,010	0,010
Netto consumption	0,217	0,228	0,239	0,251	0,264
Pollution					
MeS (FF/kg)	126	134	142	150	159
MO (FF/kg)	252	267	283	300	318
NR (FF/kg)	143	151	160	170	180
NO (FF/kg)	-	-	-	-	-
MI (FF/kg equitox)	4.688	4.969	5.267	5.583	5.918
P (FF/kg)	675	716	758	804	852
AOX (FF/kg)	-	-	-	-	-
METOX (FF/kg)	-	-	-	-	-
MEOOTOX	-	-	-	-	-
Soluble salts (FF; MHO/cm Xm^3)	2.000	2.000	2.000	2.000	2.000

3.1.4 Investments 1992-1996

The Sixth Actions Programme of the Basin Water Agency is very ambitious: 2770 and 265 millions of French francs will be invested respectively in the reduction of groundwater and surface water pollution (la lutte contre la pollution) and the protection and exploitation of water sources (amélioration des ressources en eau). Compared with the Fifth Action Programme this means an increasment of the total budget with 112%. The budget is available for the whole basin Artois-Picardie, including the Scheldt basin.
At about 50% (= 1518 millions of French francs) will be invested in the Scheldt basin. The activities will be financed with the receipts of the taxes, the repayment of loans and advances and various sources. The figure 3.1 gives an overview of the estimated receipts of the sixth programme. The appendix 3.1 shows the measures of the Sixth Actions Programme of the Basin Water Agency Artois-Picardie 1992-1996.

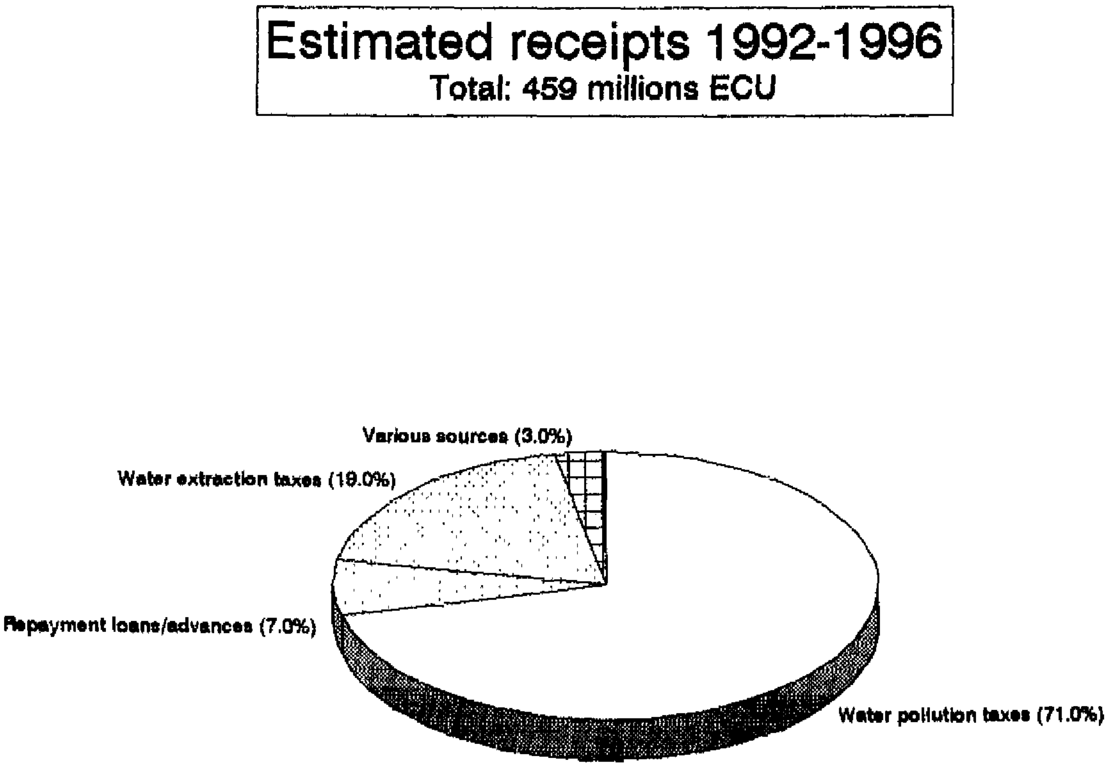


Figure 3.1 The estimated receipts of the Agence de l'Eau Artois-Picardie in the period 1992-1996. Total: 459 millions ECU. Plusminus 50% (230 millions ECU) of the receipts will be invested in the Scheldt basin.

The figure 3.2 shows the evolution of the total investments in waste water treatment equipment in the Basin Artois-Picardie, including these of the Basin Water Agency. The share of the Basin Water Agency is 40% of the total investments. The data have been corrected for the devaluation of the French franc. At the end of the 70's and the beginning of the 80's the investments declined due to changing economic conditions. Since 1982 the investments increase considerably.

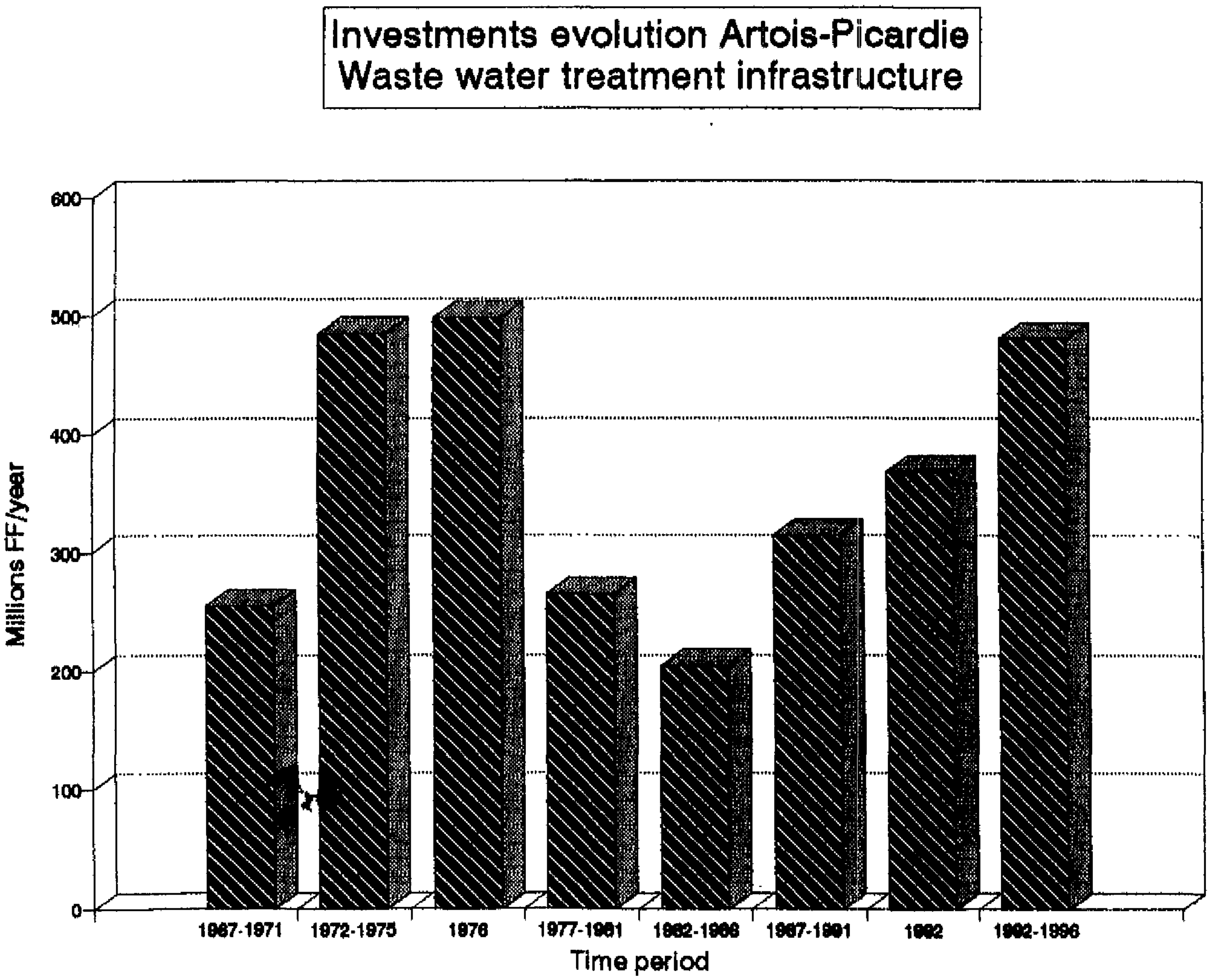


Figure 3.2 Evolution of the investments in the basin Artois-Picardie (period: 1967-1996). Investments: waste water treatment plants, collector networks and sewage systems. The share of the Agence de l'Eau Artois-Picardie is 40%.

3.2 Brussels

3.2.1 Organization

The Administration des Ressources naturelles et de l'Environnement (Administration of Natural Sources and the Environment) is responsible for the technical and administrative aspects of water management, including discharge permits and monitoring of surface and groundwater quality. The Brussels Instituut voor Milieubeheer develops the water policy for the Brussels Region.

3.2.2 Environmental permitting

Since the 1th of november 1993 a new integrated environmental permit system is in force. This system is based on the Flemish VLAREM-regulation.

3.2.3 Environmental tax system

A tax system on industrial discharges is in force since the end of 1993. The included parameters are:

* BOD
* COD
* suspended matter
* nitrogen
* phosporous
* some heavy metals and chlorine-solvents

Due to the big number of small industries it is impossible for the Brussels water management administration to control these all regularly. The bigger companies have to monitor their own waste water streams: a system of self-control.

3.2.4 Investments 1992-2000

The cabinet of Didier Gosuin, Minister of Environmental Affairs, has made an investments programme till 1996. The main lines of this programme are: the expansion of waste water treatment equipment (waste water treatment plants and collectors), storm lagoons, and the consolidation of the banks of the river Zenne.

Two waste water treatment plants are planned in the Brussels Region:

- Brussels-South: in the border area between Anderlecht and Vorst (where the Zenne enters the Brussels Region). Forty percent of the waste water from the Brussels Region will be treated at this plant The dimensions of this plant (five times the flow rate at dry weather) will make it possible to treat a part of the rainwater too.
  Design-capacity: 4,000,000 habitant-equivalents. No tertiair equipment.

- Brussels-North: in the border area between Neder-Over-Heembeek and Haren (where the Zenne leaves the Brussels Region). Sixty percent of the waste water from the Brussels Region will be treated at this plant. Design-capacity: 1,100,000 habitant-equivalents. The possibilities for tertiar equipment are still studied.

It has to be emphasized that only the waste water of the Brussels Region will be treated at this two installations, not the water of the river Zenne that enters the Brussels Region. The total design-capacity of the two plants is 1,500,000 habitant-equivalents. 1,000,000 habitant-equivalents will be used for the treatment of the communal waste water produced by the 1,000,000 habitants. The remaining capacity will be used for the treatment of industrial waste water (5,000,000 pollution-equivalents).

Storm lagoons will collect the rainwater that can not be removed via the sewage systems in extremely wet periods. As a result the chance that floods appear locally during heavy weather will be diminished. Because of the bad conditions of the banks of the river Zenne, parts of this river (the so-called risk-zones) will be arched over. Some other instable parts will be protected by the construction of dam boards.

Between 1992 and 1996 160 millions ECU will be invested in the Brussels Region. In the period 1996-2000 340 millions ECU will be invested in water quality management.

3.3 Wallonia

3.3.1 Organization

The Ministry of the Wallonian Region has the aministrative and technical water management responsibilities. The Direction of Natural Sources and the Environment of this ministry is in charge with the water quality aspects of all surface waters and the quantitative aspects of non-navigable watercourses of the first category.
The Ministry of Equipment and Transport is responsible for the quantitative aspects of the navigable watercourses. The provinces have the responsibility for the quantitative management of the non-navigable watercourses of the second category, unless these watercourses are under the jurisdiction of the polderboards (les wateringues). The polder-boards are responsible for the quantitative management of non-navigable watercourses of the second, third and fourth category.
The municipalities manage the sewage systems and are in charge with quantitative aspects of non-navigable watercourses of the third and fourth category.
The Ministry of the Wallonian Region has ordered the so-called intercommunales to build and exploit the waste water treatment infrastructure and to give advisement on environmental permitting for industies that discharge waste water to sewage systems. The intercommunales are financially fully dependent on the Ministry of the Wallonian Region. In Wallonia there are 8 intercommunales. Three of them are situated in the Scheldt basin (IDEA, IPALLE and IBW).

Since October 1985 there is a water management advise committee (**Commission wallonne pour la protection des eaux de surface contre la pollution**). In this committee representants of several organisations (from industries to fishermen) take place. The committee gives advise to the Wallonian Executive.

The water management in Wallonia is mainly based on the following national laws and royal decisions and the regional decrees and decisions:

National laws and royal decisions:

- Law on the protection of surface waters against pollution (1971);
- Royal Decision concerning a general reglementation on the waste water discharges in normal surface waters, public sewage networks and artificial draining-routes (03/08/1976);
- Royal Decision concerning a revision of the general reglementation of the Royal Decision of 03/08/1976; in this decision 57 sectorial standards are laid down (12/07/1985);
- Royal Decision concerning the destination of general water quality objectives for fishing-water (17/02/1984, revised on 09/12/1987), swimming-water (17/02/1984), shellfish-water (17/02/1984) and drinking water (25/09/1984);
- Royal Decision concerning the destination of basis water quality objectives on the watercourses of the public hydrographic networks (04/11/1987);
- Several Royal Decisions on the destination of sectorial discharge prescriptions (1985-1990).

Regional Decrees and decisions:

- Decree concerning the protection of surface waters against pollution (07/10/1985);
- Decision of the Wallonian Executive concerning the indication of protection areas in surface waters (20/07/1989);
- Decree concerning taxes on communal and industrial discharges (30/04/1990);
- Decree concerning the exploitation and protection of surface waters that are used for the production of drinking-water (30/04/1990).

In the period 1993-1996 the Direction of Natural Sources and the Environment will have to make an annual report about the condition of the environment (**l'Etat de l'Environnement Wallon**). In the 1995 report the water quality, the water quality management organization and the industrial sector will be described.

3.3.2 Environmental permitting

The "Decree concerning the protection of surface waters against pollution" gives the reglementation on environmental permitting. This reglementation is based on the EU guide-lines and includes general and sectorial waste water discharge standards.
A waste water discharge permit has to contain the following aspects:

* maximum admissable concentrations (individual parameters)
* monitoring prescriptions (parameters and frequencies)
* the validity and the the validity periods
* water quality objectives of receiving watercourses
* maximum admissable daily flow rate
* admissable peak flow rates.

The individual permits do not include technical prescriptions for pollution prevention and waste water treatment. The licensees have to meet the prescription objectives, but they are free to choose the technical equipment by themselves.
It is not obliged to include all the polluting substances of a waste water stream in the discharge permit. Pollution indicators and parameters that are part of the general and sectorial discharge regulations have to be included in the permits. The presence of parameters in a waste water stream, which have not been mentioned in a permit, is allowed as long as the discharged amounts are no problem in relation to the quality objectives of the receiving watercourse. The presence of toxic and other dangerous substances which are mentioned in the European regulations (lists I and II of the European guideline CE/76/464) is prohibited, unless explicit permission is issued.
The sectorial approach means that all industries of the same sector have to meet the same discharge prescriptions independent of the production scale, used technologies and the age of the used technologies in the individual industries.
In order to meet the quality objectives of the watercourses in a hydrographic subbasin, the discharge permits have to be compared. The presence of other industries in the neighbourhood, the self-purification capacity of the receiving watercourses, the presence of protected zones and so on have to be considered of in the decision making and the permit prescriptions.
A request for a discharge permit have to be sent by means of a registered letter to the Ministry of the Wallonian Region. The Ministry has a maximum of eight months to prepare the permit. The proposed permit has to be signed by the Minister responsible for water management affairs.

Three divisions of the Direction of Natural Sources and the Environment carry out the control of industrial discharges:

- the Industrial Pollution Division;
- the Water Division;
- the Discharges Division (taxes regulation).

There is no systematic organization of the control activities of these divisions. The cooperation between these divisions will be improved. The information collected from the system of industrial self-control will be verified more intensively.

If a new industry wants to start, a discharge permit is required including the strongest standards. Due to the bad social-economic circumstances it is more difficult to change the discharge conditions for existing companies.

3.3.3 Environmental tax system

The present tax system for the discharge of communal and industrial waste water is based on BOD and COD. The tax rate for industrial discharges is 8.26 ECU per pollution-equivalent. The tax rate for communal discharges is based on the water consumption amounts (0.18 ECU per m^3).

3.3.4 Investments 1992-1996

In order to meet the objectives of international agreements the Wallonian Region will invest 239 millions ECU in the building of waste water treatment plants and collector networks in the Scheldt basin between 1992 and 1996. As a result the design-capacity will increase with 661,400 inhabitant-equivalents.
The figure 3.3 gives an overview of the investments (waste water treatment plants and collector networks) per hydrographic subbasin. The appendix 3.2 gives a detailed overview of the investments per hydrographic subbasin.

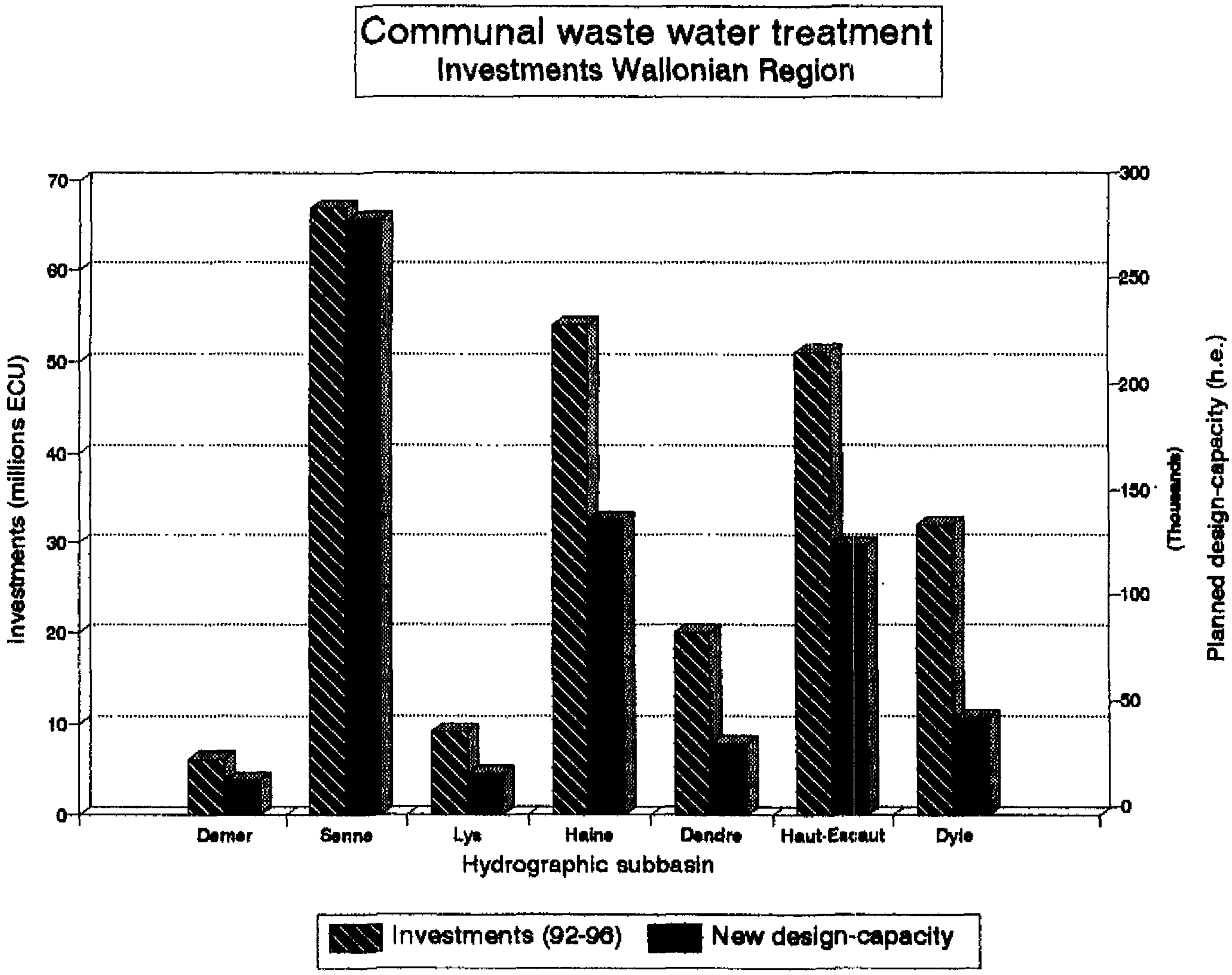


Figure 3.3 Investments per hydrographic subbasin in the Wallonian Region (period: 1992-1996). Investments: waste water treatment plants and collector networks.
Total: 239 millions ECU.

3.4 Flanders

3.4.1 Organization

The water management administrations in Flanders use a division in navigable and non-navigable watercourses. Navigable watercourses are economical important transport routes that also have an drainage function. The non-navigable watercourses are the smaller ones. These are divided in three categories, from the source (category 3), via the middle parts (category 2) to the mouth (category 1).

The Department of Environmental Affairs and Infrastructure, one of the six departments of the Flemish Region, has the administrative and technical responsibility for the water management in Flanders.
The Administration Environment, Nature and Social Climate (AMINAL), under the jurisdiction of this department, is in charge with the water management strategy, the qualitative aspects of the operational water management of the navigable watercourses and the qualitative and quantitative aspects of the operational water management of the non-navigable watercourses of the first category.
The Administration Waterinfrastructure and Marine Affairs, under the jurisdiction of the same department, is responsible for the quantitative aspects of the operational water management of the navigable watercourses.
The provinces are in charge with the management and maintenance of the non-navigable water-courses of the second category.
The polderboards/wateringues carry out the quantitative management of the watercourses of the second and third category. The polderboards are responsible for the maintenance of the dikes and the regulation of the inland water levels. Wateringues are in charge with the regulation and protection of suitable conditions for agriculture and hygiene.
The municipalities build and exploit the sewage systems and carry out the operational management for non-navigable watercourses of the third category.

Besides these administrations several so-called "paragovernmental institutes" exist with their own tasks and objectives. One of these is the Flemish Environment Agency (VMM), operational since January 1991. The VMM is in force with the following general tasks:
- the setup and exploitation of monitoring programmes for industrial and communal discharges, water quality and the quality of the air;
- the setup of the General Waste Water Treatment Programmes (= Algemeen Waterzuiverings Programma's; AWP's);
- the setup of the investment programmes on the building and exploitation of new purification works;
- the estimation of the tax rates and the collecting of the taxes on water pollution;
- the advisement of AMINAL with regards to the application of the Flemish Environmental Permitting Regulation (VLAREM);
- the annual publication of the results of the monitoring programmes;
- the setup of annual load balances per hydrographic basin.

The head-direction in Aalst coordinates the activities and is responsible for the waste water treatment policy in Flanders. Since the 1th of January 1994, AQUAFIN exploits and improves existing waste water treatment plants, pumping-plants, collectors and pressure-pipelines. AQUAFIN also build and exploit new waste water treatment plants.

Besides the national laws and royal decisions (as described in paragraph 3.3.2) the water management in Flanders is based on the following decrees and royal decisions:

- Decree concerning the management of waste substances (1981);
- Decision of the Flemish Executive on the destination of water quality objectives for all surface waters of the hydrographic networks and the adjudgement of the water quality objectives drinking-water, swimming-water, fishing-water and shellfish-water (21/10/1987);
- Decision of the Flemish Executive for the reconstruction of the Ministry of the Flemish Region (31/07/1990);
- Decree concerning the Administrative Policy (12/12/1990), in which the new organization of the Flemish water management administrations is described;
- Decree concerning the revision of the tax system on waste water discharges (21/12/1990);
- Decree concerning the set up of the MINA-fund (23/01/1991);
- Decision of the Flemish Executive concerning the set up of the MINA-counsil (29/04/1991);
- Decision of the Flemish Executive concerning environmental ppermitting (06/02/1991).

3.4.2 Environmental permitting

The environmental permitting policy is mainly based on the Law on the protection of surface waters against pollution (1971). In principle if an industrie wants to discharge waste water it will have to obtain a discharge permit. The general and sectorial standards are the basis of the permit prescriptions. Discharge standards have been made for 51 industrial sectors. Since the 1th of September 1991 the Flemish Environmental Permitting Rgelementation (VLAREM) is in force. In VLAREM a big number of improvements has been made:

- Except the building-permit permits concerning air, water and land pollution are part of one new integrated environmental permit.
- The discharge prescriptions depend on the water quality objectives of the receiving watercourses.
- The juridical foundations has been improved. All data are accesible to the citizens. Dictation is possible for social groups and individual citizens. The issued environmental permits are claimable at the municipalities by the citizens, with retrospective legislation. Important papers concerning environmental permitting can be obtained. Environmental Protection organizations have requisition rights since the end of 1992.

- If a industrie has been connected to a collector that is not yet connected to a waste water treatment plant, than the industrie has to meet the discharge standards for industries that are connected to a treatment plant.

The environmental permitting and the permit prescriptions control are tasks of the AMINAL, respectively of the Direction Environmental Licences and the Direction Environmental Inspection. The VMM gives advise on environmental permitting and permit prescriptions control. Therefore the VMM participates in specialized committees.

3.4.3 Environmental tax system

A tax has to be paid for all categories of waste water discharges. This means that not only individual citizens or householdings and industries which are connected to a sewage system, but also industries which discharge their waste water directly to a watercourse, have to pay a tax.
In the tax system a distinguishment is made between persons/industries that use small amounts of water (less than 500 m^3 a year) and persons/industries that use large amounts of water (more than 500 m^3 a year).
The water consumption of the two million persons/industries that use small amounts is measured; for every 40 m^3 one pollution equivalent is calculated. Per pollution equivalent 14 ECU have to be paid. The minimum annual tax rate is 14 ECU (individuals). The tax rate for householdings depends on the number of children. Two measures have been taken to lighten the financial burdens:
- the first 30 m^3 (about the annual water consumption of an individual) is tax free;
- from the third child a discount of 5.7 ECU per child is calculated.

For the users of large water amounts the tax rate depends on the discharged pollution amounts. The definition of a pollution equivalent is based on the flow and the discharged oxygen demanding substances, heavy metals, nitrogen and phosphorus.

In order to calculate the number of pollution equivalents the data of the drinking-water production companies and the analysis data of the waste water streams are used. Analysis data are not available for the major part of the industries. In order to estimate the number of pollution equivalents of these industries calculation coefficients are used. These coefficients are based on the production process or the water consumption.
Industries that discharge directly to a surface water have to meet both the basis water quality objectives and the sectorial discharge prescriptions (which are less severe). Therefore a transition period is in force until the end of 1995 during which a reduction of the tax rate can be obtained.
The receipts of the taxes on waste water discharges were 0.11 and 0.14 milliard Belgian francs in respectively 1991 and 1992. The share of the users of small water amounts and large water amounts was respectively 45 and 55%.
In order to fulfil the principle "the polluter pays" the tax rate should be equal to the discharged pollution amount. A direct connection is made for the users of small water

amounts. For the industries the measurements of the waste water streams are the basis for the calculation of the tax rate. The waste water is only analyzed at 1000 industries; at about 3000 industries no analysis takes place at this moment, although this is a part of the permits.

3.4.4 Investments 1991-1999

The figure 2.4 gives the investments of the Flemish Executive in the period 1991-1999. In the period 1991-1994 513 millions ECU will be invested in new waste water treatment infrastructure (treatment plants, collector networks, pump-stations and sewage systems). In the period 1995-1999 583 millions ECU will be invested.

The AWP-II basins that have the highest priority are:

AWP-II 10	Kluizen
AWP-II 16	Leie tot aan Afleidingskanaal
AWP-II 18	Dender
AWP-II 22	Boven-Schelde
AWP-II 25	Grote Nete
AWP-II 26	Boven-Demer

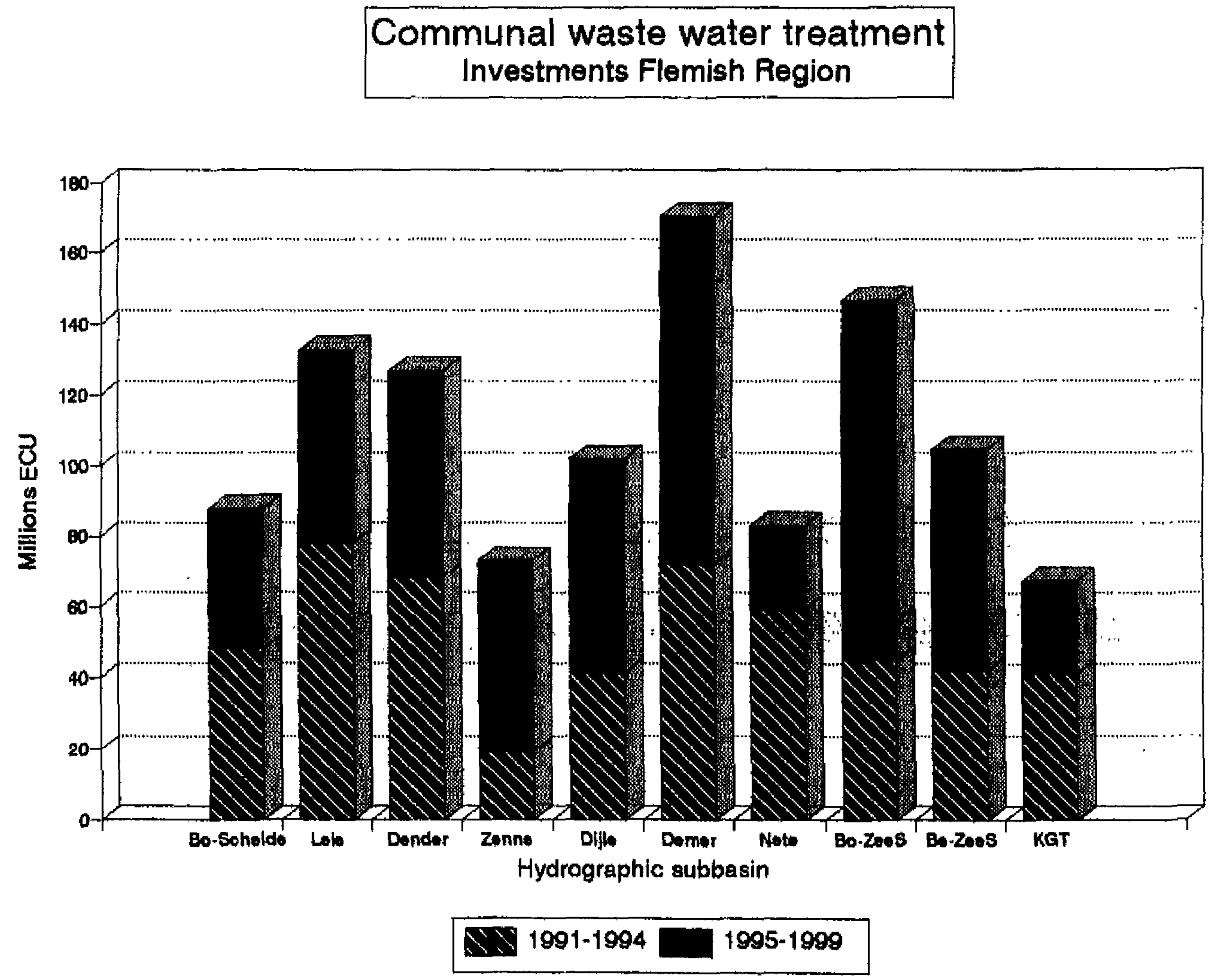


Figure 3.4 Investments per hydrographic subbasin in the Flemish Region (period: 1991-1999). Total: 1096 millions ECU.

3.5 The Netherlands

3.5.1 Organization

The Dutch government divides the surface waters in national and regional watercourses. The national watercourses pass the regional borders and form the major navigation routes between the main ports and industrial areas. They include ecological valuable areas and migration routes for animals like fishes, although several locks and sluices form barriers. The national waters are rivers (like Rijn and Maas), canals, the North Sea and the Wadden Sea and the sea-arms (like the Westerschelde). The water management (qualitatively and quantitatively) of the national watercourses is the task of the Rijkswaterstaat. The regional Directorate Zeeland has the responsibilty for the water management of the Westerschelde.
The water quality management of the regional watercourses is the task of the provinces. Each province has a provincial water management department. Together with the waterschappen and the municipalities this department carries out the water management (quantitative and qualitative aspects). The waterschappen build and exploit the waste water treatment plants, maintain the dikes and regulate the water quantity in the provinces. The municipalities manage the harbours, channels and the sewage systems.

The water management (national watercourses) is divided in three categories:

- quantitative water management, which is mainly regulated in the Law on the Organization of the Waterstaat (Waterstaatswet; 1900) and the Law on Water Management (Wet op de waterhuishouding; 1989);
- qualitative water management as regulated in the Law on the Pollution of Surface waters (Wet Verontreiniging Oppervlaktewateren; 1970);
- groundwater management, as regulated in the Groundwater Law (Grondwaterwet; quantitative aspects) and the Law on the bottom protection (Wet Bodembescherming; 1987; qualitative matters).

The water management (regional watercourses) is based on the provincial water management programmes and the water management programmes of the waterschappen.

Policy documents

The Third National Policies Document on Water Management (Derde Nota Waterhuishouding; NW3, 1989) describes the guide-lines of the Dutch water management. This document, which is titled as "Water for today and tomorrow", the water management gives the objectives for the period 1990-1994. At the end of 1993 Rijkswaterstaat published an evaluation document: Evaluation Document on Water Management (Evaluatie Nota Water 1993). In this document the first results of the NW3 are described. The progresses and the bottle-necks are summarized. The document includes additional measures and financial investments for 1994-1998. In 1998 the Fourth National Policies Document on Water Management (NW4) will be published.

The objectives of the NW3 are translated in the Management Programme for the National Waters (Beheersplan voor de Rijkswateren; 1993). This programme describes the measures and financial investments for the period 1992-1996. Each regional division of Rijkswaterstaat has to make a regional translation of this national programme. The Management Programme for the National Waters in Zeeland, the action programme 1993-1996 of the Directorate Zeeland (Regionota Zeeuwse Rijkswateren 1993-1996) has been published in December 1993.

In the Netherlands the water management is based on an integrated approach. This means that a watersystem (like the Westerschelde) is considered as an unity of surface water, bottom sediment and the banks. A watersystem can be described by means of fysical, chemical and biological characteristics. The integrated management approach is chosen to establish sustainable functioning water systems in a way that the interests of all the users of the water systems can be respected: today and tomorrow. Therefore measures will have to be taken on the water pollution prevention and reduction, the sanitation of polluted bottom sediments, the management and development of intertidal areas and banks, the general recovery of watersystems (for example by means of active biological management) and the water distribution.

The final objectives of the water management organization (NW3) are:

- the borders of the management areas of the waterschappen will be the same as the borders of the natural, hydrographic units;
- quantitative, qualitative and navigation aspects of surface waters will be managed by one administration; the national watercourses by Rijkswaterstaat and the regional watercourses by the waterschappen;
- the instruments in order to establish an integrated water management will be optimalized; therefore the Law on Water Management will be replaced by a new law on ***integrated*** water management;
- the financial organization is fully based on an integrated water system approach .

One of the instruments is the ***target group policy***. This means that governmental administrations and industries can draw up convenants and intention declarations to tackle environmental problems by a joint, coordinated approach. Water quality and emission aspects are part of these agreements.

An good example of the integrated water system approach is the Policy Document for the Westerschelde (*Beleidsplan voor de Westerschelde; 1991*). This document is subscribed by:

- the Ministry of Transport, Public Works and Water Management (Rijkswaterstaat Division Zeeland);
- the Ministry of Environmental Affairs (VROM);
- the Ministry of Agriculture, Nature Conservation and Fishery (LNV);
- the Ministry of Economical Affairs (EZ);
- the Province Zeeland;
- the waterschappen and the municipalities around the Westerschelde.

The document includes an integrated water management programme especially for the Westerschelde.

3.5.2 Environmental permitting

The Law on the Pollution of Surface Waters (WVO; 1970) contains only the legislation framework on the water pollution prevention and reduction. The national government works out the guide-lines of this law by means of the so-called General Governmental Measures (Algemene Maatregelen van Bestuur; AMvB's) or ministrial regulations. The provinces can do the same by means of provincial regulations. Waterschappen may also make regulations, but only under the jurisdiction of Rijkswaterstaat and the provincial waterstaat. The provincial regulations have to be approved of by the Minister of Transport, Public Works and Water Management.

In the WVO surface water is defined as:

> Every water body unity, which has a border surface with the bottom and an open border surface with the atmosphere, and which is present continuously or during a big part of the year.

This law is *not* concerning groundwater, water in sewage systems, discharges of radioactive substances (as regulated in the Nuclear Power Act) and discharges at the North-Sea (as regulated in the Law on the Pollution of the Sea Water).

The main guide-lines of these legislation are:

1. All direct waste water discharges to a surface water require a permit. The permits are issued by the water manager. In case of the national waters by Rijkswaterstaat, in case of the regional waters by the provincial department of water management or the waterschappen. The Institute for Inland Water Management and Waste Water Treatment (RIZA) advises the water managers. Indirect discharges, via sewage systems or waste water treatment plants require no permit. The managers of the final discharge points of the sewage networks or waste water treatment plants need a discharge permit. They can settle down prescriptions for this kind of discharges. In general, these prescriptions are noted down in municipal sewage system or discharge regulations. Indirect discharges of substances which are part of an AMvB and substances deriving from discharge sources which are part of an AMvB also require a permit.
2. A discharge permit includes prescriptions for the composition of the waste water stream. The permit standards are partly based on the EU-guideline 76/464. Because of the fact only a few substances are included in this EU-guideline the permit standards are also based on the Rhine Action Programme and the North Sea Action Programme.
3. The civil servants of Rijkswaterstaat and the Inspectors of Environmental Hygiene and the Environmental police control the permit prescriptions. There is a WVO contact team that carries out routine control activities and an annual control action. The contact team inventories the number of offenders. Between the 10 and 20% of the industries offend the WVO.
4. A tax can be introduced on the discharge of certain substances. The receipts have to be spent on the water pollution reduction. The tax rate is partly based on the required financial means in a management area. A part of the receipts flows back to the industries and the waterschappen for the financement of waste water treatment efforts.
5. The Law on Environmental Management (Wet Milieubeheer; 1992) includes the procedures on participation and the appealment against convictions with respect to requests for environmental permits and changements in the permit precriptions. This law also regulates the Environmental Impact Report procedure and the publicity of figures. The Law Environmental Management is the new Dutch law in which almost all environmental laws have been or will be integrated in future. The old Law of General Rules on Environmental Hygiene (Wet Algemene Bepalingen Milieuhygiëne; WABM) has been replaced by this new law.

Since March 1993 it is possible to set **general rules** for discharges to surface waters or, for certain caregories, to sewage systems by means of a AMvB. These general rules can replace or exist beside the permits. This instrument is used to regulate **homogenous discharge groups** in order to reduce the governmental investments. Two advantages of this instrument are that the procedure is easier and that the treatment of more or less equal dischargers is the same. The main disadvantage is that individual treatment is not possible anymore. On the other hand water managers can get the authority to settle down more severe objectives for certain parts of a permit. The instrument will be used for discharges by or from:

- dentist practices;
- glasshorticultural companies;
- diffuse spreaded buildings;
- bottom sanitation projects;
- direct discharges from watersports centres;
- "gritstralen" and preservation works.

At this moment there is a delay in the environmental permitting. The ministries of Transport and Public Works (VW) and the Housing of people, Town and Country Planning and Environmental Affairs (VROM) will coordinate their activities more intensively. At the end of 1994 the problems will be solved.

3.5.3 Environmental tax system

The tax system on waste water discharges is based on two principles:

1. **The polluter pays** as noted down in the Law on the Pollution of the Surface Waters. This law regulates the tax on the surface water pollution. All polluting substances could be part of the WVO-tax.
   However, only oxygen demanding substances and heavy metals are part of the tax. Each person, organisation or industrie that discharge waste water to a surface water or a sewage system has to pay a WVO-tax. The tax rate is based on the amounts of discharged oxygen substances and heavy metals. In 1991 respectively 60% and 40% of the WVO-receipts of Rijkswaterstaat derived from the regional water managers and the industries.
2. **Interest-payment-influence** as noted down in the Law on the Organization of the Waterschappen. Persons, organizations or industries that have interest in clean water have to pay for the waste water treatment efforts. On the other hand they also have to get influence on the decisions. Therefore, starting in 1994, the habitants of a management area can vote representatives for the government of the waterschappen by elections every four year.

The tax rate in a management area is based on the produced amount of pollution in a certain area (expressed as the number of habitant-equivalents) and the costs that the managers have to make. A householding has to pay for 3 or 3.5 habitant-equivalents a year; a single person for 1 habitant-equivalent a year. The term habitant-equivalent gives an impression of the amount of biodgradable substances that is produced by a human being in a certain time-period: 1 inhabitant-equivalent = 1.11 x (BOD + 4.57 x KjN). The factor 1.11 is based on a daily flow rate of 150 liter.

Improvement of the financial water mangement organization.
In 1990 and 1991 the **Research Committee Water Management Financement System** (= **Committee Zevenbergen**) analysed the advantages and disadvantages of the present financial water management organization in the Netherlands. This committee summarized the major bottl-necks and did proposals for the improvement of the financial organization.

Four important bottle-necks are:

1	The present waste water discharge tax sysem only includes a small part of the polluting substances.
2	The causers of water pollution can not be forced to pay for historical and bordercrossing pollution.
3	Measures on the establishment of the integrated water management approach can not be financed from the taxes on surface water pollution.
4	The pollution deriving from diffuse sources (navigation, agriculture, non-connected householdings, sewage water overflows) is not a part of the present tax-system.

Navigation activities
The navigation activities cross the borders of the different water quality management areas; these activities are partly international. The professional and recreative shipping cause an annual pollution of ± 150,000 habitant-equivalents. At the short term, a WVO-tax will not be introduced for the shipping activities because of the practical complications (high acceptance costs, the set up of a registration duty and the lack of a control organization).

Agricultural sources
Agricultural sources are responsible for the pollution of surface waters with nutrients and chemical substances. The committee has proposed the introduction of a WVO-tax of 0.5 habitant-equivalents per hectare, based on a minimum amount of pollution. Due to other environmental investments that landfarmers will have to make this tax will not be introduced on the short term.

Sewage water overflows
The sewage water overflows are another problem, due to a lack of sufficient sewage systems. The Dutch government has made a policy document on sewage systems. Spread over a period of 10-15 years 4587 millions ECU will be invested in the construction, the maintenance and improvement of sewage systems. A WVO-tax could possibly be introduced for municipalities that carry out too less measures on the water pollution reduction.

Water consumption tax
The possibilities for the establishment of a tax system based on the water consumption amounts have been studied. The idea is that if people would have to pay for the amounts of consumption water that they use, they would use less water. The growth of the drinking-water consumption will have to be stopped for several reasons:
- groundwater levels descend and as a consequence natural areas dry up;
- the use of chemical substances in the drinking-water production;
- the amounts of waste sludge increase;
- more natural areas have to be used to fulfil the water consumption needs of the Dutch population.

However the committee has advised the Duth government not to introduce such tax-system on the short term, because of practical problems (especially high investment costs). On the other hand the Dutch government has made an action programme on the water consumption reduction. The discussion on the introduction of a water consumption tax is still going on.

Water quality tax
Principally the WVO tax system is meant to finance measures on the water pollution reduction. An integrated water management approach means that also more general measures have to be taken which are not directly related to water pollution, like active biological management, development and protection of river banks and so on. Therefore the committee has proposed to establish a water quality tax based on the Law on the Organization of the Waterschappen. This tax should be used to finance 5-10% of the investments of the regional watermanagers.

As a result of the proposals of the Committee Zevenbergen the following measures will be carried out in the period 1994-1998:

1	Organohalogene substances will be part of the WVO-tax per the 1th of January 1995. These substances cause extra costs for water management (sediment pollution) and cause eco-toxicological effects;
2	Effluent discharges deriving from waste water treatment plants, which are mainly managed by the waterschappen, will be partly exempt from the WVO-tax with 15% in 1994, 30% in 1995 and 50% from 1996.

3	Possibilities will be studied for the includement of diffuse sources in the WVO tax.
4	Concerning diffuse pollution (agricultural sources) possibilities for the application of mineral book-keeping in relation to water management will be discussed. Farmers in the Netherlands have to make a mineral book-keeping every year;
5	Per the 1th of January 1994 legal charges will have to be paid on the issuing of environmental permits which are based on the WVO.
6	Waterschappen have the possibility to introduce a water quality tax in order to finance measures which are not directly related to water pollution.
7	The Law on Bottom Protection will be extended with a regulation concerning the financement of water bottom sanitation projects.
8	A stimulation regulation for industries will be introduced. If an industry introduces treatment measures a tax rate reduction (heavy metals and organic halogenes) can be obtained for 1993, 1994 and 1995.

3.5 Investments 1993-1996
The table 3.4 gives the planned financial investments of Rijkswaterstaat Zeeland over the period 1993-1996.

Table 3.4 Financial investments integrated water management 1993-1996 (in millions of Dutch guilders).

Article	Description	1993	1994	1995	1996	Total
050601	Prevention and combatment of calamities	0.14	0.09	0.05	0.0	0.28
051500	Prevention and reduction of pollution (WVO)	3.49	6.65	6.42	1.51	18.07
052101	Banks and intertidal areas/recoverage of water systems	3.76	5.60	4.95	3.07	19.7
052201	Sanitation of polluted water bottoms	0.78	1.01	1.97	2.48	6.24
Total→		8.17	14.16	13.39	7.06	44.29

In the period 1993-1996 44 millions ECU will be invested in integrated water management by Rijkswaterstaat Zeeland. At about 45% (19.8 millions ECU) will be invested in the Westerschelde.

To give an impression of the exploitation costs and the investments of a waterschap in the Westerschelde area the figures of the Waterschap De Drie Ambachten (WS23) for the period 1990-1995 are given in the table 3.5.

Table 3.5 Financial figures of the Waterschap De Drie Ambachten (1990-1995).

Treatment plant	Exploitation costs (in millions Dutch guilders)	Investments 1990-1995 (in millions Dut						
		Description	90	91	92	93	94	95
De Drie Ambachten	1.91 1)	Building 1990/ investments	10.32			0.16	-	-
Hulst	0.51 1)	investments	0.04	0.10	0.18	-	0.16	0.32
Kloosterzande	0.21 1)	investments	-	-	0.00 8	0.03	0.03	0.28
Breskens	0.40 2)	investments	-	-	-	0.006	-	0.09
Oostburg	0.46 2)	investments	2.092	0.31 9	0.46	0.006	-	0.09
Groede	0.07 2)	investments	-	-	-	0.006	-	-
Retranchement	0.18 2)	investments	-	-	-	0.121	1.376	1.376
Nieuwvliet-Bad	0.02 2)	renovation 1993	-	-	-	x	-	-
Total→	3.76		12.454	0.4 2	0.2 05	0.331	0.157	2.162

1) Figures exploitation costs 1992 exclusive pumping-stations and pressure pipelines.
2) Figures exploitation costs 1991 exclusive pumping-stations and pressure pipelines.

3.6 Short analysis water management Scheldt basin

In this paragraph some strong and weak aspects of the water management organization in the Scheldt riparian states are summarized, based on the collected information, reports about the river Scheldt and the workshop in Namur (2 and 3 June 1993). The appendix 2.1 gives an overview of the ministries and administrations that are involved in the strategical and operational water management (quantitative and qualitative aspects). In France and the Netherlands the watercourses are divided in national and regional waters. In the Netherlands the national waters are navigable watercourses; the regional watercourses include both navigable and non-navigable watercourses. In France the national waters include both navigable and non-navigable watercourses; the regional waters are non-navigable watercourses.
In Flanders and Wallonia the watercourses are divided between navigable and non-navigable watercourses.
Compared to Brussels, Wallonia, Flanders and the Netherlands the number of ministries and administrations involved in water management in North-France is much bigger.

3.6.1 North-France

Strong aspects
Since 1991 there is a "mature" Ministry of Environmental Affairs: it is no longer a kind of Parliamentary Undersecretariat. On the other hand this ministry is partly dependant on the civil servants of the other ministries; this ministry has not a large decentralized apparatus. The idea of one big ministry in which different aspects of environmental management, including water quality policy and management, are integrated is a good one.
The basin approach with the Basin Committees on one hand (water policy) and the Basin Water Agences (executive tasks) on the other hand is a good step in the direction of an integrated water management approach. In 1992 the organization of making plans and programmes has been changed. The Basin Committees will get more influence. Together with the Regional Parliament and the Departemental Parliament the Basin Committees will have to write a "directive water management schedule (Schéma directeur d' Aménagement). This plan will give the guidelines of water management in a river basin, the water quality objectives and the activities to meet these objectives in a river basin.
The financial autonomous status of the Basin Water Agencies. The receipts of the taxes are mainly invested in waste water treatment measures and do not disappear in "invisible" investments of other (governmental) administrations.
Compared with the Fifth Action Programme, the budget of the Basin Water Agency Artois-Picardie is doubled. Plusminus 230 millions ECU will be invested in the Scheldt basin between 1992 and 1996.
The policy of the river basin contracts (la politique de contrat de rivière) could be a good basis for an integrated management approach.

Weak aspects:
The responsibilities on water management are divided over a big number of governmental administrations. The coordination of the activities is a complex matter.
The civil servants that are responsible for the environmental permitting are also responsible for the control tasks. There are too less inspectors to control the discharge permits prescriptions.

The Direction de la Recherge, de l'Industrie et de l'Environnement (DRIRE), part of the Ministry of Industry is responsible for the issuing of environmental permits as well as for the stimulation of industrial development. On the other hand, since two years DRIRE has been divided between the Ministry of Industry and the Ministry of Environmental Affairs.
The Direction Départementale de l'Agriculture (DDA), part of the Ministry of Agriculture, is responsible for the issuing of environmental permits as well as for the stimulation of agricultural production.
The tax rates for industrial water pollution are based on amounts of discharged substances which are calculated (production processes). It would be better to base the tax rates on the monitored discharged amounts in waste water streams.

3.6.2 Brussels

Strong aspects:
The presence of a water quality improvement investments programme for the period 1992-2000. In 2000 two waste water treatment plants will be operational with a total design-capacity of 1,500,000 habitant-equivalents. This capacity will be sufficient to treat both communal (1,000,000 habitant-equivalents) and industrial (± 500,000 pollution-equivalents) waste water.
The introduction of a tax system on the surface water pollution. Industries will have to pay for discharged amounts of BOD, COD, suspended matter, nitrogen , phosphorus, heavy metals and chlorine-solvents.

Weak aspects:
The lack of information on the organization of the water management in Brussels. For example the role of the Brussels Instituut voor Milieubeheer (BIM) is still unclear. The lack of information on the organization of environmental permitting.

3.6.3 Wallonia

Strong aspects:
The strenghtening of the water management organization and the increasment in investments on water management. Between 1992 and 1996 239 millions ECU will be invested in waste water treatment infrastructure.
The concentration of water management affairs within one ministry. The idea of one big ministry in which different aspects of environmental management, including water quality policy and management, are integrated is a good one.

Weak aspects:
The individual industrial discharge permits do not include technical prescriptions for pollution prevention and waste water treatment. The licensees have to meet the prescription objectives, but they are free to chooses the technical equipment.
The control of industrial discharge permits is carried out by three divisions of the Direction of Natural Sources and the Environment. There is no systematic organization of the control activities of these divisions.

3.6.4 Flanders

Strong aspects:
The investments in water management are enlarged. For example 22,313 millions of Belgian francs will be invested in new purification works (purification plants, collectors, and sewage systems) between 1991 and 1995.
The Flemish Environmental Permits Regulation (VLAREM): one integrated environmental permit concerning air, water and land pollution.
The publicity of environmental permits since 1991.
The principle of the basin committees: these (10) committees, in which all groups of interest participate, give advisement on the data collection and management and on water management affairs. Within a few years the committees will act as formal advise groups.

Weak aspects:
The tax rates on water pollution are too low (14 ECU per pollution-equivalent; a family with two children pays 46-69 ECU a year).
There is too little information available about the relations between discharges and water quality.
The present manpower on water management is insufficient to establish an integrated water management approach.
An insufficient organization on the issuing and control of environmental permits.

3.6.5 The Netherlands

Strong aspects:
The integrated water management approach (more or less comparable with the approach of the basincommittees and the principle of the river basin contract. For each water system there is an governmental committee in which Rijkswaterstaat, provinces, waterschappen and municipalities participate. For the Westerschelde there is the Westerschelde Deliberation Group. This group made the Western-Scheldt Policy Plan (Beleidsplan Westerschelde). This plan gives objectives and an action programme.
The standards and objectives of the Third National Document on Water Policies are stronger than the EU-directives.
There is a continuous dialogue between involved water managers. The waterschappen are working together in the Union of Waterschappen (Unie van Waterschappen). The provinces work together in the Interprovincial Deliberation Group (Interprovinciaal Overleg). The municipalities have organized themselves in the Union of Dutch municipalities (Vereniging van Nederlandse Gemeenten). The municipalities around the Westerschelde are coordinating the water management activities in the Westerschelde Municipality Group. Only the municipality Terneuzen is not participating in this group.
Much knowledge is available about the structure and functioning of water systems.
The regulations on the environmetal permits are integrated in one law: the Law on Environmental Affairs (Wet Milieubeheer).
The Netherlands has a strong water management organization. In the period 1993-1996 19.7 millions ECU will be invested in the Westerschelde by Rijkswaterstaat.

Weak aspects:
There are several laws on environmental affairs. Three ministries are involved in environmental management: the Ministry of Transport, Public Works and Water Management, the Ministry of Agriculture, Nature Conservation and Fisheries and the Ministry of Housing, Land Development and Environmental Affairs. Different aspects of water management (groundwater, surface water, quantitative and qualitative management) are handled by different administrations. The integration of the environmental management, including water management, is difficult. A first step in the right direction has been made by the first version of the Law on Environmental Management. In this law all environmental laws will be integrated, except the Law on the Pollution of Surface Waters and the Law on Water Management.
Not all users pay equally for the usage of surface water and water systems. Especially agriculture and shipping contribute less.
Procedures like the Environmental Impact Rapportage take too much time.
The present manpower is strong but asks much time for a good coordination.
Sustainable development is a difficult principle to give concrete form to.
Issuing and contrtol of WVO permits are divided among different administrations.

4. Scheldt-GIS

4. Scheldt-GIS

4.1 Introduction

One of the ISG objectives is the setup and management of a Geographical Information System (GIS) especially for the Scheldt basin: a Scheldt-GIS. The Rijksinstituut voor kust en Zee of the Dutch Rijkswaterstaat has built the first parts of this GIS during the first project year. The GIS is used as a medium for the storage, linkage, analysis and presentation of data which are collected by the participants. At the plenary meetings the participants decide which kind of data should be put in the Scheldt-GIS and which questions should be answered by means of the GIS.

The basis of the Scheldt-GIS is equal accesibility and easy acces to the data.

4.2 GIS-definition and objectives

A Geographical Information System is a database filled with all kinds of data which have a geographic component. The database is managed and used by means of a computer system. By means of the geographic components the data can be related to eachother and to other external databases. The information can be presented on maps.
The GIS products can help the water managers and the policy makers in making decisions and chosing strategies. Environmental impacts of measures can be made visible, relations between emissions and water quality, differences between area, hydrographic subbasins and rivers can made clear and so on.
In this report some examples are presented like a map of the Scheldt basin, which shows the operational and planned waste water treatment plants and their design-capacities (see chapter 5).

The main Scheldt-GIS objectives are:

1	The storage, management and updating of water quality management information in a Scheldt basin database.
2	The information distribution among the ISG participants.
3	The analysis and linkuage of the available data.
4	The presentation of data and analyses results by means of maps and progress reports.
5	The setup of GIS applications that can be used by the ISG participants.

4.3 Framework of Scheldt-GIS

The components of the Scheldt-GIS are:

* hardware
* software
* geographic database
* thematic database
* users-interface
* output data and/or anlysing results

4.3.1 Hardware/software

The ISG data are stored in the HP-9000 computer of the Rijksinstituut voor Kust en Zee. This computer includes the software programme ARC/INFO. The data are stored and managed by means of this ARC/INFO geographical information system. Besides the setup and management of the database RIKZ will make an application which shows the water manager the available data and the analysis and presentation possibilities. This and other applications are designed by means of ARC/INFO macro's.

4.3.2 Geographic and thematic databases

The geographic database contains all relevant topographic figures of the study area. The ISG participants use different methods to project the earth surface on a map. The Netherlands use a stereographic projection. Flanders uses the Lambert (I) projection method which is a conic projection. North-France uses the Lambert (II) projection method. In order to obtain an uniform database all coordinates are translated in UTM cartographic projection coordinates. UTM (Universal Transverse Mercator) is a global projection system between 84° north and 84° south of the equator. The UTM zone 31 encloses the area between 0.00° and 6.00° eastern latitude and 48.00° and 56.00° northern latitude. The UTM projection is an international used standardization method. The whole Scheldt basin is situated in the UTM zone 31.
The thematic data are stored in table format. These data are related to topographic data. The thematical data consist of descriptions and values of parameters. The appendix 4.1 gives an idea of the ISG data model.

Within the databases the data items have an ISG code, according to the following codation system:

North-France	1-1000
Wallonia	1001-2000
Flanders	2001-3000
The Netherlands	3001-4000
Brussels	5001-6000

It is possible to store more environmental data when the Scheldt-GIS is extended to an overall information system. If the contents of the database is increasing one of the options is the usage of an external database for thematic or non-geographic data.

4.3.3 Output/results

The users have to define the products of the Scheldt-GIS. This report contains some examples. Dependent on the wishes of the participants and the investments that will be made, there are several options like:

1	One administration makes only a database and takes care of the updating of the database. The ISG participants get the database and will make there own products and applications.
2	The Scheldt-GIS is used as a databank. The ISG participants define the products like reports, maps and tables. One administration manages the system and delivers the products.
3	The Scheldt-GIS is used as a databank. The ISG participants define the products like reports, maps an tables and (pc-) applications. One administration manages the system and delivers the products and applications.
4	The Scheldt-GIS is introduced at the participating administrations. Each administration can defines and makes its own products and applications, besides the joint products and applications. One administration takes care of the updating of the databases and the deliverance of joint products and applications.

4.4 Scheldt-GIS 1994

The participants will have to decide about the objectives and products of the Scheldt-GIS in 1994 and further. If one of the four options will be chosen the financial consequences will have to be discussed. Each administration should think about the advantages of a Scheldt-GIS in relation with its activities and in relation with the establishment of an integrated water management approach in the river Scheldt basin.

5. Emissions in the Scheldt basin

5. Emissions in the Scheldt basin

5.1 Introduction

A detailed inventory of the different emission sources categories is necessary to describe the relations between emissions and water quality. In the Netherlands, Rijkswaterstaat Division Zeeland (RWS-ZLD) and the National Institute for Coastal and Marine Management (RIKZ) run a project in which emission sources and surface water quality are linked. The main objective of this project is to study the consequences of emission reduction measures for parameter concentrations, discharges and physical, chemical and biological processes in the Scheldt-estuary. The most important instrument within this project is the water quality model for the Scheldt estuary, named as the SAWES model. A distinguishment is made in five categories:

* communal emission sources
* industrial emission sources
* polder water
* atmospheric deposition
* outlet of canals

In 1993 a start has been made with the collection of figures on communal and industrial emission sources. This chapter gives an overview of the available data.

5.2 Waste water treatment plants

The first step in river system restoration is the treatment of communal and industrial waste waters. This paragraph gives an overview of the available and planned communal waste water treatment infrastructure in the Scheldt riparian states. The figure 5.1 is a map of the Scheldt basin which shows the available and planned waste water treatment plants. Although the total design-capacity in the French part of the Scheldt basin will increase with ± 900,000 habitant-equivalents (period 1992-1996), no detailed figures are available on the planned locations.

The figure 5.2 shows the communal waste water treatment balance of the Scheldt basin in 1991. If France, Wallonia and Brussels carry out their investments programmes, in 2000 the design-capacity could be sufficient to treat the waste water of all the habitants. In Flanders at the end of 1994 the available capacity could be sufficient for 83.1% of the required design-capacity. In the Netherlands the present available design-capacity is sufficient.

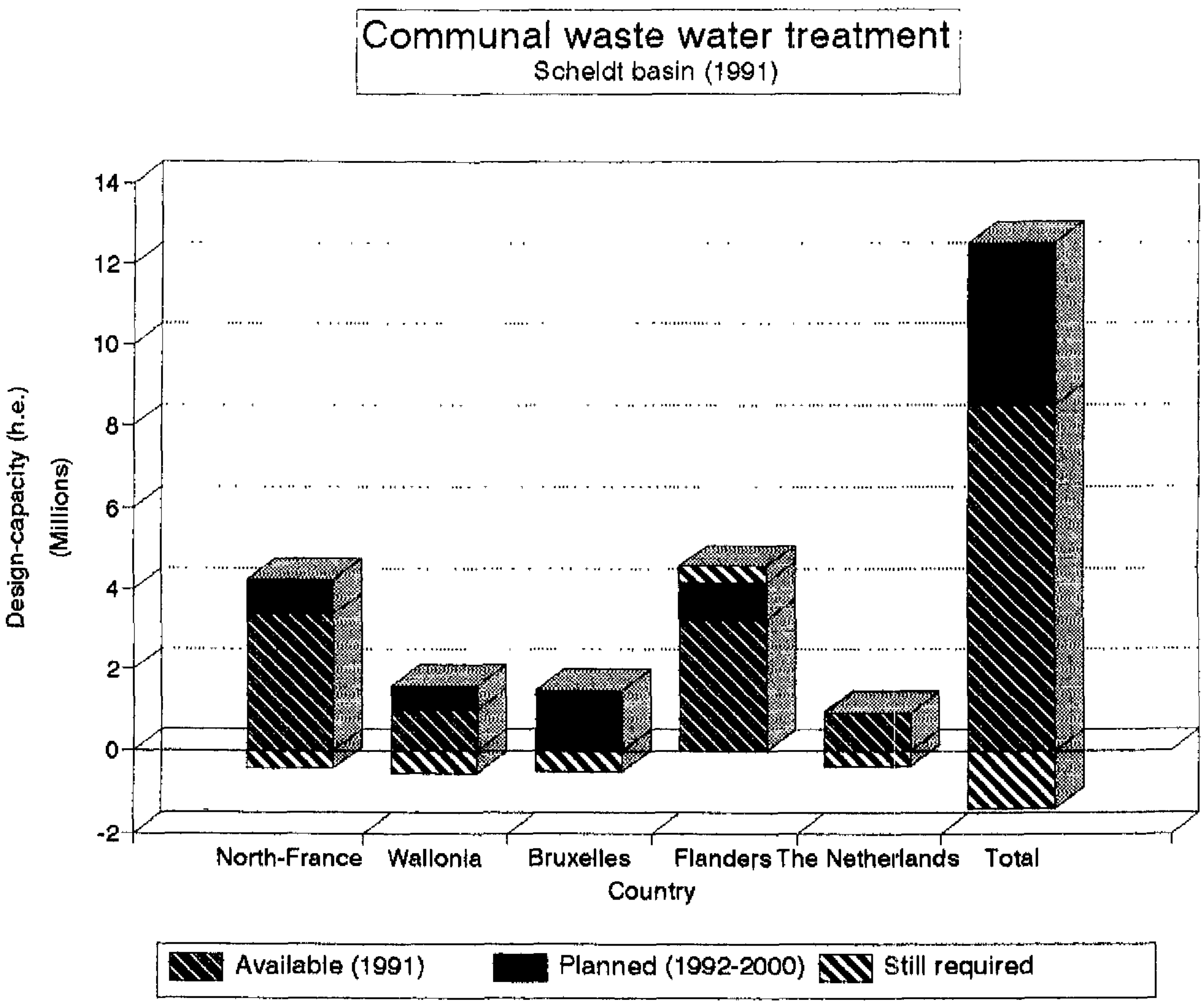


Figure 5.2 The communal waste water treatment balance of the Scheldt basin (situation 1991). If the still required capacity part is negative, it means that there is an over-capacity.

In 2000 in the whole Scheldt basin the average available design-capacity could be sufficient to treat the waste waters of housholdings (biodegradable substances). This conlusion can only be drawn if there are no industries connected to the communal waste water treatment plants and if the total treatment infrastructure (including sewage systems and collector networks) is sufficient. If some industries stay connected to the communal waste water treatment plants the required design-capacity is much higher.

Until 1991 in all riparian states the emphasis lied on the treatment of biodegradable substances. Between 1992 and 2000 investments will also be made on denitriphication and dephosphatation.

5.2.1 North-France

In the French part of the Scheldt basin (les secteurs E1, E2 and E3) there are 136 waste water treatment plants available with a total design-capacity of 3,358,400 habitant-equivalents. The appendix 5.1 is an overview of these treatment plants.
The figure 5.3 shows the available treatment plants and the required design-capacity in the area E1 + E2 (Haut-Escaut + Scarpe) and E3 (Lys). The figures of this inventory show that the available design-capacity (1991) could be sufficient for the treatment of 88% of the waste water from the 3,833,199 habitants. Especially in E3 there is a lack of waste water treatment plants. Due to insufficient investments in the collector networks the equipment can not be used completely. As a result in 1990 only 46% of the communal pollution was eliminated.

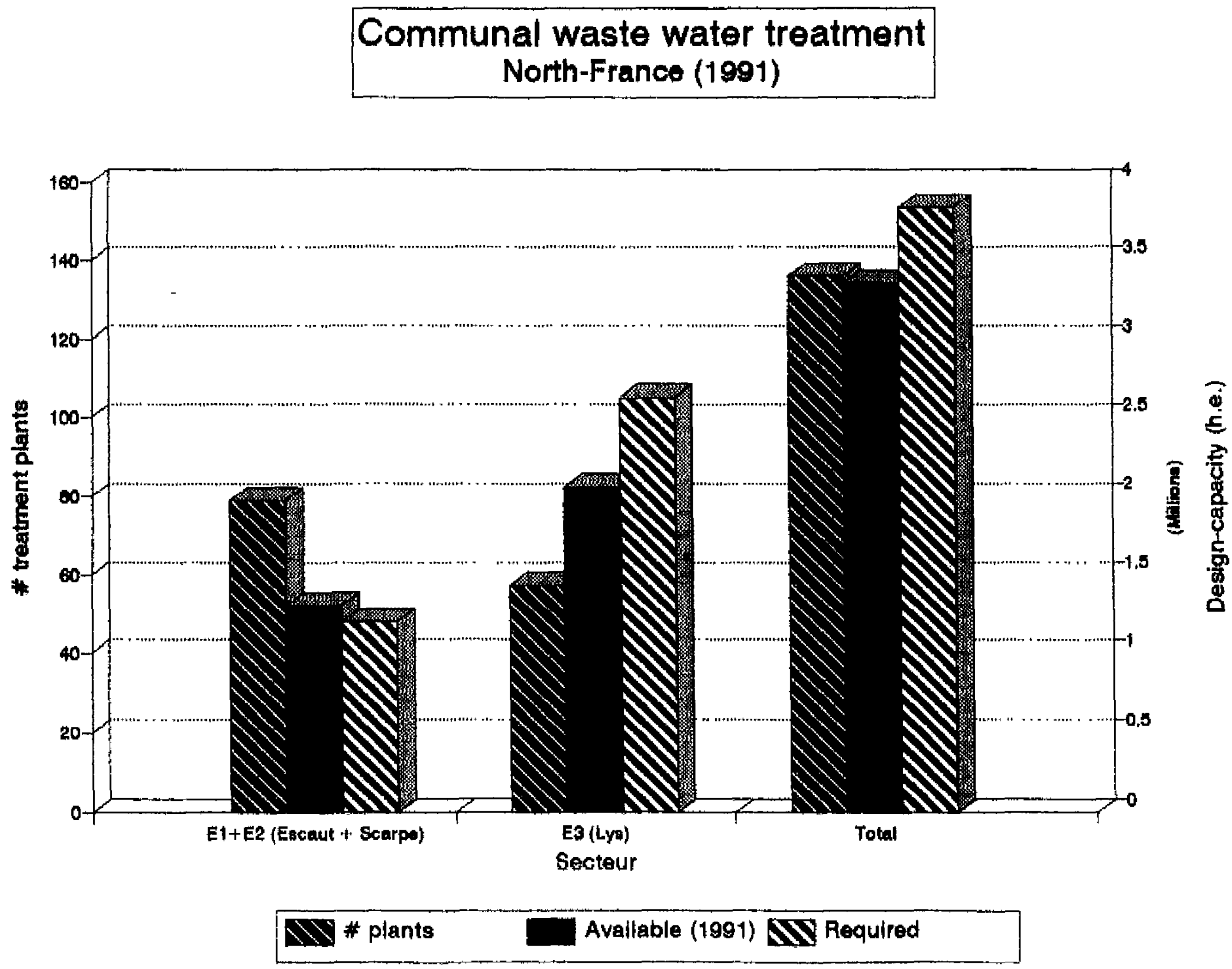


Figure 5.3 Communal waste water treatment balance of the French part of the Scheldt basin (situation 1991).

Based on the presentation method of the Agence de l'Eau Artois-Picardie, there are five size categories:

I	plants with a design-capacity of > 0 and < 5,000 h.e.
II	plants with a design-capacity of ≥ 5,000 and < 10,000 h.e.
III	plants with a design-capacity of ≥ 10,000 and < 50,000 h.e.
IV	plants with a design-capacity of ≥ 50,000 and < 100,000 i.e.
V	plants with a design-capacity of ≥ 100,000 h.e.

The figure 5.4 shows the treatment plant size distribution (situation 1991). The majority of the treatment plants are small (categories I, II and III), especially located in zone E1 (Upper-Scheldt).

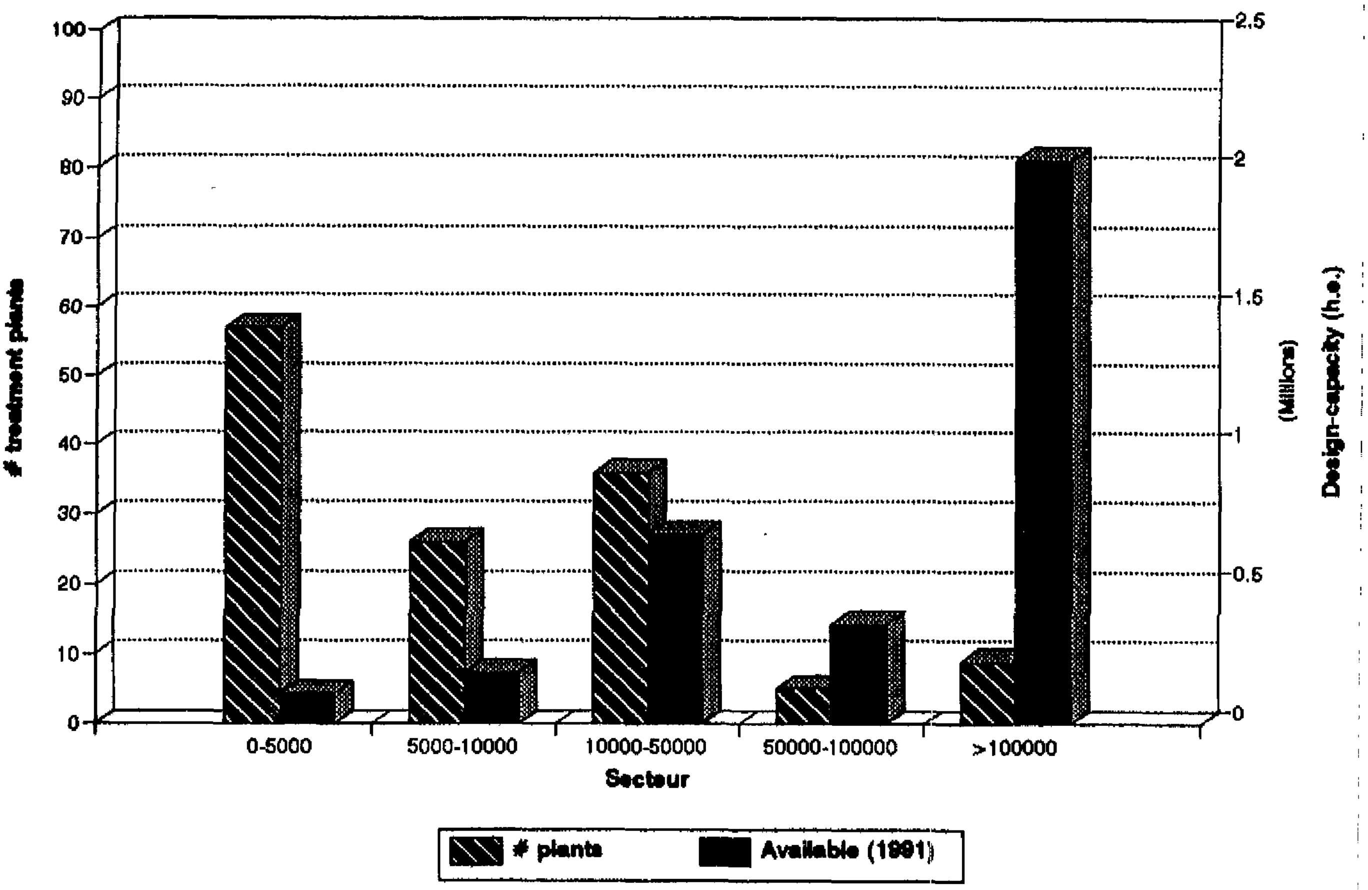


Figure 5.4 Waste water treatment plant size distribution in the French part of the Scheldt basin (situation 1991).

The figure 5.5 shows the evolution in the available and planned design-capacity in the French part of the Scheldt basin. The total design-capacity is given for the periods 1967-1971, 1972-1976, 1977-1981, 1982-1986, 1987-1991 and 1992-1996. These periods are related to the investment programs of the Agence de l'Eau Artois-Picardie. The available design-capacity is the design-capacity that is available at the beginning of the period. The planned design-capacity is the capacity which has been built during the period.
In the periods 1972-1976, 1977-1981 and 1987-1991 the French government made large investments. In the period 1992-1996 the emphasis lies on the development and exploitation of sewage systems, the connection of house-holdings to sewage systems, the expansion of the available design-capacity and denitriphication and dephosphatation.

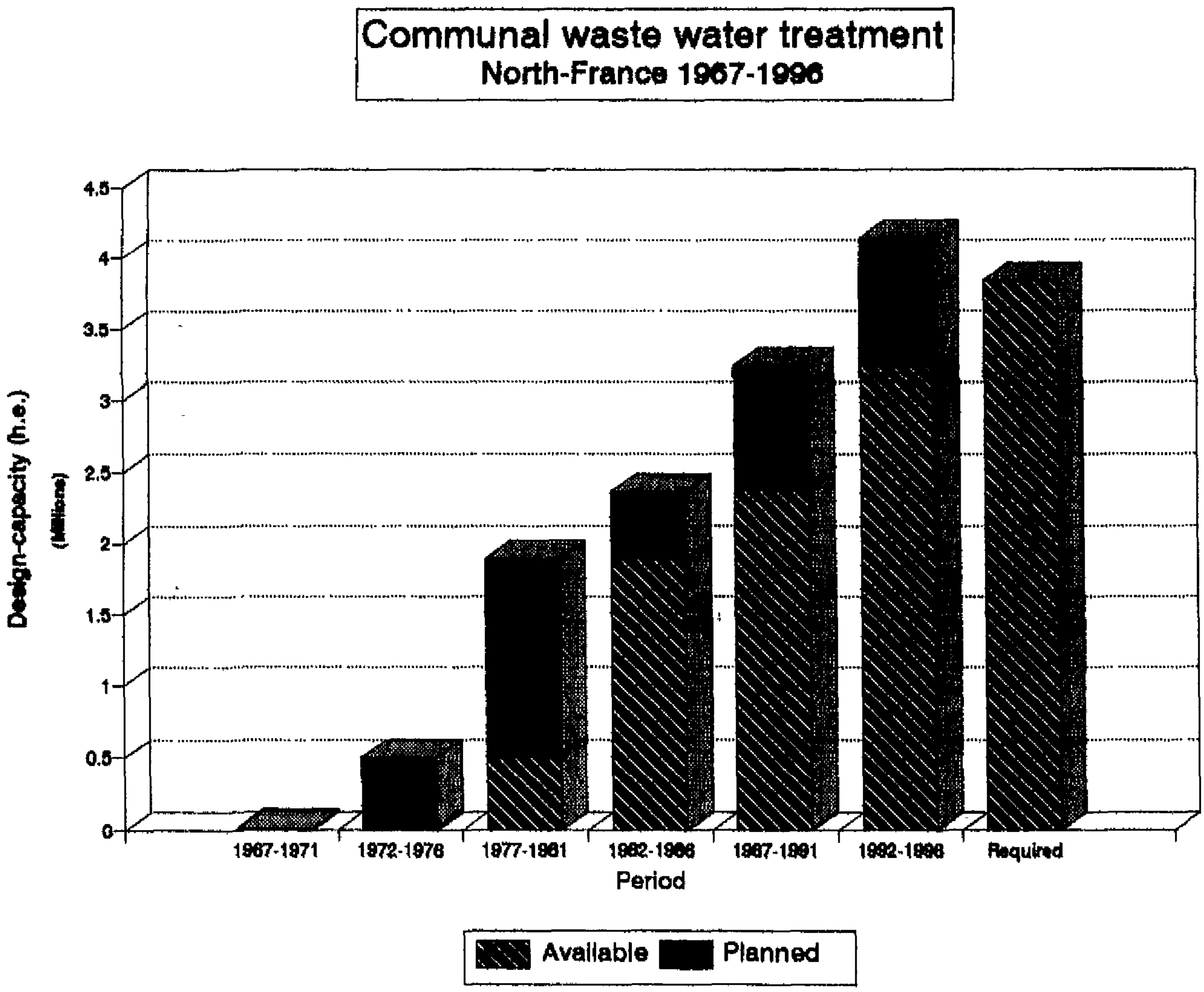


Figure 5.5 Evolution of the available and planned design-capacity in the French part of the Scheldt basin (period: 1967-1996).

Until 1991 the emphasis has lied on the treatment of organic and suspended matter. Therefore the majority of the available waste water treatment plants has not the equipment for the elimination of nitrogen and phosphorus. One of the main problems is that some industries are also connected to the communal waste water treatment plants. Accidental discharges and strong fluctuations in the influent can cause damage and disfunctioning of treatment plants.

The figure 5.6 shows the mean treatment efficiencies of suspended matter (MeS), organic matter (MO) and reduced nitrogen (MA = organic + ammonia nitrogen) over the period 1985-1992. MO is defined as (COD + $2BOD_5$)/3. The appendix 5.2 gives the mean treatment efficiencies and the standard deviations per season. The figures are related to treatment plants with a design-capacity of more than 10,000 habitant-equivalents.
The mean treatment efficiencies for respectively MO, MA and MeS are 75%, 40% and 87%. The ranges for respectively MO, MA and MeS are 28-95%, 15-94% and 63-98%.

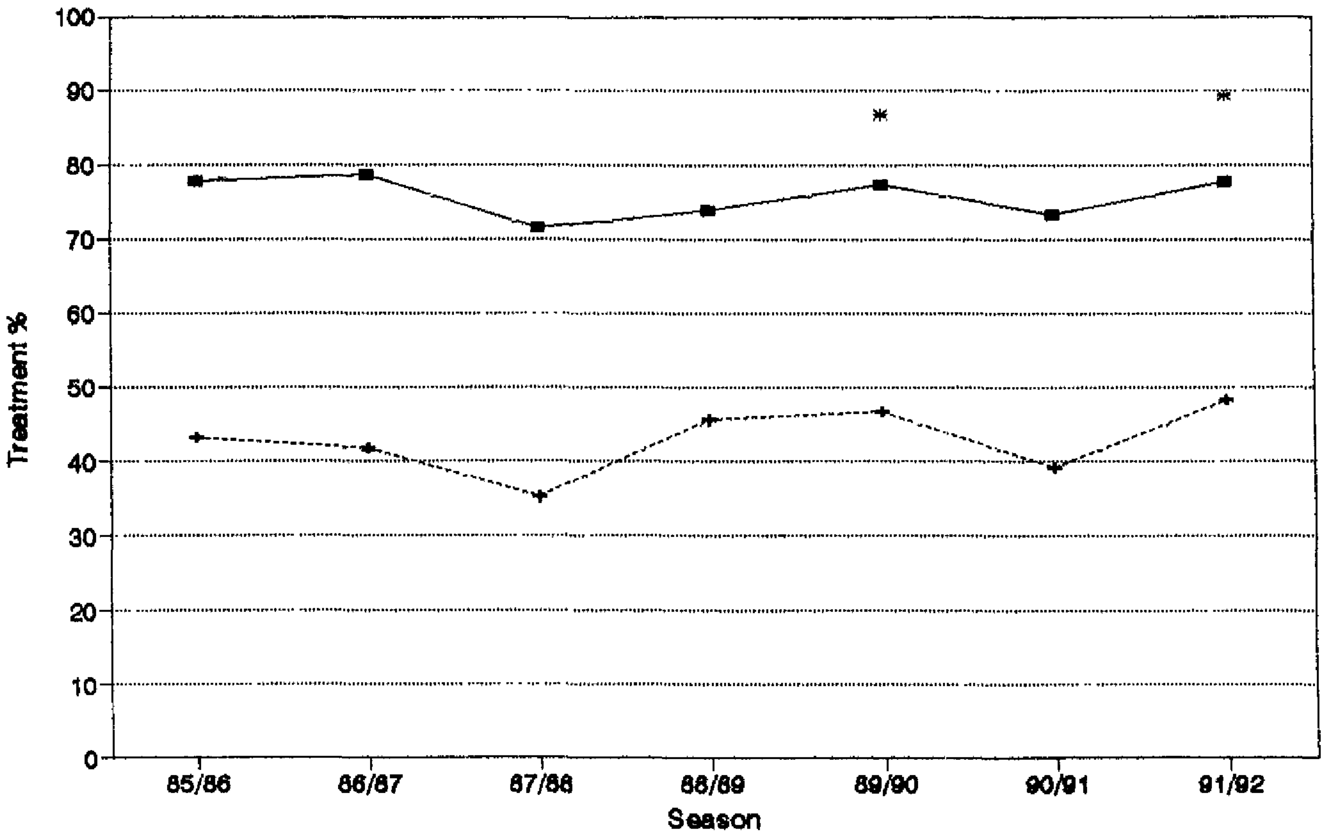


Figure 5.6 Mean treatment efficiencies of waste water treatment plants in North-France (period 1985-1992). Parameters: MO, MA and MeS. Only treatment plants with a design-capacity > 10,000 habitant-equivalents are included.

5.2.2 Wallonia

In the Wallonian part of the Scheldt basin there are 57 waste water treatment plants available with a total design-capacity of 992,475 habitant-equivalents. This capacity could be sufficient for the treatment of 91.7% of the communal waste water. The appendix 5.3 is an overview of all waste water treatment plants in the administrative area IBW (Senne, Dijle and Demer), IDEA (Haine and Senne) and IPALLE (Haut-Escaut, Lys and Dendre).

The figure 5.7 shows the available design-capacity (1991), the planned design-capacity (1992-1996) and the required design-capacity in each administrative area. The available design-capacity in 1996 in the area IBW and IDEA could be sufficient for the treatment of the communal waste water. In the IPALLE area more equipment will be required. One of the main problems is the connection of industries to communal waste water treatment plants. At none of the operational treatment plants the technical equipment is available for denitrification and/or dephosphatation.

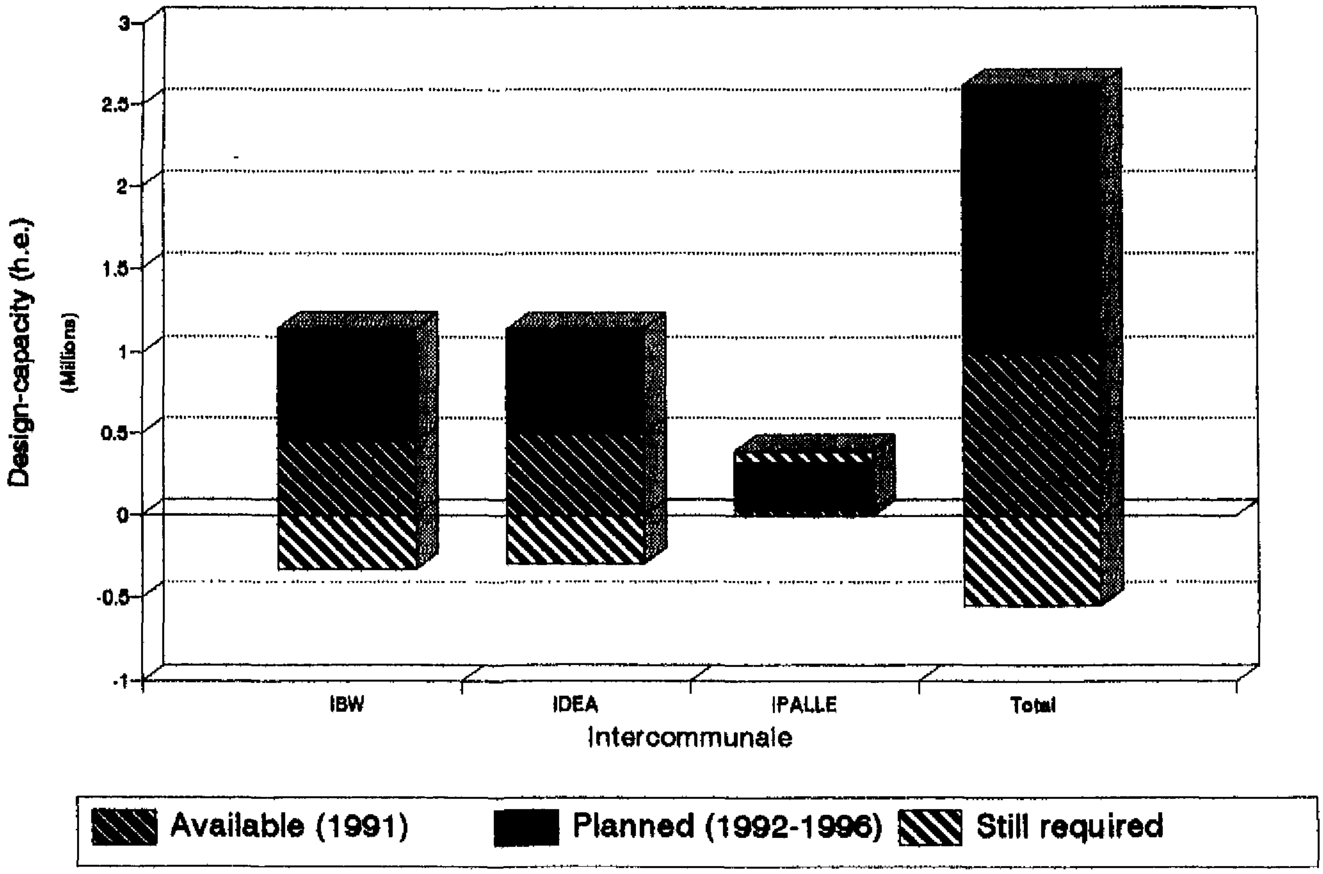


Figure 5.7 Waste water treatment balance in the Wallonian part of the Scheldt basin (situation 1991). A negative still required part means that there is an over-capacity.

The figure 5.8 shows the treatment plant size distribution (situation 1991). The majority of the plants (81%) are small (plants with a design-capacity between 0 and 5,000 habitant-equivalents), especially located in the zones IBW and IPALLE.
The figure 5.9 shows the evolution of the available and planned design-capacity in the Wallonian part of the Scheldt basin. In the periods 1972-1976 and 1982-1986 the Wallonian government made large investments.
In the period 1992-1996, 239 millions ECU will be invested in the building and adaptation of treatment plants and collectors. As a result the design-capacity will increase with 661,400 habitant-equivalents. A number of small plants will be replaced by bigger ones. At four treatment plants the technical equipment will be installed to denitriphicate and/or dephosphatate. The appendix 5.4 gives an overview of the planned waste water treatment equipment and adaptations.

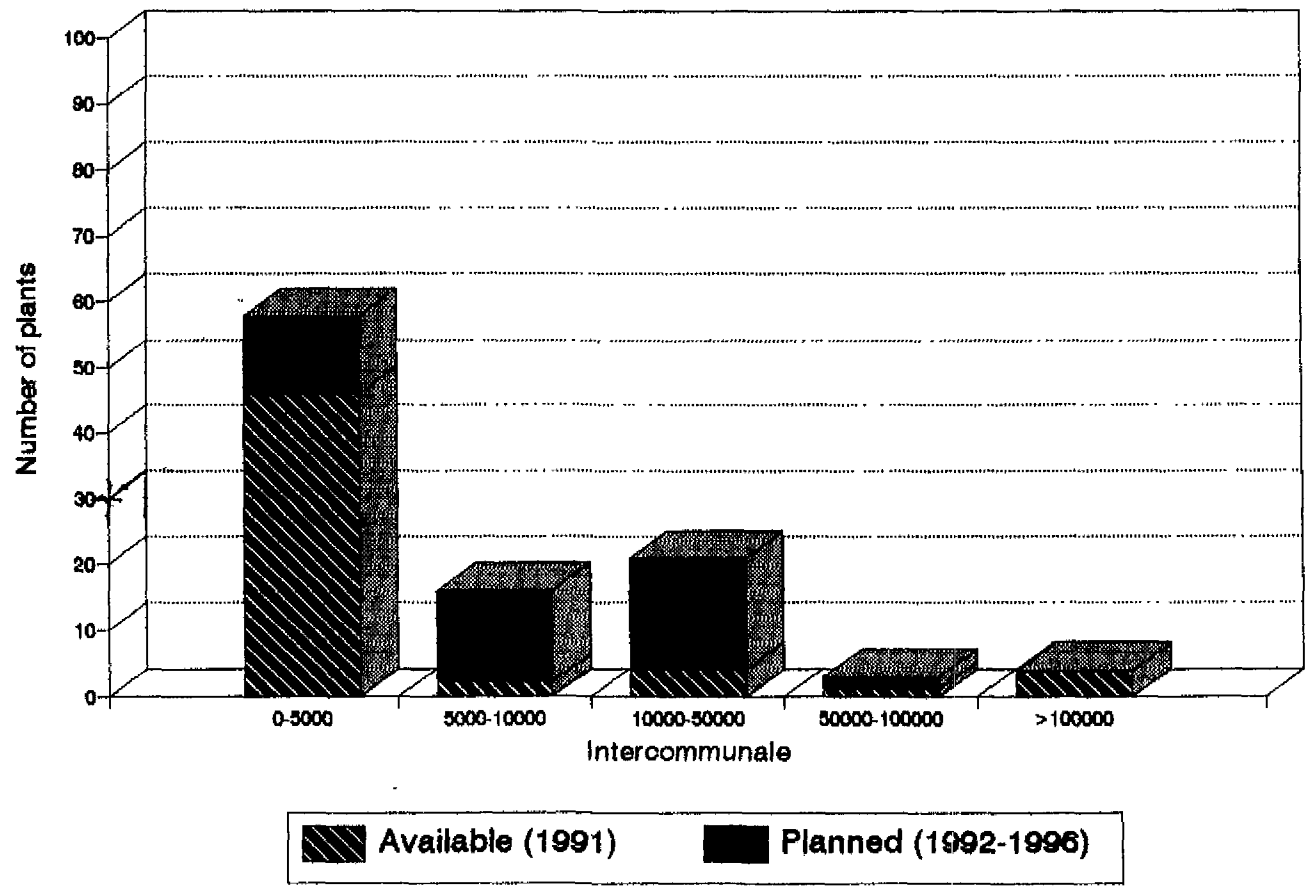


Figure 5.8 Waste water treatment plant size distribution in the Wallonian part of the Scheldt basin (situation 1991).

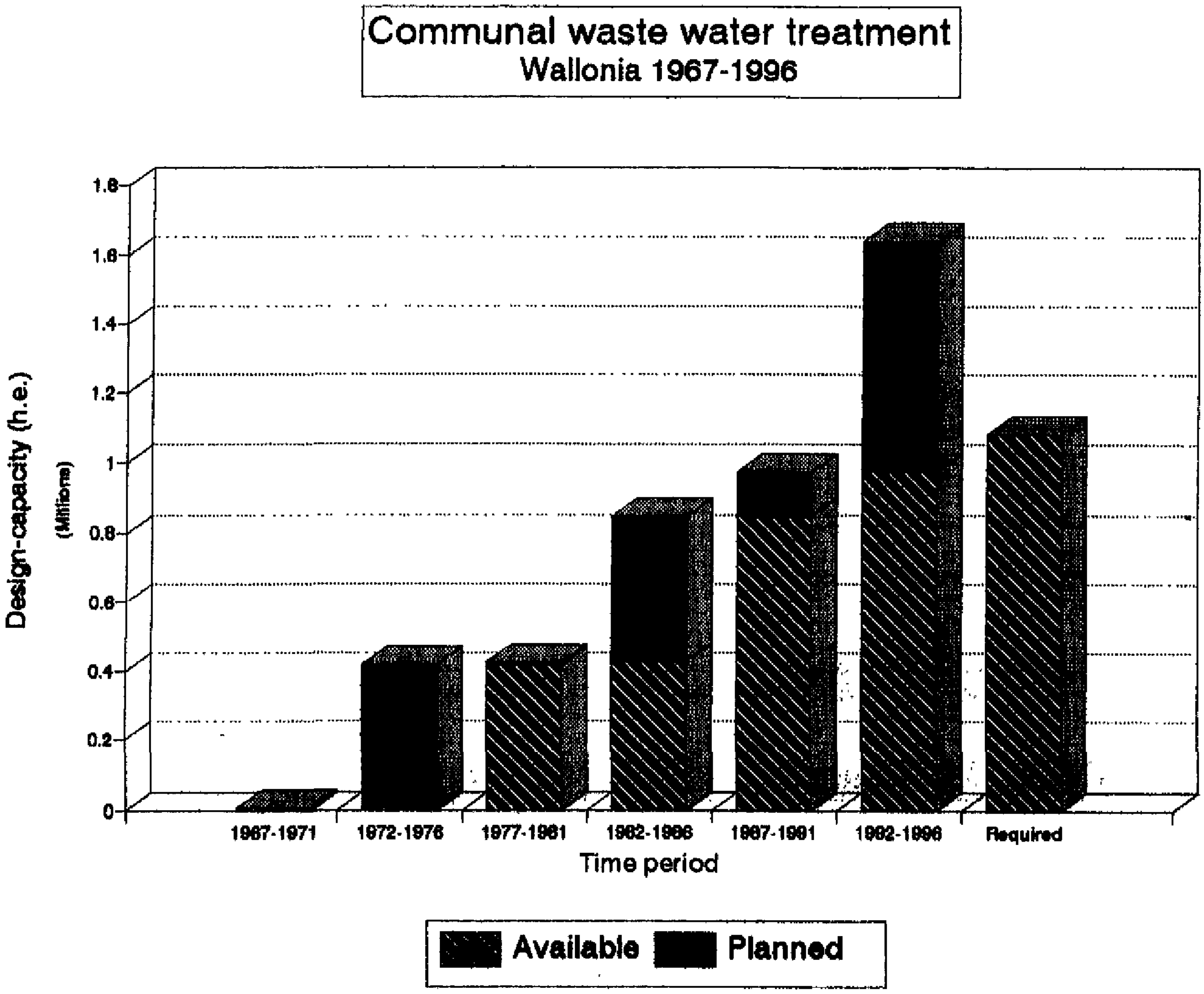


Figure 5.9 Evolution of the available and planned waste water treatment plants in the Wallonian part of the Scheldt basin (period 1967-1996).

5.2.3 Brussels

At this moment there are no communal waste water treatment plants in the Brussels Region. Therefore the waste water of the householdings in the Brussels region is not treated, although more than 95% of the habitants have been connected to a sewage system. In 2000 two treatment plants will be operational with a total design-capacity of 1,500,000 habitant-equivalents. This capacity will be sufficient to treat both communal (1,000,000 habitant-equivalents) and industrial (± 500,000 pollution-equivalents) waste water.

5.2.4 Flanders

In the Flemish part of the Scheldt basin (the selected AWP-II basins) 87 communal waste water treatment plants are operational with a total design-capacity of 3,218,960 habitant-equivalents. This capacity could be sufficient for 62.4% of the required capacity. At 46 treatment plants industrial waste water is also treated. Therefore the design-capacity is not only available for the treatment of communal waste water. The appendix 5.5 is an overview of all waste water treatment plants in the Flemish part of the Scheldt basin. The appendix 5.6 gives an overview of the treatment characteristics in the hydrographic subbasins in Flanders.

The figure 5.10 shows the available design-capacity (1991), the planned design-capacity (1992-1994) and the required design-capacity per hydrographic subbasin.

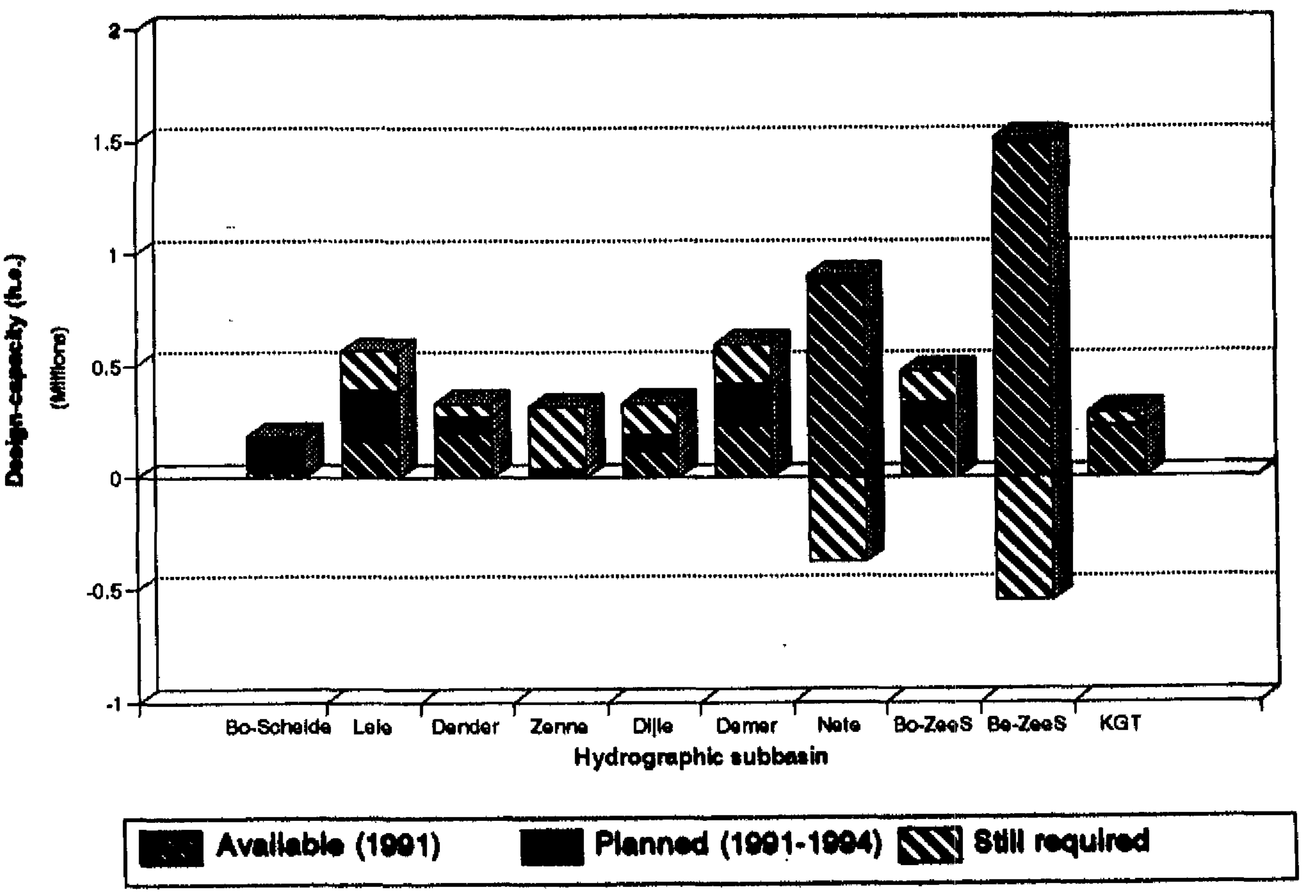


Figure 5.10 Communal waste water treatment balance in the Flemish part of the Scheldt basin. A negative still required capacity part means that there is an over-capacity.

The figure 5.11 shows the mean sewage percentage and the mean waste water treatment percentage (expressed as the percentage of the habitants that are connected to a sewage system) per hydrographic subbasin.
The figure 5.12 shows the required design-capacity (if 1 habitant = 1 habitant-equivalent) and the number of habitant-equivalents that is treated (situation 1991).

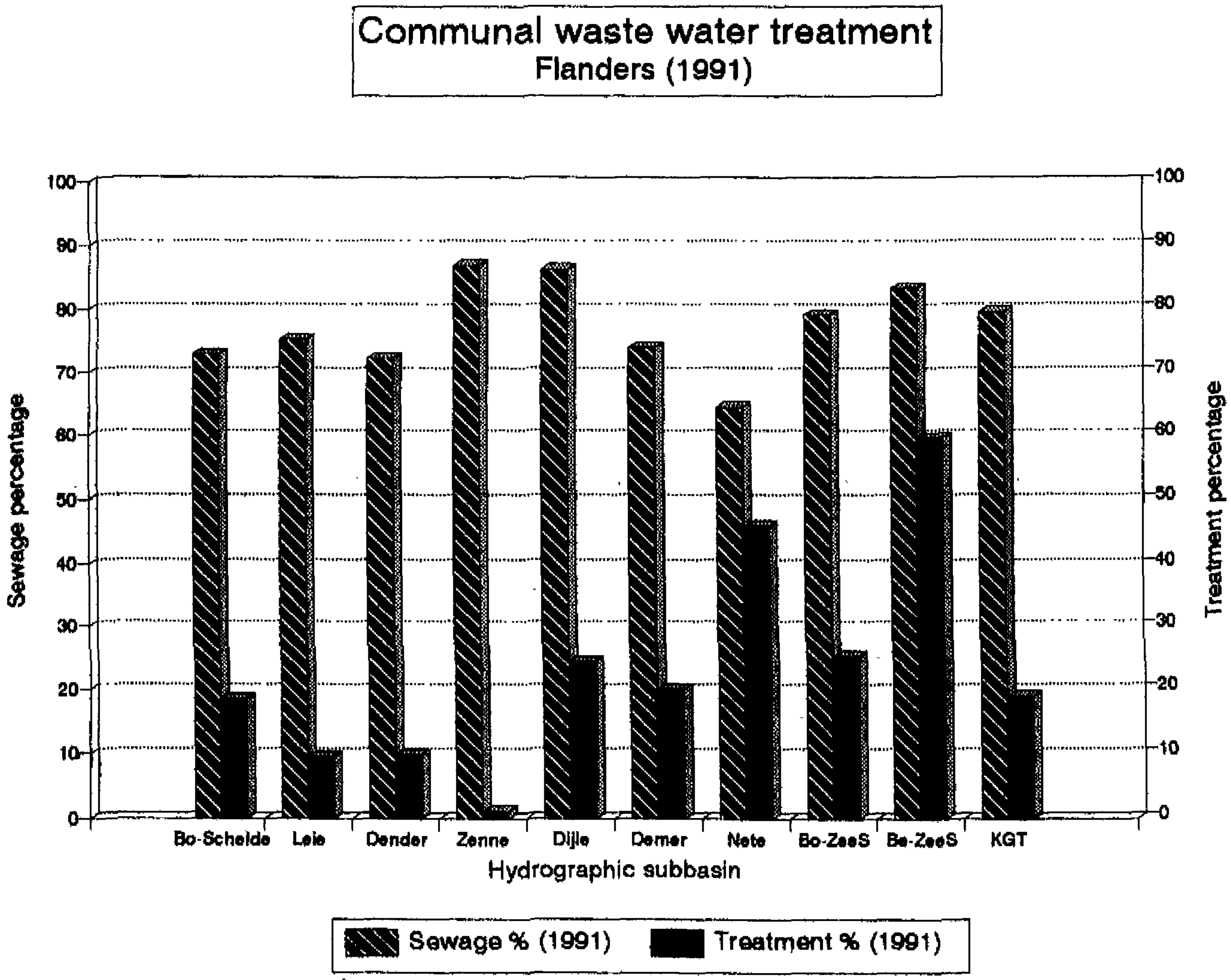


Figure 5.11 Communal waste water treatment characteristics per hydrographic subbasin in the Flemish part of the Scheldt basin (situation 1991). The waste water treatment percentage is defined as the percentage of the habitants that are connected to a sewage system.

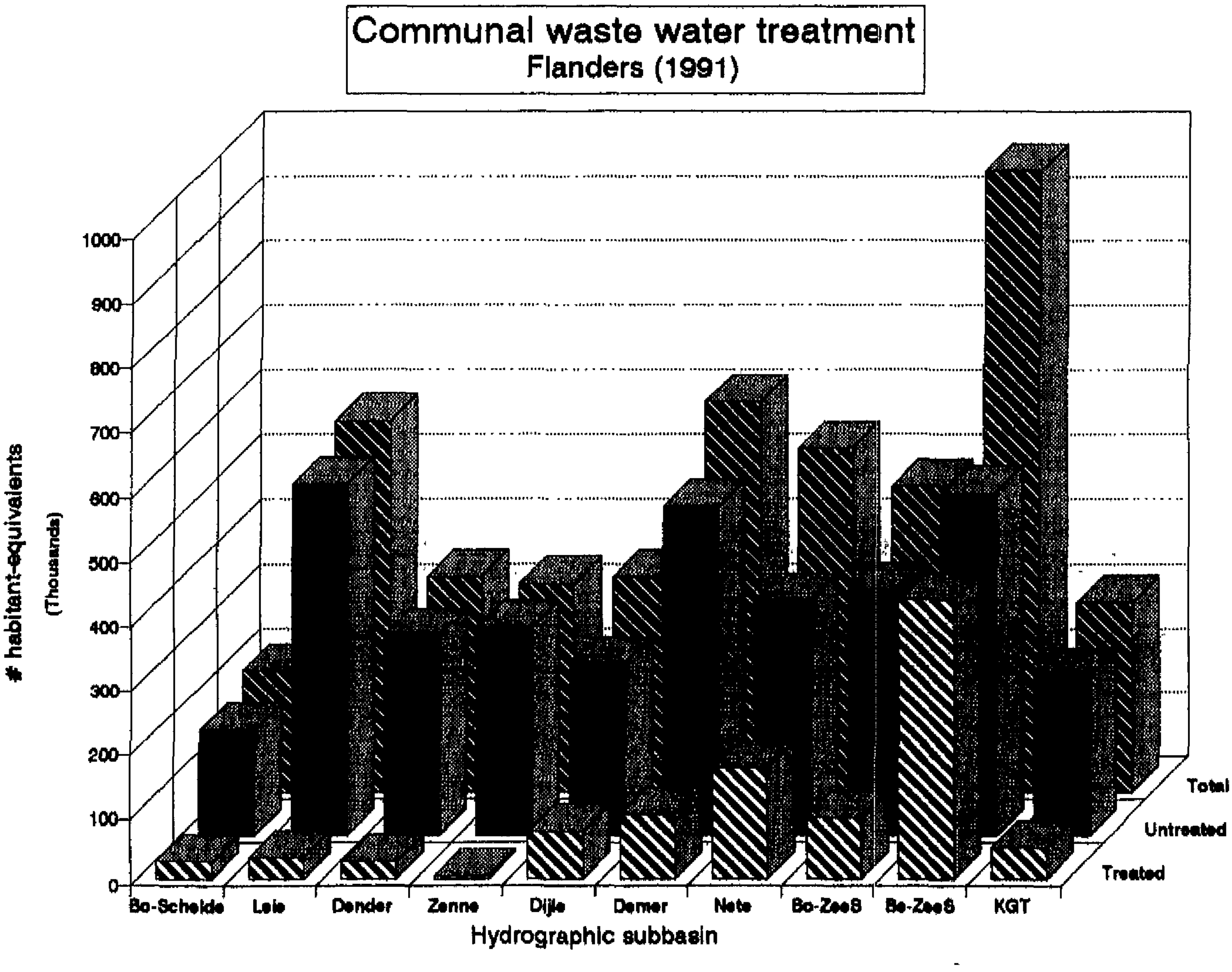


Figure 5.12 Required design-capacity and the number of habitant-equivalents that are treated per hydrographic subbasin in the Flemish part of the Scheldt basin.

The mean sewage percentage in this area is 76%. Due to a lack of collector networks only 21% of the waste water produced by the 5,160,500 habitants is treated (situation 1991). In the Nete and the Beneden-Zeeschelde subbasins there is an overcapacity. At the end of the investments programme 1991-1994 the available capacity could be sufficient for 81.3% of the required capacity.

The figure 5.13 shows the waste water treatment plant size distribution (1991).
The majority of the plants (81%) are small (categories I, II and III).
The figure 5.14 shows the evolution in the available and planned design-capacity in the Flemish part of the Scheldt basin.

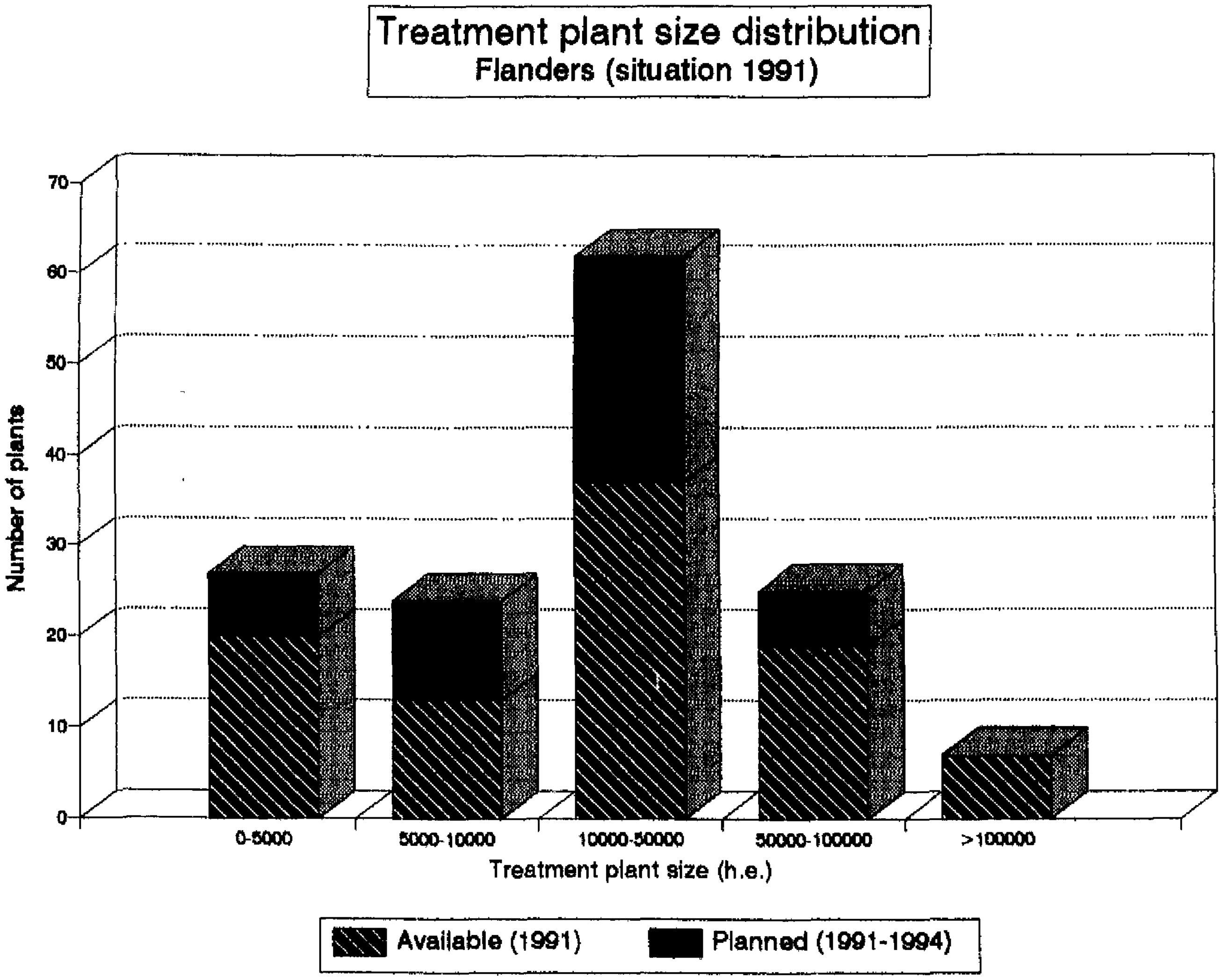


Figure 5.13 Waste water treatment plant size distribution in the Flemish part of the Scheldt basin.

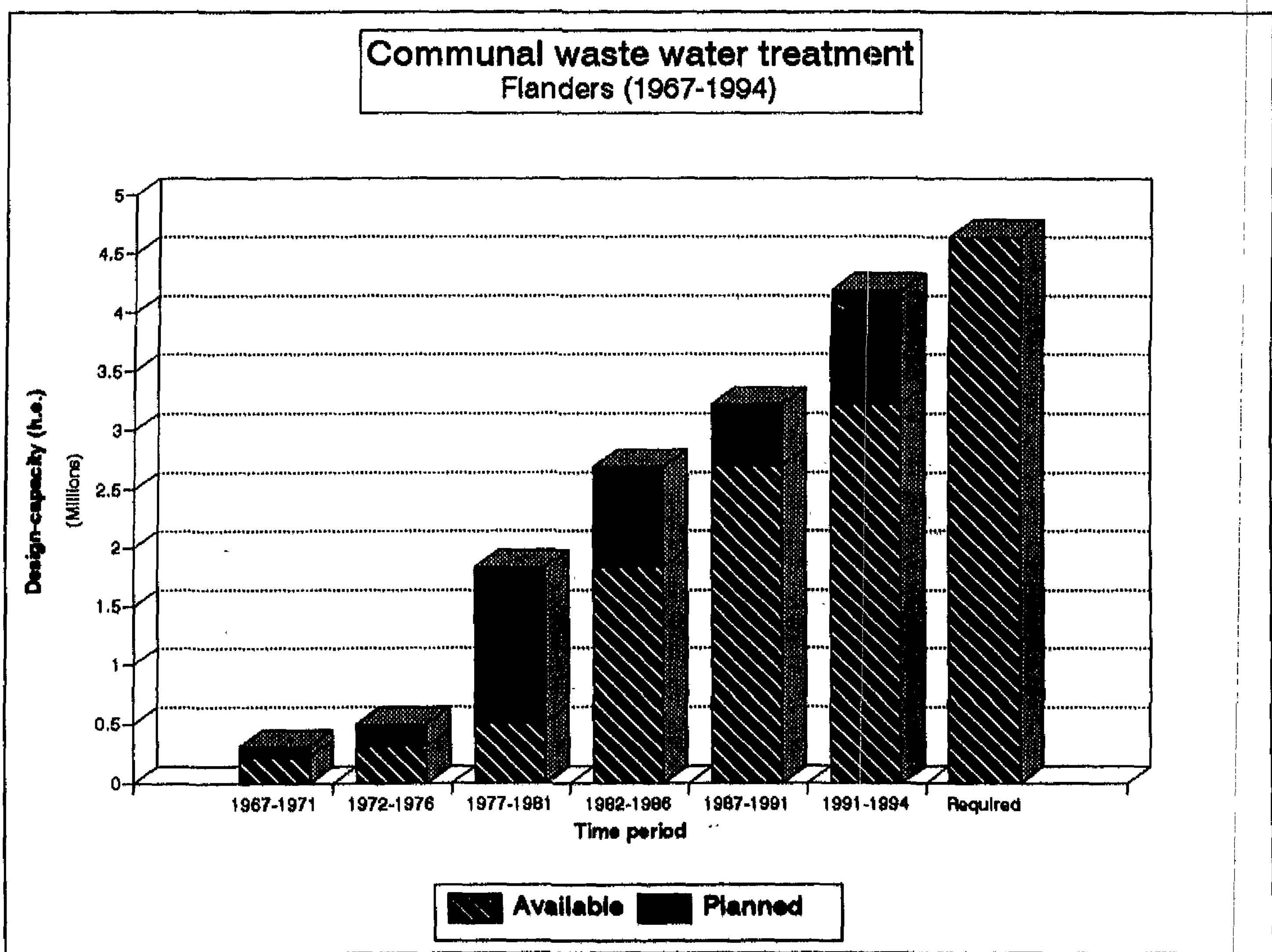


Figure 5.14 Evolution in the available and planned design-capacity in the *Flemish* part of the Scheldt basin.

The appendix 5.7 gives an overview of the planned waste water treatment plants in the period 1991-1994. A total number of 49 plants is planned; at 12 of these the treatment equipment will be installed for denitriphication and/or dephosphatation. The design-capacity will increase with 976,635 habitant-equivalents.

The Flemish Executive makes an annual investments programme based on the General Waste Water Treatment Programmes. AQUAFIN has to setup and execute technical plans concerning new treatment infrastructure. For each AWP-II basin or a part of such basin a technical plan has to be made. The VMM, AMINAL and the basin committees discuss these technical plans. If the Minister of Environmental Affairs agrees with the plans Aquafin can execute these.
In the period 1991-1994 six AWP-basins have the highest priority:

AWP-II 18	Dender
AWP-II 22	Boven-Schelde
AWP-II 24	Kleine Nete
AWP-II 25	Grote Nete
AWP-II 26	Boven-Demer
AWP-II 27	Beneden-Demer

In a short time period a big number of treatment plants will have to be designed and built. The choise of the treatment technology depends on the design-capacity and the water quality objectives for the effluents receiving watercourses.
The standard values of BOD, COD and SM are independant of the design-capacity of a treatment plant. The standard values of N and P are more severe for bigger treatment plants.
If a big part of the waste water in the influent derives from industrial sources more advanced technologies have to be used. For example: the major part of the influent of the treatment plant Waregem (60%) will be waste water from the textile industries. In order to destruct the complex biological components advanced technology will have to be used. As a consequence the investments costs and the exploitation costs will be very high.
The appendix 5.8 summarizes the available information on treatment efficiencies.

The efficiencies are calculated for the parameters COD, BOD, SM, Kjeldahl-nitrogen, COD/BOD, $NH4+$ and total-P (1989, 1990, 1991) and $NO3-$, $NO2-$, As, Cr, Cu, Pb, Ni, Ag, Zn, Hg and Cd (1990, 1991). The figures 5.15 and 5.16 show the mean treatment efficiencies for the period 1989-1991.

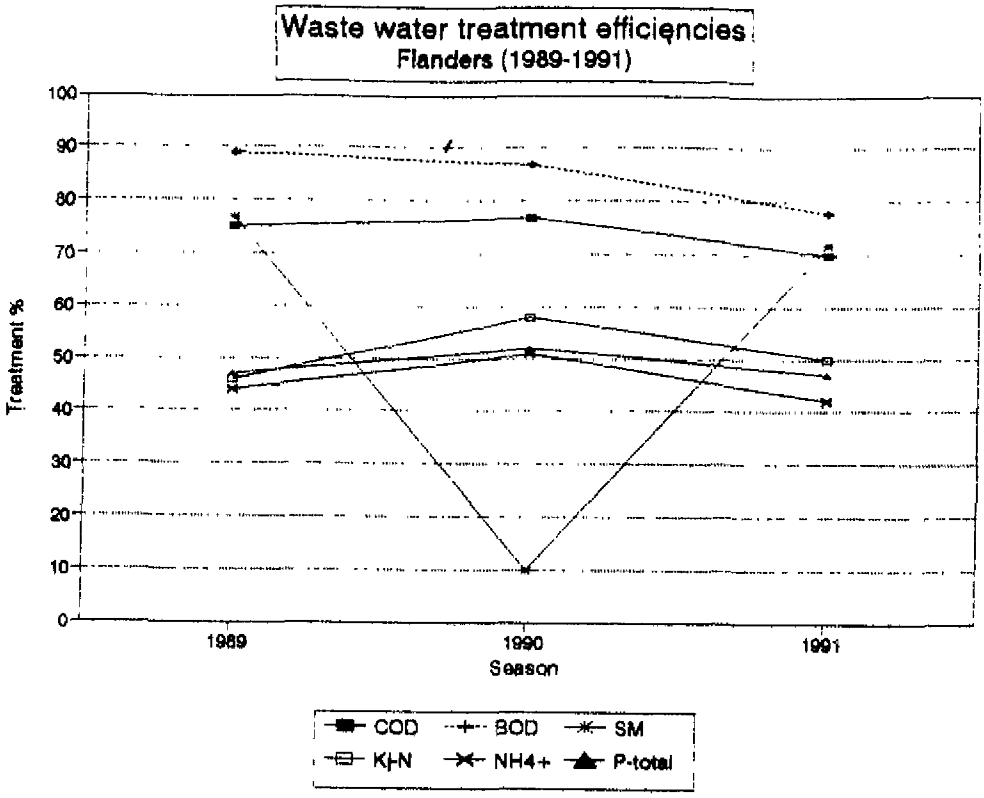


Figure 5.15 Treatment efficiencies of waste water treatment plants in Flanders (period 1989-1991). Parameters: BOD, COD, SM, Kj-N, NH4 and P-total.

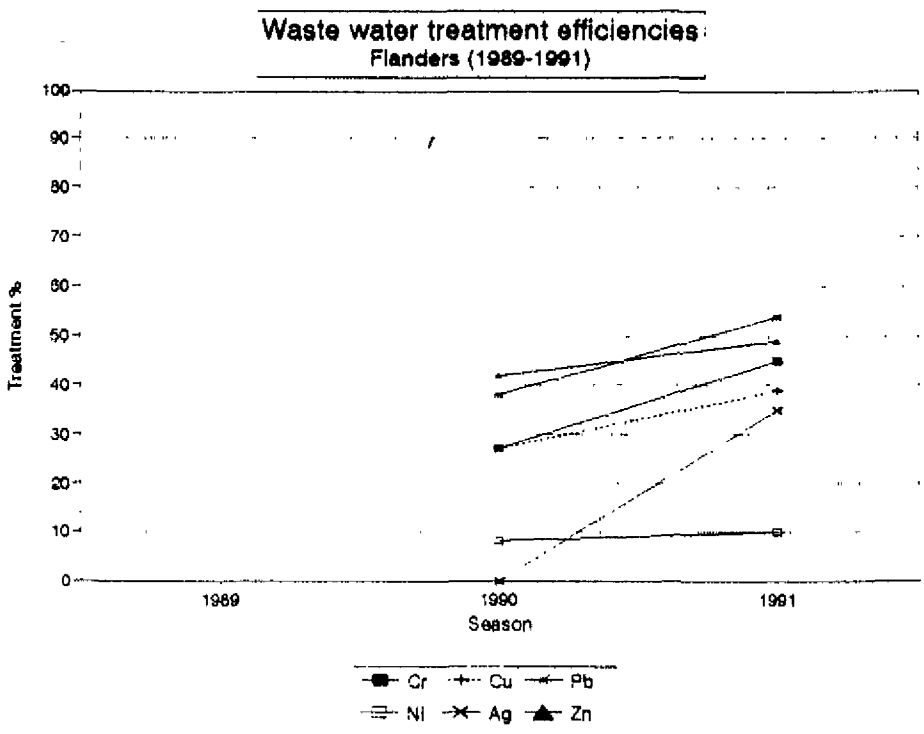


Figure 5.16 Treatment efficiencies of waste water treatment plants in Flanders (period 1990-1991). Parameters: Cr, Cu, Pb, Ni, Ag and Zn.

5.2.5 The Netherlands

In the Dutch part of the Scheldt basin there are 24 communal waste water treatment plants available with a total design-capacity of 966,600 habitant-equivalents (1991). This capacity is sufficient to treat the waste water of the 543,944 habitants. The mean sewage percentage is 93%. The appendix 5.9 is an overview of all waste water treatment plants in the Dutch part of the Scheldt basin.

The figure 5.17 shows the available and the required design-capacity (1991) in the management area of the Waterschappen.

The figure 5.18 shows the treatment plant size distribution.

The figure 5.19 shows the evolution in the available and planned design-capacity in the Dutch part of the Scheldt basin.

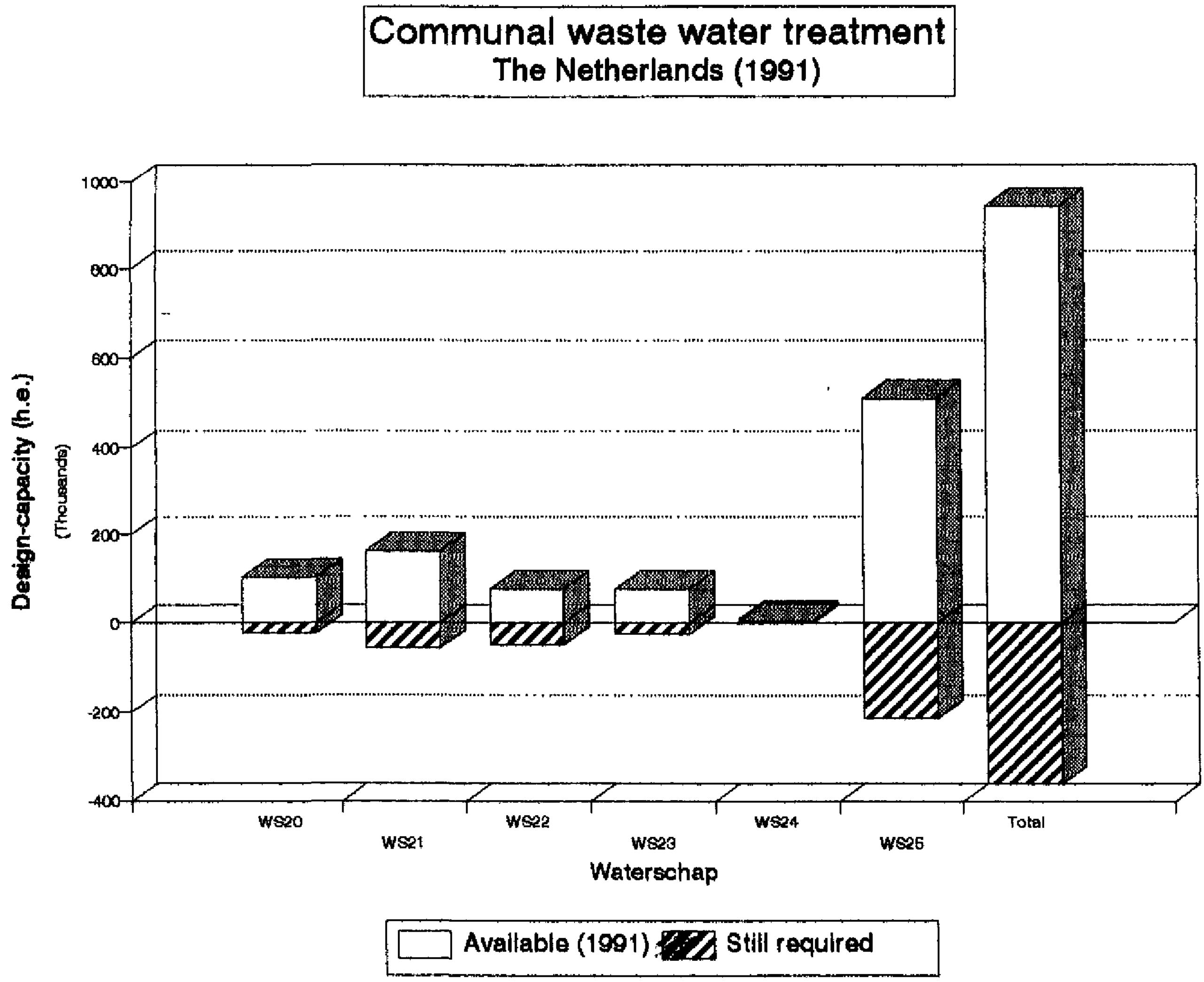


Figure 5.17 Communal waste water treatment balance of the Dutch part of the Scheldt basin (Westerschelde subbasin; situation 1991). A negative still required capacity part means that there is an over-capacity.

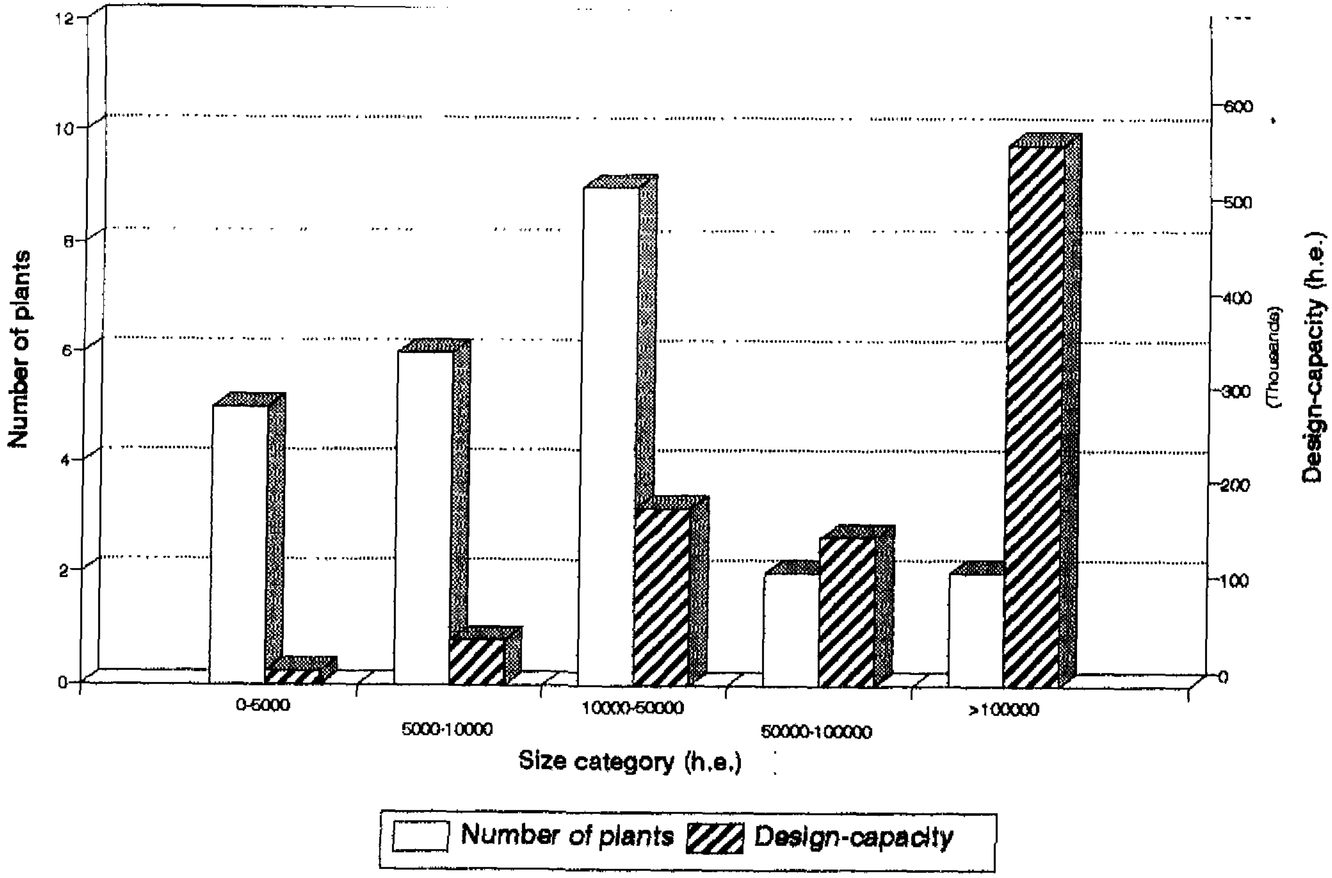


Figure 5.18 **Waste water treatment plant size distribution in the Dutch part of the Scheldt basin (situation 1991).**

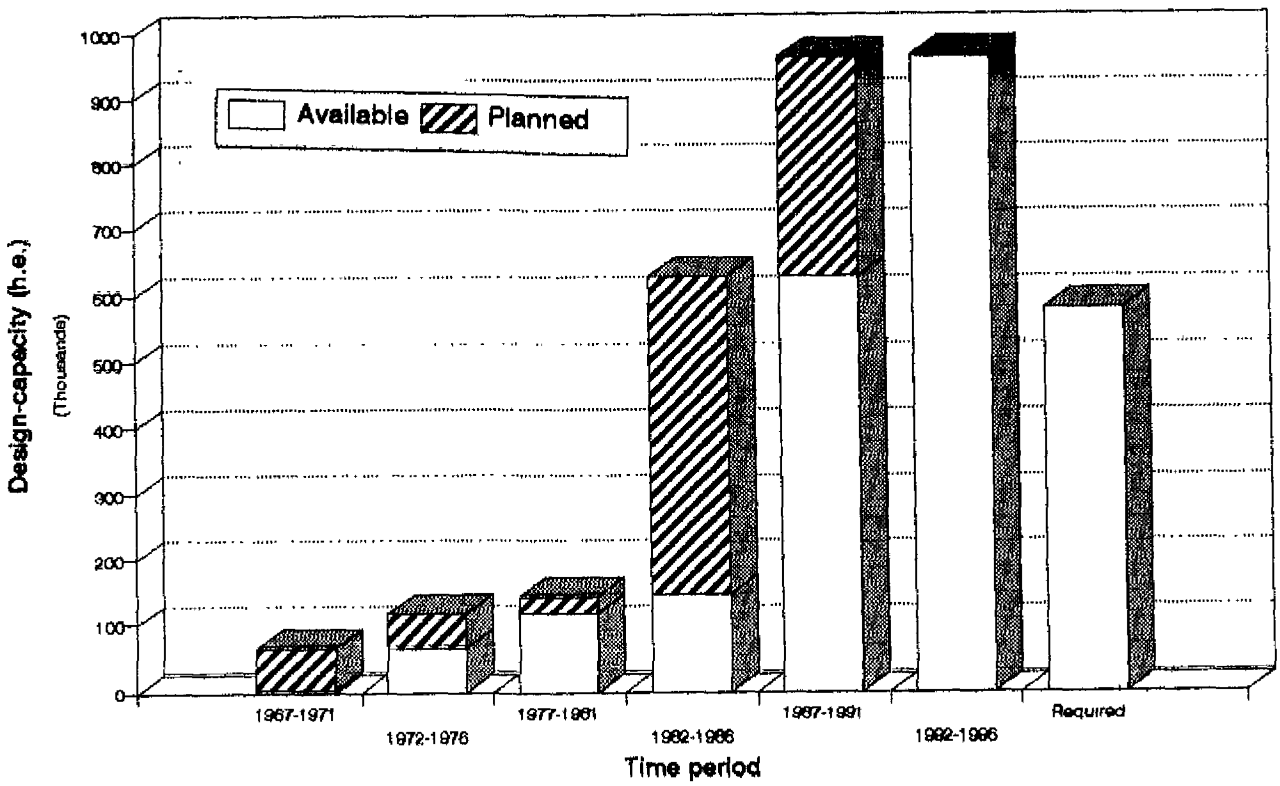


Figure 5.19 Evolution of the available and planned design-capacity in the Dutch part of the Scheldt basin (period: 1967-1996).

The majority of the plants are small ones (0-50,000 h.e.). Some industries are also connected to a treatment plant. Especially at the treatment plants Walcheren and Hulst there is an overcapacity in order to treat the extra waste water amounts deriving from tourists in summer periods.

There are no planned treatment plants in the Dutch part of the Scheldt basin. Until 1998 the emphasis lies on the optimalization of the available plants and on dentrification and dephosphatation activities.

The choise of the treatment technology depends on the size of the treatment plant. The effluent standards are related to the size of a treatment plant. They are mainly based on EC guideline 91/271 concerning the treatment of urban waste water and are the same for all purification plants in the Netherlands. The table 5.1 gives an overview of these standards. In general the standards are in force for available and planned treatment plants. In case of nitrogen and phosphorus the standards are in force for the planned plants. For the existing plants the nitrogen standards (N-tot) have to be met before 1998; the phosphorus standards (P-tot) before 1995.

Table 5.1 Effluent standards Dutch waste water purification plants.

Parameter	Maximum effluent concentration (mg/l)	Rendement in total management area (%) *)
BOD_5^{20}	20	90
COD	100	75
P-tot (in P; 1)	1	80
P-tot (in P; 2)	2	80
N-tot (in N; 3)	10	75
N-tot (in N; 4)	15	75
NH4-N (in N)	10	75
SM	30	-

The design-capacities are based on a average charge of 54 g BOD per i.e. per day.
1) Purification plants with a design-capacity ≥ 100,000 i.e.
2) Purification plants with a design-capacity < 100,000 i.e.
3) Purification plants with a design-capacity < 20,000 i.e.
4) Purification plants with a design-capaciyty ≥ 20,000 i.e.
*) A water manager has to reach an average efficiency percentage for the whole management area. This means that not at every treatment plant the standard has to be met.

The appendix 5.10 gives an overview of the treatment efficiencies of the individual treatment plants. As the figures show there are no problems with BOD and COD.

The Dutch objectives concerning nitrogen and phosphorus are:

- a emission reduction (householdings, industries and agriculture) to the surface waters with 75 and 70% of respectively phosphor and nitrogen (final objective);
- a reduction percentage between 1985 and 1995 of 50% for both phosphor and nitrogen (interim objective).

In the table 5.2 the mean effluent concentrations and the treatment efficiencies of P-tot and N-tot are given for the period 1990-1992. Column 2 gives the overstep percentages of the 1998 objective (N-tot); column 4 shows how far away the 75% management area reduction objective (1998) is, calculated as 100 - ((mean treatment efficiency/75) x 100)) %. Column 6 gives the overstep percentages of the 1995 ojective (P-tot). Column 8 shows how far away the 80% management area reduction objective (1995) is, calculated as 100 - ((mean treatment efficiency/80) x 100)) %.
For example the treatment efficiency (P-tot) at the purification plant Willem Annapolder has to increase with 40% in order to meet the 1995 objective. It has to be emphasized that if a water manager exploits more than one plant he can take measures at only one plant in order to meet the 75 and 80% management area reduction objectives.
As this table shows the 1995 and 1998 objectives are already met at the treatment plant Kloosterzande (the negative values). The Waterschap Noord- en Zuid-Beveland has the technical possibilities to meet the reduction objectives for N and P by adaptations of the treatment plant Willem Annapolder. The Waterschap Het Hulster Ambacht will adaptate the treatment plant Hulst in order to meet the 75% reduction objective for the whole management area before the end of 1995. No adaptations are necessary at the purification plant Kloosterzande (the 1995 and 1998 objectives are already met).
The Waterschap Walcheren will start with dephosphatation at 1995. It also prepares denitriphication plans. The Hoogheemraadschap West-Brabant will start with dephosphatation in 1995. It has not been a decision yet on denitrification activities. The Waterschap De Drie Ambachten will start with dephosphatation in 1995.

Table 5.2 Mean treatment efficiencies (N-tot, P-tot) in the period 1990-1992.

Treatment plant	N in effluent (mg/l)	2	Treatment effieciency (%)	4	P in effluent (mg/l)	6	Treatment effieciency (%)	8
Waarde	13.5	35	61.9	21	3.6	80	49.8	38
Willem Annapolder	26.7	167	55.4	69	7.1	255	48	40
Walcheren	42.4	324	26.4	65	3	200	62	21.5
Groede	21.8	45	68.7	7.4	4.1	105	57.7	28
Oostburg	22.8	52	44.3	41	3.1	55	55.3	30.9
Breskens	29	93	42	44	3.3	65	60.3	19.6
Retranchement	28.9	189	35.7	54.4	4.4	120	48.7	39.2
Nieuwvliet Bad	60.4	302.7	47	37.3	4.6	130	48.7	39.2
De Drie Ambachten	23.1	131	34	54.7	4.9	145	43.7	45.4
Kloosterzande	10.6	-30	79.3	-5	1.4	-30	86	-8
Hulst	25.5	155	50.7	32.4	3.5	75	64.3	19.6
Bath	25	150	46.3	38.3	3.5	250	57.7	27.9

2: overstep percentage of the 1998 objective (N-tot)
4: 100 - ((mean treatment effieciency/75) x 100)) %
6: overstep percentage of the 1995 objective (P-tot)
8: 100- ((mean treatment efficiency/80) x 100)) %

5.3 Industrial emission sources

This paragraph gives an overview of the available information on industrial emission sources. The emphasis lies on industries which are responsible for 90% of the emissions in a management area.

5.3.1 North-France

This subparagraph shows an overview of the industrial emissons (MO and MA) in the area E1, E2 and E3. The figures represent the situation in 1990. MO is defined as (COD + 2BOD^5)/3. MA is defined as organic nitrogen + ammonia nitrogen.
The discharged amounts in North-France are calculated, not measured. The calculations are based on production process tables for the different industrial sectors.

The table 5.3 gives an first, global impression of 90% of the avarage daily discharged amounts of MA and MO in the zones E1, E2 and E3 (1990). **It should be emphasized that several industries are connected to a waste water treatment plant: therefore the discharged amounts to surface waters could propably be less.**

Table 5.3 Industrial discharge amounts (MA and MO) in the zones E1, E2 and E3 (1990)

Zone	n	Discharged amount MA (kg/day)	% of total discharged amount MA	n	Discharged amount MO (kg/day)	% of total discharged amount MO
E1	37	10,070	9	31	862	7
E2	40	11,530	11	27	1,571	13
E3	89	86,749	80	58	9,812	80
Total (E1 + E2 + E3)	166	108,349	100	116	12,245	100

n = number of industries

The figure 5.20 shows the discharged amounts MO in the area E1, E2 and E3. The figure 5.21 shows the discharged amounts MA in the area E1, E2 and E3.

In total 607 industries, that discharge MO and/or MA, lie in the administrative area E1, E2 and E3. The total average discharged amounts of MA and Mo are respectively 120.3 tons/day and 13.6 tons/day. Respectively 166 and 108 industries cause 90% of the average discharged amounts of MA and MO (108,349 kg/day and 12,245 kg/day). Eighty percent of the amounts is discharged in area E3 (la Lys et la Deûle). In this area cities like Tourcoing, Roubaix and Lille are situated.

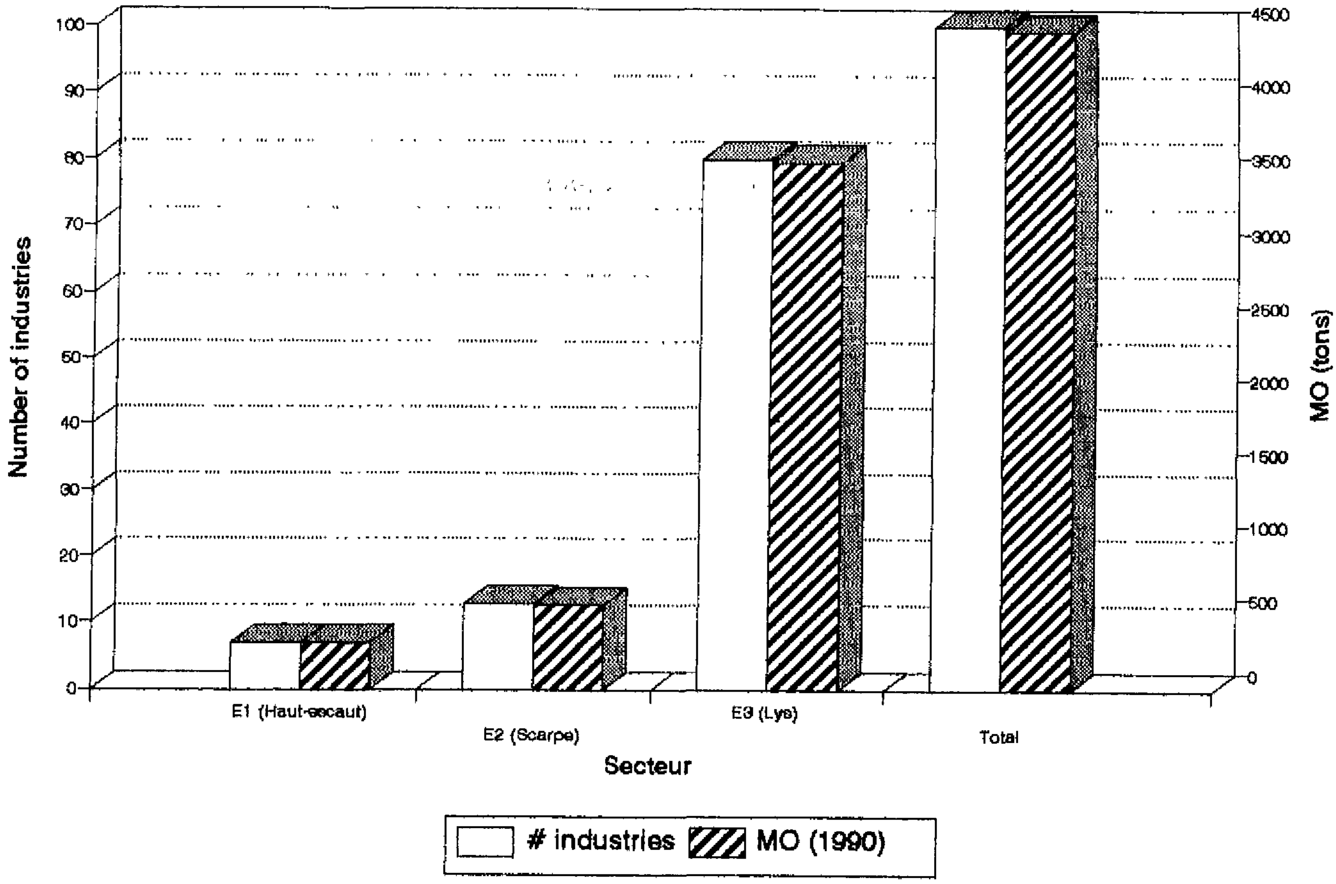


Figure 5.20 **Industrial discharges of MO in the French part of the Scheldt basin (situation 1990).**

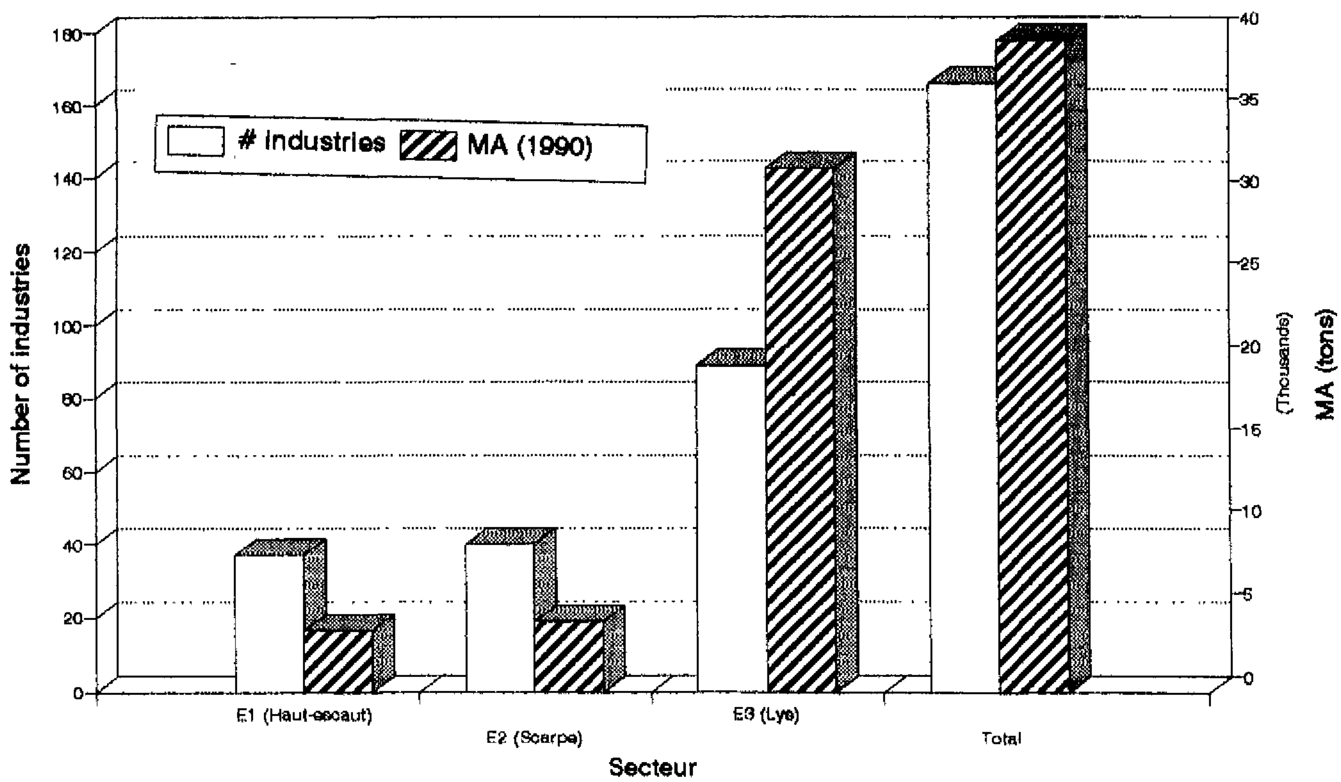


Figure 5.21 Industrial discharges of MA in the French part of the Scheldt basin (situation 1990).

The information only gives a global impression of the situation in North-France. More detailed information is required about industries that are connected to waste water treatment plants, the charge figures of the treatment plants, the treatment technology at the industries themselves, the discharge permit prescriptions, the standards for the different industrial sectors and so on.

5.3.2 Wallonia

During a ISG workshop at Namur the Direction Générale des Ressources Naturelles et de l'Environnment (DGRNE; Ministère de la Région Wallone) provided detailed information on the emission reduction policy. This direction gave an overview of the future actions for emission reduction in the industrial area of Tertre and Ghlin-Badour. These area are sitiuated in the management area of the intercommunale IDEA.
In Wallonia the international agreements form the main basis of the emission reduction policies. The control of industrial point sources and the contamination of the sediments are considered as the main future problems.
The DGRNE makes an inventory of the main emission sources. This inventory includes the parameters of the black and grey EU lists. Relations between discharges and water quality will also be studied. The DGRNE asked the industries to make a survey of the historical and present discharge situation. Prognoses for the future (till 1996) will be made. The inventory will be finished in 1994. The number of cokeplants has decreased over the last few years.

5.3.3 Brussels

There is no detailed information available on industrial discharges in the Brussels Region.

5.3.4 Flanders

In 1991 the VMM started with the emission monitoring programme. This programme concerns discharges to sewage systems (indirectly to surface waters) and surface waters. At 1,225 localities in Flanders samples are taken. Depending on the available infrastructure (measuring-flumes) flow rate proportional samples or "schepmonsters" are taken. At each locality samples are taken during an average of three days.
The monitored parameters are:

* flow rate	* Cd
* COD	* Cr
* BOD	* Cu
* SM	* Hg
* N-total	* Ni
* P-total	* Pb
* Ag	* Zn
* As	

Historical, present and future situation of the indsutrial zones of Tertre and Ghlin-Badour

The urban waste water treatment plant of Wasmuël (design-capacity: 400,000 habitant-equivalents) is operational since 1969. In principle, this plant treats the oxygen demanding substances (BOD and COD) in the waste water from the householdings around and in Wasmuël. Due to the changing economic conditions in the seventies (crisis in 1974/1975) only 160,000 inhabitants-equivalents were connected to the treatment plant. This means that only 40% of the design-capacity is exploited.
An important problem is that several industries are also connected to the treatment plant. As a result not only amounts of COD and BOD but also considerable amounts of nitrogen are part of the influent stream of the plant. The exploitation costs are excessive due to the under-usage of the design-capacity and the low investments of the industries.
In the period 1976-1979 all industries in the zones of Tertre and Ghlin-Badour obtained discharge permits for the connection to the public sewage systems. These permits have an unrestricted validity and are still in force now.
To illustrate the present problems of the treatment plant in Wasmuël: 7000 kg a day of total nitrogen are treated at the plant (Tertre + AKZO in Ghlin-Badour + urban waste water). Only 2300 kg (33%) can be eliminated at the plant!
The Ministère de la Région Wallonne has decided that the original destination of the treatment plant of Wasmuël should be protected. The plant has been developped in the first place to treat communal waste water streams (BOD + COD), not to eliminate nitrogen. The new policy is to "force" the industries to make a choise between discharges to a sewage system or surfaces directly to a surface water. The permits will be revised, including stronger standards.
If an industrie wants to stay connected to the traetment plant in Wasmuël it will have to introduce a system of self-treatment in order to reduce the total amount of nitrogen in its waste water streams (the ratio BOD/N will have to be higher than 15).
AKZO (Ghlin), Crompton, Carcoke and New Carbochim (Tertre) have decided to stay connected to Wasmuël. Kemira, Sedema and Reilly Chemicals have decided to discharge directly to a surface water.
In the sixties an amount of 40,000 kg N/day (industrial discharges) was allowed. The 1995 objective is an amount of 1800 kg N/day; the 2000 objective is an amount of 1000 kg N/day.
No direct financial support will be given to industries unless new technologies will be introduced (subsidy with a maximum of 25% of the costs).

Some notes have to made at the emission monitoring programme of the VMM:

1. Only industries are included that are monitored by the VMM.
2. Not all monitored industries have measuring-flumes. Therefore flow rates can not be measured at these industries and therefore the discharged amounts can not be calculated. The totalized values for the AWP-II basins show a first inclomplete picture of the industrial emissions.
3. In future the discharged amounts for the not monitored industries will be calculated by means of the figures provided by these industries.
4. It has to be emphasized that the industries with the highest concentrations not a priori are the biggest polluters. The degree of pollution depends on both the flow rates and the parameter concentrations.

The figure 5.22 shows the discharged amounts BOD in the hydrographic subbasins (industries and waste water treatment plants; 1991). The figure 5.23 shows the discharged amounts COD in the hydrographic subbasins (industries and waste water treatment plants; 1991). The figure 5.24 shows the discharged amounts N-total in the hydrographic subbasins (industries and waste water treatment plants; 1991).

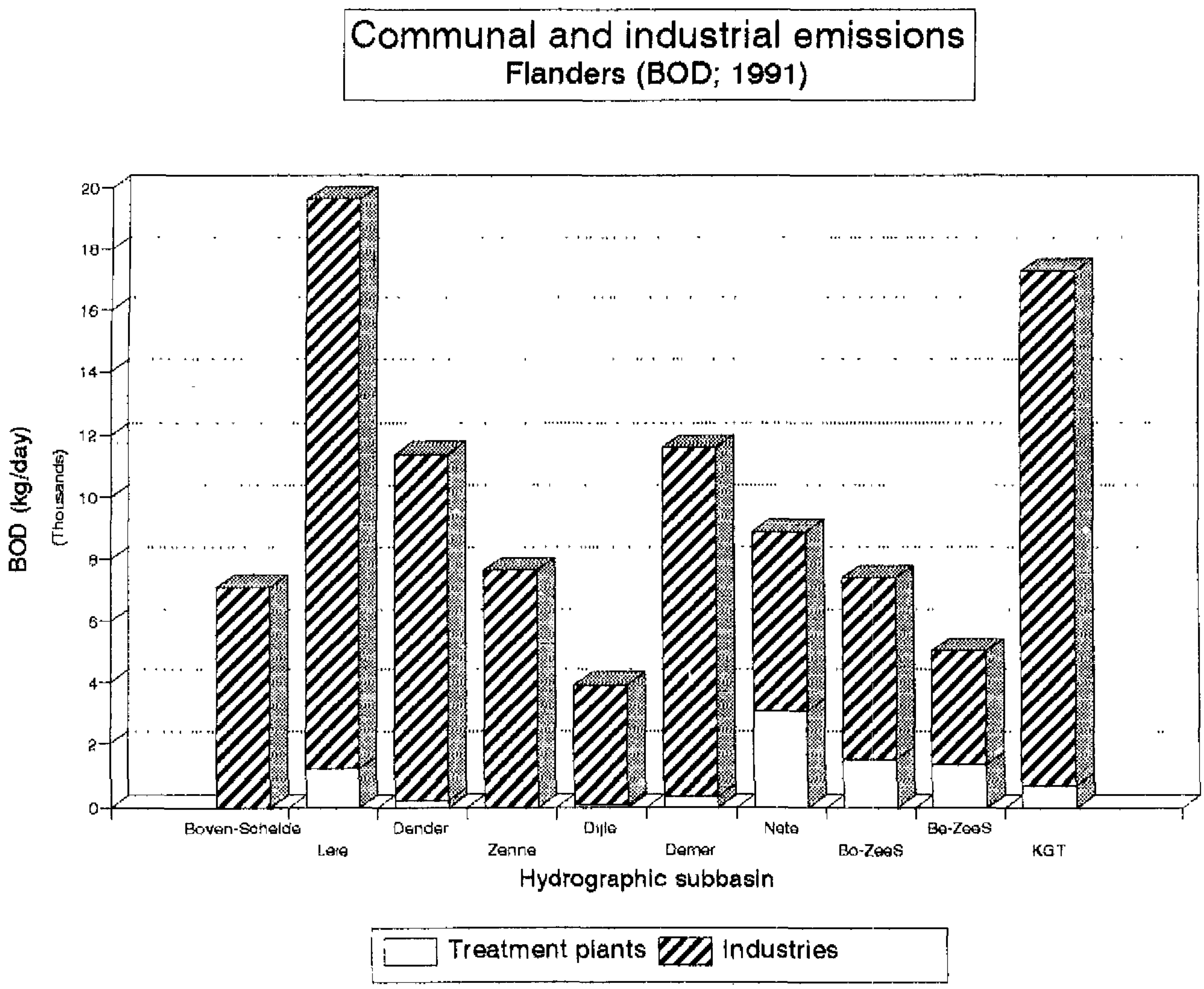


Figure 5.22 Communal and industrial discharged amounts BOD per hydrographic subbasin in Flanders (1991).

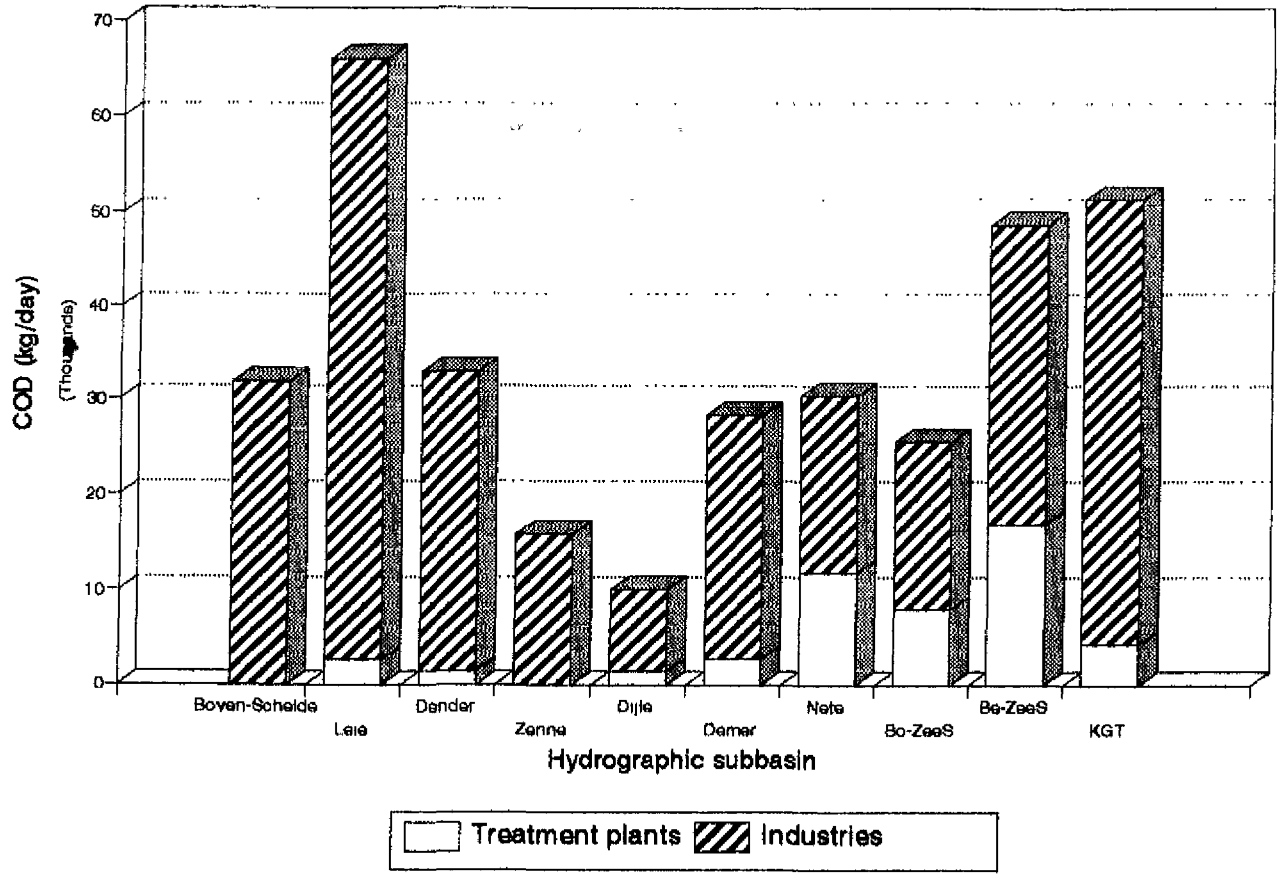


Figure 5.23 **Communal and industrial discharged amounts COD per hydrographic subbasin in Flanders (1991).**

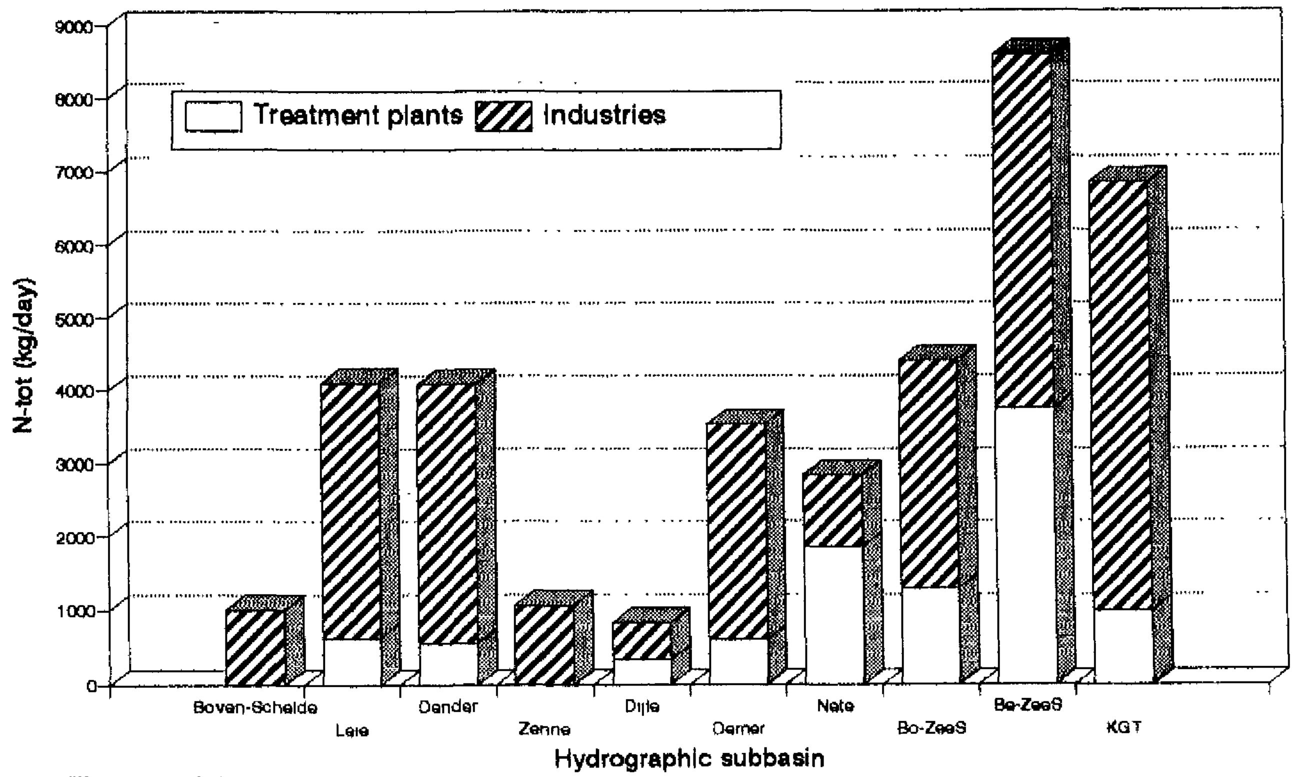


Figure 5.24 Communal and industrial discharged amounts N-total per hydrographic subbasin in Flanders (1991).

One of the main objectives of the VMM is to make clear the relations between emission sources and water quality. Heavy metals and PAH's should be the priority substances. For Flanders there is a lack of knowledge about these relations. Especially the PAH's are a big problem; there is little knowledge about these substances. Concerning denitriphication and dephosphatation the objectives of the EU-directives and the NAP will be worked out for both communal and industrial emission sources.

5.3.5 The Netherlands

This survey includes industries around the Westerschelde and the Kanaal Gent-Terneuzen that have to report discharge data to Rijkswaterstaat Directorate Zeeland. The figures of these industries are stored in the WIER database. Rijkswaterstaat compares the provided figures with the results of its own monitoring activities and makes an annual emission report. The data are used as input for the SAWES model (SAWES = System Analysis WEStersehelde). Within the SAWES model the Scheldt estuary between Rupelmonde and Vlissingen is divided in 14 area. The figure 5.25 gives an overview of these area. The area 6 till 14 are situated in the Westerschelde.

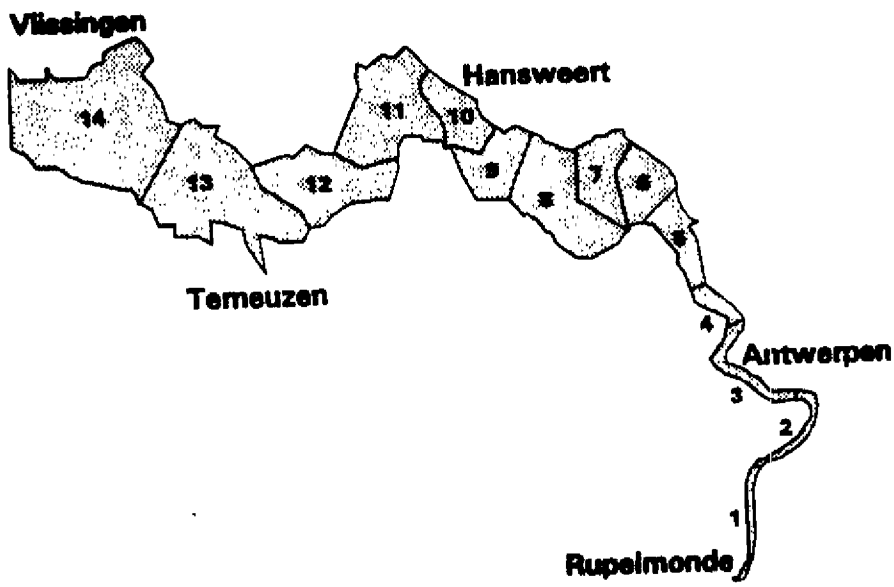


Figure 5.25 Division of the Scheldt estuary as used in the SAWES model.

There are four discharge categories concerning the Westerschelde. The table 5.4 shows the industries and the waste water treatment plants in these categories.

Table 5.4 Communal and industrial emission sources Westerschelde

Direct industrial discharges:	Indirect industrial discharges:
* Meyer Frozen Foods BV * General Electrics Plastics * SVZ Baarland * Oostrom's conservenfabriek * ACZC * Broomchemie BV * Engelhard BV * Hydro Agri Sluiskil BV * DOW Benelux BV * Stortplaats Koegorspolder * Cerestar Benelux BV * Pechiney Nederland NV * Atochem Vlissingen BV * Hoechst Holland NV * Total Raffinaderij Nederland NV * Martens en Zn. Vlissingen * PZEM Centrales Borssele N.V. * Industry Moerdijk (treated) * Industry West-Brabant (treated)	
Direct communal discharges: * RWZI Waarde * RWZI Bath * RWZI De Drie Ambachten * RWZI Walcheren * RWZI Ossendrecht * RWZI Putte	**Indirect communal discharges:** * RWZI Willem-Annapolder * RWZI Groede * RWZI Oostburg * RWZI Breskens * RWZI Retranchement * RWZI Nieuwvliet bad * RWZI Kloosterzande * RWZI Hulst

Two industries discharge directly to the Kanaal Gent-Terneuzen: Zuid Chemie BV and Glasfabriek Sas van Gent BV.
The Volkerak/Zoommeer and its catchment area are also part of the study area. Therefore the waste water treatment plants and industries in this area are included too. The table 5.5 gives the industries and treatment plants around the Volkerak/Zoomeer. The influence of the Volkerak/Zoommeer catchment area is monitored at the outlet of the Bathse Spuikanaal to the Westerschelde.

Table 5.5 Industries and waste water treatment plants Volkerak/Zoommeer.

Direct industrial discharges:	Indirect indutrial discharges: * Industries (untreated) * Industries (treated)
Direct communal discharges: * RWZI Dinteloord * RWZI Ooltgensplaat * RWZI Oude Tonge * RWZI Tholen	**Indirect communal discharges:** * RWZI Baarle-Nassau * RWZI Chaam * RWZI Etten-Leur * RWZI Halsteren * RWZI Lepelstraat * RWZI Nieuw-Vosmeer * RWZI Rucphen * RWZI St. Willebrord * RWZI Zegge

The appendix 5.11 gives an overview of the industries around the Westerschelde and the Kanaal Gent-Terneuzen.
The figure 5.26 gives the discharged amounts COD and Kj-N (direct industrial and communal discharges; 1991) to the Westerschelde.

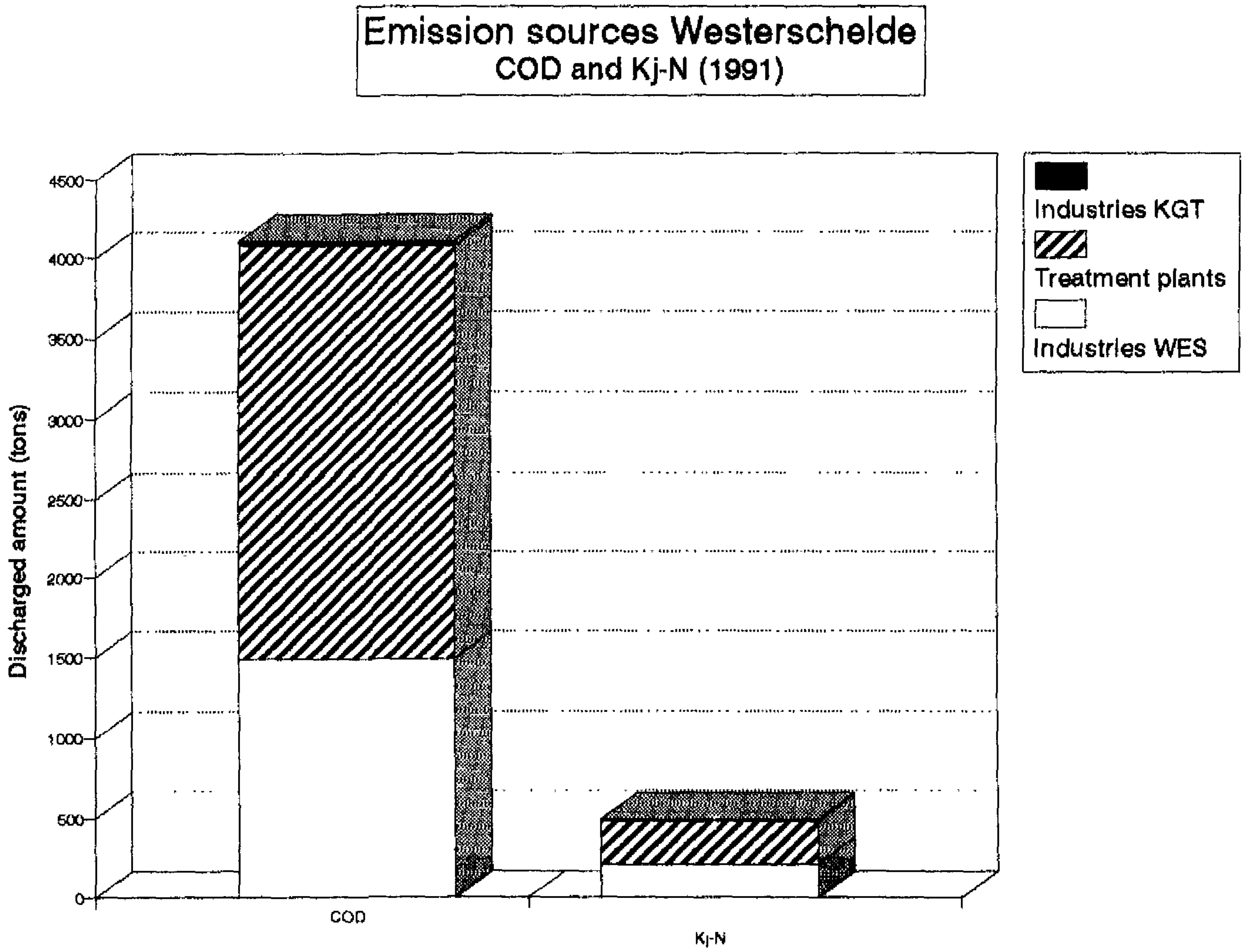


Figure 5.26 Communal and industrial emission sources in the Westerschelde subbasin (COD and Kj-N; 1991).

6. Water quality monitoring in the Scheldt basin

6. Water quality monitoring in the Scheldt basin

6.1 Introduction

This chapter gives an overview of the water quality objectives and the water quality monitoring programmes in the Scheldt basin. The first results of the Scheldt-GIS (oxygen concentrations and BOD contents in 1990 and 1991) are shown. The emphasis in this report lies on the physical-chemical water quality. An ecological workgroup will inventory and describe the ecological water quality and values in the Scheldt basin. This workgroup starts in 1994.

6.2 Water quality objectives

In the period 1975-1979 the European Union laid down EC guidelines concerning water quality objectives for swimming-water (76/160), drinking-water (75/440), fishing-water (78/659) and shellfish-water. Only the guideline concerning drinking-water has been revised once (79/689). France, Flanders and the Netherlands defined an ecological minimum objective for surface waters, named as basis water quality. The basis water quality objectives in Flanders and the Netherlands are, for almost all parameters, more severe than the objectives for swimming-water, fishing-water and shellfish-water. There are three drinking-water quality objective categories: A1, A2 and A3. Only the objectives for some parameters in the A1 category are more severe than those of the basis water quality. In France there are four water quality objective categories. Category III includes the basis water quality objectives. Category I is comparable with the Flemish and Dutch basis water quality objectives. Therefore the basis water quality objectives of Flanders and the Netherlands and the category I objectives of France are used in this report to describe the water quality in the Scheldt basin.

The inventory includes the parameters which are part of the polluting substances list of the North Sea Action Programme. This list is extended with parameters of the Rhine Action Programme (RAP) and some general parameters which are monitored in the Scheldt basin.

The figure 6.1 shows the water quality objectives for the river Scheldt and the main tributaries. In the appendix 6.1 the parameters which are part of the North-Sea Action Programme and the Rhine Action Programme are summarized. This appendix also gives the parameters which are monitored in **all Scheldt riparian states**. In appendix 6.2 the basis water quality objectives of Flanders and the Netherlands and the French category I are shown. The appendix 6.3 gives an overview of the parameters that are monitored in each Scheldt riparian state.

6.3 Monitoring programmes

This paragraph gives an overview of the immission monitoring programmes of France, Wallonia, Brussels, Flanders and the Netherlands. To meet one of the main objectives of this project a start has been made with a description of the water quality of the main watercourses in the Scheldt catchment. The participants made a first selection of the water quality monitoring localities in their part of the Scheldt catchment area. Localities have been selected which are:

- part of the present monitoring programmes;
- situated upstream or downstream discharge locations (communal and industrial sources);
- situated in the mouth and just upstream and downstream the mouth of the main tributaries;
- situated at the borders of the hydrographic subbasins;
- situated at the borders of the administrative area;
- situated in the neighbourhood of locks and sluices;
- at the starting-point and mouth of canals.

These criteria have been chosen in order to make clear the relations between emissions (discharges) and immissions (water quality). The figure 6.2 shows the ISG selected water quality monitoring localities in the Scheldt basin. The ISG codes 1 till 87 are the French localities; 1001 till 1026 the Wallonian localities; 2001 till 2082 are the Flemish localities and 4001 till 4019 the Dutch localities.

6.3.1 North-France

In the French part of the Scheldt basin (zones E1, E2 and E3) there are 87 water quality monitoring localities. Twelve of these localities are situated in the river Scheldt, six in the river Scarpe and nine in the river Lys. In 1990 the number of localities was 84; in 1991 85. The localities 001225 (la Marque at Tourmignies) and 076100 (l'Escebrieux at Flers-En-Escebrieux) were excluded in 1991; the localities 019000, 019100 (L'Escaut Canalisée at Mortagne-Du-Nord and Warcoing) and 051100 (l'Espierre at Spiere) were added. The appendix 6.4 gives an overview of the water quality monitoring localities (surface water and bottom sediment).
In 1990 12 parameters were regulary monitored with a frequency of six or twelve times.

These parameters are:

* pH
* conductivity ($\mu S/cm$)
* suspended matter (mg/l)
* BOD (mg/l)
* COD (mg/l)
* O_2 (mg/l)
* oxygen saturation percentage (%)
* NH4-N (mg/l)
* NO2-N (mg/l)
* NO3-N (mg/l)
* Kjeldahl nitrogen (mg/l)
* ortho-P (mg/l)

P-total was only monitored at five localities: in the river Scheldt just downstream of Cambrai and Valenciennes, in the Scarpe just upstream of Douai, in the Lys upstream of Aire-sur-la-Lys and at the border between France and Wallonia. In 1991 the same parameters were monitored regulary with a frequency of six or twelve times; P-tot was also monitored regulary at more localities (71). Although toxic substances are part of the tax system, heavy metals and organic micropollutants have not been included in the water quality monitoring programme.

6.3.2 Wallonia

The Industrial Pollution Division (la Division des Pollutions industrièlles), part of the Environmental Department (la Direction des Ressources naturelles et de l'Environnement de la Région wallone) manages the water quality monitoring programme in the Wallonian Région. The physical-chemical monitoring programme has been carried out by the Institute of Hygiene and Epidemiology until April 1993. One hundred localities were included in this programme; 26 of those were situated in the Scheldt basin. The appendix 6.5 gives an overview of the water quality monitoring localities in the Wallonian part of the Scheldt basin (1990/1991). The number of monitored parameters per locality depends on the water quality objectives of the watercourses.

Generally the parameters are monitored five times a year. There are three stations at the border with France: 360 (the Scheldt at Bléharies), 580 (l'Espierres at Leers-North) and 670 (the Lys at Warneton). At these stations the parameters are monitored twelve times a year.

In the Haine an automatic monitoring station will be operational in 1994 (frequency: once per two months).

6.3.3 Brussels

In Brussels the Administration of Natural Ressources and the Environment is responsible for the set up of the water quality monitoring programme, the sampling and the management of the results.

6.3.4 Flanders

The Water Service under the jurisdiction of the Flemish Environment Agency is responsible for the management of the routine water quality monitoring programmes in the Flemish Region. There are two complementary programmes, namely a physical-chemical one and a biological one. The results of the physical-chemical programme give a "snapshot impression" of the actual water quality at the monitored localities.
The results of the biological programme give a "flashback" of the water quality at the monitored localities. The used Belgian Biotic Index gives an integrated view of the physical, chemical and biotic conditions over a certain period.

The objectives of the physical-chemical monitoring programme are:

- the regularly measurement of the values of the parameters which are part of the surface water quality standards;
- to give an overview of the water quality in Flanders by means of indices and water quality classes;
- to make a comparison between the measured values and the water quality standards;
- the calculation and publication of the annual (communal and industrial) discharges in each AWP-II basin.

In 1991 950 localities were part of the physical-chemical monitoring programme; 1100 localities of the biological monitoring programme. The criteria for the selection of the localities are:

- upstream and downstream of important industrial discharges, effluent discharges of waste water treatment plants/collector networks and the mouth of important tributaries;
- at the borders of the hydrographic subbasins and the AWP-II basins;
- the legal determined functions of the watercourses;
- at the borders with France, Wallonia, Brussels and the Netherlands;
- in the near vicinity of limnimeters (in order to calculate annual discharges).

At all 950 localities a set of basic (general) parameters is monitored:

* water temperature (°C)
* dissolved oxygen concentration (mg/l)
* chemical oxygen demand (COD in mg/l)
* NH3-N (mg N/l)
* NO2-N (mg N/l)
* NO3-N (mg/l)
* o-P (mg P/l)
* chloride (mg/l)
* conductivity
* pH
* P-total

For a selected number of localities the parameters biochemical oxygen demand (BOD in mg/l), Kjeldahl-nitrogen (Kj-N in mg N/l), sulphates (mg/l) and suspended matter (mg/l) are added. Heavy metals (Cd, Cr, Hg, Cu, Zn, Ni, As and Pb) are monitored only at localities in the vicinity of industrial discharges and in the vicinity of the country borders. The monitoring frequency is 8-10 times a year for the majority of the localities.

Strong and the weak aspects of the physical-chemical monitoring programme are:

Strong aspects
- there is one asministration involved in the exploitation of the programme;
- the high density of monitoring localities (950) in order to get a first overview of the water quality of all watercourses in Flanders;
- the coupling of physical-chemical data with biotic data.

Weak aspects
- the small number of monitored parameters (The basis quality of surface waters as defined in Flanders contains standards for 54 parameters. At the water quality monitoring localities only a selected number of parameters is analyzed due to the big number of localities and the financial aspects involved. The emphasis lies on the oxygen economy and the presence of nutrients;
- a lack of information on discharges of several parameters;
- a lack of flow rate measurements;
- the monitoring freqency of 8-10 times a year is insufficient.

The monitoring programme of the VMM is a relatively new one and therefore still in development. The main objective of the present programme is to make a first inventory of the situation of the watercourses in Flanders. In future less localities will be monitored more freqently, including a bigger number of parameters in order to study the situation of the watercourses more in detail. Finally a detailed inventory of problem substances will be made.
The number of localities that are part of the physical-chemical monitoring programme will be diminished from 950 to 300; the monitoring frequency will increase from eight times a year to twelve or 24 times a year. One of the objectives is to monitor weekly at the Dutch-Belgium border (Schaar van Ouden Doel). The monitoring of organic micropollutants will be a essential part of the routine programme. The number of localities that are part of the biological programme will increase from 1100 to 1400; the frequency will stay at one time a year (bigger watercourses).
The setup of a big databank is prepared in which water quality and emission data will be integrated. The setup of permanent monitoring stations in the Maas, the Schelde and the Kanaal Gent-Terneuzen is part of the negotiations between Belgium and the Netherlands.

The Flemish Environment Agency has made a selection of 82 water quality monitoring localities that are situated in the Scheldt catchment. The appendix 6.6 gives an overview of these localities.

6.3.5 The Netherlands

Two specialized services of Rijkswaterstaat, namely the RIKZ and the Governmental Institute for Inland Water Management and Waste Water Treatment (RWS-RIZA), manage the physical-chemical water quality monitoring programmes. These programmes include surface water, suspended matter and bottom sediment. There are also biological monitoring programmes. Since 1993 the activities of the physical-chemical and the biological monitoring programmes are fully integrated.

The objectives of the physical-chemical monitoring programmes are:

- the measurement of the "actual" water quality;
- the comparison of the monitoring results with the water quality standards;
- the studying of changes in surface water quality in both time and space;
- the calculation of the annual discharges of polluting substances by means of flow rates and water quality data.

The RIKZ carries out the water quality monitoring programmes in the Westerschelde. are The appendix 6.7 gives an overview of the selected monitoring localities in the Westerschelde. Three localities in the Kanaal Gent-Terneuzen and two localities in the North Sea are also included.

The criteria for the parameter selection in the Scheldt estuary are:

- the so-called PARCOM parameters: black and grey list sub-stances (based on international agreements);
- parameters from the third Policy Document on Water Management in the Netherlands;
- for the SAWES model (System Analysis WEstern-Scheldt) the parameters with the highest concentrations and discharged amounts have been selected.

The strong and weak aspects of the physical-chemical monitoring programme are:

Strong aspects:
- a small number of localities where more than 60 parameters are monitored combined with a number of localities where less parameters are monitored;
- for a number of parameters the concentrations in bottom sediment and/or suspended matter are also monitored;
- a general shift from chemical to biological monitoring;
- the parameters related to suspended matter are monitored by sampling and analyzing the suspended matter using a centrifugation technique.

Weak aspects:
- different authorities carry out monitoring programmes;
- the water quality data are not yet easily accessible for the water managers: the data are available 3 till 4 months after sampling;
- due to the large water management organization the time period between monitoring and the publication of the results is too long;
- the working out of biological samples takes a long time;
- at the moment it is not possible to monitor continously at the Dutch-Belgian border (Schaar van Ouden Doel).

6.4 Water quality in the Scheldt basin (1990 and 1991)

In the first project year a start has been made with a description of the water quality in the Scheldt basin in 1990 and 1991. The maps in this report show some of the possibilities of the Scheldt-GIS.

6.4.1 Oxygen concentrations

The processes concerning the oxygen economy of surface waters are very well described in the Scheldt report of the Interparliamental Benelux Counsil (October 1991). The figure 6.3 shows the the average oxygen concentrations in 1990. The figure 6.4 shows the average oxygen concentrations in 1991. The size of a circle is proportional with the absolute value. A pink coloured circle means that the average oxygen concentration was under the 5 mg/l standard. A light blue coloured circle means that the average oxygen concentration was above the 5 mg/l standard.

As the figures show the average oxygen concentrations in the Lys, the Scheldt (from the French-Wallonian border to the Flemish-Dutch border), the Zenne and the Kanaal Gent-Terneuzen were very low (< 5 mg/l) in both 1990 and 1991. The situation in the Demer was better in 1991: at four localities (from Lessines to just downstream of Aalst) the oxygen concentration changed from < 5 to > 5 mg/l.
The average situation is very bad in the Belgian part of the river Scheldt. Tributaries like the Scarpe, the Spiere, the Zwalm, the Dorpsloop, the Rupel, the Barbierbeek and the Grote Schijn have an average concentration below 5 mg/l.

6.4.2 BOD contents

The figure 6.4 shows the average BOD contents in the Scheldt basin in 1990. The figure 6.5 shows the average BOD contents in the Scheldt basin in 1991. The size of a circle is proportional with the absolute value. A light blue coloured circle means that the average BOD content was between 0 and 6 mg/l (low charge with oxygen demanding substances). A pink coloured circle means that the average BOD content was between 6 mg/l and 500 mg/l (high charge of oxygen demanding substances).
The figures show that the BOD contents in the Scheldt basin are very high. In the river Scheldt (from source to the Flemish-Dutch border), the Lys, the major parts of the Scarpe, the Dender, the Zenne, the Spiere, the Demer, the Dijle and the Nete localities are found where the BOD contents are between the 6 and 500 mg/l. In the river Dender the BOD contents in 1991 where lower at all monitoring localities.

7. Conclusions, discussion and future activities

7. Conclusions, discussion and future activities

7.1 Introduction

The setup of the **International Scheldt Group** is the consequence of informal movements of the water managers in the Scheldt riparian states onwards a closer cooperation. The first project year has shown that France, Brussels, Wallonia, Flanders and the Netherlands all have the willingness to work together and to tune their activities. The joint main objective is the improvement of the water quality in the river Scheldt basin. Although there is still a long way to go, a first step in the right direction has been made. Especially the workshop in Namur showed that the water management organization in all Scheldt riparian states is changing and that large investments on waste water treatment infrastructure are made.

This report is the result of the first project year. The emphasis lied on the collection and comparison of available data concerning water quality management organization, industrial and communal waste water discharges and water quality. The information is far from complete. Therefore ISG continues its acitivities in 1994. In the next paragraphs conclusion are drawn and recommendations are made on the continuation of the project.

7.2 Description of the study area

The authorities and water management organizations use several divisions of the Scheldt basin. Within the division in hydrographic subbasins, as made by the Vlaamse Milieumaatschappij, the emphasis lies on the river Scheldt and her main tributaries. The authorities and water management organizations also use divisions in administrative areas.
The division in hydrographic subbasins is useful to get a first global overview of the main rivers in the Scheldt basin and the management problems. The divisions in administrative area is useful to get a more detailed insight in the country or region bounded problems.
Many canals are situated in the river Scheldt basin or flow in and out the basin. Big parts of the Scheldt and her tributaries have been canalized and are shippable. There are many locks, sluices and artificial junctions between natural watercourses and canals.
There is hardly any information available on the hydrographic situation in the Scheldt basin. There is no or little communication between the administrations that collect hydrographic data of the river Scheldt and its tributaries. There are big differences between summer and winter periods. In dry, summer periods surface water of the rivers Lys and Scheldt is diverted to the coastal area since 1971. Consequently, the mean annual flow rates of the Upper-Scheldt and the Lys are lower since then. Approximately 65% of the surface water in the Scheldt basin upstream from Gent is diverted to the North Sea via canals. Fresh water is essential for the "survival" of the Scheldt-estuary with the fresh- , brackish and salt intertidal area. If more fresh water will be diverted, the Scheldt-estuary will salt.

The high number of habitants (eleven millions), the high degree of industrialisation and the agricultural use of a big part of the area mean a considerable burden to the aquatic ecosystems in the Scheldt basin. The water management problems are comparable in the different parts of the Scheldt basin:

* low groundwater and surface water levels
* pollution of ground- and surface water
* insufficient waste water treatment infrastructure
* the management of transboundary watercourses
* sediment contamination

Generally, from source to mouth the emphasis of the problems shifts from the surface water tot the bottom sediment. In the Scheldt estuary the main specific problems are:

* The physical-morphological disturbance because of the dredging activities.
* The erosion of tidal flats and shores.
* The reduction of the fresh water stream to the estuary.

7.3 Water quality management organization

7.3.1 France

In France nine ministries are involved with different aspects of environmental protection and management. The Ministry of Environmental Affairs coordinates the activities of the different ministries. This ministry has not a large decentralized apparatus. Therefore it is partly dependant on the civil servants of the other ministries.
The regions, the departments and the municipalities play also roles in the water management organization. Because the responsibilities on water management are divided over many administrations, the coordination of the activities is a complex matter.
The basin approach with the Basin Committees on the one hand (water policy) and the Basin Water Agencies (executive tasks) on the other hand is a good step in the direction of an integrated water management approach. The policy of the river basin contracts could also be a good basis for an integrated management approach: all kinds of groups of interest participate in these contracts.
The civil servants that are responsible for the environmental permitting, are also responsible for the control tasks. There are too less inspectors to control the discharge permit

prescriptions. The administrations involved are responsible for environmental permitting as well as for the stimulation of the industrial and agricultural development.
The tax rates for industrial water pollution are based on discharged amounts which are calculated (production processes). It would be better to base the rates on the monitored discharged amounts in waste water streams.
Compared with the Fifth Action Programme, the Agence de l'Eau Artois-Picardie doubles its budget. Approximately 230 millions ECU's will be invested in the Scheldt basin between 1992 and 1996.

7.3.2 Brussels

The Administration des Ressources naturelles et de l'Environnement is responsible for the technical and administrative aspects of water management, including discharge permits and monitoring of surface and groundwater quality. The Brussels Instituut voor Milieubeheer develops the water policiy for the Brussels Region.
Since the 1th of November a new integrated environmental permit system is in force, based on the Flemish VLAREM-regulation.
A tax system for industrial discharges is in force since the end of 1993. Due to the big number of small industries it is impossible for the Brussels water management administration to control these all regularly. The bigger companies have to monitor their own waste water streams: a system of self-control.
Between 1992 and 2000, 500 millions ECU's will be invested in water quality management. The Brussels Region planned two waste water treatment plants, with a total design-capacity of 1,500,000 habitant-equivalents. This capacity will be sufficient for the treatment of the waste waters from the 1,000,000 habitants in the Brussels Region. The over-capacity will be used for the treatment of industrial waste water (500,000 habitant-equivalents).

7.3.3 Wallonia

In Wallonia there is one large ministry in which differents apects of environmental management, including water quality policy and management, are integrated. Until 1996 the Direction of Natural Sources and the Environment makes an annual report about the condition of the environment. In the 1995 report the water quality, the water quality management organization and the industrial sectors will be described.
The "Decree concerning the protection of surface water against pollution" gives the regimentation on environmental permitting. This regimentation is based on the EU guidelines and includes general and sectoral waste water discharge standards. The individual industrial discharge permits do not include technical prescriptions for pollution prevention and waste water treatment. There is no systematic organization of permit control activities. If a new industry wants to start, a discharge permit is required including the strongest standards. Due to the bad social-economic circumstances, it is

more difficult to change the discharge conditions for existing comnpanies.
The present tax system for the discharges of communal and industrial waste water is based on BOD and COD.
In the period 1992-1996 the Wallonian Region invests 239 millions ECU's in the building of waste water tratment plants and collector networks in the Scheldt basin.

7.3.4 Flanders

The Department of Environmental Affairs and Infrastructure, one of the six departments of the Flemish Region, has the the administrative and technical responsibility for the water quality management in Flanders. The Vlaamse Milieumaatschappij (VMM) is responsible for the waste water treatment policy in Flanders. AQUAFIN exploits and improves existing waste water treatment plants and collector networks. AQUAFIN also build and exploit new waste water treatment infrastructure. The principle of the basin committees is a good example of the integrated water management approach.
The environmental permitting in Flanders is mainly based on the "Law on the protection of surface waters against pollution" and the Flemish Environmental Permitting Regimentation (VLAREM). There is an insufficient organization on the environmental permitting and control activities. Since 1991 there is publicity of environmental permits.
In Flanders a tax has to be paid for all waste water discharge categories. In the tax system a distinguishment is made between citizens or industries that use small consumption water amounts (less than 500 m^3 a year), and citizens or industries that use large consumption water amounts (more than 500 m^3 a year). The tax rate for the "small users" is based on the measured water consumption. The tax rate for the "large users" is based on the discharged pollution amounts. Therefore the waste water streams of the industries are analysed. In 1991 at only 1000 of the 4000 industries in Flanders the waste water streams were analysed. If analysis data are not available, the number of pollution-equivalents is estimated, based on the production processes.
The Flemish Executive will invest 1096 millions ECU's in new waste water treatment infrastructure in the period 1991-1999. In the period 1991-1994 the hydrographic subbasins of the Boven-Schelde, Dender, Leie, Nete and Demer have the highest priority.

7.3.5 The Netherlands

The water management (qualitatively and quantitatively) of the national watercourses like the Westerschelde is the task of the Rijkswaterstaat. The Third National Policies Document on Water Management (NW3; 1989) describes the guidelines of the Dutch water management. The Evaluation Document on Water Management (1993) shows the first results of the NW3, and includes additional measures and financial investments until 1998.
In the Netherlands the water management is based on an integrated approach to establish sustainable functioning water systems in a way that the interests of all the users of the water systems can be respected: today and tomorrow. Therefore measures are taken on

the pollution prevention and reduction, the sanitaion of contaminated sediments, the management and development of intertidal area and banks, the general restoration of water systems and the water distribution.
One instrument is the ***target group policy***. This means that governmental administrations and industries can draw up convenants and intention declarations to tackle environmental problems by a joint, coordinated approach. Water quality and emission aspects are part of these agreements.
An example of the integrated water system approach is the Policy Document for the Westerschelde (1991). This document includes an integrated water management programme especially for the Westerschelde.
The Law on the Pollution of Surface Waters (WVO; 1970) contains the legislation framework on the environmental permitting. The guidelines of this law are worked out more in detail by the so-called General Governmental Measures (Algemene Maatrgelen van Bestuur; AMvB's) or ministrial regulations. The Law Environmental Management (Wet Milieubeheer; 1992) is the new Dutch law which will integrate all environmental laws.
The civil servants of Rijkswaterstaat and the Inspectors of Environmental Hygiene and the Environmental Police control the WVO permit prescriptions. There is a WVO contact team that carries out routine control activities and an annual control action. The contact team inventories the number of offenders of the WVO. Between the 10 and 20% of the industries offend the WVO.
Each person, organization or industry that discharge waste water to a surface water or a sewage system has to pay a tax. The tax rate is based on the amounts of discharged oxygen substances and heavy metals in a management area and the costs that the managers have to make. The tax system includes two principles: "the polluter pays" and the "interst-payment-influence".
In the period 1993-1996 Rijkswaterstaat Division Zeeland will invest 19,8 millions ECU in the Westerschelde. Until 1998 the financial water management organization in the Netherlands will be evaluated and improved. Therefore in 1990 and 1991 the Research Committee Water Management Financement System (= Committee Zevenbergen) analysed the major bottle-necks and did proposals for the improvement of the financial organization.

7.4 Scheldt-GIS

In 1993 the National Institute for Coastal and Marine Management of the Dutch Rijkswaterstaat has setup the Scheldt-GIS. The Scheldt-GIS is used as a medium for the storage, linkage, analysis and presentation of data which are collected by the participants. At the plenary meetings the participants decide which kind of data should be put in the Scheldt-GIS and which questions will be should be answered by means of the Scheldt-GIS.
The participants will have to decide about the objectives and products of the Scheldt-GIS in 1994 and further. If one of the following options will be chosen, the financial consequences will have to be discussed. Each administration should think about the advantages

of a Scheldt-GIS in realation with its activities and in relation with the establishment of an integrated water management approach in the river Scheldt basin.

The possible 1994 options are:

1	One administration makes only a database and takes care of the updating of the database. The ISG participants get the database and will make there own products and applications.
2	The Scheldt-GIS is used as a databank. The ISG participants define the products like reports, maps and tables. One administration manages the system and delivers the products.
3	The Scheldt-GIS is used as a databank. The ISG participants define the products like reports, maps an tables and (pc-) applications. One administration manages the system and delivers the products and applications.
4	The Scheldt-GIS is introduced at the participating administrations. Each administration can defines and makes its own products and applications, besides the joint products and applications. One administration takes care of the updating of the databases and the deliverance of joint products and applications.

7.5 Emissions in the Scheldt basin

7.5.1 Waste water treatment plants

If the Scheldt riparian states carry out their investments programmes, in 2000 the average available design-capacity in the whole Scheldt basin **could be sufficient** *to treat the waste waters of the eleven millions of habitants (biodegradable substances). This conclusion can only be drawn if no industries will be connected to the communal waste water treatment plants and if the total treatment infrastructure (including sewage systems and collector networks) will be sufficient. If some industries stay connected to the communal waste water treatment plants the required design-capacity is much higher.*

Until 1991 in all riparian states the emphasis lied on the treatment of biodegradable substances. Between 1992 and 2000 investments will also be mnade on denitriphication and dephosphatation.

7.5.1.1 North-France

In the French part of the Scheldt basin (area E1, E2 and E3) there are 136 waste water treatment plants available with a total design-capacity of 3,358,400 habitant-equivalents (situation 1991). This capacity could be sufficient for treatment of 88% of the communal waste water. Especially in area E3 (la Lys et la Deule) there is a lack of waste water treatment plants. Due to insufficient investments in the collector networks the equipment can not be used completely. As a result in 1990 only 46% of the communal pollution was eliminated.

In the period 1992-1996 the total design-capacity in the French part of the Scheldt basin will increase with plusminus 900,000 habitant-equivalents.

Until 1991 the emphasis has lied on the treatment of organic and suspended matter. Therefore the majority of the available waste water treatment plants has not the equipment for the elimination of nitrogen and phosphorus. One of the main problems is that some industries are also connected to the communal waste water treatment plants. Accidental discharges and strong fluctuations in the influent can cause damage and disfunctioning of treatment plants.

In the period 1985-1993 the mean treatment percentages for the parameters MO, MA an MeS (treatment plants with a design-capacity > 10,000 habitant-equivalents) were respectively 75%, 40% and 87%.

In the periods 1972-1981 and 1987-1991 the French government made large investments on waste water treatment infrastructure. In the period 1992-1996 the empasis lies on the development and exploitation of sewage systems, the connection of house-holdings to sewage systems, the expansion of the available design-capacity and denitriphication and dephosphatation.

7.5.1.2 Brussels

At this moment there are no communal waste waater treatment plants in the Brussels Region. Therefore the waste waste water of the householdings is not treated, although more than 95% of the habitants have been connected to a sewage system. In 2000 two treatment plants will be operational with a total design-capacity of 1,500,000 habitant-equivalents. This capacity will be sufficient to treat both communal (1,000,000 habitant-equivalents) and industrial (± 500,000 habitant-equivalents) waste water.

7.5.1.3 Wallonia

In the Wallonian part of the Scheldt basin there are 57 waste water treatment plants available with a total design-capacity of 992,475 habitant-equivalents (situation 1991). This capacity could be sufficient for the treatment of 91.7% of the communal waste water.

In the period 1992-1996 the design-capacity will increase with 661,400 habitant-equivalents. The available design-capcity in 1996 in the area IBW and IDEA could be sufficient for the communal waste water

treatment. In the IPALLE area more equipment will be required.
Until 1991 the emphasis has lied on the treatment of biodegradable substances. At none of the operational treatment plants the technical equipment is available for denitriphication and/or dephosphatation.
One of the main problems is the connection of industries to communal waste water treatment plants.
In the periods 1972-1976 and 1982-1986 the Wallonian government made large investments in waste water treatment infrastructure.
In the period 1992-1996 investments will be made in the building and adaptation of treatment plants and collector networks. A number of small plants will be replaced by bigger ones. At four plants the technical equipment will be built for the denitriphication and/or dephosphatation.

7.5.1.4 Flanders

In the Flemish part of the Scheldt basin 87 communal waste water treatment plants are operational with a total design-capacity of 3,222,960 habitant-equivalents (situation 1991). This capacity could be sufficient for 62.6% of the required capacity. At 46 plants industrial waste water is also treated. The mean sewage percentage is 76%. Due to a lack of collector networks only 21% of the communal waste water is treated.
In the period 1991-1994 the design-capacity will increase with 976,635 habitant-equivalents. The availble capacity in 1995 could be sufficient for 81.3% of the required design-capacity. At 12 of the planned treatment plants denitriphication and/or dephosphatation equipment will be installed.
In the period 1989-1991 the mean treatment efficiencies of BOD, COD, NH4+, P-total, Cr, Cu, Pb, Ni, Ag, Zn, Hg and Cd respectively were 85%, 74%, 45%, 48%, 36%, 33%, 46%, 11%, 18%, 45%, 5% and 12%.

7.5.1.5 The Netherlands

In the Dutch part of the Scheldt basin there are 24 communal waste water treatment plants available with a total design-capacity of 966,600 habitant-equivalents (situation 1991). This capacity is sufficient to treat the waste water of the 598,935 habitant-equivalents. The mean sewage percentage is 93%. The over-capacity is sufficient to treat both communal and industrial waste water. There are no planned treatment plants in the Dutch part of the Scheldt basin.
The mean treatment percentages of the parameters BOD, N-total and P-total (period 1990-1992) of the treatment plants around the Westerschelde were respectively 95-98%, 26-79% and 44-86%.
In the periods 1967-1971 and 1982-1991 large investments were made on the waste water treatment infrastructure. Until 1998 the emphasis lies on the optimalization of the available plants and the denitriphication and dephosphatation activities.

7.5.2 Industrial emission sources

Within the inventory the emphasis lies on the industries that are responsible for 90% of the emissions in a management area. One of the objectives is to make a distinguishment between industrial and communal discharged amounts. The available information gives only a first, global impression. No information is available on the relations between emissions and water quality.

7.5.2.1 North-France

In North-France the discharged amounts are calculated, based on production process tables for the different industrial sectors.

Figures (1990) have been provided of the parameters MO (= (COD + 2BOD)/3) and MA (= organic nitrogen + ammonia nitrogen). Respectively 166 and 108 industries cause 90% of the average discharged

amounts of MA and MO (108,349 kg/day and 12,245 kg/day). Eighty percent of the amounts is discharged in area E3 (la Lys et la Deule).

In this area cities like Tourcoing, Roubaix and Lille are situated.

No information is available on the discharged amounts by treatment plants.

7.5.2.2 Brussels

No information is available on the of the industrial emissions in the Brussels Region.

7.5.2.3 Wallonia

The Direction Générale des Ressources Naturelles et de l'Environnement makes an inventory of the main emission sources. This inventory includes the parameters of the black and grey EU lists. Relations between discharges and water quality will also be studied. The DGRNE asked the industries to make a survey of the historical and present discharge situation. Prognoses until 1996 will be made. No information is available on the discharged amounts by communal waste water treatment plants.

7.5.2.4 Flanders

In 1991 the Vlaamse Milieumaatschappij started with the emission monitoring programme. At 1,225 of the 4,000 industries waste water samples were taken. The monitored parameters are: flow rate, COD, BOD, SM, N-total, P-total, Ag, As, Cd, Cr, Cu, Hg, Ni, Pb and Zn.

The 1991 inventory gives only a first global impression of the discharged amounts. Until 2000 the monitoring programme will be improved.

7.5.2.5 The Netherlands

The survey includes industries around the Westerschelde and the Kanaal Gent-Terneuzen that have to report discharge data to Rijkswaterstaat Division Zeeland. The figures of these industries are stored in the WIER database. Rijkswaterstaat compares the provided figures with the results of its own monitoring activities and makes an annual emission report. The data are used as input for the SAWES model.

The Volkerak/Zoommeer and its catchment area are also part of the study area. The influence of the Volkerak/Zoommeer catchment area is monitored at the outlet of the Batshe Spuikanaal to the Westerschelde.

7.6 Water quality monitoring in the Scheldt basin

7.6.1 Monitroing programmes and objectives

The basis water quality objectives of Flanders and the Netherlands and the category I objectives of France are the most severe water quality standards in the Scheldt catchment. Therefore these will be used to describe the water quality. it should be emphasized that these objectives are refer to a **minimum** ecological water quality level (!).
The appendix 6.1 shows that from the parameters which are part of the North Sea Action Programme, only phosphorus and nitrogen are monitored in **all** Scheldt riparian states (!).
The parameters which are monitored in all Scheldt riparian states are (see the appendix 6.3): PO4-P, P-tot, SM, dissolved oxygen, BOD_5, NH4-N, Kj-N, NO2-N, NO3-N and conductivity. No information is available about the monitoring programme in the Brussels Region.

In the French part of the Scheldt basin (area E1, E2 and E3) 87 water quality monitoring localities have been selected. Thirteen parameters were monitored regularly (6 or 12 times a year) in 1990 and 1991: pH, conductivity, SM, BOD, COD, dissolved oxygen, oxygen saturation percentage, NH4-N, NO2-N, NO3-N, Kj-N, PO4P and P-tot. Although toxic substances are part of the tax system, heavy metals and organic micropollutants have not been included in the water quality monitoring programme until this moment.

In the Wallonian part of the Scheldt basin 26 localities have been selected. The number of monitored parameters per locality depends on the water quality objectives of the monitored watercourse.
Generally the parameters are monitored five times a year. There are three stations at the Wallonian-French border: Haut-Escaut at
Bléharies, l'Espierres at Leers-Nord and la Lys at Warneton. At these stations the parameters are monitored twelve times a year.
In la Haine an automatic monitoring station will be operational in 1994 (frequency: once per two months).

In the Flemish part of the basin 82 monitoring localities of the the physical-chemical monitoring programme of the Vlaamse Milieumaatschappij have been selected. At the majority of the localities a set of basic (general) parameters is monitored with a frequency of 8-10 times a year: temperature, dissolved oxygen concentration, COD, NH3N, NO2N, NO3N, PO4P, chloride, conductivity, P-total and pH. For a selected number of localities the parameters BOD, Kj-N, sulphates and SM are added. Heavy metals are monitored only at localities in the vicinity of industrial discharges and in the vicinity of the country borders. The monitoring programme of the VMM is a relatively new one and still in development.

In the Dutch part of the Scheldt basin 19 monitoring localities have been selected. The Dutch routine monitoring programme includes the PARCOM parameters. The monitoring frequency is twelve times a year at almost all localities. At the Dutch-Belgian border the monitoring frequency is 24 times a year. In general there is a shift from chemical to biological monitoring. Since January 1993 the activities of the physical-chemical and the biological monitoring programmes are fully integrated.
It would be a good thing to monitor continuously at the Dutch-Belgian border (Schaar van Ouden Doel). At this locality the improvement of the water quality as a result of the investments in waste water treatment infrastructure could possibly be monitored in the forthcoming years.

7.6.2 Water quality (1990 and 1991)
The average oxygen concentrations in the Lys, the Scheldt (from the French-Wallonian border to the Flemish-Dutch border), the Zenne and the Kanaal Gent-Terneuzen were very low (< 5 mg/l) both in 1990 and 1991. The situation in the Demer was better in 1991: at four localities (from Lessines to just downstream of Aalst) the oxygen concentration changed from < 5 to > 5 mg/l. River Scheldt tributaries like the Scarpe, the Spiere, the Zwalm, the Dorpsloop, the Rupel, the Barbierbeek and the Grote Schijn have an average oxygen concentration below 5 mg/l.

In general the BOD contents in the Scheldt catchment are very high. In the rivers Scheldt (from source to the Flemish-Dutch border), the Lys, the major parts of the Scarpe, the Dender, the Zenne, the Spiere, the Demer, the Dijle and the Nete localities are found where the BOD contents are between the 6 and 500 mg/l.

Except in the Scheldt estuary, almost no efforts are made on the inventory and sanitation of contaminated water bottoms. Prof. dr. Wollast has written a notice on the relations between contaminated sediments and surface water quality. The appendix 7.1 contains this notice.

7.7 ISG objectives and activities in 1994

During the last meeting of ISG in 1993 the participants agreed on the 1994 objectives and actions.

The ISG objectives in 1994 are:

1	The collection, analysis, presentation and distribution of information concerning water management, emissions, water quality, sediment quality, water distribution, ecology and investments.
2	The updating and expansion of the Scheldt-GIS: an information databank and presentation system for the Scheldt basin.
3	The collection of information that is needed for the both LIFE projects on the setup of a water management decision supporting system.
4	The advice of policy makers in the river Scheldt riparian states and the European Union. Advice: recommendations on the setup of an international cooperation of water management administrations based on the collected information.

In 1994 ISG will give the highest priority to the following activities:

1	The inventory of communal and industrial emission sources is continued. The inventory is extended with diffuse emission sources and extreme events. The emphasis will lie on the relations between emission sources and water quality. Recommendations will be made on the inventory methods and the analysis of the data.
2	A proposal is made on the setup of a small intercalibration programme and a joint water quality monitoring programme. Similarities and differences in the sampling and analysis methods are summarized. Monitoring localities are seleced and the monitored parameters and freqency are discussed.
3	The effects of investments and measures in the Scheldt basin will be studied more in detail. A comparison of instruments and tax systems wil be made. The environmental efficicency of investents, measures and instruments will be studied.

4	A workgroup of information specialists will inventory the possibilities for the implementation of a Scheldt-GIS at the water management administrations in the Scheldt riparian states. The advantages and disadvantages of the possible future objectives and activities (like the distribution of information) will be discussed.
5	The description of the water quality will be extended with maps of the parameters of the North Sea Actions Programme (1990, 1991 and 1992).
6	A inventory will be made ofthe quality, policy, management and sanitation efforts of contaminated sediments. A list is made of involved administrations and research institutes.
7	A special workgroup will make a Description of the Ecology of the Scheldt basin (DES).

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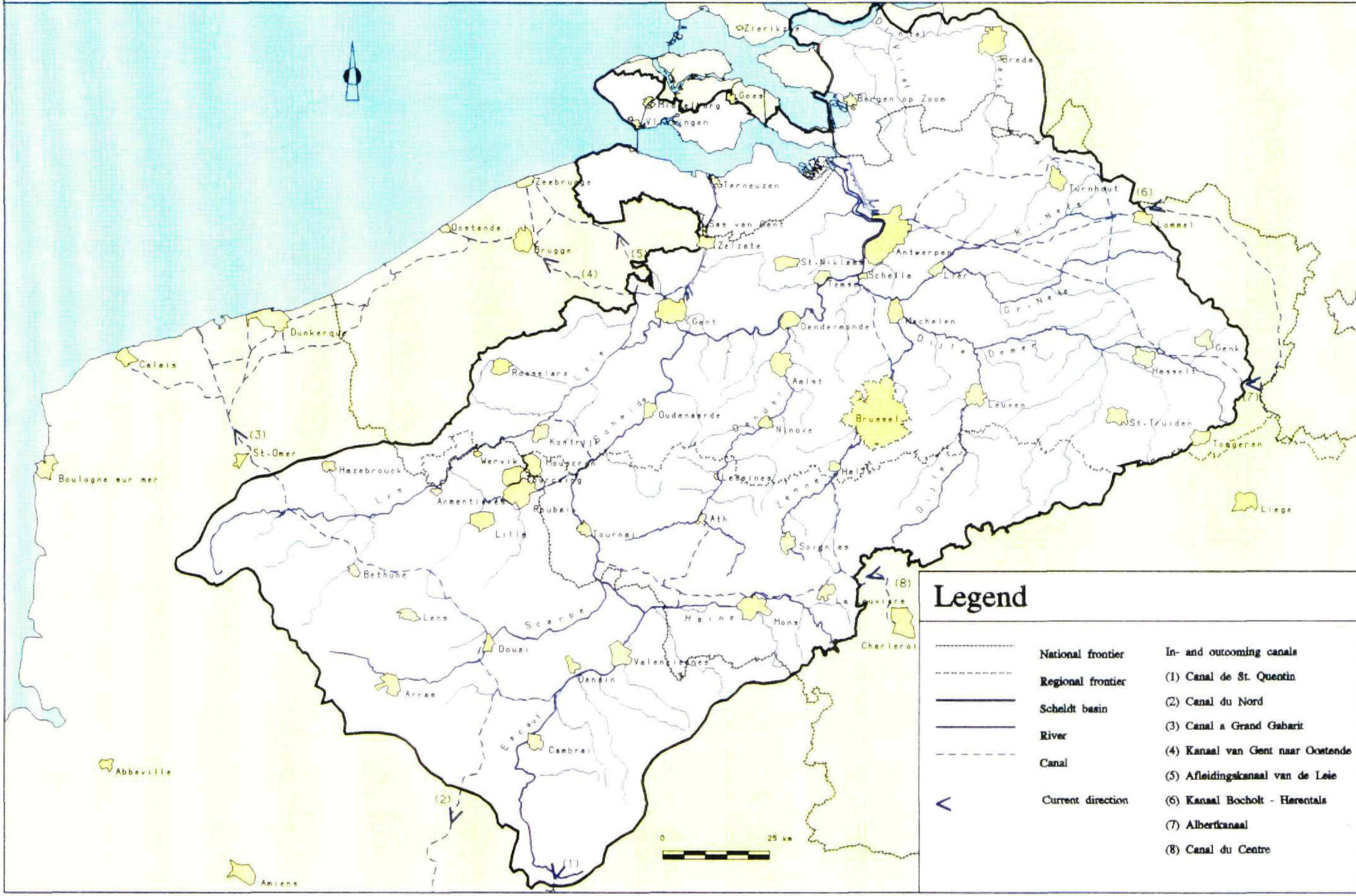
GIS-maps

Topographic map of the Scheldt basin

ISG 1993



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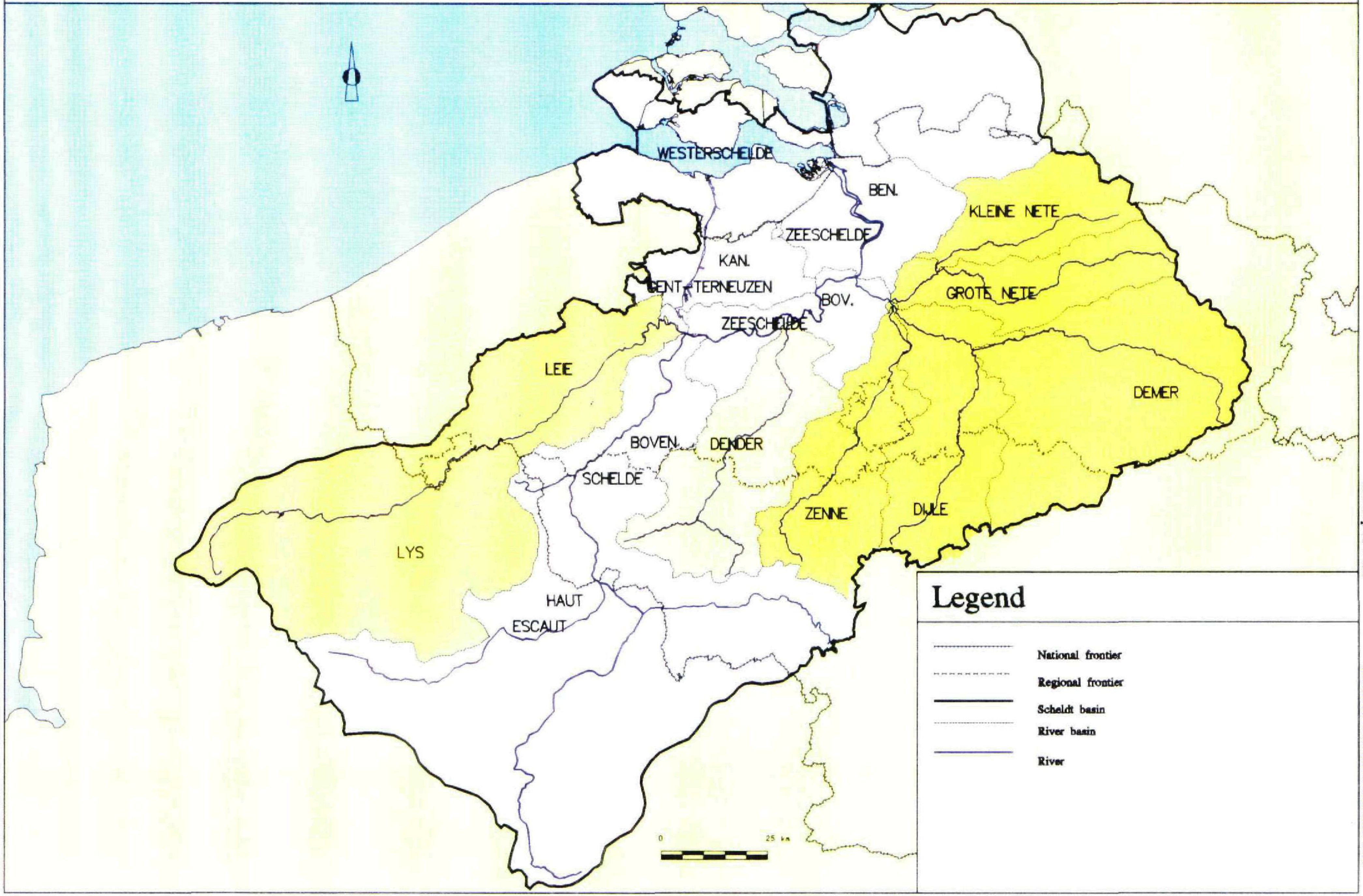
INTERIM PROGRESS REPORT 1993

Hydrographic subbasins in the Scheldt basin

ISG 1993



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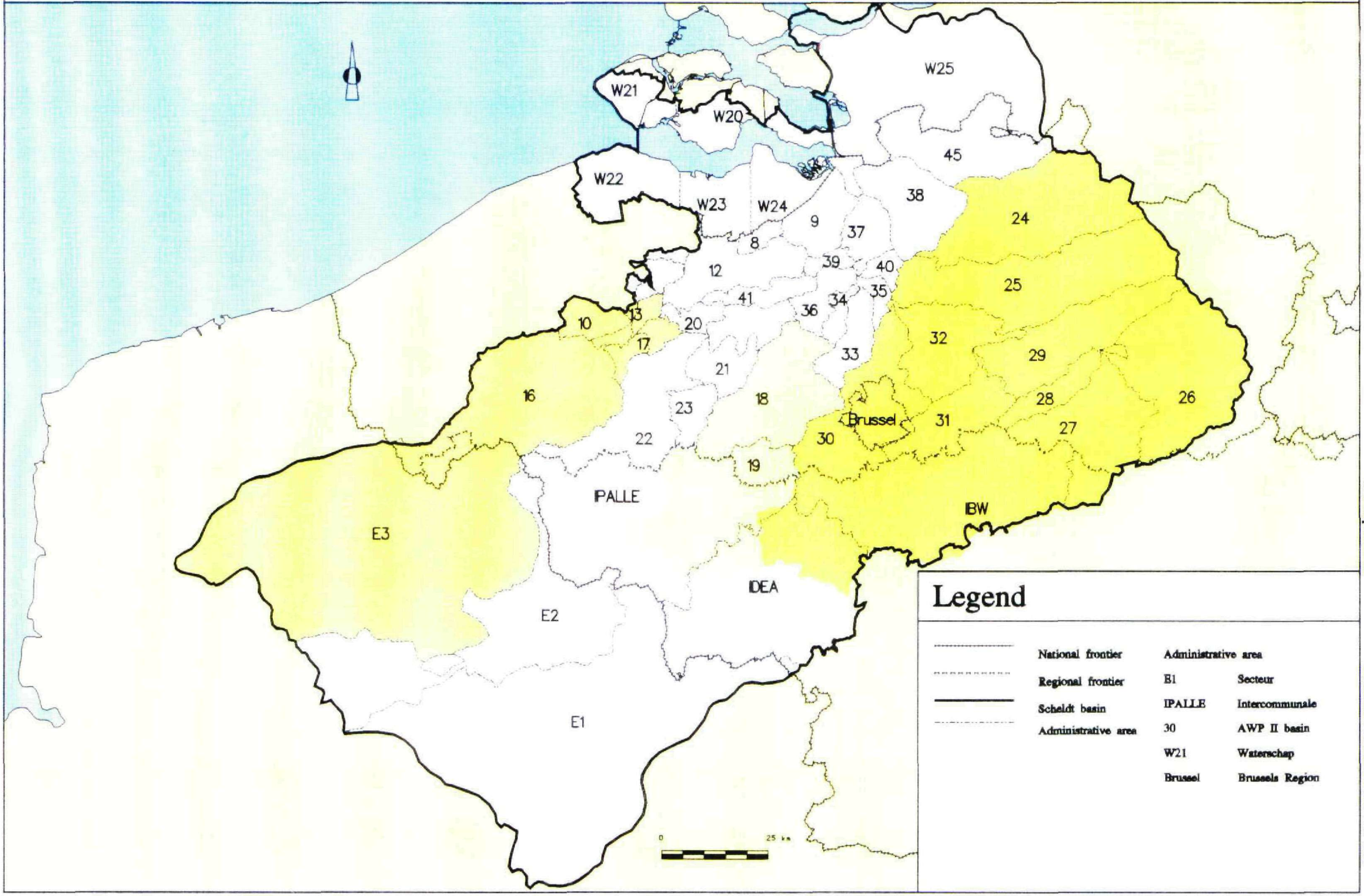
INTERIM PROGRESS REPORT 1993

Administrative area in the Scheldt basin

ISG 1993



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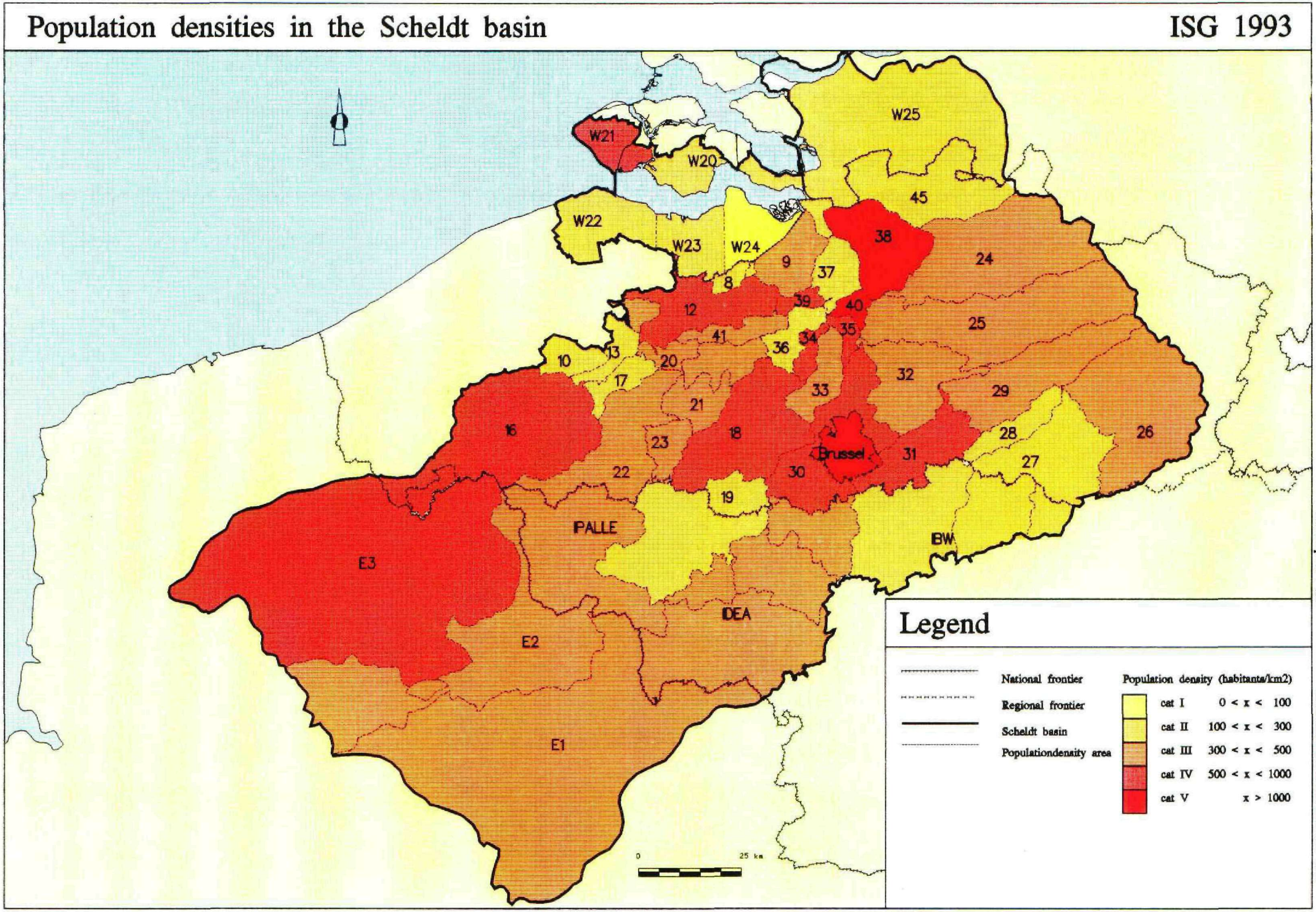

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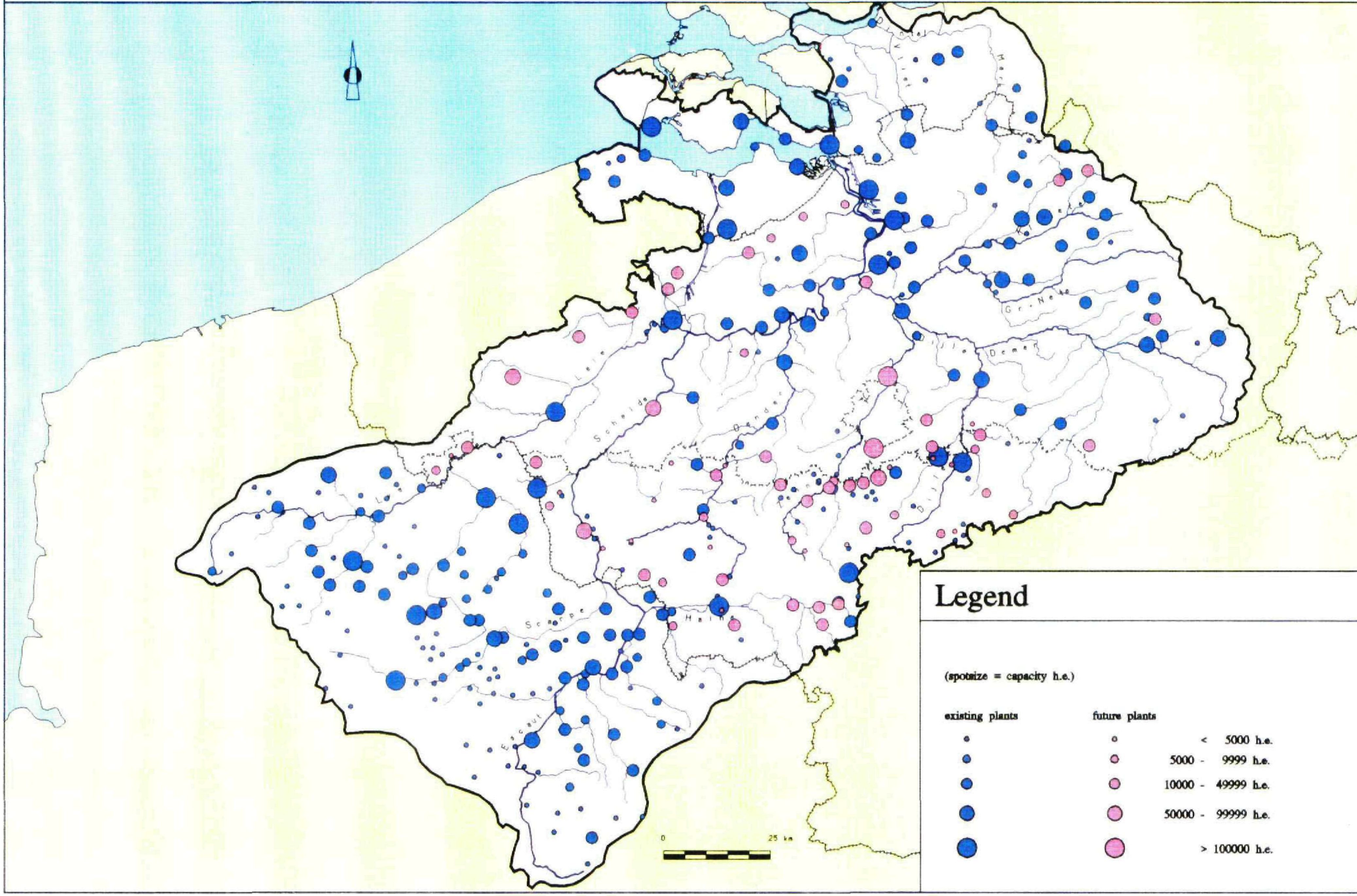
INTERIM PROGRESS REPORT 1993

Waste water treatment plants in the Scheldt basin

ISG 1993



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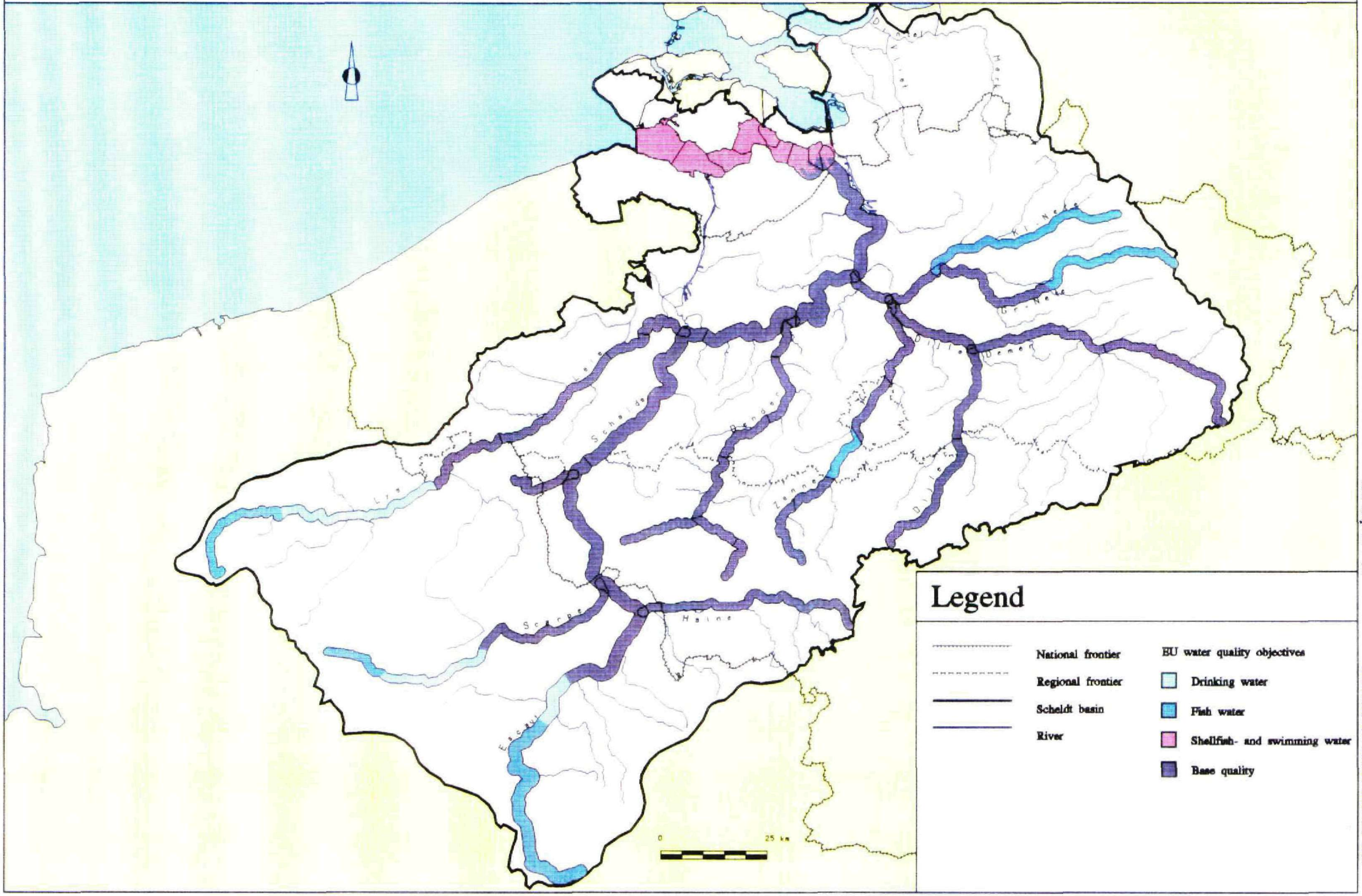
INTERIM PROGRESS REPORT 1993

Water quality objectives in the Scheldt basin

ISG 1993



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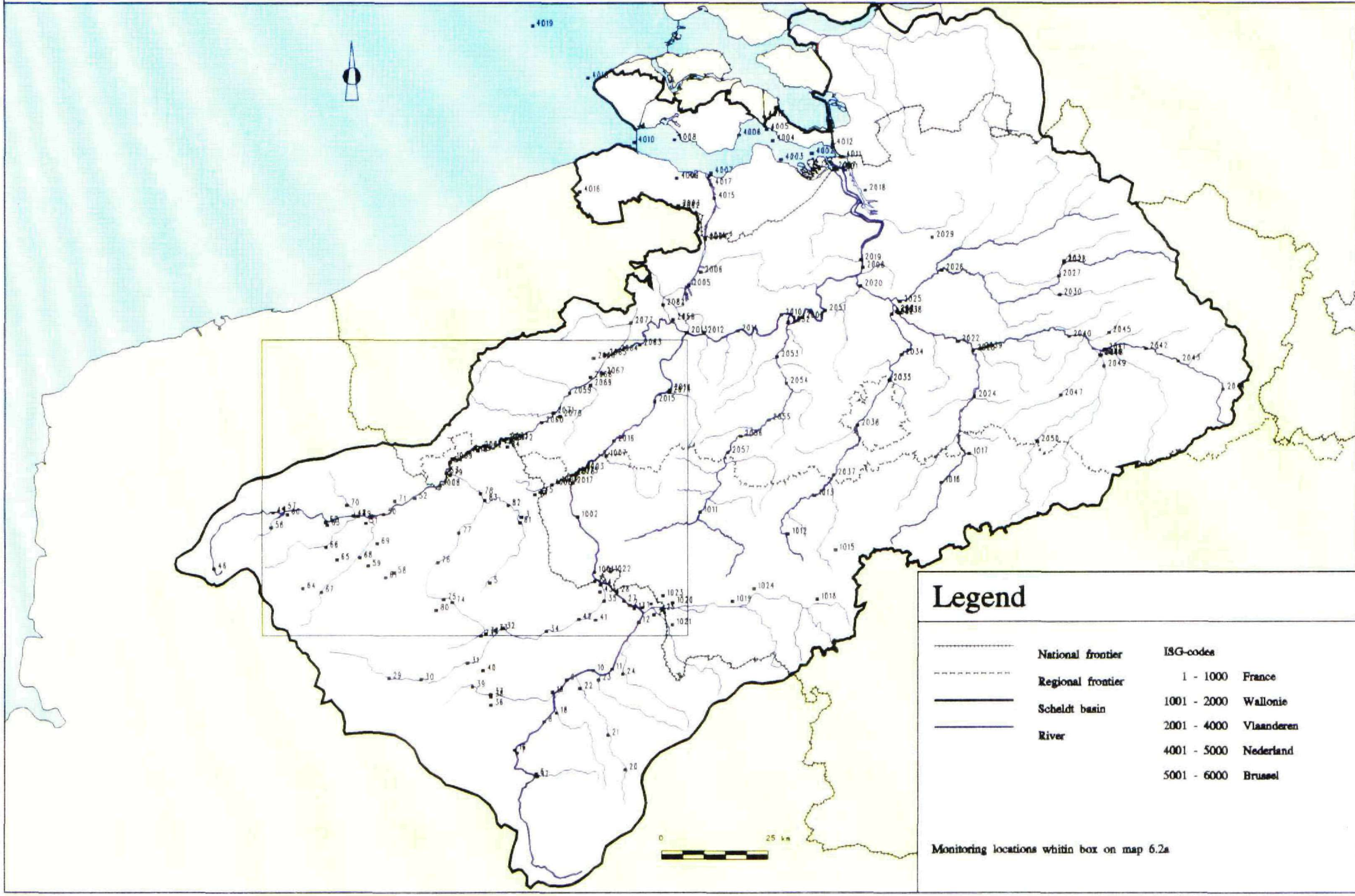
Water quality monitoring localities in the Scheldt basin

ISG 1993



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INTERIM PROGRESS REPORT 1993

Water quality monitoring localities in the Scheldt basin

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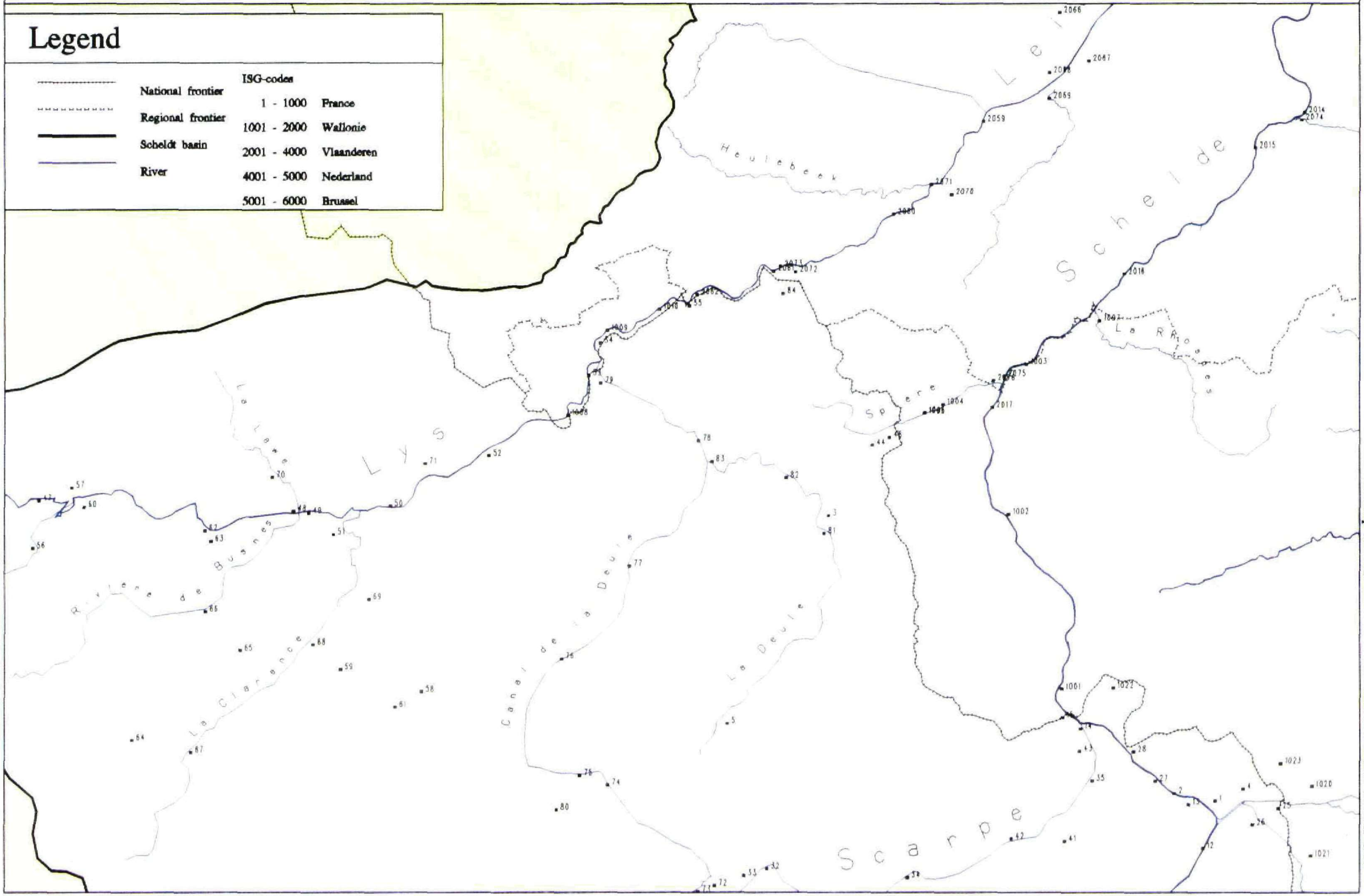
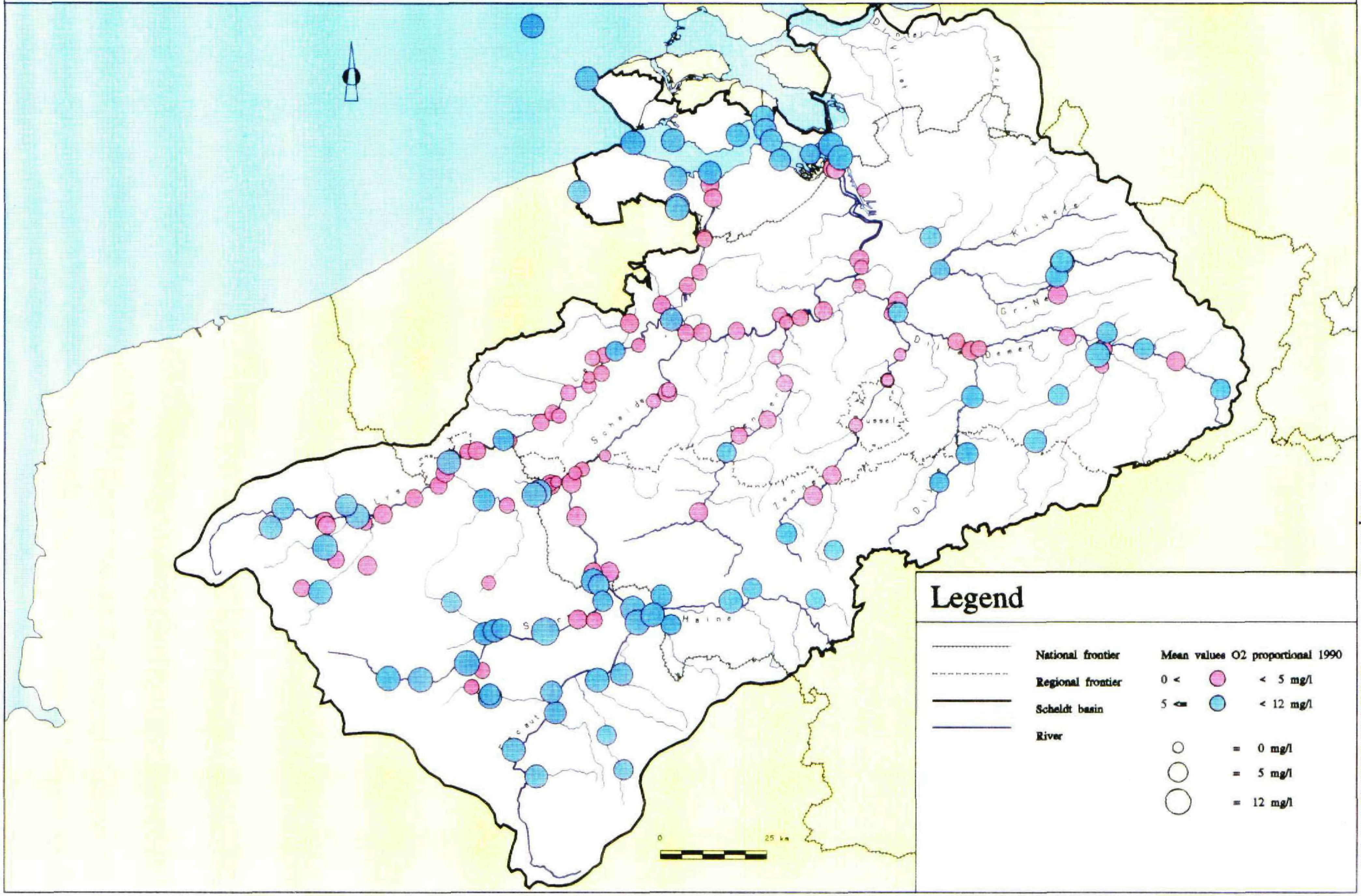


O2-concentrations 1990 in the Scheldt basin

ISG 1993



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INTERIM PROGRESS REPORT 1993

BOD-contents 1990 in the Scheldt basin

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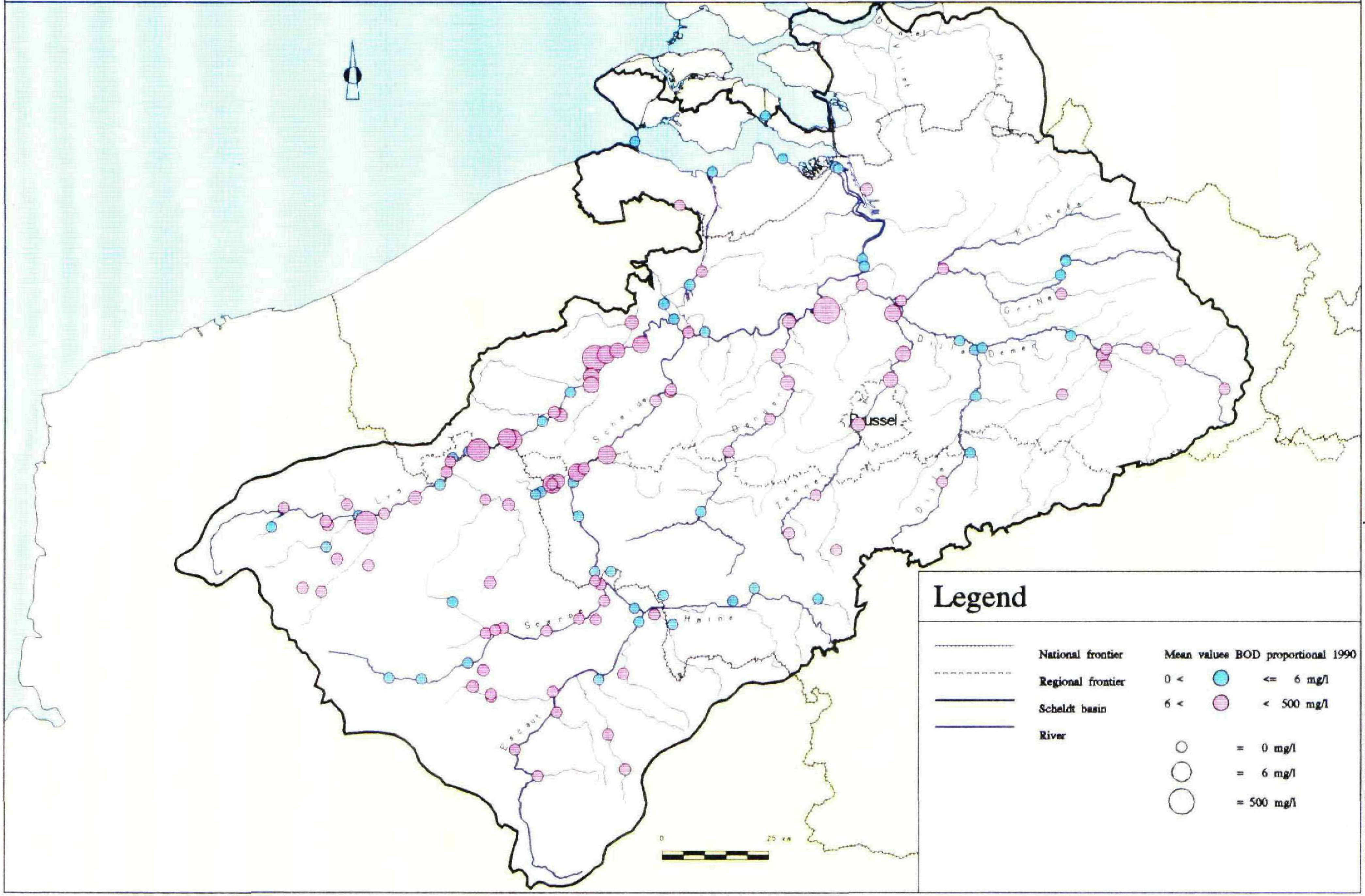

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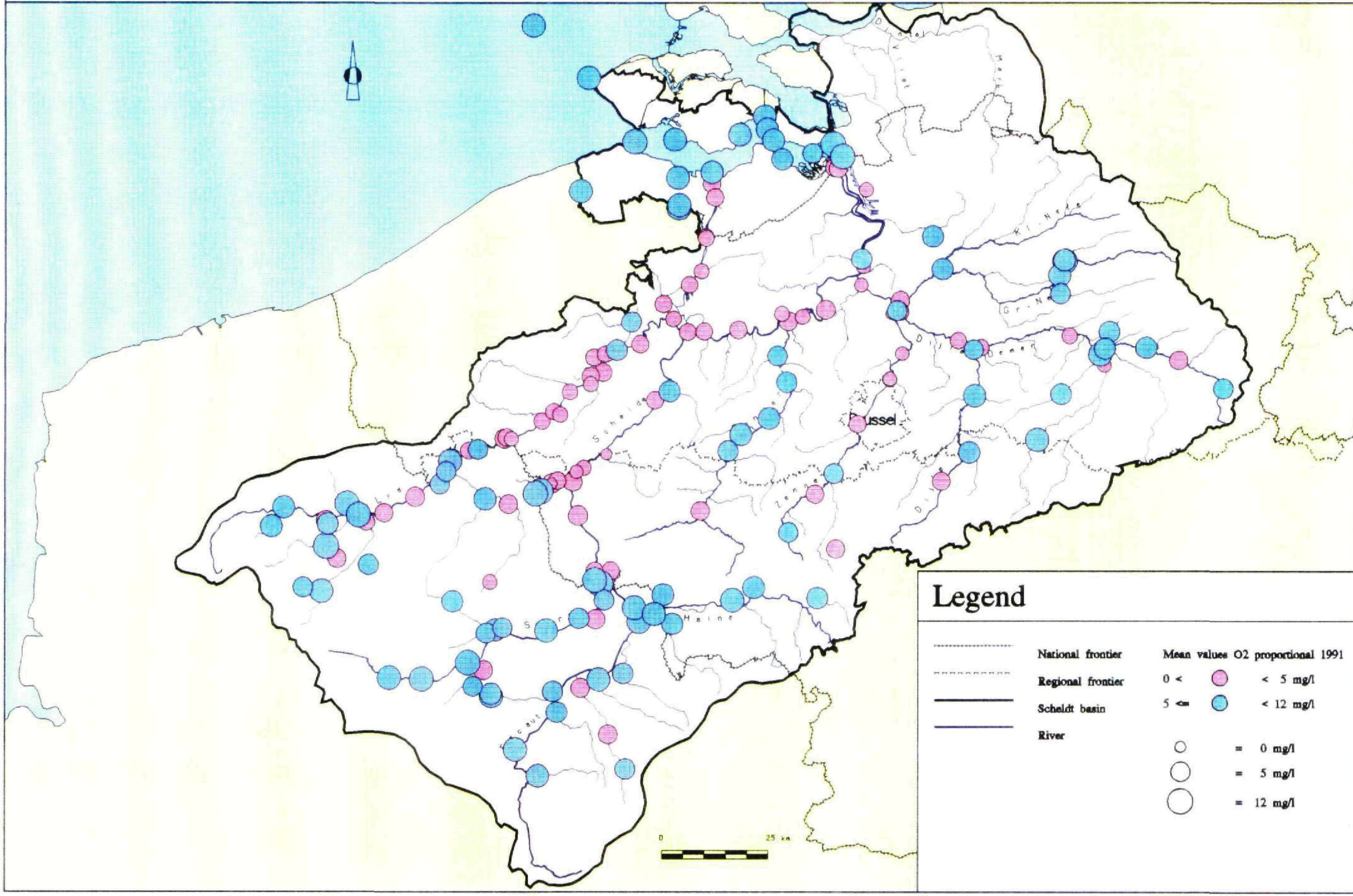

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INTERIM PROGRESS REPORT 1993

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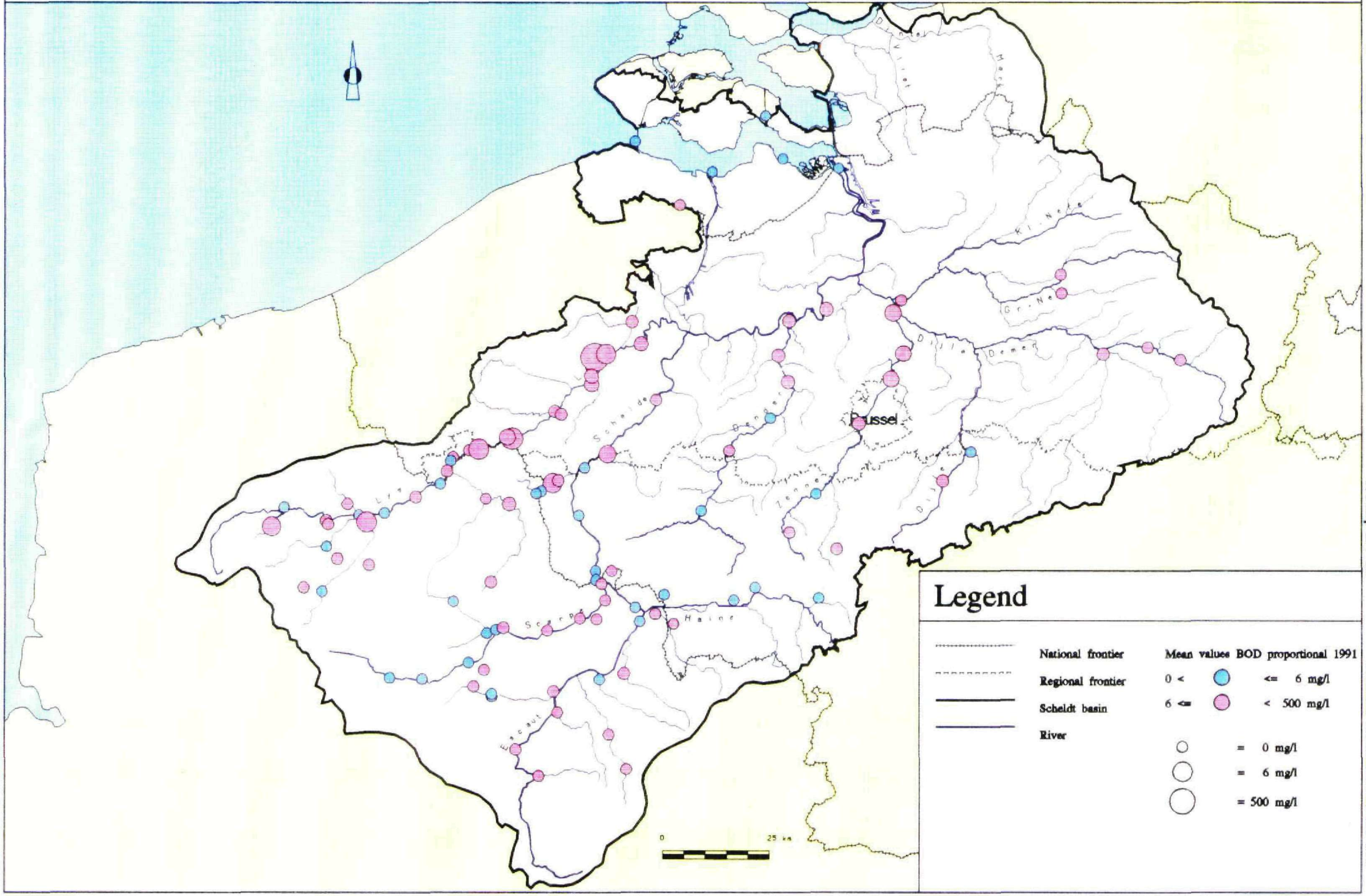

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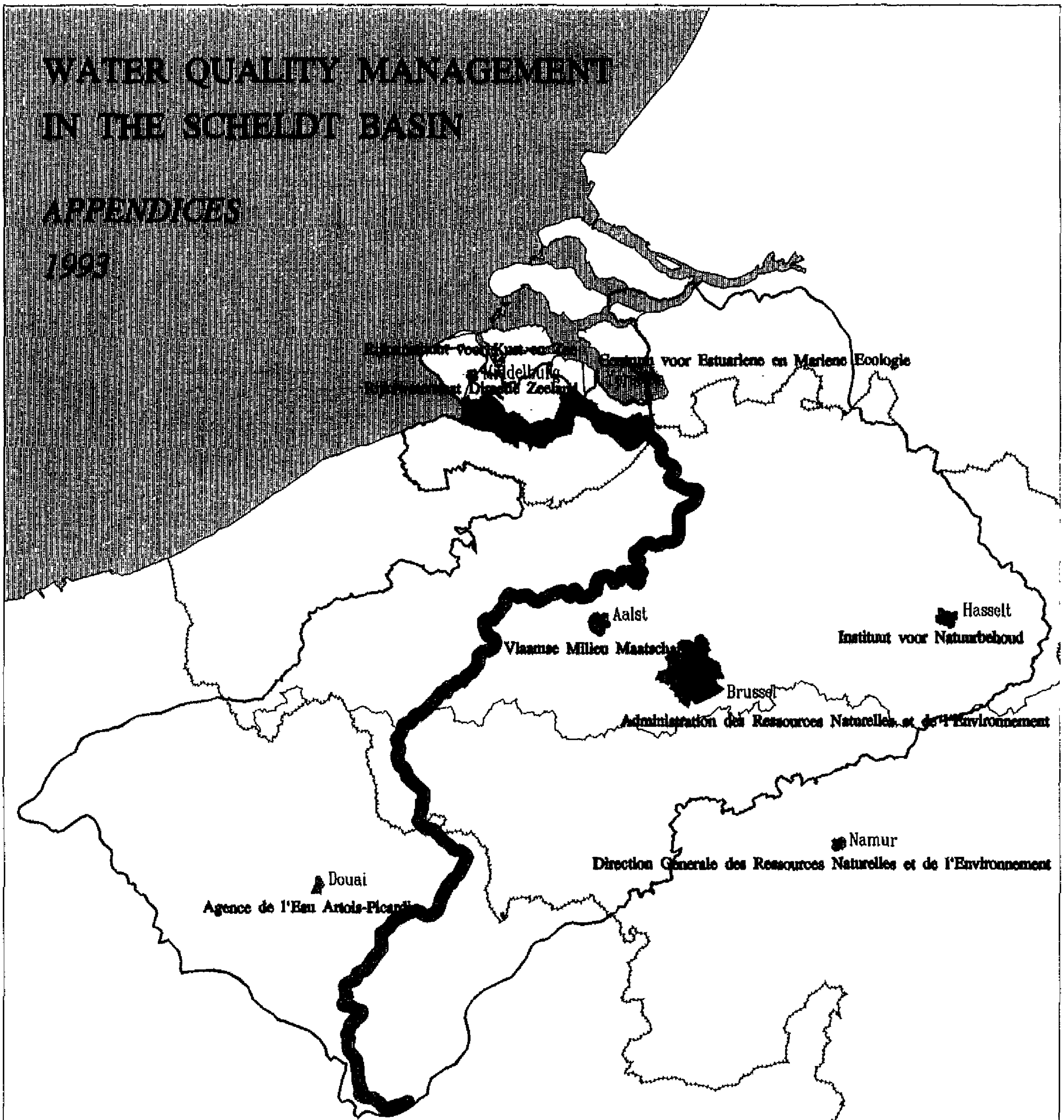
WATER QUALITY MANAGEMENT IN THE SCHELDT BASIN

APPENDICES

1993



INTERNATIONAL SCHELDT GROUP

(ISG)

Water quality management in the Scheldt basin

(Appendices 1993)

International Scheldt Group (ISG)
Agence de l'Eau Artois-Picardie Ministere de la Region Wallonne Ministere de la Region de Bruxelles-capitale Vlaamse Milieumaatschappij Instituut voor Natuurbehoud Rijkswaterstaat Directie Zeeland Rijkswaterstaat, Rijksinstituut voor Kust en Zee Centrum voor Mariene en Estuariene Ecologie

Author: Ir. L.L.P.A. Santbergen (Rijkswaterstaat, Directie Zeeland)

Contribution: Prof. dr. R. Wollast (Université Libre de Bruxelles)

Citation: International Scheldt Group (ISG). Water quality management in the Scheldt basin (appendices 1993). March, 1994. Pages: 105. Report AX/94/0 14.

Contents

1. Introduction

Appendix 1.1 Addresses-list of the International Scheldt Group

Chairman ISG/DWS
Prof. Dr. C.H.R. Heip
Centrum voor Mariene en Estuariene Ecologie (CEMO)
Vierstraat 28
4401 EA Yerseke
The Netherlands

Tel: (01131-)1920
Fax: (01131)-3616

Projectleader
Ir. L.L.P.A. Santbergen
p/a Rijkswaterstaat Directie Zeeland
Postal box 5014
4330 KA Middelburg

Tel: (01180-)86402
Fax: (01180-)86231 or 40215

Participants:

Agence de l'Eau Artois-Picardie (North-France)

Mr. M. Boulan	Directeur Générale
Mr. M. Grandmougin	Directeur pour la Lutte contre la Pollution
Mr. J.-M. Journet	Chef de Mission Données Techniques
Mme. D. Dhainaut	Ingénieur Qualité des Eaux

764 Boulevard Lahure
Boîte Postale 818
59508 Douai Cedex
France

Tel: 27999000
Fax: 27999015

Administration des ressources Naturelles et de l'Environnement (Brussels)
Mme M. Derick
Mr. M. Sponar

Avenue Louise 54
1050 Bruxelles
Belgium

Tel: 02-5171200
Fax: 02-5119442

Ministère de la Région wallonne/Direction Générale des ressources Naturelles et de l'Environnement (Wallonia)

Ir. C. Delbeuck	Directeur Générale
Ir. J.-M. Wauthier	Chef Directeur de la Direction des Eaux de Surface
Ir. B. de Kerckhove	EC correspondent of the Wallonian region and coordinator of international contacts.
Ir. B. Tricot	Agronomical Engineer; contrats de rivière
Ir. D. Marchot	Direction de la Politique Générale de l'Eau
Ir. E. Flore	Agronomical Engineer; Division des Pollutions Industrielles
Ir. P. Hecq	Coordination monitoring programmes
Ir. F. Paulus	PEGASE model and information systems
J. Szwarcenstztajn	Direction du Contrôle de l'Eau; industrial zone of Tertre

Ministère de la Région wallonne
Direction Générale des Ressources Naturelles et de l'Environnement
Avenue Prince de Liège 15
5000 Namur
Belgium

Tel: 081-325813 or 325805
Fax: 081-325984

Vlaamse Milieumaatschappij (Flanders)

Ir. M. Bruijneel	Director of the Direction Monitoring Programmes and Planning
Ir. H. Maeckelberghe	Chef Water Service
Miss. M. Van Den Langenbergh	Coordination external contacts
Ir. M. Verdievel	Research on water bottoms.
Ir. F. Monsieur	Information systems

Vlaamse Milieumaatschappij
Gasthuisstraat 42
9300 Aalst
Belgium

Tel: 053-726211
Fax: 053-773290

Instituut voor Natuurbehoud (Flanders)

Dr. E. Kuijken	General Director
Dr. P. Meire	Research Scheldt-estuary/international contacts
Ir. T. Ysebaert	Research Scheldt-estuary/international contacts

Instituut voor Natuurbehoud
Kiewitdreef 3
3500 Hasselt
Belgium

Tel: 011-210110
Fax: 011-242262

Rijkswaterstaat Directie Zeeland (the Netherlands)

Dr. H.L.F. Saeijs	Chief-engineer director
Drs. A.R. Kop	Director of Water Management and Water Control Infrastructure head-department
Ir. E. Turkstra	Director of Integrated Water Management and Planning Department
Ir. F. de Bruijckere	Chemist at the Integrated Water Mangement and Planning Department

Rijkswaterstaat Directie Zeeland
Postal Box 5014
4330 KA Middelburg
The Netherlands

Tel: 01180-86000 (reception)
01180-86310 (Saeijs)
01180-86410 (Kop)
01180-86400 (Turkstra)
01180-86404 (De Bruijckere)
Fax: 01180-86231 or 40215

Rijkswaterstaat, Rijksinstituut voor Kust en Zee (the Netherlands)
Ir. H. Smit — Director Delta division
J.P. Vreeke — Information Systems/Scheldt-GIS

Rijkswaterstaat, Rijksinstituut voor Kust en Zee
Postal Box 8039
4330 EA Middelburg
The Netherlands

Tel: 01180-72200 (reception)
01180-72233 (Smit)
01180-72271 (Vreeke)
Fax: 01180-16500

Contributors Interim Progress Report 1993

Prof. dr. R. Wollast
Université Libre de Bruxelles
Campus Plaine C.P. 208
Bd du triomphe
1050 Bruxelles
Belgium

Tel: 02-6505213
Fax: 02-6463492

Trainees at Rijkswaterstaat Directie Zeeland (The Netherlands)
Mariska Bijleveld (trainee)
Joeri van Belle (trainee)
Marco van Dijk (trainee)

Rijkswaterstaat Directie Zeeland
Postal Box 5014
4330 KA Middelburg
The Netherlands

Tel: 01180-86402 (Santbergen)
Fax: 01180-86231 or 40215

Waterschappen around the Westerschelde (The Netherlands)

Waterschap Noord- en Zuid-Beveland
Drs. H. Haarlem
Postbus 114
Goes
The Netherlands

Waterschap Walcheren
Drs. A.W. Fortuin
Postbus 179
4330 AD Middelburg
The Netherlands

Waterschap De Drie Ambachten
Ir. P. Stouten
Postbus 1107
4530 GC Terneuzen
The Netherlands

Waterschap 't Vrije van Sluis
Ing. J.A.J. Boekhout
Postbus 28
4500 AA Oostburg
The Netherlands

Hoogheemraadschap West-Brabant
Ir. R.E.M. van Oers
Postbus 2212
4800 CE Breda

International numbers

Netherlands-Belgium	00-32
Netherlands-France	00-33
Belgium-Netherlands	00-31
Belgium-France	00-33
France-Netherlands	19-31
France-Belgium	19-32

2. Description of the study area

Appendix 2.1
Surfaces and number of habitants of the hydrographic subbasins

International Scheldt Group 1993

Hydrographic subbasin	Surface (km2)						Number of habitants					
	France	Wallonia	Flanders	Brussels	The Netherlands	Total	France	Wallonia	Flanders	Brussels	The Netherlands	Total
Haut-Escaut/Boven-Schelde	3,965	1,543	580	-	-	6,088	1,199,016	517,677	189,500	-	-	1,906,193
Lys/Leie	2,794	44	1,467	-	-	4,305	2,634,183	- *)	577,000	-	-	3,211,183
Dendre/Dender	-	677	709	-	-	1,386	-	106,966	337,000	-	-	443,966
Senne/Zenne	-	574	435	162	-	1,171	-	185,402	327,000	1,000,000	-	1,512,402
Dyle/Dijle	-	615	650	-	-	1,265	-	165,435	337,000	-	-	502,435
Demer	-	395	1,793	-	-	2,188	-	106,255	606,400	-	-	712,655
Nete	-	-	1,560	-	-	1,560	-	-	534,000	-	-	534,000
Grote Nete + Beneden Nete	-	-	*758*	-	-	*866*	-	-	290,000	-	-	290,000
Kleine Nete	-	-	*802*	-	-	*813*	-	-	244,000	-	-	244,000
Boven Zeeschelde (between Gent and Rupelmonde)	-	-	1,007	-	-	1,007	-	-	475,000	-	-	475,000
Beneden Zeeschelde (between Rupelmonde and Dutch-Belgian border)	-	-	1,854	-	-	1,854	-	-	964,300	-	-	964,300
Kanaal Gent-Terneuzen	-	-	474	-	194	668	-	-	297,300	-	54,535	351,835
Westerschelde (between border and Vlissingen)	-	-	-	-	2,515	2,515	-	-	-	-	580,275	580,275
Total→	6,759	3,848	10,529	162	2,709	23,000	3,833,199	1,081,735	5,160,500	1,000,000	634,810	11,728,240

*) The number of habitants in the French part of the Lys subbasin includes also the number of habitants in the (small) Wallonian part of the Lys subbasin.

Appendix 2.2 **Population densities of administrative areas**		**Legend:** **Population density categories (habitants/km²)** **I** $0 \leq x < 100$ **II** $100 \leq x < 300$ **III** $300 \leq x < 500$ **IV** $500 \leq x < 1000$ **V** $x > 1000$ **International Scheldt Group (1993)**	
Hydrographic subbasin	**Administrative area**	**Population density (habitants/km2)**	**Density category**
Haut-Escaut/Boven-Schelde	E1, E2	302	III
	Parts of IDEA and IPALLE (Haut-Escaut and Haine)	336	III
	AWP-II 22	326	III
	AWP-II 23	329	III
Lys/Leie	E3 *)	943	IV
	AWP-II 10	162	II
	AWP-II 16	503	IV
	AWP-II 17	294	II
Dendre/Dender	part of IPALLE	158	II
	AWP-II 18	541	IV
	AWP-II 19	169	II
Senne/Zenne	part of IBW	323	III
	Brussels Region	6173	V
	AWP-II 30	755	IV
Dyle/Dijle	part of IBW	296	II
	AWP-II 31	570	IV

Appendix 2.2 **Population densities of administrative areas**		**Legend:** **Population density categories (habitants/km²)** **I 0 ≤ x < 100** **II 100 ≤ x < 300** **III 300 ≤ x < 500** **IV 500 ≤ x < 1000** **V x > 1000** **International Scheldt Group (1993)**	
Hydrographic subbasin	**Administrative area**	**Population density (habitants/km2)**	**Density category**
	AWP-II 32	472	III
Demer	part of IBW	269	II
	AWP-II 26	424	III
	AWP-II 27	267	II
	AWP-II 28	172	II
	AWP-II 29	323	III
Grote Nete + Beneden Nete	AWP-II 25	383	III
Kleine Nete	AWP-II 24	304	III
Boven-Zeeschelde (between Gent and Rupelmonde)	AWP-II 20	495	III
	AWP-II 21	308	III
	AWP-II 33	490	III
	AWP-II 34	704	IV
	AWP-II 35	896	IV
	AWP-II 36	741	IV
	AWP-II 45	180	II
Beneden-Zeeschelde (between Rupelmonde and Dutch-Belgium border)	AWP-II 9	347	III

Appendix 2.2 **Population densities of administrative areas**		**Legend:** **Population density categories (habitants/km²)** **I** $0 \leq x < 100$ **II** $100 \leq x < 300$ **III** $300 \leq x < 500$ **IV** $500 \leq x < 1000$ **V** $x > 1000$	**International Scheldt Group (1993)**
Hydrographic subbasin	**Administrative area**	**Population density (habitants/km2)**	**Density category**
	AWP-II 37	288	II
	AWP-II 38	1420	V
	AWP-II 39	530	IV
	AWP-II 40	1480	V
	AWP-II 41	435	III
Kanaal Gent-Terneuzen	AWP-II 8	154	II
	AWP-II 12	686	IV
	WS23	282	II
Westerschelde (between border and Vlissingen)	WS20	166	II
	WS21	595	IV
	WS24	42	I
	WS25	187	II

Appendix 2.3/A Tributaries/canals that debouche in the Haut-Escaut/Boven-Schelde.			
Country/region	**North-France**	**Wallonia**	**Flanders**
Administrative basins	E1, E2	IPALLE, IDEA	AWP-II 22 AWP-II 23
Surface (km²)	3,965	1,543	580
Number of habitants	1,199,016	517,677	189,500
Tributaries/canals	le Canal de la Sensée	le Canal Péronnes	Spierkanaal
	la Sensée Rivière		Grote Spierebeek/Zwarte Spierebeek
	l'Erclin		Kanaal Bossuit-Kortrijk
	la Selle		le Rhieu de l'Haie
	l'Ecaillon		la Rhosnes
	la Rhonelle		Rijtgracht
	la Haine (via le Canal du Mons)		Oude Schelde (Kerkhove)
	la Nouvelle Haine (via le Canal du Mons)		Nederbeek/Zijpte
	le Canal du Jard		Molenbeek (Oudenaarde)
	La Scarpe		Markebeek
			Riedekensbeek
			Spouwwaterbeek
			Zwalm
			Stampkotbeek
			Oude Schelde (Meilegem)
			Wallebeek
			Oude Schelde (Kriephoek)
			Molenbeek (Merelbeke)
			Moerbeek/Coupure
			Oude Schelde /Doornhammeke (De Pinte)
			Zwartekobensbeek
ISG-1993			Oude Schelde-Zonneput (Gent)

Appendix 2.3/B
Tributaries/canals that debouche in the river Lys/Leie.

Country/region	North-France	Wallonia	Flanders
Administrative basins	E3	IPALLE	AWP-II 10 AWP-II 16 AWP-II 17
Surface (km^2)	2,794	44	1,467
Number of habitants	2,634,183	-	577,000
Tributaries/canals	La Laquette	Le Canal de la Deûle *)	Geluwse Beek
	La Melde-Du-Pas-De-Calais	Douwebeek *)	La Becque de Neuville/ Gaverbeek
	La Rivière de Busnes	Kortekeerbeek *)	Lauwsebeek
	Le Canal de la Bourre	La Haute Planche *)	Neerbeek
	La Clarence/La Nave		Markebeek
	La Lawe		Canal Bossuit-Kortrijk
	La Becque de Steenwerck		Heulebeek
			Gaverbeek
			Vaarnewijkbeek
			Plaatse Beek
			Mandel
			Zouwbeek
			Gottem
			Tichelbeek/Gaverbeek
			Kattebeek
			Astene
			Petegemse Beek
			Kalebeek
			Rosdambeek
			Lieve

*) These tributaries debouche in the Lys at the French-Wallonian border.

Appendix 2.3/C Tributaries/canals that debouche in the Dendre/Dender		
Country/region	**Wallonia**	**Flanders**
Administrative basins	IPALLE	AWP-II 18 AWP-II 19
Surface (km²)	677	709
Number of habitants	106,966	337,000
Tributaries/canals	La Sille	Molenbeek (Geraardsbergen)
	Le Rieu de Trimpont	Molenbeek (3x in Ninove)
	La Rivière d'Ancre	Bellebeek
	La *Marcq*	Wildebeek
		Molenbeek (2x in Aalst)
		Molenbeek (Erpe-Mere)
		Molenbeek (Dendermonde)
		Steenbeek
		Vondelbeek

Appendix 2.3/D Tributaries/canals that debouche in the Zenne.			
Country/region	**Wallonia**	**Brussels**	**Flanders**
Administrative basins	IBW		AWP-II 30
Surface (km²)	574	435	162
Number of habitants	185,402	1,000,000	327,000
Tributaries/canals	La Brainette	La Wolluwe	Molenbeek-Aabeek
	La Senette		

Appendix 2.3/E Tributaries/canals that debouche in the Dyle/Dijle.		
Country/region	**Wallonia**	**Flanders**
Administrative basins	IBW	AWP-II 31 AWP-II 32
Surface (km²)	615	650
Number of habitants	165,435	337,000
Tributaries/canals	L'Orne	La Lasnes
	La Thyle	Vaalbeek
	Le Train	Ijsse
	Nethen *)	Leigracht
		Molenbeek
		Voer
		Blauwputbeek
		Vunt
		Leibeek (Leuven)
		Demer
		Laakbeek/Laak
		Leibeek (Boortmeerbeek)
		Molenbeek/Weesbeek
		Barebeek
		Platte Beek
		Vrouwvliet
		Zenne
		Canal Leuven-Mechelen

*) This watercourse ends up in the Dijle at the Wallonian/Flemish border.

Appendix 2.3/F Tributaries/canals that debouche in the Demer.		
Country/region	**Wallonia**	**Flanders**
Administrative basins	IBW	AWP-II 26 AWP-II 27 AWP-II 28 AWP-II 29
Surface (km²)	395	1,793
Number of habitants	106,255	606,400
Tributaries/canals		Munsterbeek/Molenbeek
		Kaatsbeek
		Roosterbeek
		Mangelbeek
		Herk
		Gete
		Zwarte Beek
		Begijnenbeek
		Zwart Water
		Laarbeek
		Grote Motte
		Winge

Appendix 2.3/G Tributaries/canals that debouche in the Grote Nete and the Kleine Nete		
Country/region	Flanders	
Surface (km²)	1,560	
Number of habitants	534,000	
Subbasin	Grote Nete	Kleine Nete
Tributaries/canals	Kleine Hoofdgracht/Balengracht	Achterste Nete
	Asbeek	Voorste Nete
	Heiloop	Desselse Nete/Weerbeekse Nete/Zwarte Nete
	Zeeploop/Rosselaarloop	Klein Neetje
	Molse Neet	Wamp
	Hezemeerloop	Bankloop
	Grote Laak	Kneutersloop
	Varendonkse Loop	AA
	Steenkensbeek	
	Kalsterloop/Molenbeek/ Herseltse Loop	
	Bruggeneindse Laak	
	Bergebeek	
	Goorloop	
	Wimp	
	Gestelsebeek	
ISG-1993	Berlaarse Laak	

Appendix 2.3/H Tributaries/canals that debouche in the Boven-Zeeschelde.	ISG-1993
Country/region	Flanders
Administrative basins	AWP-II 20 AWP-II 21 AWP-II 33 AWP-II 34 AWP-II 35 AWP-II 36 AWP-II 41
Surface (km^2)	1,007
Number of habitants	475,000
Tributaries/canals	Lys (Gent)
	Ledebeek (Destelbergen)
	Damsloot/Mostbeek (Destelbergen)
	Molenbeek (Melle)
	Molenbeek (Wetteren)
	Maanbeek (Laarne)
	Oude Schelde (Wichelen)
	Molenbeek (Wichelen)
	Donkmeer (Berlare)
	Nieuwe Dender (Dendermonde)
	Dender (Dendermonde)
	Dorpsloop (Sint-Amands)
	Beek Mariekerke (Bornem)
	Durme (Hamme)
	Oude Schelde (Bornem)
	Kragewiel (Bornem)
ISG-1993	Rupel

Appendix 2.3/I
Tributaries/canals that debouche in the Beneden-Zeeschelde

Country/region	Flanders
Administrative basins	AWP-II 9 AWP-II 37 AWP-II 38 AWP-II 39 AWP-II 40 AWP-II 45
Surface (km^2)	1,854
Number of habitants	964,300
Tributaries/canals	Grote Struisbeek (Hemiksem)
	Barbierbeek (Kruibeke)
	Grote Leigracht (Antwerpen)
	Holle Beek (Antwerpen)
	Schijn (Antwerpen)
	Melselebeek (Mechelen)

Appendix 2.3/J
Tributaries/canals that debouche in the Kanaal Gent-Terneuzen

Country/region	Flanders	The Netherlands
Administrative basins	AWP-II 8 AWP-II 12	WS23
Surface (km^2)	474	194
Number of habitants	297,300	54,535
Tributaries/canals	Ringvaart (Gent)	
	Nieuwe Moervaart (Gent)	
	Molenvaardeken (Evergem)	
	Avrijevaart (Evergem)	

Appendix 2.3/K Tributaries/canals that debouche in the Westerschelde	
Country/region	The Netherlands
Administrative basins	WS20, WS21, WS22, WS24, WS25
Surface (km^2)	2,515
Number of inhabitants	580,275
Tributaries/canals	Bathse Spuikanaal
	Kanaal door Zuid-Beveland
	Kanaal Gent-Terneuzen
	Kanaal door Walcheren

Appendix 2.4 **Canals in the Scheldt basin**	**International Scheldt Group (1993)**	
Canal	**Description**	**Flow direction (in, out or inside the Scheldt basin)**
Canal de St. Quentin	Connection between *Haut-Escaut* and the *Meuse*.	out
Canal du Nord	Connection between *Haut-Escaut* and the river basins of the *Somme* and *Seine*.	out
Canal de la Sensée	Connection between basins of *Haut-Escaut* and *Scarpe*. Connected to Canal de la Deule, river Scarpe, Canal du Nord and river Haut-Escaut.	inside
Canal de la Deule	Connection between the basins of *Scarpe* and *Deule*.	inside
Canal de Roubaix	Connection between *Haut-Escaut* and *Deule*.	inside
Canal d'Aire	Connection between *Canal de la Deule, the Deule* and *the Lys*.	inside
Canal de Neuffossé	Connection between *Canal d'Aire*, the river *Aa* and the coastal zone (*Calais, Dunkerque*)	out
La Nouvelle Haine (= Canal de la Haine)	Connection between the river Haine and the Haut-Escaut. *La Nouvelle Haine* debouches in the Haut-Escaut via the *Canal Mons-Condé*.	inside
Canal Mons-Condé	Connection between *Haut-Escaut* and *la Nouvelle Haine/la Haine*.	inside
Canal du Centre	Connection between the *Sambre*, the *Canal Charleroi-Bruxelles* and the *Canal Péronnes*.	in
Canal Blaton-Ath	Connection between *Canal Péronnes* and *la Dendre*.	inside
Canal Charleroi-Bruxelles	Connection between the *Rupel* and the *Sambre* via the *Canal du Centre*. Downstream of Bruxelles the name of this canal is *Kanaal van Willebroek*.	inside
Kanaal Bossuit-Kortrijk	Connection between the *Boven-Schelde* en the *Leie*.	inside

Appendix 2.4 **Canals in the Scheldt basin**	**International Scheldt Group (1993)**	
Canal	**Description**	**Flow direction (in, out or inside the Scheldt basin)**
Kanaal Gent naar Oostende	Connection between *Boven-Schelde* and the North Sea (at Oostende).	out
Afleidingskanaal van de Leie	Connection between *Boven-Schelde* and the North Sea (at Zeebrugge).	out
Ringvaart Gent	Connection between *Boven-Schelde*, *Leie*, *Kanaal Gent-Terneuzen* and *Kanaal Gent-Oostende*.	inside
Kanaal Gent-Terneuzen	Connection between *Boven-Schelde*, *Leie* and *Westerschelde*.	inside
Moervaart	Connection between *Durme* and *Kanaal Gent-Terneuzen*.	inside
Albertkanaal	Connection between Meuse and *Beneden Zeeschelde* (Antwerpen) via *Grote* and *Kleine Nete* and *Demer*.	in
Netekanaal	Connection between *Beneden Nete* and *Albertkanaal*.	inside
Schelde-Rijn verbinding	Connection between Rhine and Scheldt.	in
Batshe Spuikanaal	Connection between *Zoommeer* and *Westerschelde*.	in
Kanaal door Zuid-Beveland	Connection between *Oosterschelde* and *Westerschelde*.	in
Kanaal door Walcheren	Connection between *Veerse Meer* and *Westerschelde*.	

Appendix 2.5
Flow rates monitoring localities in the Scheldt basin.

ISG-1993

	1950-1959					1960-1969					1970-1979					1980-1989					1990-1999				
	01	23	45	67	89	01	23	45	67	89	01	23	45	67	89	01	23	45	67	89	01	23	45	67	89
HAUT-ESCAUT/BOVEN-SCHELDE																									
La Selle at Noyelle sur Escaut (F)							x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx					
L'Ecaillon at Thiant (F)							x x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx					
La Rhonelle at Aulnoy (F)							x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx					
Condé (F)			x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x										
La Haine at St. Aybert (F)									x	x x	x x	x x	x x	x x	x										
L'Hogneau at Thivencelle (F)												x x	x x	x x	x x	xx	xx	xx	xx	xx					
Bléharies (W)																x		x							
Kain (W)			x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x									
Avelgem (Fla)																x		x							
L'Espierre at la Passerelle du facteur (F)																				x					
Spiere at Estaimouis (Fl)																x		x							

Appendix 2.5
Flow rates monitoring localities in the Scheldt basin.

ISG-1993

	1950-1959					1960-1969					1970-1979					1980-1989					1990-1999				
	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9
Zwalm at																	xx	xx	xx	xx					
ZEESCHELDE																									
Merelbeke (Fla)												x x	x x	x x	x x	xx	xx	xx	x						
Melle (Fla)																				x	x				
Gent (Fla)					x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx	xx	x			
Dender at Denderbelle (Fla)					x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx	xx	x			
Durme at (Fla)																									
Zeeschelde upstream of Rupelmonde (Fla)																				x					
Zenne at Eppegem (Fla)					x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx	xx	x			
Dijle at Haacht (Fla)					x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	xx	xx	xx	xx	xx	xx	x			
Grote Nete at Ittegem (Fla)																x		x		x					
Kleine Nete at Grobbendonk (Fla)																x		x		x	x				
Rupel at Rupelmonde (Fla)																				x					

Appendix 2.5
Flow rates monitoring localities in the Scheldt basin.

ISG-1993

	1950-1959					**1960-1969**					**1970-1979**					**1980-1989**					**1990-1999**				
	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9	0 1	2 3	4 5	6 7	8 9
Schelle (Fla)					x	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	x			
Boei 87 (Nl)															x	xx	xx	xx	xx	xx	xx				
Vlissingen (Nl)															x	xx	xx	xx	xx	xx	xx				
RIVER LYS																									
Delettes (F)				xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx										
Armentières (F)													xx	xx	xx	xx	xx	xx	xx	xx					
Wervik (F)						xx	xx	xx	xx	xx	xx	xx	xx	xx	xx										
St. Eloois			x	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	x									
la Marque at Bouvines (F)									xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx					
KANAAL GENT-TERNEUZEN																									
Tolhuisstuw										xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx				
Terneuzen																									

3. Water quality management organization

Appendix 3.1 Water management organization in the Scheldt riparian states.

THE NETHERLANDS	NATIONAL WATERS (NAVIGABLE)				REGIONAL WATERS (NAVIGABLE AND NON-NAVIGABLE)			
	WATER QUANTITY		WATER QUALITY		WATER QUANTITY		WATER QUALITY	
	Strat.	*Operat.*	*Strat.*	*Operat.*	*Strat.*	*Operat.*	*Strat.*	*Operat.*
National government (RWS)	*	*	*	*				
Province (PWS)				(*)	*	*	*	*
Waterschap				(*)		*		*
Municipality								*

FLANDERS	NAVIGABLE WATERCOURSES				NON-NAVIGABLE WATERCOURSES							
	WATER QUANTITY		WATER QUALITY		WATER QUANTITY				WATER QUALITY			
	Strat.	*Operat.*	*Strat.*	*Operat.*	*Strat.*	*Operat.*			*Strat.*	*Operat.*		
						1	2	3		1	2	3
Administratie voor Milieu, Natuurlijke Hulpbronnen en Leefmilieu (AMINAL)	*		*	*	*	*				*		
Antwerpse Zeehavendienst; AZ)		*										
Vlaams Milieu Maatschappij (VMM))			*	*					*	*	*	*
Region (AQUAFIN BV)				(*)						(*)	(*)	(*)
Province							*				*	
Polder board/watering							*	*				
Municipality								*				*

WALLONIA	NAVIGABLE WATERCOURSES				NON-NAVIGABLE WATERCOURSES											
	WATER QUANTITY		WATER QUALITY		WATER QUANTITY						WATER QUALITY					
	Strat.	*Operat.*	*Strat.*	*Operat.*	*Strat.*			*Operat.*			*Strat.*			*Operat.*		
					1	2	3	1	2	3	1	2	3	1	2	3
Ministère de la Région wallone			*	*	*	*	*	*			*	*	*	*	*	*
Region (Ministère wallon de l'Equipment et du Transport)	*	*														
Intercommunale				*										*	*	*
Province									*							
Watering									*	*						
Municipality										*						

NORTH-FRANCE	NATIONAL WATERCOURSES				REGIONAL WATERCOURSES			
	WATER QUANTITY		WATER QUALITY		WATER QUANTITY		WATER QUALITY	
	Strat.	*Operat.*	*Strat.*	*Operat.*	*Strat.*	*Operat.*	*Strat.*	*Operat.*
Ministère de l'Environnement	*		*		*		*	
Ministère des Travaux Publics	*	*						
Mission Interministérielle de l'Eau	*		*		*		*	
Comité National de l'Eau	*		*		*		*	
Région (Conseil Régional)	*	*	*	*	*	*	*	*
Département (Conseil Général)	*	*	*	*	*	*	*	*
Municipalities				*		*		*
Comité de Basin	*		*		*		*	
Agence de l'Eau de Basin		*		*		*		*

BRUSSELS	NAVIGABLE WATERCOURSES				NON-NAVIGABLE WATERCOURSES											
	WATER QUANTITY		WATER QUALITY		WATER QUANTITY						WATER QUALITY					
	Strat.	*Operat.*	*Strat.*	*Operat.*	*Strat.*			*Operat.*			*Strat.*			*Operat.*		
					1	2	3	1	2	3	1	2	3	1	2	3
Administration des Ressources Naturelles et de l'Environnement		*		*				*	*	*				*	*	*
Brussels Instituut voor Milieubeheer	•		•		•	•	•				•	•	•			

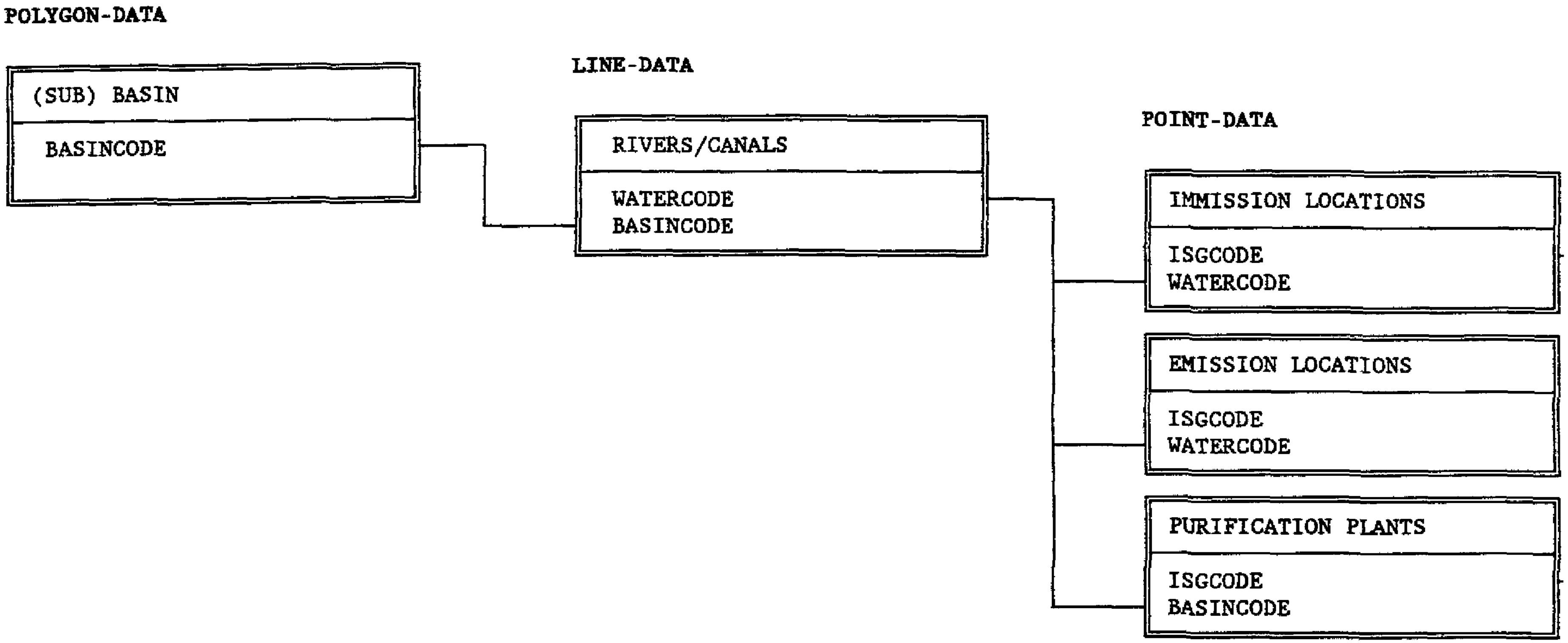
(*) = only concerning waste water treatment.

4. Scheldt-GIS

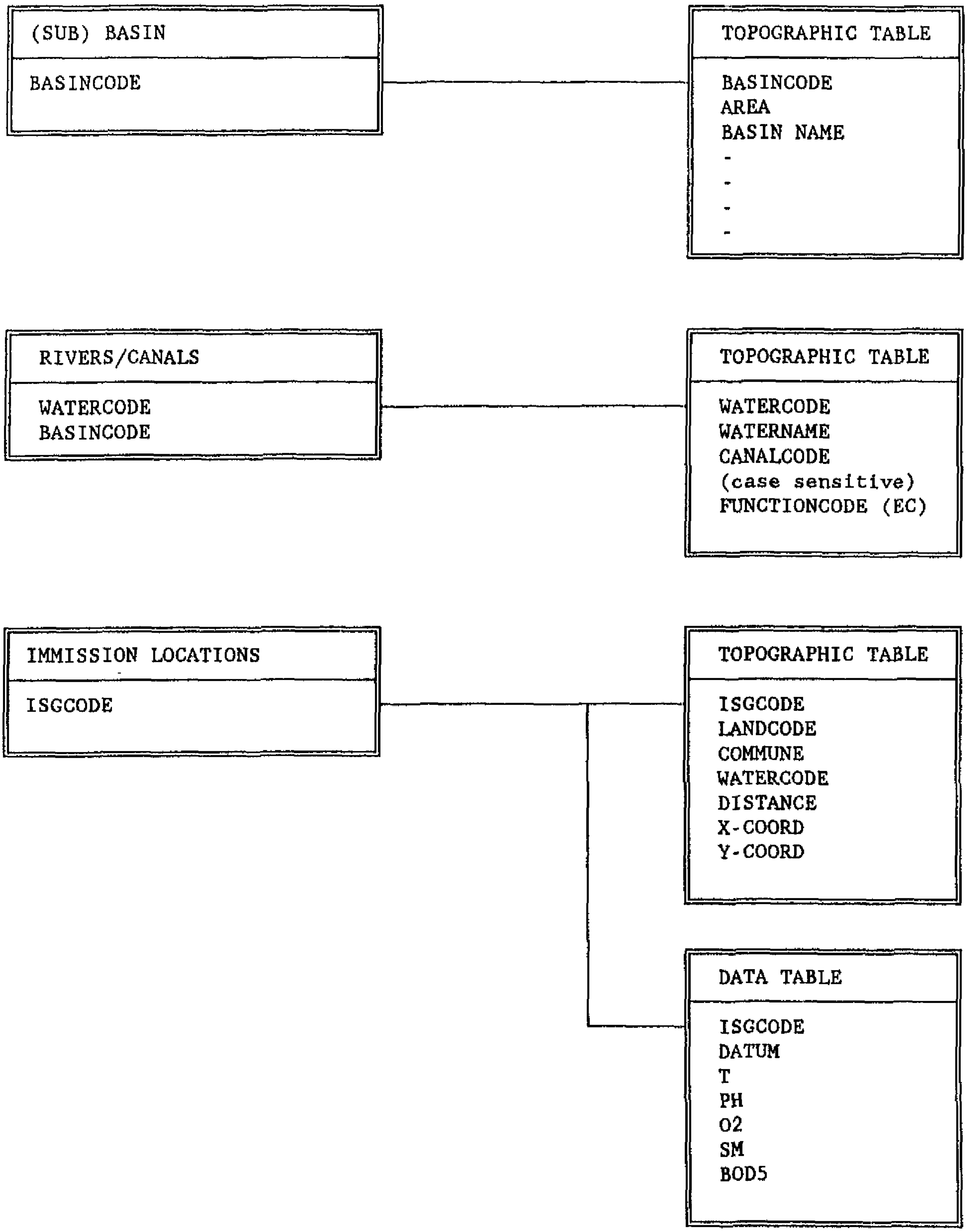
Appendix 4.1 Datamodel ISG/DWS

DATAMODEL ISG/DWS

ARC/INFO GEOGRAPHIC DATA



GEOGRAPHIC DATA THEMATIC DATA



GEOGRAPHIC DATA | THEMATIC DATA

EMISSION LOCATIONS

ISGCODE
WATERCODE

TOPOGRAPHIC TABLE

ISGCODE
OWNER CODE
COMMUNE
WATERCODE
DISTANCE
X-COORD
Y-COORD

DATA TABLE

ISGCODE
DATUM
PAR1
PAR2
PARn

PURIFICATION PLANTS

ISGCODE
BASINCODE

TOPOGRAPHIC TABLE

ISGCODE
NAME
YEAR (AGE)
CAPACITY (DESIGN)
OWNER
HABITANTS
PURIFIED AREA (NAME
PURIFIED AREA (HA)
SEWAGE PERC.
COSTS
TECHNOLOGY
AIM

DATA TABLE

ISGCODE
DATUM
BZV
BZV REND. %
CZV
CZV REND. %
P-TOT
P-TOT REND. %
N-TOT
N-TOT REND. %

5. Emissions in the Scheldt basin

Appendix 5.1 Waste water treatment plants in zones E1, E2, E3.

Source: Agence de L'Eau Artois-Picardie

Zone	Department	Treatment plant (municipality)	Year of application	Design capacity (h.e.)	Effluent to (watercourse)
E1	62	ACHIET LE GRAND	1990	1000	
E1	59	AUBIGNY AU BAC	1973	3000	la Sensée rivière
E1	59	AULNOY LEZ VALENCIENNES	1975	14000	la Rhonelle
E1	59	BANTOUZELLE	1988	1500	Torrent d'Esnes
E1	62	BAPAUME	1981	7000	
E1	59	BAVAY	1975	3500	l'Hogneau
E1	2	BEAUREVOIR	1984	1500	
E1	59	BEAUVOIS EN CAMBRESIS	1985	7500	l'Erclin
E1	59	BEUVRAGES	1989	23000	l'Escaut Canalisé
E1	2	BOHAIN EN VERMANDOIS	1976	12500	
E1	59	BRUAY SUR L ESCAUT	1981	16000	l'Escaut Canalisé
E1	59	CAMBRAI	1976	70000	l'Escaut Canalisé
E1	59	CAUDRY	1973	11000	l'Erclin
E1	59	CAULLERY	1984	7000	l'Escaut rivière
E1	59	CONDE SUR L ESCAUT	1974	20000	le Jard
E1	59	CRESPIN	1981	12000	l'Hogneau
E1	59	CREVECOEUR SUR L ESCAUT	1982	2000	l'Escaut rivière
E1	59	DENAIN	1959	8000	l'Escaut Canalisé
E1	59	DOUCHY LES MINES	1980	16000	la Selle
E1	62	ECOURT ST QUENTIN	1981	2000	la Sensée rivière
E1	59	ELINCOURT	1972	2500	
E1	59	FECHAIN	1977	4200	la Sensée rivière
E1	59	FLESQUIERES	1985	400	Canal du Nord
E1	59	FONTAINE NOTRE DAME	1981	2500	Canal de St-Quentin
E1	62	GOUZEAUCOURT	1976	3000	Canal de St-Quentin
E1	62	GRAINCOURT LES HAVRINCOURT	1983	1000	Canal du Nord
E1	62	HERMIES	1986	1250	Canal du Nord
E1	59	IWUY	1973	5000	l'Erclin
E1	59	JENLAIN	1974	3000	l'Aunelle
E1	59	LE CATEAU	1981	25000	la Selle
E1	59	LE QUESNOY	1981	6000	la Rhonelle
E1	59	MARCOING	1975	4000	l'Escaut rivière
E1	59	MARESCHES			la Rhonelle
E1	59	MARQUETTE EN OSTREVENT	1988	2500	la Sensée rivière
E1	59	MASNIERES	1973	4000	Canal de St-Quentin
E1	62	MONCHY LE PREUX	1987	500	la Sensée rivière
E1	59	ONNAING	1985	10000	l'Escaut Canalisé

Zone	Department	Treatment plant (municipality)	Year of application	Design- capacity (h.e.)	Effluent to (watercourse)
B1	62	PELVES	1986	2300	la Scarpe
B1	59	POIX DU NORD	1978	6000	L'Ecaillon
B1	59	PREUX AU BOIS	1976	1500	L'Ecaillon
B1	59	RIEUX EN CAMBRESIS	1989	10000	l'Erclin
B1	59	ROEULX	1979	10000	l'Escaut Canalisé
B1	59	SAULTAIN	1978	6000	la Rhonelle
B1	59	SOLESMES		15000	la Selle
B1	59	ST AUBERT	1990	8000	l'Erclin
B1	62	TORTEQUESNE	1985	1000	la Sensée rivière
B1	59	TRITH ST LEGER	1984	15000	l'Escaut Canalisé
B1	2	VAUX ANDIGNY	1988	1000	la Selle
B1	59	VILLERS OUTREAUX	1973	3000	l'Escaut rivière
B1	62	VITRY EN ARTOIS	1982	7000	la Scarpe
B1	2	WASSIGNY	1979	1200	la Selle
B1	59	WAVRECHAIN SOUS DENAIN	1980	67000	l'Escaut Canalisé
Total capacity zone B1 : 465350 i.e.					
Number of stations zone B1 : 52					

Zone	Department	Treatment plant (municipality)	Year of application	Design-Capacity (h.e.)	Effluent to (watercourse)
B2	59	ARLEUX	1985	400	
B2	62	ARRAS		101000	la Scarpe
B2	62	ATHIES	1984	3000	la Scarpe
B2	59	AUBERCHICOURT	1975	30000	(la Scarpe)
B2	62	AUBIGNY EN ARTOIS	1981	1300	la Scarpe
B2	62	AVESNES LE COMTE	1980	2000	Ruisseau de l'Ugy
B2	62	BEAUMETZ LES LOGES	1991	1250	le Crinchon
B2	62	BEUVRY LA FORET	1981	12500	Courant de l'Hopital
B2	62	BIACHE ST VAAST	1979	6000	la Scarpe
B2	62	BREBIERES	1978	6000	la Scarpe
B2	59	CANTIN	1973	1500	Canal de la Sensée
B2	62	CORBEHEM NORD	1973	1250	
B2	62	CORBEHEM SUD	1987	2500	Canal de la Sensée
B2	59	DOUAI	1992	90000	la Scarpe
B2	59	ESTREES	1979	1000	Canal de la Sensée
B2	59	GOEULZIN	1979	2000	Canal de la Sensée
B2	59	HORNAING	1990	1500	la Grande Traitoire
B2	59	LALLAING			(la Scarpe)
B2	59	LEWARDE	1991	5000	(la Scarpe)
B2	59	MARCHIENNES	1979	3500	le Décours

Zone	Department	Treatment plant (municipality)	Year of application	Design-Capacity (h.e.)	Effluent to (watercourse)
E2	59	ORCHIES	1978	7000	Courant de l'Hopital
E2	59	PECQUENCOURT	1981	10000	(la Scarpe)
E2	59	SIN LE NOBLE	1989	35000	(la Scarpe)
E2	59	SOMAIN	1981	25000	(la Scarpe)
E2	59	ST AMAND LES EAUX	1980	23000	la Grande Traitoire
E2	59	WALLERS	1984	15000	la Grande Traitoire
E2	59	WATTRELOS	1987	450000	l'Espierre
Total capacity zone E2 : 836700 i.e.					
Number of stations zone E2 : 27					

Zone	Department	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to (watercourse)
E3	62	ACHEVILLE	1988	500	Canal de la Deule
E3	62	AIRE SUR LA LYS	1975	12400	la Lys
E3	59	ANNOEULLIN	1975	13000	(Canal de la Deule)
E3	62	ARLEUX EN GOHELLE			la Gohelle
E3	59	ATTICHES	1975	2000	la Marque
E3	59	AUBERS	1980	2000	(la Lys)
E3	59	AUBY	1986	10000	Canal de la Deule
E3	62	AUCHY-HAISNES	1990	9500	
E3	59	BAILLEUL	1975	40000	Becque de Steenwerck
E3	62	BAILLEUL SIR BERTHOULT	1986	1200	la Scarpe
E3	59	BAUVIN	1976	6000	Canal de la Deule
E3	62	BETHUNE	1975	105000	la Lawe
E3	59	BEUVRY	1980	23000	la Lawe
E3	59	CAMPHIN EN CAREMBAULT	1974	5500	(Canal de la Deule)
E3	59	COMINES	1990	100000	la Lys
E3	62	COURCELLES LES LENS	1989	20000	Canal de la Deule
E3	62	COURRIERES	1956	6000	
E3	59	CYSOING	1989	9000	la Marque
E3	62	DIEVAL	1985	700	la Lawe
E3	62	DOUVRIN	1973	14000	Canal d'Aire
E3	62	FOUQUIERES LES LENS	1990	70000	(Canal de Lens)
E3	62	FRUGES	1972	7500	la Lys
E3	59	GONDECOURT	1984	6200	(Canal de la Deule)
E3	62	GOSNAY	1976	30000	la Lawe
E3	59	HAZEBROUCK	1984	60000	Canal de la Bourre
E3	62	HELFAUT	1983	2000	la Melde du Pas de Calais
E3	62	HENIN BEAUMONT	1982	100000	Canal de la Deule
E3	59	HOUPLIN ANCOISNE	1977	180000	Canal de la Deule
E3	62	ISBERGUES	1973	10000	Canal d'Aire

Zone	Department	Treatment plant (municipality)	Year of application	Design-capacity (i.e.)	Effluent to (watercourse)
E3	59	LA GORGUE	1977	24600	la Lys
E3	62	LABEUVRIERE	1983	1500	la Clarence
E3	62	LAPUGNOY	1974	35000	la Clarence
E3	62	LILLERS	1973	10000	la Nave
E3	62	LOISON SOUS LENS	1980	115000	la Souchez
E3	62	MAMETZ	1979	1300	la Lys
E3	59	MARQUETTE LEZ LILLE	1977	750000	Canal de la Deule
E3	62	MAZINGARBE	1983	30000	la Surgeon
E3	59	MERVILLE	1977	8000	La Lys
E3	59	MORBECQUE	1982	4000	Canal de Nieppe
E3	59	NEUF BERQUIN	1986	3000	(Canal de la Bourre)
E3	62	NEUVIREUIL	1980	400	la Scarpe
E3	59	NIEPPE	1990	9500	la lys
E3	62	NOEUX LES MINES	1983	35000	la Loisne
E3	59	OSTRICOURT	1989	8000	(Canal de la Deule)
E3	62	PERNES	1986	3000	la Clarence
E3	59	PONT A MARCQ	1978	5000	la Marque
E3	62	RACQUINGHEM		450	la Melde du Pas de Calais
E3	62	REBREUVE RANCHICOURT	1975	1600	la Lawe
E3	62	RICHEBOURG	1979	1200	la Lawe
E3	62	SERVINS	1984	800	la Scarpe
E3	59	STEENWERCK	1973	3000	Becque de Steenwerck
E3	59	THUMERIES	1990	8500	la Marque
E3	62	VALHUON	1988	500	
E3	59	VILLENEUVE D ASCQ	1985	130000	la Marque
E3	62	VIMY	1983	3500	
E3	62	VIOLAINES	1977	3000	(la Lys)
E3	62	WINGLES	1986	15000	Canal de la Deule
Total capacity zone E3 : 2056350 i.e.					
Number of stations zone E3 : 57					

<u>Departments</u>:

2 : Aisne
59 : Nord
62 : Pas de Calais

Appendix 5.2 Mean treatment efficiencies and standard deviations in the period 1985-1990 (MO, MA, MeS).
Source: Agence de l'Eau Artois-Picardie.

Parameter→	MO			MA			MeS		
Season↓	n	mean value	standard deviation	n	mean value	standard deviation	n	mean value	standard deviation
85/86	20	77.7	14.7	20	43.1	26.9			
86/87	20	78.5	16.9	20	41.7	27.3			
87/88	20	71.5	17.7	20	35.1	27.4			
88/89	20	73.8	16.1	20	45.6	26.5			
89/90	25	77.4	20.3	25	46.5	33.8	25	86.7	12.4
90/91	20	73.2	24.4	20	39.1	29.9			
91/92	25	77.7	17.1	25	48.2	28.3	25	89.2	8.3

Appendix 5.3 Waste water treatment plants in the Wallonian part of the Scheldt basin.
Source: Ministère de la Région Wallonne

Inter-communale	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Subbasin	Effluent to	Financement	Treatment technology	Additional information
IBW	Hannut	1954	5,500	la Gette	la Petite Gette		bacteriological filter	
	Perwez	1950	2,000	la Gette	la Grande Gette	public		Replacement proposed
	Waterloo (commune)	1970	15,000	la Rupel	la Lasne	public	bacteriological beds and digestors	
	Institut technique de l'Etat/Argenteuil	1979	200	la Rupel	la Lasne	public	biodiscs	
	Step de Rosières (S.E. de la Lasne)	1984	125,000	la Rupel	la Lasne	public	activated sludge	80000 ie com./45000 ie ind.
	Basse-Wavre	1985	165,000	la Rupel	la Dyle	public	activated sludge/burning process	com./ind.
	Chaumont-Gistoux	1975	700	la Rupel	la Dyle	fonds brunfaut	activated sludge/prolongated aeration	Stoppage proposed
	Genappe (Baisy-Thy)	1987	750	la Rupel	la Dyle	public	lagune with plants	
	Genappe (Glabais)	1982	500	la Rupel	la Dyle	private	activated sludge/prolongated aeration	Stoppage proposed
	Genappe (Cité S.N.T.)	1978	200	la Rupel	la Dyle			Collector out of service

Inter-communale	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Subbasin	Effluent to	Financement	Treatment technology	Additional information
	Villers-la-Ville/Marbais (cité C.I.B.)		260			private	activated sludge/prolongated aeration	
	Villers-la-Ville/Marbais (cité des Prés *St-Pierre*)	1976	310			fonds brunfaut	activated sludge	Stoppage *proposed*
	Chastre (Lot. "Bois Champs")	1980	2,000	la Rupel	la Dyle	fonds brunfaut	activated sludge/prolongated aeration	Stoppage proposed
	Cortil-Noirmont (Lot. "Clair Logis")	1979	170	la Rupel	la Dyle		activated sludge/prolongated aeration	Stoppage proposed
	Braine/L'Alleud (Ophain-Terrain football)	1976	700	la Rupel	le Hain	private	activated sludge/prolongated aeration	
	Braine/L'Alleud (Lot. "La Justice")	1975	700	la Rupel	le Hain	private	activated sludge/prolongated aeration	
	Braine-le-chateau (Lot. "Bois du Foyau")	1971	800	la Rupel	le Hain	private	activated sludge/prolongated aeration	Stoppage proposed
	Wauthier-Braine (Bois d'Haumont)	1978	1,000	la Rupel	le Hain	private	activated sludge/prolongated aeration	
	Saint-Gery (Lot. "Clair Logis")	1978	500			fonds brunfaut	activated sludge/prolongated aeration	Stoppage proposed
	Mont-St-Guibert (Cité "la Blocquière")	1980	225			fonds brunfaut	activated sludge/prolongated aeration	Collector out of service

Inter-communale	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Subbasin	Effluent to	Financement	Treatment technology	Additional information
	Mont-St-Guibert (Cité "Résidence du Centre")	1973	300			fonds brunfaut	activated sludge/prolongated aeration	Collector out of service
	Ottignies (Centre W. Lennos)	1973	1,400			private		
	Ottignies (Clinique St-Pierre)	1973	890			private	activated sludge	
	Tubize/Saintes (Quartier de l'Espinette)	1981	200	la Rupel	la Senne	private	activated sludge/prolongated aeration	Stoppage proposed
	Tubize/Saintes (Résidence Trullemans)	1974	130	la Rupel	la Senne	private	activated sludge	Stoppage proposed
	Tubize (Lot. Deschuyffeleer et Musch.)	1980	160	la Rupel	la Senne	fonds brunfaut	activated sludge/prolongated aeration	Stoppage proposed
	Tubize (Cité H.B.M. Rue Neuve Cour)	1970	1,100	la Rupel	la Senne	fonds brunfaut	activated sludge/prolongated aeration	Stoppage proposed
	Tubize (Rue de la Maraude)	1981	250	la Rupel	la Senne	private	activated sludge/prolongated aeration	Stoppage proposed
	Tubize (Lot. Hyfibel du Bois de Oisquercq)	1981	180	la Rupel	la Senne	private	biodiscs	Stoppage proposed
	Tubize (Avenue Mirande-Quartier de la Bruyère)	1979	3,600	la Rupel	la Senne	fonds brunfaut	contact stabilis	Stoppage proposed
	Tubize (Cité S.N.T. Avenue Salvatore Allende)	1979	1,100	la Rupel	la Senne	fonds brunfaut	activated sludge	Stoppage proposed
	Bierges (Rest. Autoroute)		330			private	divers	
	Rixensart/Rosieres (S.E. de la Lasne)	1984	125,000			public	activated sludge	

Inter-communale	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Subbasin	Effluent to	Financement	Treatment technology	Additional information
	Subtotal IBW		**456,155**					
IDEA	*Braine-le-Comte etc.*	1977	250	la Rupel	la Senne		activated sludge	
	Chapelle-lez-Herlaimont	p	12,000			public	lagoon	
	Hensies (S.E. de Hensies-Pommeroeul)	1984	3,500			public	aeration lagoon	
	Jurbise-Erbisoeul (Cité S.N.T.-Quartier du bon air)	1975	200	la Dendre	la Dendre orientale		activated sludge	
	Morlanwelz	p	20,000	la Haine	la Haine moyenne et supérieure	public	lagoon	
	Quaregnon-Wasmuel	1972	400,000			public	activated sludge	
	Quevy-Genly (Lot le Coquelet)	1981					aeration/decantation etc.	
	Grand-Reng	1987	1,600	la Haine	la Trouille		aerated lagoon	
	Seneffe/Soudromont	1987	65,000	la Rupel	la Samme/C. Brux.-Char.	public	activated sludge/dentrification	com./ind.
	Subtotal IDEA		**502,550**					
PALLE	Ath (Arbre)	1971	100			fonds brunfaut	prolongated aeration	
	Ath (Ath)	1991	9,000			public	activated sludge	
	Ath (Maffle)	1988	3,200			public	aeration lagoon	
	Beloeil	1991	4,000			public	aeration lagoon	
	Chievres (Cité des Sablières)	1978	160	la Dendre	la Dendre Orientale	fonds brunfaut	prolongated aeration	
	Enghien (Petit Enghien)	1974	1,000			fonds brunfaut	prolongated aeration	

Inter-communale	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Subbasin	Effluent to	Financement	Treatment technology	Additional information
	Estaimpuis-Estaimbourg	1978	200	l'Escaut	l'Escaut	fonds brunfaut	prolongated aeration	
	Leuze	1992	11,000	la Dendre	la Dendre Occidentale	public	activated sludge	
	Peruwelz-Callenelle (Lot. du Logis Tournaisien)	1979	180	l'Escaut	l'Escaut	fonds brunfaut	prolongated aeration	
	Silly-Hellebecq	1981					activated sludge	
	Silly-Hoves	1979	360			fonds brunfaut	prolongated aeration	
	Flobecq	1991	2,000	la Dendre	la Dendre canalisée		aeration lagoon	
	Tournai-Barry (Cité Jardin la Cavée)	1973	420	la Dendre	la Dendre Occidentale	fonds brunfaut	oxydation (total)	
	Mont-Saint-Aubert	1984	600			public	aeration lagoon	
	Tournai (Clinique mut. Soc.)			l'Escaut	l'Escaut	private	activated sludge	
	Vaulx (Rue de Tournai)	1975	800			fonds brunfaut	prolongated aeration	
	Vaulx (Rue de la Dondaine)	1973	450			fonds brunfaut	prolongated aeration	
	Gaurain (Route d'Antoing)		300	l'Escaut	l'Escaut			
	Subtotal IPALLE		**33,770**					
	Total		**992,475**					

Appendix 5.4 Planned waste water treatment equipment and adaptations in the Wallonian part of the Scheldt basin.
Source: Ministère de la Région Wallonne

Planned waste water treatment equipment and adaptations in the Wallonian part of the Scheldt basin.							
Intercommunale	Treatment plant (municipality)	Design-capacity (h.e.)	Subbasin	Effluent to	Building costs (in millions BF)	Type	Description
IBW	*la Step d'Avernas le Baudoin*	3,000	la Gette	*la Petite Gette*	48	c + p	Replacement Hannut
	Perwez	5,000	la Gette	la Grande Gette	75		
	Jodoigne/Glimes/Jauchelette/St. Jean-Geest	7,500	la Gette	la Grande Gette	152		
	Rosières		le Rupel	la Lasne	150	t	Adaptation (tertiair)
	Waterloo		le Rupel	la Lasne	60	t	Adaptation (tertiair)
	Basse-Wavre		le Rupel	la Dyle	198	t	Adaptation (tertiair)
	Gastuche	7,000	le Rupel	la Dyle	117	c + p	
	Nethen-Hamme Mille Beauvechain	7,000	le Rupel	la Dyle	147	c + p	
	Chaumont-Gistoux	5,500	le Rupel	la Dyle	133	c + p	
	Genappe/Vieux Genappe	6,500	le Rupel	la Dyle	182	c + p	
	Mellery/Tilly Marbais	5,500	le Rupel	la Dyle	92	c + p	
	Chastre/Cortil-Norimont	4,500	le Rupel	la Dyle	85	c + p	
	Archennes/Grey-Doiceau/Bossut-Gottechain	9,500	le Rupel	la Dyle	210	c + p	

	Feluy	2,300	le Rupel	la Senette (Samme/c. Charl.-Brux.)	27		
	Nivelles	25,000	le Rupel	la Senette (la Thines)	560	c + p	
	Braine l'Alleud	75,000	le Rupel	la Senette (le Hain)	1000	c + p	
	Braine le Chateau/Wauthier Braine	12,000	le Rupel	la Senette (le Hain)	232	c + p	
	Braine le Comte	28,000	le Rupel	la Senette (la Senne)	450	c + p	
	Tubize	20,000	le Rupel	la Senette (la Senne)	299	c + p	
	Rebecq	10,000	le Rupel	la Senette (la Senne)	167	c + p	
	Soignies	17,000	le Rupel	la Senette (la Senne)	320	c + p	
	Naast	2,500	le Rupel	la Senette (la Senne)	45	c + p	
	Clabecq	6,000	le Rupel	la Senette (la Senne)	107	c + p	
	Subtotal→	**258,800**			**4,856**		
IDEA	Frameries/la Bouverie/Sars-la-Bruyère	20,000	la Haine	la Trouille	200	p	
	Wasmuel		la Haine	la Haine inférieure + canal Nimy-Blaton	400		Adaptations
	Morlanwelz	18,000	la Haine	la Haine moyenne et supérieure	155	p	
	Binche/Leval-Trazegnies/Epinois-Ressaix-Battignies/Peronnes	25,000	la Haine	la Haine moyenne et supérieure	390	c + p	

	Saint Vaast/Haine St. Paul/Haine St. Pierre	25,000	la Haine	la Haine moyenne et supérieure	440	c + p	
	Boussoit/Roeulx/Houdeng-Strepy/Thieu	45,000	la Haine	la Haine moyenne et supérieure	670	c + p	
	Quiévrain	6,700	la Haine	la Grande Honelle	104	c + p	
	Frasnes-lez-Buissenal	3,600	la Rhosnes	la Rhosnes	100	c + p	
	Subtotal→	**143,300**			**2,459**		
IPALLE	Comines	10,000	la Lys	la Lys	250	c + p	
	Warneton	4,000	la Lys	la Lys	100	c + p	
	Ploegsteert	5,000	la lys	la Lys	47	c	
	Barry	1,000	la Dendre	la Dendre Occidentale	10		
	Casteau	3,600	la Dendre	la Dendre Orientale	97	c + p	
	Blaton	6,000	la Dendre	la Dendre Orientale	158	c + p	
	Chievres	4,000	la Dendre	la Dendre Orientale	106	c + p	
	Ath	9,000	la Dendre	la Dendre canalisée		ex	Extension
	Enghien	12,000	la Dendre	la Dendre canalisée		t	Tertiair (denitrification)
	Lessines	10,000	la Dendre	la Dendre canalisée	264	c + p	
	Deux-Acren	4,000	la Dendre	la Dendre canalisée	103	c + p	
	Ellezelles	42,000	la Dendre	la Dendre canalisée	112	c + p	
	Tournai/Froyennes	71,000	l'Escaut	l'Escaut	1130	c + p	
	Antoing	4,200	l'Escaut	l'Escaut	130	c + p	
	Estaimbourg	4,000	l'Escaut	l'Escaut	134	c + p	
	Templeuve	5,000	l'Escaut	l'Escaut	110	c + p	

	Peruwelz	10,000	l'Escaut	l'Escaut	350	c + p	
	Mouscron	29,800	l'Escaut	l'Escaut	290	c + p	
	Subtotal→	**233,600**			**3,391**		
	Total IBW + IDEA + IPALLE→	**635,700**			**10,706**		

Explanation: c = collector(s); p = treatment plant; t = tertiair; ex = extension.

Appendix 5.5 Waste water treatment plants in the Flemish part of the Scheldt basin.
Source: Vlaamse Milieu Maatschappij (VMM)

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
12	RWZI Gent	1988	175,000	Beneden-Zeeschelde	Activated sludge/denitrification	Basis quality	communal/industrial
12	RWZI Zelzate	1982	20,000		activated sludge	Basis quality	communal
12	RWZI Lokeren	1956	15,000		Oxydation bed	Basis quality	communal/industrial
12	RWZI Sinaai	1988	2,500	Speeuwsbeek	Activated sludge	Basis quality	communal
Subtotal			212,500				
16	RWZI Harelbeke	1986	150,000	Lys	Aerated activated sludge	Basis quality	communal/industrial
Subtotal			150,000				
17	RWZI St.-Denijs-Westrem	1988	9,000	Rosdambeek	Prefab purification (system Evens)	Basis quality	surface water
17	RWZI Deurle	1989	1,000	Scheidbeek	Reedfilter	Basis quality	surface water/communal
17	RWZI St.-Martens-Latem	1989	800	Meersbeek	Reedfilter	Basis quality	surface water
Subtotal			10,800				
18	RWZI St.-Niklaas	1964	80,000	Molenbeek	Bacteriological bed	Basis quality	communal/industrial
18	RWZI Aalst	1987	80,000	Molenbeek	Aerated activated sludge	Fishing water	communal/industrial
18	RWZI Lede	1977	1,500		Biological	Basis quality	communal
18	RWZI Ninove	1986	25,000	Dender	Aerated activated sludge	Fishing water	communal/industrial

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
18	RWZI Geraardsbergen	1958	6,500	Dender	Bacterial bed	Fishing water	communal
Subtotal			193,000				
20	RWZI Zele	1983	50,000	Schelde	Activated sludge	Basis quality	communal/industrial
20	RWZI Laarne	1981	28,000	Maanbeek	Activated sludge	Basis quality	communal/industrial
20	RWZI Berlare	1982	20,000	Schelde	Activated sludge	Basis quality	communal/industrial
Subotal			98,000				
23	RWZI Zwalm	1992	25,000	Zwalmbeek	Activated sludge	Drinking water	communal/industrial
Subtotal			25,000				
24	RWZI Herentals	1986	36,000	Kleine Nete/Lopken	Aerated activated sludge	Fishing water	communal
24	RWZI Zoersel	1986	160	Monikkenloop	biologisch	Basis quality	communal
24	RWZI Grobbendonk	1982	7,500	Kleine Nete	Activated sludge/oxydation ditch	Fishing water	communal/industrial
24	RWZI Malle	1977	12,500	Lopende Beek	Aerated activated sludge	Basis quality	communal/industrial
24	RWZI Vosselaar	1974	7,000	Rietloop	Oxydation ditch	Basis quality	communal
24	RWZI Turnhout	1957	30,000	AA/Nattenloop	Bacterial bed	Basis quality	communal/industrial
24	RWZI Retie	1975	15,500	Zwarte Neet	Activated sludge	Fishing water	communal/industrial
24	RWZI Ravels	1983	15,000	Wouwerloop	Activated sludge	Basis quality	communal/industrial
24	RWZI Pulderbos (Zandhoven)	1982	12,500	Molenbeek/ Bollaak	Acitvated sludge/oxydation ditch	Basis quality	communal/industrial
24	RWZI Nijlen	1978	18,000	Krekelbeek/ Kattebeek	Oxydation bed	Basis quality	communal

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
24	RWZI Lichtaart (=Kasterlee)	1981	55,000	Grote Kaliebeek	Activated sludge/oxydation bed		communal/industrial
24	RWZI Dessel	1977	20,000	Kleine Nete	Activated sludge	Fishing water	communal/industrial
24	RWZI Viersel	1989	500	Molenbeek	Aerated lagoon	Fishing water	communal
24	RWZI Zwijndrecht	1976	22,000	Laarbeek	Oxydation ditch	Basis quality	communal
24	RWZI Beerse	1978	18,000	Grote Beek	Activated sludge/oxydation bed	Basis quality	communal/industrial
Subtotal			269,650				
25	RWZI Duffel	1969	25,000	Nete/Beneden Nete	Bacterial bed	Basis quality	communal/industrial
25	RWZI Itegem	1973	5,000	Grote Neet	Oxydation bed	Fishing water	communal
25	RWZI Westerlo	1979	46,000	Grote Neet	Oxydation bed/activated sludge	Fishing water	communal/industrial
25	RWZI Walem	1972	2,000	Nete/Beneden Nete	Bacterial bed	Fishing water	communal
25	RWZI Geel	1976	40,000	Grote Neet	Activated sludge	Fishing water	communal/industrial
25	RWZI Waarloos	1981	61,400		Activated sludge		
25	RWZI Balen	1986	4,000	Molse Neet	Oxydation bed	Basis quality	communal
25	RWZI Hulshout	1988	800	Bruggeneinde Laak	Aerated activated sludge	Basis quality	communal
25	RWZI Mol	1964	16,000	Molse Neet	Oxydation bed	Basis quality	communal/industrial
25	RWZI Hove (Bautersembeek)	1983	41,500	Lochenebeek	Activated sludge	Basis quality	communal
25	RWZI Wiekevorst	1981	51,500	Wimp	Oxydation bed/activated sludge	Fishing water	communal/industrial

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
Subtotal →			293,200				
26	RWZI Borgloon-Tivoli	1958	3,500	Kleine Herk	Bacterial bed	Basis quality	communal
26	RWZI Heusden-Zolder	1957	6,000		Bacterial bed	Basis quality	communal
26	RWZI Genk	1975	60,000	Stiemerbeek	Bacterial bed	Basis quality	communal/industrial
26	RWZI Borgloon-Nerem	1986	1,000	Motbeek	Bacterial bed	Basis quality	communal
Subotal→			70,500				
27	RWZI Tienen	1939	38,000	Grote Gete	Activated sludge	Fishing water	communal
Subtotal →			38,000				
28	RWZI Zonhoven	1975	15,000	Roosterbeek	Activated sludge	Basis quality	communal/industrial
28	RWZI Hasselt	1988	60,000	Demer	Activated sludge	Basis quality	communal/industrial
Subtotal →			75,000				
29	RWZI Bokrijk	1986	550		Percolation reedfilter	Basis quality	communal
29	RWZI Beringen-Koersel	1979	19,000		biologisch	Basis quality	communal
29	RWZI Tessenderlo	1985	22,500	Grote Beek	activated sludge	Basis quality	communal/industrial
Subotal→			42,050				
30	RWZI Vlezenbeek	1977	450		biologisch	Basis quality	communal
30	RWZI St.-Pieters-Leeuw	1974	700	Vogelsanckbeek	Activated sludge	Basis quality	communal
30	RWZI Halle-Windmoleleken	1984	500		Activated sludge	Basis quality	communal

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
30	RWZI Halle-Lot	1953	6,000	Zenne	Bacterial bed	Basis quality	communal/industrial
30	RWZI Halle-Lembeek	1973	200	Canal Brussel-Charleroi	Minutec	Fishing water	communal
Subtotal→			7,850				
31	RWZI Leuven	1983	50,000	Dijle	Activated sludge	Basis quality	communal/industrial
Subtotal→			50,000				
32	RWZI Mechelen-Noord	1983	60,000	Dijle	Activated sludge	Basis quality	communal/industrial
32	RWZI Zemst-Hofstade	1973	5,500	Barebeek	Activated sludge	Basis quality	communal
			65,500				
34	RWZI Beringen-Beverlo	1972	6,000		biologisch	Basis quality	communal
34	RWZI Bornem-Weert	1976	400		System Evens	Basis quality	communal
34	RWZI Dendermonde	1985	90,000	Schelde	Activated sludge	Basis quality	communal/industrial
34	RWZI Bornem	1967	16,000	Schelde	Bacterial bed	Basis quality	communal/industrial
34	RWZI Sint-Amands	1976	8,000	Schelde	Bacterial bed	Basis quality	communal
Subtotal →			120,400				
37	RWZI Antwerpen-Zuid ("Kielsbroek")	1990	100,000		Aerated lagoons		communal
Subtotal			100,000				
38	RWZI Deurne (Schijnpoort)	1977	325,000	Canal Albert/Lobroekdok	Activated sludge	Drinking water	communal/industrial
38	RWZI Brasschaat	1978	25,000	Groot Schijn	Bacterial bed	Drinking water	communal/industrial

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
38	RWZI Boechout (Koude Beek)	1981	48,000	Koude Beek	Activated sludge	Basis quality	communal/industrial
38	RWZI Schoten	1970	35,000	Canal Albert	Bacterial bed	Drinking water	communal/industrial
38	RWZI Antwerpen-Noord	1980	481,000	Groot Schijn	Activated sludge	Basis quality	communal/industrial
38	RWZI Schilde (Zwanebeek)	1989	18,000		Aerated activated sludge	Fishing water	communal
38	RWZI Merksem "Ijskelder"	1978	125,000	Canal Albert	Activated sludge	Drinking water	communal/industrial
Subtotal			1057,000				
40	RWZI Wilrijk-Sruisbeek	1982	150,000	Boven-Vliet	Activated sludge	Basis quality	communal/waste water
40	RWZI Wilrijk-Blaasveld	1976	500		System Putox-Passavant	Basis quality	communal
40	RWZI Edegem	1982	46,500	Edegemse Beek	Activated sludge	basis quality	communal
Subtotal			197,000				
41	RWZI Hamme	1968	15,000	Durme	Bacterial bed	Basis quality	communal/industrial
Subtotal			15,000				
45	RWZI Baarle-hertog	1962	7,500	Bremer	Bacterial bed		communal
45	RWZI Zondereigen	1982	500	Noordermark	Biorotors	Fishing water	communal
45	RWZI Minderhout	1982	45,000	Mark	Bacterial bed and activated sludge	Fishing water	communal/industrial
45	RWZI Meer	1988	4,000	Mark	Activated sludge	Fishing water	communal/industrial
45	RWZI Kalmthout	1987	50,000	Kleine Aa/Wildertse Beek	Bacterial bed and activated sludge	Basis quality	communal/industrial

AWP-II Basin	Treatment plant (municipality)	Year of application	Design-capacity (h.e.)	Effluent to:	Treatment technology	Quality objective receiving watercourse	Type waste water
45	RWZI Essen	1974	11,000	Kleine Aa/Wildertse Beek	Activated sludge	Basis quality	communal/industrial
45	RWZI Brecht	1991	5,500		Activated sludge		communal
45	RWZI Loenhout	1971	4,000		Activated sludge		industrial
45	RWZI Merksplas	1973	5,000	Mark	Activated sludge	Fishing water	communal/industrial
Subtotal			132,500				
Total			3,222,960				

Appendix 5.6 Waste water treatment characteristics of the Scheldt basin in Flanders.
Source: Vlaamse Milieu Maatschappij (VMM)

Hydrographic subbasin	Number of habitants	Number of treatment plants	Design-capacity (h.e.)	Mean sewage percentage	Mean treatment percentage
Boven-Schelde	189,500	1	25,000	73	14
Leie	577,000	4	160,800	75.3	5.5
Dender	337,000	5	193,000	72.3	7.5
Zenne	327,000	5	7,850	87	1
Dijle	337,000	3	115,500	86.5	21
Demer	606,400	10	225,550	74	15.8
Nete	534,000	26	562,860	64.5	31.5
Boven-Zeeschelde	475,000	9	233,400	78.8	15.5
Beneden-Zeescheldo	964,300	20	1,486,500	87.8	47.4
Kanaal Gent-Terneuzen	297,300	4	212,500	80	25
Total	**5,160,500**	**87**	**3,222,960**	**76**	**21**

Appendix 5.7 Planned waste water treatment plants in the Flemish part of the Scheldt basin.
Source: Vlaamse Milieu Maatschappij (VMM)

AWP-II basin	Treatment plant (municipality)	Programme	Design-capacity (h.e.)	Technology
19	Galmaarden	1991	10,000	tertiair
10	Nevele (Landegem)	1991	10,000	tertiair
16	Tielt	1991	33,000	tertiair
31	Oud-Heverlee (Vaalbeek)	1991	1,800	
8	De Klinge (Sint-Gillis-Waas)	1991	5,000	
22	Oudenaarde	1991	60,000	
Subtotal 1991			119,800	
35	Blaasveld (Willebroek)	1992	6,000	tertiair
12	Stekene (St. Niklaas)	1992	8,000	tertiair
27	Landen-Rumsdorp	1992	13,000	tertiair
31	Tervuren-Voer	1992	15,000	tertiair
12	Moerbeke (Eksaarde)	1992	20,000	tertiair
10	Evergem	1992	25,000	tertiair
31	Neerijse (Huldenberg)	1992	35,000	tertiair
19	Bever-Beverbeek	1992	535	
9	Kieldrecht (Beveren-Waas)	1992	8,000	
24	Oud-Turnhout	1992	10,000	
26	Houthalen-centrum	1992	30,000	

AWP-II basin	Treatment plant (municipality)	Programme	Design-capacity (h.e.)	Technology
31	Kortenberg	1992	24,000	
16	Waregem	1992	65,000	
16	Roeselare	1992	80,000	
Subtotal 1992			339,535	
23	Brakel	1993	7,000	tertiair
10	Ertvelde (Evergem)	1993	11,000	tertiair
21	Lede (Wichelen)	1993	7,500	
24	Arendonk	1993	14,000	
26	Zolder	1993	13,500	
38	Wommelgem (Den Tip)	1993	10,000	
35	Niel (Boom)	1993	34,000	
26	Halen-Lummen	1993	26,000	
30	Lot	1993	40,000	
41	Lokeren	1993	54,000	
Subtotal 1993			217,000	
22	Aalbeke	1994	500	
22	Halkijn	1994	2,500	
22	Outrijve	1994	12,000	
18	Zandbergen	1994	8,000	
18	Lierde	1994	5,000	
18	St.-Antelinks	1994	2,000	
22	Ronse	1994	65,000	

AWP-II basin	Treatment plant (municipality)	Programme	Design-capacity (h.e.)	Technology
22	Nukerke	1994	1,200	
25	Lier	1994	30,000	
26	Beverst	1994	23,000	
26	Kermt	1994	9,300	
26	Wimmertingen	1994	14,000	
26	Houthalen-Oost	1994	7,500	
18	Liedekerke	1994	50,000	
17	Hoegaarden	1994	7,300	
27	Zoutleeuw	1994	10,000	
29	Diest	1994	27,000	
29	Aarschot	1994	25,000	
18	Geraardsbergen	1994	1,000	
Subtotal 1994			300,300	
Total 1991-1994			976,635	

Appendix 5.8
Treatment efficiencies waste water treatment plants in Flanders (1989-1991)

	1989			1990			1991		
Parameter	**n**	**x (%)**	**sd (%)**	**n**	**x (%)**	**sd (%)**	**n**	**x (%)**	**sd (%)**
COD	4	74.96	13.03	19	77.46	15.48	58	70.27	17.62
BOD	4	88.80	8.22	19	86.88	15.98	58	79.70	22.56
SM	4	77.03	13.18	18	9.52	131.50	58	71.90	23.53
Kj-N	2	46.20	42.20	19	58.40	26.93	58	50.32	32.02
COD/BOD	4	-145.59	44.56	19	-160.31	131.50	58	-122.17	126.46
NH4+	2	43.84	51.60	18	50.99	41.97	50	41.46	48.17
NO3-				14	-3734.79	6163.92	28	-2336.77	4506.52
NO2-				12	-17.67	106.83	19	-186.76	320.89
Tot-P	1	46.55	-	19	52.05	19.28	58	46.79	25.26
As				11	32.83	43.71	35	-113.76	804.89
Cr				12	27.46	36.32	42	44.64	35.50
Cu				15	26.85	66.74	52	39.48	109.93
Pb				15	37.96	43.08	45	54.11	43.33
Ni				14	7.65	44.52	40	10.41	78.72
Ag				8	0.00	0.00	26	35.47	49.12
Zn				13	41.75	26.30	56	48.79	34.59
Hg				8	0.00	0.00	13	9.62	45.11
Cd				9	12.12	33.09	27	11.76	21.46

n = number of waste water treatment plants.

Appendix 5.9 Waste water treatment plants in the Dutch part of the Scheldt basin.
Source: Waterschappen.

Area code	Water manager	Treatment plant	Year of application	Design-capacity (i.e.)	Management area (municipalities + surface)	Number of inhabitants	Average percen-tage (%)	Effluent to:	Type waste water (communal and/or industrial in % of design-capacity)	Monitored parameters in effluent	Treatment technology
WS20	Waterschap Noord & Zuid beveland	Waarde	1984	28.000	Reimerswaal 9,185 ha	19,896 (1/1/93)	91.6	Westerschelde	33% industrial 67% communal	COD, BOD, TOD, KjN, P-tot, N-tot, NO3N, SM, Cu, Cd, Zn, Hg, As, Pb, Ni, Cr.	activated sludge; biological purification
		Willem-Annapolder	1989	76.000	Goes e.o. 26,265 ha	64,201 (1/1/93)	95.5	(Westerschelde)	10% industrial 90% communal	COD, BOD, TOD, KjN, NO3N, NH4N, N-tot, P-tot, SM	biological purification; pre-sedimentation; oxydation bed; anaerobe sludge stabilisation.
	Waterschap Walcheren	Walcheren	1988	165,000	Walcheren	110,000	89.0	(Westerschelde)		COD, BOD, KjN, NO3, NH4, P-tot, Cu, Ni, Zn, As	pre-sedimentation; activated sludge; anaerobe sludge stabilisation
	Waterschap Het Vrije van Sluis	Groede	1974	8,800	Groede	1,184	91	(Westerschelde)		COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification
		Oostburg	1982	12,500	Oostburg/Zuidzande/ Schoondijke/ Waterland-kerkje/Aardenburg	11,385	91	(Westerschelde)		COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification
		Breskens	1989	19,000	Biervliet/Breskens/ Hoofdplaat/Ijzendijke	9,351	91	(Westerschelde)		COD, BOD NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification
		Retranchement	1974	33,300	Retranchement/Sluis/ Cadzand	4,070	91	(Westerschelde)		COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification

Area code	Water manager	Treatment plant	Year of application	Design-capacity (h.e.)	Management area (municipalities + surface)	Number of habitants	Sewerage percentage (%)	Effluent to:	Type waste water (communal and/or industrial in % of design-capacity)	Monitored parameters in effluent	Treatment technology
		Nieuwvliet Bad	1969	2,500	Nieuwvliet	456	91	(Westerschelde)		COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological oxydation
WS23	Waterschap De Drie Ambachten	De Drie Ambachten	1990	77,500	Canalzone: Terneuzen/Axel/Sas van Gent	54,535	97	Westerschelde	>80% communal <20% industrial	COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification
WS24	Waterschap Het Hulster Ambacht	Kloosterzande	1983	8,000	Hontenisse	7,692	92	(Westerschelde)	100% communal	COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification
		Hulst	1978	25,000	Hulst	18,660	92	(Westerschelde)	100% communal	COD, BOD, NH4N, NO3N, KjN, N, P, PO4P, SM	activated sludge; biological purification
WS25	Hoogheemraadschap West-Brabant	Bath	1983	405,000	AWP/West-Brabant	202,343	93.7	Westerschelde	47% industrial/53% communal	COD, BOD, NH4N, NO2N, NO3N, KjN, N, P, PO4P, As, Cd, Cr, Cu, Hg, Zn, WVFEN, SM	activated sludge; anaerobe sludge stabilisation
		Baarle Nassau	1984	14,000		7,638	93.7	(Zoommeer)	100% communal		
		Chaam	1976	6,250		3,620	93.7	(Zoommeer)	100% communal		
		Dinteloord	1985	7,200		5,470	93.7		100% communal		
		Etten-Leur	1969	30,000		32,825	93.7	(Zoommeer)	100% communal		
		Halsteren	1984	10,350		10,915	93.7	(Zoommeer)	100% communal		
		Lepelstraat	1968	2,400		1,926	93.7	(Zoommeer)	100% communal		
		Nieuw Vossemeer	1972	2,400		2,105	93.7	(Zoommeer)	100% communal		
		Ossendrecht	1967	9,800		5,017	93.7	(Westerschelde)	100% communal		
		Putte	1967	6,200		3,617	93.7	(Westerschelde)	100% communal		

Area scale	Water manager	Treatment plant	Year of application	Design-capacity (h.e.)	Management area (municipalities + surface)	Number of habitants	Sewage percentage (%)	Effluent to:	Type waste water (communal and/or industrial in % of design-capacity)	Monitored parameters in effluent	Treatment technology
		Rucphen	1963	3,000		6,717	93.7	(Zoommeer)	100% communal		
		St. Willebrord	1969	12,000		13,967	93.7	(Zoommeer)	100% communal		
		Zegge	1973	2,400		2,245	93.7	(Zoommeer)	100% communal		
Total				[illegible]		[illegible]					

The design-capacity is based on 54 g BOD per habitant-equivalent.

Appendix 5.10 Treatment efficiencies of the treatment plants around the Westerschelde.
Source: the Dutch waterschappen.

Water manager	Treatment plant	Year	BOD (mg/l)	BOD (mg/l)	Efficiency (%)	COD (mg/l)	COD (mg/l)	Efficiency (%)	P-total (mg/l)	P-total (mg/l)	Efficiency (%)	N-total (mg/l)	N-total (mg/l)	Efficiency (%)
Waterschap Noord- en Zuid-Beveland	Waarde	1990	148.0	3.7	97.5	421	43.0	89.8	7.8	4.2	46.2	34.9	13.3	61.9
		1991	132,1	3,7	97,2	397.3	44.5	88.8	7.9	3.9	50.7	36.8	14.0	62.0
		1992	129,6	3,5	97,3	438.9	41.7	90.5	5.9	2.8	52.6	34.7	13.3	61,7
	Willem Annapolder	1990	294	14.7	95.0	835.7	93.6	88.8	15.2	7.4	51.3	65.6	29.8	54.6
		1991	192,3	12,5	93,5	586.8	84.5	85.6	12.2	7.3	40.4	58.9	27.4	53,1
		1992	198,4	12,7	93,6	774.5	75.9	90.2	13.7	6.5	52.4	54.9	22.8	58,5
Waterschap Walcheren	Ritthem	1990												
		1991												
		1992	200	14	93	506.7	76	85	7.5	2.7	64	56.9	41	28
Waterschap Het Vrije van Sluis	Groede	1990	270	5,4	98	614.3	43.0	93	11.9	3.2	73	76.1	25.1	67
		1991	270	2,7	99	600	30.0	95	8.6	4.3	50	63.6	14.0	78
		1992	213,3	6,4	97	601.3	48.1	92	9.4	4.7	50	67.7	26.4	61
	Oostburg	1990	53	5,3	90	175	49.0	72	9.3	4.0	57	56.0	26.9	52
		1991	101,7	6,1	94	307.7	40.0	87	5.5	2.6	53	32.3	22.3	31
		1992	138	6,9	95	373.3	44.8	88	5.5	2.6	53	38.6	19.3	50

Water manager	Treatment plant	Year	BOD (mg/l)	BOD (mg/l)	Efficiency (%)	COD (mg/l)	COD (mg/l)	Efficiency (%)	P-total (mg/l)	P-total (mg/l)	Efficiency (%)	N-total (mg/l)	N-total (mg/l)	Efficiency (%)
	Breskens	1990	380	3,8	99	740	37.0	95	10.6	3.4	68	58.5	26.9	54
		1991	380	3,8	99	780	39.0	95	8.7	3.3	62	53.4	31.0	42
		1992	270	5,4	98	585.7	41.0	93	6.5	3.2	51	41.7	29.2	30
	Retran-chement	1990	168.3	10.1	94	440	66.0	85	9.3	5.3	43	61.2	39.8	35
		1991	100.0	17.0	83	371.9	100.4	73	9.5	5.4	43	33.9	25.8	24
		1992	113.3	10.2	91	424.4	67.9	84	6.5	2.6	60	40.6	21.1	48
	Nieuwvliet Bad	1990	137.5	5.5	96	450	45.0	90	11.5	6.1	47	73.3	28.6	61
		1991	143.3	4.3	97	457.1	32.0	93	8.6	3.8	56	58.5	31.0	47
		1992	165	6.6	96	348.3	41.8	88	6.8	3.9	43	49.4	33.1	33
Waterschap De Drie Ambachten	Terneuzen	1990	66.7	12.0	82	251.7	73.0	71	9.4	6.8	28	32.1	22.5	30
		1991	100.0	17.0	83	371.9	100.4	73	9.5	5.4	43	33.9	25.8	24
		1992	113.3	10.2	91	424.4	67.9	84	6.5	2.6	60	40.6	21.1	48
Waterschap Het Hulster Ambacht	Kloosterzande	1990	260	2.6	99	680	34.0	95	11.8	1.3	89	60.7	8.5	86
		1991	202.5	8.1	96	700	49.0	93	9.0	1.8	80	48.1	13.0	73
		1992	165	3.3	98	857.5	34.3	96	10.9	1.2	89	48.6	10.2	79
	Hulst	1990	190	3.8	98	683.3	41.0	94	12.4	4.2	66	61.0	25.0	59
		1991	240	12.0	95	788.9	71.0	91	11.6	3.7	68	54.3	25.0	54
		1992	136.7	4.1	97	430	38.7	91	6.6	2.7	59	43.4	26.5	39

Water manager	Treatment plant	Year	BOD (mg/l)	BOD (mg/l)	Efficiency (%)	COD (mg/l)	COD (mg/l)	Efficiency (%)	P-total (mg/l)	P-total (mg/l)	Efficiency (%)	N-total (mg/l)	N-total (mg/l)	Efficiency (%)
Hoogheemraadschap West-Brabant	Bath	1990	200	4	98	600	60	90	7.9	3.1	61	51.2	22	57
		1991	200	4	98	600	60	90	8.4	3.2	62	49.0	25	49
		1992	133.3	4	97	461.5	60	87	8.2	4.1	50	41.8	28	33

6. Water quality monitoring in the Scheldt basin

Appendix 6.1 Parameters of NAP and RAP and these monitored in the Scheldt basin.

Parameter	NAP	RAP	Monitored in the Scheldt catchment
Nutrients			
Phosphates	(1)	*	*
NH4-N	-	*	*
N-tot	(1)	-	(*)
Heavy metals			
Hg	*	*	-
Cd	*	*	-
Cu	*	*	-
Zn	*	*	-
Pb	*	*	-
Cr	*	*	-
Ni	*	*	-
As	*	-	-
Organic halogenes			
Pentachlorinephenol	*	*	-
Hexachlorinebenzene	*	*	-
Hexachlorobutadieen	*	*	-
Tetrachlorinecarbon	*	*	-

Parameter	NAP	RAP	Monitored in the Scheldt catchment
Chloroform	*	*	-
Trichloro-ethene	*	*	-
Tetrachlorine-ethene	*	*	-
Trichlorine-benzenes	*	*	-
1,2-dichlorine-ethane	*	*	-
1,1,1-trichlorine-ethane	*	*	-
chlorine-nitro-benzenes	-	*	-
chlorine-aniline	-	*	-
benzene	-	*	-
bentazon	-	*	-
2-chlorinetoluene	-	*	-
4-chlorinetoluene	-	*	-
Organic phosphorus remedies			
Azinphos-methyl	*	*	-
Fenthion	*	*	-
Parathion	*	*	-
Parathion-methyl	*	*	-
Azinphos-ethyl	*	*	-
Fenitrotion	*	*	-
Malathion	*	*	-
Organic-chlorine remedies			
Drins	*	*	-

Parameter	NAP	RAP	Monitored in the Scheldt catchment
DDT	*	-	-
Organotin-combinations			
Tributyltin-oxyde	*	*	-
Triphenyltin-combinations	*	*	-
Dibutyltincombinations	-	*	-
Tetrabutyltincombinations	-	*	-
Polychlorobiphenyls (PCB's)			
PCB's	(1)	*	
Organic-chloro remedies			
Endosulphan	*	*	-
HCH (lindane)	*	-	-
Remaining substances			
Trifluralin	*	*	-
Simazine	*	*	-
Atrazine	*	*	-
Dichlorovos	*	*	-
Dioxines (PCDD's and PCDF's)	*	-	-
AOX	-	*	-

(1) The North-Sea riparian states have laid down a special reduction programme concerning PCB's and nutrients.
PAH's, mineral oil, radio-active parameters, chlorine-esterase draggers, VOX and EOX are no part of the NAP/RAP.
The last column only gives the parameters which are monitored in **all Scheldt riparian states**.

Appendix 6.2 Strongest water quality objectives in the Scheldt basin.

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
General parameters					
T (°C)		25 (M)	A ≤ 25		≤ 25
pH	6.5-8.5	6-9 (M)	6,5 ≤x ≤ 8,5 (A)		6,5 ≤ x ≤ 9,0
SM (mg/l)	≤ 70		A < 50		
Secchi (m)					≥ 0,4 (z,n)
Conductivity	≤ 2,000				
Oxygen economy ↓					
O2 (mg/l)	> 5		A ≥ 5		≥ 5
%O2	> 70	50 (M)			
BOD_5^{20} (mg/l)	< 5	6 (M)	A ≤ 6		
COD_5^{20} (mg/l)	< 25		A < 30		
KMNO4 4h (oxydabilité) (mg/l)	< 5				
Nutrients ↓					
$NO3^-$	< 25 (mg/l)				
$NO2^-$	≤ 0.3 (mg/l)				
$NH4^+$	< 0.5 (mg/l)	2 (M; mg N/l)	G < 1 en A < 5 (mg N/l)		
NH3	≤ 0.025 (mg/l)		A < 0.2 (mg N/l)		≤ 0.02 (mg N/l)
TKN	< 2 mg/l	6 (M; mg N/l)	A < 6 (mg N/l)		

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
NO_3^- + NO_2^- (mg N/l)			A ≤ 10		
Tot-N (= KjN + NO2 + NO3; mg N/l)					≤ 2.2 (z)

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
P-tot (mg P/l)		1 (M)	G ≤ 0.3 en A < 1		≤ 0.15 (z)
PO4-P (mg/l)	≤ 0.5				
PO4-P (mg P/l) (current)			A < 0.3		
PO4-P (mg P/l) (stagnant)			A < 0.05		
CHL-a (µg/l)			G < 100		≤ 100 (n,z)
Salts ↓					
Cl^- (mg/l)	≤ 200	250 (M)	A < 200		200 (n)
SO_4^{2-} (mg/l)	≤ 150	150 (M)	A < 100		100
F^- (mg/l)	< 1		A < 1.5		1.5
Br^- (mg/l)					8
Heavy metals ↓					
Cd (µg/l)	≤ 1.0	1 (t, M)	≤ 2.5 (t, A)	0.2 (t)	0.05 (t)
Hg (µg/l)	≤ 0.5	0.5 (t, M)	≤ 0,5 (t, A)	0.03 (t)	0.02 (t)
Cu (µg/l)	< 50	50 (t, M)	≤ 30 (t, A)	3 (t)	3 (t)
Pb (µg/l)	≤ 50	50 (t, M)	≤ 50 (t, A)	25 (t)	4 (t)
Zn (µg/l)	< 500	300 (t, M)	≤ 200 (t, A)	30 (t)	9 (t)

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Cr (µg/l)	≤ 50	50 (t, M)	≤ 50 (t, A)	20 (t)	5 (t)
Ni (µg/l)		50 (t, M)	≤ 50 (t, A)	10 (t)	9 (t)
As (µg/l)	< 1	50 (t, M)	≤ 30 (t, A)	10 (t)	5 (t)
Fe-tot (µg/l)	≥ 1500				
Mn (µg/l)	< 250		A < 200		
Se-tot (µg/l)	≤ 10		A < 10		
Ba-tot			A < 1000		

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Surface active substances ↓					
MBAS (µg/l)		500 (M)	M ≤ 100		100 (M)
NID + CID (µg/l)			M ≤ 1000		
NID (µg/l)		500 (M)			100 (M)
CID (µg/l)					100 (M)
Bacteries ↓					
EColi	≤ 2000				
FColi (n/100ml)	≤ 5000		≤ 2000 (M)		≤ 2000 (M)
TTColi (MPN/1 ml)	20 (M)				
Radio-activity ↓					
Alpha (Bq/l)					≤ 0.1 (j)
Rest-ß (Bq/l)					≤ 1 (j)

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Tritium (Bq/l)					≤ 200 (j)
Organic micropollutants ‡					
MAH (µg/l)		2 (M)	≤ 2 (M)		2 (M)
PAH-tot (ng/l)		100 (M)	≤ 100 (M)		
Fluoranthene (µg/l)				0.07	0.006
Naftalene (µg/l)				0.1	0.1
Benzo(a)anthracene (µg/l)				0.008	0.003
Benzo(k)fluoranthene (µg/l)				0.02	0.003
Benzo(a)pyrene (µg/l)				0.005	0.003
Fenanthrene (µg/l)				0.02	0.02
Benzo(ghi)perylene (µg/l)				0.004	0.001
Indeno(123-cd)pyrene (µg/l)				0.004	0.002
Anthracene (µg/l)				0.02	0.02
Chrysene (µg/l)				0.008	0.003

PARAMETERS	FRANCE (Class I)	BELGIUM, (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
ΣChlorine-pesticides (ng/l)		30 (M) 10 (Min)	≤ 20 (M) ≤ 10 (Min)		3
Dieldrin (ng/l)				2 (t)	0.07 (t)
γ-HCH (lindane; ng/l)				10 (t)	0.2 (t)
α-Endosulphan + sulphate (µg/l)				0.01 (t)	

PARAMETERS	FRANCE (Class I)	BELGIUM, (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Hexachlorobutadiene (μg/l)				0.12 (t)	
Azinphos-methyl (ng/l)				20 (t)	0.7 (t)
Azinphos-ethyl (ng/l)				0.05 (t)	
Choline-esterase-inhibitors (μg/l)		0.5 (M)	≤ 0.5 (M)	0.5 (t)	
Dichloro-VOS (μg/l)				0.002 (t)	
Parathion-methul (μg/l)				0.2 (t)	
Parathion-ethyl (ng/l)				5 (t)	0.05 (t)
Malathion (ng/l)				4 (t)	0.04 (t)
Diazinon (ng/l)				30 (t)	0.9 (t)
Fention (μg/l)				0.02 (t)	
Foxim (μg/l)				0.2 (t)	
Mevinphos (μg/l)				0.005 (t)	
Pyrazophos (μg/l)				0.003 (t)	
Oxydemethon-methyl (μg/l)				0.1 (t)	
Fen (μg/l)					0,02 (t, G)
Feni (μg/l)					0,05 (t, G)
Chl-bifen (ng/l)		7 (M)	≤ 7 (Mt)		7 (Mt)
Chl-aro-amin (μg/l)			≤ 1 (Mt)		
Chloro-phenols (ng/l)		100 (Min)	≤ 50 (Min)		
Monochlorophenols (μg/l)				9 (t)	0.25 (t)
Dichlorophenols (μg/l)				0.08 (t)	0.08 (t)

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Trichlorophenols (µg/l)				2.5 (t)	0.025 (t)
Tetrachlorphenols (µg/l)				1 (t)	0.01 (t)
Pentachlorophenol (µg/l)				0.05 (t)	0.02 (t)
Dichlorobenzenes (µg/l)				2	
Trichlorobenzenes (µg/l)				0.4	
Tetrachlorobenzenes (µg/l)				0.2	
VOX (µg/l)			≤ 5 (M)		5 (M)
EOX (µg/l)			≤ 5 (M)		5
AOX (µg/l)			≤ 40 (M)		40 (M)
1,3-dichlorpropene (µg/l)				1	
Trichloro-ethene (µg/l)				2	
Hexachloro-ethane (µg/l)				1	
Tributyltin (µg/l)				0.01 (t)	
Trifenyltin (µg/l)				0.01 (t)	
Dinoseb (µg/l)				0.02 (t)	
DNOC (µg/l)				0.3 (t)	
Aldicarb (µg/l)				0.5 (t)	
Oxamil (µg/l)				0.5 (t)	
Carbendazim (µg/l)				0.03 (t)	
Maneb (µg/l)				1.0 (t)	
Thiram (µg/l)				0.02 (t)	

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Zineb (µg/l)				0.6 (t)	
Metham-natrium (µg/l)				0.01 (t)	
Aniline (µg/l)				2 (t)	
NTA (µg/l)				200 (t)	
2,4-dichlorophenoxycarbonacid (µg/l)				11 (t)	
mcpa (µg/l)				0.2 (t)	
Mecoprop (µg/l)				0.1 (t)	

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1995)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
Chl-F (mg/l)			< 0,004 (A)		
CN-tot (mg/l)		0,05 (M)	< 0,05 (A)		
Simazine (µg/l)				0.4	
Atrazine (ng/l)				100	7.5
TCEe (µg/l)					2 (t, G)
C6H5OH (µg/l)			≤ 5 (M)		
Fenol-tot (µg/l)	≤ 1		< 40 (A)		
Indice biotique	≤ 3				
ABS (détergents; mg/l)	≤ 0.2				
Fer (mg/l)	< 1				

PARAMETERS	FRANCE (Class I)	BELGIUM (1993)	FLANDERS (1996)	THE NETHERLANDS (1995)	THE NETHERLANDS (2000)
SEC (mg/l)	< 0.5				
CN^- (mg/l)	≤ 0.05				
Trifluoralin (μg/l)				0.2	
Pentachloronitrobenzene (μg/l)				0.4	
Propachloro (μg/l)				0.1	
Linuron (μg/l)				0.1	
3,3-dichlorobenzidine (μg/l)				0.2	
Captaphol (μg/l)				0.2	
Captan (μg/l)				0.3	

M : median value
A : absolute value
z : mean summer value
t : total concentration in water (= dissolved + suspended matter)

Appendix 6.3 Parameters which are monitored in the Scheldt basin.

Parameter	France	Wallonia	Flanders	The Netherlands
Insight depth (Secchi)	-	m	-	dm
Temperature (*t*)	-	°C	°C	°C
pH	*	*	*	*
Salinity	-	-	-	*
Dissolved organic carbon (after filtration; DOC)	-	mg C/l	-	mg/l
Particulated organic carbon (POC)	-	-	-	mg/l
Total organic carbon (TOC)	-	-	-	mg/l
Chlorophyl-*a*	-	-	-	µg/l
Orthophosphates (o-P)	mg/l	mg P/l	mg P/l	mg/l
Total phosporus (P-tot)	mg/l	mgP/l	mgP/l	mg/l
Suspended matter (SM)	mg/l	mg/l	mg/l	mg/l
Dissolved oxygen (O_2)	mg/l	mg/l	mg/l	mg/l
Dissolved oxygen after 120 hours (O_2 120)	-	mg/l	-	-
Oxygen saturation	% O_2	% O_2	-	% O_2
Biochemical Oxygen Demand (BOD_5)	mg/l	mg/l	mg/l	mg/l
Chemical Oxygen Demand (COD)	mg/l	mg/l	mg/l	-

Parameter	France	Wallonia	Flanders	The Netherlands
Daily flow rate	-	m_3/s	-	-
Ammonium nitrogen (NH4-N)	mg/l	mg/l and mg N/l	mg N/l	mg/l
Kjeldahl-nitrogen (Kj-N)	mg/l	mg N/l	mg N/l	mg/l
Nitrite-nitrogen (NO2-N)	mg/l	mg/l	mg N/l	mg/l
Nitrate-nitrogen (NO3-N)	mg/l	mg/l	mg N/l	mg/l
Nitrite + nitrate (NO2NO3-N)	-	mg N/l	-	mg/l
E (=N/P)	-	*	-	-
Conductivity	µS/cm	µS/cm	µS/cm	mS/cm
Chlorides (Cl-)	-	mg/l	mg/l	mg/l
Sulphates ($SO4^{2-}$)	-	mg/l	mg/l	mg/l
Fluorides (F-)	-	mg/l	-	mg/l
Arsene (As)	-	µg/l	-	µg/l
Total Arsene (As-t)	-	µg/l	-	-
Arsene after filtration (As-f)	-	µg/l	-	µg/l
Cadmium (Cd)	-	µg/l	-	µg/l
Total cadmium (Cd-t)	-	µg/l	-	-
Cadmium after filtration (Cd-f)	-	µg/l	-	µg/l
Chromium (Cr)	-	µg/l	-	µg/l
Total chromium (Cr-t)	-	µg/l	-	-
Chromium after filtration (Cr-f)	-	µg/l	-	µg/l
Copper (Cu)	-	µg/l		µg/l

Parameter	France	Wallonia	Flanders	The Netherlands
Total copper (Cu-t)	-	µg/l	-	µg/l
Copper after filtration (Cu-f)	-	µg/l	-	µg/l
Mercury (Hg)	-	µg/l	-	µg/l
Total mercury (Hg-t)	-	µg/l	-	-
Mercury after filtration (Hg-f)	-	µg/l	-	µg/l
Nickel (Ni)	-	µg/l	-	µg/l
Total nickel (Ni-t)	-	µg/l	-	-
Nickel after filtration (Ni-f)	-	µg/l	-	µg/l
Lead (Pb)	-	µg/l	-	µg/l
Total lead (Pb-t)	-	µg/l	-	-
Load after filtration (Pb-f)		µg/l	-	µg/l
Zinc (Zn)	-	µg/l	-	µg/l
Total zinc (Zn-t)	-	µg/l	-	-
Zinc after filtration (Zn-f)	-	µg/l	-	µg/l
VOX	-	-	-	µg/l
EOX	-	µg Cl/l	-	µg/l
AOX	-	µg Cl/l	-	µg/l
Benzene	-	µg/l	-	µg/l
Toluene	-	µg/l	-	µg/l
Monocyclic Aromatic Carbonhydrogens (MAK)	-	-	-	µg/l
Pentachlorophenol (PCP)	-	-	-	µg/l
Tetrachloroethene (TCEe)	-	-	-	µg/l

Parameter	France	Wallonia	Flanders	The Netherlands
Tetrachloromethane (T4CM)	-	-	-	μg/l
Trichloro-ethene (TCEe)	-	-	-	μg/l
Trichloro-methane (chlorophorm; TCM)	-	-	-	μg/l
Aldrin	-	ng/l	-	μg/l
Dieldrin	-	ng/l	-	μg/l
DDT	-	-	-	μg/l
Σ pesticides	-	-	-	μg/l
Thermotolerant Coli bacteries (TColi)	-	-	-	n/ml
Faecal Streptococs (FStrep)	-	-	-	n/ml
Faecal Colibacteries (FColi)	-	-	-	n/ml
Salmonellae	-	-	-	n/l
Alpha-hexachlorocyclohexane (HCH-α)	-	ng/l	-	μg/l
Beta-hexachlorocyclohexane (HCH-ß)	-	ng/l	-	μg/l
Gamma-hexachlorocyclohexane (HCH-γ)	-	ng/l	-	μg/l
Alpha-endosulphan (α-Endo)	-	ng/l	-	μg/l
Choline-esterase draggers (CHOLREM)	-	μgp/l	-	μg/l
Total alpha activity (Alpha)	-	-	-	mBq/l
Total beta activity (Beta)	-	-	-	mBq/l
Remaining beta activity (Rest-ß)	-	-	-	mBq/l
Beta activity of tritium (H3 (mBq/l)	-	-	-	mBq/l

Appendix 6.4

International Study Group/Description of the Water quality of the Scheldt Basin (ISG/DWS)

Subject: *Immission monitoring program (surface water and sediment) in the French part of the Scheldt Basin (1990/1991).*
Code: ISG/DWS/22
Date: 27 November 1992

Table 1a. ISG-selected immission monitoring localities in the French part of the Scheldt Basin.

Code /	ISG-code /	Watercourse /	Municipal /		Code /	ISG-code /	Watercourse /	Municipal /
000431	ISG1	Le Jard	Conde-Sur-Escaut		028000	ISG25	L'Ecaillon	Thiant
000437	ISG2	Le Jard	Vieux-Conde		029000	ISG26	La Rhonelle	Famars
000535	ISG3	La Petite Marque	Hem		030500	ISG27	Canal de Mons	Saint-Aybert
001148	ISG4	Courant de Bernissart	Bernissart		032000	ISG28	L'Hogneau	Thivencelles
001225	ISG5	La Marque	Tourmignies		033000	ISG29	Canal du Jard	Hergnies
010000	ISG6	L'Escaut Riviere	Crevecoeur-Sur-Escaut		034000	ISG30	La Vergne Noire	Flines-Les-Mortagne
011000	ISG7	L'Escaut Riviere	Caintaing-Proville		035000	ISG31	La Scarpe Riviere	St. Catherine-Les-Arras
012000	ISG8	L'Escaut Canalise	Eswars		036000	ISG32	Canal de la Scarpe	Fampoux
013000	ISG9	Canal de L'Escaut	Neuville-Sur-Escaut		037000	ISG33	La Scarpe Canalisee	Brebieres
014000	ISG10	Canal de L'Escaut	Rouvignies		039000	ISG34	La Scarpe Canalisee	Raches
015000	ISG11	Canal de L'Escaut	Trith St Leger		039100	ISG35	Courant de Bernicourt	Roost-Warendin
016000	ISG12	Canal de L'Escaut	Fresnes-Sur-Escaut		040000	ISG36	Canal de la Scarpe	Marchiennes
017000	ISG13	Canal de L'Escaut	Vieux-Conde		041000	ISG37	Canal de la Scarpe	Nivelles
018000	ISG14	Canal de L'Escaut	Mortagne-Du-Nord		042000	ISG38	Canal Du Nord	Oisy le Verger
019000	ISG15	L'Escaut Canalisee	Mortagne-Du-Nord		043000	ISG39	La Sensee Riviere	Arleux
019100	ISG16	Canal de L'Escaut	Warcoing		044000	ISG40	La Sensee	Palluel
019300	ISG17	Canal de L'Escaut	Helkijn		045000	ISG41	La Sensee	Tortequesne
021000	ISG18	Canal de St.Quentin	Cantaing-Sur-Escaut		046000	ISG42	Canal de la Sensee	Ferin
022000	ISG19	Torrent d'Esnes	Crevecoeur-Sur-Escaut		047000	ISG43	La Grande Traitoire	St-Amand
023000	ISG20	L'Erclin	Iwuy		048800	ISG44	Courant de l'Hopital	Millonfosse
024000	ISG21	La Sensee	Bouchain		049000	ISG45	Le Decours	Thun-St-Amand
025000	ISG22	La Selle	Montay		050000	ISG46	Canal de Roubaix	Leers
026000	ISG23	La Selle	Saint-Python		051000	ISG47	L'Espierre	Wattrelos
027000	ISG24	La Selle	Noyelles-Sur-Selle		051100	ISG48	L'Espierre	Spiere
					052000	ISG49	La Lys	Lugy

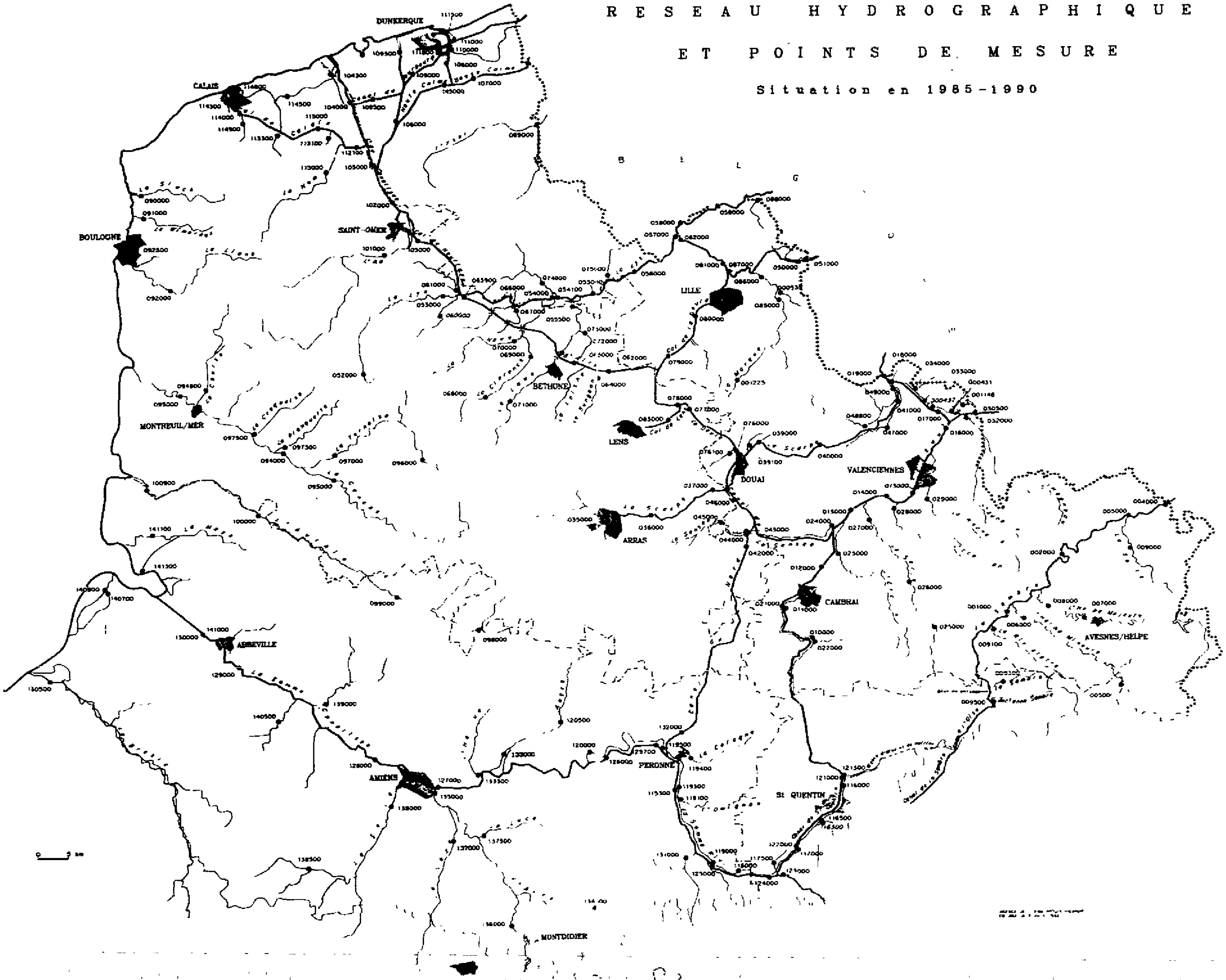
Table 1b. ISG-selected immission monitoring localities in the French part of the Scheldt Basin.

Code /	ISG-code /	Watercourse /	Municipal /		Code /	ISG-code /	Watercourse /	Municipal /
053000	ISG50	La Lys	Aire-Sur-La-Lys		075000	ISG74	Becque de Steenwerck	Steenwerck
054000	ISG51	La Lys Canalisee	Merville		076000	ISG75	Canal de la Deule	Flers-En-Escrebieux
054100	ISG52	La Lys Canalisee	Merville		076100	ISG76	L'Escrebieux	Flers-En-Escrebieux
055000	ISG53	La Lys Canalisee	Estaires		077000	ISG77	Canal de la Deule	Courrieres
055500	ISG54	La Lawe	Lestrem		078000	ISG78	Canal de la Deule	Courrieres
056000	ISG55	La Lys Canalisee	Erquinghem		079000	ISG79	Canal de la Deule	Don
057000	ISG56	La Lys Canalisee	Deulemont		080000	ISG80	Canal de la Deule	Haubourdin
058000	ISG57	La Lys Canalisee	Warneton		081000	ISG81	Canal de la Deule	Wambrechies
059000	ISG58	La Lys Canalisee	Wervicq		082000	ISG82	Deule Canal	Deulemont
060000	ISG59	La Laquette	Wittemesse		083000	ISG83	Canal de Lens	Harnes
061000	ISG60	La Melde Du Pas-De-Calais	Aire-Sur-La-Lys		085000	ISG84	La Marque	Forest-Sur-Marque
062000	ISG61	Canal d'Aire A La Bassee	Cuinchy		086000	ISG85	La Marque	Wasquehal
063000	ISG62	Canal d'Aire A La Bassee	Beuvry Les Bethune		087000	ISG86	Canal de Roubaix	Marquette Les Lile
063900	ISG63	Canal d'Aire A La Bassee	Aire-Sur-La-Lys		088000	ISG87	Becque de Neuville	Halluin
064000	ISG64	Le Surgeon	Cambrin					
066000	ISG65	Guarbecque	Saint-Venant					
067000	ISG66	Riviere de Busnes	Saint-Venant					
068000	ISG67	La Clarence	Calonne Ricouart					
069000	ISG68	La Clarence	Choques					
070000	ISG69	La Nave	Busnes					
071000	ISG70	La Lawe	Bruay-En-Artois					
072000	ISG71	La Lawe	Essars					
073000	ISG72	La Loisne	Couture					
074000	ISG73	Canal de la Bourre	Merville					

R E S E A U   H Y D R O G R A P H I Q U E

E T   P O I N T S   D E   M E S U R E

S i t u a t i o n   e n   1 9 8 5 - 1 9 9 0



Appendix 6. Water quality monitoring localities in the Wallonian part of the Scheldt basin.

Code	Zone	Watercourse	Municipality
360	Ipalle	l'Escaut	Bléharies
380	Ipalle	l'Escaut	Kain
400	Ipalle	l'Escaut	Pottes
551	Ipalle	Canal de l'Espierres	Saint-Leger
560	Ipalle	Canal de l"Espierres	Leers-Nord
580	Ipalle	l'Espierres	Leers-Nord
630	Ipalle	la Rhosnes	Orroir
660	Ipalle	la Lys	Ploegsteert
670	Ipalle	la Lys	Warneton
690	Ipalle	la Lys	Comines
1270	Ipalle	la Dendre	Ath
1390	Idea	la Senne	Soignies
1395	Ibw	la Senne	Quenast
1530	Idea	Canal Charleroi-Bruxelles	Courcelles
1532	Idea	le Tintia	Viesville
1541	Idea	Pieton	Gouy-Lez-Pieton
1552	Idea	Canal Charleroi-Bruxelles	Feluy
1650	Ibw	La Dyle	Limal
1780	Ibw	Le Train	Archennes
2230	Idea	la Haine	Saint-Vaast
2261	Idea	la Haine	Jemappes
2280	Idea	la Haine	Hensies
2300	Idea	l'Hogneau	Quievrain
2340		Canal Pommeroel-Antoing	Peronnes
2361		le Grand Courant	Bernissart
2390	Idea	Canal du Centre	Nimy

Appendix 6.6 Selected water quality monitoring localities in the Flemish part of the Scheldt basin.

Location code VMM	ISG-Code	AWP-II basin	Watercourse	Municipality
60	2001	7	Leopoldkanaal	Brugge
110	2002	7	LeopoldKanaal	Assenede
120	2003	7	Leopoldkanaal/ Isabellakanaal	Sas van Ghent (Netherlands)
300	2004	12	Kanaal Gent-Terneuzen	Zelzate
340	2005	12	Kanaal Gent-Terneuzen	Gent
380	2006	12	Nieuwe Moervaart	Gent
1540	2007	37	Schelde	Antwerpen
1620	2008	37	Schelde	Hemiksem
1640	2009	36	Schelde	Dendermonde
1650	2010	21	*Schelde*	*Zele*
1680	2011	21	Schelde	Wetteren
1690	2012	20	Schelde	*Destelbergen*
1720	2013	20	Schelde	Gent
1730	2014	22	Schelde	Zwalm
1740	2015	22	Schelde	Oudenaarde
1760	2016	22	Schelde	Avelgem
1790	2017	22	Schelde	Pecq
1800	2018	38	Groot Schijn	Antwerpen
1980	2019	39	Barbierbeek	Kruibeke
2100	2020	35	Rupel	Niel
2120	2021	32	Dijle	Mechelen
2150	2022	32	Dijle	Rotselaar
2160	2023	31	Dijle	Rotselaar
2200	2024	31	Dijle	Leuven
2500	2025	25	Beneden Nete	Mechelen
2520	2026	25	Grote Nete	Geel
2580	2027	25	Grote Nete	Geel
2600	2028	25	Grote Nete	Geel

Location code VMM	ISG-code	AWP-II basin	Watercourse	Municipality
2700	2029	24	Kleine Nete	Lier
3250	2030	25	Grote Laak	Laakdal
3290	2031	25	Molse Neet	Geel
3410	2032	30	Zenne	Mechelen
3420	2033	30	Zenne	Brussel
3450	2034	30	Zenne	Zemst
3460	2035	30	Zenne	Brussel
3470	2036	30	Zenne	Brussel
3500	2037	30	Zenne	Halle
3700	2038	32	Vrouwvliet	Mechelen
3900	2039	29	Demer	Rotselaar
3930	2040	29	Demer	Diest
3970	2041	26	Demer	Lummen
3980	2042	26	Demer	Hasselt
3990	2043	26	Demer	Hasselt
4020	2044	26	Demer	Bilzen
4190	2045	29	Zwartebeek	Lummen
4230	2046	28	Velpe	Halen
4250	2047	28	Velpe	Kortenaken
4270	2048	27	Gete	Halen
4280	2049	27	Gete	Halen
4420	2050	27	Grote Nete	Hoegaarden
4990	2051	34	Dorpsloop	St. Amands
4995	2052	18	Nieuwe Dender	Dendermonde
5000	2053	18	Dender	Aalst
5040	2054	18	Dender	Denderleeuw
5070	2055	18	Dender	Ninove
5080	2056	18	Dender	Geraardsbergen
5110	2057	18	Dender	Geraardsbergen
5710	2058	20	Leie	Ghent
5780	2059	16	Leie	Wielsbeke
5800	2060	16	Leie	Kortrijk

Location code VMM	ISG-code	AWP-II basin	Watercourse	Municipality
5820	2061	16	Leie	Menen
5830	2062	16	Leie	Wervik
5890	2063	16	Petegemse beek	Deinze
5930	2064	16	Tichelbeek/Gaverbeek	Zulte
5960	2065	16	Oude Mandel	Dentergem
5980	2066	16	Speibeek	Dentergem
5990	2067	16	Zouwbeek	Zulte
6030	2068	16	Mandel	Dentergem
6300	2069	16	Gaverbeek	Waregem
6330	2070	16	Gaverbeek	Harelbeke
6500	2071	16	Heulebeek	Kortrijk
6640	2072	16	Gaverbeek/Becque de Neuville	Menen
6650	2073	16	Geluwse Beek	Menen
7150	2074	23	Zwalm	Zwalm
7440	2075	22	Grote Spierebbeek/Zwarte Spierebeek	Spiere-Helkijn
7450	2076	22	Grote Spierebeek	Spiere-Helkijn
7510	2077	10	Poekebeek	Nevele
7650	2078	10	Schipdonkkanaal-Afleidingskanaal	Damme
7700	2079	11	Kanaal Gent-Oostende	Oostende
7720	2080	11	Kanaal Gent-Oostende	Brugge
7760	2081	11	Kanaal Gent-Oostende	Beernem
7800	2082	17	Ringvaart	Gent

7. Conclusions, discussion and future activities

appendix 7 1

Mr. Leo Santbergen
Ministry of Transport, Public Works and
Water Management
Direction Zeeland
P.O.Box 5014
NL - 4330 KA Middelburg

RW/O/93/572

Brussels, May 19th 1993

Dear Mr. Santbergen:

Re: Workshop 2/3 Juni - Namur

Please find enclosed the documents of ICES concerning the use of sediments as monitoring tool for studies of contaminants.

Dr. G.T.M. van Eck of the Rijkswaterstaat has collected data concerning the composition of sediments in the Scheldt estuary (heavy metals, pcb's, pak's, etc...). I strongly suggest to include a summary of these data in the report.

I 'll unfortunately not be able to attend the meeting in Namur because of the exams at the University.

Yours faithfully,

Professor R. WOLLAST

Encls.

Workshop Report
on
Shelf Edge Exchange Processes: Mediterranean versus North Atlantic

Lei CHOU
Laboratoire D'Océanogrpahie Chimique
Université Libre de Bruxelles

The discussion of the workshop session was concentrated on the identification of key questions and of gaps related to studies on shelf edge exchange processes. Recommendations were suggested by the key speakers and other workshop participants for future research.

1. Biogeochemical Cycles

Coastal zones are areas of high productivity and thus are important for the quantification of the global carbon cycle. However, air/sea exchange measurements of CO_2 carried out in previous studies rarely include the coastal oceans. It is recommended that in the future global carbon budget for CO_2 fluxes take into account processes occurring in this region.

Until present the amount of organic carbon being transferred from the coast zone to the open ocean across the ocean margins is unknown. This is certainly one of the key questions to be addressed in future studies.

It was also pointed out that the understanding of the hydrodynamics in the shelf/slope regions is essential for the quantification of global biogeochemical cycle of carbon and the associated elements.

2. Physical Processes

The following recommendations are proposed concerning the physics on the shelf edge exchange:

- To clarify the mechanisms that generate and maintain the eddies of filaments in the shelf/slope regions because they are important for the mass transfer of elements across the ocean margins.
- To quantify important exchange associated with transport and energy at mesoscale.
- To conduct processes-oriented studies in order to quantify relative importance of physical processes.
- To conduct substantial field and theoretical studies.

3. Sediment Transport

It is important to link the hydrodynamic system with the transport of sediments. This requires interdisciplinary studies.

One should also investigate how the sediment transport system changes when the climate changes. It was suggested to monitor the sediment transport at the seafloor at a key location. For instance, the Norwegian Sea - Greenland area can be a key area for this type of study because they are likely subject to climatic change.

The assistance from the modellers is highly desirable.

4. Biology

One needs to know the energy flow via the pelagic-benthic coupling system. Processes controlling the transfer of organic carbon in shelf/slope regions is poorly understood, which involves chemistry, physics and biogeochemical cycling. There are gaps in all branches of biological studies concerning this subject. Collection of basic data of high quality is strongly needed. Again, interdisciplinary research is strongly recommended.

5. Coordination of Multi-Disciplinary Studies

The necessity for a multi-disciplinary research on shelf edge exchange processes has been pointed out throughout the discussion. There are lots of information existing in this field. However, there are no links to provide data exchange. It was then suggested that a single study area be chosen for this type of interdisciplinary project.

One of the workshop participants pointed out that multi-disciplinary studies should become easier now. Because there are several large scale integrated projects in the framework of the MAST II programme, which covers various disciplines.

15 GUIDELINES FOR THE USE OF SEDIMENTS AS A MONITORING TOOL FOR STUDIES OF CONTAMINANTS IN THE MARINE ENVIRONMENT

15.1 Introduction

The following is an amplification of earlier advice provided by the ACMP on the use of sediments as a monitoring tool for studies of contaminants in the marine environment. This amplification was requested by the Oslo and Paris Commissions to meet needs specified by the Joint Monitoring Group.

15.2 Sampling Methods

Different problems dictate different approaches and levels of sophistication in monitoring sediments. The ACMP suggests three levels of sampling and analysis appropriate to differing requirements.

15.2.1 First level

The first level is limited to the measurement of total contaminant concentrations in surface sediments. Analysis of bottom grab samples can provide an immediate assessment of the present levels of contamination in an area in relation to the textural and geochemical characteristics of the sediment.

Tightly closing grab samplers are usually adequate for studies of the most recently deposited layer, provided that they are well designed and handled. Normally, only the uppermost layer is used for the studies. Such grab samples do not, however, provide much information on the accumulation of contaminants in the past. In the case of strong biological perturbation of the sediments, the contamination signal of the surficial layer may also be significantly damped. A visual inspection of the sample is often sufficient to indicate the absence of animal disturbance, especially in the case of unambiguously laminated sediments.

Sampling of sediments should be exclusively performed in accumulating areas. Since many contaminants are enriched in the fine particulate fraction of sediments, zones in which muds accumulate are to be preferred. Background information can be provided from topographic maps and current charts. Areas of interest are associated with zones of low hydraulic energy related to weak tidal currents and wave actions. They are normally found at the deepest parts of an area. This background information can be usefully supplemented by topographic mapping using echo-sounding and seismic profiling.

The diversity and varying intensity of physical, chemical and biological conditions in marine areas imposes a need to assess variability in a given area through appropriate sampling. The number of samples required for this purpose can be evaluated by appropriate statistical analysis of the variance within and between samples.

15.2.2 Second level

The second level involves the sampling of cores at selected sites with a box-corer or a large diameter gravity corer. With these samplers, assuming that they are properly deployed, recovered and sub-sampled, the surface is more reliably sampled and it is possible to examine the vertical structure and composition of the sediments.

The depth and intensity of biological mixing can often be qualitatively assessed by visual inspection or by X-radiography of cores. In unmixed sediments, the vertical distribution of the concentrations reveals the evolution of the depositional flux of contaminants in the most recent past and allows one to define a reference level of concentrations in the deepest part of the core, which may represent the natural level in the area in question.

In most areas, 1 cm slices are a reasonable compromise between the desired vertical (historical) resolution, the number of samples to be processed and the amount of material necessary for a variety of different analyses. Smaller slices, down to about 2 mm, are still practicable in areas of low deposition, depending on the intensity of biological mixing.

15.2.3 Third level

The sampling methods at this level are the same as those at the second level, but with the addition of radiochemical (e.g., Pb-210, Th-234, Cs-137, and Pu-239/Pu-240) or other measurements to determine the rate of deposition and the nature and consequences of biological mixing. It is the objective of this work to understand the rate and mechanism of contaminant build-up in the sediment reservoir and eventually to determine contaminant budgets and temporal trends.

15.3 Sampling frequency

The sampling frequency (and vertical resolution) is essentially determined by the rate of deposition, the intensity of biological mixing and the thickness of the layer one can sample. It also depends on the anticipated changes of contaminant fluxes to the sediment with time and on the reproducibility of the analytical methods applied for contaminant determinations. Since high depositional rates in coastal environments are of the order of a few centimeters per decade, the required time interval for repeated sampling of marine sediments in a monitoring programme is usually several years.

15.4 Sample description

A log book should be used during sampling where a visual description of the sample is made. The description should contain the following information:

- textural description,
- homogeneity and indication of bioturbation or stratification,
- colour (Munsell colour chart).

If possible, the sediment cores should be X-rayed before slicing to confirm the information on textural changes and biological mixing.

15.5 Sub-sampling and sample storage

The sub-sampling of sediments should preferably be performed immediately after sampling. Care should be taken to avoid smearing of the sides of extruded cores. Sub-samples for physical and chemical analysis should be stored frozen or freeze-dried.

15.6 Sedimentological and Geochemical Information

For any study of marine sediments in relation to contamination, a basic amount of *information is necessary* about the deposit and its composition. This information requires the determination of:

- water content
- grain size characteristics
- organic and inorganic carbon content
- Al (or Sc) and Fe (or Mn) content
- the contaminants of concern.

The redox potential should be evaluated at least qualitatively (i.e., whether the surficial sediments are oxic or anoxic and, if oxic, whether there exists a redoxcline within the core).

15.6.1 Grain size distribution

As contaminant levels are usually much higher in finer grained sediments, it is appropriate to determine the fine-grained size fraction and to apply the chemical analysis to that fraction. It is convenient to separate particles at the sand/silt size classification boundary (63 µm). The grain size separation may be performed by dry-sieving or wet-sieving using uncontaminated deionized water. In cases where contamination of the coarse fraction is suspected, both fractions should be analysed.

15.7 Chemical analysis

For the analysis of inorganic constituents, the sample should preferably be freeze-dried. Alternatively, the sediments may be dried at 105°C, except for subsequent analysis of volatile substances (e.g., dimethyl mercury). Sub-sampling should be performed on a dry sample previously homogenized in a mortar.

For organic constituents, sub-sampling of wet sediments is recommended. The water content may be determined on a parallel sample. Alternatively, freeze-dried sediments may be used following careful checks on loss of volatile substances and of contamination (e.g., by vacuum pump oil).

For most types of analyses of organic and inorganic constituents, well-documented methods are available. However, for coordinated studies only satisfactorily intercompared methods should be used. Some guidance in relation to the expected reproducibility of those methods is given in reports of recent intercalibration exercises.

16 SEDIMENT QUALITY CRITERIA: NORMALIZATION TECHNIQUES FOR METALS

16.1 Introduction

This section of the report presents a tentative normalization technique for evaluating the concentrations of metallic contaminants in sediments with respect to background or natural levels expected for similar non-contaminated deposits. Its purpose is to determine where anomalous concentrations occur relative to those normally expected in marine sediments under natural conditions.

A wide variety of substances entering the marine system are subjected to various biogeochemical processes and become associated with fine-grained particulate matter in such a way that the behaviour and fate of these substances are determined by particulate dynamics. Thus, preferential accumulation of particle-associative contaminants occurs in zones of fine sediment deposition and a comparison of sediments from various areas must, therefore, take into account the granulometric distribution. Two approaches to normalization have been selected here. The first is purely physical and consists of characterizing the sediment by measuring its content of fine material. The second approach is of a chemical nature and is based on the fact that the small size fraction is usually rich in clay minerals, iron and manganese oxi-hydroxides and organic matter. Chemical parameters representative of these components may thus be used to characterize the small size fraction.

It is strongly suggested that several parameters be used in the evaluation of quality criteria of sediments. The types of information gained by utilizing these various parameters are often complementary and extremely useful, considering the complexity and diversity of situations encountered in the sedimentary environment. Furthermore, the measurements of the parameters selected here are relatively simple and inexpensive.

The interpretation of the data generally requires a comparison between the chemical composition of the sediments from a selected area and background or natural values found in uncontaminated sediments. In this context, the relationships between the concentrations of contaminants and various sedimentary characteristics, such as grain-size distribution and mineralogical composition, are very useful. A step-by-step description of the selected procedure and a short justification of the methodology are given below.

16.2 Sampling Strategy

Ideally, a sampling strategy should be based on a knowledge of the source of contaminants, the transport pathways of suspended matter and the rates of accumulation of sediments in the region of interest. However, existing data are often too limited to define the ideal sampling scheme.

14 STUDIES OF CONTAMINANTS IN SEDIMENTS

The ACMP considered the "Guidelines for differentiating anthropogenic from natural trace metal concentrations in marine sediments", prepared by the WGMS. The ACMP noted that these revised guidelines were based on a debatable definition of the normalization concept which, furthermore, does not apply to substances such as chlorinated hydrocarbons that do not have both a natural and an anthropogenic source. The ACMP noted that the submitted guidelines document was limited to the case of trace metals in sediments. The ACMP decided to amend the document in order to respond better to the urgent request of the Oslo and Paris Commissions for advice on normalization of the concentrations of a wide variety of contaminants in marine sediments.

14.1 Normalization Techniques for Sediment Quality Assessment

14.1.1 Introduction

Normalization in this discussion is defined as a procedure to compensate for the influence of natural processes on the measured variability of the concentration of contaminants in sediments. Most contaminants (metals, pesticides, hydrocarbons) show high affinity to particulate matter and are, consequently, enriched in the bottom sediments of estuaries and coastal areas. In practice, natural and anthropogenic substances entering the marine system are subjected to a variety of biogeochemical processes. As a result, they become associated with fine-grained suspended solids and colloidal organic and inorganic particles. The ultimate fate of these substances is determined, to a large extent, by particulate dynamics. They therefore tend to accumulate in areas of low hydrodynamic energy, where fine material is preferentially deposited. In areas of higher energy, these substances are "diluted" by coarser sediments of natural origin and low contaminant content.

It is obvious that the grain size is one of the most important factors controlling the distribution of natural and anthropogenic components in the sediments. It is, therefore, essential to normalize for the effects of grain size in order to provide a basis for meaningful comparisons of the occurrence of substances in sediments of various granulometry and texture within individual areas or among areas. Excess levels, above normalized background values, could then be used to establish sediment quality.

For any study of sediments, a basic amount of information on their physical and chemical characteristics is required before an assessment can be made on the presence or absence of anomalous contaminant concentrations. The concentration at which contamination can be detected depends on the sampling strategy and the number of physical and chemical variables that are determined in individual samples.

The various granulometric and geochemical approaches used for the normalization of trace elements data as well as the identification of contaminated sediments in estuarine and coastal sediments has been extensively reviewed by Loring (1988). Two normalization approaches widely used in oceanography and in atmospheric sciences have been selected here. The first is purely physical and consists of characterizing the sediment by measuring its content of fine material. The second approach is chemical in nature and is based on the fact that the small size fraction is usually rich in clay minerals, iron and manganese oxi-hydroxides and organic matter. Furthermore, these components often exhibit a high affinity for organic and inorganic contaminants and are responsible for their enrichment in the fine fraction. Chemical parameters (e.g., Al, Sc, Li) representative of these components may thus be used to characterize the small size fraction under natural conditions.

It is strongly suggested that several parameters be used in the evaluation of the quality of sediments. The types of information that can be gained by the utilization of these various parameters are often complementary and extremely useful considering the complexity and diversity of situations encountered in the sedimentary environment. Furthermore, measurements of the normalizing parameters selected here are rather simple and inexpensive.

This report presents general guidelines for sample preparation, analytical procedures, and interpretation of physical and chemical parameters used for the normalization of geochemical data. Its purpose is to demonstrate how to collect sufficient data to normalize for the grain-size effect and to allow detection, at various levels, of anomalous concentrations of contaminants within estuarine and coastal sediments.

14.1.2 Sampling Strategy

Ideally, a sampling strategy should be based on a knowledge of the source of contaminants, the transport pathways of suspended matter and the rates of accumulation of sediments in the region of interest. However, existing data are often too limited to define the ideal sampling scheme. Since contaminants concentrate mainly in the fine fraction, sampling priority should be given to areas containing fine material that usually correspond to zones of deposition.

The high variability in the physical, chemical and biological properties of sediments implies that an evaluation of sediment quality in a given area must be based on a sufficient number of samples. This number can be evaluated by an appropriate statistical analysis of the variance within and between samples. To test the representativity of a single sediment specimen at a given locality, several samples at one or two stations should be taken.

The methodology of sampling and analysis should follow the recommendations outlined in the "Guidelines for the Use of Sediments as a Monitoring Tool for Contaminants in the Marine Environment" (ICES, 1987). In most cases, the uppermost layer of sediments, collected with a tightly closing grab sampler (level 1 in the Guidelines), is sufficient to provide the information concerning the contamination of the sediments of a given area compared to sediments of uncontaminated locations or other reference material.

Another significant advantage of using sediments as monitoring devices is that they have recorded the historical evolution of the composition of the suspended matter deposited in the area of interest. Under favourable conditions, the degree of contamination may be estimated by comparison of surface sediments with deeper samples, taken below the biological mixing zone. The concentrations of trace elements in the deeper sediment may represent the natural background level in the area in question and can be defined as baseline values. This approach requires sampling with a box-corer or a gravity corer (levels 2 and 3 in the Guidelines).

14.1.3 Analytical Procedures

Typical analytical procedures to be followed are outlined in Table 6. The number of steps that are selected will depend on the nature and extent of the investigation.

14.1.3.1 Grain size fractionation

It is recommended that at least the amount of material less than 63 µm, corresponding to the sand/silt classification limit, be determined. The sieving of the sample at 63 µm is, however, often not sufficient, especially when sediments are predominantly fine grained. In such cases, it is better to normalize with lower size thresholds since the contaminants are mainly concentrated in the fraction less than 20 µm, and even more specifically in the clay fraction (< 2 µm). It is thus proposed that a determination be made, on a sub-sample, of the weight fraction less than 20 µm and that less than 2 µm with the aid of a sedimentation pipette or by elutriation. Several laboratories are already reporting their results relative to the content of fine fractions of various sizes and these results may be useful for comparison among areas.

14.1.3.2 Analysis of contaminants

It is essential to analyse the total content of contaminants in sediments if quality assessment is the goal of the study, and it is thus recommended that the unfractionated sample be analyzed in its entirety. The total content of elements can be determined either by non-destructive methods, such as X-ray fluorescence or neutron activation, or by a complete digestion of the sediments (involving the use of hydrofluoric acid (HF)) followed by methods such as atomic absorption spectrophotometry or emission spectroscopy. In the same way, organic contaminants should be extracted with the appropriate organic solvent from the total sediment.

An individual size fraction of the total sediment may be used for subsequent analysis, if required, to determine the absolute concentrations of contaminants in that fraction, providing that its contribution to the total is kept in perspective when interpreting the data. Such size fraction information might be useful in tracing the regional dispersal of metals associated with specific grain-size fractions, when the provenance of the material remains the same. However, sample fractionation is a tedious procedure that introduces considerable risk of contamination and potential losses of contaminants due to leaching. The applicability of this approach is thus limited.

14.1.4 Normalization Procedures

14.1.4.1 Granulometric normalization

Since contaminants tend to concentrate in the fine fraction of sediments, correlations between total concentrations of contaminants and the weight percent of the fine fraction, determined separately on a sub-sample of the sediment by sieving or gravity settling, constitute a simple but powerful method of normalization. Linear relationships between the concentration and the weight percentage of the fine fraction are often found and it is then possible to extrapolate the relationships to 100% of the fraction studied, or to characterize the size dependence by the slope of the regression line.

14.1.4.2 Geochemical normalization

Granulometric normalization alone is inadequate to explain all the natural trace variability in the sediments. In order to interpret better the compositional variability of sediments, it is also necessary to attempt to distinguish the sedimentary components with which the contaminants are associated throughout the grain-size spectrum. Since effective separation and analysis of individual components of sediments is extremely difficult, such associations must rest on indirect evidence of these relationships.

Since contaminants are mainly associated with the clay minerals, iron and manganese oxi-hydroxides and organic matter abundant in the fine fraction of the sediments, more information can be obtained by measuring the concentrations of elements representative of these components in the samples.

An inert element such as aluminium, a major constituent of clay minerals, may be selected as an indicator of that fraction. Normalized concentrations of trace elements with respect to aluminium are commonly used to characterize various sedimentary particulate materials (see below). It may be considered as a conservative major element, that is not affected significantly by, for instance, early diagenetic processes and strong redox effects observed in sediments.

In the case of sediments derived from the glacial erosion of igneous rocks, it has been found that contaminant/Al ratios are not suitable for normalizing for granular variability (Loring, 1988). Lithium, however, appears to be an ideal element to normalize for the grain size effect in this case and has the additional advantage of being equally applicable to non-glacial sediments.

In addition to the clay minerals, Mn and Fe compounds are often present in the fine fraction, where they exhibit adsorption properties strongly favouring the incorporation of various contaminants. Mn and Fe are easily analysed by flame atomic absorption spectrometry and their measurement may provide insight into the behaviour of contaminants.

Organic matter also plays an important role as scavenger of contaminants and controls, to a major degree, the redox characteristics of the sedimentary environment.

Finally, the carbonate content of sediments is easy to determine and provides additional information on the origin and the geochemical characteristics of the sediments. Carbonates usually contain insignificant amounts of trace metals and act mainly as a diluent. Under certain circumstances, however, carbonates can fix contaminants such as cadmium and copper. A summary of the normalization factors is given in Table 7.

14.1.4.3 Interpretation of the data

The simplest approach in the geochemical normalization of substances in sediments is to express the ratio of the concentration of a given substance to that of the normalizing factor.

Normalization of the concentration of trace elements with respect to aluminium (or scandium) has been used widely and reference values on a global scale have been established for trace elements in various compartments: crustal rocks, soils, atmospheric particles, river-borne material, marine clays and marine suspended matter (cf., e.g., Martin and Whitfield, 1983; Buat-Menard and Chesselet, 1979).

This normalization also allows the definition of an enrichment factor for a given element with respect to a given compartment. The most commonly used reference level of composition is the mean global normalized abundance of the element in crustal rock (Clarke value). The enrichment factor EF is given by:

$$EF_{crust} = (X/Al)_{sed}/(X/Al)_{crust}$$

where X/Al refers to the ratio of the concentration of element X to that of Al in the given compartment.

However, estimates of the degree of contamination and time trends of contamination at each sampling location can be improved upon by making a comparison with metal levels in sediments equivalent in origin and texture.

These values can be compared to the normalized values obtained for the sediments of a given area. Large departures from these mean values indicate either contamination of the sediment or local mineralization anomalies.

When other variables (Fe, Mn, organic matter and carbonates) are used to characterize the sediment, regression analysis of the contaminant concentrations with these parameters often yields useful information on the source of contamination and on the mineralogical phase associated with the contaminant.

A linear relationship between the concentration of trace constituents and that of the normalization factor has often been observed (Windom et al., 1989). In this case and if the natural geochemical population of a given element in relation to the normalizing factor can be defined, samples with anomalous normalized concentrations are easily detected and may indicate anthropogenic inputs.

According to this method, the slope of the linear regression equation can be used to distinguish the degree of contamination of the sediments in a given area. This method can also be used to show the change of contaminant load in an area if the method is used on samples taken over intervals of some years (Cato, 1986).

A multi-element/component study, in which the major and trace metals, along with grain size and organic carbon contents, have been measured, allows the interrelationships between the variables to be established in the form of a correlation matrix. From such a matrix, the most significant ratio between trace metal and relevant parameter(s) can be determined and used for identification of metal carriers, normalization and detection of anomalous trace metal values. Factor analyses can sort all the variables into groups (factors) that are associations of highly correlated variables, so that specific and/or non-specific textural, mineralogical, and chemical factors controlling the trace metal variability may be inferred from the data set.

Natural background levels can also be evaluated on a local scale by examining the vertical distribution of the components of interest in the sedimentary column. This approach requires, however, that several favourable conditions are met: steady composition of the natural uncontaminated sediments; knowledge of the physical and biological mixing processes within the sediments; absence of diagenetic processes affecting the vertical distribution of the component of interest. In such cases, grain-size and geochemical normalization permits compensation for the local and temporal variability of the sedimentation processes.

14.1.5 Conclusions

The use of the granulometric measurements and of component/reference element ratios are useful approaches towards complete normalization of granular and mineralogical variations, and identification of anomalous concentrations of contaminants in sediments. Their use requires that a large amount of good analytical data be collected and specific geochemical conditions be met before all the natural variability is accounted for, and the anomalous contaminant levels can be detected. Anomalous metal levels, however, may not always be attributed to contamination, but rather could easily be a reflection of differences in sediment provenance.

Geochemical studies that involve the determination of the major and trace metals, organic contaminants, grain size parameters, organic matter, carbonate, and mineralogical composition in the sediments are more suitable for determining the factors that control the contaminant distribution than the measurement of absolute concentrations in specific size fractions or the use of potential contaminant/reference metal ratios alone. They are thus more suitable for distinguishing between uncontaminated and contaminated sediments. This is because such studies can identify the factors that control the variability of the concentrations of contaminants in the sediments.

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TABLE 6

A TYPICAL APPROACH FOR DETERMINATIONS OF PHYSICAL AND CHEMICAL PARAMETERS IN MARINE SEDIMENTS

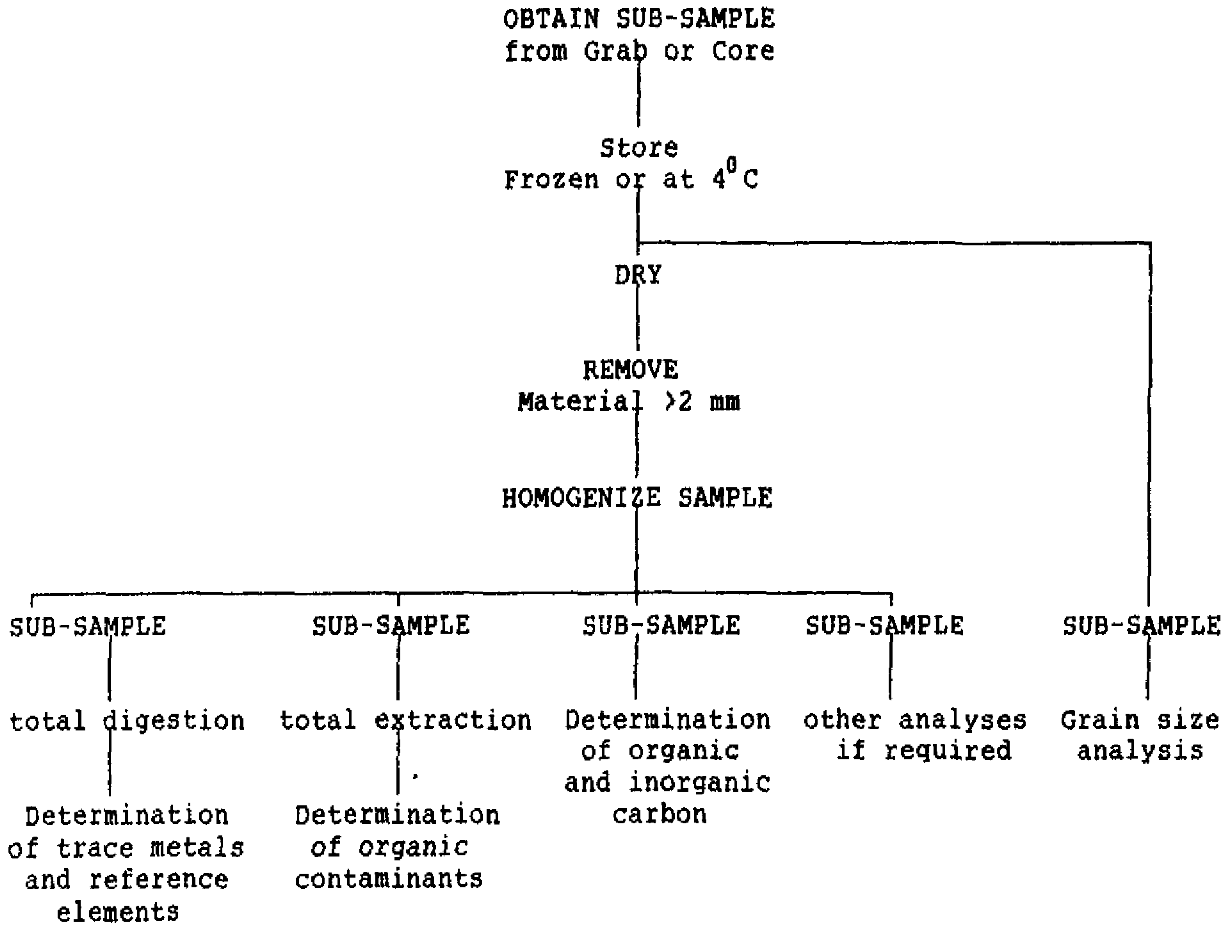

TABLE 7

SUMMARY OF NORMALIZATION FACTORS

Normalization factor	Size (μm)	Indicator	Role
Textural			
			Determines physical sorting and depositional pattern of metals
Sand	2000-63	Coarse-grained metal-poor minerals/compounds	Usually diluent of trace metal concentrations
Mud	<63	Silt and clay size metal-bearing minerals/compounds	Usually overall concentrator of trace metals
Clay	<2	Metal-rich clay minerals	Usually fine-grained accumulator of trace metals
Chemical			
Si		Amount and distribution of metal-poor quartz	Coarse-grained diluter of contaminants
Al		Al silicates, but used to account for granular variations of metal-rich fine silt + clay size Al-silicates	Chemical tracer of Al-silicates, particularly the clay minerals
Li, Sc		Structurally combined in clay minerals and micas	Tracer of clay minerals, particularly in sediments containing Al-silicates in all size fractions
Organic carbon		Fine-grained organic matter	Tracer of organic contaminants. Sometimes accumulator of trace metals like Hg and Cd
Fe, Mn		Metal-rich silt + clay size Fe-bearing clay minerals, Fe-rich heavy minerals and hydrous Fe and Mn oxides	Chemical tracer for Fe-rich clay fraction. High adsorption capacity of organic and inorganic contaminants
Carbonates		Biogenic marine sediments	Diluter of contaminants. Sometimes accumulate trace metals like Cd and Cu