NOWPAP POMRAC

Northwest Pacific Action Plan
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UNEP

REGIONAL OVERVIEW

on River and Direct Inputs of Contaminants into the Marine and Coastal Environment in NOWPAP Region

POMRAC, Vladivostok, Russian Federation

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Foreword

The Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities was adopted in 1995 and since then significant results have been achieved. Because about 80% of pollutants entering the marine environment originate from land-based activities, the GPA implementation is supported by more than 100 Governments, the European Commission and many international and non-governmental organizations. The comprehensive, multi-sectoral approach of the GPA reflects the desire of Governments to strengthen the collaboration and coordination of all agencies with mandates relevant to the impact of land-based activities on the marine environment, through their participation in a global programme. The Second Intergovernmental Review Meeting (16-20 October 2006, Beijing, People's Republic of China) will consider the status of GPA implementation and future actions. Several pollutant categories are covered by the GPA including sewage, persistent organic pollutants, heavy metals, oils (hydrocarbons) and nutrients.

This Overview on River and Direct Inputs of Contaminants to the Marine and Coastal Environment of the Northwest Pacific has been prepared by the Pollution Monitoring Regional Activity Center (POMRAC) of NOWPAP. The Overview can be considered as a NOWPAP contribution to the GPA implementation in the Northwest Pacific region. From the data and information presented in this document, NOWPAP member states can draw conclusions and recommendations regarding further actions necessary to protect their shared marine and coastal environment. Some suggestions on methodologies of pollutant monitoring require attention of member states as well.

Future activities of NOWPAP POMRAC will include the Integrated Coastal Area and River Basin Management (ICARM) and preparation of the State of Marine Environment Report. These activities will also hopefully contribute to the GPA implementation and, thus, to the protection of the marine and coastal environment in the Northwest Pacific region.

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List of Acronyms

ADORC	Acid Deposition and Oxidant Research Center
BOD	Biological oxygen demand
CEARAC	Special Monitoring and Coastal Environmental Assessment Regional Activity Centre
CNEMC	China National Environmental Monitoring Centre
COD	Chemical oxygen demand
DDTs	Dichlorophenylethane compounds
DO	Dissolved oxygen
FERHRI	Far Eastern Regional Hydrometeorological Research Institute
EQS	Environment quality standard
FPM	Focal Points Meeting
GDP	Gross domestic product
HCHs	Hexachlorcyclohexane compounds
IC	Ion Chromatography
IGM	Intergovernmental meeting
LOICZ	Land-Ocean Interaction in the Coastal Zone
MAP	Mediterranean Action Plan
MDL	Minimum detection limit
MOE	Ministry of Environment
MOMAF	Ministry of Maritime Affairs and Fisheries
MOST	Ministry of Science and Technology
MPC	Maximum permissible concentration
MTS	MAP Technical Report Series
NIER	National Institute of Environmental Research
NOWPAP	Northwest Pacific Action Plan
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAHs	Polyaromatic hydrocarbons
PCBs	Polychlorbiphenyle compounds
PGI	Pacific Geographical Institute
PHCs	Petroleum hydrocarbons
POI	Pacific Oceanographic Institute
POMRAC	Pollution Monitoring Regional Activity Centre
POPs	Persistent organic pollutants
QA/QC	Quality Assurance/Quality Control
SEPA	State Environmental Protection Administration
SS	Suspended solids
UNEP	United Nations Environment Programme
WG	Working Group
WQS	Water quality standard

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1. Executive Summary

This document is prepared based on decisions taken at the 3rd POMRAC Focal Points Meetings held in Vladivostok Russia on October 13-14 2005. This document, based primarily on data from National Reports, summarizes the current status of monitoring of surface water quality and chemical substance concentrations in river water. Certain chemical substance runoff coming from rivers that is discharged directly in the sea is evaluated for the main parts of the NOWPAP region.

A brief description of natural environmental conditions and of socio-economic factors in four countries (China, Japan, Korea, Russia) is provided as part of the analysis of natural and anthropogenic impacts on chemical substances entering the sea. The total area of the river watersheds in the entire NOWPAP region is about 1,792,000 km^2 (excluding the Yangtze River basin), with a shoreline of about 30,000 km. Average river runoff is about 406.9 km^3/year, again excluding the Yangtze River, and 1,358 km^3/y with the Yangtze. Regional population in the study area is 560 million and is very unevenly distributed, ranging from 4 people/km^2 in Russia to 475 people/km^2 in Korea. The volume of industrial and agriculture production varies from 864 USD per capita in Russia to 15,340 USD per capita in Japan in fiscal 2002 values.

The legal basis for water quality monitoring in the four NOWPAP countries is briefly described in this report. The report also describes the existing monitoring network, responsible agencies, methods used and water quality criteria. The main criteria of water quality in all NOWPAP countries are a compliance with standards: EQS – environmental quality standards, WQS – water quality standards, MPC – maximum permissible concentration. Similarities and differences in standards, approaches, and methods used are also outlined.

This document summarizes the current status of river water quality based on monitoring results for the year 2002. Discharge quantity for major rivers is calculated and hence the pollution load for the NOWPAP region can be estimated. The current status and historical trends for chemical substances in river water are also described and stability and certain improvements in conditions noted. Existing problems with data compatibility issues are described, including discrepancies in the list of parameters monitored, the different methods used to measure COD, and the use of filtered or unfiltered samples for analysis.

A second group of problems relate to determining micro pollutants during routine water quality monitoring. The analysis of National Reports shows that there are currently rather rare reliable data on dissolved forms of trace metals and persistent organic pollutants (PCBs, PAHs, pesticides like DDTs and HCHs) in the surface (river) waters of NOWPAP countries making a comprehensive evaluation of the input of these substances into the sea at the regional and sub-regional levels impossible. These are not problems that are typical of NOWPAP countries only. Similar issues are raised by more developed programs like MAP or OSPAR.

Existing data on micro pollutant levels are in most cases far below EQS (WQS, MPC) and so in this respect the situation appears satisfactory. But reliable background concentration data for these substances would make it possible to trace and to assess anthropogenic impacts on surface waters at early pollution stages. This would aid in forecasting future environmental problems with water quality and to elaborate measures to reduce damage. Increased cooperation among NOWPAP members and application of scientific research results within the NOWPAP region are approaches to addressing these issues. Discussion of these issues can be topics of mutual interest for future activities of POMRAC.

2. Introduction

2.1. Goals and Objectives of the Overview

The first goal of this Regional Overview is to give a comparative description of the national programs of China, Japan, Korea and Russia for evaluating contaminant inputs into marine environments directly or via rivers. This goal includes an overview of laws, a comparison of the main environmental standards, of the key features of monitoring programs and of the methods used. The objective of this part of the Overview is to review existing data compatibility issues and to suggest for discussion some measures to harmonize pollution monitoring activities in the NOWPAP region in the future.

The second goal of this Regional Overview is to present available information on the concentrations of some chemical substances in river water and to assess contaminant run off into marine environments directly and via rivers at the regional level. In addition to a comprehensive picture of river inputs for different parts of the NOWPAP region, this regional overview could be integrated with regional overview on atmospheric deposition for a comprehensive assessment of chemical substances entering marine environment. This overview could also be integrated with the reports of other RACs to obtain a holistic assessment of marine environment quality.

2.2. General Background Information on NOWPAP

For nearly three decades UNEP has fostered regional cooperation on behalf of marine and coastal environments. It has stimulated the creation of "Action Plans" - prescriptions for sound environmental management - for each region. Now, more than 140 coastal countries are participating in 13 Regional Seas Programs established under UNEP auspices. Five partner programs are also fully operational.

NOWPAP (*Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region*) is one of the action plans that covers the Northwest Pacific region. The area surrounding the Northwest Pacific is one of the most highly populated parts of the world and there are enormous pressures being placed on the environment. The countries of the region, the People's Republic of China, Japan, the Republic Korea and the Russian Federation have joined forces to participate in NOWPAP.

NOWPAP was adopted at the First Intergovernmental Meeting (IGM) in 1994, was followed by a series of meetings of experts and by National Focal Point Meetings that started as early as 1991. The overall goal of the NOWPAP is "the wise use, development and management of the coastal and marine environment so as to obtain the utmost long-term benefits for the human beings of the region, while protecting human health, ecological integrity and the region's sustainability for future generations".

The IGM, made up of senior representatives of the NOWPAP members, provides policy guidance and decision-making for NOWPAP. The plan incorporates seven priority projects that are implemented through a network of Regional Activity Centers (RACs) - CEARAC, DINRAC, MERRAC and POMRAC. The RACs play a central role in coordinating regional activities in specific fields of priority projects. NOWPAP's Regional Coordinating Unit (RCU), co-hosted by Japan and the Republic of Korea, serves as nerve center and command post for Action Plan activities. The opening of two RCU offices in Toyama, Japan, and Busan, Korea was agreed to at the 6th IGM in December 2000, and these two offices were established in November 2004.

The activities agreed to as part of the implementation of the NOWPAP are largely financed by contributions from the members, international organizations and non-governmental organizations contributing to the NOWPAP Trust Fund.

NOWPAP priority projects are:

NOWPAP 1: Establishment of a comprehensive database and information management system;

NOWPAP 2: Formation of a survey of national environmental legislation, objectives, strategies and policies;

NOWPAP 3: Establishment of a collaborative regional monitoring program;

NOWPAP 4: Development of effective measures for regional cooperation in marine pollution preparedness and response;

NOWPAP 5: Establishment of Regional Activity Centre (RAC) and the network among these centers;

NOWPAP 6: Promotion of public awareness of the marine, coastal, and associated freshwater environments;

NOWPAP 7: Assessment and management of land-based activities.

2.3. Geographic Scope of NOWPAP Region

According to an agreement between China, Japan, ROK, and Russia (1994) based on United Nation principals, the NOWPAP region includes marine, coastal and offshore basins at 33°-52°N and 121°-143°E (Fig. 1). Though the mouths of major Chinese rivers are technically outside of the NOWPAP region, an assessment of river impact on the quality of marine environments is impossible without accounting for the impact of such great Chinese rivers as the Yangtze and Yellow and Huaihe. For this reason, these rivers are assessed in our overview. The rivers discussed in this Regional Overview and key river features (watershed size and water discharge) are listed in Table 1. Main part of big rivers are depicted on Figure 1.

The terrestrial part of China occupies the lowland west coast of the Bohai Sea and the Yellow Sea where the mouths of the Yangtze, Huaihe, Huanhe, Haihe and Liaohe rivers are situated. In addition, two large hilly peninsulas, Liaodong and Shandong, with an average elevation of 500 m, are located between the Bohai Sea and the Yellow Sea. Land use in eastern China is very intensive. Vegetation rates in Liaoning Province, Heilongjiang Province and Jilin Province are 28.7%, 41.9% and 42.4%, respectively. In contrast to these provinces, vegetation rates in Shandong and Jiangsu Provinces are much lower: 21.5% and 10.6%, respectively. Protected areas in Liaoning, Shangdong and Heilongjiang Provinces cover 9.7%, 6.0% and 5.05% of the total area. The percentage of protected areas in Jiangsu and Jilin provinces is less. The major river basins of the region include Songhua River, Liaohe River, Haihe River, Yellow River, Huaihe River and Yangtze River, with overall annual (2002) input of 1,193 km^3 directly or indirectly related to the NOWPAP marine area. The Yangtze River provides 80% of this water discharge. When the Yangtze and Songhua Rivers are excluded, annual river input is about 177 km^3. All rivers have peak runoff in summer and minimum discharge in winter.

Western Japan is rather mountainous, with elevations up to 3,000 m in central Honshu Island and up to 1,800 m in the south of Kyushu Island. Despite relatively high population and intensive agriculture, forests cover 34.7% of the prefectures facing the NOWPAP marine region. Wildlife parks occupy an additional 26.7% of territory. Eight large rivers exist among the numerous rivers on the west coast of Japan: Teshio, Ishikari, Yoneshiro, Omono, Mogami, Agano, Shinano, Jintsu; they have a total annual (2002) discharge of about 73 km^3, whereas total input from all west coast Japanese first class rivers amounts to 88 km^3.

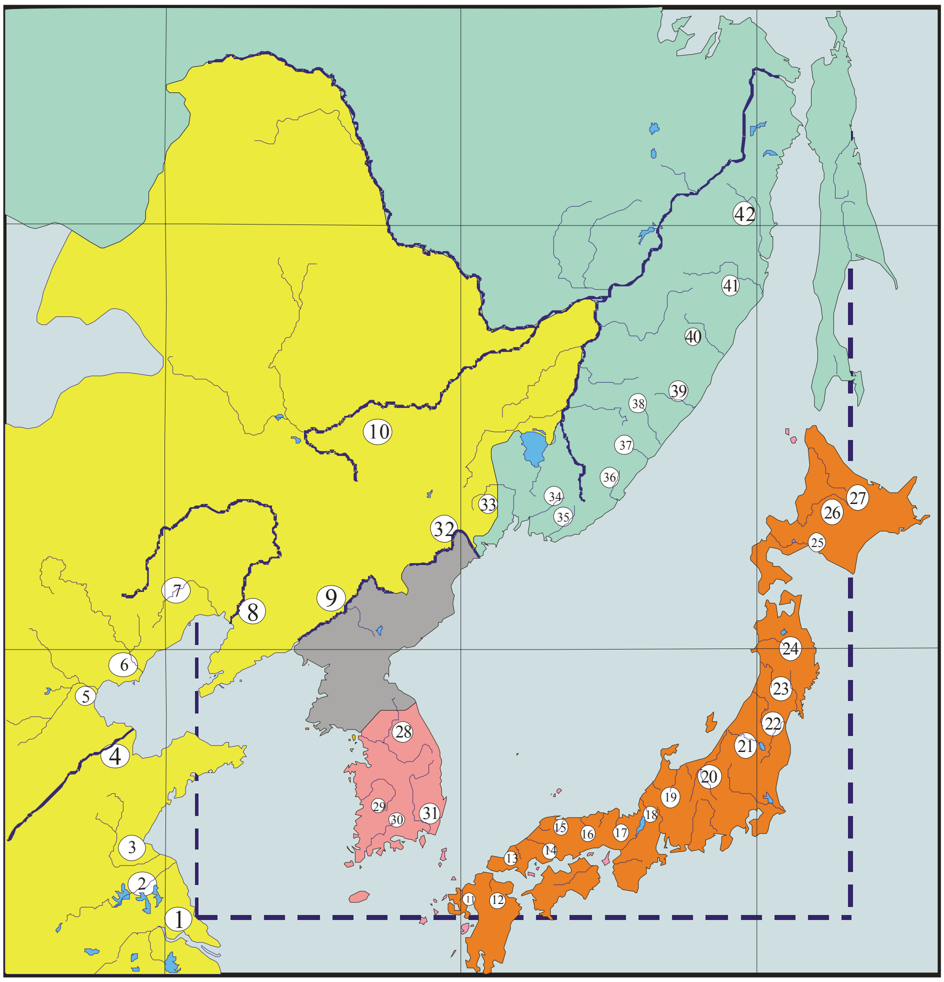

Figure 1. NOWPAP Region (within dashed line) with Rivers Keyed to Table 2.1

The southern part of the Korean peninsula is mostly rugged, mountainous terrain. The principal range is the T'aebaek-sanmaek that extends in a generally north-south direction parallel to the east coast. The country's highest peak is located on the island of Cheju, is Halla-san (1,950 m). Mixed deciduous and coniferous forests cover about three-quarters of the peninsula. Protected areas make up about 7 percent of South Korea and include more than a dozen national parks. Less than one-fifth of the total area are plains and these are concentrated in the west along the coast; the coastal plains in the east and south are very narrow. Apart from the east coast, South Korea has a highly indented coastline characterized by high tidal ranges.

There are five main rivers: Han River, Guem River, Yongsan River, Somjin River and Nakdong River with total annual input of about 46 km^3.

The Russian territory of NOWPAP includes Primorskii Krai, parts of southeastern Khabarovskii Krai, and parts of southwest Sakhalin Island. About 80% of Primorskii Krai and the adjoining part of Khabarovskii Krai has abundant mountain ridges belonging to the Sikhote Alin mountain system. Average elevation is 600 meters, with the highest peaks reaching 1,855 meters. Southwestern Sakhalin Island has low mountains and hills. Almost 80% of the territory is covered by forest and an additional 8.1% is occupied by wildlife reserves. The main rivers are the Tumannaya (Tumen), Razdolnaya (Suifun), Suchan, Samarga, Koppi, Botchi, Tumnin with a total annual input of about 27 km^3; total annual input of all rivers in the Russian portion of the NOWPAP is about 43 km^3.

Monsoon atmospheric circulation is a key climatic feature of the entire NOWPAP region, but there are obvious climatic differences along this more than 2,000 km south to north stretch. The climate of Jiangsu Province and Shandong Province in China belongs to the warm temperate zone with moist continental monsoon features. In summer these provinces are often hit by typhoons. Annual precipitation in Jiangsu Province is about 1,000 mm, while Shandong Province gets 550~950 mm. The other three Provinces (Liaoning, Jilin, Heilongjiang) belong to the temperate continental monsoon climate zone that has cloudy spring days and hot, rainy summer days. Winter lasts longer than in other Chinese provinces. Annual precipitation in Liaoning Province, 600~1,100 mm and is most abundant of these three Provinces.

The climate of the NOWPAP region of the Japanese coast is characterized by heavy snowfall brought on by humid northwest winter monsoons. Despite rather high annual average temperatures that increase from 8.4° C on the western Hokkaido coast to 13.7° C in Toyama, maximum snow cover reaches 69-118 cm. Annual precipitation increases from 1,218 mm at Otaru (Hokkaido) to 2,133 mm at Toyama (middle Honshu) and then decreases to 1,632 mm at Fukuoka. Summers in Japan, as in China, bring typhoons.

The climate in Korea is similar to the temperate climate of the Japanese and Chinese coasts. Average January temperatures range from -7°C to +1°C and average July temperatures range from 22°C to 29°C in Seoul. Rainfall is concentrated in the summer months of June through September. The river runoff is maximum in summer also. The southern coast gets late summer typhoons that bring strong winds and heavy rains. Average annual precipitation in Seoul is 1,370 millimeters and in Busan - 1,470 mm.

Cold dry winters and moderate warm humid summers are typical for the Primorskii Krai – Russian mainland part of NOWPAP region. There is clear shift of air temperature decrease in winter and increase in summer in moving away from the coast to the west even for the distance 30-50 km. The average temperature in coastal zone is – 10-12°C in winter, and +16°C in summer. Annual precipitation decreases as one moves away from the coast, with Vladivostok getting, on the average, 806 mm while Lake Khanka gets 650 mm. 80-95% of annual precipitation comes in the April to October period, and major part of river runoff takes place in summer.

Climate of southwestern part of Sakhalin Is. is more soft with average temperature - 6°C in January, and +19°C in August. Annual precipitation is close to Primorskii Krai, but distribution through the year is more even, and distinct snow accumulation is observed. The bi-modal distribution of Sakhalin's river discharge takes place due to this reason.

Table 2.1. Major Rivers Exerting an Impact on the NOWPAP Region

N*	River	Province, region, sub-region,	Watershed square, 10^3 км^2	Coast length, km	Discharge, m^3/s (2002)
	China		**4,000(1,634[1])**	**10,054**	
1	Yangtze	Jiangsu	1,809	2,498	30,166
2	Huaihe	Jiangsu/Shandong	269		1,972
3	Yihe	Shandong	nd		nd
4	Yellow	Shandong	752	1728	2,087
5	Haihe	Hebei/Tianjin	264		723
6	Luanhe**	Liaoning	44		144.3
7	Dalinghe**	Liaoning	14.4	1828	117.6
8	Daliaohe	Liaoning	229		469
9	Yalu**	Liaoning/Jilin	61.9		1,200
10	Songhua	Jilin/Heilongjiang	557		2,416
	Japan		**89.5**	**11,610**	
27	Teshio & Rumoi	Hokkaido	5.9	1,486***	197.7
26	Ishikari River	Hokkaido	14.3		457.9
25	Shiribetsu River	Hokkaido	1.6		58.8
	Shiribeshitoshibetsu	Hokkaido	0.7		21.9
	Iwaki River	Touhoku	2.5	1,158	92.3
24	Yoneshiro River	Touhoku	4.1		223.6
23	Omono River	Touhoku	4.7		314.9
	Koyoshi River	Touhoku	1.2		81.3
22	Mogami River	Touhoku	7.0		407.7
	Aka River	Touhoku	0.9		98.2
	Ara River	Hokuriku (N)	1.2	585	144.8
21	Agano River	Hokuriku (N)	7.7		474.6
20	Shinano River	Hokuriku (N)	11.9		404.1
	Seki River	Hokuriku (N)	1.1		54.9
	Hime River	Hokuriku (N)	0.7		43.8
	Kurobe River	Hokuriku (S)	0.7	117	84.9
	Joganji River	Hokuriku (S)	0.4		14.8
19	Jintsu River	Hokuriku (S)	2.7		161.0
	Sho & Oyabe	Hokuriku (S)	1.9		107.6
	Tedori & Kakehashi	Kiriki	1.2	2,072	100.1
18	Kuzuryuu River	Kiriki	2.9		46.9

17	Yura River	Kiriki	1.9		46.9
16	Maruyama River	Kiriki	1.3		34.6
	Chiyo River	Chugoku/Kyusyu	1.2	1904	37
	Tenjin & Hino	Chugoku/Kyusyu	1.4		35.8
15	Hii River	Chugoku/Kyusyu	2.1		39.3
14	Gono River	Chugoku/Kyusyu	3.9		119.2
13	Takatsu River	Chugoku/Kyusyu	1.1		30.8
12	Onga River	Chugoku/Kyusyu	1.0		8.6
11	Matsuura River	Chugoku/Kyusyu	0.4		4.7
	Korea		**68.1**	**6,050**	
28	Han River	Gyeonggi	26.0 (34.0)1	310	598.9
29	Geum River	Chungnam, Jeonbuk	9.9	963	209.3
30	Youngsan River	Jeonnam	3.4	2,103	85.6
	Seomjin River	Jeonnam	4.9		123.7
31	Nakdong River	Gyeongbuk, Gyeongnam,	23.9	1,668	437.6
	Russia		**103.9**	**3,092**	
32	Tumen	Jilin/Heilongjiang	33.2		287
	Tsukanovka etc.[2]	Primorskii-1	1.5	376	25.4
33	Razdolnaya	Primorskii-2	16.8	113	71.9
34	Artyomovka etc.[3]	Primorskii-3	2.6	295	15.7
35	Partizanskaya	Primorskii-3	4.1		42.0
	Margaritovka etc.[4]	Primorskii-4	5.7	404	66.9
36	Avvakumovka	Primorskii-4	3.2		31.9
	Zerkalnaya	Primorskii-4	1.9		17.5
37	Rudnaya	Primorskii-5	1.1	18	14.5
38	Serebryanka etc.[5]	Primorskii-6	8.6	1,119	94.2
39	Maksimovka	Primorskii-6	2.2		32.1
40	Samarga etc.[6]	Primorskii-6	12.1		155.9
41	Koppi	Primorskii-6	7.3		68.5
42	Tumnin	Primorskii-6	22.4		252
	Rivers from SW of Sakhalin Is.	Sakhalin-SW	5.3	767	105.7

* - Number of river on Figure 1; ** - Data from Zhang et al.,1998; *** - Coastline within NOWPAP region; 1 – Including watershed in PDRK; 2 – Including Amba, Barabash and Narva Rivers; 3 – Including Shkotovka and Suhodol Rivers; 4 – Including Kievka,Chernaya and Milogradovka Rivers; 5 – Including Gigit, Kema, and Amgu Rivers; 6 – Including Svetlaya, Peya, Kabanya and Edinka Rivers

2.4. General Information on River and Direct Inputs of Pollutants

Most of the material entering the marine ecosystem is of terrestrial origin. Three general terrestrial patterns are identified: 1) atmospheric; 2) via rivers; 3) direct flow into the sea via dumping, sewages and storm water runoff. Atmospheric pollutants include material that are dropped with rain and snow; these are reviewed in Regional Overview of WG1.

The difference between river input and direct input is obvious in theory but in practice only dumping and sometimes sewage can be assessed separately because most storm waters are difficult to account for and a portion of the sewage flows into rivers. Typical sources of river water pollution in all NOWPAP countries are domestic wastewater, industrial wastewater, and natural loads. The pollutant loads from these sources flow into the sea via rivers running through urban and rural areas, industrial areas, and agricultural regions. The current features of water pollution sources in different NOWPAP countries are outlined in sections of this overview.

Many of China's rivers carry contaminated water into marine and coastal environments. Most, but not all wastewater sources are well treated before release. Many national and local laws and regulations exist to manage and control pollution from discharging sources. There are two basic environmental and effluent quality standards to protect the environment and to reduce pollution volumes; discrepancies in these standards are being addressed. There are environmental standards for surface water, ground water, marine water, and for special usage water as well. Generally speaking, the main parameters that are regulated include chemical oxygen demand (COD), biochemical oxygen demand (BOD), and ammonia nitrogen (NH_4-N) in fresh water, and COD, oils, inorganic nitrogen (IN), and active phosphate (PO_4) in marine water.

In Japan domestic wastewater is classified in two categories, human sewage (sometimes called night soil) and gray water, wastewater from kitchens, laundries, and bathrooms, excluding human sewage. The human sewage or night soil is 100% treated. However, as of 2003, 77% of the gray water discharge is treated nationally, thus a percentage of the gray water is discharged untreated. Domestic wastewater load is on the decline since sewage systems are becoming more wide spread and because the nation is converting to a combined processing johkasou* (septic tank) from the single processing johkasou.

Industrial wastewater discharge in Japan is regulated by the Water Pollution Control Law, the basis for national effluent standards. Prefectures are authorized to establish more stringent standards to regulate wastewater discharged from factories and business establishments into public water bodies. The standards are applied to factories and business, with the "Specified Facilities" defined by cabinet orders.

In Japan the concept of natural load includes the load of naturally occurring substances flushed into rivers or the sea from forest, agricultural area and urban areas, and from the atmosphere as a result of rainwater or snowmelt runoff. Controlling natural loads from non-point sources is difficult. The government is studying potentially effective control measures. The government has developed a new type of drainage support system and the creation of management plans for the aquatic environment to reduce the pollution load from non-point sources.

Discharge to the sea is regulated in Japan by the Agreement Concerning the Prevention of Seawater Pollution by the Dumping of Waste and Other Things (London Convention 1972). The Japanese legal system allows waste discharge to the sea only in designated areas of the sea and only after the articles and standards prescribed by Waste Management and Public Cleansing Law and Law Concerning the Prevention of Seawater Pollution and Maritime Disasters are applied. A protocol to rescind the amendment of the London Convention of 1972 was adopted in 1996 (1996 Protocol). In the protocol, the list (Reverse List) of wastes that can be discharged into the sea was replaced by the present list of prohibited substances. The Japanese government is preparing to ratify the protocol, expecting that the bill will go into effect in several years.

Wastewater in Korea is divided into industrial, livestock, and domestic. The latter accounts for 85% of the total volume of wastewater, about 18 million tons/day. Industrial wastewater is 14%, and livestock is only 1% of all wastewater. The role of different sources can change depending on substances considered. In the case of BOD load, for example, industrial wastewater input increases to 39% and livestock - 15%, while the role of domestic wastewater decreases to 46%. The domestic sewage treatment rate varies from 41-43% in the agricultural Jeonnam and Chungnam Provinces to 99% in Seoul, with the national average at 79%. Industrial and livestock wastewater is subject of treatment also.

Domestic wastewater runoff in Russia is assessed by water supply data without distinction between night soil and gray water. In Primorskii Krai about 41% of the domestic wastewater is discharged untreated and 19% is only partially treated. The annual discharge of domestic wastewater in Primorskii Krai in 2002 was about 0.162 km^3. The annual discharge of industrial wastewater in Primorskii Krai in 2002 was about 0.296 km^3, with 86% of this volume discharged untreated. Fortunately, 99.6% of the untreated industrial wastewater is cooling water from electric power stations that release relatively low levels of contamination. Information on direct input of contaminants in Russia is gathered from official data on municipal and industrial waste volumes and on expert assessment of storm water runoff.

Information on river input and chemical substances concentration in river water used for the current overview come from observation points located much closer to river mouths and without special attention to processes in the estuaries and mixing zones, though author realizes that estuarine processes are extremely important from the point of view influence of river runoff on the coastal sea areas.

Sources Used to Develop this Regional Overview:

National Report of China on River and Direct Inputs of Contaminants Into the Marine and Coastal Environment in the NOWPAP Region (prepared by Ms. Mingcui Wang and Prof. Yibing Su)

National Report of Japan on River and Direct Inputs of Contaminants Into the Marine and Coastal Environment in the NOWPAP Region (prepared by Global Environmental Issues Division, Global Environment Bureau, Ministry of the Environment, Japan)

National Report of Korea (ROK) on River and Direct Inputs of Contaminants Into the Marine and Coastal Environment in the NOWPAP Region (prepared by Dr. Jae Ryoung Oh)

National Report of the Russian Federation on River and Direct Inputs of Contaminants Into the Marine and Coastal Environment in the NOWPAP Region (prepared by Vladimir M. Shulkin, Galina I. Semykyna, Anatoly N. Kachur)

Information sources used to prepare the National Reports are cited here, as well as other sources such as scientific papers and open official statistics with proper citation.

3. Social and Economic Situation

Brief social and economic information relevant to Chinese Provinces for 2002 is listed in Table 3.1. It should be noted that only a portion of the Provinces belong to the NOWPAP region. Exact data for impacts within the Provinces will be unavailable until a time in the future when more study and research will be carried out.

Total industrial value in Heilongjiang Province is about 24,148 million USD and has increased by 11% in the last year. Heilongjiang Province is abundant in green food, the major industry in this region.

Total industrial value in Jilin Province at the end of 2002 was 18,068 million USD, of which industry accounted for 70.1%. The dominant industries in Jilin Province are resource extraction and manufacturing, including oil and natural gas extraction, tobacco production, ferrous metals, and transportation manufacturing.

Total industrial value in Liaoning Province in 2002 was 61,310 million USD, a 15.3% increase over the previous year. The major industries of Liaoning Province are metallurgy, oil refining and petrochemicals, and electronics manufacturing.

Total industrial value in Shandong Province in 2002 was 43,755 million USD, a 17.3% increase over the previous year. The added production value of heavy industry and light industry was 26,705 and 17,075 million USD, respectively. Industries includes petroleum and natural gas extraction, food production, textiles, chemical production, non-metal mineral manufacturing, and wiring manufacturing, whose production value accounts for the 54.8% of the whole.

Total industry value in Jiangsu Province in 2002 was 60,250 million USD, a 14.0% increase over the previous year. Industries include heavy and light manufacturing, textiles, electronics, chemical manufacture.

Table 3.1. Geographical Characteristics and Economic Conditions in Chinese Provinces Relating to NOWPAP (2002)

Province	**Area, 10^3 km^2**	**Population (million)**	**Population density (per/km^2)**	**GDP, 10^6 USD**	**GDP per capita, USD/person**
Jiangsu	100	74.058	741	155,670	2,102
Shandong	150	91.25	608	155,399	1,703
Liaoning	150	42.10	281	75,022	1,782
Jilin	180	27.037	150	31,525	1,166
Heilongjiang	460	38.15	83	55,432	1,453
Subtotal/average	**1,040**	**272.6**	**373**	**473,048**	**1,641.2**

Total energy consumption in 2002 was about 1.5 billion tons of coal, which is 0.5 billion tons more than in 1990, for an average growth of 3.6%. Coal provides 66.3% of energy needs, oil - 23.5%, natural gas - 2.6% and hydro and nuclear power - 7.6%.

Nearly 70% of the coal is not fully burned which causes SO_2 and dust emission and creates acid rain. High grade energy such as petrol and natural gas account for 33.7% of total energy consumption in 2002, an increase of 9.9% over 1990. Energy consumption is lower than in developed countries, with the per capita energy consumption at 156 KWh, which is only 7.7 % of Japan and 4% of USA.

Socio-economic characteristics for Japanese prefectures in the NOWPAP region are listed in Table 3.2. The population in these prefectures is 34,383,000, or 26.98% of Japan's total population. Average population density is 303 people per km^2, which is below the national average of 340 people per km^2.

Population density in the study region registered an overall growth rate of 1.0% over the ten-year period from 1990 to 2000. Hyogo and Fukuoka Prefectures exhibited especially large growth of 2 ~ 4%. In contrast, Akita, Shimane, and Yamaguchi Prefecture exhibited a decrease in population density of -2.4 ~ -3.1%. Cities with populations over one million are Sapporo City (1,823,000 people), Fukuoka (1,302,500 people), and Kitakyushu (999,800 people). Cities with populations between 300,000 to 500,000 people include Niigata, Kanazawa, Asahikawa, Nagano, Toyama, Akita, Yamagata, Fukui, and Shimonoseki, these in declining order. 7,181,198 people (20% of total) live in such big cities.

Table 3.2. Socio-Economic Characteristics of Japanese Prefectures in the NOWPAP Region (2002)

Prefecture	**Region**	**Area, km^2**	**Population (1000 peoples)**	**Population density (per km^2)**	**Industrial GDP 10^6 USD**	**GDP, USD per capita**
Hokkaido	Hokkaido	83,454	5,670	73	47,886	8,445
Aomori	Touhoku	9,235	1,469	154	9,936	6,764
Akita		11,434	1,176	102	11,201	9,525
Yamagata		7,394	1,235	133	23,804	19,274
Niigata	Hokuriku(N)	10,939	2,465	97	36,501	14,808
Toyama	Hokuriku(S)	2,802	1,119	264	28,564	25,526
Ishikawa		4,185	1,180	282	19,936	16,895
Fukui		4,189	828	198	13,864	16,743
Nagano	Chubu	12,598	2,217	163	46,883	21,147
Kyoto	Kiriki	4,613	2,642	573	40,606	15,369
Hyogo		8,393	5,578	661	110,573	19,823
Tottori	Chugoku	3,507	612	175	9,055	14,795
Shimane		6,707	757	114	8,709	11,505
Yamaguchi		6,111	1,518	250	44,900	29,578
Fukuoka		4,841	5,043	1,009	62,573	12,408
Saga		2,439	874	359	12,446	14,240
Subtotal		**182,841**	**34,383**	**Av.303**	**527,435**	**Av. 15,340**

The number of people employed in the service area is 29.2%, in trade - 28.7%, in finance - 3.8%, in government - 3.6%. The total service industry accounts for 65.3% of all employees. The amount of employees in manufacturing is 17.6%, in construction - 9.8%, in transport - 6%, and only 0.7% work in agriculture / forestry and fishing. So the number of employees in primary industries is 0.5%, the number in secondary industries - about 30%, and the number in tertiary industries - about 70%. These figures clearly indicate that most employees are concentrated in the tertiary industries.

An especially large percentage of employees work in service industries and wholesale food and beverage trade, each of which accounts for 29.3% of all employment, with both industries accounting for about 60% of total employment. Moreover, the number of employees in primary and secondary industries has been decreasing since 1991, whereas the number of employees in tertiary industries has tended to increase.

The distribution of employees in different kinds of businesses within Prefectures in the NOWPAP region is similar to rest of Japan, that is main part of employees work in tertiary industries.

Table 3.3 summarizes the percentage of value of manufactured goods produced and shipped by individual Prefectures according to various industrial categories. The amount of manufactured goods produced and shipped from Hyogo Prefecture is the largest, followed by Fukuoka Prefecture. Shimane Prefecture has the smallest industrial output in the region. The statistics for Hokkaido, Aomori, Kyoto and Hyogo include data for areas not in the NOWPAP region.

Table 3.3. Percentage of Different Kinds of Goods and Total Value of Goods Manufactured in Prefectures Related to the NOWPAP Region (2002)

Prefecture	Foods	Textile	Woods & paper	Chemicals	Metallurgy	Mashinery	Other	Summary product, 10^6USD
Hokkaido	41.7	0.4	15.9	14.4	9.0	12.9	5.6	47,886
Aomori	33.8	1.1	14.6	4.9	8.5	31.3	5.8	9,936
Akita	11.4	1.8	11.6	5.8	6.9	57.0	5.5	11,201
Yamagata	12.0	2.4	4.6	7.6	4.7	61.0	7.6	23,804
Niigata	16.7	2.9	8.8	12.2	15.8	38.9	4.8	36,501
Toyama	5.8	2.1	9.3	21.7	25.3	29.6	6.2	28,564
Ishikawa	15.7	4.7	7.8	8.3	6.3	52.7	4.5	19,936
Fukui	4.7	10.4	8.5	18.7	11.2	40.3	6.2	13,864
Nagano	13.5	0.5	4.7	5.3	5.4	67.1	3.4	46,883
Kyoto	21.1	2.6	9.2	6.8	5.5	42.8	12.0	40,606
Hyogo	15.4	1.2	5.8	16.3	13.6	41.0	5.1	110,573
Tottori	23.2	2.6	12.3	2.2	3.3	53.5	3.0	9,055
Shimane	9.6	2.7	9.0	5.3	14.5	52.6	6.3	8,709
Yamaguchi	5.9	0.4	4.0	45.7	12.9	26.8	4.3	44,900
Fukuoka	18.8	0.7	7.7	11.0	13.7	42.3	5.8	62,573
Saga	22.9	1.4	8.5	15.5	10.5	32.0	9.1	12,446
Total	**17.3**	**1.7**	**8.0**	**14.8**	**11.7**	**40.8**	**5.8**	**527,435**

Table 3.4. Socio-Economic Characteristics of Korean Provinces in 2002

Province	Area, km^2	Population (1000 peoples)	Population density (per km^2)	Industrial GDP 10^6 USD	GDP, USD per capita
Gyeonggi[1]	11,776	21,354	1,813		
Gangwon	16,874	1,487	88		
Chungbuk	7,432	1,467	197		
Chungnam[2]	9,137	3,213	352		
Jeonbuk	8,051	1,891	235		
Jeonnam[3]	12,547	3,349	267		
Gyeongbuk[4]	19,911	5,206	261		
Gyeongnam[5]	12,338	7,656	621		
Jeju	1,848	513	278		
Total	**99,913**	**46,136**	**478**	**457,200**	**9,446**

1 – With Seoul and Incheon, 2 – With Daejeon, 3 – With Gwangju, 4 – With Daegu, 5 – With Busan and Ulsan

Korea's population in 2002 stood at 48.4 million. Population density is very high in the cities. The seven largest cities (Seoul – 9.9 million peoples, Busan – 3.7 million peoples, Daegu – 2.5 million peoples, Incheon – 2.5 million peoples, Gwangju – 1.4 million peoples, Daejeon – 1.4 million peoples and Ulsan – 1.0 million peoples) accounted for almost half the population of Korea. The 3% population growth rate of the 1960s declined sharply to 2% in the 1970s due to improved social and financial living standards, changed social perspective on population issues, and campaigns to control the growing population. The rate has dropped further to below 1% since 1985. The social-economical features of Korea provinces, including largest cities are presented on the Table 3.4.

The three major industrial activities in Korea are service (34% of all employees), commercial (20% of all employees) and manufacturing (26% of all employees), with Korea's leading industries being shipbuilding, semiconductors, electronics and auto manufacturing. A significant number of employees work in construction (7%), transport (7%) and bank/insurance (5%) business.

Korean agriculture and fishing industries currently face great challenges and account for a very low, 1% of all employees.

Socio-economic features of Russian coastal regions in the NOWPAP region are presented in Table 3.5. There are three population areas: in Primorskii Krai (regions 1 – 5 and part of 6 – 1,229 million people), in Khabarovskii Krai (part of region 6 – 1,107 million people), and in Sakhalinskaya Oblast (region 7 – 151.2 thousand people). This is 60.4%, 7.8%, and 28.1% of total population of Primorskii Krai, Khabarovskii Krai and Sakhalinskaya Oblast, respectively. This means that Primorskii Krai, compared to other large administrative regions (Khabarovskii Krai and Sakhalinskaya Oblast), plays the key role in the economy represented in the Russian part of the NOWPAP region. The population of Primorskii Krai decreased over the last 5 years by 30.6 thousand people per year.

The major cities in Primorskii Krai are Vladivostok – 613,400, Artem – 111,500, Nakhodka – 174,600, Fokino – 35,400, Bolshoi Kamen – 39,300, Partizansk – 51,500, Dalnegorsk – 49,400.

Industrial employees (industrial enterprises, transport, construction, wholesale, agriculture, forestry) account for about 58.5% of all employees; only 3.7% work in agriculture and forestry. Service sector employment (service, medicine, education, science, officials) is about 41.5%. The percentage of people employed in goods manufacture has decreased to 52.5% during last 5 years.

Table 3.5. Socio-Economic Characteristics of Russian Coastal Regions of in the NOWPAP Region in 2002

Regions	Area, $*10^3$ km^2	Population $*10^3$ person	Population density, per./km^2	Industrial production $*10^6$ USD	Agriculture, $*10^6$ USD	Volume of production USD per capita
1	4.13	36.8	8.9	15.5	3.8	526
2	2.66	764	287.2	650.7	33.0	895
3	7.51	307.5	40.9	190.1	22.2	690
4	15.32	57.7	3.8	75.5	5.8	1,409
5	5.34	49.4	9.2	72.9	3.6	1,548
6	42.7	73.8	1.7	134.5	8.1	1,932
7	26.2	151.2	5.8	364.1	31.3	2,615
Total	**103.9**	**1,440.4**	**13.9**	**1,503.2**	**107.8**	**1,118**

The regions include: 1 – Khasanski Raion; 2 – Nadezhdinskii Raion plus Vladivostok and Artem, 3 – Shkotovskii and Partizanskii Raions plus Nakhodka and Fokino, 4 – Lazovskii, Olginskii and Kavalerovskii Raions, 5 – Dalnegorskii Raion, 6 - Terneiskii and part of Sovgavanskii Raions, 7 – Southwestern Raions of Sakhalin Island.

Table 3.6. Amount of Goods (% of Total Industrial Production) Produced in Sub-Regions of Primorskii Krai

Sub-region*	Foods	Textile	Wood	Chemic	Coal/ Metal	Machine	Energy	Construction	Summary product, 10^6 USD
1	17.6	1.4	1.6	-	-	63.5	15.9	-	15.5
2	48.4	1.6	1.9	0.6	7.6	12.7	30.3	3.4	650.7
3	69.3	1.7	3.8	0.3	1.8	16.6	5.2	2.0	190.1
4	84.7	-	7.1	-	-	0.6	7.0	0.5	75.5
5	2.9	-	9.3	44.6	16.1	0.1	20.8	0.1	72.9
6**	2.0	-	92.0	-	-	-	6.0	-	61.6**

*- sub-regions as presented in Table 3.1,
** - area in Primorskii Krai

The main areas of industrial production in Primorskii Krai include energy production and delivery, coal and ore mining, machinery, chemicals, timber industry, textiles, construction and food production. The mining and chemical industries are concentrated in Dalnegorskii Raion (sub-region 5). The Artem - Vladivostok area (sub-region 2) and Nakhodka (sub-region 3) are the major food and machinery producers. Terneiskii Raion (sub-region 6) specializes on wood manufacturing (Table 3.6).

4. Monitoring and Assessment of Activities in NOWPAP Member Countries

4.1. Overview of National and International Policies and Laws

China. National and international laws and regulations relating to China are listed in Table 4.1.

Table 4.1. Main Laws Related to the Contamination of Environment in China

Type	Title
Laws, approved by People's representative Committee of China	Law of Fishery (1986)
	Law of Environmental Protection (1989)
	Law of Water and Soil Conservation (1991)
	Law of Prevention on Environmental Pollution by Solid Wastes (1995)
	Law of Water Pollution Prevention (1996)
	Law of Marine Environmental Protection (1999)
	Law of Water (2002)
	Law of Environmental Influences Assessment (2003)
	Managing Guidelines to Protecting on Propagation of Aquaculture Resources (1979)
Legislation approved by State Council of China	Managing Guidelines to Prevention Marine from Shipping (1983)
	Managing Guidelines to Keep Contamination and Damage from Coastal Construction and Engineering (1990)
	Managing Guidelines to Keep Contamination and Damage from Pollutants in Terrestrial Sources (1990)
	Technical Guidelines on Environmental Impacts Assessment (1993)
	Rules on Implementation of the Law of Prevention of Water and Soil (1993)
	Guidelines on Natural Preservation Zones (1994)
	Detailed Rules on Implementation of the Law of Prevention of Water Pollution (2000)
	Sanitary Standard for Drinking Water (1985)
Standards approved by National or Ministries	Water Quality Standard for Fisheries (1989)
	Wastewater and Sludge Disposal Standard for Municipal WTP (1993)
	Integrated Wastewater Discharge Standard (1996)
	Sea Water Quality Standard (1997)
	Discharge Standard for Municipal Wastewater (1999)
	Environment Quality Standard for Surface Water (2002)
	Standard for Pollution Control of Sewage Marine Disposal Engineering (2000)

The State Environmental Protection Administration is responsible for all surface water (lakes, reservoirs and rivers), ground water, coastal and near shore seawater, and wastewater discharge. It monitors water quality, biology, sediments and discharge volumes. Responsibility is based in national laws and regulations, such as the Environmental Protection Law and the Water Pollution Prevention Law.

Chapter I, Article 7 of the Environmental Protection Law directs the State Council to empower several departments and ministries to carry out environmental protection activities.

Articles 3 and 4 of the Law of the People's Republic of China on the Prevention and Control of Water Pollution (Amended 5/15/1996) establish departments under the State Council and local people's governments to supervise and manage the prevention and control of water pollution.

Article 19 requires urban sewage be disposed of in a centralized way through the sewage treatment facilities.

The Regulation on Environmental Monitoring of the People's Republic of China puts the China National Monitoring Center at the top of the environmental monitoring network. Monitoring stations at each administrative level carry out routine monitory tasks and additional tasks mandated by supervisory requirements.

The Ministry of Water Resources is responsible for water resources. Water volume and hydrological characters are the key monitoring issues. Responsibility is based in the National Water Law. Measurement stations, divided into different drainage or river basins grades, take regulation surveys and carry out additional tasks.

The National Marine Administration is responsible for surveying coastal water quality at four marine areas. Responsibility is based in the State Law of Marine Environmental Protection. Major tasks are hydraulic, physical, chemical, biologic and sediment surveys.

Japan. The system of Japanese statutes governing the discharge of pollutants into rivers or directly into the marine environment is summarized in Table 4.2. The key laws are described below.

The Environment Basic Law, which supplants The Basic Law for Environmental Pollution Control (1967), sets out the basic principles for environmental protection policy. This law went into effect on 19 November 1993. The law's intent is to comprehensively and systematically promote environmental protection polices that ensure healthy and cultured living for both current and future generations. It also contributes to the welfare of mankind by articulating basic principles, clarifying the responsibilities of State, local government, corporations and citizens, and by prescribing basic policy considerations for environmental protection.

Through the Environment Basic Law the government creates a basic environmental protection plan (Basic Environment Plan) to comprehensively and systematically promote environmental protection policy. Under this law, Environmental Quality Standards (EQS) for water pollutants are established as target levels for water quality to be achieved and maintained in public waters.

The Water Pollution Control Law prevents the pollution of public water bodies by regulating effluent discharged by factories and other industrial establishments into surface or groundwater, thus protecting human health and preserving living organisms. The law establishes monitoring procedures to observe the quality of effluent discharged from factories and other industrial establishments into public water bodies, as well as monitoring water quality conditions within those public water bodies. The law establishes a set of national effluent standards. National effluent standards set maximum permissible levels of specific substances water discharged from the factories and businesses where specified facilities are set up.

Table 4.2. Laws on the Discharge of Pollutants into Rivers or Directly into the Marine Environment

Type	Title	Purpose, responsibility
Law	Environment Basic Law (1993)	Monitoring of public water
	Water Pollution Control Law	Regulating of effluent quality and quantity
	Sewage Law	Sewage construction and management
	Johkasou (Septic Tank) Law	Treatment of domestic wastewater
	Wastes Management and Public Cleansing Law	Water quality monitoring of dumping sites and regulation of night soil treatment
	Prevention of Marine Pollution and Maritime Disasters Law (according to London Convention (1996) and MARPOL73/78)	Effluent control of oil, hazardous substance, and waste from ships and marine facility, and dumping as well.
	Law Concerning Special Measures Against Dioxins	Establish measures relating to soil and water contamination by dioxins
	Chemical Substance Release, Reporting and Management Promotion Law	Management of 354 potentially harmful or hazardous chemicals released to the environment
Standards	Environmental Quality Standards	Environment Basic Law
	Uniform National Effluent Standards	Water Pollution Control Law
	Effluent Quality Standards for Sewage Treatment Facilities	Sewage Law
	Criteria for Ocean Dumping	Prevention of Marine Pollution and Maritime Disasters Law
	Environmental Standards for Dioxins Concerning Water Quality	Law Concerning Special Measures Against Dioxins

The Sewage Law promotes the construction and use of sewage systems to improve public health, to contribute to the healthy development of cities, and to maintain the quality of water in public water bodies.

The Law Concerning Special Measures Against Dioxins was enacted in 1999. The purpose of this law is to protect the health of citizens by establishing policy standards on dioxins, to establish necessary regulations, and to establish measures relating to soil pollution.

In addition to the eight key laws listed in Table 4.2, there are other laws that have water quality provisions, such as the River Law, Coast Law, Harbors Law, and Fishing Port Law. These laws authorize those in charge of managing rivers, coastal areas, and harbors to regulate or restrict human activities for the purpose of protecting water quality.

Korea. There are 47 laws in Korea that address different environment quality issues. Those relating to water quality, water use and protection are presented in Table 4.3.

Table 4.3. Key Korean Water Quality Laws

Title	Enacted on
Waste Cleaning Act (Repealed on 12.31.1986)	12/30/1961
Environment Pollution Prevention Act (Repealed on 12.31.1977)	12/31/1961
Act relating to Toxic and Hazardous Substances (Repealed on 08.02.1999)	12/13/1963
Environmental Conservation Act (Repealed on 12.30.2002)	12/31/1977
Compound waste Treatment Corporation Act (Repealed on 12.30.2003)	12/28/1979
Waste Control Act (Repealed on 2003)	12/31/1986
Toxic Chemical Control Act (Repealed on 2000)	08/01/1990
Water Quality Conservation Act (Repealed on 2004)	08/01/1990
Act on the Disposal of Sewage, Excreta and Livestock Wastewater (2004)	03/08/1991
Natural Environment Conservation Act (2004)	12/31/1997
Management of Drinking Water (2003)	01/05/1995
Promotion of Waste Disposal Facilities Act (2004)	01/05/1995
Act relating to Han River Water Quality Improvement… (2003)	02/08/1999
Act on Geum River Watershed Management… (2003)	01/14/2002
Act on Nakdong River Watershed Management… (2003)	01/14/2002
Act on Yeongsan & Seomjin River Watershed Management… (2003)	01/14/2002

Russia. Federal laws, Federal Government decisions, and water quality standards established and amended at the Federal level (Table 4.4) are the legal basis for water use and protection in Russia. The goal of the Federal Environmental Protection Law is to establish and strengthen environmental law enforcement and to maintain environmental safety in the Russian

Federation. Government monitoring of water objects is an integral part of a system of environmental monitoring and is described in detail in the Federal Water Code.

Table 4.4. Key Russian Water Quality Laws

Type	Title	Purpose, responsibility
Laws approved by State Duma and Federal Council	Federal Law «On Environmental Protection» (Article 1), (No. 7-FZ of January 10, 2002).	definition and management of state environment monitoring
	"Water Code" of the Russian Federation (Article 78) (October 18, 1995).	description of water objects monitoring
	«The Federal law on wildlife» (No.52 - FZ of April 24,1995)	monitoring of water quality in protected areas
	Federal Law « On a continental shelf of the Russian Federation » (Article 33)	water quality issues during resources use at the continental shelf
Legislation approved by Government of the Russian Federation Decisions	"The agreement on cooperation in the field of ecological monitoring of the states - participants of the CIS » (The decision of the Government No.299 of April 04,2000)	coordination of structure and monitoring schemes within CIS
	« On Organization and Realization of the State Monitoring of Environment (the State Ecological Monitoring) – The Decision of the Government No. 177 of March 30,2003	improvement of existing territorial structure for the state ecological monitoring
	"On State Service of Environmental Monitoring" - The Decision of the Government No. 622 of August 23, 2000	definition and creation of state service of environmental monitoring
Standard approved by Ministries	Sanitary Standard for Drinking Water (1996) SanPIN 2.1.4.559-96	Sanitary Epidemiological Service of the Ministry of Health (up to 2001)
	Sanitary Standard for the water of domestic, drinking and cultural uses – "public waters" (1996) according to SanPIN 2.1.4.559-96	
	Sanitary Standard for Drinking Water (2003) according to GN 2.1.2.1315-03	State Office for Supervision on the Protection of Consumer's Rights and Human Welfare – subdivision of Ministry of Health and Social Development (after 2001)
	Sanitary Standard for the water of domestic, drinking and cultural uses – "public waters" (2003) according to GN 2.1.2.1315-03	
	Standard for the waters used for the fishery purposes – VNIRO, 1999	State Fishery Service – subdivision of Ministry of Agriculture

Government monitoring of water objects is managed by specially authorized government agencies established to regulate the use and protection of water resources. They work alongside of specially authorized government agencies that address environmental protection, government agencies that deal with hydrometeorology and environmental monitoring (surface water objects) and government agencies that deal with the use and protection of ground water sources.

Federal authorities of the Russian Federation establish monitoring procedures for water objects.

4.2. National and International Monitoring Programs

The monitoring of surface water quality (rivers and lakes) as well as of coastal water is the distinct responsibility of each NOWPAP country. International cooperation is needed to exchange information, to conduct joint research projects, and to hold training activities. Water quality monitoring is carried out as part of each country's national program and according to country rules.

China

The State Environmental Protection Administration is responsible for all surface water (lakes, reservoirs and rivers), underground water, coasts and near shore seawater, and wastewater discharge. It monitors water quality, biology, sediments and discharge volumes. This authority is provided in national laws and regulations, such as the Environmental Protection Law and the Water Pollution Prevention Law. Monitoring stations at every administrative level carry out routine monitory tasks and additional tasks mandated by supervisory requirements.

There are four levels of environmental monitoring in China: (1) China National Environmental Monitoring Center; (2) environmental monitoring centers in different provinces or municipalities governed by the central government; (3) environmental monitoring centers in municipalities governed by the provincial government; (4) environmental monitoring center in the counties and the district of municipalities.

Monitoring stations at each administrative level carry out routine monitoring tasks and additional tasks called for in regulatory requirements. There are two sets of river monitoring stations.

The first set includes 479 stations in six key drainage areas in NOWPAP regions: Haihe, Huaihe, Liaohe, Yangtze, Yellow, and Songhua Rivers. Water temperature, pH, electrical conductivity, dissolved oxygen, COD_{Mn}, BOD_5, N-NH_4, oil, volatile hydroxybenzene, Hg, Pb, water discharge are monitored monthly.

A second set includes 43 automatic stations within the drainage areas mentioned above. Automatic stations have operated since 1999 and register hourly and report weekly on water temperature (T), pH, dissolved oxygen (DO), electric conductivity (EC), turbidity (TB), chemical oxygen demand (COD_{Mn}), total organic carbon (TOC) and ammonium nitrogen (NH_3-N).

The assessment of surface water quality complies with the Environmental Quality standard for surface water (GB3838-2002) (Table 4.5). A single factor assessment method is used for the surface water quality classification system, namely once any assessment indicator at a certain monitoring site exceeds standards, water quality is changed to the next grade.

Surface water is divided into 5 grades according to the standard:

Grade I: River, lake, etc; nature reserve water source.

Grade II: First level reserve area drinking water source, habitat of rare aquatic animals and plants, spawning area for fish and shrimp, food source area of cub hood fish.

Grade III: Second level reserve area drinking water source, winter habitat for fish and shrimp, migration routes, fishery area and swimming area.

Grade IV: Water source for industry and water for amusement.

Grade V: Agricultural water source and water for sight seeing.

Table 4.5. Chinese Surface Water Standards (GB3838-2002)

No.	Item	Unit	Grade I	Grade II	Grade III	Grade IV	Grade V
1	pH	pH unit	6~9				
3	DO ≥	mg/L	7.5	6	5	3	2
4	COD_{Mn}≤	mg/L	2	4	6	10	15
5	COD≤	mg/L	15	15	20	30	40
6	BOD_5 ≤	mg/L	3	3	4	6	10
7	NH_4^- ≤	mg/L	0.15	0.5	1.0	1.5	2.0
8	T P ≤	mg/L	0.02	0.1	0.2	0.3	0.4
9	T N ≤	mg/L	0.2	0.5	1.0	1.5	2.0
10	Cu ≤	mg/L	0.01	1.0	1.0	1.0	1.0
11	Zn ≤	mg/L	0.05	1.0	1.0	2.0	2.0
12	F- ≤	mg/L	1.0	1.0	1.0	1.5	1.5
13	Se ≤	mg/L	0.01	0.01	0.01	0.02	0.02
14	As ≤	mg/L	0.05	0.05	0.05	0.1	0.1
15	Hg ≤	mg/L	0.00005	0.00005	0.0001	0.001	0.001
16	Cd ≤	mg/L	0.001	0.005	0.005	0.005	0.01
17	Pb ≤	mg/L	0.01	0.01	0.05	0.05	0.1
18	Cr^{6+} ≤	mg/L	0.01	0.05	0.05	0.05	0.1
19	CN-≤	mg/L	0.005	0.005	0.2	0.2	0.2
20	V-phen≤	mg/L	0.002	0.002	0.005	0.01	0.1
21	oils≤	mg/L	0.05	0.05	0.05	0.5	1.0
22	LAS≤	mg/L	0.2	0.2	0.2	0.3	0.3
23	S-≤	mg/L	0.05	0.1	0.2	0.5	1.0
24	Fcg≤	cell/L	200	2,000	10,000	20,000	40,000

Japan.

Monitoring of surface, ground and coastal water quality is the responsibility of prefect governments and local offices of national administrative agencies. Moreover, a company that discharges effluents from specified factories are mandated to measure pollutant levels in their effluents and keep records of the measured findings for government inspection. Table 4.6 presents an outline of water quality monitoring. There are 247 in the NOWPAP region where environmental standard points check compliance with different EQS is checked and the supplementary points on the first class rivers (35 rivers NOWPAP).

The assessment of water and effluent quality is based on compliance with Environmental Quality Standards (EQS). Japanese EQS include EQS to protect human health (Table 4.7), EQS to protect living organisms (Table 4.8, 4.9), and effluent standard parameters (Table 4.10).

Table 4.6. Water Quality Monitoring under the Water Pollution Control Law

Water Type	Responsibility	Number of Survey Points	Content of Observations	Frequency
Public water area (river, lakes and coastal area)	Prefectural governor and government ordinance mayor	Environmental standards monitoring point (4,614 points for all Japan)	Environmental quality standard item concerning protection of human health	More than once a month
			Environmental quality concerning conservation of living environment	More than once a month
Industrial wastewater	Operating company	Facilities under the pollution control law	Effluent standard item	Measuring according to the situation

Table 4.7. Environmental Quality Standards to Protect Human Health

Item	Standard Value
Cd, Pb, As, Se	0.01 mg/L or less
Chromium (VI)	0.05 mg/L or less
Total mercury	0.0005 mg/L or less
Alkyl mercury & PCBs	not detectable
Dichloromethane, Dichloroethylene, Thiobencarb	0.02 mg/L or less
Carbon tetrachloride1, 3-dichloropropene	0.002 mg/L or less
1, 2-dichloroethane	0.004 mg/L or less
cis-1, 2-dichloroethylene	0.04 mg/L or less
1, 1, 1-trichloroethane	1.0 mg/L or less
1, 1, 2-trichloroethane, Thiuram	0.006 mg/L or less
Trichloroethylene	0.03 mg/L or less
Benzene, Tetrachloroethylene	0.01 mg/L or less
Simazine	0.003 mg/L or less
Nitrate nitrogen and Nitrite nitrogen	10 mg/L or less
Fluorine, Boron	0.8 -1.0 mg/L or less
Chloroform, 1, 2-dichlorpropane	0.06 mg/L or less*
trans-1, 2-dichloroethylene, Isoprothiolane	0.04 mg/L or less*
p-dichlorobenzene	0.2 mg/L or less*
Diazinon	0.005 mg/L or less*
Fenitrothion (MEP)	0.003 mg/L or less*
Chlorothalonil (TPN)	0.05 mg/L or less*

Propyzamide, Dichlorvos (DDVP), Iprobenphos (IBP), Isoxathion	0.008 mg/L or less*
Fenobucarb (BPMC)	0.03 mg/L or less*
Xylene & Toluene	0.4-0.6mg/L or less*
di (2-etylhexyl) phatalate	0.06mg/L or less*
Molybdenum	0.07mg/L or less*
Antimony	0.02mg/L or less*
Vinyl chloride monomer	0.002mg/L or less*
Epichlorohydrin	0.0004mg/L or less*
1,4-dioxane	0.05mg/L or less*
Total manganese	0.2mg/L or less*
Uranium	0.002mg/L or less*

*- Additional data on their health effects must be collected before EQS can be established and their concentrations in the environment monitored.

Table 4.8. Environmental Quality Standards to Protect Rivers/Lakes

Class	**Item**	**Standard value (annual mean)**							
	Water Use	**pH**	**BOD***	**SS**	**DO**	**Total Coli**	**Total N****	**Total P****	**Total Zn**
AA	Water supply class 1, conservation of natural environment, and uses listed in A-E	6.5-8.5	1 mg/L or less	25/1 mg/L or less	7.5 mg/L or more	50 MPN /100 ml	0.1 mg/l or less	0.005 mg/l or less	0.03 mg/l
A	Water supply class 2, fishery class 1, bathing and uses listed in B-E	6.5-8.5	2 mg/L or less	25/5 mg/L or less	7.5 mg/L or more	1000 MPN /100 ml	0.2 mg/L or less	0.01 mg/L or less	0.03
B	Water supply class 3, fishery class 2, and uses listed in C-E	6.5-8.5	3 mg/L or less	25/15 mg/L or less	5 mg/L	5000 MPN /100 ml	0.4 mg/L or less	0.03 mg/L or less	0.03
C	Fishery class 3, industrial water class 1, and uses listed in D-E	6.5-8.5	5 mg/L or less	50 mg/L or less	5 mg/L or more	-	0.6 mg/L or less	0.05 mg/L or less	0.03
D	Industrial water class 2, agricultural water, and uses listed in E	6.0-8.5	8 mg/L or less	100 mg/L or less	2 mg/L or more	-	1 mg/L or less	0.1 mg/L or less	
E	Industry water class 3 and conservation of environment	6.0-8.5	10 mg/L or less		2 mg/L or more	-	1 mg/L or less	0.1 mg/L or less	

Notes: * - BOD for rivers, CODM for lakes, SS: Suspended Solids, DO: Dissolved Oxygen, MPN: Most Probable Number; ** - for lakes only- At intake for agriculture, pH should be between 6.0 and 7.5 and DO shall be higher than 5mg/L. - Standard values are applied to unfiltered sample.

Environmental quality standards (EQS) to protect living organisms are established in accordance with a Japanese classification system that sets six grades for all public water bodies (Table 4.8). Some additional guidelines are established for substances dangerous for most sensitive aquatic organisms (salmon, crustaceans, their spawning stages) (Table 4.9).

Table 4.9. Guideline Values for Some Toxic Substances to Protect Most Sensitive Aquatic Organisms

Items	Water Area	Class	Guideline Value
Chloroform	River and Lakes	Aquatic Organisms A	0.7 mg/L or less
		Aquatic Organisms special A	0.006 mg/L or less
	Coastal Areas	Aquatic Organisms special A	0.8 mg/L or less
Phenols	River and Lakes	Aquatic Organisms A	0.05 mg/L or less
		Aquatic Organisms special A	0.01 mg/L or less
	Coastal Areas	Aquatic Organisms A	2 mg/L or less
		Aquatic Organisms special A	0.2 mg/L or less
Formaldehyde	River and Lakes	Aquatic Organisms A	1 mg/L or less
	Coastal Areas	Aquatic Organisms A	0.3 mg/L or less
		Aquatic Organisms special A	0.03 mg/L or less

Notes : Standard values are applied to unfiltered sample

Table 4.10. Uniform National Effluent Standards (Examples)

Items related to the protection of the human health	Permissible Limits
Cd, Pb, As and its compounds	0.1mg/L
Organic phosphorus compounds and cyanide compounds	1mg/L
Chromium compounds	0.5mg/L
Total mercury	0.005mg/L
PCBs	0.003mg/L
Trichloroethylene	0.3mg/L
Benzene, Tetrachloroethylene	0.1mg/L
Dichloromethane, 1,1-dichloro ethylene, Thiobencarb	0.2mg/L
Total nitrogen	100mg/L
Items related to the conservation of living environment	**Permissible Limits**
pH	5.8-8.6 fresh water,
Biochemical Oxygen Demand (BOD)	160mg/L (DAv 120mg/L)
Chemical Oxygen Demand (COD)	160mg/L (DAv 120mg/L)
Suspended solids (SS)	200mg/L (DAv 150mg/L)
N-hexane extracts (mineral oil)	5mg/L
Phenols	5mg/L
Dissolved Cr, Cu, Zn, Fe, Mn	2, 3, 5, 10, 10 mg/L
Number of coliform groups	3,000/cm^3 (DAv)
Nitrogen	120mg/L (DAv 60mg/L)
Phosphorus	16mg/L (DAv 8mg/L)

Note: These limits are applied to unfiltered sample in principle; DAv – daily averaged

National effluent standards are uniformly applied in Japan and consist of two categories: those that protect human health (24 substances including heavy metals) and those that protect living organisms (16 items). National effluent standards represent the maximum permissible levels of specific substances allowed in water discharged from the factories and from businesses. Some of the regulated substances and permissible limit values established under the effluent standards are presented in Table 4.10. Where the national effluent standard is judged inadequate to attain the EQS in a certain water body, the governor of the prefecture is authorized to establish more stringent standards through a prefecture ordinance.

Korea. Monitoring freshwater qualities is the jurisdiction of the Ministry of Environment (MOE). Local Environmental Offices affiliated with MOE, local governments, the Korean Water Resources Cooperation (KOWACO) and the Korean Agricultural and Rural Infrastructure Corporation (KARICO) are responsible for managing and operating the monitoring system. Local environmental agencies are responsible for monitoring lakes and rivers. Local governments and KOWACO monitor drinking water supply source. KARICO handles agricultural waters. The National Institute of Environmental Research (NIER) of MOE provides necessary support to MOE and to other monitoring agencies. Regional environmental agencies are responsible for 461 stations, local governments for 820 stations, KOWACO for 139 stations, and KARICO for 417 stations.

Korea's freshwater quality monitoring system is presented in Table 4.11 and includes water type, frequency of observations, number of stations and parameters. River water is monitored 12 times per year for 16 essential parameters, 4 times per year for 11 parameters, including trace metals. Water quality parameters at major points (21 stations) of five main rivers (Han, Nakdong, Keum, Yeongsan, and Seomjin) and in the Keumho River are measured 48 times per year for 16 essential parameters, 12 times per year for 11 parameters and once per year for 4 organic compounds.

Lake water is monitored 12 times/year for 21 parameters including nutrients, 4 times/year for 7 parameters including trace metals, and 1 time/year for 4 organic compounds.

Drinking water supply sources, such as rivers and lakes, are monitored more than once per month for 5 parameters, and 4 times per year for 18 parameters, including trace metals and organic compounds. Groundwater quality is measured more than 2 times per year for 19 parameters, including trace metals and pesticides.

The MOE has installed and operates 22 automated water quality stations to constantly monitor water quality near water supply facilities in four major Korean rivers: Han, Nakdong, Keum, and Yeongsan. They act as an early warning system for pollution into lakes and rivers by signaling managers and operators when a sudden increase in pollutants is detected. This enables a rapid response to any contamination accident.

Water Quality Standards (WQS) in Korea are the basis for a water quality-based pollution control program mandated by the Clean Water Act of Korea. WQS define the goals for a water body by designating its uses (recreation, water supply, aquatic life, agriculture), by setting criteria to protect those uses (numeric pollutant concentrations and narrative requirements), and by establishing provisions to protect water bodies from pollutants. WQS for Korean river water are presented in Table 4.12.

There are other WQS in Korea established for lake water, ground water and sea water. The differences in WQS for river and lake water is minimal (for example, the suspended solids

– SS in lake water should be less than 1, 5, 15 mg/l, for water Grade I, II, III, respectively). WQS for ground water include NO_3 (20 mg/l), Cl^- (250 mg/l), phenols (0.005 mg/l), tri- and tetrachlorethylene (0.03 and 0.01 mg/l) (the numbers are the most strict values).

Table 4.11. Fresh Water Quality Monitoring in Korea

Classification		Frequency	Stations	Parameters
River water		12 times/yr (five rivers: 48 times/yr)	559 (five rivers: 21)	Water level (flow rate), pH, DO, BOD, COD, SS, TN, NH_3-N, NO_3-N, TP, phenol, Conductivity, MPN, Phytoplankton
		4 times/yr (12 times/yer)		DTN, DTP, PO_4-P, Chl.a, Cd, CN, Pb, Cr^6+, As, Hg, ABS
		One time/yr		PCB, Organochloride, TCE, PCE
Lake water		12 times/yr	165	Water level (flow rate), pH, DO, BOD, COD, SS, TN, DTN, NH_3-N, NO_3-N, TP, DTP, PO_4-P W.T., phenol, Cond., Chl.a, Transp., MPN, Phytoplankton
		4 times/yr		Cd, CN, Pb, Cr^6+, As, Hg, ABS
		One time/yr		PCB, Organochloride , TCE, PCE
Water Supply Source	Rivers	monthly	563	BOD, pH SS, DO, MPN
		4 times/yr		Cd, CN, Pb, Cr^{6+}, As, Hg, F, Se, ABS, phenol, NH_3-N, NO_3-N , TCE, PCE, PCB, Cabaryl, 1,1,1-trichloroethane, Organochloride
	Lakes	monthly		COD, pH, DO, SS, MPN
		4 times/yr		Cd, CN, Pb, Cr 6+, As, Hg, F, Se, ABS, phenol, NH_3-N, NO_3-N , TCE, PCE, PCB, Cabaryl, 1,1,1-trichloroethane, Organochloride .
	Under-ground	> 2 times/yr		Cd, As, CN, Pb, Cr^{6+}, Hg, F, Se, ABS, phenol, NH3-N, NO3-N , TCE, PCE, Cabaryl, 1,1,1-trichloroethane, Organochloride, Insecticides.
Agricultural Water		2 times/yr	417	DO, pH, BOD, COD, SS, TN, TP, Cu, Pb, Cd, Cl-, Conductivity, Phytoplankton
Industrial wastewater		24 times/yr	83	DO, pH, BOD, COD, SS, W.T., Cond.
		12 times/yr		Cd, CN, Pb, Cr^{6+}, As, Hg, Cu, Zn, Cr, F, ABS, TN, TP, phenol, N-hexan, dis.-Mn, dis.-Fe, MPN, Color
		One time/yr		Organochloride , PCB, TCE, PCE

Table 4.12. The Water Quality Standards for Korean River Water

Purpose	**Grade**	**Water use type**	**Water Quality Standard**				
			pH	**BOD (mg/l)**	**SS (mg/l)**	**DO (mg/l)**	**Coli (MPN/ 100ml)**
Living Environ ment	I	- 1st grade source water for municipal use - Conservation of natural environment	6.5-8.5	≤1	≤25	≥7.5	≤50
	II	-2nd grade source water for municipal use -1st grade fishery water -Swimming water	6.5-8.5	≤3	≤25	≥5	≤1,000
	III	-3rd grade source water for municipal use -2nd grade fishery water -1st grade water for industrial use	6.5-8.5	≤6	≤25	≥5	≤5,000
	IV	-2nd grade water for industrial use -Irrigation water	6.0-8.5	≤8	≤100	≥2	nd
	V	-3rd grade water for industrial use -Conservation of municipal living environment	6.0-8.5	≤10	No trashes	≥2	nd
Protection of human health	whole water area	· No detection: CN, Hg, Organic Phosphorous, PCBs · ≤ 0.01mg/l : Cd · ≤ 0.05 mg/l : As, Cr^{6+} · ≤ 0.1mg/l : Pb · ≤ 0.5 mg/l : ABS					
Remarks	1. 1st grade fishery water: For aquatic creatures of clean water area 2. 2nd grade fishery water: For aquatic creatures of a slightly polluted water area 3. Conservation of natural environment: Environmental protection for natural monuments 4. 1st grade source water for municipal use: Usable after low level of treatment like filtration 5. 2nd grade source water for municipal use: Usable after general water treatment such as sedimentation and filtration 6. 3rd grade source water for municipal use: Usable after advanced water treatment including pre-treatment 7. 1st grade water for industrial use: Usable after usual treatment like sedimentation 8. 2nd grade water for industrial use: Usable after advanced water treatment like chemical application 9. 3rd grade water for industrial use: Usable after special treatment 10. Conservation of living environment: the degree not to give displeasure to daily lives of people 11. nd – not determined and/or not used						

Russia. The Federal Service on Hydrometeorology and Environmental Monitoring (ROSHYDROMET) is responsible for routine monitoring in Russia. In Primorskii Krai, monitoring of contamination of river and coastal waters is implemented by the Primorskii Krai Office on Hydrometeorology and Environmental Monitoring according to State Monitoring Programs.

The amount and quality of all types of municipal and industrial wastewater are controlled by regional agencies of the Federal Service for Environmental, Technological and Nuclear Supervision. Key is setting Maximum Permissible Discharges of wastes – MPD. MPD are developed by scientific and engineering organizations for different water users and are approved by the Federal Service for Environmental, Technological and Nuclear Supervision, and Ministry of Natural Resources. The regional offices of the Ministry of Natural Resources are responsible for ground water quality.

Table 4.13. Maximum Permissible Concentrations of Chemical Substances (mg/l) in Waters Used for Different Purposes

Parameter	Drinking	"Public" waters	Fishery purpose	TL
pH	6-9	6-9	6.5-8.5	4
Mineralization	1000	1000	1000	4
BOD_5	nd	nd	2.0	4
COD	5 ($KMnO_4$)	5 ($K_2Cr_2O_7$)	15 ($K_2Cr_2O_7$)	4
PHC(petroleum hydrocarbons)	0.1	0.1	0.05	3
Detergents (Surfactants)	0.5	0.5	0.1	4
Phenols (summary)	0.25	0.25	0.001	3
Al^{3+}	0.5	0.5	0.04	2/4
Be^{2+}	0.0002	0.001	0.0003	1/2
B (summary)	0.5	0.5	10*, 0.1	2/4
Fe (summary)	0.3	0.3	0.05*, 0.1	3/4
Cd (summary)	0.001	0.001	0.005	2
Mn(summary) , Ni(summary)	0.1	0.1	0.05*, 0.01	3/4
Cu(summary)	1.0	1.0	0.005*, 0.001	3
As(summary)	0.05	0.05	0.01*, 0.05	2/3
Se(summary)	0.01	0.01	0.0016	2
Hg(summary)	0.0005	0.0005	0.0001*	1
Cr	0.05 Cr^{6+}, 0.5 Cr^{3+}	0.02Cr^{6+}, 0.07 Cr^{3+}		3
Zn (summary)	5	1.0	0.05*, 0.01	3
Pb(summary)	0.03	0.03	0.01*, 0.1	3
$N\text{-}NO_3^-$	10	10	9.1	2
$N\text{-}NO_2^-$	0.75	0.8	0.02	3
$N\text{-}NH_4^-$	nd	1.0	0.4	2
SO_4^{2-}	500	500	100	3/4
F^-	1.2-1.5	1.5	0.75	2
CN^-	0.035	0.1	0.05	2/3
HCH	0.002	0.02	<0.00001	2/3
DDT (summary)	0.002	0.1	<0.00001	1
PCBs	0.001	0.001	0.0001	2/1

* - for sea water only; nd – not determined; TL for drinking water/TL for fisheries

Water quality assessments in Russia are based in compliance with maximum permissible concentrations (MPC is analogue of EQS). There are three sets of MPC in ambient water: (1) for the drinking water; (2) for the water of domestic, drinking and cultural uses – "public waters" (both according to former SanPIN 2.1.4.559-96, from the July 2003 – GN 2.1.2.1315-03); (3) for the water used for the fishery purposes. All substances are divided into four danger classes (toxicity level - TL) according to their toxicity for people and/or fish, cumulative and prolonged effects, etc: 1st class – extremely dangerous, 2nd class – high dangerous, 3rd class – dangerous, 4th – moderately dangerous.

MPC for the most common, potentially hazardous chemical substances in water for different types of water use are presented in Table 4.13. This list covers only a small part of the substances for which MPC are established. MPC are also set for more than 600 organic chemical substances in drinking water, more than 1,000 chemical substances in public water, and more than 800 chemical substances in water used for fisheries.

MPC for drinking water are a mandatory hygienic norm with no exceptions. For some public water and water used for fisheries, MPC are an environmental norm, that is, there is an option to exceed MPC with adequate deterioration of water quality.

Table 4.14. Water Quality Criteria based on Chemical Substance Concentrations (mg/l)

Parameter	**Type of water use**	**MPC**	**High pollution**	**Extremely high pollution**
Mineralization	fisheries	1,000	> 10,000	> 50,000
DO	fisheries		< 3.0	< 2.0
BOD_5	fisheries	2.0	> 10	> 40
$COD(K_2Cr_2O_7)$	fisheries	15	> 150	> 750
$N\text{-}NH_4^+$	fisheries	0.4	> 4.0	> 20
$N\text{-}NO_2$-	fisheries	0.02	> 0.2	> 1.0
$N\text{-}NO_3$-	fisheries	9.1	> 91	> 910
$P\text{-}PO_4$	fisheries	0.05	> 0.5	> 2.5
SO_4^{2-}	fisheries	100	> 1,000	> 5,000
Fe	hygienic	0.1	> 3.0	> 5.0
Al	fisheries	0.04	> 0.4	> 2.0
Zn	fisheries	0.01	> 0.1	> 0.5
Mn	fisheries	0.01	> 0.3	> 0.5
Ni	fisheries	0.01	> 0.1	> 0.5
Cu	fisheries	0.001	> 0.03	> 0.05
Cd	hygienic	0.005	> 0.015	> 0.025
Pb^{2+}	hygienic	0.006	> 0.018	> 0.03
Cr^{6+}	fisheries	0.02	> 0.2	> 1.0
Cr^{3+}	fisheries	0.07	> 0.7	> 3.5
PHC	fisheries	0.05	> 1.5	> 2.5
Detergents	fisheries	0.1	> 1.0	> 5.0
Phenols	fisheries	0.001	> 0.030	> 0.050
HCH, DDTs	fisheries	0.00001	> 0.00003	> 0.00005
F-	fisheries	0.75	> 7.5	> 37.5
B	hygienic	2.67	> 26.7	> 133.5
H_2S	fisheries	0.00001	> 0.00010	> 0.00050

The quantitative criteria for observed concentrations are established to classify contamination events in ambient water (Table 4.14). According to these criteria, all events are divided into pollution (exceeding MPC), high pollution (exceeding 5-30 MPC), and extremely high pollution (exceeding 20-50 MPC). The Office for Supervising the Protection of Consumer's Rights and Human Welfare, an agency of the Ministry of Health and Social Development, is the executive authority responsible for establishing sanitary hygienic MPC. The State Fishery Service, a subdivision of the Ministry of Agriculture, is responsible for establishing and confirming MPC for fisheries water.

The water quality assessment in all NOWPAP countries is based on the compliance with basic standards. Despite the differences in the substances listed in each country, there is an obvious, general similarity in water quality standards - EQS , WQS, MPC - in different countries (Table 4.15).

Table 4.15. Comparison of Some EQS (mg/l) for Surface Water in NOWPAP Countries

Characteristic	China*	Japan**	Korea***	Russia****	MDL, mg/L
DO ≥	7.5	7.5	7.5	5	0.2; 0.5
COD_{Mn}≤	2	1(lakes)	1(for lakes)	5	0.5
COD_{Cr}≤	15	nd	nd	15	1.5
BOD_5 ≤	3	1 (rivers)	1	2	0.4; 2.0
NH_4- ≤	0.15	nd	nd	0.4	0.002; 0.05
NO_3^- <	nd	10	nd	9.1	0.2; 0.01; 0.5
T P ≤	0.02	0.05	0.01(for lakes)	0.05[1]	0.001; 0.01
T N ≤	0.2	0.1	0.2 (for lakes)	9.5[1]	0.002; 0.05
Cu ≤	0.01	0.04	nd	0.001	0.001; 0.005
Zn ≤	0.05	0.03	nd	0.01	0.0005-0.05
F- ≤	1.0	0.8	nd	0.75	0.05; 0.2
Se ≤	0.01	0.01	nd	0.01	0.002
As ≤	0.05	0.01	0.05	0.005	0.0005; 0.005
Hg ≤	0.00005	0.0005	BDL	0.0005	0.00005; 0.0005
Cd ≤	0.001	0.01	0.01	0.001	0.0005; 0.002
Pb ≤	0.01	0.01	0.1	0.006	0.005; 0.040
Cr^6+ ≤	0.01	0.05	0.05	0.02	0.004; 0.010
CN-≤	0.005	BDL	BDL	0.035	0.01; 0.1
V-phen≤	0.002	nd	0.005	0.002	0.002; 0.005
oils≤	0.05	nd	nd	0.05	0.01; 0.02
surfactants≤	0.2	nd	0.5	0.1	0.01; 0.05
ColiForm≤	200	50	50	100	

All standards in mg/L, except ColiForm in MPN/100ml; MDL – minimum detection limit according to working documents of NOWPAP countries.
*- EQS for Grade I waters;
** - EQS for Grade AA waters and human health protection;
*** - WQS for Grade I Water;
**** - most strict MPC for fishery purpose waters; nd – not determined or not used; BDL - should be below detection limit; [1] – for dissolved forms (PO_4 and NO_3+NH_4+NO_2).

It should be noted that in China, Japan and Korea the EQS are applied to unfiltered water, though in Russia some MPC (for nutrients and some metals) are applied to filtered samples (for dissolved forms, only).

4.3. Methodologies and Procedures

4.3.1. Brief Characteristic of National Monitoring Water Quality Networks

China. 479 monitoring stations report monthly on t°C, pH, conductivity, DO, COD_{Mn}, BOD_5, NH_4-N, oil, volatile phenols, Hg, Pb as monitoring items, and 43 weekly reported automatic monitoring stations with t°C, pH, DO, COD_{Mn}, conductivity, turbidity, total organic carbon (TOC) and NH_4-N as monitoring items.

Japan. 247 stations report monthly on environmental standard and supplementary points for the first class rivers (35 rivers NOWPAP). Monitoring items include SS, DO, COD_{Mn}, BOD_5, T-N, T-P, NO_2, NO_3, Pb, Cd, Cr^{6+}, As, Hg, Se, F, B plus 15 organic pollutants like benzene, thiuram, PCBs etc.

Korea. 559 monitoring stations report monthly on 4 rivers, including 21 major stations that report weekly. Monitoring items include pH, SS, Conductivity, DO, COD_{Mn}, BOD_5, T-N, NO_3 , NH_4-N, T-P, phenols, Coli. Some additional parameters (PO_4, Chl-a, CN, Cd, Pb, As, Cr^{6+}, Hg, detergents) are measured quarterly (4 times/yr) and others (PCBs, organic pollutants) are measured once a year on the same network.

Russia. 43 stations, including 20 that report monthly and 13 quarterly (4 times/yr) reported. Monitoring items at monthly reported stations include t°C, pH, conductivity, DO, SS, BOD_5, COD_{Cr}, and 2-3 characteristic pollutants. On the quarterly operated stations the additional parameters are determined including macro-ions, N-NH_4, NO_3, NO_2, PO_4, Fe, Si, oil products (PHC), PAHs, trace metals, POPs.

4.3.2. Methodological Features of Sample Preservation and Analysis

The main features of water sample analysis used for the water quality monitoring in the NOWPAP countries are presented at the Table 4.16 and 4.17. Preservation methods are fairly similar in all NOWPAP countries. The key discrepancy is data on nutrients and metals because Russia pre-treats filtered samples and other NOWPAP countries use unfiltered samples. Another issue is a COD using $KMnO_4$ as an oxidant in China, Japan and Korea, and COD using a stronger reagent $K_2Cr_2O_7$ in Russia. A third issue is the widespread use of total nitrogen (TN) and total phosphorus (TP) for the assessment of water quality in all NOWPAP countries except Russia.

The methods used in the NOWPAP countries to determine many substances are similar, for example, dissolved oxygen (DO), BOD_5, COD, NH_4-N, metals, CN-ions, TP, TN, detergents. The main methods are **UV-Vis Spectrophotometry** (=Colorimetry=Absorptiometry) for nutrients, surfactants (detergents, ABS), CN-ions, boron determination; **Ion selective potentiometry** for DO, BOD, pH determination; **Atomic absorption spectrophotometry** in different modification (or **ACP-OES/ACP-MS**) to determine metals with corresponding sensitivity; **Ion Chromotography** (**IC**) for nutrients (alternatevily or complementary), sulfate, chloride; **Gas Chromatograhy** (**GC**) for the organic contaminants (PCBs, chlorine- and phosphorus-organic pesticides, chloroethylenes, etheres, volatile compounds like benzene and toluene). The detection limits are depended upon equipment used, but as a rule significantly less than water quality standards. The only exception is absorptiometric determination of volatile phenols with detection limit 0.002-0.005 mg/l in China, Korea, and Russia that is practically equal to the water quality standards.

Table 4.16. Water Sample Preservation Methods Used in NOWPAP Countries

Parameter	**China unfiltered**	**Japan unfiltered**	**Korea unfiltered**	**Russia***
COD_{Mn}	0-5° C	0-5° C	H_2SO_4 (pH<2)	u 0-5° C
COD_{Cr}	H_2SO_4 (pH<2)	nd	nd	u 0-5° C
BOD_5	0-5° C	0-5° C	0-5° C	u 0-5° C
NH_4^-	H_2SO_4 (pH<2)	0-5° C	H_2SO_4 (pH<2)	f, $CHCl_3$
T P	H_2SO_4 (pH<2)	0-5° C	H_2SO_4 (pH<2)	nd
T N	H_2SO_4 (pH<2)	0-5° C	H_2SO_4 (pH<2)	nd
Cu, Zn, Cd	HNO_3(pH<1)	HCl (pH<1)	HNO_3 (pH<1)	f, HNO_3(pH<1)
Se	HNO_3(pH<1)	HCl (pH<1)	HNO_3 (pH<1)	f, HNO_3(pH<1)
As	HNO_3(pH<1)	HCl (pH<1)	HNO_3 (pH<1)	f, HNO_3(pH<1)
Hg	HNO_3(pH<1)	HCl (pH<1)	HNO_3(pH<1)	f, HNO_3(pH<1)
Pb	HNO_3(pH<1)	HCl (pH<1)	HNO_3 (pH<1)	f, HNO_3(pH<1)
Cr^{6+}	NaOH (pH8-9)	HCl (pH<1)	0-5° C	f, 0-5° C
CN^-	NaOH (pH8-9)	NaOH, pH>11	NaOH (pH>11)	u, NaOH (pH>11)
V-phen	H_3PO_4(pH<2)	nd	H_2SO_4 (pH<4)	u 0-5° C
Oils	HCl (pH<2)	nd	H2SO4 (pH<2)	u, CCl_4 (2ml/l)
Surfactants	H_2SO_4(pH<2)	nd	0-5° C	u, $CHCl_3$(2ml/l)

*Russia – unfiltered samples (u), except nutrients (NH_4-N, NO_3, NO_2, PO_4) and dissolved metals which are analyzed in filtered samples (f); nd - not determined or not used in regular monitoring of water quality.

Significant differences in methods are listed in Table 4.17. There is a difference in detecting NH_4-ions limits due to various modifications of the methods used. Nitrate analysis is carried out using different methods: absorptiometric in Japan, ion chromatography in Korea, and ion selective potentiometry in Russia with corresponding sensitivity. In China nitrate content is not a monitored parameter in river water. The same is true for fluorine determination. The analysis of phenols is carried out by less sensitive absorptiometric methods in China, Korea and Russia. The minimum detection limit (MDL) for the determination of phenols by this method is close to the EQS for the Grade I and Grade II surface waters in China or MPC for the pristine waters in Russia, and improvements of the analytical method is needed. The monitoring of phenols in Japan is carried out in the effluents only by the conventional methods according to the pretty high permissible limits. Oil (petroleum hydrocarbons extracted by hexan or carbon tetrachloride) content in water is analyzed by IR-spectrophotometry in China and Russia, but in Japan and Korea this parameter is not used in the routine monitoring of surface water quality.

Table 4.17. Key Differences in Water Analysis Methods Used in NOWPAP Countries

Parameter	China	Japan	Korea	Russia
NH^{4-}	Colorimetric, 0.01-0.05 mgN/l	Absorptiometric, 0.7 mgN/l	Absorptiometric, 0.002 mgN/l	Colorimetric, 0.05 mgN/l
NO_3	nd	Absorptiometric, 0.2 mgN/l	IC, 0.01 mgN/l	Ion selective electrode, 0.5 mgN/l
F-	nd	Absorptiometric, 0.2 mg/l	nd	Ion selective electrode, 0.01mg/l
Phenols	4-AAP spectrophotome tric, 0.002 mg/l	nd	Absorptiometric 0.005 mg/l	Absorptiometric, 0.002 mg/l
Oils	IR-spectrophoto-metry, 0.01 mg/l	nd	nd	IR-spectrophoto-metry, 0.02 mg/l

nd - not determined and/or not used for water quality monitoring.

4.3.3. QA/QC Procedures

In China QA/QC procedures for water quality monitoring are described in detail in the GB3838-2002 - Environmental Quality Criterion of the Surface Water - that includes guidelines for sampling, storage, preservation and analysis.

In Japan each institution conduction analyses must obtain a license guaranteeing accuracy; this is mandated in the Measurement Law. It must also comply with ISO/IEC17025 (JIS Q 17025), an international standard for accurate management and skills testing based on ISO/IEC Guide 43-1 (the Japan Chemical Analysis Academy).

In Korea the QA/QC procedures for surface water quality monitoring are implemented according to rules set and approved by the MOE. The components of QA/QC include well calibrated equipment, use of only standard operating procedures, personnel training, rigorous quality control procedures (precision and accuracy), measurements that ensure data tracking and data verification.

The QA/QC procedures in Russia (Primorskii Krai Environmental Monitoring Center (EMC) are executed according to official recommendations of the State Committee of Russia on Standards, Metrology and Certification No. 52.24.509-96, “Implementation of Measures Regarding the Quality of Hydrochemical Information”, and No. 52.18.599-98 “Implementation of Inspections of the Accredited Laboratories (Centers).” External quality control by the State Hydrochemical Institute (Rostov-on-Don), Scientific-Production Association “Typhoon” (Obninsk) and the ADORC Center (Niigata) is regularly carried out to verify analytical techniques, thus using blind samples (at least once a year).

4.4. Research Activities (National and International)

China. A joint Chinese and Republic of Korea international cooperation project called "Yellow Sea Environmental Cooperative Research" was carried out during 1996-2004. Another cooperative project on technologies for environmental protection and management of the Olympic sailing boat venue and adjacent marine environment was executed in 2002 with the cooperation of the Qingdao Environmental Monitoring Center and the First Institute Oceanography of State Oceanic administration and Ocean University of China. This is a successful, ongoing project.

Japan. There are a number of past and current research projects underway on river environments to the fill data gaps left in National Monitoring Programs. For instance, chemical substance loads in rivers cannot be evaluated without additional data. Furthermore, the load assessment needs certain models to estimate unknown variables. In this regard, research activities to design models are equally important to the monitoring effort.

A group of civil engineering researchers have systematically assessed environmental changes in rivers based on the data of the River Water Quality Monitoring and they proposed adding inorganic nutrients such as nitrate, nitrite, ammonia, phosphate and silicate to the monitoring parameters, although the main indicators of the river environment have primarily been BOD, total-N and total-P.

A group of researchers recently proposed the "Global NEWS" (Global Nutrient Export from Watersheds) as a program for LOICZ under the IGBP (International Geosphere-Biosphere Program). The objective is to construct a spatially explicit, multi-element (N, P, Si and C) model to understand human and natural processes. They also intend to link up with the UNEP-Mediterranean Action Plan and with UNESCO. Research includes verification of the "silica deficiency hypothesis" as the project studies deterioration of marine environments due excessive N and P and a decline in Si, including an analysis of historic data on river water quality before and after the 1960s (period of rapid economic growth) and an assessment of the effect of the economic growth. Dissolved inorganic nutrients are measured monthly in the Sai River (with dams) and the Chikuma River (with fewer dams) that merge to form the large Shinano River flowing into the NOWPAP Region.

Korea. A network of research institutes that include NFRDI, KORDI and NIER are carrying out various research projects.

NFRDI (National Fisheries Research & Development Institute under MOMAF authority) is responsible for the national marine environment monitoring program. It has also surveyed the outbreak of red tides in coastal areas. NFRDI plans to revise the monitoring program to include trace metals and persistent organic pollutants in the sediment and biota (fish and bivalves). It needs high resolution GC-MS, HPLC-MS to study the persistent organic pollutants and endocrine disruptors in the marine environment.

KORDI (Korea Ocean Research & Development Institute) has been carrying out short-term, typically three year, research projects funded by MOMAF, MOE, MOST and by other government agencies and private sectors. It has been carrying out monitoring projects to not only survey pollution levels but to also look at the effects of pollutants on marine organisms like biomarkers (histopathology of bivalves) and marine snails. It needs high resolution GC-MS, HPLC-MS to study the persistent organic pollutants and endocrine disruptors in the marine environment.

NIER (National Institute of Environmental Research) is responsible for supporting the Ministry of Environment in formulating environmental policies through surveys and studies, research, tests and assessments related to environmental pollution prevention. NIER is responsible for monitoring air and surface and ground water quality. Since the appearance of phenol pollution in river water used for drinking, the Ministry of Environment has invested adequately to purchase modern equipment like high resolution GC-MS and ICP-MS.

Russia. Scientific research on surface water chemical composition and quality is carried out at Russian Academy of Sciences Institutes (Pacific Geographical Institute - PGI, Pacific Oceanographic Institute - POI, Far Eastern Geological Institute - FEGI), ROSHYDROMET divisions (FERHRI) and universities.

PGI and FERHRI specialists have for several decades been studying river inputs into marine environments. Chudaeva (2002) recently published a book on river transport of different chemical substances in the Russian Far East from Chukotka to Primorskii Krai. Shulkin (2004) at PGI obtained and published new data on Zn, Cd, Pb, Cu, Mn and Fe concentration levels in river water in Primorskii Krai. These data improve the opportunities to use metal concentrations in river water to trace the level of anthropogenic press on ecosystems. Gavrilevski et al. (1998) at FERHRI has collected and analyzed information on possible sources that are directly polluting the sea adjacent to Vladivostok.

Specialists at the Pacific Oceanographic Institute (POI) carried out comprehensive investigations of river-sea interactions. Field surveys in the NOWPAP region were implemented in the Razdolnaya River and its estuary that flows into Amursky Zaliv. Different kinds of laboratory experiments and computer modeling of river-sea systems (carbonate system components in estuaries) were also performed (Tischenko et al., 2005, Zvolinski et al., 2005).

Sorption process modeling shows that mercury, vanadium, and arsenic in sea water and river water are largely an adsorbed form while the share of suspended cobalt and chromium in river water is only 14.4 and 4.6%, respectively. In sea water they are in totally dissolved form.

POI researchers also estimated the discharge of trace metals to the marine environment via different routes: river inputs, industrial wastewater and atmospheric deposition (e.g., Mishukov et al., 2001).

4.5. Training Activities

China. Technical training and forums on automated monitoring of surface water were conducted three times in 2002. Participants represented 42 automated stations and the relevant provincial monitoring centers. Technical training to assess surface water was held in XinJiang Province on September 23-25, 2004. The participants came from 31 Provincial monitoring centers and the monitoring centers of 47 key cities.

Technical training for monitoring red tide was held in Zhoushan in June, 2004. The participants learned theory and techniques for monitoring red tide.

In October - December 2004 CNEMC and the Off-Shore Environmental Monitoring Center held meetings for marine water monitoring laboratories. The components are NO_3-N, NO_2-N, NH_3-N and active phosphate.

Japan. The National Environmental Research and Training Institute (Ministry of the Environment) conducts trainings for MoE, national and local government staff on environmental administration. The training issues include 1) administration training, 2) international training, 3) analysis training, 4) training for environmental officials, and 5) an environmental administrative business. The analysis training includes water quality, endocrine disrupters, dioxins, plankton and benthos, advanced analysis technology.

The Japan Sewage Works Agency conducts practical training for government sanitary and sewer engineers that includes 1) planning and design of sewage systems and treatment works, 2) management, 3) execution design, 4) construction supervisor management, and 5) control of maintenance with water quality issues.

The Research Laboratory for Public Health set up in prefectures and designated cities for an integrated organization to protect human health from infectious diseases, toxic chemicals (dioxin etc.) in food and drinking water. The laboratory also conducts training and provides guidance on health, safety and environmental protection.

Korea. The Environmental Training Department of the National Institute (NIER, MOE) carries out trainings in various fields of environmental administration for national and local government staff responsible for protecting the environment. Training issues include: 1) environmental administration, 2) environmental policy, 3) natural environment, 4) water management, 5) waste management, 6) environment management, and 7) environmental analysis. The content of the last is the analysis of water quality, endocrine disrupters, toxic chemicals including dioxins, and familiarization with advanced equipment.

The Training Support Team of NFRDI (MOMAF) trains Government officers, Fishermen and Marine industry. Training areas are Basic and Professional Training Course, Fishermen Training Course, and Video Communicating Training Course.

The Korea Institute of Maritime and Fisheries Technology (KIMFT) carries out education and training of personnel engaged in maritime and fisheries sectors, services promoting an international exchange of technology related to maritime affairs and fisheries, and services for the execution of the maritime license examination. KIMFT has devoted great effort to improve seamen competency and proficiency together with developing training courses, publishing up-to-date training materials, dispatching trainers for on-board, practical study, and to installing high-tech training facilities.

KORDI carries out international training for APEC and PEMSEA countries twice a year in courses that last three weeks. Training includes analytical techniques for POPs, oil pollution, nutrients and on board training.

Russia. Primorskii Hydrometeorological Service specialists are trained in Moscow and Rostov-on-Don and at ROSHYDROMET central institutions. Training at research institutions is done using a “hands-on” approach, i.e. young researchers are being trained during field surveys, expeditions, laboratory experiments.

The specialists from the subdivisions of Federal Service for Environmental, Technological and Nuclear Supervision, involved in the control of the chemical composition of wastes, are trained in the key laboratories of central institutions, and at the different training courses arranged by Federal Service. The central office of the Ministry of Natural Resources is responsible for the training courses on the management of water use, including the issues of water quality assessment.

5. Present Situation

5.1. Chemical Composition of River Run-Off

China. The 2002 annual averaged water quality data available for down streams areas in the Chinese sector of the NOWPAP are presented in Table 5.1. These data are obtained by China National Environmental Monitoring Center (CNEMC) at the closest to the river mouth sections.

Table 5.1. Chemical Composition of Main Chinese Rivers Flowing into the NOWPAP Marine Environment.

Rivers	**Water discharge (m3/s)**	**SS (mg/l)**	**BOD_5 (mg/l)**	**COD_{Mn} (mg/l)**	**DO (mg/l)**	**NH_4 (mgN/l)**	**NO_2 (mgN/l)**
Yalu	1200*	76.5	1.63	3.33	9.8	0.086	nd
Daliaohe	469	383.4	2.57	12.9	4.1	1.801	0.355
Dalinghe	117.6**	nd	7.34	8.68	7.3	1.920	nd
Luanhe	144.3**	6.3	2.09	3.20	10.54	0.177	0.042
Yongdingxinhe	nd	nd	6.14	6.46	nd	0.978	nd
Chaobaixinhe	nd	nd	12.4	15.7	nd	9.0	nd
Haihe	723	nd	8.68	7.13	nd	16.4	nd
Yellow	2,087	nd	2.83	4.09	8.27	0.35	0.024
Huaihe	1,972	34.4	1.0	3.49	7.68	0.687	0.033
Yangtze	30,166	nd	2.31	2.51	nd	0.075	nd
MPC*		nd	***3***	***2***	***7.5***	***0.15***	nd
Rivers	**NO_3 (mgN/l)**	**oils (mg/l)**	**Phenols (mg/l)**	**Pb (μg/l)**	**Cd (μg/l)**	**Hg (μg/l)**	**As (μg/l)**
Yalu	2.2*	0.024	0.0017	1.0	nd	0.02	4.0
Daliaohe	0.38	0.114	0.0003	1.1	1.0	0.01	1.0
Dalinghe	nd	0.384	0.0073	2.0	nd	0.05	4.0
Luanhe	2.20	0.01	0.001	1.0	0.07	0.01	4.0
Yongdingxinhe	nd	0.41	0.009	4.0	nd	0.41	nd
Chaobaixinhe	nd	0.81	0.001	10.0	nd	nd	nd
Haihe	nd	0.037	0.003	6.0	nd	0.24	nd
Yellow	3.15	0.009	0.001	8.0	0.2	nd	nd
Huaihe	0.36	0.052	0.001	1.0	0.1	0.11	4.0
Yangtze	nd	0.068	0.001	1.0	0.1	0.02	nd
MPC*	nd	***0.05***	***0.002***	***1.0***	***1.0***	***0.05***	***50***

Notes: * - by Zhang et al., 1998; ** - discharge assessed by watershed square; MPC** = maximum permissible concentration for the Grade I waters; nd - no data. SS - suspended solids; DO – dissolved oxygen; All nutrients and metal in unfiltered samples; No data on Si, PO_4, Fe_{tot} , Mn, Cu, Zn, HCH and DDT concentrations in river waters

Japan. 2002 data on water quality of first class Japanese rivers that flow into the NOWPAP region are presented in Table 5.2. These data were obtained at the environmental standard points closest to the river mouths.

The mean value of BOD is in the range of 0.5-2.1mg/L, and COD is 1.7-5.5mg/L. COD and BOD are indexes of organic pollution in rivers that flow in the NOWPAP region.

All volatile organic compounds (dichloromethane, trichlorethylen etc.) as well as benzene, thiuram, thiobencarb are not found in the first class Japanese rivers, that is less than MDLs, which in turn one order less than EQSs.

Table 5.2. Water Quality of the Japanese Rivers that Flow into the NOWPAP Region (mg/L)

Rivers	SS	BOD_5	COD	T-N	T-P	NO_2	NO_3	NH_4*	Si*	Pb	As
Teshio	5	0.6	3.6	0.51	0.032	0.020	0.76			<0.005	0.007
Rumoi	15	2.1	5.5	1.27	0.065	0.043	0.117			**0.008**	nd
Ishikari	35	1.0	4.9	1.12	0.074	nd	nd	0.10	8.4	nd	<0.005
Shiribetsu	4	0.5	2.4	nd	nd	nd	nd			nd	<0.005
Iwaki	15	1.7	3.8	1.4	0.075	0.044	nd			**0.002**	**0.001**
Yoneshiro	5	1.2	nd	0.68	0.023	nd	nd			<0.005	<0.001
Omono	9	1.2	nd	0.84	0.033	nd	nd			<0.005	<0.001
Koyoshi	9	1.2	nd	0.74	0.049	nd	nd			<0.005	<0.001
Mogami	17	0.9	2.5	0.73	0.03	nd	nd	0.01	7.0	<0.005	<0.001
Aka	11	0.8	2.1	0.61	0.029	0.01	0.2			<0.005	<0.005
Ara	4	0.6	2.2	0.33	0.016	<0.01	0.22			<0.005	<0.005
Agano	8	0.8	2.5	0.59	0.056	nd	nd			nd	<0.005
Shinano	13	1.2	3.2	0.92	0.085	nd	nd	0.04	7.2	nd	nd
Seki	25	1.2	3.9	1.13	0.073	0.02	0.41			<0.005	<0.005
Hime	95	0.9	3.5	0.64	0.288	nd	nd			nd	0.006
Kurobe	7	0.6	1.7	0.28	0.018	<0.05	0.16			<0.005	<0.005
Joganji	9	0.8	2.1	0.58	0.022	<0.05	0.24			<0.005	<0.005
Jintu	7	1.3	2.4	1.53	0.039	<0.05	0.62	1.43	5.8	<0.005	<0.005
Sho	10	0.9	2.4	nd	nd	nd	nd			nd	<0.005
Oyabe	8	2.1	4.4	1.4	0.105	<0.05	0.77			<0.005	<0.005
Tedori	34	1.1	nd	0.52	0.044	0.01	0.34	0.01	4.1	<0.005	<0.005
Kakehashi	11	0.8	nd	0.69	0.039	0.01	0.4			**0.005**	<0.005
Kuzuryu	9	1.4	3.7	nd	nd	nd	nd	0.13	4.7	<0.002	<0.005
Kita	9	0.6	2.3	nd	nd	nd	nd			<0.002	<0.005
Yura	4	0.7	2.5	0.78	0.049	0.01	0.61			<0.005	<0.005
Maruyama	5	2.0	nd	0.48	0.054	nd	nd			**0.002**	**0.001**
Chiyo	3	1.4	1.9	nd	nd	nd	nd			<0.005	<0.005
Tenjin	2	0.8	1.8	nd	nd	nd	nd			<0.005	<0.005
Hino	16	1.3	3.5	nd	nd	nd	nd			<0.005	<0.005
Hii	7	1.3	nd	0.71	0.03	0.003	0.317			<0.005	<0.005
Gono	2	0.5	nd	nd	nd	nd	nd	0.01	5.6	<0.005	<0.005
Takatsu	2	0.5	nd	nd	nd	nd	nd	0.12	4.7	<0.005	0.005
Onga	7	1.7	3.3	1.31	0.105	nd	nd	0.15	1.1	<0.005	<0.005
EQS for AA	***25***	***1.0***	***5.0*****	***0.4*****	***0.03*****	nd	nd			***0.010***	***0.010***

Notes: Unfiltered samples are measured for all monitoring items except NO_2^- and NO_3; nd - no data; "<" means that the values are under the MDL (1974); dissolved oxygen (DO) concentration in Japanese rivers vary from 8.3 to 12 mg/l that is always more than EQS 7.5 mg/l; * - data on NH_4 and Si are from 2000; ** EQS for the lakes III class (according to SS values)

Cd, Cr, Hg, and Se concentrations are always less than MDL registered in the government manual published in 1974, that is Cd < 0.001-0.005 mg/l; Cr^{6+} <0.02-0.005 mg/l; Hg < 0.0005 mg/l, Se<0.002 mg/l. The values for Cd, Se, and Cr^{6+} (partly) are one order less than corresponding EQS. For Hg MDL established in 1974 (0.0005 mg/l or 0.5 µg/l, or 500 ng/l) is equal to EQS. Fluorine and boron concentrations vary between <0.02-0.30 mg F^-/l and <0.08-0.15 mg B/l, that is far less than EQS 0.8 and 1.0 mg/l respectively.

High level scientific research to determine persistent organic pollutants (POPs) has been carried out on the Ishikari River (Hokkaido Island) (Table 5.3).

Table 5.3. Concentration of POPs in the Ishkari River on 2002 (ng/L)

POPs	Sample No. 1	Sample No. 2	Sample No. 3	Average	MDL
PCBs	0.180	0.420	0.370	0.32	0.0009
Aldrin	0.0013	0.0011	0.0013	0.0012	0.0006
Dieldrin	0.071	0.076	0.082	0.076	0.0018
Endrin	0.008	0.008	0.008	0.008	0.006
DDT(p,p'+ o,p')	0.272	0.246	0.497	0.338	0.0006
DDE(p,p'+ o,p')	0.114	0.089	0.154	0.119	0.0006
DDD(p,p'+ o,p')	0.068	0.065	0.109	0.081	0.00024
Chlordane	0.041	0.042	0.068	0.050	0.0015
alpha-HCH	0.150	0.180	0.250	0.19	0.0009
beta-HCH	1.1	1.1	1.1	1.1	0.0009

Korea. The results of monitoring the water quality of the major rivers that flow into the NOWPAP region in fiscal year 2002 are summarized in Table 5.4. These values are the average for downstream rivers. The mean value of COD is in the range of 2.9-6.2 mg/L, and BOD is 0.9-3.4 mg/L.

The COD standard is established for lake water with low SS only. COD is higher in the much more turbid rivers. BOD standards at 2 and 3 mg/l are considered normal. COD and BOD values in Korean rivers indicate 'satisfactory' condition. However, some small rivers like Anseongcheon, Sapghocheon and Hyeongsan (not included in the list of major rivers in Table 2.1) showed BOD values 4.0-6.7 mg/l and COD 6.6-8.8 mg/l indicating attention is necessary.

High counts of fecal coliform bacteria in rivers, streams and lakes are caused by feces contamination. While most Korean rivers fall within the safe Grade I and II range, Han and Nakdong Rivers and some small streams exceed the upper limit.

Slightly below WQS concentration of dissolved oxygen (DO) is observed in Han River only, though DO observed (7.1 mg/l) much higher than fatal 2 mg/l, and even more than 5-6 mg/l level is sufficient for most aquatic species. The pH values in Korean Rivers fall within range 7.0-7.8 that is complies with WQS.

Total Nitrogen (TN) and total Phosphorus (TP) are used as a eutropication index in closed water areas such as lake and bays, so assessing river water quality with TN and TP should be done with care. The US EPA recommended values for TN in rivers is 6 mg/L and Han River exceeded this limit. The US EPA recommended values for TP is 1 mg/L and fortunately, the value is far lower in all the sampled rivers. The US EPA limit for NO_3 is 10 mg/L and the values in Table 5.4 is much lower.

A value of 0.2 mg/L was identified as a pollution threshold for ammonia. If we apply this to our data, 80% of the sampled rivers exceed this limit. According to US EPA, phosphates in rivers should not exceed 0.025-0.05 mg/L.

Table 5.4. Water Quality of Major Korean Rivers (2002)

River	DO (mg/l)	COD (mg/l)	BOD (mg/l)	SS (mg/l)	E-Coli (MPN)	TN	TP	NO_3	NH_4	PO_4
Han	7.1	6.2	3.4	13.2	1.3×10	7.9	0.3	2.2	2.0	0.2
Nakdong	9.2	5.8	2.5	16.1	6.8×10^2	3.3	0.1	2.4	0.4	0.1
Geum	9.0	7.4	3.3	22.1	1.7×10^3	4.4	0.1	2.6	0.9	0.1
Yeongsan	9.9	5.7	1.9	12.7	2.8×10^2	5.2	0.1	3.1	0.3	0.1
Seomjin	7.9	2.9	0.9	2.8	1.1×10^1	0.7	0.0	0.4	0.1	0.0
WQS	***>7.5***	***6****	***1-3****	***25***	***50-1000****	***0.2****	***0.01****	***9.1*****	***0.2***	***0.05*****

*- US EPA standards;
** - Russian MPC;
*** - Korea WQS for ground waters and river waters I and II Grade.

Cd, Pb, Cr^{6+}, As, Hg, phenols and cyanide (CN) were also monitored, but all were under the method detection limit (MDL). Moreover MDL for all metals except Hg are one order below WQS. For Hg, CN-ions and phenols MDLs are close to WQS. Noteable ABS (alkyl benzene sulfonate) concentrations 0.010 mg/l have been found in Han River only.

Russia. 2002 data on chemical composition and concentration of contaminants in the river water of Primorskii Krai obtained by the state Environmental Monitoring Center (EMC) of Primorskii Territorial Office on Hydrometeorology and Environmental Monitoring are presented in Table 5.5. The data were used on the stations of State Observation Network closest to the sea coast. One must note that hydro-chemical observations of the region are rather uneven. A number of rather large rivers in the largely unpopulated north, including the Koppi, Botchi and Tumnin Rivers are not described with respect to contaminant concentrations.

Dissolved oxygen (DO) and pH of river water do not indicate any deterioration in water quality. At the same time, BOD values exceed MPC 2 mg/l in all rivers draining moderately populated and economically developed watersheds. The only exception is down stream of the Tumen River with rather low BOD but with elevated COD that exceeds MPC 15 mg/l.

NH_4 and NO_2 as well as PO_4 ions in river water equal or exceed MPC in the most anthropogenically loaded Razdolnaya and Rudnaya Rivers only. Down stream of the Tumen River in China, NH_4 content is also elevated, but near the Tumen River mouth in Russia NH_4 decreases while NO_3 increase.

Phenol and oil (petroleum hydrocarbons – PHC) concentrations exceed MPC in the most anthropogenically influenced rivers, though MPC for phenol is nearly equal to MDL and improvement of the method used for the determination of phenol is needed. The concentrations of chloro-organic pesticides group DDT (sum of DDT and its metabolites DDD and DDE) were less than 35 ng/l, and group HCH (sum of hexachlorcyclohexan isomers) were less than 4 ng/l in the rivers studied.

Table 5.5. Chemical Composition of Primorskii Krai Rivers Flowing into the Sea (average for 2002)

Rivers	**SS* (mg/l)**	**BOD_5 (mg/l)**	**COD (mg/)**	**DO (mg/l)**	**Si (mgSi/)**	**NH_4 (mgN/l)**
Tumen**	124 (126)	1.93 (2.18)	18.8 (20.1)	10.5 (5.59)	12.2 (-)	0.17 (0.54)
Tsukanovka	9.6	3.79	4.32	12.1	7.96	0.03
Razdolnaya	73	11.9	15.1	12.1	6.4	0.44
Artyomovka	38.7	1.94	7.76	11.4	5.7	0.03
Partizanskaya	38.7	2.2	6.7	11.7	3.9	0.02
Margaritovka	22.5	1.75	5.4	10.7	4.6	0.05
Avvakumovka	22.5	1.81	5.9	12.4	5.0	0.04
Zerkalnaya	22.5	1.28	5.4	11.5	4.0	0.08
Rudnaya	19.6	1.03	6.5	12.5	4.5	0.10
Serebryanka	21.7	1.4	4.3	11.8	5.3	0.07
Maksimovka	21.7	2.4	7.5	13.2	5.4	0.04
Samarga	21.7	0.7	9.0	13.4	5.3	0.05
MPC	***-***	***2.0***	***15***	***<3.0***	nd	***0.4***
Rivers	**NO_2 (mgN/l)**	**NO_3 (mgN/l)**	**PO_4 (mgP/l)**	**PHC (mg/l)**	**Phenols (mg/l)**	**Sufract (mg/l)**
Tumen	0.014 (0.015)	0.29 (0.19)	0.013 (-)	0.02 (-)	0.003 (0.0028)	0.020 (-)
Tsukanovka	0.004	0.01	0.007	0.01	0.001	0.015
Razdolnaya	0.03	0.22	0.047	0.04	0.004	0.024
Artyomovka	0.003	0.01	0.006	0.06	0.001	0.008
Partizanskaya	0.004	0.01	0.003	0.07	0.001	0.012
Margaritovka	0.001	0.02	0.001	0.03	0.001	0.005
Avvakumovka	0	0.02	0.002	0.13	0.001	0.005
Zerkalnaya	0.003	0.05	0.034	0.08	0.003	0.014
Rudnaya	0.022	0.02	0.117	0.04	0.002	0.018
Serebryanka	0	0.12	0.002	0.04	0.002	0.005
Maksimovka	0	0.01	0.003	0.01	0.001	0.005
Samarga	0	0.08	0.002	0.08	0.002	0.016
MPC	***0.020***	***9.1***	***0.050***	***0.050***	***0.001***	***0.100***

*– averaged for all period of observation; **SS** = suspended solids; All **nutrients** in filtered samples, other parameters in unfiltered; **Sufract** – concentration of anionic detergents; **MPC** = maximum permissible concentration for the Russian fresh waters analogous to Water Class I-II (Korea) or A-AA (Japan);
** - data from Chinese NR are presented in brackets

The observation on the down reach of Tumen River are carried out by China specialists (40 km up stream of river mouth), and Russia specialists (15 km up stream of river mouth). Taking in mind some differences in sampling places and methods, data for down stream reaches of the Tumen River gathered by Russia and China show good concordance.

The use of trace metal (heavy metal) concentrations for water quality assessment as part of routine monitoring procedures in Russia meets with some of the same problems as encountered in other countries (for example, MAP MTS #141, 2003). The main reasons are analytical problems in obtaining reliable “contamination-free” results and the need to use filtered samples for analysis given an affinity of most metals to suspended particles. Analytical monitoring procedures in China, Japan and Korea are, as a rule, carried out with unfiltered samples. At the same time, the usefulness of metal concentrations in rivers for assessing anthropogenic influence on the surface waters is obvious.

Existing reliable data on dissolved forms of some metals in Russian rivers within the NOWPAP region are presented in Table 5.6. These data have been borrowed from the scientific research of Pacific Geographical Institute RAS.

Table 5.6. Concentration of Dissolved Forms of Metals (μg/l, filtered through 0.45 μm pore filters) in Some Rivers Flowing into the NOWPAP Region of Primorskii Krai

Rivers	**Pb**	**Cu**	**Mn**	**Fe**	**Cd**	**Zn**	**Ni**
Tumen	0.14	1.82	115	75.3	0.030	1.14	0.63
Tsukanovka	0.037	0.44	5.6	11.5	0.025	0.21	0.14
Razdolnaya	0.023	1.27	14.9	23.7	0.012	0.36	0.80
Artyomovka	0.19	0.75	10	44	0.014	0.7	0.61
Rudnaya	0.64	1.35	110	21	0.25	120	0.8
MPC	***6***	***1***	***10***	***100***	***5***	***10***	***10***

The concentrations of most potentially hazardous dissolved forms for heavy metals Cd and Pb are far below MPC as well as for Zn and Ni. The only exception is the polluted Rudnaya River that drains a mining district. Dissolved Cu concentrations exceed MPC 1 μg/l (0.001 mg/l) in many rivers, but are explained by unsupportable low MPC established for exclusively ionic dissolved forms of Cu, though in natural water the major part of dissolved Cu is presented by less toxic organic complexes. Dissolved Mn and Fe are not very toxic, but in some rivers concentrations of these metals exceed MPC. This is explained by prevalence of colloidal forms for Fe and mobilization from solid phase for Mn.

5.2. Temporal Trends in River Water Quality

The trend in water quality from 1995 to 2002 in the rivers of west coast Japan is a plateau or a decreasing tendency though there is a difference of the change pattern in each rivers. In Korea the only parameter that has shown a decreasing trend over the 1995-2003 was a BOD that is a sign of improving water quality. COD measurements confirm this trend. In Russia a significant trend was observed for the Razdolnaya River where BOD values showed an increase during the 1995-2003 period, although ammonia concentration decreased at the same time, and dissolved oxygen increased

5.3. Pollution Loads through Rivers

When referring to river water quality, the concentration of chemical substances is an issue, but when discussing river input into, and river influence on the marine environment, the load (flux) of substances carried by rivers becomes more important. It is necessary to keep in mind the possible impact of tides and estuarine processes on real fluxes, but the first proxy of estimation of river fluxes to the sea can multiplies water discharge (Table 2.1) by the chemical substance concentrations (Table 5.1, 5.2, 5.4, 5.5, 5.6). Such estimates are presented in Table 5.7, 5.8, 5.9, 5.10 for China, Japan, Korea and Russia, respectively.

Table 5.7. Annual Discharge of Water (km^3) and Some Chemical Substances (tons/year) in Major Chinese Rivers Adjoining NOWPAP Region (2002 data)

Rivers	**Water**	**SS**	**BOD_5**	**COD_{Mn}**	**NH_4**	**NO_2**	**NO_3**
Yalu *	37.8	2,899,830	61,788	126,228	3,260	nd	83,160
Daliaohe	14.8	5,672,840	38,036	190,920	26,655	5,254	5,654
Dalinghe **	3.7	nd	27,221	32,191	7,121	nd	nd
Luanhe **	4.6	28,669	9,511	14,562	805	191	10,011
Haihe	22.8	nd	197,904	162,564	373,920	nd	nd
Yellow	65.8	nd	186,214	269,122	23,030	1,579.2	207,270
Huaihe	62.2	2,139,680	62,200	217,078	42,731	2,052.6	22,392
Yangze	951.3	nd	2,195,914	2,390,141	70,948	nd	nd
Total	1144	nd	2,778,788	3,402,806	548,470	nd	nd
Total***	193	10,741,019	582,874	1,012,665	477,522	9,077	328,487
Rivers	**oils**	**Phenols**	**As**	**Pb**	**Cd**	**Hg**	
Yalu *	910	64.4	151.6	38.0	nd	0.76	
Daliaohe	1687	4.44	14.8	16.3	14.8	0.148	
Dalinghe **	1424	27.1	14.8	7.4	nd	0.19	
Luanhe **	46	4.6	18.2	4.6	0.3	0.05	
Haihe	844	68.4	nd	136.8	nd	5.47	
Yellow	592	65.8	263.2	526.4	13.2	nd	
Huaihe	3234	62.2	248.8	62.2	6.22	6.84	
Yangze	64,213	951.3	nd	4,756.5	nd	19.03	
Total	72,950	1,179.84	nd	5,548.2	nd	32.488	
Total* **	**8,737**	**228.54**	**199.4**	**791.7**	**34.52**	**13.458**	

* - water discharge for evaluation from Zhang et al., 1998;
** - water discharge for evaluation is assessed by watershed square;
*** - data except Yangtze River; nd – no data

Table 5.8. Annual Discharge of Water (km^3) and Some Chemical Substances (tons/year) in Major Japan Rivers Flowing into the NOWPAP Region (2002 data)

Rivers	**Water**	**SS**	**BOD_5**	**COD_{Mn}**	**NH_4**	**NO_3**	**NO_2**	**PO_4**	**TN**
Teshio	5.92	29,579	3,550	2,297	nd	nd	nd	nd	3,017
Rumoi	0.32	4,792	671	1,757	nd	nd	nd	nd	406
Ishikari	14.44	505,379	14,439	70,753	1,835*	12,054*	393*	1,653*	16,172
Shiribetsu	1.85	7,416	927	4,450	nd	nd	nd	nd	nd
Shiribeshit	0.69	2,758	414	1,792	nd	nd	nd	nd	227
Iwaki	2.91	43,638	4,946	11,055	nd	nd	128	nd	4,073
Yoneshiro	7.06	35,256	8,461	nd	nd	nd	nd	nd	4,795
Omono	9.93	89,376	11,917	nd	nd	nd	nd	nd	8,342
Koyoshi	2.56	23,066	3,076	nd	nd	nd	nd	nd	1,897
Mogami	12.86	218,557	11,571	32,141	156*	5,736*	106*	237*	9,981
Aka	3.10	34,076	2,478	6,505	nd	620	31	nd	1,776
Ara	4.55	18,269	2,740	10,048	nd	1,005	nd	nd	1,507
Agano	14.97	119,726	11,973	37,414	nd	nd	nd	nd	8,076
Shinano	12.74	165,684	15,294	40,784	458*	9,223*	244*	887*	11,607
Seki	1.73	43,260	2,076	6,748	nd	709	35	nd	1,806
Hime	1.38	131,221	1,243	4,834	nd	nd	nd	nd	897
Kurobe	2.68	18,746	1,607	4,553	nd	428	nd	nd	735
Joganji	0.47	4,186	372	977	nd	112	nd	nd	308
Jintu	5.08	35,530	6,598	12,182	7,379*	5,108*	550*	279*	7,298
Sho	1.17	11,684	1,052	2,804	nd	nd	nd	nd	nd
Oyabe	2.22	17,786	4,669	9,782	nd	1,712	nd	nd	3,042
Tedori	2.55	86,625	2,803	nd	18*	814*	3*	45*	1,365
Kakehashi	0.61	6,678	486	nd	nd	243	6	nd	404
Kuzuryu	1.48	13,317	2,072	5,475	192*	681*	13*	111*	nd
Kita	0.15	1,357	90	347	nd	nd	nd	nd	nd
Yura	1.48	5,919	1,036	3,699	nd	903	15	nd	964
Maruyama	1.09	5,448	2,179	nd	nd	nd	nd	nd	523
Chiyo	1.17	3,500	1,634	2,217	nd	nd	nd	nd	nd
Tenjin	0.42	838	335	754	nd	nd	nd	nd	nd
Hino	0.71	11,333	921	2,479	nd	nd	nd	nd	nd
Hii	1.24	8,669	1,610	nd	nd	393	4	nd	879
Gono	3.76	7,517	1,879	nd	36*	1,580*	18*	124*	nd
Takatsu	0.97	1,945	486	nd	117*	224*	26*	21*	nd
Onga	0.27	1,894	460	893	80*	193*	6*	15*	702
Matsuura	0.15	2,084	134	476	nd	nd	nd	nd	195
Total	**124.66**	**1,717,108**	**126,197**	**(277,216)**	**(1,835)**	**(41,738)**	**(393)**	**(1,653)**	**(90,995)**

*- data for 2000 by the NOWPAP Promoting Project Report, NPEC, 2003; nd - no data; in brackets - subtotal by some rivers only

Table 5.9. Annual Discharge of Water (km^3) and Some Chemical Substances (tons/year) in Major Korea Rivers Flowing into the NOWPAP Region (2002 data)

Rivers	**Water**	**SS**	**BOD**	**COD**	**NH_4**	**NO_3**	**TN**	**PO_4**	**TP**
Han	18.9	249,307	64,215	117,099	37,774	41,551	149,207	3,777	5,666
Nakdong	13.8	222,182	34,500	80,041	5,520	33,120	45,541	1,380	1,380
Geum	6.6	145,871	21,782	48,844	5,940	17,161	29,042	660	660
Yeongsan	2.7	34,283	5,129	15,387	810	8,368	14,037	270	270
Seomjin	3.9	10,923	3,511	11,313	390	1,560	2,731	nd	nd
Total	**45.9**	**662,567**	**129,137**	**272,683**	**50,434**	**101,762**	**240,557**	**6,087**	**7,976**

nd – no data

Table 5.10. Annual Discharge of Water (km^3) and Some Chemical Substances (tons/year) in Major Russia Rivers Flowing into the NOWPAP Region (2002 data)

Rivers, Sub-Regions	**Water**	**SS**	**BOD**	**COD**	**NH_4**	**NO_3**	**NO_2**	**PO_4**
Tumen	9.05	1,122,200	17,467	170,140	1,539	2,625	127	118
West PTG Bay, (1)	0.8	7,700	3,032	3,440	20	8	3	6
Razdolnaya, (2)	2.27	165,700	27,013	37,146	999	499	68	107
East PTG Bay, (3)	1.97	76,200	4,137	13,593	45	20	8	8
Primorsky coast "south"(4)	3.67	82,600	6,239	20,552	206	73	7	11
Rudnaya (5)	0.46	9,000	474	2,990	45	7	10	54
Primorsky coast "north"(6)	21.7	470,900	26,040	190,960	977	260	22	43
Southwest Sakhalin coast (7)	3.33	353,000	nd	nd	nd	50	nd	123
Total	**43.25**	**2,287,300**	**84,401**	**438,821**	**3,830**	**3,543**	**245**	**469**
Rivers, Sub-Regions	**Oils**	**Si**	**phenols**	**Pb***	**Cd***	**As***	**Fe***	**Mn***
Tumen River	181	110,410	27.2	1.27 +72.9	0.272 +0.51	31.7	681 +68,679	1,041 +4,480
West PTG Bay, (1)	10	6,368	0.8	0.03 +0.20	0.020 +0.005	1.0	9.2 +363	4.5 +6.0
Razdolnaya River, (2)	100	14,528	9.1	0.05 +7.0	0.027 +0.058	3.2	54 +8.915	33.8 +253
East PTG Bay, (3)	128	8,156	3.9	0.37 +2.40	0.028 +0.023	nd	87 +3,095	19.7 +95
Primorsky coast "south"(4)	128	16,515	3.7	0.18 +26.3	0.092 +0.78	nd	42 +2,593	36.7 +85
Rudnaya (5)	17	2,070	0.9	0.29 +7.1	0.115 +0.335	nd	9.7 +334	50.6 +23
Primorsky coast "north"(6)	282	104,160	21.7	1.09 +150.2	0.543 +4.42	nd	250 +14,789	217 +485
Southwest Sakhalin coast (7)	nd	12,321	Nd	nd +15.2	nd	nd	68.9 +13,060	27.3 +162
Total	**847**	**274,528**	**67.3**	**3.29 +281.4**	**1.1 +6.1**	nd	**1,202 +111,826**	**1,430 +5,589**

*- data from PGI studies: first number - output of dissolved forms (Shulkin, 2005), + output of metals with suspended solids (SS), assessed by Chudaeva, 2002 and Shulkin, 2005 data; nd – no data; PTG Bay – Peter The Great Bay, number in brackets means sub-regions from Tables 2.1 and 3.5

The direct comparison of assessments presented in tables 5.7 – 5.10 is complicated by the quite different scale of the rivers considered, by the partially incompatible parameters that are measured, and by the absence of data for some rivers or parameters. Moreover, there is a significant difference in the shape and length of coast lines. Normalization procedures can be recommended to facilitate comparisons. One is a traditional watershed square normalization (specific discharge in l/s. km^2 or tons/year km^2) that mainly characterizes the intensity of processes taking place in the watershed. For an assessment of the intensity of input from a land to a marine environment, another measure was recently suggested (Shulkin, 2005): coastal specific discharge which is the input of any substances divided by the length of the coast line. This assessment method could prove useful at the regional and sub-regional level as a first stage comparison. Some examples of comparative assessment of river water and suspended matter input from the NOWPAP countries on a coast line basis are presented in Table 5.11. On the example of water run-off, it is obvious that traditional specific discharge (normalized on watershed square, Q/S) is not suitable for the assessment of a river's impact on a marine environment, e.g. it is smallest for China which does not reflect the actual situation. Therefore, normalization of other fluctuations of coastal specific discharge (F/L, where F – input of any substances, tons/year, L – length of coast line) is used (Table 5.11). Of course, such an assessment is a rough estimate, especially given the shortage of available data. Nevertheless, the calculated values in Table 5.11 are reasonable enough to see the differences between countries regarding possible impact of river input on coastal waters.

More detailed study could be undertaken using this approach to evaluate river input impact from the different sub-regions of countries.

Table 5.11. Normalized parameters of river inputs of water, suspended solids, and some chemical substances for NOWPAP countries

Country	**S, 10^3km^2**	**L, km**	**Q, km^3**	**Q/S, l/s*km^2**	**Q/L, l/s*km**	**SS/L,t /y.km**	**BOD/L t/y.km**	**COD/L t/y.km**	**NH_4/L t/y.km**	**NO_3/L t/y.km**
China*	1634	10,054	193	3.7	609	***	58	100.7	47.5	31.9
Japan	89.5	11,610	124.7	44.2	341	147.9	11	31.4	0.4	6.2
Korea	68.1	6,050	45.9	21.4	241	109.4	21	45.1	8.3	16.8
Russia**	133.4	3,095	43.3	9.9	428	738.9	27	141.8	1.2	1.1

Watershed Size (S), Coast line length (L), Annual water discharge (Q), Specific discharges for water (Q/S and Q/L), Suspended solids (SS/L)
* - without Yangtze and Songhua Rivers;
** - including Tumen River; COD determined by $K_2Cr_2O_7$ method;
*** - not evaluated due to data lack

A comprehensive comparative assessment of the impact from river runoff of such chemical contaminants as metals, phenols, petroleum hydrocarbons (PHC), PCBs, pesticides, including chlorinated ones, polyaromatic compounds (PAHs) from all NOWPAP countries is impossible since the necessary data are incomplete or entirely lacking.

Table 5.12 gives recent reliable data on dissolved forms of metals in the rivers of China, Korea and Russia, based on the scientific publications along with the most recent assessment of world averaged values.

Table 5.12. Recent Reliable Data on Dissolved Metals (µg/l) in NOWPAP Rivers

	Fe	Mn	Zn	Cu	Pb	Cd	References
Yangtze (China)	31	-	0.06	1.66	0.054	0.003	Zhang, 1995
Yellow (China)	13	1	0.2	1.27	0.030	0.003	Zhang, 1995
Han (Korea)	197	128	12.3	6.17	2.26	0.041	Hong et a., 1997
Guem (Korea)	6	7	0.5	0.64	0.010	0.006	Hong et a., 1997
Tumen (Russia)	75.3	115	1.14	1.82	0.14	0.030	Shulkin, 2005
Razdolnaya (Russia)	23.7	14.9	0.36	1.27	0.023	0.012	Shulkin, 2005
Tsukanovka (Russia)	11.5	5.6	0.21	0.44	0.037	0.025	Shulkin, 2005
World average	66	34	0.6	1.48	0.079	0.080	Gaillardet et al., 2003
WQS, EQS, MPC	**100**	**10**	**10-50**	**1-40**	**1-100**	**1-10**	

Excluding data for the Han River published by Lee et al. in 1989, the concentration of dissolved metals in the rivers of the region seems pretty close to recent world average assessment (Gaillardet et al., 2003) and far less than any WQS. For the reason provide above (page 47), the only exception is dissolved Cu MPC (maximum permissible concentration) for fishery waters in Russia.

The scarcity of concentration data means the evaluation of the input of dissolved metals with river run-off into the sea is a rough estimate at best, with an error factor of one order of magnitude. Nevertheless, some assessment for the Yellow Sea has been done by Hong (Hong et al., 1997) and that is presented in Table 5.13, as well as an assessment based on world averaged concentrations of dissolved forms of Zn, Mn, Cu, and concentration of dissolved Pb 0.050 µg/l, and dissolved Cd 0.017 µg/l.

The discrepancy between our assessment and the results of Hong (1997) is explained by different volumes of water run-off used for evaluation.

In a discussion of metal load with river input one should remember that most metals are not dissolved but are adsorbed on the surface of suspended particles. This is why the particulate phase is normally by far the dominant transport form for heavy metals in rivers. Monitoring programs in China, Japan and Korea only measure total metals without filtering the sample, and these data strongly depend on suspended solids content with limited value for monitoring pollution. A spatial and temporal inter-comparison of data requires a sampling strategy that is representative of the total suspended sediment transport. This is almost impossible with the sampling frequency normally applied by national monitoring agencies because including one high-turbid sample or not in a data set may completely change the resulting average assessment.

Table 5.13. Assessments of Dissolved Metal River Input (tons/year) into the Yellow Sea and other NOWPAP Marine Regions

	Fe	Mn	Zn	Cu	Pb	Cd
Yellow Sea* –Korean rivers	2,009	1,317	125.7	64.6	22.8	0.43
Yellow Sea* – Chinese rivers	747	77	11	71.4	1.5	0.19
Yellow Sea* (sum)	2,756	1,395	136.8	136	24.3	0.62
Yellow Sea**	14,599	7,521	132.7	327.3	11.1	3.76
Yellow Sea** – Chinese rivers (without Yangtze)	12,738	6,562	115.8	285.6	9.7	3.28
Yellow Sea** –Korean rivers	1,861	959	16.9	41.7	1.4	0.48
Korean rivers, south & east coasts	1,168	602	10.6	26.2	0.9	0.30
Japanese** rivers	8,230	4,240	74.8	184.6	6.2	2.12
Russian** rivers	2,858	1,472	26.0	64.1	2.2	0.74

* - by Hong et al., 1997;
** - by water discharge from Table 2.1 and world averaged concentrations with minor changes;

Recent reliable data on persistent organic pollutants (POPs) in NOWPAP region rivers are very restricted (Table 5.3) even though POPs are very important from the point of view water quality. It is worth noting that these data are scarce even for rivers of regions with a long standing history of monitoring river water quality (Table 5.14). PCBs concentrations in the Ishikari River correlate well with the lower range of PCB concentrations in Europe rivers, though in other Japanese river PCB concentrations as high as 8.4 ng/l have been published (UNEP Chemicals…, 2002). Chlororganic pesticides in the Ishikari River were determined to be at the low range level compared with European rivers.

Table 5.14. Comparison of POPs Concentrations in the Ishikari River with Recent Data for Other Rivers

POPs	Ishikari R.	Ebro R.**	Rhone R.**	Seine R.**	Nile**	Germany***
PCBs	0,32	76±23	nd	nd	17-1000	0.2-2.6
Cyclodiene POPs*	0.085	0.4-1.6	0.2-0.6	0.2-0.6	0.004-0.008	nd
Total DDTs	0.54	0.3-0.9	3.6	0.2-0.8	26-103	nd
Chlordane	0.050	nd	nd	nd	nd	nd
HCHs	1.29	0.7-2.7	5.6	7.0	0.05-0.5	0.2- 1.5

*- sum of Endrin, Dieldrin, Aldrin, Heptachlor; ** - data from UNEP/MAP/MTS_141, 2003;
*** - data from OSPAR Commission, 2005; nd - no data.

The current lack of data means it is unrealistic to estimate river input of POPs into the NOWPAP marine environment at the regional or sub-regional levels. The use of data on POP concentrations in bottom sediments and in mollusks might be an alternative for assessing the impact of land based sources on coastal marine areas since contaminated coastal sediments are large a result of freshwater discharge.

5.4. Direct Inputs of Contaminants

Three **Chinese** provinces are responsible for the direct input of pollutants into the marine environment adjoining the NOWPAP region. Municipal sewage and industrial wastewater are two major sources of direct input. The evaluation of direct discharge of pollutants from Chinese provinces adjoining the NOWPAP region is presented at Table 5.15.

Table 5.15. Direct Discharge of Municipal Sewage and Industrial Wastewater (million tons/year) and Pollutants (tons/year) to the Chinese (for 2002)

Province	**Sewage**	**Industry wastes**	**COD sewage**	**COD industrial**	**NH_4 sewage**	**NH_4 industrial**	**Phenol**	**oils**	**As**	**Pb**	**CN-**
							Industrial Wastewater				
Liaoning	13.6	3.1	10,225	1,477	1,684	627	nd	0.0	0.006	0.038	0.1
Jiangsu	226.4	10.4	82,588	25,185	9,616	2,200	3.4	16.5	0.645	0.012	0.6
Shandong	81.6	52.3	26,146	16,262	3,480	338	1.0	14.8	0.039	0.001	0.2
Total	321.6	65.9	118,959	42,924	14,780	3,165	4.4	31.3	0.690	0.051	0.9

nd - no data

The discharge of treated wastewaters of sewage treatment plants is one of the documented source of direct inputs of contaminants in **Japan**, and the available data are listed in Table 5.16.

Table 5.16. Direct Discharge of Sewages Assessed by BOD and COD (tons/year) to the NOWPAP Region

Prefecture	**BOD**	**COD**	**Prefecture**	**BOD**	**COD**
Hokkaido	25	70	Nagano	74	251
Akita	115	378	Hyogo	134	266
Yamagata	2	7	Tottori	3	5
Niigata	31	49	Shimane	250	535
Toyama	501	662	Yamaguchi	1,764	3,089
Ishikawa	29	80	Fukuoka	52	153
Fukui	44	110	**Nominal Total**	**3,024**	**5,656**

Another source of direct input of pollutants into the sea is waste dumping. Japan dumped 9,476,000 tons of waste into the sea in 2002. 59% of this amount was dredged sediments, 26% - bauxite residues and construction sludge, and only 15% or 1,430 tons was municipal sewage rich in organic substances. One-third of nationwide amount of waste, or 3.2 million tons per year are dumped in the NOWPAP region.

In **Korea** most of the waste generated by industry (81.5%), with domestic sources contributing 18.5% and the remaining 3% classified as special waste. A significant, 40% increase in waste production has occurred in the last 8 years and the total volume of waste has reached 108 million tons/year. The increase is in industrial waste and not domestic waste generation.

Wastewater generation in Korea in 2002 reached 2,908 million tons, with only 0.6% of this volume night soil and 1.7% livestock wastewater. Industry generated most of the wastewater. Of the total wastewater produced, nearly 30% or 891 million tons/year are discharged into rivers and coastal marine habitat. There is, however, a clear difference in levels of treatment. The best treatment management is seen on the south coast (only 12% is untreated sewage). On the other hand, on the east coast more than 85% of the wastewater is discharged into rivers and the sea (Table 5.17). The effectiveness of wastewater treatment, as assessed by BOD load, is much better and runs from 1 to 25%, and is 14% nationwide (Table 5.17).

Korea increased by 8.87 million tons the amount of waste dumped into the ocean in 2003. The rate has steadily increased and is now 270% of the 1994 amount. There are three main dump sites: western – 200 km west off Gunsan, east-a – 125 km east off Pohang and east-b – 90 km east off Busan. East-a is the most active and accounts for 50% of the national total, with a 350% increase in the last decade. Dumping in the western sector has doubled, but it the Busan area it has not yet to double. The Ministry of Maritime Affairs & Fisheries plans to reduce dumping amount by 5 million tons/year in 2011.

Table 5.17. Wastewater Discharge by River Basins and Coasts of Korea (2002)

River basins, coasts	**Wastewaters, 10^6 tons/year**		**BOD load, tons/year**	
	Generated	**Discharged**	**before treatment**	**after treatment**
Hang River	240.5	100.4	101,835	1,095
Nakdong River	304.8	219.4	163,520	2,555
Geum River	132.1	62.4	76,650	1934.5
Yeongsan River	14.2	9.9	5,840	127.8
Seomjin River	3.3	2.2	1,460	40.2
Other rivers	176.3	78.1	106,215	1,387
East Coast	180.3	166.1	112,055	1,277.5
West Coast	675.3	135.1	242,360	2,226.5
South Coast	1,180.8	116.8	62,415	1,825
Total	**2,907.6**	**891.3**	**879,650**	**12,410**

The volume of wastewater generated and discharged in **Russia** in 2002 in the sub-regions of Primorskii Krai in the NOWPAP reached 398 million m^3/year (Natural Resources and

Protection of Environment…, 2003). Sewage from the region's largest city, Vladivostok, accounts for 84% of this amount. About 85% of all wastewater was untreated or poorly treated. Expert assessment adds an additional 138 million m^3/year of waste and storm water from the Vladivostok area and 21 million m^3/year from the rest part of region as storm water run-off. An assessment of annual direct input can be made (Tabl. 5.19) accounting for the concentrations of some chemical substances in waste and storm water run-off (Table 5.18).

Table 5.18. Concentrations (mg/l) of Substances in the Waste and Storm Water Wastes of Vladivostok (Gavrilevski et al., 1998)

	BOD_5	**NH_4**	**PO_4**	**Sufr***	**PHC****	**Phenols**
Wastewater	32.6	4.2	1.9	0.11	0.92	0.015
Storm Water wastes	17.8	3.5	0.25	0.17	1.09	0.011

*Sufr means detergents or surface active compounds; ** PHC means petroleum hydrocarbons

Table 5.19. Summary of Annual Wastewater Input (10^6 m^3) and Chemical Substances (tons) in Sewage and Storm Water Wastes from other Districts of Primorskii Krai

Districts**	**V***	**BOD_5**	**NH_4**	**PO_4**	**Sufr**	**PHC**	**Phenols**
Khasanskii (1)	6.16	189	25	10.4	0.73	5.8	0.10
Vladivostok+Artem + Nadezhdinskii (2)	484.4	14,859	1,990	816.5	57.06	456.4	7.01
Shkotovskii+Fokino +Nakhodka+Partizansk (3)	44.52	1,366	183	75	5.24	41.9	0.64
Lazovskii+Olginskii +Kavalerovskii (4)	3.22	99	13	5.4	0.38	3.0	0.05
Dalnegorskii (5)	18.62	571	77	31.4	2.19	17.5	0.27
Terneiskii (6)	0.42	13	2	0.7	0.05	0.4	0.01
Total	**557.5**	**17,101**	**2,291**	**939.6**	**65.67**	**525.2**	**8.07**

V* - total volume of wastes equal to official data (V* from Table 5.7) corrected by increasing coefficient 1.22 plus 15% addition of storm water wastes; ** Wastewater data are presented on administrative districts base, number in parentheses indicated the closest closed sub-regions from Table 2.1

Overview data on direct discharge of wastewater and direct dumping into marine environments are presented in the Table 5.20.

A direct comparison between countries is complicated by the different formats for data and by the different schemes for evaluating wastewater discharge. Nevertheless, China and Russia could possibly assess the significance of direct input of some chemical substances by comparing input via rivers (Figure 2 and Figure 3). The wastewater generated on the Russia coast line within NOWPAP accounts for 20% of the BOD_5 and phenols that reach the sea. The figures reach 40% for ammonia and petroleum hydrocarbons and 80% for phosphate, plus direct input of phosphor into coastal water. Most of China's pollutants come via river input, but the relatively elevated level of ammonia and petroleum hydrocarbons in some Chinese rivers (Table 5.1) means a significant volume of the anthropogenic wastewater entering the sea from China comes via river discharge.

Table 5.20. Generalized Data on Direct Input of Wastewater and Dumping to the Sea in NOWPAP Countries

	River water, km^3	**Wastewater, 10^9 tons/year**	**Wastewater BOD, tons/year**	**Wastewater COD, tons/year**	**Dumping to sea, 10^6 tons/year**
China*	193	0.388	Nd	161,883	nd
Japan**	124.7	Nd	3,024	5,656	3.2
Korea**	45.9	0.891	12,410	nd	8.9
Russia**	43.3	0.558	17,101	nd	nd

* - Wastewater discharged directly to the coast besides rivers;
** - wastewater discharged directly and partly through the rivers
nd - no data

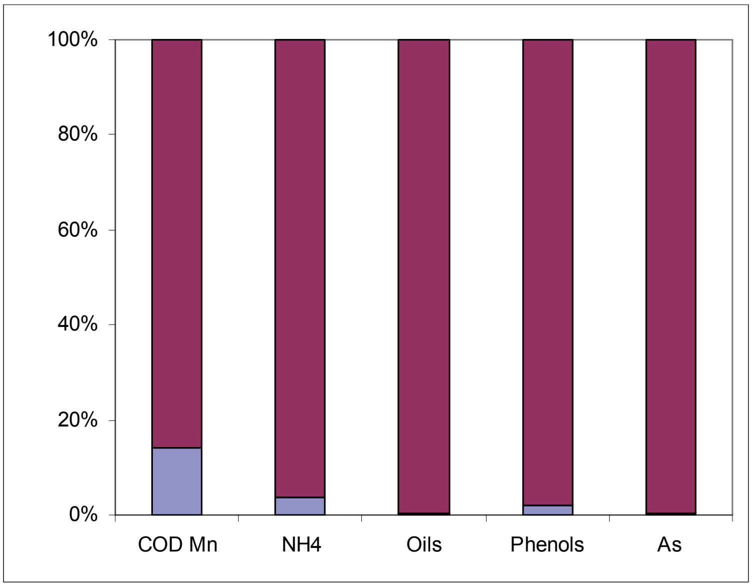

Figure 2. The Percentage of River Input (purple) and Direct Discharge (blue) of Chemical Substances into Chinese Coastal Waters in the NOWPAP Region

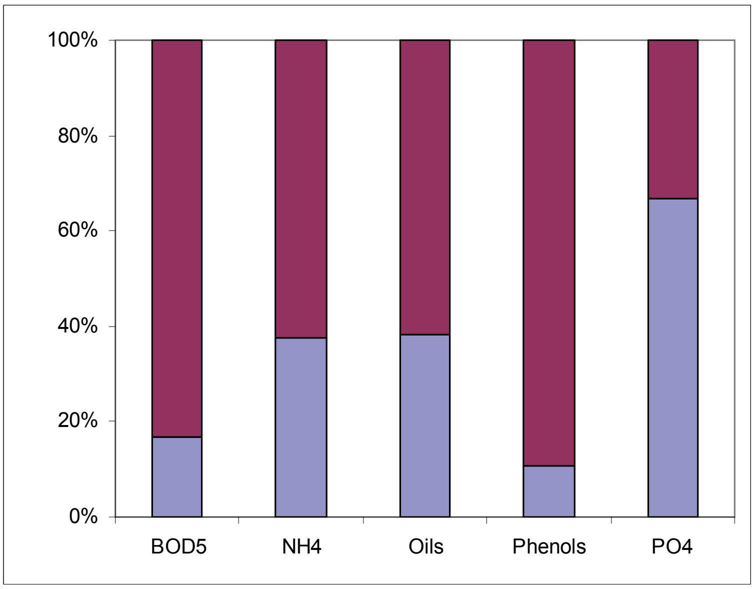

Figure 3. The Percentage of River Input (purple) and Direct Discharge (blue) of Chemical Substances into Russian Coastal Waters in the NOWPAP Region

6. Proposals presented by NOWPAP countries in National Reports

China proposes following activities in NOWPAP region:

1) Strengthen capacity building on ocean monitoring: automated stations should be setup at special sea areas.
2) Willingness to use uniform monitoring methods and assessment standards so that data from different countries are compatible for all partners. Trainings on methods and standards should also be held.
3) Pilot projects on the pollution impact from large rivers seawater should be started.

The government of **Japan** proposes the following management approaches for the aquatic environment in Asia:
1) Water Environmental Partnership in Asia (WEPA) proposal aimed at promoting conservation of aquatic environments and capacity building in Asia. A Network of Asian River Basin Management Organizations (NARBO) was established in February 2004 whose aim is to share technology and information among Asian countries; Japan supports cooperation among the member countries. The Ministry of the Environment is starting a survey on marine litter in the Japanese waters in the fiscal year 2005.
2) Future regional activities of POMRAC should aim to share monitoring data through these activities.

Korea proposes the following programs:

1) Based on its spearheading the Tripartite Environment Ministers Meeting among Korea, China, and Japan (TEMM) to regularly discuss major environmental issues in northeast Asia, Korea would like to strengthen cooperation in the near future. The initial focus of TEMM projects was to strengthen the sense of environmental community among the three countries through joint education of environmental officials, tripartite networking of environmental educational organizations, and maintenance of the TEMM website (www.temm.org). In line

with these activities, Korea, China and Japan organized environmental industry round-tables to boost environmental industry cooperation and launched a freshwater pollution prevention project. TEMM should be expended in the near future to support water pollution projects in this region.

2) The East Asian Seas (EAS) Congress is the next pioneering, region-wide platform for capacity-building, strategic action and cooperation for the sustainable management and development of the Seas of East Asia. The Congress brings together government ministers and high-level officials, heads of regional, international and non-governmental organizations, experts, and private sector/civil society representatives for comprehensive forums and runs plenary sessions, workshops and seminars. The strategic aim of the Congress is to provide a dynamic format for meaningful exchange of information, to support dialogue and interaction between key players and stakeholders in sustainable coastal and ocean management. PEMSEA was set up in 1999 with financial support from the Global Environment Facility, an arm of the United Nations, and an East Asian Seas (EAS) Congress is held every three years.

Russian priorities for future regional activities in the water quality monitoring field include:

1) Need to resolve data compatibility and collection issues through joint training courses and/or special workshops.

2) Conduct comparative assessments of the different aspects of nutrient and suspended solid inputs into marine environments. The environmental issues raised by euthrophication the lower reaches of rivers and coastal waters are of great importance and NOWPAP countries should develop an exchange of information and methodological approaches.

3) Effective monitoring of trans-boundary water bodies by establishing monitoring stations at the Tumen River and at Khanka Lake (Russia, China, DPRK).

4) Prioritize persistent toxic substances (PTS) carried with river and direct inputs to the coastal environment of the NOWPAP region. Obviously the list of persistent toxic substances will be different for different countries but close interaction and an information exchange during the preparation of this list is desirable to establish a coherent list of substances of concern.

5) Participate in a regional program called "The Water Environmental Partnership in Asia" (WEPA) that aims to enhance governance in conservation of aquatic environments and capacity building in Asia. The Network of Asian River Basin Management Organizations (NARBO) was established in February 2004 and aims to share technology and information among the Asian countries and would be another forum for future regional cooperation.

7. Conclusions

The environmental and socio-economic factors presented in this Regional Overview are an index of the human activity connected with contaminant load in the NOWPAP region. The legal basis for regulating surface water pollution and direct discharge of waste into marine environments in different NOWPAP countries is also described. This overview presents the water quality monitoring programs in different countries, including the methods used and the research activities taken to improve data interpretation, analysis and forecasting. Monitoring and research activities are also reviewed to summarize methods for pollutants analysis and QA/QC measures for the data observed.

This overview also summaries the present situation with river water quality based on 2002 monitoring results. River borne inputs of some pollutants to the NOWPAP region have been estimated using water discharge data. Current status and historical trends for chemical substances in river water are also described.

Monitoring Program

Every NOWPAP country has a national program and system for monitoring fresh water quality. The common approach for countries is the application of various water quality standards (EQS in China and Japan, WQS in Korea, and MPC in Russia). Water quality assessments are carried out according to water use types.

In China the State Environmental Protection Administration (SEPA) and its four-level network of branches and agencies is responsible for monitoring surface water quality. Two sets of stations operate: 479 stations that monthly monitor water temperature, pH, electrical conductivity, dissolved oxygen, COD_{Mn}, BOD_5, N-NH_4, oil, Hg, Pb, volatile hydroxybenzene, water discharge and 43 automated stations that report weekly on water temperature (T), pH, dissolved oxygen (DO), electric conductivity (EC), turbidity (TB), chemical oxygen demand (COD_{Mn}), total organic carbon (TOC) and ammonium nitrogen (NH_3-N).

In Japan water quality monitoring is the responsibility of prefectural governments and local offices of national administrative agencies. Effluent discharge is measured and controlled by operating companies. The total number of environmental standard points for the 35 first class rivers in the NOWPAP region is 247. The list of parameters includes SS, DO, COD_{Mn}, BOD_5, T-N, T-P, NO_2, NO_3, Pb, Cd, Cr^{6+}, As, Hg, Se, F, B plus organic pollutants like benzene, thiuram, PCBs.

Monitoring freshwater quality in Korea is the jurisdiction of the Ministry of Environment (MOE). Local Environment offices affiliated with MOE and some other agencies involved in monitoring are responsible for 559 river and 165 lake stations. There are more than 1,000 stations that check water supply quality. The list of parameters monitored vary but always includes DO, COD, BOD, suspended solids (SS), total N (TN) and total P (TP), E-Coli.

The Federal Service on Hydrometeorology and Environmental Monitoring (ROSHYDROMET) is responsible for monitoring of surface water quality in Russia. The amount and quality of all municipal and industrial wastewater types are controlled by the subdivisions of the Federal Service for Environmental, Technological and Nuclear Supervision. There are 43 stations in the NOWPAP region, including 20 that report monthly and 13 quarterly. Monitoring always includes conductivity, DO, SS, BOD_5, COD_{Cr}, and 2-3 characteristic pollutants. Quarterly operated stations include macro-ions, N-NH_4, NO_3, NO_2, PO_4, Fe, Si, oil products (PHC), PAHs, trace metals, POPs.

Methodologies and Procedures

There is reasonable compliance with the water quality criteria (WQS, EQS, MPC) used in various NOWPAP countries. The same is true for sample preservation and analysis methods for the same parameters. There are minor differences in NH_4^- and NO_3 determination, and COD is measured in Russia using stronger oxidant $K_2Cr_2O_7$ as compared with $KMnO_4$ in other NOWPAP countries. Russia once used both by $K_2Cr_2O_7$ and $KMnO_4$ to measure COD and possible correspondences can be established between these parameters. Determining total organic carbon (TOC) might be a good alternative for measuring organic matter pollution in future. Unfiltered water samples are used for analysis in China, Japan and Korea, though in Russia filtered samples are used for determination of dissolved forms of nutrients (N, P) and metals.

Research Activities

There are numerous research activities and research projects related to surface water quality and to assessments of pollution input into coastal environments via rivers or directly. Key research institutes and distinguished universities in NOWPAP member countries lead most of the research projects.

Present Environmental Status

Contamination by organic matter is an issue in most surface river water in China according to National Reports. The Hai River is seriously contaminated. Water quality in tributaries of the Yellow, Liaohe and Huaihe Rivers is bad. Conditions are satisfactory in the Yangtze River.

BOD and COD are considered the best water quality parameters for assessing water pollution in Japan. Total phosphorus (TP) and total nitrogen (TN) are important eutrophication indicators for partially enclosed sea areas. The concentration of other pollutants like heavy metals and pesticides are below analytical detection limits and so their inputs into the NOWPAP region is negligible. The pollution loads of the Ishikari, Omono, Mogami, Agano, and Shinano Rivers located in the Hokkaido and Hokuriku regions indicate that these rivers carry elevated pollution loads. Data from 1995-2002 indicate pollutant loads that are almost stable or tending to decline, although some of the rivers do not follow the general pattern.

COD and BOD values for rivers indicate a satisfactory condition in Korea. However, some small rivers like the Anseongcheon, Sapghocheon and Hyeongsan show BOD values 4.0-6.7 mg/l and COD 6.6-8.8 mg/l. Although most Korean rivers are within the safe range for Grade I and II waters, there is feces contamination in the Han and Nakdong Rivers and in some small streams. Most of micro-pollutants (heavy metals, phenols, cyanide, PCBs) were under the detection limit (MDL). The only parameter showing the decease over the 1995-2003 was BOD, a sign of improving quality of water.

Anthropogenic flux of phosphate within the NOWPAP region of the Russia coast reaches 80% of total input of phosphorus for coastal water. For ammonia and petroleum hydrocarbons the anthropogenic flux reaches 40%. BOD_5, oxidizable organic matter and phenol fluxes from anthropogenic sources form at least about 20% of total fluxes. BOD values exceed the rather strict MPC of 2 mg/l in all rivers draining populated and economically developed watersheds.

Identification of Gaps and Needs

There is some discrepancy in the list of parameters that need to be monitored:

1) Nitrate content is not a parameter monitored in river water in China;

2) Oil product content (petroleum hydrocarbons extracted by hexane or carbon tetrachloride) in water is analyzed by IR spectrophotometry in China and Russia, but in Japan and Korea this parameter is not used in the routine monitoring of surface water quality;

3) China, Korea and Russia monitor phenols in surface water. Japan controls phenol compounds in effluents and, according to Japanese experts, this is suitable enough for the environmental conservation of the river and coastal waters .

4) Total nitrogen (TN) and total phosphorus (TP) are broadly used to assess water quality in all NOWPAP countries except Russia.

A discussion is necessary to elaborate measures to overcome these discrepancies. For example, to obtain reliable relationships between TN and other dissolved species of N, or TP and phosphate not within state monitoring format, but through the research work inside each countries with following discussion could be useful for all NOWPAP counries.

Another issue is the use of unfiltered surface water samples in China, Japan and Korea. The common indices of water quality like COD, BOD, TP and TN should be measured in unfiltered samples. In Russia filtered samples are used for dissolved forms of nutrients and metals. Both filtered and unfiltered samples are needed for a comprehensive assessment of water quality and of river borne contaminants entering the sea.

There are problems in determining micro pollutants in routine monitoring of water quality. The analysis of National Reports shows that there are currently scarce reliable data on dissolved forms of trace metals and persistent organic pollutants (PCBs, PAHs, pesticides like DDTs and HCHs) in the surface (river) waters of NOWPAP countries making a comprehensive evaluation of the input of these substances into the sea at the regional and sub-regional levels impossible. These are not problems that are typical of NOWPAP countries only. Similar issues are raised with much more developed programs like MAP or OSPAR.

Existing data on micro pollutant levels are, in most cases, far below EQS (WQS, MPC) and this would indicate a satisfactory condition. But reliable data on background concentrations of these substances will make it possible to track and assess anthropogenic impact on surface water at early pollution stages. Better data will aid in timely forecasting of environmental problems associated with water quality and in elaborate measures to reduce damage. A way to resolve this issue is to cooperate and share scientific research results within and outside the NOWPAP region.

8. Recommendations for Future Regional Activities and Priorities

Based on the conclusions that are discussed above and on the proposals presented in the National Reports of NOWPAP countries, the following recommendations are made:

1. Harmonize methodologies and procedures for monitoring water quality by studying relationships between parameters that are now inconsistent: COD_{Mn}/COD_{Cr}/TOC, and TN/NO_3, and TP/PO_4. Research could be aided by training courses and analysis of existing data. The use of data gathered at automated stations in China and Korea would be very desirable for this purpose.

2. Account for the influence filtered / unfiltered samples have on data used to evaluate river input of contaminants bound to particulate matter.

3. Enhance the effort to obtain reliable data on micro pollutants (dissolved forms of some metals and persistent organic pollutants) in river and coastal water at the national and regional levels.

4. Initiate joint research projects on the use of micro pollutants as indicators of early stage anthropogenic impact on water quality and on the influence of their flux via big rivers on the coastal waters.

5. Promote, through POMRAC activities, cooperative approaches among NOWPAP countries to resolve issues 1-4 by applying data obtained in other regions (MAP, OSPAR, US EPA).

6. Promote cooperation and information exchange among various environmental programs in the NOWPAP region (NOWPAP, WEPA, NARBO, TEMM, PICES)

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