Table 4 Cont.....

Total Coliform	23[i,j]	2.2[i,j]	-	-
Fecal Coliform	-	-	2.2c	100
Protozoa Cysts	1[k]	1[k]	-	-
Worms	1[k]	1[k]	1.0	1.0

Footnotes:

* MtAv : Monthly average, MA : Max. Allowed, UR : Unrestricted, R : Restricted
* All parameters are expressed in mg/l except Temperature (Delta ^{0}C), pH (pH units), Turbidity (NTU) and Total and Fecal Coliform (MPN/100 ml), Protozoan Cysts and Worms (No./10 ml of sample).
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Table 3. Showing Pollution Loads of Source Liquid Discharges From Municipal Waste Water Treatment Plants (Tons/Year)

Facility Name	Parameters				
	BOD	COD	NH_3-N	Phosphate	
Khobar	971	6,893	58	549	
Dammam	2,278	9,490	182	797	
Qatif	3,680	11,957	92	1,058	
Ahssa	969	2,261	155	121	
Khafji	201	1,004	9	81	
Jeddah	21,000	53,000	4,600	1,300	
Taif	620	1,550	200	31	
Makkah	3,700	9,300	810	190	
Riyadh	6,200	16,000	1,300		1,200
Madinah	3,900	9,900	850		460
Inaizah	3,100	7,700	760		200
Abha	160	400	34	32	
Khamis Mushayt	180	440	40	35	
Jubail	120	300	26	6	
Yanbu	39	99		8	2
Total	47,118	130,294	9,124		6,062

Table 1 Cont.....

Microbiological Pollutants

Total Coliform (MPN/100 ml.)	70	1,000	-

Note:All parameters are expressed as mg/l except stated otherwise.

* None attributable to the discharge

** MEPA determines the thermal properties of discharged water to fit the properties of receiving water and such properties are determined on case by case basis. [1]These PSDD are applicable beyond the edge of the mixing zone. Each direct discharge shall be adequately dispersed and mixed with the receiving water. A mixing zone shall be designed to minimize adverse effects to designated beneficial uses. Adequacy of the mixing zone shall be determined on a case-by-case basis. [2]Facilities using, transferring or storing oil and petroleum hydrocarbons are required to prepare, maintain and update a spill prevention, control and clean-up plan.

tons, sulfides 127 tons, chlorine 240 tons, total suspended solids 851 tons, BOD 1339 tons and COD 4020 tons per year respectively (MEPA/World Bank, 1998).

Petrochemical Industrial Complexes of Jubail and Yanbu:

In Saudi Arabia, the major heavy industries are located in the industrial cities of Jubail and Yanbu, where, in addition to certain diversified secondary industry, most of the petrochemical and fertlizer plants are located. Royal Commission For Jubail and Yanbu is responsible for the management of these two industrial cities.

These industrial cities of Jubail and Yanbu have their own central industrial waste water treatment facilities with tertiary and advanced level treatment. All the industries in these areas are connected to the central industrial wastewater treatment plants. In addition, industries in these industrial cities have their own individual pre-treatment facilities to occasionally or regularly handle the discharges to the central facility, if the quality of discharges violate the pre-treatment guidelines. The quality of the treated effluent from the Royal Commission industrial waste water treatment plants is generally good and the treated waste water is reused for irrigation of green belts in and around the RC areas in Jubail and Yanbu. Royal Commission Jubail has also developed a penalty system for the violators of Waste Water Discharge Standards. The loads of pollutants discharged from the industrial waste water treatment plants of industrial cities of Jubail and Yanbu are shown in table 2. The overall loads are chlorine 5.8, TSS 56.9, BOD 214.7, COD 272.5 (only Yanbu), TOC 64.4 (only Jubail), Oil & Grease 7.3 (only Yanbu), TKN 14.3 (only Jubail), ammonia 2.04 (only Jubail), Nitrate 31.6 (only Yanbu), Sulfide 0.18 and Phenol 0.6 (only Yanbu), cadmium 0.06, copper 0.18 and lead 1.1 (only Jubail) tons per year.

In addition, RC Jubail has constructed a seawater cooling water canal to supply fresh cooling seawater to various industries in the area.

Power and Desalination Plants:

There are seven major dual purpose desalination plants in the Kingdom using steam turbines and multistage flash (MSF) technology to generate power and produce desalinated water. These are located in Jubail, Khobar, Jeddah, Shoaiba, Yanbu (2) and Assir. There are a few more power plants elsewhere using the steam turbine technology to generate power.

Liquid pollution generated from such facilities include; chlorine, thermal pollution caused by sea water return and chemicals used to control corrosion and scaling. Seawater return also carry its higher salt content with it to the receiving water body.

Small and Medium-Scale Industrial Cities:

Industrial cities, housing the medium and small-scale industries (secondary industry) are located in most of the major cities of the Kingdom.

There are eight small and medium scale industrial cities in the Kingdom: two (2) in Dammam, two (2) in Riyadh, one (1) in Jeddah, One (1) in Qassim, one (1) in Madinah and one (1) in Makkah. Out of these eight industrial cities, only three industrial cities, namely Jeddah, Riyadh II and Dammam II, which constitute 40-50% of the total number of industries, have their own secondary level aerobic biological treatment plants with capability of pH adjustment by acid and alkali dosing systems. Phosphoric acid addition is also possible to increase the phosphate content of waste to encourage the growth of micro-organisms.

The overall pollution load estimates of liquid discharges from industrial cities of Jeddah, Riyadh II and Dammam II are shown in table 2. The overall loads from all of the three cities were: chlorine 3.95 tons, TSS 336.1 tons, VSS 123.4 tons (only from Riyadh and Jeddah), BOD 371.4 tons, COD 1414.7 tons, phosphate 52.48 tons per year respectively (MEPA/World Bank, 1998). Trace metals like cadmium, chromium, copper, nickel and zinc were

Premier, Minister of Defence and Aviation and Inspector General and represented by relevant sector Ministries and Departments is the highest institutional authority on environmental issues. Meteorology and Environmental Protection Administration (MEPA), the central environmental regulatory agency established in 1981 by a Royal Decree No. 7/M/1809 dated 21/4/1401 H acts as the secretariat of MCE.

MEPA's functions and responsibilities can be summarised as the following:

1. Establish National Environmental Policy to enable the Kingdom to secure current and future generations a safe and healthy environment along with a sound and prosperous economy.

2. Preparatory work to implement international and regional environmental conventions, treaties, agreements signed and ratified by the Kingdom.

3. Develop/promulgate environmental standards, i.e., air, water and & hazardous wastes. This includes updating, modification and revision of these standards from time to time and to enforce these standards in co-ordination with other Government agencies.

4. Inventory of pollutants emitted/discharged/generated throughout the Kingdom and monitoring the quality of source emissions/discharges and the quality of ambient (natural) environment.

5. Review Environmental Impact Assessment (EIA) studies of the existing major facilities and for the new proposed projects and evaluate the proposed industrial/developmental projects vis-a-vis environmental quality and pollution control measures.

6. Protection of human health and natural resources from anthropogenic pollution.

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8. Submit reports on the state of the environment and follow-up on the application of environmental standards and their impacts.

The above mentioned objectives are aimed at achieving development while conserving the natural resources for future generations and protecting the public health by controlling the deterioration in the environmental quality to a minimum.

In addition, there are certain other government agencies which have specific environmental roles in the protection of the environment and conservation of natural resources as part of their responsibilities. These institutions are: Ministries of: Agriculture and Water, Municipal and Rural Affairs, Health, Industry and Electricity, petroleum and Mineral Resources, Planning, Interior, Finance and National Economy, Communication, National Commission For Wildlife Conservation and Development (NCWCD), Royal Commission For Jubail and Yanbu, Arriyadh Development Authority and King Abdulaziz City For Science and Technology (KACST).

Industrial and Municipal Waste Water Management in the Kingdom of Saudi Arabia

Promulgation of standards, inventory of pollution sources and monitoring of pollutants at source and in the ambient environment, environmental audit and enforcement of standards are important components of a comprehensive industrial and municipal waste water management program.

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MEPA promulgated its first Environmental Protection Standards in 1401 H (1981) revised in 1409 H (1989)

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