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INLAND WATERS DIRECTORATE
WATER PLANNING AND MANAGEMENT BRANCH
OTTAWA, CANADA, 1985

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Abstract

This report summarizes the results of the 1981 Survey of Industrial Water Use, updating the 1976 survey. The report presents figures and discussion on various parameters of water used by industry, such as intake, recirculation and discharge. Similar figures are given for water used by industry within each province. This is the third of a continuing series of surveys to be undertaken at five-year intervals, with the next being planned for 1987.

Résumé

Ce rapport résume les résultats de l'étude faite en 1981 sur l'utilisation industrielle de l'eau et constitue une mise à jour des résultats de l'étude précédente (1976). On y présente des chiffres et on y analyse divers paramètres relatifs à l'utilisation de l'eau dans l'industrie, comme les prises, la recirculation et le rejet de cette eau. On y fournit aussi des données semblables sur l'utilisation industrielle de l'eau dans chaque province. Cette étude est la troisième d'une série d'enquêtes entreprises tous les cinq ans, la prochaine étant prévue pour 1987.

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1. INTRODUCTION

This paper describes and discusses the statistical results of an industrial water use survey for 1981. It represents an updating of two similar surveys for Canada, completed in 1972 and 1976 (Canada, 1977, 1983). Data collected during the survey have already been used in a variety of federal and provincial studies, and publication of this statistical summary represents the final stage of the survey process.

1.1 Scope of the Survey

The industrial water use survey, consisting of four sectors - manufacturing, mineral extraction, thermal power and hydro power - was undertaken under the Federal Statistics Act. Some assistance was provided by officers of the Manufacturing and Primary Industries Division, Statistics Canada, in selecting the mailing list for the survey. Environment Canada was responsible for all other tasks, such as survey design, editing, data processing and production of the final results. This national survey also benefited from the cooperation of the Planning Division, Alberta Environment, which performed its own survey and data tabulation within that Province, using the same questionnaire. The Alberta results have been incorporated into this publication. The Water Resources Branch of the Manitoba Department of Natural Resources also provided valuable assistance to the survey of industries in that province through its involvement in the follow-up phase.

1.1.1 Outline of the Paper

This paper concentrates on water use in the manufacturing sector. The major part of the discussion examines water use patterns by the various sectors of manufacturing and by province. The Appendices contain basic details on the mineral extraction sector (Appendix A), thermal power sector (Appendix B) and copies of the questionnaires (Appendix C). No data are presented on the hydro power sector, since the hydro questionnaire elicited data on power generation plus a series of technical questions about operating characteristics.

1.2 Survey Methods

1.2.1 Respondent Selection

The survey was based upon a universal mailing to selected categories of the manufacturing industry, the mineral extraction industry, the thermal power plants and hydroelectric power plants across the country. Although the mineral extraction and power sectors are not included in the discussion undertaken in this paper, basic water use data are presented in Appendices A and B.

Within the manufacturing sector, respondents were selected on the basis of the 1976 survey results and the type of questionnaire sent by Statistics Canada during their annual Census of Manufacturing. During the first survey in 1972, questionnaires had been sent to a relatively large number of respondents who used very little water. In an attempt to omit such users, the 1976 survey was sent only to members of those industries classified as belonging to the ten largest water-using two-digit SIC groups[1] within the manufacturing sector. For these ten groups, only those establishments that had received the long-form questionnaires[2] during the 1976 Census of Manufacturing were selected. In the 1981 survey, some refinement was made to the 1976 survey of these industries by eliminating some of the minor water-using components. For example, in the 1981 survey, only sawmills were surveyed in the wood products industry (SIC-25) instead of 11 industries in the 1976 survey. Although the change in water use data may be small, the number of employees or plants may be noticeably reduced in some industries. For the 1981 survey, a new industry group - metal fabricating - was added. As well, a reporting cut-off of less than one million gallons annual water use was provided for the convenience of the smaller operations, in the manufacturing, mineral extraction and thermal sectors.

The selection of establishments to be surveyed in the mineral extraction industry was based on the major water-using industries from the 1976 survey as well as the addition of the establishments in the crude petroleum and natural gas industry. Basically, an attempt was made to include all significant operating establishments. All thermal power plants in operation were included in the 1981 survey. For the first time, the hydroelectric power generating plants were included in the 1981 survey.

1.2.2 Response Rates

The number of plants surveyed and the response rates obtained in the four sectors are shown in Table 1. For the manufacturing sector, the largest in the survey, 4868 questionnaires were distributed to industrial firms. Of this number, 3268 were returned, for a gross response rate of 67%. The remaining 1600 returns contained basic information such as employment, operating days and product descriptions but little or no water use information. Because their water use information had to be estimated to obtain survey totals, these unusable returns were considered

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[1]Standard Industrial Classification (SIC), as defined by Statistics Canada. The two-digit level is the second coarsest level of the SIC. The four-digit level is the most refined definition of industry.

[2]Long-form questionnaires are those that request detailed input and output data from "large" establishments. The definition of "large" varies from industry to industry, but, in general terms, includes all those establishments of a specified size which together account for a significant proportion (usually 90%) of total industry shipments of goods of own manufacture. Remaining establishments in the industry receive a short-form questionnaire, requiring minimum information. This procedure significantly reduces the response burden on small firms and, at the same time, provides essential operational-type statistics for the industry, with a minimum loss of commodity detail.

Table 1. Summary of Survey Returns, 1981

Sector	Total number of questionnaires	Number of respondents	Number of non-respondents	Response rate (%)
Manufacturing	4868	3268	1600	67
Mineral extraction	251	230	21	92
Thermal power	88	88		100
Hydro power	351	330	21	94
Total	5558	3916	1642	70

non-respondents. The process used for the estimation procedure for these non-respondents is outlined later. For the mineral extraction sector, the response rate was much higher, with only a small amount of estimation required. In the thermal sector, complete coverage of all plants was obtained. The hydro sector obtained a very high response rate as well.

A high response rate was achieved in all sectors for the Alberta portion, as Alberta Environment attempted to duplicate the returns of the 1976 Industrial Water Use Survey for comparative purposes. In contrast with Alberta Environment, which was directly involved in all survey phases, including the mail-out, the participation of the Water Resources Branch of the Manitoba Department of Natural Resources was focussed on the follow-up phase of the survey. This agency assisted in the collection of water use data and late returns from Manitoba firms and provided valuable information for the estimation procedure.

1.2.3 Water Use Terminology

The water use terminology and definitions of each water use parameter for the 1981 survey are similar to those employed in the 1976 survey. Total water intake refers to the total amount of water added to the water system of the plant to replace water discharged or consumed during production. Water intake is broken down in this paper into the amounts withdrawn from various sources and the amounts used for cooling, processing, condensing and steam generation, sanitary and other purposes. Cooling and condensing water refers to that water used for the production of steam. Processing water refers to water that comes in contact with an intermediate or final product of the manufacturing operation. Sanitary water use is self-explanatory. Recirculated water refers to water used at least twice in the manufacturing process. Recirculation does not refer to water used a number of times within a particular process subsystem of a plant but only to water that leaves a particular process subsystem and re-enters it or is used in another process. Gross water use of a plant or

a process refers to the total amount of water used in the production of the product. It is the sum of total water intake and water recirculation. Water consumption refers to water that is lost in the production process. In other words, consumed water is not returned to its original source. The two major portions of consumed water are escaped steam and the incorporation of water into a product, as for example in the production of soft drinks. Water discharged refers to water that is returned to the environment in the form of water, usually in close proximity to the plant. Discharged water may be treated or untreated. Together, water discharge and water consumption form the effluent subsystem of the plant. The sum of these two parameters is approximately equal to the total water intake of the plant. These definitions are also applicable to the mineral extraction and thermal power sectors.

1.2.4 Questionnaire Design

The following description pertains principally to the manufacturing questionnaire as an example of the design used; the same basic design was used for mineral extraction. Section 1 of each questionnaire requested basic information on employment, plant operations, and process-product descriptions. Section 2 was devoted to information on the monthly pattern of water intake and discharge, and their annual totals. The sources of water intake were covered in section 3, while section 4 requested details on the various treatments given to the intake water. Section 5 was concerned with intake water by purpose and section 6, with data on water recirculation or reuse of intake water. Section 7 was devoted to the various types of treatment to discharge water prior to discharge. Finally, section 8 was used to collect data on the discharge of the effluent by discharge point. For the first time, questions pertaining to the cost of water acquisition, water treatment, water recirculation and waste treatment were included.

1.2.5 Estimation Procedure for Non-Respondent Data

As shown in Table 1, estimation of water data for non-respondents, especially in the manufacturing sector, was required. These estimated data were generated by using coefficients developed from the respondent data. The coefficients were developed at the four-digit SIC level and on a provincial basis. The estimation was done by multiplying each water use coefficient by the employment for the non-respondent plants. Actually, two procedures were used in estimating manufacturing respondents: (1) with a small universe, the SIC were manually reviewed and estimates prepared at the provincial level and (2) with a larger universe, the estimates were provided by multiplying the aggregated respondent data at the SIC and provincial level by a percent and adding the resultant value for the non-respondents to the respondent data. By these procedures, estimated results for the non-respondents were calculated and then combined with the respondent data to provide the results for the survey universe. For the other two sectors, the universe of non-respondents was small, enabling these estimates to be prepared at the SIC and provincial levels. The data were then combined as in the manufacturing sector to provide the results for the survey.

2. PATTERNS OF CANADIAN MANUFACTURING WATER USE

The following section presents the results for the manufacturing sector of the survey and provides some basic analysis of the data. The data are discussed first on an industry-by-industry and then on a provincial basis.

2.1 Industry-by-Industry Water Use Patterns

2.1.1 General Characteristics

Just over 795 000 persons were employed in the 4868 manufacturing plants surveyed (Table 2). These plants represented the majority of large water-using industries in Canada, and about 43% of the nation's total manufacturing employment was engaged in the surveyed plants; the rest were employed in industries which are relatively small water users and, therefore, not surveyed. As shown in Table 3, the surveyed plants withdrew a total of 9936 million cubic metres (MCM) from ambient water bodies in 1981. This total withdrawal, when combined with recirculation use, resulted in a total gross water use of 20 683 MCM. Analysis reveals that the water intake was recirculated a total of 2.1 times, a use rate down slightly from that of 2.3 in 1976. Water consumption totalled 494 MCM, or approximately 5.0% of total withdrawal, whereas about 9442 million cubic metres was discharged back to the ambient water bodies. This consumptive use rate of 5.0% is down only slightly from 5.3% in 1976.

Paper and allied products, primary metals, chemical and chemical products, and petroleum and coal products industries were the four largest water-using manufacturing sub-groups covered in the survey, and together accounted for about 91% of both total intake and total discharge and 87% of total consumption.

Use rates and consumption rates by industry are shown in Table 4. The use rate is formed by the ratio of gross water use to water intake, and represents an index of recirculation. The minimum value of the ratio is 1.0, denoting no recirculation, but it may assume high values for firms which recirculate large amounts of water. The average use rate was 2.1 for the survey, and ranged between 1.3 for the food and beverage industry and 2.6 for the paper and allied products industry. Two of the other large water-using industrial sectors, primary metals and chemical and chemical products, had use rates slightly below the national average. The use rates for most of the surveyed industrial sectors rose between 1972 and 1976, indicating a short-term trend toward the increasing use of recirculation technology. In the 1981 survey, the rubber and plastics, non-metallic mineral products, petroleum and coal products and wood industries showed large increases in use rates. The rates, however, declined in all other industries, especially in the largest water-using industry, paper and allied products, thereby offsetting the effect of increased recirculation in the other three industrial sectors. This caused the national aggregate use rate to decline slightly from 1976.

The consumption rate is an index of the amount of water lost during production, most commonly through evaporation or incorporation of water into products. As noted earlier, the national average rate of

Table 2. Employment by Industry Group and Province for Manufacturing, 1981 (Persons)

Industry group	New found-land	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatch-ewan	Alberta	British Columbia	Yukon	Northwest Terri-tories	Total
Food and beverage	9 889	2013	10 052	10 167	39 430	60 638	7 531	3568	10 795	13 800	-	40	167 925
Rubber and plastics	-	-	3 474	75	10 638	28 856	669	89	1 155	1 105	-	-	46 060
Textiles	-	20	1 413	260	18 118	13 521	65	-	226	169	-	-	33 792
Wood	22	-	528	2 622	8 143	5 757	220	420	1 902	23 980	-	-	43 594
Paper and allied	2 764	-	2 800	5 905	33 301	31 901	1 285	507	2 213	15 652	-	-	96 331
Primary metals	-	-	2 570	969	26 955	64 106	5 087	1569	3 788	6 927	-	-	111 972
Metal fabricating	220	-	520	519	7 482	15 236	1 460	642	2 127	1 929	-	-	30 136
Transportation equipment	750	174	3 658	1 495	33 331	98 629	3 775	80	1 956	6 027	-	-	149 876
Non-metallic mineral products	376	22	446	952	8 997	18 649	1 303	783	4719	3001	-	20	39 270
Petroleum and coal products	84	-	532	540	2 897	4 375	185	304	1348	1480	-	40	11 785
Chemical and chemical products	489	10	599	292	17 264	37 110	712	232	5570	2128	18	-	64 424
Canada total	14 594	2239	26 594	23 797	206 558	378 781	22 292	8196	35 798	76 200	18	100	795 170

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table 3. Characteristics of Manufacturing Water Use in Canada, 1981 (MCM)

Industry group	Number of plants	Total water intake	Recirculation	Gross water use	Consumption (imputed)	Total discharge
Food and beverage	1513	430	117	547	31	399
Rubber and plastics	450	54	744	798	7	47
Textiles	162	124	50	174	6	118
Wood	360	73	57	130	4	69
Paper and allied	271	2899	4 612	7 511	159	2740
Primary metals	171	2719	1 692	4 411	38	2681
Metal fabricating	324	30	130	160	1	29
Transportation equipment	329	109	73	182	3	106
Non-metallic mineral products	674	83	530	613	15	68
Petroleum and coal products	42	563	1 457	2 020	34	529
Chemical and chemical products	572	2853	1 284	4 137	197	2656
Canada total	4868	9936	10 747	20 683	494	9442

Note: In this table, recirculation = gross water use - total water intake, and consumption = total intake - total discharge.
The addition of figures may not be possible due to rounding.

consumption was 5.0% of intake. The rate varied between 18.1% for the non-metallic mineral products industry and 1.4% for the primary metals industry.

2.1.2 Water Sources

Water intake by source in the manufacturing industries is shown in Table 5. About 7% of the total water intake of 9936 MCM was derived from public utilities, a reduction of about 6% from 1976. Most industrial water, about 89%, was obtained from private freshwater surface sources. Slightly less than 1% of the total came from fresh ground-water sources, and the remaining 3% was accounted for by private brackish sources. The latter two sources were inadequate in either size or quality, thereby accounting for an insignificant proportion of total intake.

Table 4. Use Rates and Consumption Rates by Industry, 1981

Industry group	Use rate	Consumption rate (%)
Food and beverage	1.3	7.2
Rubber and plastics	14.8	13.0
Textiles	1.4	4.8
Wood	1.8	5.5
Paper and allied	2.6	5.5
Primary metals	1.6	1.4
Metal fabricating	5.3	2.6
Transportation equipment	1.7	2.7
Non-metallic mineral products	7.4	18.1
Petroleum and coal products	3.6	6.0
Chemical and chemical products	1.4	6.9
Canada average	2.1	5.0

Note: $\text{Use rate} = \frac{\text{Total gross water use}}{\text{Total water intake}}$

$$\text{Consumption rate} = \frac{\text{Total water consumption}}{\text{Total water intake}} \times 100\%$$

Table 5. Water Intake by Source for Industry Groups, 1981 (MCM)

Industry group	Public	Freshwater self-supplied			Brackish water self-supplied			Total
		Surface	Ground	Other	Ground	Tide	Other	
Food and beverage	179	172	31	1	1	46	-	430
Rubber and plastics	32	14	8	-	-	-	-	54
Textiles	28	94	2	-	-	-	-	124
Wood	13	27	2	-	-	31	-	73
Paper and allied	116	2742	27	7	-	7	-	2899
Primary metals	85	2536	2	10	-	84	2	2719
Metal fabricating	21	8	1	-	-	-	-	30
Transportation equipment	49	60	-	-	-	-	-	109
Non-metallic mineral products	22	49	5	6	-	-	-	82
Petroleum and coal products	20	489	2	-	-	50	2	563
Chemical and chemical products	119	2675	11	9	-	39	-	2853
Canada total	684	8866	91	33	1	257	4	9936

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

There was a notable difference with regard to water source between industries dominated by large establishments and those dominated by relatively small establishments. This observation emerged both from the examination of individual plant returns and from the inspection of the aggregate data of Table 5. For example, the food and beverage industry, composed generally of many relatively small water users, withdrew 42% of its total intake from public sources (virtually the same as 43% in 1976). This industry was characterized not only by small plants but by a requirement for high quality intake water. Thus, it relied upon public supplies for much of its water. In contrast, the four largest water withdrawing industries - paper and allied products, primary metals, petroleum and coal products, and chemical and chemical products - withdrew 4%, 3%, 4% and 4%, respectively, from public supplies. These industries were characterized by fewer and generally larger plants than the food and beverage industry.

2.1.3 Water Intake Treatment

The quantities of intake water treated by type are tabulated in Table 6. Since many plants employ two or more treatment processes prior to use, the total amount of water reported here was substantially greater than the total water intake reported in Table 3. On the other hand, a substantial number of plants reported little treatment prior to the initial use of water. The total quantity of water treated by the manufacturing firms surveyed was 12 491 MCM. The most frequently used process in quantitative terms was screening, followed by chlorination and disinfection and filtration. Together these three treatment types accounted for about 85% of the total amount treated. The "other" category was included to capture those processes, such as dechlorination and distillation, not easily classified to other types. The primary metals group dominated all categories except filtration and screening, which were led by the paper and allied group and the chemical and chemical products group, respectively. In general, it is clear that manufacturing industries treated substantial amounts of intake water prior to use. This reflected a need in many industries for water of high quality.

2.1.4 Initial Purpose of Water Use

The breakdown of total intake by initial purpose of water use is shown in Table 7. Cooling, condensing and steam generation was the largest user of new water taken into plants, accounting for 63% of total intake. Processing water accounted for 35% of intake, with sanitary and other uses accounting for the remaining 2%. Cooling, condensing and steam generation accounted for the largest proportion of initial use in nine of the eleven industries surveyed. The largest water-using industry, paper and allied, used most of its new water intake for processing, thereby having a significant impact on the total amount of processing water reported in Table 7. The metal-fabricating industry also reported more of its intake used in processing than in cooling and condensing.

2.1.5 Monthly Water Use Patterns

The monthly distribution of annual water intake was found to be consistent with that of water discharge. Thus, only the intake pattern has

Table 6. Manufacturing Water Intake by Type of Intake Treatment, 1981 (MCM)

Industry group	Filtration	Chlorination and disinfection	Corrosion and slime control	Screening	Hardness and alkalinity control	Other	Total treatment	Total intake
Food and beverage	48	107	16	43	22	6	242	430
Rubber and plastics	1	3	1	6	4	-	15	54
Textiles	21	38	7	57	15	1	139	124
Wood	5	1	-	29	2	-	37	73
Paper and allied	1027	871	151	1374	209	131	3 763	2899
Primary metals	145	1121	672	1714	24	288	3 964	2719
Metal fabricating	3	-	-	1	1	-	5	30
Transportation equipment	-	5	1	52	2	-	60	109
Non-metallic mineral products	1	8	1	28	1	-	39	82
Petroleum and coal products	25	155	120	459	36	38	833	563
Chemical and chemical products	143	1065	63	2008	86	29	3 394	2853
Treatment totals	1420	3374	1032	5769	403	493	12 491	9936
Totals as a percentage of total manufacturing water intake	14	34	10	58	4	5	-	-

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table 7. Manufacturing Water Intake by Purpose, 1981 (MCM)

Industry group	Processing	Cooling, condensing and steam	Sanitary	Other	Total
Food and beverage	129	260	36	5	430
Rubber and plastics	19	32	3	-	54
Textiles	46	76	2	-	124
Wood	20	48	5	-	73
Paper and allied	2188	658	43	10	2899
Primary metals	711	1943	54	11	2719
Metal fabricating	16	12	2	-	30
Transportation equipment	48	52	7	2	109
Non-metallic mineral products	19	58	3	2	82
Petroleum and coal products	38	516	3	6	563
Chemical and chemical products	195	2614	31	13	2853
Total	3429	6269	189	49	9936

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table 8. Distribution of Monthly Water Intake by Industry, 1981 (percent of annual total)

Industry group	J	F	M	A	M	J	J	A	S	O	N	D
Food and beverage	7.7	7.4	7.4	7.4	8.4	9.5	9.1	10.0	10.0	8.6	8.1	6.5
Rubber and plastics	7.4	7.4	9.3	7.4	9.3	9.3	7.4	9.3	9.3	9.3	7.4	7.4
Textiles	6.5	6.5	6.5	6.5	8.9	10.5	10.5	9.7	10.5	8.9	7.3	6.5
Wood	8.2	8.2	9.6	9.6	8.2	9.6	5.5	5.5	8.2	9.6	8.2	8.2
Paper and allied	8.4	7.9	8.7	8.4	8.7	8.9	7.7	6.7	8.6	9.1	8.6	8.2
Primary metals	8.4	7.8	8.6	8.3	8.9	9.0	9.3	8.5	7.9	7.7	7.4	8.2
Metal fabricating	10.0	10.0	10.0	10.0	10.0	10.0	10.0	6.7	6.7	6.7	6.7	6.7
Transportation equipment	7.9	7.9	8.5	8.5	8.6	9.0	8.0	8.1	8.7	8.6	8.3	7.9
Non-metallic mineral products	7.2	7.2	7.2	8.4	8.4	8.4	8.4	9.6	8.4	9.6	8.4	8.4
Petroleum and coal products	7.5	7.3	8.0	7.6	8.0	8.5	9.1	9.6	7.9	8.9	8.2	8.5
Chemical and chemical products	8.1	7.8	8.8	8.3	9.1	8.5	8.9	8.2	8.0	8.1	7.8	8.2
Canada total	8.2	7.8	8.6	8.3	8.8	8.8	8.7	8.0	8.3	8.4	8.0	8.1

been tabulated, as shown in Table 8. The data were converted to percentage terms for the purposes of this table, to facilitate inter-industry comparisons without the effect of size. If there was an even monthly distribution of the data, each month would account for 8.3% of annual intake. Table 8 demonstrates that some seasonality was experienced, with total intake tending to be higher in the summer and fall months. This pattern was expected in view of higher cooling requirements in the summer and the effects of fall processing in the food and beverage industry. Inter-industry patterns were variable, as shown in Table 8. The food and beverage and the petroleum and coal industries were the two large water users displaying the most significant trends toward summer peaking, with differences of over 2% between the lowest and highest pumpage months. The other industries showed a more uniform pattern throughout the year.

2.1.6 Water Discharge Points

The distribution among discharge points of the 9442 MCM of industrial water discharge is shown in Table 9. This distribution is as follows: public sewers, 5%; private surface water disposal, 72%; tidewater, 23%; and less than 1% to ground water and other uses. The food and beverage industry discharged 39% of its effluent to the public sewer, a proportion nearly equal to its withdrawal from the public water supply

Table 9. Water Discharge by Point of Discharge, 1981 (MCM)

Industry group	Public sewer	Freshwater body	Tidewater body	Ground	Transferred to other uses	Total
Food and beverage	158	167	66	7	1	399
Rubber and plastics	29	17	-	1	-	47
Textiles	30	89	-	-	-	119
Wood	3	34	30	1	-	68
Paper and allied	28	1885	813	13	1	2740
Primary metals	87	1472	1092	12	18	2681
Metal fabricating	25	2	-	2	-	29
Transportation equipment	26	77	3	-	-	106
Non-metallic mineral products	13	52	-	3	-	68
Petroleum and coal products	5	466	57	1	-	529
Chemical and chemical products	75	2509	64	6	2	2656
Canada total	479	6770	2125	46	22	9442

Note: Dashes (-) refer to negligible discharge.
The addition of figures may not be possible due to rounding.

system. In contrast, the four largest water-using industries discharged relatively small amounts of water to public sewers (i.e., paper and allied products, 1%; primary metals, 3%; petroleum and coal products, 1%; and chemical and chemical products, 3%). The use of various discharge points was related directly to the magnitude of the waste water discharged, the location of the plant and also to the characteristics of the pollutants in the waste water. The food and beverage industry, being composed of relatively small water users, usually does not have sufficient water discharge to justify building and operating individual waste treatment facilities. There were, of course, exceptions to this general point, and many plants in the industry pre-treated their waste before discharging to the public sewer. Also, wastes from food and beverage plants, being composed mainly of biochemical oxygen demand (BOD) and suspended solids, tend to be compatible with municipal waste treatment processes. On the other hand, the larger plants of other industrial groups generate large volumes of waste. Often, these volumes are too large to be handled in municipal treatment plants, with the result that most waste water must be handled internally and discharged directly to surface waters. Also, some of the pollutants generated by large industries are incompatible with municipal waste treatment processes, resulting in the need for internal treatment and subsequent direct discharge.

2.1.7 Waste Water Treatment

Many of the firms surveyed afforded some type of treatment to their waste water prior to discharge. The quantities of waste involved are shown in Table 10, categorized by the generic type of treatment. Primary treatment refers to mechanical methods of treating wastes, such as screening, coagulation and filtration. Secondary treatment refers to some form of biological treatment to reduce the biochemical oxygen demand of the effluent. Activated sludge and trickling filter methods are common forms of secondary treatment. Tertiary treatment refers to the use of methods to "polish" the effluent subsequent to secondary treatment. One common form of tertiary treatment is phosphorus removal.

As in water intake treatment, the same physical volume of water may be processed by more than one level of treatment. It is common for a plant to treat its wastes by primary methods initially and then to the secondary level prior to final discharge. Thus, the amounts recorded in the "total treatment" column of Table 10 will contain a substantial degree of double counting. The brief discussion below focusses on the data within each column in an attempt to avoid the double counting as much as possible.

About 45% of all discharge was treated by some form of waste treatment. The amounts of water treated under each category were distributed among the industrial groups in roughly the same way as other characteristics of water use. The largest amount treated in all categories was accounted for by the paper and allied products industry, with 36% of the total amount treated by primary methods (3521 MCM), 79% by secondary (697 MCM) and 46% by tertiary (35 MCM). This dominance reflects the concerted efforts made by plants in the industry during the 1970s to install pollution control devices. Chemical and chemical products, primary metals and petroleum and coal products groups accounted for the next most significant industries in terms of the quantities of waste water treated.

Table 10. Manufacturing Water Discharge by Type of Treatment, 1981 (MCM)

Industry group	Primary	Secondary	Tertiary	Total treatment	Total discharge
Food and beverage	76	20	3	99	399
Rubber and plastics	5	-	-	5	47
Textiles	12	7	-	19	119
Wood	6	-	-	6	69
Paper and allied	1254	551	16	1821	2740
Primary metals	659	3	4	666	2681
Metal fabricating	10	2	1	13	29
Transportation equipment	34	4	-	38	106
Non-metallic mineral products	8	1	-	9	68
Petroleum and coal products	437	62	7	506	529
Chemical and chemical products	1020	47	4	1071	2656
Treatment totals	3521	697	35	4253	9442
Total as a percentage of total manufacturing discharge	37	7	<1	-	-

Note: Dashes (-) refer to negligible discharge.
The addition of figures may not be possible due to rounding.

Table 11. Water Recirculation by Purpose, 1981 (MCM)

Industry group	Processing	Cooling and condensing	Other	Total
Food and beverage	22	91	4	117
Rubber and plastics	80	664	-	744
Textiles	3	48	-	51
Wood	9	48	-	57
Paper and allied	4174	414	24	4 612
Primary metals	491	804	397	1 692
Metal fabricating	120	9	1	130
Transportation equipment	25	33	15	73
Non-metallic mineral products	20	509	1	530
Petroleum and coal products	34	1419	4	1 457
Chemical and chemical products	45	1233	6	1 284
Total	5021	5274	452	10 747

Note: Dashes(-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

2.1.8 Water Recirculation

The data on water recirculation presented in Table 11 reinforced the importance of recycling or reuse to the four major water-using industries. These industries accounted for over 80% of the total recirculation reported of 10 747 MCM. The paper and allied group alone recycled almost 43% of the total. Only this industry and the metal-fabricating industry recycled most of the water for processing purposes. Most recycled water was used for cooling and condensing purposes by the petroleum and coal products, chemical and chemical products and primary metals industries as well as the rubber and plastics industry. The rubber and plastics industry also reported a significant increase in the amount of water recirculation practised in 1981, compared with that in 1976.

2.1.9 The Cost of Water

The 1981 survey collected data on the cost of water acquisition (purchasing), the treatment cost of intake and waste water and the cost of water recirculation (Table 12). It should be noted that these data constitute only part of the total cost of water to the industries surveyed. Not included here, for example, were data on the capital costs of self-supplied water acquisition, although some of these firms did include their operation and maintenance costs. The cost of water acquisition consisted mainly of the amounts paid by firms to water suppliers, normally local public utilities, for water services. The cost of waste treatment referred to annual operation and maintenance costs but may also have included a sewer surcharge. In the 1981 survey, the response to the new questions on water treatment and water recirculation costs were encouraging and the data provided a basis for further analysis. No attempt was made to estimate costs for non-respondents.

The cost of water acquisition totalled just under $109 million in 1981. About 25% of this amount was accounted for by the food and beverage industry, denoting the reliance of this industry on clean water largely supplied by municipalities. The chemical and chemical products industry was the second most significant contributor to this cost (19%), with primary metals (about 15%) the third contributor, followed by paper and allied products (about 13%). The data on intake treatment costs also reflected the dominance of these four major water-using industries. These four water users plus the food and beverage industry spent approximately 93% of the total cost reported for intake treatment, over $86 million. The cost of discharge or waste treatment was similar to water acquisition costs, at just over $109 million. Of this total, the paper and allied group spent just over $52 million, or 48%. Costs of the other three large water users, chemical and chemical products, primary metals and petroleum and coal products followed the paper and allied group. The other significant costs for waste treatment were incurred by the transportation equipment and the food and beverage industries.

The costs for water recirculation reflected the importance of recirculation to the four major water-using industries which account for 78% of the total cost. The chemical and chemical products group alone spent just over $19 million, or about 42% of this cost. Other significant contributors to recirculation costs are ranked as follows: the paper and

Table 12. Water Costs by Cost Component, Manufacturing, 1981 ($000's)

Industry group	Water acquisition cost	Intake treatment cost	Recirculation cost	Discharge treatment cost	Total cost
Food and beverage	26 978	6 046	3 461	6 480	42 965
Rubber and plastics	3 691	1 058	1 990	649	7 388
Textiles	3 764	1 628	386	635	6 413
Wood	1 846	446	376	379	3 047
Paper and allied	14 554	35 209	7 326	52 519	109 608
Primary metals	16 181	9 168	3 950	11 680	40 979
Metal fabricating	2 882	331	854	1 933	6 000
Transportation equipment	8 061	1 226	1 491	7 330	18 108
Non-metallic mineral products	4 840	877	1 543	447	7 707
Petroleum and coal products	4 873	6 123	5 606	11 598	28 200
Chemical and chemical products	21 237	24 044	19 438	15 850	80 569
Canada total	108 908	86 156	46 422	109 498	350 984

Note: The addition of figures may not be possible due to rounding.

Table 13. Manufacturing Water Use by Province, 1981 (MCM)

Province	Total water intake	Recirculation	Total gross use	Consumption (imputed)	Total water discharge
Newfoundland	93	13	106	1	92
Prince Edward Island	4	-	4	1	3
Nova Scotia	270	96	366	15	255
New Brunswick	273	284	557	16	257
Quebec	2319	2 740	5 059	131	2188
Ontario	4414	3 633	8 047	192	4222
Manitoba	95	179	274	5	90
Saskatchewan	43	182	225	3	40
Alberta	243	929	1 172	64	179
British Columbia	2182	2 690	4 872	66	2116
Northern Territories	1	-	1	-	1
Canada total	9936	10 747	20 683	494	9442

Note: Dashes (-) refer to a negligible quantity too small to be included.
The addition of figures may not be possible due to rounding.

allied, petroleum and coal products, primary metals, and food and beverage industries.

Through the extensive telephone follow-up undertaken to complete returns for some of the survey respondents, additional information was obtained on the costs of water acquisition and treatment. Hence the values obtained for the 1981 survey are more representative than those of the 1976 survey, where only a minimum amount of time was available for the follow-up inquiries. The response to these cost items also reflects several interesting points about current water management practices. First, there has been an increasing use of meters by both the municipalities and the larger industries, resulting in improved records of the amounts of money spent on water use. Second, owing to the greater concentration of effort in the area of treatment, especially waste treatment, companies are monitoring the costs of each treatment method and its efficiency in terms of dollars as well as water quality. The data also reflect the greater emphasis being placed in all industrial sectors on the recirculation and reuse of the water used in their plant processes.

2.2 Provincial Water Use Patterns

2.2.1 General

Tables 13 through 17 focus upon patterns of water use in the provinces. Ontario accounted for over 44% of the total Canadian manufacturing water intake, followed by Quebec with 23% of the total, and British Columbia with 22% (Table 13). In contrast, Prince Edward Island and the Northern Territories accounted for an insignificant proportion of the total. This distribution of water intake among the provinces reflected provincial industrial structures. For the following tables, data for the Yukon and Northwest Territories have been combined under the heading Northern Territories.

Use and consumption rates by province are given in Table 14. In general, the use rates in the Atlantic region (i.e., the four eastern provinces) were among the lowest in Canada. These lower use rates resulted from several factors. First, water is more readily available in the Atlantic region, reducing the need for recirculation. Also, the industrial mix of the region was such that industry groups with higher use rates, such as petroleum and coal products and chemical and chemical products, were not predominant. Finally, the industrial base of the Atlantic region tended to be older than that of the rest of Canada and thus employed older technological methods that did not recirculate large amounts of water. The use rate for New Brunswick was slightly lower than that for Quebec, but higher than that for Ontario. The low use rate for Ontario was probably due to a generally plentiful water supply from the Great Lakes. The use rates for the three Prairie provinces were substantially higher than those in the rest of Canada. These rates reflect the need for greater recirculation by plants in this region, owing in part to a semi-arid climate and the need for enhanced water conservation efforts, especially in Saskatchewan and Alberta. The use rate for British Columbia was lower than that for any of the Prairie provinces, but above the national average, reflecting the industrial mix and location patterns of industry in this Province.

Table 14. Use Rates and Consumption Rates by Province, 1981

Province	Use rate	Consumption rate (%)
Newfoundland	1.1	1.1
Prince Edward Island	1.0	2.5
Nova Scotia	1.4	5.6
New Brunswick	2.0	5.9
Quebec	2.2	5.6
Ontario	1.8	4.4
Manitoba	2.9	5.3
Saskatchewan	5.2	7.0
Alberta	4.8	26.3
British Columbia	2.2	3.0
Northern Territories	1.0	-
Canada average	2.1	5.0

Note: $\text{Use rate} = \frac{\text{Total gross water use}}{\text{Total water intake}}$

$\text{Consumption rate} = \frac{\text{Total water consumption}}{\text{Total water intake}} \times 100\%$

Dashes (-) refer to negligible quantities.

The consumption rates varied substantially among the provinces, ranging from 1.1% in Newfoundland to 26.3% in Alberta. The consumption rates for Alberta and Saskatchewan were the highest of the Canadian provinces and substantially above the national average. These higher rates may have resulted from the relatively high evaporation rates during the summer because of the greater recirculation practices. However, Manitoba, the third Prairie province, was the exception, having a lower consumption rate than several other provinces.

2.2.2 *Water Sources*

The distribution of the total water intake by source among the various provinces is reflected in Table 15. Each of the four Atlantic provinces was different with respect to its intake sources, revealing that each had a different source for the largest proportion of its intake. Yet collectively, about 18% of their industrial water was withdrawn from public systems, as opposed to a national average of 7% and a low of 2% in British Columbia. Atlantic firms withdrew less water from their own freshwater sources (51%) than the national average of 89%, and much less than Ontario and British Columbia (93%) and Quebec (90%). These findings illustrate that the smaller plants in the Atlantic region relied more heavily upon the public systems than the larger plants in Ontario, Quebec and British Columbia. Although the national average for withdrawals from ground-water

Table 15. Water Intake by Source for Provinces, 1981 (MCM)

Province	Public	Freshwater self-supplied			Brackish water self-supplied			Total
		Surface	Ground	Other	Ground	Tide	Other	
Newfoundland	17	53	-	-	-	23	-	93
Prince Edward Island	2	-	1	-	-	1	-	4
Nova Scotia	47	80	4	3	-	135	1	270
New Brunswick	51	193	3	-	-	24	2	273
Quebec	206	2080	16	15	-	2	-	2319
Ontario	266	4111	21	13	1	-	1	4413
Manitoba	10	74	11	-	-	-	-	95
Saskatchewan	6	35	2	-	-	-	-	43
Alberta	24	212	6	1	-	-	-	243
British Columbia	55	2026	27	1	-	73	-	2182
Northern Territories	-	1	-	-	-	-	-	1
Total	684	8865	91	33	1	258	4	9936

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table 16. Water Discharge by Point of Discharge by Province, 1981 (MCM)

Province	Public sewer	Freshwater body	Tidewater body	Ground	Transferred other	Total
Newfoundland	7	2	83	-	-	92
Prince Edward Island	1	-	2	-	-	3
Nova Scotia	8	7	238	2	-	255
New Brunswick	7	158	92	-	-	257
Quebec	200	1854	128	4	2	2188
Ontario	163	4036	-	6	17	4222
Manitoba	12	66	-	12	-	90
Saskatchewan	4	36	-	-	-	40
Alberta	20	152	-	5	2	179
British Columbia	57	460	1582	17	-	2116
Northern Territories	-	1	-	-	-	1
Canada total	479	6771	2125	46	21	9442

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table 17. Distribution of Monthly Water Intake by Province, 1981 (percent of annual total)

Province	J	F	M	A	M	J	J	A	S	O	N	D
Newfoundland	7.4	8.0	8.0	7.7	7.8	8.7	9.4	9.8	9.4	9.3	7.5	7.0
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	8.5	7.8	8.5	8.2	6.7	8.9	9.5	8.8	8.5	8.4	8.1	8.1
New Brunswick	7.8	8.2	8.8	8.1	8.0	8.2	8.1	8.8	8.4	9.2	8.2	8.2
Quebec	8.1	7.5	8.2	8.2	8.5	8.6	9.0	9.0	8.5	8.5	8.2	7.7
Ontario	8.2	7.9	8.8	8.4	9.1	8.7	9.1	8.3	7.9	8.0	7.5	8.1
Manitoba	9.6	8.6	9.0	8.2	8.5	8.5	7.4	8.6	7.9	7.6	7.8	8.3
Saskatchewan	7.7	6.8	8.1	8.3	9.5	9.9	8.0	8.4	9.0	8.8	7.9	7.6
Alberta	8.1	7.3	8.3	7.8	8.3	8.6	8.6	8.9	8.8	8.6	8.0	8.7
British Columbia	8.4	7.9	8.7	8.3	9.1	9.5	7.6	6.0	8.6	9.0	8.5	8.4
Canada total	8.2	7.8	8.6	8.3	8.8	8.8	8.7	8.0	8.3	8.4	8.0	8.1

Note: Dashes (-) refer to negligible quantities.

sources was less than 1% of the total withdrawals, the ground-water withdrawals in the three Prairie provinces were substantially above this average, with a high of 12% in Manitoba. The coastal provinces combined to provide a national average of 3% from tidewater sources.

2.2.3 Water Discharge Points

The four Atlantic provinces and British Columbia relied heavily upon discharge to tidewater (about 22% of the national total) (Table 16). The plants in the inland provinces relied substantially upon discharge to surface water bodies (about 72% of the national total). In all provinces, a small proportion of waste water was discharged to public systems usually by the smaller plants (about 5% of the national total). As in the intake distribution, the distribution of discharge to ground water and other sources was small, contributing less than 1% of the national total.

Table 17 shows the monthly distribution of water intake for each province. Because of their small intake requirements, no breakdown was provided for Prince Edward Island, the Yukon or Northwest Territories. The distribution patterns for the provinces were similar for both intake and discharge. Hence, only the monthly intake distribution is covered here. Several provinces withdrew a large proportion of their intake during the summer and fall months. The distribution patterns also reflect the unique characteristics of each province, showing their lowest and highest or peak months. The annual distribution range is the lowest in British Columbia (just over 1%) and the highest in Saskatchewan (just over 3%).

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Appendix A
Mineral Extraction Survey Tables

Mineral Extraction Survey Tables

The mines surveyed withdrew a total of 648 MCM, which combined with recirculation of 2792 MCM to produce a gross water use of 3440 MCM (Table A-1). The metal mines, the largest group surveyed, were the largest water users in all parameters. The use rate for the three mining sectors was calculated at 5.3%. Owing to the inclusion of mine water in the discharge totals, the actual water consumption could not be imputed. Although the metal mines group reported the largest volume of recirculation in Table A-1, the highest degree of recirculation was practised by the mineral fuels group, particularly by the non-conventional crude oil operations, the oil sands extraction plants, and natural gas processing plants.

Most of the water intake (Table A-2) was drawn from surface water bodies (74%), with the second source of supply being ground-water sources (10%). In Table A-3, the largest amount of intake water was used for processing (68%), followed by cooling and condensing (27%), with the rest for sanitary and other purposes.

Screening was the dominant method of intake treatment (Table A-4) followed by filtration, chlorination and disinfection, corrosion and slime control. The discharge from the mines has been distorted by the inclusion of mine water (or mine dewatering) only in the discharge totals. The proportions of the various discharge points are realistic, however, with the freshwater bodies receiving the largest share (Table A-5). The amounts transferred to tailings ponds reflected the importance of tailings recovery processes in the metal mines and the re-injection schemes in the oil and gas operations. To a lesser degree, the tailings ponds were used for by-product recovery through natural evaporation by the potash and salt mines. These Saskatchewan mines also injected their salty wastes to disposal wells for permanent ground storage.

Much of the effluent from all three mining sectors received at least primary treatment (Table A-6). The metal mines provided all three levels of treatment to cleanse their effluent before discharge. The costs of these treatment methods are shown in Table A-7. The discharge treatment costs were almost double their water acquisition costs. The high recirculation costs in the metal mines and mineral fuels industries mirrored the importance of recirculation from tailings ponds. The significant amount spent on intake treatment by the mineral fuels group is attributable to the high quality requirements for some processes within the oil sands and gas processing plants.

Table A-1. Characteristics of Water Use in Mineral Extraction, 1981 (MCM)

Mineral group	Number of employees	Number of mines	Total intake	Total recycled water	Gross water use	Total discharge
Metal mines	60 960	114	449	1247	1696	1240
Mineral fuels	20 060	77	140	1125	1265	108
Non-metal mines (except coal mines)	14 391	60	59	420	479	80
Total	95 411	251	648	2792	3440	1428

Note: The addition of figures may not be possible due to rounding.

Table A-2. Water Intake by Source, Mineral Extraction, 1981 (MCM)

Mineral group	Public	Freshwater self-supplied			Brackish water self-supplied			Total
		Surface	Ground	Other	Ground	Tide	Other	
Metal mines	45	321	41	42	-	-	-	449
Mineral fuels	1	126	12	1	-	-	-	140
Non-metal mines (except coal mines)	7	34	9	-	-	6	3	59
Total	53	481	62	43	-	6	3	648

Note: Dashes (-) refer to negligible quantities
The addition of figures may not be possible due to rounding.

Table A-3. Water Intake by Purpose, Mineral Extraction, 1981 (MCM)

Mineral group	Processing	Cooling condensing and steam	Sanitary service	Other	Total water intake
Metal mines	342	84	16	7	449
Mineral fuels	68	69	2	1	140
Non-metal mines (except coal mines)	33	21	4	1	59
Total	443	174	22	9	648

Note: The addition of figures may not be possible due to rounding.

Table A-4. Treatment of Intake Water by Type, Mineral Extraction, 1981 (MCM)

Mineral group	Filtration	Chlorination and disinfection	Corrosion and slime control	Screening	Hardness and alkalinity control	Other	Total
Metal mines	20	95	18	92	9	12	246
Mineral fuels	35	36	23	85	23	3	205
Non-metal mines (except coal mines)	2	7	2	8	1	1	21
Total	57	138	43	185	33	16	472

Note: The addition of figures may not be possible due to rounding.

Table A-5. Water Discharge by Discharge Point, Mineral Extraction, 1981 (MCM)

Mineral group	Public sewer	Freshwater body	Tidewater body	Ground	Tailings pond transfer	Transferred (Other)	Total
Metal mines	73	803	24	57	278	5	1240
Mineral fuels	-	65	1	6	36	-	108
Non-metal mines (except coal mines)	1	37	13	19	9	1	80
Total	74	905	38	82	323	6	1428

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table A-6. Treatment of Waste Water by Type, Mineral Extraction, 1981 (MCM)

Mineral group	Primary Treatment (I)	Primary Treatment (II)	Secondary Treatment (I)	Secondary Treatment (II)	Tertiary Treatment (I)	Tertiary Treatment (II)	Total
Metal mines	337	8	24	-	11	1	381
Mineral fuels	27	5	8	-	2	3	45
Non-metal mines (except coal mines)	20	3	1	-	-	-	24
Total	384	16	33	-	13	4	450

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table A-7. Water Costs by Cost Component, Mineral Extraction, 1981 ($000's)

Mineral group	Water acquisition cost	Intake treatment cost	Recirculation cost	Discharge treatment cost	Total cost
Metal mines	6 880	1 351	5 218	12 379	25 828
Mineral fuels	1 978	9 496	3 707	1 839	17 020
Non-metal mines (except coal mines)	2 602	362	1 003	160	4 127
Total	11 460	11 209	9 928	14 378	46 975

Note: The addition of figures may not be possible due to rounding.

Appendix B
Thermal Power Survey Tables

Thermal Power Survey Tables

Tables were prepared for the various use parameters indicated in the survey of 88 thermal power plants. Approximately 94% of intake was withdrawn by the electrical utilities, with the industrial establishments producing electricity and steam for their processes accounting for the rest. Of these industries, the three major water users accounted for 86% of this category, primary metals being the largest (Table B-1). The intake sources were predominantly surface water bodies, with the secondary source being tidewater, especially for the electrical utilities. This tidewater source accounted for only about 9% of that group's intake. The discharge data revealed that the large part of the effluent (about 90%) was discharged to these same bodies, with only a small amount being held in cooling ponds (Table B-2).

Table B-3 presents the quantities of intake water treated by the various treatment types. The most frequently used process was screening, followed by corrosion and slime control, and chlorination and disinfection. These three treatments accounted for about 98% of treatment. The electrical utilities dominated all categories, with chemical and chemical products, paper and allied and primary metals industries ranked by treatment volumes.

The survey data on costs for water acquisition and intake treatment emphasized the dominance of the electric power utilities. Among the industries, however, the chemical and chemical products group spent the most on water acquisition, and the paper and allied industry spent the most on intake treatment (Table B-4). This table also reveals that the primary metals group, the largest industrial water user reporting thermal use, spent considerably less than either of these other major water-using industries.

Although the recirculation data received were not sufficient for analysis, it appears that almost all of the water was used for condenser cooling purposes. This use accounted for about 99% of the water recirculated by the electric power utilities, the predominant water user.

Table B-1. Water Intake by Source, Thermal Power, 1981 (MCM)

Industry	Number of plants	Public	Freshwater self-supplied			Brackish water self-supplied		Total
			Surface	Ground	Other	Ground	Tide	
Metal mines	1	-	-	-	-	-	-	-
Mineral fuels	1	-	59	-	-	-	-	59
Non-metal mines	2	-	4	-	-	-	-	4
Food and beverage	3	-	13	-	-	-	-	13
Rubber and plastics	1	-	1	-	-	-	-	1
Textiles	1	-	5	-	-	-	-	5
Wood	8	2	45	8	-	-	19	74
Paper and allied	20	32	235	1	-	-	-	268
Primary metals	6	4	342	-	-	-	29	375
Chemical and chemical products	3	1	315	-	-	-	-	316
Electric power	42	37	16 450	-	17	-	1662	18 166
Total	88	76	17 469	9	17	-	1710	19 281

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table B-2. Water Discharge by Discharge Point, Thermal Power, 1981 (MCM)

Industry	Public sewer	Freshwater body	Tidewater body	Ground	Artificial body	Transferred other	Total
Metal mines	-	-	-	-	-	-	-
Mineral fuels	-	59	-	-	-	-	59
Non-metal mines	-	-	-	-	-	4	4
Food and beverage	1	9	-	-	-	-	10
Rubber and plastics	-	1	-	-	-	-	1
Textiles	4	-	-	-	-	-	4
Wood	1	45	19	-	8	-	73
Paper and Allied	-	99	135	12	-	-	246
Primary metals	4	337	-	-	1	-	342
Chemical and chemical products	1	289	-	-	-	-	290
Electric power	1	16 366	1663	1	7	46	18 084
Total	12	17 205	1818	12	16	50	19 113

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table B-3. Treatment of Intake Water by Type, Thermal Power, 1981 (MCM)

Industry	Filtration	Chlorination and disinfection	Corrosion and slime control	Screening	Hardness and alkalinity control	Other	Total
Metal mines	-	-	-	-	-	-	-
Mineral fuels	-	-	-	59	-	-	59
Non-metal mines	-	2	1	-	-	-	3
Food and beverage	-	-	-	12	-	-	12
Rubber and Plastics	-	1	-	-	-	-	1
Textiles	5	-	5	5	5	-	20
Wood generation	-	-	-	46	1	-	47
Paper and allied	106	12	26	343	28	4	519
Primary metals	1	1	2	356	15	11	386
Chemical and chemical products	1	222	-	315	4	-	542
Electric power	18	132	671	10 221	11	12	11 065
Total	131	370	705	11 357	64	27	12 654

Note: Dashes (-) refer to negligible quantities.
The addition of figures may not be possible due to rounding.

Table B-4. Water Costs by Cost Component, Thermal Power, 1981 ($000's)

Industry	Water acquisition	Intake treatment cost	Total cost
Metal mines	15	23	38
Mineral fuels	400	400	800
Non-metal mines	75	92	167
Food and beverage	142	19	161
Rubber and plastics	44	209	253
Textiles	175	257	432
Wood	311	28	339
Paper and allied	1 629	2 359	3 988
Primary metals	132	491	623
Chemical and chemical products	1 918	101	2 019
Electric power	6 470	7 699	14 169
Total	11 311	11 678	22 989

Note: The addition of figures may not be possible due to rounding.

Appendix C
Questionnaires

Statistics Canada
Environment Canada

Statistique Canada
Environnment Canada

WATER USE IN MANUFACTURING INDUSTRIES 1981

In all correspondence concerning this questionnaire please refer to the first seven digits in the top line of the mailing address below.

Si vous désirez un questionnaire en français, veuillez cocher ☐ et retourner à la Division des industries manufacturières et primaires, Statistique Canada, Ottawa, K1A 0T6

Mailing Address (Please correct if necessary)

Physical Location of Establishment (Please correct if necessary)

(Form EC-5-3309-2.1)

SECTION 1: GENERAL INFORMATION

1.1 AUTHORITY This survey is conducted the authority of the Statistics Act, Statutes of Canada, 1970-71-72, Chapter 15. To reduce response burden and to ensure more uniform statistics, Statistics Canada has entered into an agreement with the Department of the Environment under Section 11 of the Canada Statistics Act for sharing of data herein. This Section 11 agreement shall not apply if an authorized officer or person of your Company **objects in writing to the Chief Statistician and mails that letter to the Manufacturing and Primary Industries Division of Statistics Canada** together with the completed questionnaire.

Department of the Environment may in turn share data if requested by the provincial agencies (as listed below) with the province in which this establishment is located **unless you object in writing.** These agencies are: Newfoundland Department of Environment; Prince Edward Island Department of Community Affairs, Nova Scotia Department of Environment, New Brunswick Department of Environment, Quebec Department of Natural Resources, Ontario Ministry of the Environment, Manitoba Environmental Management Division, Saskatchewan Department of the Environment, Alberta Department of the Environment and the British Columbia Ministry of the Environment or their successor or equivalent provincial agencies.

1.2 COMPLETION AND RETURN The data included in this report must relate to the **calendar year 1981.** Please complete this questionnaire **within 30 days of receipt,** retain one copy for your files and return one copy to Statistics Canada utilizing the return envelope provided.

NOTE

(i) Shaded areas are for office use only.

(ii) Water volumes are to be reported in the units in use of the plant. Some of the more common units are . . .

	CODE
☐ thousand imprial gallons	0.1
☐ cubic feet	0.2
☐ cubic metres	0.3

If one of these units has been used please check the appropriate box.

If another unit has been used, please specify: _____ | 0.4

Please report all monthly or annual water volumes in terms of the unit indicated above.

(iii) Please report all cost items in Canadian dollars (omitting cents).

(iv) Has this plant been in operation for more than five (5) years? Yes No

DETAILS OF OPERATION	CODE	NUMBER
1a Indicate the average annual number of employees:	1.1	employees
1b Indicate the number of days of operation during the reporting period	1.2	
1c Indicate the number of hours worked in an average day	1.3	

1d Indicate the major products produced by your plant and list the process used. (So that distinction between products made by different processes can be made.)

PRODUCT	PROCESS

SECTION 2: MONTHLY TOTAL WATER INTAKE AND DISCHARGE

INSTRUCTIONS (i) In this section please report the quantity of new water brought into your operation and the quantity of water routed to its ultimate point of discharge. For the purpose of this questionnaire "new water" is defined as water introduced for the first time into this establishment regardless of source or quality.

(ii) Please break down, as accurately as possible, the total yearly intake and discharge into monthly totals. Report in units specified in section 1.2 (ii)

(iii) Do not report the volume of water held in ponds, lagoons or basins and intended for recirculation or reuse until such water is actually discharged.

(iv) **Do not include as discharge** any water lost in production through evaporation, or otherwise consumed (i.e. included in a final product). Include such water only as intake.

(v) Annual total intake should be greater than or equal to annual total discharge.

Month	Code	Volume per month		Month	Code	Volume per month	
		Intake	Discharge			Intake	Discharge
January	2.1			July	2.7		
February	2.2			August	2.8		
March	2.3			September	2.9		
April	2.4			October	2.10		
May	2.5			November	2.11		
June	2.6			December	2.12		

ANNUAL TOTAL	2.13		

If the annual total amount indicated in box 2.13 above is less than:
1 million gallons
or 160,000 cubic feet
or 4,500 cubic metres
And your plant does not practice recirculation, please ignore the remaining questions, sign the back page, and return the questionnaire as instructed on page 1. Thank you.

SECTION 3: WATER INTAKE BY SOURCE AND KIND

INSTRUCTIONS (i) In this section please breakdown your new water intake by source and kind.

(ii) Report in units specified in section 1.2 (ii), **OR** as a percentage of the annual total as reported in box 2.13 above. Where percentages are used, please indicate with a percent sign (%).

(iii) "Brackish water" is defined as water containing more than 1000 parts per million of dissolved solids.

(iv) In items 3a, 3b and 3d describe source by giving the name.

(v) In items 3c and 3e please specify the type of source.

(vi) In item 3a please include the volume of water supplied by any type of water utility which serves either the general public and/or another industry.

(vii) In items 3b to 3d please include water obtained from your own water supply system and your portion of water obtained from any joint water supply system. EXCLUDING WATER RECIRCULATION IN YOUR PLANT AND WATER PUMPED BY PLANT FACILITY BUT INTENDED FOR USE OUTSIDE THE INDUSTRIAL ESTABLISHMENT.

SOURCE	3.0	%	CODE	Volume per year	
				Fresh	Brackish
3a Public water utility system (name)			3.1		XXX
3b Self-supplied surface water system (lake, river, etc.) (name)			3.2		XXX
3c Self-supplied groundwater system (well, spring, etc.) (specify)			3.3		
3d Self-supplied tide water (~~salt~~ water) body (bay, ocean, etc.) (name)			3.4	XXX	
3e Other sources (specify)			3.5		
3f Total water intake (sum of 3a to 3e) Quantity should equal the amount reported in box 2.13 or 100%			3.6		

3g Estimated total annual operating and maintenance cost of water acquisition (excluding water treatment costs)	3.7	COST	$

SECTION 4: TREATMENT OF INTAKE WATER

INSTRUCTIONS (i) Indicate the amount of intake water treated prior to use.
(ii) Report in units specified in section 1.2 (ii).

CATEGORY OF TREATMENT	CODE	Volume per year
4a Filtration	4.1	
4b Chlorination & disinfection	4.2	
4c Corrosion and slime control	4.3	
4d Screening	4.4	
4e Hardness and alkalinity control	4.5	
4f Other (specify)	4.6	
4g Total amount of water treated (not necessarily equal to the values reported in box 2.13)	4.7	

4h Estimated annual operating and maintenance cost of water treatment	4.8	COST	$

SECTION 5: WATER INTAKE BY PURPOSE

INSTRUCTIONS (i) Report the amount of water used within the industrial plant by initial use. This section should **not** include recirculated water except as stated in section 5a. For a definition of "recirculated water", see section 6.
(ii) In 5d **"Other Uses"** should **not** include water pumped by plant facility, and intended for initial use outside the industrial establishment.
(iii) Report in units specified in section 1.2(ii) **OR** as a percentage of annual total as reported in section 2. Where percentages are used please indicate with a percent sign (%).

PURPOSE	5.0	%	CODE	Volume per year
5a Process water — includes all water which comes in direct contact with products and/or materials. It is further defined to include water which is consumed in milling and special processes, water which is included in final output or water which has been recycled or recirculated from another purpose, and is undergoing its final use as process water.			5.1	
5b Cooling, condensing and steam — Defined as water which **does not** come in direct contact with the products, materials or by-products of the processing operation. Includes pass-through water used in the operation of cooling or process equipment (including air conditioning) and water introduced into boilers for the production of steam for process operations or electric power.			5.2	
5c Sanitary service			5.3	
5d Other uses (specify)			5.4	
5e Total (5a to 5d should equal sum of figures reported in box 2.13 or 100%)			5.5	

SECTION 6: WATER RECIRCULATED OR REUSED BY PURPOSE

INSTRUCTIONS (i) If there was any water recirculated or reused within your plant, please indicate the additional quantity of water that would have been required by purpose had no water been recirculated or reused. For the purpose of this questionnaire "water recirculated or reused" is defined as water which is discharged from the plant or from a particular process within the plant, which is subsequently reinjected into the same process or into a different process within the plant.
(ii) Report in units specified in section 1.2 (ii).

PURPOSE	CODE	Volume per year
6a Process	6.1	
6b Cooling, condensing, etc.	6.2	
6c Other uses (specify)	6.3	
6d Total (items 6a to 6c)	6.4	

6e Estimated annual operating and maintenance cost of water recirculation	6.5	COST	$

SECTION 7: TREATMENT PRIOR TO DISCHARGE

INSTRUCTIONS (i) In items 7b to 7d, specify treatment process used in each of the treatment methods.
(ii) Include only on-site treatment.
(iii) If more than one treatment method is employed, the total reported in 7e may exceed the total reported in 7a.
(iv) Report in units specified in section 1.2 (ii).

	TREATMENT METHOD	CODE	Volume per year
7a	Indicate the total volume of water treated prior to discharge (if any)	7.1	
7b	Primary or mechanical (specify process) (i)	7.2	
	(ii)	7.3	
7c	Secondary or biological (specify process) (i)	7.4	
	(ii)	7.5	
7d	Tertiary or advanced treatment (specify process) (i)	7.6	
	(ii)	7.7	
7e	Total (items 7b to 7d)	7.8	

7f	Estimated annual operating and maintenance cost of treatment prior to discharge	7.9	COST	$

SECTION 8: WATER DISCHARGE

INSTRUCTIONS (i) In this section please report the volume of all water routed to its ultimate point of discharge.
(ii) Report in units specified in Section 1.2 (ii), OR as a percentage of the annual total discharge reported in Section 2.13. Where percentages are used, please indicate with a percent sign (%).
(iii) Do not report the volume of water held in ponds, lagoons or basins and intended for recirculation or reuse until such water is actually discharged.
(iv) Do not include the volume of water lost in production, through evaporation, or otherwise consumed and not brought to the ultimate point of discharge.
(v) In items 8a to 8c please describe point of discharge by giving the name.
(vi) In item 8d please specify.
(vii) In item 8e please identify the use intended.

	DISCHARGE POINT	8.0	%	CODE	Volume per year
8a	Public utility sewer (municipality, etc.) (name)			8.1	
8b	Fresh water body (lake, river, etc.) (name)			8.2	
8c	Tide water (salt water) body (bay, ocean, etc.) (name)			8.3	
8d	Ground (incl. seepage from holding ponds, lagoons, etc.) (specify)			8.4	
8e	Transferred to other uses outside plant after use in process (use)			8.7	
8f	Total water discharge (Quantity should equal discharge values as reported in box 2.13 or 100%)			8.8	

CERTIFICATION: I certify that the information contained herein is complete and correct to the best of my knowledge and belief and covers the calendar year of 1981.

Signature of authorized person	Title	Date

Name of contact regarding this report	Address (if different from front page)	Telephone area code	Telephone number	Telephone ext.	Telex

Comments:

Statistics Canada
Environment Canada

Statistique Canada
Environnment Canada

WATER USE IN THE MINERAL EXTRACTION INDUSTRY 1981

In all correspondence concerning this questionnaire please refer to the first seven digits in the top line of the mailing address below.

Si vous désirez un questionnaire en français, veuillez cocher ☐ et retourner à la Division des industries manufacturières et primaires, Statistique Canada, Ottawa, K1A 0T6.

Mailing Address (Please correct if necessary)

Physical Location of Establishment (Please correct if necessary)

(Form EC-5-3309-1.1)

SECTION 1: GENERAL INFORMATION

1.1 AUTHORITY This survey is conducted under the authority of the Statistics Act, Statutes of Canada, 1970-71-72, Chapter 15. To reduce response burden and to ensure more uniform statistics, Statistics Canada has entered into an agreement with the Department of the Environment under Section 11 of the Canada Statistics Act for the sharing of data herein. This Section 11 agreement shall not apply if an authorized officer or person of your Company **objects in writing to the Chief Statistician and mails that letter to the Manufacturing and Primary Industries Division of Statistics Canada** together with the completed questionnaire.

Department of the Environment may in turn share data if requested by the provincial agencies (as listed below) with the province in which this establishment is located **unless you object in writing.** These agencies are: Newfoundland Department of Environment; Prince Edward Island Department of Community Affairs, Nova Scotia Department of Environment, New Brunswick Department of Environment, Quebec Department of Natural Resources, Ontario Ministry of the Environment, Manitoba Environmental Management Division, Saskatchewan Department of the Environment, Alberta Department of the Environment and the British Columbia Ministry of the Environment of their successor or equivalent provincial agencies.

1.2 COMPLETION AND RETURN NOTE The data included in this report must relate to the **calendar year 1981.** Please complete this questionnaire **within 30 days of receipt,** retain one copy for your files and return one copy to Statistics Canada utilizing the return envelope provided.

(i) Shaded areas are for office use only.

(ii) Water volumes are to be reported in the units in use of the plant. Some of the more common units are

	CODE
☐ thousand imperial gallons	0.1
☐ cubic feet	0.2
☐ cubic metres	0.3

If one of these units has been used please check the appropriate box.

If another unit has been used, please specify: _____ 0.4

Please report all monthly or annual water volumes in terms of the unit indicated above.

(iii) Please report all cost items in Canadian dollars (omitting cents).

DETAILS OF OPERATION	CODE	NUMBER
1a Indicate the average annual number of employees:	1.1	employees
1b Indicate the number of days of operation during the reporting period	1.2	
1c Indicate the number of hours worked in an average day	1.3	

1d Indicate the principal type of operation carried on by this unit
(i.e. underground mine, stripmine, gas plant, oil extraction plant, etc.) _____

SECTION 2: MONTHLY TOTAL WATER INTAKE AND DISCHARGE

INSTRUCTIONS

(i) In this section, please report the quantity of new water brought into your operation, and the quantity of water routed to its ultimate point of discharge.
For the purpose of this questionnaire, "new water" is defined as water introduced for the first time into this establishment, regardless of source or quality.

(ii) Please break down as accurately as possible the total yearly water intake and discharge into monthly totals.

(iii) Report in units specified in section 1.2 (ii).

(iv) In mining operations please include waste water pumped from the mine, and not used for any other purpose **as discharge water only.**

(v) In oil and gas operations please include produced water not reused for any other purpose (including reinjection) **as discharge water only.** "Produced water" is defined as water which is removed from the original oil-water mixture.

(vi) **Do not include as discharge** any water lost in production through evaporation or otherwise consumed (i.e. included in a final product or slurry). Include such water **only** as intake.

(vii) **Do not** include water held in ponds, lagoons, or basins and intended for recirculation or reuse until such water is actually discharged.

(viii) Note, annual total discharge may be greater than annual total intake as explained above in items 2 (iv) and 2 (v).

Month	Code	Volume per month		Month	Code	Volume per month	
		Intake	Discharge			Intake	Discharge
January	2.1			July	2.7		
February	2.2			August	2.8		
March	2.3			September	2.9		
April	2.4			October	2.10		
May	2.5			November	2.11		
June	2.6			December	2.12		
				ANNUAL TOTAL	2.13		

If the annual total amounts indicated in box 2.13 above are less than: 1 million gallons, or 160,000 cubic feet, or 4,500 cubic metres, and your plant does not practice recirculation, please ignore the remaining questions, sign the back page, and return the questionnaire as instructed on page 1. Thank you.

SECTION 3: WATER INTAKE BY SOURCE AND KIND

INSTRUCTIONS

(i) In this section please break down your new water intake by source and kind.

(ii) Report in units specified in section 1.2 (ii), OR as a percentage of the annual total as reported in section 2.13. Where percentages are used, please indicate with a percent sign (%).

(iii) "Brackish water" is defined as water containing more than 1000 parts per million of dissolved solids.

(iv) In items 3a, 3b and 3d describe source by giving the name.

(v) In items 3c and 3e please specify the type of source.

(vi) In item 3a please include the volume of water supplied by any type of water utility which serves either the general public and/or another industry.

(vii) In items 3b to 3d please include water obtained from your own water supply system and your portion of water obtained from any joint water supply system, EXCLUDING WATER RECIRCULATION IN YOUR ESTABLISHMENT AND WATER PUMPED BY YOUR FACILITY BUT INTENDED FOR USE OUTSIDE THE INDUSTRIAL ESTABLISHMENT.

SOURCE	3.0	%	CODE	Volume per year	
				Fresh	Brackish
3a Public water utility system (name)			3.1		XXX
3b Self-supplied surface water system (lake, river, etc.) (name)			3.2		XXX
3c Self-supplied groundwater system (well, spring, etc.) (specify)			3.3		
3d Self-supplied tide water (salt water) body (bay, ocean, etc.) (name)			3.4	XXX	
3e Other sources (specify)			3.5		
3f Total water intake (sum of 3a to 3e) Quantity should equal the amount reported in box 2.13 or 100%			3.6		

3g Estimated total annual operating and maintenance cost of water acquisition (excluding water treatment costs)	3.7	COST	$	

SECTION 4: TREATMENT OF INTAKE WATER

INSTRUCTIONS (i) Indicate the amount of intake water treated prior to use.
(ii) Report in units specified in section 1.2 (ii).

	CATEGORY OF TREATMENT	CODE	Volume per year
4a	Filtration	4.1	
4b	Chlorination and disinfection	4.2	
4c	Corrosion and slime control	4.3	
4d	Screening	4.4	
4e	Hardness and alkalinity control	4.5	
4f	Other (specify)	4.6	
4g	Total amount of water treated (not necessarily equal to the sum of the figures reported in box 2.13)	4.7	

4h	Estimated annual operating and maintenance cost of water treatment	4.8	COST	$

SECTION 5: WATER INTAKE BY PURPOSE

INSTRUCTIONS (i) Report the amount of water used within your establishment by initial use. This section should **not** include recirculated water, except as stated in section 5a. For a definition of "recirculated water", see section 6.
(ii) In 5d "Other Uses" should **not** include water pumped by plant facility, and intended for initial use outside the plant.
(iii) Report in units specified in section 1.2 (ii) OR as a percentage of annual total as reported in section 2.13. Where percentages are used please indicate with percent sign (%).

	PURPOSE	5.0	%	CODE	Volume per year
5a	Process water — includes all water which comes in direct contact with products and/or materials. It is further defined to include water which is consumed in milling and special processes, water which is included in final output, or water which has been recycled or recirculated from another purpose, and is undergoing its final use as process water.			5.1	
5b	Cooling, condensing and steam — Defined as water which **does not** come in direct contact with the products, materials or by-products of the processing operation. Includes pass-through water used in the operation, cooling of process equipment (including air conditioning) and water introduced into boilers for the production of steam for process operations or electric power.			5.2	
5c	Sanitary service			5.3	
5d	Other uses (specify)			5.4	
5e	Total (5a to 5d should equal sum of figures reported in box 2.13 or 100%)			5.5	

SECTION 6: WATER RECIRCULATED OR REUSED BY PURPOSE

INSTRUCTIONS (i) If there was any water recirculated or reused within your plant, please indicate the additional quantity of water that would have been required by purpose had no water been recirculated or reused. For the purpose of this questionnaire "water recirculated or reused" is defined as water which is discharged from the plant or from a particular process within the plant, which is subsequently reinjected into the same process or into a different process within the plant.
(ii) Report in units specified in section 1.2 (ii).

	PURPOSE	CODE	Volume per year
6a	Process	6.1	
6b	Cooling, condensing, etc.	6.2	
6c	Other uses (specify)	6.3	
6d	Total (items 6a to 6c)	6.4	

6e	Does this operation have a tailings pond?	6.6	Yes 1 ☐	No 2 ☐
	If yes, indicate the volume of water recirculated or reused from the tailings pond.	6.7		
6f	Does this operation reinject water into an oil bearing formation?	6.11	Yes 1 ☐	No 2 ☐
	If yes, indicate the volume of water reinjected	6.12		
6g	Estimated annual operating and maintenance cost of water recirculation	6.8	COST	$

SECTION 7: TREATMENT PRIOR TO DISCHARGE

INSTRUCTIONS
(i) In items 7b to 7d specify treatment process used in each of the treatment methods.
(ii) Include only on-site treatment.
(iii) If more than one treatment method is employed, the total reported in 7e may exceed the total reported in 7a.
(iv) Report in units specified in section 1.2 (ii).

	TREATMENT METHOD	CODE	Volume per year
7a	Indicate the total volume of water treated prior to discharge (if any) during 1981	7.1	
7b	Primary (or mechanical) (i)	7.2	
	(ii)	7.3	
7c	Secondary (or biological) (i)	7.4	
	(ii)	7.5	
7d	Tertiary or advanced treatment (specify process) (i)	7.6	
	(ii)	7.7	
7e	Total (items 7b to 7d)	7.8	

7f	Estimated total annual operating and maintenance cost of treatment prior to discharge	7.9	CCST	$

SECTION 8: WATER DISCHARGE

INSTRUCTIONS
(i) In this section please report the volume of all water routed to its ultimate point of discharge.
(ii) Report in units specified in section 1.2 (ii), OR as a percentage of the annual total discharge reported in section 2.13. Where percentages are used, please indicate with a percent sign (%).
(iii) Do not report the volume of water held in ponds, lagoons or basins and intended for recirculation of reuse until such water is actually discharged.
(iv) Do not include the volume of water lost in production, through evaporation, or otherwise consumed and not brought to the ultimate point of discharge.
(v) In items 8a to 8c please describe point of discharge by giving the name.
(vi) In item 8d please specify.
(vii) In item 8f please identify the use intended.

	DISCHARGE POINT	8.0	%	CODE	Volume per year
8a	Public utility sewer (municipality, etc.) (name)			8.1	
8b	Fresh water body (lake, river, etc.) (name)			8.2	
8c	Tide water (salt water) body (estuary, bay, ocean) (name)			8.3	
8d	Ground (incl. seepage from holding ponds, lagoons, etc.) (specify)			8.4	
8e	Transferred to tailings pond or reinjected to producing formation (specify)			8.5	
8f	Transferred to other uses outside plant after use in process (Use)			8.7	
8g	Total water discharged Quantity should equal the amount reported in Box 2.13, or 100%			8.8	

CERTIFICATION: I certify that the information contained herein is complete and correct to the best of my knowledge and belief and covers the calendar year 1981.

Signature of authorized person	Title	Date

Name of contact regarding this report	Address (if different from front page)	Telephone			Telex
		area code	number	ext.	

Comments:

Statistics Canada
Environment Canada

Statistique Canada
Environnment Canada

WATER USE BY THERMAL POWER PLANTS 1981

In all correspondence concerning this questionnaire please refer to the first seven digits in the top line of the mailing address below.

Si vous désirez un questionnaire en français, veuillez cocher ☐ et retourner à la Division des industries manufacturières et primaires, Statistique Canada, Ottawa, K1A 0T6.

Mailing Address (Please correct if necessary)

Physical Location of Establishment (Please correct if necessary)

(Form EC-5-3309-3.1)

SECTION 1: GENERAL INFORMATION

1.1 AUTHORITY This survey is conducted under the authority of the Statistics Act, Statutes of Canada, 1970-71-72, Chapter 15. To reduce response burden and to ensure more uniform statistics, Statistics Canada has entered into an agreement with the Department of the Environment under Section 11 of the Canada Statistics Act for the sharing of data herein. This Section 11 agreement shall not apply if an authorized officer or person of your Company **objects in writing to the Chief Statistician and mails that letter to the Manufacturing and Primary Industries Division of Statistics Canada** together with the completed questionnaire.

Department of the Environment may in turn share data if requested by the provincial agencies (as listed below) with the province in which this establishment is located **unless you object in writing.** These agencies are: Newfoundland Department of Environment; Prince Edward Island Department of Community Affairs, Nova Scotia Department of Environment, New Brunswick Department of Environment, Quebec Department of Natural Resources, Ontario Ministry of the Environment, Manitoba Environmental Management Division, Saskatchewan Department of the Environment, Alberta Department of the Environment and the British Columbia Ministry of the Environment or their successor or equivalent provincial agencies.

1.2 COMPLETION AND RETURN The data included in this report must relate to the **calendar year 1981.** Please complete this questionnaire **within 30 days of receipt,** retain one copy for your files and return one copy to Statistics Canada utilizing the return envelope provided.

NOTE (i) Shaded areas are for office use only.

(ii) Water volumes are to be reported in the units in use at the plant. Some of the more common units are . . .

	CODE
☐ thousand imperial gallons	0.1
☐ cubic feet	0.2
☐ cubic metres	0.3

If one of these units has been used please check the appropriate box.

If another unit has been used, please specify: _____ 0.4

Please report all monthly or annual water volumes in terms of the units indicated above.

(iii) Please report all cost items in Canadian dollars (omitting cents).

DETAILS OF OPERATION		CODE	
1a Indicate the average number of employees required to operate the power plant in 1981		1.1	employees
1b Indicate the number of days of operation during 1981		1.2	days
1c Indicate the number of hours worked in an average day		1.3	hours
1d Indicate the amount of power produced at this plant in 1981	(i) net generation	1.4	MW.h
	(ii) station service	1.5	MW.h
1e Indicate the average heat rate of the plant		1.6	BTU/KW.h
1f Indicate the capacity of water intake pumps (specify units)		1.7	
1g Indicate the average heat rejection rate of the plant		1.8	% (eg. 38%)
1h Does your facility provide water for uses other than in the power plant?		1.9	1 ☐ yes 2 ☐ no
If yes, indicate the percentage of total raw water pump capacity, as reported in 1f, allocated to the power plant water intake		1.10	% (eg. 90%)

Canada

SECTION 2: MONTHLY TOTAL WATER INTAKE AND DISCHARGE

INSTRUCTIONS

(i) In this section please report the quantity of new water brought into your operation and the quantity of water routed to its ultimate point of discharge. For the purpose of this questionnaire, "new water" is defined as water introduced for the first time into this establishment regardless of source or quality.

(ii) Please break down, as accurately as possible, the total yearly water intake and discharge into monthly totals. Report in units specified in 1.2 (ii).

(iii) Do not report the volume of water held in ponds, lagoons or basins and intended for recirculation or reuse until such water is actually discharged.

(iv) Do not include as discharge the volume of water lost in production, through evaporation, or otherwise consumed. Include such water only as intake water.

(v) Annual total intake should be greater than or equal to annual total discharge.

Month	Code	Volume per month		Month	Code	Volume per month	
		Intake	Discharge			Intake	Discharge
January	2.1			July	2.7		
February	2.2			August	2.8		
March	2.3			September	2.9		
April	2.4			October	2.10		
May	2.5			November	2.11		
June	2.6			December	2.12		
				ANNUAL TOTAL	2.13		

SECTION 3: WATER INTAKE BY SOURCE AND KIND

INSTRUCTIONS

(i) In this section please break down your new water intake by source and kind.

(ii) Report in units specified in section 1.2 (ii), OR as a percentage of the annual total as reported in box 2.13 above. Where percentages are used, please indicate with a percent sign (%).

(iii) Brackish water is defined as water containing more than 1000 parts per million of dissolved solids.

(iv) In items 3a, 3b and 3d describe source by giving the name.

(v) In items 3c and 3e please specify the type of source.

(vi) In item 3a please include the volume of water supplied by any type of water utility which serves either the general public and/or another industry.

(vii) In items 3b to 3d please include water obtained from your own water supply system and your portion of water obtained from any joint water supply system, EXCLUDING WATER RECIRCULATION IN YOUR PLANT AND WATER PUMPED BY PLANT FACILITY BUT INTENDED FOR USE OUTSIDE THE INDUSTRIAL ESTABLISHMENT.

	SOURCE	3.0	%	CODE	Volume per year	
					Fresh	Brackish
3a	Public water utility system (name)			3.1		XXX
3b	Self-supplied surface water system (lake, river, etc.) (name)			3.2		XXX
3c	Self-supplied groundwater system (well, spring, etc.) (specify)			3.3		
3d	Self-supplied tide water (salt water) body (bay, ocean, etc.) (name)			3.4	XXX	
3e	Other sources (specify)			3.5		
3f	Total water intake (sum of 3a to 3e). Quantity should equal the amount reported in box 2.13, or 100%			3.6		

3g	Estimated total annual operating and maintenance cost of water acquisition (excluding water treatment costs)	3.7	COST	$

SECTION 4: TREATMENT OF INTAKE WATER

INSTRUCTIONS (i) Indicate the amount of intake water treated prior to use.
(ii) Report in units specified in section 1.2 (ii).

	CATEGORY OF TREATMENT	CODE	Volume per year
4a	Filtration	4.1	
4b	Chlorination & disinfection	4.2	
4c	Corrosion & slime control	4.3	
4d	Screening	4.4	
4e	Hardness & alkalinity control	4.5	
4f	Other (specify)	4.6	
4g	Total amount of water treated (not necessarily equal to the values reported in box 2.13)	4.7	

4h	Estimated annual operating and maintenance cost of water treatment	4.8	COST	$

SECTION 5: WATER USAGE

INSTRUCTIONS (i) Report the amount of water used within the thermal plant by initial use. This section should not include recirculated water.
(ii) Report in units specified in section 1.2 (ii) OR as a percentage of annual total as reported in section 2.13. Where percentages are used please indicate with percent sign (%).

		CODE	
5a	Is there a water-cooled condenser set in your plant?	5.6	Yes 1 ☐ No 2 ☐
	If yes, what is the design temperature rise for the cooling water in your condenser cooling cycle?	5.7	_____ °C (ex. 51°C)
5b	Did this plant produce steam for purposes other than power generation? (i.e. process, for sale)	5.8	Yes 1 ☐ No 2 ☐

			5.0	%	CODE	Volume per year
5c	What was the amount of boiler make-up water required for power generation purpose? (excluding production for steam sales or transfer)				5.9	
5d	Of the total water intake reported in box 2.13 what was the amount required for	(i) condenser cooling for power generation purpose only?			5.10	
		(ii) sanitary, fire protection or other?			5.11	
5e	What were the estimated water losses	(i) in boilers?			5.12	
		(ii) in cooling cycle?			5.13	
		(iii) in ash control system (include evaporation losses from all ponds)?			5.21	

SECTION 6: WATER RECIRCULATED OR REUSED

INSTRUCTIONS (i) In this section "water recirculated or reused" is defined as water which is discharged from the plant or from a particular process within the plant, which is subsequently reinjected into the same process or into a different process within the plant.

			CODE	Factor
6a	If this plant recirculated water in the cooling and condensing system (open or closed) by what factor would your total water intake, reported in 5d (i) need to be multiplied by had no recirculation taken place (ex. 3.1X)	(i) fresh	6.9	
		(ii) brackish	6.10	

SECTION 7: WATER DISCHARGE

INSTRUCTIONS

(i) In this section please report the volume of all water routed to its ultimate point of discharge.
(ii) Report in units specified in section 1.2 (ii) OR as a percentage of the annual total discharge reported in section 2.13. Where percentages are used, please indicate with a percent sign (%).
(iii) Do not report the volume of water held in ponds, lagoons or basins and intended for recirculation or reuse until such water is actually discharged.
(iv) Do not include the volume of water lost in production, through evaporation, or otherwise consumed and not brought to the ultimate point of discharge.
(v) In items 7a to 7c please describe point of discharge by giving the name.
(vi) In item 7d please specify.
(vii) In item 7f please identify the use intended.

DISCHARGE POINT	8.0	%	CODE	Volume per year
7a Public utility sewer (municipality, etc.) (name)			8.1	
7b Fresh water body (lake, river, etc.) (name)			8.2	
7c Tide water (salt water) body (bay, ocean, etc.) (name)			8.3	
7d Ground (including seepage from holding ponds, lagoons etc.) (specify)			8.4	
7e Final discharge to artificial surface body (specify)			8.6	
7f Transferred to other uses outside plant after use in process (use)			8.7	
7g Total water discharge (sum of 7a to 7f)			8.8	
7h Was the discharge water reported in 7g treated so as not to exceed a certain given temperature			8.9	Yes 1 ☐ No 2 ☐

If yes, please specify the methods of head dissipation employed.

7i Indicate the highest and lowest temperature of water permanently discharged from the plant during 1981 along with the corresponding months of occurence (ex. 83°C)

	CODE	TEMPERATURE	CODE	MONTH
High	8.10	°C	8.11	
Low	8.12	°C	8.13	

SECTION 8: MONTHLY OUTPUT

In this section please break down, as accurately as possible, for the calendar year 1981 the electrical net power generation as specified in 1d (i). Please report below in net MW.h (megawatt hours) per month.

Month	Code	MW.h per month	Month	Code	MW.h per month
January	9.14		July	9.20	
February	9.15		August	9.21	
March	9.16		September	9.22	
April	9.17		October	9.23	
May	9.18		November	9.24	
June	9.19		December	9.25	
			ANNUAL TOTAL	9.26	

CERTIFICATION: I certify that the information contained herein is complete and correct to the best of my knowledge and belief and covers the calendar year 1981.

Signature of authorized person	Title	Date

Name of contact regarding this report	Address (if different from front page)	Telephone			Telex
		area code	number	ext.	

Comments:

Statistics Canada
Environment Canada

Statistique Canada
Environnment Canada

HYDRO GENERATION WATER USE, 1981

In all correspondence concerning this questionnaire please refer to the first seven digits in the top line of the mailing address below.

Si vous désirez un questionnaire en français, veuillez cocher ☐ et retourner à la Division des industries manufacturières et primaires, Statistique Canada, Ottawa, K1A 0T6.

Mailing Address (Please correct if necessary)

Physical Location of Establishment (Please correct if necessary)

(Form EC-5-3309-4.1)

SECTION 1: GENERAL INFORMATION

1.1 AUTHORITY This survey is conducted under the authority of the Statistics Act, Statutes of Canada, 1970-71-72, Chapter 15. To reduce response burden and to ensure more uniform statistics, Statistics Canada has entered into an agreement with the Department of the Environment under Section 11 of the Canada Statistics Act for the sharing of data herein. This Section 11 agreement shall not apply if an authorized officer or person of your Company **objects in writing to the Chief Statistician and mails that letter to the Manufacturing and Primary Industries Division of Statistics Canada** together with the completed questionnaire.

Department of the Environment may in turn share data if requested by the provincial agencies (as listed below) with the province in which this establishment is located **unless you object in writing.** These agencies are: Newfoundland Department of Environment; Prince Edward Island Department of Community Affairs, Nova Scotia Department of Environment, New Brunswick Department of Environment, Quebec Department of Natural Resources, Ontario Ministry of the Environment, Manitoba Environmental Management Division, Saskatchewan Department of the Environment, Alberta Department of the Environment and the British Columbia Ministry of the Environment or their successor or equivalent provincial agencies.

1.2 COMPLETION AND RETURN The data included in this report must relate to the **calendar year 1981.** Please complete this questionnaire **within 30 days of receipt,** retain one copy for your files and return one copy to Statistics Canada utilizing the return envelope provided.

NOTE (i) Shaded areas are for office use only.

1.3 (i) In the spaces below, please indicate:

CODE
0.5
0.6

1a. Plant Name: _____

1b. River: _____

SECTION 2: MONTHLY FLOWS

INSTRUCTIONS (i) For calendar year 1981, please provide the monthly average flow through turbines in cubic meters/second (m^3/s).

Month	Code	Flow in M^3/sec.	Month	Code	Flow in M^3/sec.
January	2.14		July	2.20	
February	2.15		August	2.21	
March	2.16		September	2.22	
April	2.17		October	2.23	
May	2.18		November	2.24	
June	2.19		December	2.25	

SECTION 3: MONTHLY SPILL

INSTRUCTIONS (i) For calendar year 1981, please provide the monthly average spill in cubic meters/second (m^3/s) at this plant.

Month	Code	Spill	Month	Code	Spill
January	2.27		July	2.33	
February	2.28		August	2.34	
March	2.29		September	2.35	
April	2.30		October	2.36	
May	2.31		November	2.37	
June	2.32		December	2.38	

SECTION 4: WATER USE DETAILS

INSTRUCTIONS (i) Please answer the following specific questions in the units specified.

4a In relation to long run averages at this plant, was calendar year 1981 (√)

a high water year? ☐ an average level year? ☐ a low water year? ☐ 5.14

4b What was the maximum (1 hour) output of this plant in calendar year 1981? 5.15 ____ MW

4c What flow (in m^3/s) was associated with the maximum output given in question 4b above? 5.16 ____ m^3/s

4d In 1981 the capacity of this plant was used for: (check either or both items as appropriate).

(a) Peaking ☐ (b) Baseload ☐ 5.17 5.20

4e In 1981, what was the capacity factor of the plant?

Capacity Factor 5.18 ____ %

4f The total usable storage (including pondage) available to this plant in cubic metres (m^3) was:

5.19 ____ m^3

SECTION 5: MONTHLY GENERATION

INSTRUCTIONS (i) In this section please break down, as accurately as possible, for the calendar year 1981, the total electrical power generation. Please report below in MW.h (megawatt hours) **per month.**

Month	Code	MW.h per month	Month	Code	MW.h per month
January	9.1		July	9.7	
February	9.2		August	9.8	
March	9.3		September	9.9	
April	9.4		October	9.10	
May	9.5		November	9.11	
June	9.6		December	9.12	

ANNUAL TOTAL	9.13	

CERTIFICATION:

I certify that the information contained herein is complete and correct to the best of my knowledge and belief and covers the calendar year 1981.

Signature of authorized person	Title	Date

Name of contact regarding this report	Address (if different from front page)	Telephone			Telex
		area code	number	ext.	

Comments: