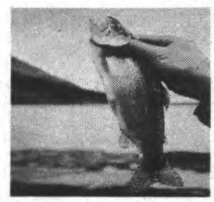
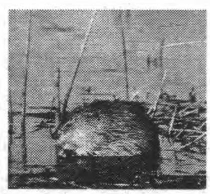
Canada Alberta Northwest Territories

Northern River Basins Study





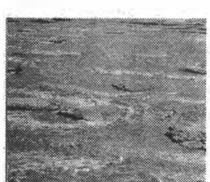






NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 79

A SYNTHESIS OF INFORMATION ON EFFLUENT CHARACTERISTICS OF MUNICIPAL AND NON-PULP MILL INDUSTRIAL SOURCES IN THE PEACE, ATHABASCA AND SLAVE RIVER BASINS



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SENTAR Consultants Ltd.

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PREFACE:

The Northern River Basins Study was initiated through the "Canada-Alberta-Northwest Territories Agreement Respecting the Peace-Athabasca-Slave River Basin Study, Phase II - Technical Studies" which was signed September 27, 1991. The purpose of the Study is to understand and characterize the cumulative effects of development on the water and aquatic environment of the Study Area by coordinating with existing programs and undertaking appropriate new technical studies.

This publication reports the method and findings of particular work conducted as part of the Northern River Basins Study. As such, the work was governed by a specific terms of reference and is expected to contribute information about the Study Area within the context of the overall study as described by the Study Final Report. This report has been reviewed by the Study Science Advisory Committee in regards to scientific content and has been approved by the Study Board of Directors for public release.

It is explicit in the objectives of the Study to report the results of technical work regularly to the public. This objective is served by distributing project reports to an extensive network of libraries, agencies, organizations and interested individuals and by granting universal permission to reproduce the material.

NORTHERN RIVER BASINS STUDY
PROJECT REPORT RELEASE FORM

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Whereas the above publication is the result of a project conducted under the Northern River Basins Study and the terms of reference for that project are deemed to be fulfilled,
IT IS THEREFORE REQUESTED BY THE STUDY OFFICE THAT;
this publication be subjected to proper and responsible review and be considered for release to the public.

(Dr. Fred J. Wrona, Science Director) — 4 Apr 96 (Date)

Whereas it is an explicit term of reference of the Science Advisory Committee "to review, for scientific content, material for publication by the Board",
IT IS HERE ADVISED BY THE SCIENCE ADVISORY COMMITTEE THAT;
this publication has been reviewed for scientific content and that the scientific practices represented in the report are acceptable given the specific purposes of the project and subject to the field conditions encountered.
SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: [ ] Yes [ ] No

(Dr. P. A. Larkin, Ph.D., Chair) — Mar 26/96 (Date)

Whereas the Study Board is satisfied that this publication has been reviewed for scientific content and for immediate health implications,
IT IS HERE APPROVED BY THE BOARD OF DIRECTORS THAT;
this publication be released to the public, and that this publication be designated for: **[ ] STANDARD AVAILABILITY [ ] EXPANDED AVAILABILITY**

(Lucille Partington, Co-chair) — March 22/96 (Date)

(Robert McLeod, Co-chair) — 01/04/96 (Date)

A SYNTHESIS OF INFORMATION ON EFFLUENT CHARACTERISTICS OF MUNICIPAL AND NON-PULP MILL INDUSTRIAL SOURCES IN THE PEACE, ATHABASCA AND SLAVE RIVER BASINS

STUDY PERSPECTIVE

> ***Related Study Questions***
>
> *2) What is the current state of water quality in the Peace, Athabasca and Slave River basins, including the Peace-Athabasca Delta?*
>
> *5) Are the substances added to the rivers by natural and man-made discharges likely to cause deterioration of the water quality?*

The primary objective of this project was to identify the location, treatment technology, and waste disposal methods of all licenced municipal and non-pulp mill effluent dischargers in the Peace, Athabasca and Slave River basins. This included a compilation and synthesis of existing information from government and industry sources on the nature of liquid effluents from these discharges (i.e., nutrients, pathogens, contaminants, etc.), and a user's guide and electronic source file in dBASE IV for this database. Where sufficient data exist, the scope of the discussion incorporated the following: (1) chemistry, microbiology and ecotoxicology; (2) physical nature (timing, duration, quantities, loading); (3) Quality Assurance/Quality Control (QA/QC); (4) licencing requirements and discussion of compliance with requirements; (5) information gaps and how gaps could be resolved; and (6) an assessment of the relative importance of various effluents with respect to nutrient, contaminant, and microbial loading.

Information for this project was obtained from annual reports and operating licences and includes 16 continuously discharging municipal sewage treatment plants, and 126 periodically discharging sewage treatment plants (only 77 have discharge data). Non-pulp mill industrial effluents include 62 licenced discharges such as oil sands plants, coal mines, cement plants, saw mill and wood processing operations. When properly designed and operated, secondary treatment of sewage from continuous discharge facilities effectively reduced the biochemical oxygen demand (BOD_5) and total suspended solids (TSS) in raw sewage, but nutrient removal was not as effective. Three of the larger municipalities that discharge sewage continuously, often released effluent with a BOD_5 exceeding the provincial guideline of 25 mg/L. The lack of accurate flow data from some municipal sewage effluents was identified as an important data gap, making it difficult to determine the load of other reported parameters such as total nitrogen and phosphorus. A review of QA/QC criteria in reporting data and handling sewage effluent samples found a lack or inconsistency in quality control measures used in some cases. Most industries in the study area do not discharge effluent into rivers. Suncor Inc. is the only industry within the study area required to submit extensive monitoring data. Suncor has loading limits for six parameters and toxicity testing requirements, none of which were exceeded over the period examined (1988-1993).

This report is one of a series of documents addressing the ecotoxicity of liquid effluents, and is not intended to cover all aspects of effluents discharged into the study area, or their impacts on aquatic ecosystems. The background information contained in this document will be valuable in the development of a comprehensive ecotoxicity strategy and cumulative effects assessment of these northern rivers.

REPORT SUMMARY

The objective of this report is to compile and synthesize existing information from government and industry sources on the nature of liquid effluents from municipalities and non-pulp mill industries in the Northern River Basins Study (NRBS) area. The study area includes the Peace, Athabasca, and Slave river basins in Alberta and the Northwest Territories.

There are two types of sanitary wastewater (sewage) discharges in the NRBS area: intermittent discharges and continuous discharges. Intermittent discharges result from waste stabilization ponds (lagoon-type processes) where the wastewater from the treatment cells (either anaerobic, facultative, or aerobic) are retained in a storage cell until allowed to discharge in the spring, fall or both. Intermittent dischargers consist of hamlets, towns, villages, campsites, schools, residential areas, and industries (sanitary wastes). Continuous discharges usually result from aerated stabilization basins, and mechanical treatment plants utilizing extended-aeration activated sludge, oxidation ditches or rotating biological contactors. The effluent may be disinfected prior to discharge. There were a total of 16 continuous dischargers in the NRBS area. When properly designed and operated, secondary treatment effectively reduces the concentrations of BOD_5 and TSS in the raw sewage, but nutrient removal is not as effective. Metals are generally removed in the sludge.

Sewage treatment plants are licensed by Alberta Environmental Protection (AEP). A maximum concentration of five-day biochemical oxygen demand (BOD_5) of 25 mg/L and, sometimes, a maximum total suspended solids (TSS) concentration of 25 mg/L are generally set for continuous dischargers according to the treatment method. A range of residual chlorine (>0.5 mg/L and <3.5 mg/L) is required occasionally.

AEP has specific requirements such as the certification of the operators, the frequency and type of effluent sampling and the methods of chemical analysis. Effluent from aerated stabilization basins is sampled weekly and analyzed for BOD_5 and TSS. Effluent from mechanical treatment plants must be sampled daily by 24-h composite samplers and analyzed daily for BOD_5 and TSS. Flowrate must also be recorded. Some plants also monitor chemical oxygen demand (COD), volatile suspended solids (VSS), pH, temperature and dissolved oxygen. Only three continuous dischargers measure nutrients and one monitors coliform bacteria. In the past, data were submitted to AEP monthly resulting in a considerable volume of data. The reporting requirements were changed in 1994. Daily monitoring must continue, but the data are now kept at each plant and only exceedances or violations are reported to AEP.

Statistical summaries of flowrate, and the BOD_5 and TSS concentrations in periodic and continuous discharges in the NRBS are provided herein. Loading could be estimated for twelve of the sixteen continuous discharges over approximately three years. The flowrate information for the majority of lagoons which discharge once or twice a year is not adequate for research purposes. Grab samples of effluent collected when the effluent is released are analyzed for BOD_5 and TSS, but a substantial amount of data is missing. The relative impact of municipal effluent was compared to the impact of industrial effluent. In general, loading from the larger municipalities (e.g. Grande Prairie and Ft. McMurray) is comparable to loading from some industries (e.g. CTMP mills).

Three of the larger municipalities that discharge continuously from waste stabilization lagoons routinely discharge effluent with a BOD_5 exceeding 25 mg/L. Peace River and Ft. Smith discharge sewage with a BOD_5 that is greater than 100 mg/L; however, the volume of effluent discharged is small in comparison to river discharge at these locations. Ft. Chipewyan and three of the periodic dischargers (Eaglesham, Peace River airport and Valleyview) routinely discharge sewage exceeding a BOD_5 of 25 mg/L. Exceedances also occur frequently at Jasper and Slave Lake.

The current purpose of the data collection and reporting is to ensure that the wastewater treatment facility is operating correctly and meeting its discharge limits. Quality control and quality assurance are critical components in determining whether the data are also suitable for scientific study and research. This review identified delays in the transportation of samples and the lack of formal quality control procedures for data entry. Little evidence of quality control being required in licences or reported routinely at in-house laboratories was found. Alberta Environmental Protection (AEP) conducts a quality assurance program; composite samples collected by municipalities with continuous discharges are split and half of the sample is picked up by AEP staff and analyzed approximately one to three times per year. The results are compared to data from the municipality. It is recommended that a QA/QC program that extends from sample collection to data entry be introduced if effluent data are to be used for scientific purposes. In its present state, the database is not adequate for research and should be used with caution; however, monitoring may be adequate for regulatory purposes.

Monitoring is primarily technology-oriented. The effluent is not monitored for environmentally-oriented effects such as toxicity. Unlike industries, municipalities in the NRBS area do not have to assess the in-stream effects of their effluent, primarily because municipal discharges are considered small in comparison to the discharges of the major rivers in the NRBS area. Nevertheless, total loadings from all point sources in the river, including municipal sewage treatment plants, are needed to assess cumulative effects in northern rivers.

The non-pulp mill industries in the northern river basin are mainly related to the regional natural resources including forests, coal, tar sands, oil, gas and gravel. Most industries do not discharge effluent to the northern rivers. The only non-pulp mill industry in the NRBS that is required to submit extensive monitoring data is Suncor Inc., which discharges about 35,000 m^3/d of industrial effluent. The operating licence for Suncor Inc. is more extensive and precise than municipal effluent licences. There are loading limits for six parameters and toxicity testing requirements. The operating licence stipulates quality control steps. Statistical summaries of data from January 3, 1988 to January 1, 1993 are provided. Suncor Inc.'s effluent did not exceed the licensed limits during this period. The results of the 96-h LC_{50} test showed that the effluent has been consistently non-toxic to rainbow trout.

ACKNOWLEDGMENTS

SENTAR Consultants Ltd. would like to thank Fred Wrona, Science Director of the Northern River Basins Study (NRBS) and NRBS staff in Edmonton for their assistance and cooperation during the preparation of this report. The Pollution Control Division and the Air and Water Approvals Division of Alberta Department of Environmental Protection provided effluent data and information regarding the regulatory process. SENTAR would like to thank them for their courteous responses to our many requests. The Northern Alberta Institute of Technology, Water and Wastewater Technology were helpful in outlining operator training and certification. SENTAR had lengthy discussions on quality control and quality assurance programs with the commercial analytical laboratories in Alberta, particularly Western Industrial Laboratories, AGAT Laboratories and Alpha Laboratories. Data interpretation and clarification were generously provided by industries, especially Suncor, Inc., and municipalities including the City of Grande Prairie, the Town of Manning and others. In addition to the corporate sources of information just mentioned, SENTAR wishes to acknowledge the many individuals who took time from their busy schedules to contribute to this report.

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SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

1.1 OBJECTIVE AND SCOPE

1.1.1 Objective

According to the Terms of Reference of the contract awarded to SENTAR Consultants Ltd. by the Northern River Basins Study (NRBS), the objective of this project is "to compile and synthesize existing information from government and industry sources on the nature of liquid effluents" ... "from municipalities and non-pulp mill industries that are being discharged into the Peace, Athabasca and Slave rivers and their major tributaries". (Appendix A: II-1-2)

1.1.2 Scope

The information required to meet the objective was compiled in a geo-referenced electronic database (dBase IV format) and supporting user guide submitted to the NRBS as a separate report. A hard copy of this database is appended (Appendix B) as required by the terms of reference (Appendix A:II-3-c). Data on the nature of the liquid effluents are also appended to this report (Appendices C, D and E).

This synthesis report describes the nature of liquid effluents from non-pulp mill and municipal sources and the impacts, or potential impacts, of these effluents on the aquatic ecosystems of the northern rivers. The synthesis report includes the following as described in the terms of reference (Appendix A:II-3-b):

- "information on the location of non-pulp mill industry and municipal effluent sources in the Study Area relative to pulp mill effluent sources" (including maps at appropriate[a] scale);
- "a discussion of the chemistry, ecotoxicology and microbiology of discharges, including a statistical summary of the parameters discussed";
- "a discussion of the physical nature of liquid effluent discharges (i.e. timing, duration, quantities, loading and concentration of discharges), including a statistical summary of the parameters discussed";
- "a discussion of the impacts or potential impacts of non-pulp mill industry and municipal liquid effluent discharges on the aquatic environment";
- "a discussion of the Quality Assurance/Quality Control measures imposed on data from various sources";
- "to the extent possible, a discussion of licencing requirements for non-pulp mill industrial and municipal discharges and compliance with these requirements (regulations)";
- "identification of information gaps and recommendations as to how information gaps can be resolved; and"

[a] The scale was subsequently changed from 1:250,000 to "appropriate" by mutual agreement.

- "an assessment of the relative importance of various non-pulp mill industry and municipal liquid effluents with respect to contaminant, pathogen (microbe) and nutrient loading in the Study Area".

1.1.3 Context

- Characterization of effluents from municipal and non-pulp mill sources is one project out of a total of three. The three projects include: (i) characterization of municipal and non-pulp mill industrial sources, (ii) contaminants in aquatic ecosystems, and (iii) ecotoxicity of pulp mill effluents. Synthesis reports will be produced for all three projects; bibliographies have been compiled and annotated for the latter two (ii and iii). Therefore, this synthesis report is one of a series of documents. As such, it is not intended to cover all aspects of effluents discharged in the NRBS area or their impacts on the aquatic ecosystems. An overall theme of the three reports is the ecotoxicity of liquids released into the aquatic environment, but this theme is less apparent in the present report because the toxicity of municipal effluents has received less emphasis historically than other effluent characteristics such as biochemical oxygen demand (BOD) and total suspended solids (TSS).

- An earlier report entitled *Review of Literature on Characteristics of Effluent from Pulp and Paper Mills in Northern River Basins of Alberta, B.C. and Northwest Territories* by McCubbin and Folke (1992) is, in a sense, a parallel document to this one. The McCubbin report characterizes pulp manufacturing processes, effluent treatment methods and the nature of the effluent.

1.2 MUNICIPAL AND INDUSTRIAL DEVELOPMENT IN THE NORTHERN RIVER BASINS

1.2.1 Study Area

The study area includes the Peace River, the Athabasca River and the Slave River within Alberta and the Northwest Territories (Figure 1). The study includes major tributaries to the three rivers; for example, the evaluation of the Peace River will include the Wapiti River and the Smoky River. Also, the Lesser Slave River is a major tributary of the Athabasca River.

1.2.2 Overview

The Athabasca Basin is sparsely populated. The major city is Ft. McMurray (population = 34,706[1]) and the larger towns near the mainstem of the river include Jasper, Hinton, and Whitecourt. Slave Lake, Edson, Lac La Biche and Barrhead are also located in the basin, but not on the mainstem. Only a few municipalities continuously discharge effluent directly to the Athabasca River (described in Section 2.3). Smaller municipalities are usually serviced by lagoon systems which may be discharged once or twice a year, normally in autumn and/or spring. Although there are many sawmills located throughout the basin, most do not discharge effluent to the river. Conventional oil and gas development in the basin is extensive. Coal mining occurs on the western side of the Athabasca River Basin. The largest industrial activity is the surface mining and extraction of tar sands. The Suncor and Syncrude mining and extraction facilities are located downstream from Fort McMurray, but only the Suncor facility discharges treated process effluent to the Athabasca River.

The water quality of the Peace River is not markedly affected by point-source effluent discharges, due in part to its large size relative to discharge from effluent and tributaries. The entire Peace River Basin is sparsely populated and largely undeveloped. The largest municipality on the Peace River in Alberta is Grande Prairie (population = 28,271[2]). The Grande Prairie sewage treatment plant discharges to the Wapiti River. Grande Cache and Peace River are also located in this drainage basin. Only a few municipalities discharge effluent continuously; most have sewage lagoons which discharge once or twice a year. The Pouce Coupé River (Shaw et al. 1990) receives treated municipal sewage from the Town of Dawson Creek, British Columbia.

The Slave River Basin is sparsely populated. Ft. Smith (population = 2,480[3]), located near the Alberta:Northwest Territories border is the only municipality that discharges treated sewage to the Slave River on a continuous basis. There are no major industries on the Slave River.

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1 population according to 1991 Census.
2 population according to 1991 Census.
3 IBID

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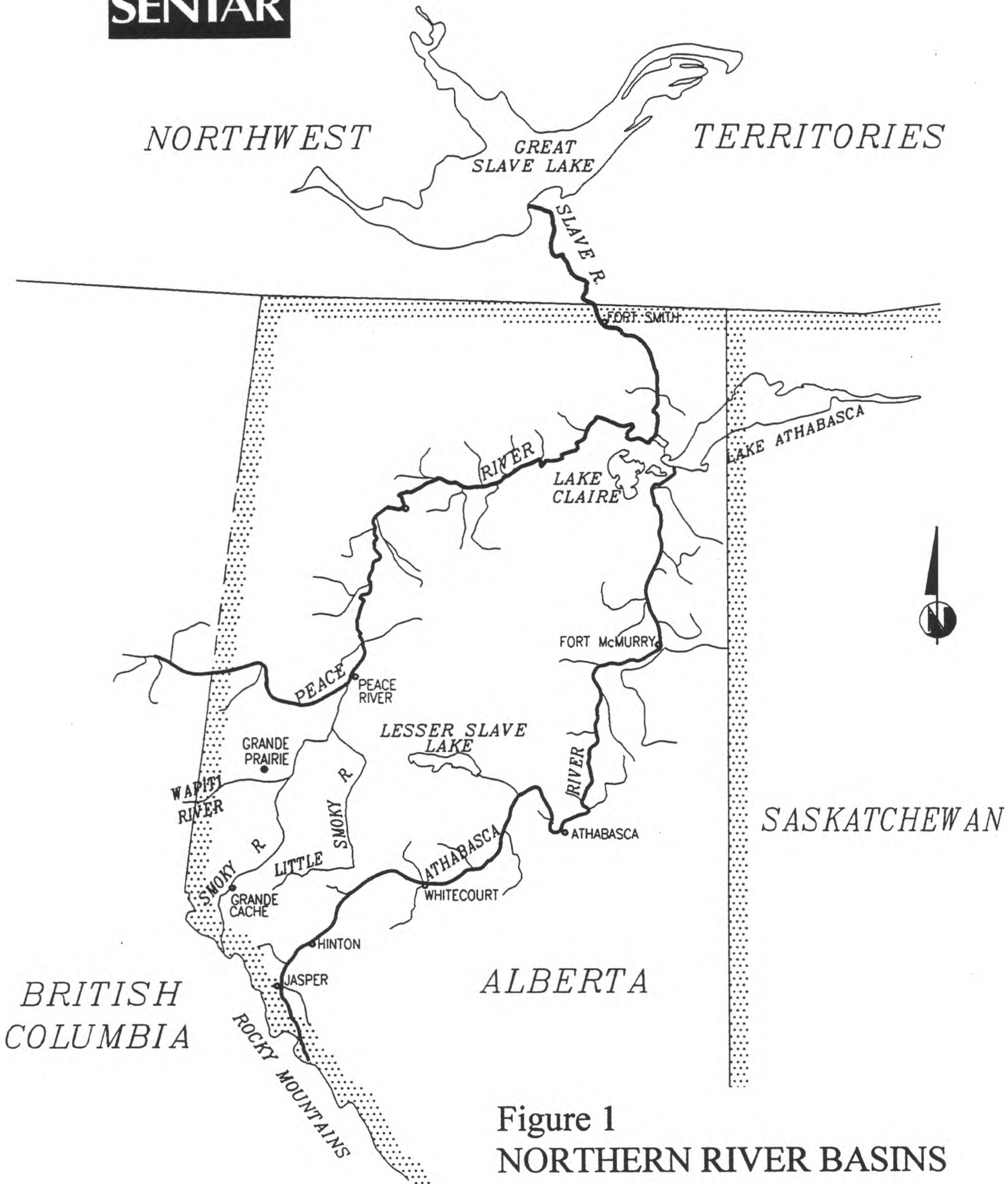

Figure 1
NORTHERN RIVER BASINS
STUDY AREA

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SECTION 2.0

SANITARY WASTEWATER TREATMENT

2.0 SANITARY WASTEWATER TREATMENT

2.1 INTRODUCTION

There are two types of sanitary wastewater (sewage) discharges in the NRBS area: intermittent discharges, and continuous discharges. Intermittent discharges result from waste stabilization ponds (lagoon-type processes) where the wastewater from the treatment cells (either anaerobic, facultative, or aerobic) are retained in a storage cell until allowed to discharge in the spring, fall or both. Intermittent dischargers consist of hamlets, towns, villages, campsites, schools, residential areas, and industries (sanitary wastes). Continuous discharges usually result from mechanical treatment plants utilizing aerated stabilization basins, extended-aeration activated sludge, oxidation ditches or rotating biological contactors. The effluent may be disinfected prior to discharge. There were a total of 16 continuous dischargers in the NRBS area. Continuous dischargers include the larger towns and villages, as well as the Peace River Correctional Centre.

Sewage treatment plants are licenced by Alberta Environmental Protection (AEP). The maximum concentrations of biochemical oxygen demand (BOD) and, sometimes, total suspended solids (TSS) and residual chlorine are generally set according to the treatment method. AEP has specific requirements for waste stabilization ponds, aerated stabilization basins and mechanical wastewater treatment systems.

2.2 DESCRIPTION OF SANITARY WASTEWATER TREATMENT METHODS

2.2.1 Waste Stabilization Pond

Wastewater treatment (stabilization) lagoons are earthen basins (ponds), open to the sun and air. They depend on natural biological, chemical, and physical processes to stabilize the wastewater. These processes, which may take place simultaneously, include sedimentation, digestion, oxidation, synthesis, photosynthesis, endogenous respiration, gas exchange, aeration, and evaporation (Metcalf and Eddy 1995).

There are several basic types of lagoons including anaerobic, facultative, aerobic, and storage lagoons. Most wastewater treatment plants in the northern river basins utilizing lagoons have anaerobic, facultative, and storage cells.

Anaerobic Lagoon

Anaerobic lagoons are so heavily loaded with organics that they do not have an aerobic (oxygen containing) zone. Only partial stabilization of the wastewater takes place. Anaerobic lagoons must be followed by facultative lagoons, aerobic lagoons or other treatment to complete stabilization of the organic material and provide additional solids removal.

Anaerobic lagoons are typically used as the first step for treatment of strong organic wastes, or to reduce the organic loading and cleaning frequency of subsequent units. The hydraulic retention time recommended by AEP for these lagoons is in the range of four to eight days (AEP 1988).

Facultative Lagoon

Facultative lagoons are medium depth lagoons with an aerobic zone overlying an anaerobic zone (with some sludge deposits) and a zone between the two where facultative bacteria mainly function. Solids in the anaerobic zone undergo fermentation and hydrolysis. The soluble organics and gases rise and are oxidized in the aerobic zone. Facultative lagoons are sometimes called oxidation lagoons or aerobic-anaerobic lagoons. They are used to treat sanitary wastewater, industrial wastewater, or a combination of both. Facultative lagoons are often preceded by anaerobic lagoons. The hydraulic retention time recommended by Alberta Environment for the facultative cell is a minimum of 60 days (AEP 1988).

Aerobic Lagoon

Aerobic lagoons are shallow lagoons that contain dissolved oxygen throughout their liquid volume at all times. There are no anaerobic or facultative zones. Aerobic bacterial oxidation and algal photosynthesis are the main biological processes. Aerobic lagoons are best suited to treating soluble wastes or wastewater relatively free of suspended solids. They are often used to provide additional treatment of effluents from primary wastewater treatment plants, anaerobic lagoons, and other partial treatment processes.

Storage Lagoon

Storage lagoons are lightly loaded, aerobic or facultative lagoons that improve the quality of the effluent from the preceding treatment units by additional oxidation and stabilization. Natural surface diffusion from the air provides the necessary oxygen. Typically, a minimum of twelve months storage is required in the storage lagoon before discharge (AEP 1988).

2.2.2 Aerated Stabilization Basin

Lagoons using mechanical devices as the principle sources of dissolved oxygen are called aerated stabilization basins (ASB). Although they use some mechanical equipment, they have significant advantages over completely mechanical plants in terms of capital, operating, and maintenance costs, ease of operation, and reliability. Completely-mixed aerated lagoons keep all of the solids in suspension and oxygen is provided by air diffusers or mechanical aerators. In partially-mixed aerated lagoons, only the upper zone is aerated by the diffusers or mechanical aerators. The lower facultative and/or anaerobic zones are relatively undisturbed. Partially mixed aerated lagoons are particularly suited to northern climates because they permit the continuation of aerobic oxidation under ice cover to reduce spring odour problems.

Completely-mixed aerated lagoons (commonly referred to as completely-mixed aerated facultative lagoons) usually have three cells. The first cell is the completely-mixed aerobic lagoon; the second is the partially-mixed facultative lagoon; and the third is the storage lagoon. The completely mixed portion usually has a hydraulic retention time of approximately two days and has enough aeration to maintain all particles in suspension. The facultative cell usually has a hydraulic retention time of approximately 28 days and has enough aeration to maintain the dissolved oxygen at levels between 2 mg/L and 3 mg/L. Only enough mixing is provided to partially suspend the particulate matter. The polishing pond is aerobic or facultative without mechanical aeration. Additional oxidation and stabilization are provided in the polishing pond, with a hydraulic retention time of at least five days (AEP 1988).

Partially-mixed aerated lagoons (commonly referred to as facultative aerated lagoons) are designed to reduce the influent BOD loading while maintaining the dissolved oxygen levels between 2 mg/L and 3 mg/L. The solids are only partially suspended; the balance of the solids are allowed to settle and undergo anaerobic decomposition. Facultative aerated lagoons typically consist of two aerated cells. The first cell has a hydraulic retention time of at least 30 days and the second polishing cell has a hydraulic retention time of five days (AEP 1988).

2.2.3 Activated Sludge

The secondary treatment process most commonly used in mechanical sewage treatment plants is activated sludge. In this system, the wastewater is aerated by mechanical or diffused-air aerators. Natural aerobic microorganisms in the aeration tank metabolize dissolved and colloidal organic material in the feed and convert it to cell mass. The cells coagulate naturally to form relatively large particles which are separated from the liquid fraction of the wastewater in a secondary clarifier.

To increase the reaction rate, the bacterial mass that is settled in the secondary clarifier is returned to the aeration tank. This increases the concentration of active microorganisms within the activated sludge in the aeration tank. Because the mass of solids in the activated sludge tank constantly increases due to the returned solids, part of the settled bacterial mass is wasted from the system, on either a continuous or an intermittent basis. This wasted bacterial mass (or sludge) usually requires further treatment and disposal.

There are several variations of the activated sludge process with the main differences being the aeration time and the organic loading rate. The organic loading rate, commonly known as the food-to-microorganism (F/M) ratio is defined as the mass of BOD_5 in the wastewater feed (in kg/d) per unit mass (in kg) of microorganisms present in the aeration tank (Metcalf and Eddy 1995).

The activated sludge processes used in the northern river basins are exclusively extended aeration processes. They utilize a long aeration time (18 h to 36 h) compared to the conventional activated sludge processes. Operation is somewhat simpler, however, because they typically do not include primary clarifiers and the relatively long detention time makes operator attention less critical. Part of the sludge in the aeration tank undergoes auto-oxidation, so the quantity of sludge which has to be subsequently treated and disposed is relatively low (Metcalf and Eddy 1995).

2.2.4 Oxidation Ditch

The oxidation ditch is essentially an extended-aeration activated sludge process. It is used in many smaller towns in Europe, but is not commonly used for sanitary wastewater treatment in North America. It consists of a ring-shaped (or horse track shaped) channel of about 2.0 m deep. A mechanical aeration rotor, consisting of a rotating metal brush or plates, is placed across the ditch. The rotation of the metal brush (or plates) causes the wastewater to slowly flow in the direction of the brush rotation and also provides the aeration necessary for the biological stabilization of the wastewater. After approximately 24 h, wastewater flows from the ditch into secondary clarifiers which remove the activated sludge floc from the wastewater (Metcalf and Eddy 1995).

2.2.5 Rotating Biological Contactor

The rotating biological contactor (RBC) process, like the activated sludge process, depends on aerobic biological processes to convert dissolved and colloidal pollutants to a settleable form. However, instead of the microorganisms being suspended in the liquid, they are allowed to grow on the surface of the solid medium. The medium consists of sheets of high density polyethylene formed into disks with a large surface area. The disks are assembled to form a cylindrical drum, which is partially submerged in a trough of the wastewater and rotated slowly. The biological growth on the surface of the disks alternatively contacts the wastewater and the air, and dissolved and colloidal matter are converted to biomass. Eventually, the film of microorganisms becomes thick enough to slough off into the effluent, and a steady state is achieved. The suspended matter which sloughs off the disks is separated from the final effluent in a secondary clarifier. There is no sludge recycle (Metcalf and Eddy 1995).

The RBC process is reliable, and capable of producing a consistently good quality effluent under a wide variety of conditions. Effluent quality is determined primarily by the type and number of units selected during the design stage, but can be adjusted within certain limits by changing the pattern of the flow within the units in the process chain. Power requirements are lower than those of the activated sludge system.

2.2.6 Effluent Chlorination

Effluent disinfection is becoming increasingly common in Alberta. Although a number of disinfectants are effective (chlorine, ozone, etc.), wastewater treatment facilities in the northern river basins utilize chlorine gas as the only disinfectant. Liquid chlorine is stored at the wastewater treatment plant in either small bottles or, more likely, large tonne containers. The chlorine is converted into a gas by evaporators and fed directly into the wastewater. Gaseous chlorine undergoes hydrolysis when it contacts the wastewater. It is readily converted into hypochlorous acid which is the main disinfectant (Snoeyink and Jenkins 1980). Disinfection usually takes place in a contact chamber with approximately 20 minutes to 30 minutes contact time. The addition of chlorine usually occurs after the secondary treatment and before the effluent is discharged into the receiving waterbody.

When chlorine is used, AEP stipulates disinfection requirements in the licence to operate; specifically, requirements for minimum and maximum chlorine residuals in the treated effluent (AEP 1988). The minimum concentration is necessary to achieve a level (unspecified) of disinfection, while the maximum concentration is necessary to minimize the toxic effects on the receiving waterbody.

2.3 RELEASES OF TREATED SANITARY WASTEWATER

2.3.1 Periodic Discharges

AEP supplied information on licenced sanitary discharges into the northern river basins. A summary of the periodic sanitary wastewater treatment facilities for which effluent data (BOD, TSS) are available is shown in Table 1. Wastewater treatment facilities without effluent data are summarized in Table 2. The numbers on these tables correspond to the numbers on Figure 2 showing the

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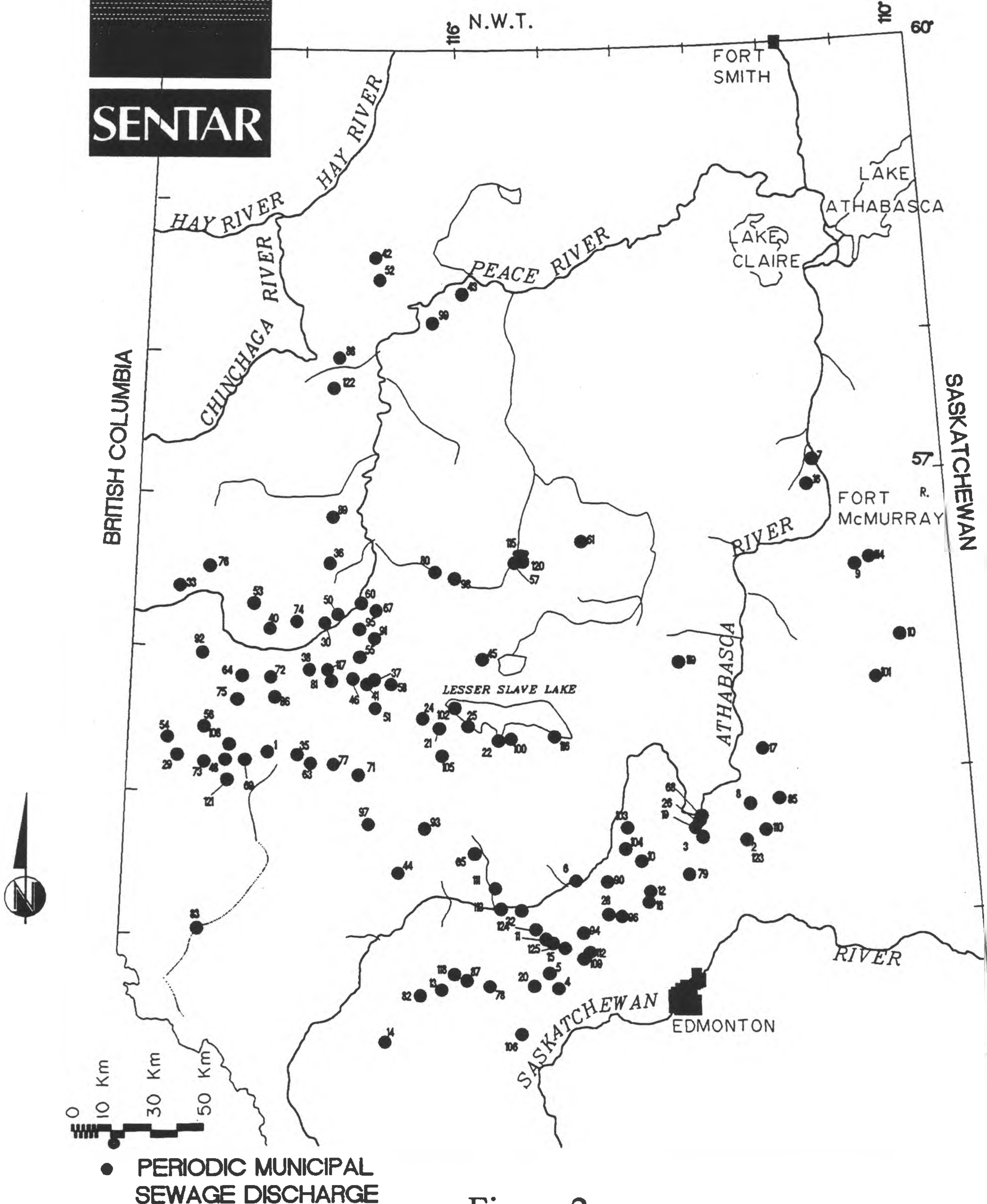

Figure 2
LOCATION OF PERIODIC SEWAGE DISCHARGES OF SANITARY WASTEWATER IN THE NORTHERN RIVER BASINS STUDY AREA

location of the periodic discharges[a]. The information was collected from annual reports and operating licences. Periodic discharges come from waste stabilization ponds (lagoons) described previously in Section 2.2.1. More lagoons discharge once a year than twice a year (58 versus 29). Of the 58 lagoons that discharge once a year, more (50) discharge in the fall. The season of discharge is not known for some of the discharges in Tables 1 and 2. The mean annual discharges (in m^3) have been calculated from the data available, but the estimates should be used with caution (see also Section 3.2).

[a] for which locations are available.

TABLE 1:
Periodic Sanitary Wastewater Discharges with Effluent Data in the NRBS Area

No.	River Basin	Discharge Source	Discharge Period	Mean Annual Discharge (m^3)	Comments[a]
1	Athabasca	Blue Ridge	Spring/Fall	39,000	c
2	Athabasca	Boyle	Fall	80,000	
3	Athabasca	Colinton	Spring/Fall	18,000	
4	Athabasca	Entwistle	Spring/Fall		n
5	Athabasca	Evansburg	Fall	85,000	
6	Athabasca	Ft. Assiniboine	Spring	16,000	c
7	Athabasca	Ft. McKay	Spring/Fall	47,000	c
8	Athabasca	Grassland	Spring/Fall	13,000	
9	Athabasca	Gregoire Lake Provincial Park	evaporation pond - no discharge		
10	Athabasca	Janvier School	Spring		n
11	Athabasca	Mayerthorpe	Spring/Fall		n
12	Athabasca	Pibroch	Spring	9,100	c
13	Athabasca	Pine Shadow Estates MHP	Fall		n
14	Athabasca	Robb	Spring		n
15	Athabasca	Sangudo	Spring/Fall		i
16	Athabasca	Swan Hills	Spring/Fall	440,000	c
17	Athabasca	Wandering River	Fall	1,300	c
18	Athabasca	Westlock	Spring/Fall		i
19	Athabasca	Westwind Mobile Home Park	Fall		n
20	Athabasca	Wildwood	Fall		n
21	Lesser Slave	Enilda	Fall	15,000	c
22	Lesser Slave	Faust	Spring/Fall	74,000	c
23	Lesser Slave	Grouard	Fall	63,000	c
24	Lesser Slave	High Prairie	Spring/Fall		i
25	Lesser Slave	Joussard	Fall	26,000	c
26	Peace	Atikameg School	Fall		n
27	Peace	Bear Canyon	Spring		n
28	Peace	Beaverlodge	Spring/Fall		n
29	Peace	Berwyn	Spring/Fall	96,000	c
30	Peace	Bezanson	Spring	4,400	c
31	Peace	Bishop Routhier School	Fall	1,000	c
32	Peace	Bluesky	Fall		n
33	Peace	Cleardale	Spring/Fall	910	c
34	Peace	Deadwood School[b]			n
35	Peace	Debolt	Fall	11,000	c
36	Peace	Dixonville	Fall	15,000	c
37	Peace	Donnelly	Fall		n
38	Peace	Eaglesham	Spring/Fall	17,000	c
39	Peace	Evergreen Park (Grande Prairie)	Fall		n
40	Peace	Fairview	Spring/Fall	490,000	c
41	Peace	Falher	Fall	170,000	c
42	Peace	Footner Lake Forestry Site	Fall	14,000	
43	Peace	Ft. Vermillion	Spring/Fall		i
44	Peace	Fox Creek	Spring/Fall	410,000	

(continued)

TABLE 1: (Concluded)

45	Peace	Gift Lake	Fall	10,000	
46	Peace	Girouxville	Spring/Fall		i
47	Peace	Grande Cache Forest Industries	Spring		n
48	Peace	Grande Prairie Airport	Fall		n
49	Peace	Grandview Hutterite Colony	Fall		n
50	Peace	Grimshaw	Fall	190,000	
51	Peace	Guy	Fall		n
52	Peace	High Level	Spring/Fall	590,000	c
53	Peace	Hines Creek	Spring/Fall	180,000	c
54	Peace	Hythe	Spring/Fall		n
55	Peace	Jean Cote	Fall		n
56	Peace	La Glace	Fall	11,000	c
57	Peace	Loon Lake School	Spring/Fall	5,000	c
58	Peace	McLennan	Fall	200,000	
59	Peace	Nose Creek School(b)			n
60	Peace	Peace River Airport	Spring/Fall		n
61	Peace	Peerless Lake School	Fall	1,700	c
62	Peace	Queen Elizabeth Provincial Park(b)		520	
63	Peace	Ridge Valley	Fall	7,600	c
64	Peace	Rycroft	Fall		n
65	Peace	Sexsmith	Spring/Fall	164,000	c
66	Peace	Shell - Peace River Complex	Spring	3,000	
67	Peace	Spirit River	Spring/Fall		i
68	Peace	St. Isadore	Fall		n
69	Peace	Triple L Mobile Home Park	Spring/Fall		n
70	Peace	Trout Lake School	Fall		n
71	Peace	Valleyview	Spring/Fall	310,000	c
72	Peace	Wanham	Fall		n
73	Peace	Wembley	Fall		i
74	Peace	Whitelaw	Fall		n
75	Peace	Woking	Fall	9,000	
76	Peace	Worsley	Spring/Fall		n
77	Peace	Young's Point Provincial Park	Fall		n

a. n = flow data were not available
i = flowrate data were inconsistent or questionable
c = flowrate data were present in gallons, and the flowrate shown in Table 1 was obtained through a conversion from Imperial gallons (assumed) to cubic metres per discharge. In many cases, it was not apparent whether the reported flowrate was U.S. or Imperial gallons.

b. Since the information was insufficient to locate the discharges, they are not shown on Figure 2.

TABLE 2:
Periodic Sanitary Wastewater Discharges without Effluent Data in the NRBS Area

No.	River Basin	Discharge Source	Discharge Period
78	Athabasca	Niton Junction	Fall
79	Athabasca	Rochester	
80	Peace	Woodland Creek Band No. 474	Fall
81	Peace	Watino	
82	Peace	Tangent	
83	Athabasca	Smith	
84	Athabasca	Rochfort Bridge	Fall
85	Athabasca	Plamondon	
86	Peace	Peoria	
87	Athabasca	Peers	Fall
88	Peace	Paddle Prairie Metis	Fall
89	Peace	Northstar	Fall
90	Athabasca	Neerlandia	
91	Peace	Nampa	
92	Peace	Moonshine Lake Provincial Park	
93	Peace	Meewap Work Camp	
94	Athabasca	Meadowview School	Fall
95	Peace	Marie-Reine	
96	Athabasca	Manola	
97	Peace	Little Smoky	Fall
98	Peace	Little Buffalo	
99	Peace	La Crete	Fall
100	Athabasca	Kinuso	
101	Athabasca	Home Oil Leismer Gas Plant	Fall
102	Athabasca	Grouard	Fall
103	Athabasca	Flatbush	
104	Athabasca	Fawcett	
105	Athabasca	East Prairie Metis STLMT	Fall
106			
107	Athabasca	Cynthia	
108	Peace	Clairmont	
109	Athabasca	Cherhill	Fall
110	Athabasca	Caslan School	
111	Peace	Carson-Pegasus Provincial Park	
112	Athabasca	Calling Lake	
113	Peace	Cadotte Lake School Division 61	
114	Athabasca	Anzac	
115	Peace	Redearth Creek	Fall
116	Athabasca	Wagner	
117	Peace	Thunder Lake Recreation Subdivision	
118	Peace	Sturgeon Heights Community	
119	Peace	Sandy Lake	
120	Peace	Redearth Creek - AB Forest Services	
121	Peace	Grovedale	
122	Peace	Dr. Mary Jackson (Keg R) School	
123	Peace	Brownvale	
124	Athabasca	Greencourt	

2.3.2 Continuous Discharges

The sanitary wastewater treatment plants that discharge continuously in the NRBS area consist of: one oxidation ditch, nine aerated stabilization lagoons, two extended-aeration activated sludge plants, one rotating biological contactor plant, and three waste stabilization lagoon systems (summarized in Table 3). The locations of these facilities are shown in Figure 3. There were a total of sixteen licenced discharges: ten in the Athabasca River Basin, five in the Peace River Basin, and one in the Slave River Basin. Information was collected from monthly reports, annual reports, and operating licences supplied by AEP.

TABLE 3:
Continuous Sanitary Wastewater Discharges in the NRBS Area

No.	River Basin	Discharge Source	Treatment Type	Flowrate (m^3/d)	Comments[a]
1	Athabasca	Barrhead	Aerated Stabilization Basin		n
2	Athabasca	Edson	Aerated Stabilization Basin	3,900	m, c
3	Athabasca	Ft. Chipewyan	Facultative Lagoons		n
4	Athabasca	Ft. McMurray	Aerated Stabilization Basin	13,000	m
5	Athabasca	Jasper	Aerated Stabilization Basin	3,900	
6	Athabasca	Lac La Biche	Aerated Stabilization Basin	1,400	q
7	Athabasca	Slave Lake	Aerated Stabilization Basin	2,700	m
8	Athabasca	Town of Athabasca	Aerated Stabilization Basin	950	
9	Athabasca	Wabasca	Aerated Stabilization Basin, Disinfection		n
10	Athabasca	Whitecourt	Extended-Aeration Activated Sludge	3,400	
11	Peace	Grande Cache	Extended-Aeration Activated Sludge	2,000	
12	Peace	Grande Prairie[b]	Rotating Biological Contactor	11,000	
13	Peace	Manning	Aerated Stabilization Basin	490	m, c
14	Peace	Peace River Correctional Centre	Oxidation Ditch, Disinfection	290	
15	Peace	Town of Peace River	Anaerobic Lagoons		n
16	Slave	Ft. Smith	Facultative Lagoons	570	

a. n = flow data were not available
q = flowrate data were inconsistent or questionable
c = flowrate data were present but obtained through a conversion from Imperial gallons (assumed) to m^3/d. In many cases, it was not apparent whether the reported flowrate was in U.S. or Imperial gallons. Equipment made in the U.S. may read in U.S. gallons and it is not known if flowrates have been converted to Imperial gallons.
m = missing flowrate data

b. Grande Prairie sewage treatment plant effluent is discharged for two weeks followed by no discharge for the next two weeks.

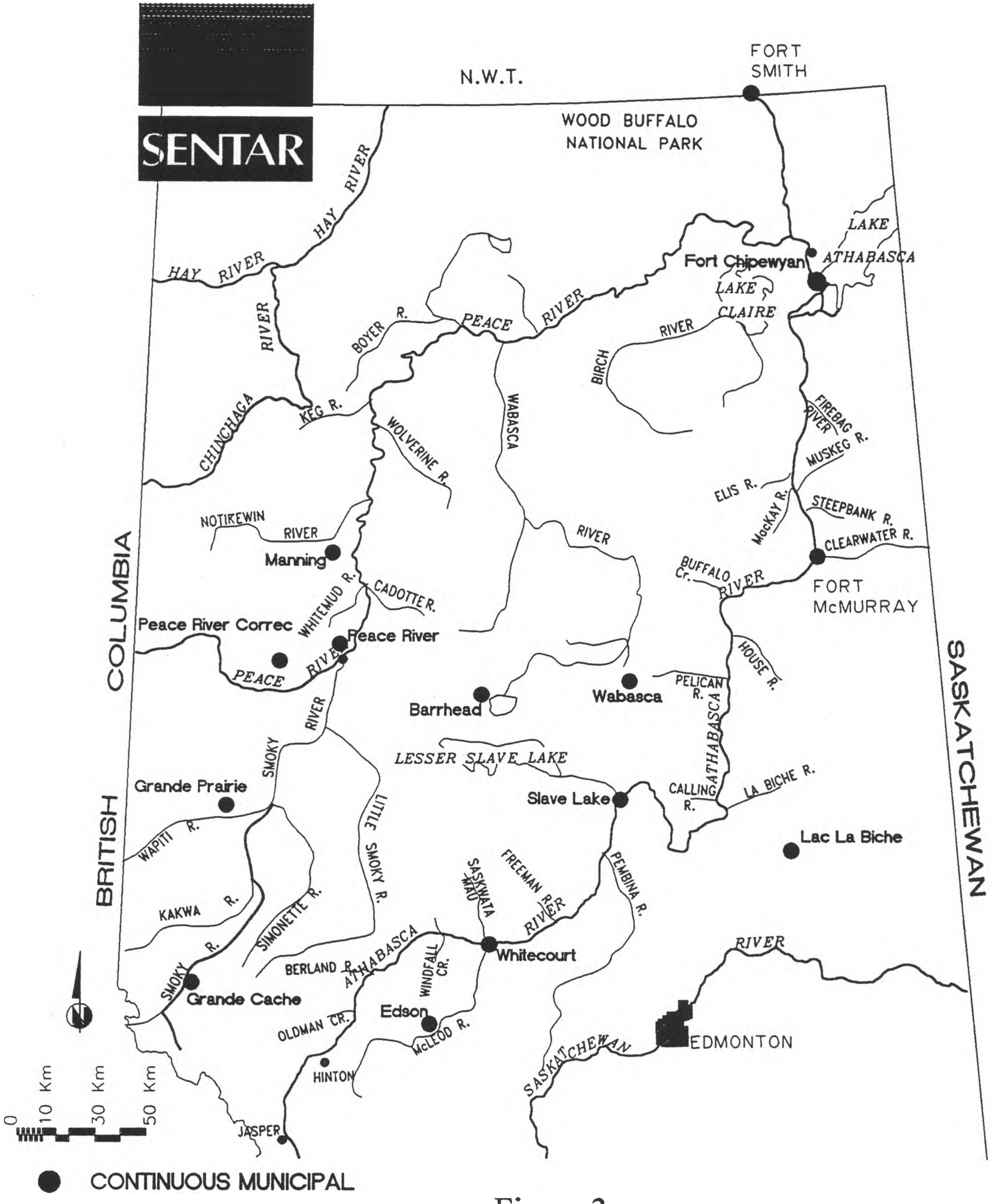

Figure 3
LOCATION OF CONTINUOUS SEWAGE DISCHARGES OF SANITARY WASTEWATER IN THE NORTHERN RIVER BASINS STUDY AREA

13-089-31-04

Communities that discharge sanitary wastewater to the Athabasca River Basin include Barrhead, Edson, Ft. Chipewyan, Ft. McMurray, Jasper, Lac La Biche, Slave Lake, Town of Athabasca, Wabasca, and Whitecourt. The names of the receiving streams are available in Appendix B. The largest volume of treated sewage entering the Athabasca River is discharged by Ft. McMurray. The total daily flow from all continuous dischargers is not known since the flowrate data from Barrhead, Ft. Chipewyan and Wabasca are unavailable. Flow data for Lac La Biche was usually provided as cubic metres per day; however, the volume appears to be the wrong order of magnitude. It is likely that the volume is actually gallons per day; occasionally, it is reported as gallons per day. The assumption has been made that metres per day is incorrect and the flowrate shown in Table 3 is based on this assumption. Sewage from Hinton is combined with the Weldwood pulp mill wastes for treatment and discharged as one effluent.

Communities that discharge sanitary wastewater to the Peace River Basin include Grande Cache, Grand Prairie, Manning, Peace River Correctional Centre, and the Town of Peace River. The Grande Prairie sewage treatment plant effluent is discharged for two weeks followed by no discharge for the next two weeks. Similar to above, the total daily flow from all dischargers is not completely known since the Town of Peace River only reports approximate annual flowrate data. The Town of Peace River reported an estimated annual volume of 213 m^3/d flowrate. This flowrate does not appear to be consistent with the size of the town since the Town of Peace River had a population of 6717 in the 1991 Census giving an estimated flowrate of 2350 m^3/d based on 350 L per person per day unit contribution (Metcalf and Eddy 1985).

Ft. Smith is the only continuous discharger on the Slave River. Flowrate data are available as monthly totals.

Since population centres are often closely tied to the industries that support them, discharges of sanitary wastewater often occur in close proximity to industrial wastewater discharges. For example, Ft. McMurray is associated with the oil sands development (Figure 4). Slave Lake, Whitecourt, Athabasca, Peace River and Grande Prairie are all located near pulp mills (towns and industries shown in Figures 4 and 5). This proximity of municipal and industrial discharges increases the potential for cumulative impacts.

2.4 REGULATORY REQUIREMENTS

The discharge of treated sewage to rivers in the NRBS area is controlled by AEP through final effluent licences. The effluent requirements for municipal sewage treatment plants in Alberta are based on a combination of technology-based limits and water quality-based limits. Technology-based limits for BOD_5 and, in some cases BOD_5 plus TSS, tend to govern in the NRBS area. They are based on providing a secondary level of treatment. In the future, all larger municipalities (design wastewater flows greater than 20,000 m^3/d) will have to reduce effluent phosphorus concentrations below 1.0 mg/L and will have to have effluent disinfection. However, no municipalities in the NRBS area fall into this category. None of the permits issued to municipal dischargers in the NRBS area have monitoring requirements, or limits, for nutrients (including ammonia) or heavy metals. Ammonia is only limited if there is a need to do so. Nutrients and heavy metals in the effluent are monitored periodically at some of the municipalities by Alberta Environment.

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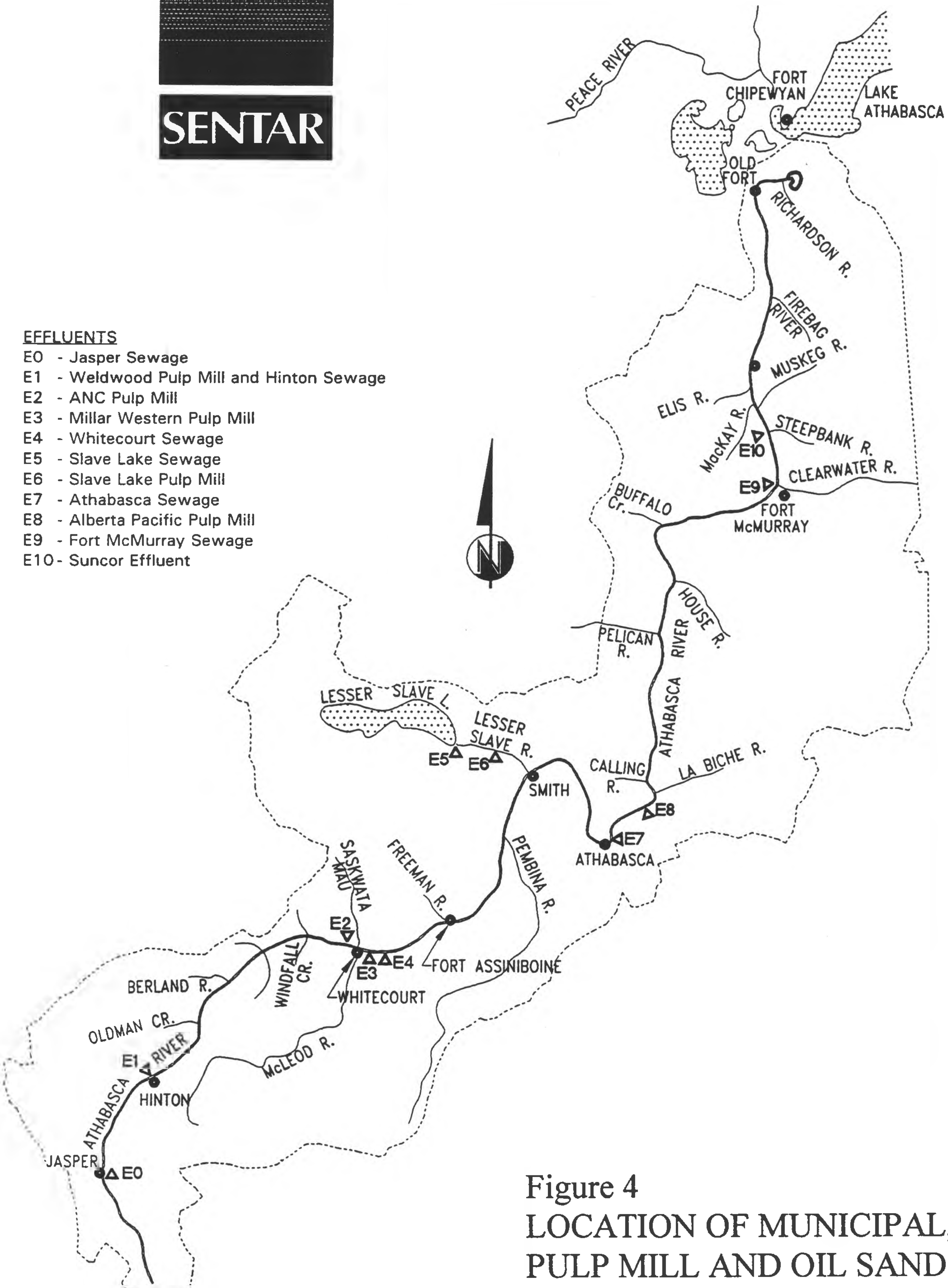

Figure 4
LOCATION OF MUNICIPAL, PULP MILL AND OIL SANDS DISCHARGES TO THE ATHABASCA RIVER

13-089-31-04

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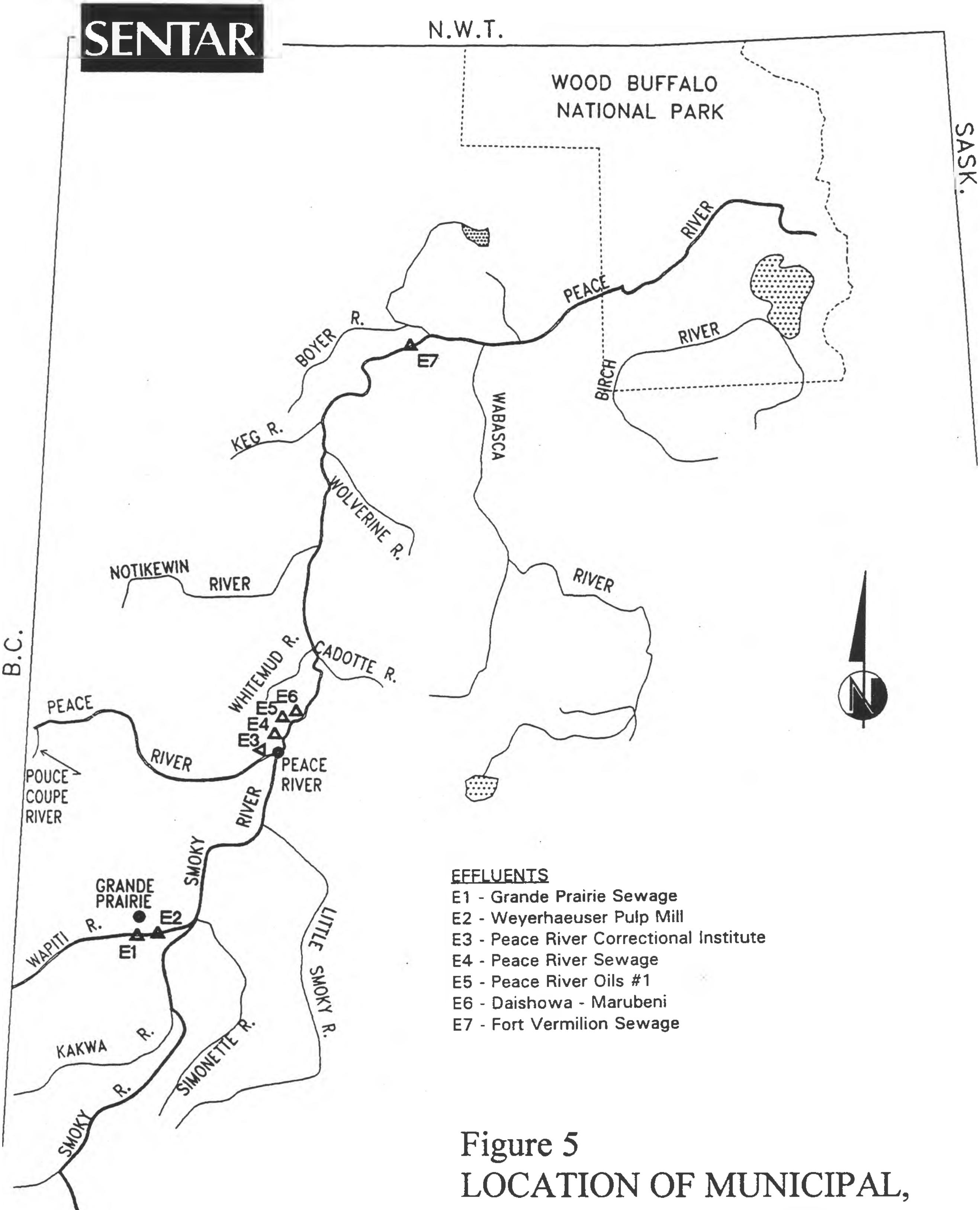

Figure 5
LOCATION OF MUNICIPAL, PULP MILL AND OTHER DISCHARGES TO THE PEACE RIVER

13-089-31-04

2.4.1 Waste Stabilization Lagoons

AEP has specific requirements pertaining to effluent quality and operation of the waste stabilization lagoons. The guideline for all waste stabilization lagoons is a BOD_5 of less than 25 mg/L (AEP 1988), but AEP emphasizes proper lagoon design, such as the physical configuration of the lagoon. A properly designed lagoon can achieve a BOD_5 of approximately 10 mg/L. Waste stabilization lagoons in Alberta must have storage cells large enough to be able to store treated wastewater for one year. The lagoons must discharge in a specified receiving area and in a specified season.

Day to day operation of these facilities must be supervised by a person who holds a Level I Wastewater Treatment Plant Operator's Certificate. This level is the first of four levels and only requires a minimal amount of on-the-job training. The operators are usually made aware of the health risks involved, the sampling procedures, and the analyses required.

AEP will also require BOD_5 and TSS analysis to be completed on a sample of the treated wastewater upon discharge. A single grab sample is collected by the operator, either before discharge or during discharge and sent to a laboratory for analysis. Information supplied by AEP indicates that several dischargers perform a considerably greater number of analyses. These samples are not required in the operating licence. However, AEP will periodically request additional samples to be collected and analyzed when they are concerned about the effectiveness of treatment, or the impact of certain parameters (e.g. phosphorus) on the receiving water. Analysis of the samples must be done according to the latest version of Standard Methods for the Examination of Water and Waste Water (APHA 1989). Results reported to AEP include BOD_5, TSS, and total volume discharged.

2.4.2 Aerated Stabilization Basins

Aerated stabilization basins have a discharge limit for BOD_5 of 25 mg/L based on a monthly average (AEP 1988). The licence for the Hamlet of Wabasca also includes a disinfection requirement. A total chlorine residual of not less than 0.5 mg/L and not more than 3.5 mg/L after 20 minutes contact is required. In order to determine the effect of the chlorination at Wabasca, bacteriological samples of the effluent must be collected during periods of low total chlorine residual according to the permit. However, no data regarding the bacterial quality of the effluent were supplied by AEP for incorporation in this report.

Aerated stabilization lagoons are required to be supervised by a person who holds a Level I Wastewater Treatment Plant Operator's Certificate. Weekly analysis of the influent and effluent samples from the aerated stabilization lagoon are sufficient for reporting purposes. Influent samples must be 24 h composite samples collected either on regular timed intervals, or continuously but proportioned by flow. Grab samples of effluent suffice for laboratory testing purposes. The Hamlet of Wabasca must also provide total chlorine residual results at least five days per week and results for the bacteriological quality of the effluent twice per month. Laboratory testing of the samples must conform to the latest version of Standard Methods for the Examination of Water and Waste Water (APHA 1989). All aerated stabilization lagoons must report the total daily influent and effluent flows for at least five daily measurements per week; however, Barrhead and Wabasca have not reported reliable flowrate data.

2.4.3 Mechanical Wastewater Treatment Systems

Mechanical wastewater treatment systems include oxidation ditches, extended-aeration activated sludge plants, and rotating biological contactors. Mechanical treatment systems have more stringent effluent requirements. A maximum limit of 25 mg/L is required for both BOD_5 and TSS based on monthly averages (AEP 1988). The oxidation ditch wastewater treatment plant system has further requirements of a total chlorine residual of not less than 0.5 mg/L and not more than 3.5 mg/L after 20 minutes contact. In order to determine the effect of chlorination, bacteriological samples must be collected from the effluent during periods of low total chlorine residual. The operating licence for the oxidation ditch specifies the standard BOD_5 test, whereas operating licences for the extended aeration plants and the rotating biological contactor plant specify nitrogen-inhibited BOD_5 tests.

The day-to-day operation of the oxidation ditch and extended aeration plants must be supervised by a person who holds a Level II Wastewater Treatment Plant Operator's Certificate. The rotating biological contactor plant requires that the day-to-day operation of this facility must be supervised by a person who holds a Level III Wastewater Treatment Plant Operator's Certificate.

The influent must be sampled daily by 24 h composite samplers; effluent may be sampled as a grab sample. Analysis for BOD_5, TSS and chlorine residual (for the oxidation ditch system) are to be measured on a daily basis, whereas the bacteriological sample for the oxidation ditch system is to be collected and analyzed twice per month. Analysis procedures must follow the latest version of Standard Methods for the Examination of Water and Waste Water (APHA 1989). Daily flowrate information is required for mechanical wastewater treatment plants.

SECTION 3.0

QUANTITY AND QUALITY OF SEWAGE TREATMENT PLANT DATA

3.0 QUANTITY AND QUALITY OF SEWAGE TREATMENT PLANT DATA

3.1 INTRODUCTION

Quality control and quality assurance in the wastewater sample collection, preservation, transportation, analysis, and reporting are all critical components in determining whether the data are suitable for rigorous scientific study and research. The current purpose of the data collection and reporting is to ensure that the wastewater treatment facility is operating correctly and meeting its discharge limits. The data are not intended for research and the existing quality control reflects this.

3.2 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAMS

3.2.1 General Sewage Treatment Plant Requirements

AEP requires certain minimum standards in the day-to-day operation of the sewage treatment facilities. Operators of waste stabilization lagoons and aerated stabilization basins are both required to have a minimum of Level I certification. Operators of oxidation ditches and extended aeration plants must have Level II certification and the operator of the rotating biological contactor must have Level III certification.

With respect to quality assurance and quality control, the Level I operators have only minimal instruction on how to operate the plant and collect samples for analysis. The experience includes approximately 1800 hours in a wastewater treatment facility, plus completion of the Level I Qualification Examination administered by AEP. Level II operators have two years operator experience as a Level I, plus completion of the Level II Qualification Examination. Level III operators have approximately one year of collective plant supervisor experience as a Level II operator, plus completion of the Level III Qualification Examination. The Northern Alberta Institute of Technology offers a two year Water/Wastewater Operator's Course. Upon completion of the course, the operators automatically progress to Level II operator status. The focus of the course is on the operation of these systems rather than laboratory analysis. Laboratory analyses with emphasis on common water and wastewater analyses is part of the curriculum; however, quality control and quality assurance are not highlighted. The laboratory course only provides the operators with the skills necessary to complete some of the basic analysis for the operation of the facility and subsequent reporting to AEP.

There is no explicit AEP requirement for any level of quality assurance or quality control. They will periodically request duplicate samples sent to a second independent laboratory but this is not done on a consistent basis.

3.2.2 Sample Collection Requirements

Effluent samples are collected as grab samples by the operators who run the wastewater treatment facility. Alberta Environmental Protection does not require duplicate samples, or blank samples when the effluent is collected. As indicated above, AEP will periodically require that a facility collect a duplicate sample and have it analyzed at an independent laboratory. It was unusual to find evidence (i.e. analytical results) of quality assurance such as replicates, blanks or spikes in the results made available by AEP.

3.2.3 Sample Preservation and Transportation Requirements

The samples periodically come in containers that are supplied by the treatment plants and are questionable in terms of prior uses, cross contamination and cleanliness. Most of the time, however, the laboratories will send out clean, unused, and preserved (when necessary) containers to the treatment plants prior to sample collection. Samples for BOD_5, pH, and temperature cannot be preserved since this interferes with the analysis. Cooling of the sample minimizes the deterioration of the BOD_5 samples. Samples collected for in-house analysis would not usually be preserved.

For regulatory purposes, the BOD_5 analysis should be conducted within six hours of sample collection, but never on samples over 24 hours old (APHA 1989). In remote areas of northern Alberta, it is unlikely that samples can be delivered within six hours. One of the laboratories indicated that it frequently receives BOD_5 samples in approximately 24 hours of sampling and then conducts the analysis. The commercial laboratory will conduct the analysis on the sample even though the sample is older than 24 hours or arrives in a questionable container. The laboratory may refuse to conduct the analysis when the sample is known to have deteriorated or advise the client of the sample condition before analysis.

3.2.4 Analytical Laboratories

All periodic dischargers appear to send collected samples to external laboratories for chemical and microbiological analysis. Laboratories most frequently listed in the information supplied by Alberta Environmental Protection (AEP) were AGAT Laboratories and Western Industrial Laboratories Ltd. Other laboratory results came from Chemex Labs Alberta Inc., Northwest Labs, Chemical and Geological Laboratories, Inc. and the Alberta Environment Provincial Laboratory.

Some continuous dischargers have in-house laboratories while others use external laboratories. Manning, Ft. Chipewyan and the Town of Peace River all send their samples to external laboratories for analysis on a regular basis. Athabasca, Barrhead, and Ft. McMurray have monthly reports, but it is not clear whether the analyses were done by external laboratories or by their own staff. Jasper, Slave Lake, Grande Prairie, Edson, Wabasca, Lac La Biche, Grande Cache, Whitecourt, and Peace River Correctional Centre appear to conduct their own routine wastewater analysis in-house.

3.2.4.1 Commercial Laboratory Requirements Commercial laboratories used for the chemical analysis of wastewater have quality control and quality assurance programs. Once received, the samples are stored and analyzed according to the latest version of *Standard Methods for the Examination of Water and Wastewater*. Analysis is typically done in large sample batches. AGAT Laboratories conducts one replicate from each batch (chosen at random) to demonstrate repeatability. They also spike one of the samples from each batch (chosen at random) and periodically check analysis with standard solutions. AGAT Laboratories is accredited with the Canadian Association of Environmental Analytical Laboratories (Standards Council of Canada), the American Industrial Hygiene Association, the Alberta Water Analysts Committee (AWAC), as well as other associations. To be accredited, the laboratory takes part in inter-laboratory testing with each of the organizations. In addition, the Canadian Association of Environmental Analytical Laboratories requires a laboratory audit. Western Industrial Laboratories Ltd. does the analyses for the majority of dischargers who send samples to a commercial laboratory. This laboratory conducts periodic duplicate analysis on sample batches and periodic standard solution analysis for checks. Western Industrial Laboratories Ltd. uses prepared standards from Environmental Resources Association to test the accuracy of their analyses. In addition, Western Industrial Laboratories Ltd.

is a member of AWAC and takes part in annual quality assurance testing for nutrients, major ions, trace metals and demand parameters (BOD, COD).

3.2.4.2 Utility-Owned, Operator-Manned Laboratory Requirements The operators of smaller utility-operated laboratories are not usually trained to conduct extensive testing of wastewater parameters. The laboratories are usually equipped with the basic equipment for temperature, BOD, TSS, and possibly several other common analyses. Sampling requiring more complicated analyses such as total phosphorus, total and fecal coliforms, phenol, total Kjeldahl nitrogen, etc. are sent to independent laboratories for analysis.

There would be quality control inherent in following standard methods, but additional quality control and quality assurance programs are not evident in the monthly reports. Since these reports are generally first-hand (often copies of hand-written observations), it is unlikely that quality assurance data (e.g. duplicates) were recorded and then deleted (as might occur in database printouts). As indicated above, the regulatory emphasis is to operate the facilities efficiently and to meet the regulatory discharge limits. Data collected by the operators need only be adequate for these purposes.

3.2.5 Inter-Laboratory Quality Assurance

The analytical laboratories in Alberta have formed the Alberta Water Analysts Committee (AWAC). There are about thirty-five members and the majority participate in a round-robin quality assurance program. The inter-laboratory testing is done once per year and includes analyses for nutrients, major ions, trace metals and demand parameters (BOD, COD, etc.). The results go to an independent auditor and a statistician evaluates the data and prepares a report. Problems and questions are addressed by a subcommittee of AWAC, the Validation subcommittee. Certificates of Validation are provided to successful laboratories.

The Canadian Association of Environmental Analytical Laboratories, part of the Standards Council of Canada, includes organic, inorganic and toxicological (*Daphnia magna* and rainbow trout) analyses in round-robin testing. The results also receive statistical analyses and evaluation. A site audit once every two years is also required.

Some Alberta laboratories belong to U.S. associations and more specialized associations (e.g. soils testing, microtox users, etc.). The emphasis on quality control and quality assurance varies between laboratories.

3.2.6 AEP Quality Assurance

There is no formal requirement for quality assurance in the sewage treatment plant licences; however, AEP conducts split sampling in conjunction with the municipal sampling. Composite samples collected by municipalities with continuous discharges are split and half of the sample is picked up by Alberta Environment staff and analyzed. Although the number of samples is small, generally 1-3 per year (Grande Prairie effluent has been sampled more often), the results of this sampling provide quality assurance data, as well as results for parameters (e.g. nutrients) not otherwise included in the analyses done by the sewage treatment plant.

During winter synoptic surveys, AEP staff take grab samples of the final effluents of the largest sewage treatment plants, large industries, as well as instream samples, along the length of the Athabasca River from the headwaters to the mouth. Although the resulting database contains only a few results for sewage treatment plant effluents, the samples are analyzed for a wider variety of constituents than reported by the sewage treatment plants. These surveys do not provide quality assurance in a formal sense. They could be used to screen for constituents of the effluent that are not routinely monitored, thereby providing some assurance that these constituents are not present in harmful concentrations (at least at the time of sampling).

3.3 QUANTITY AND QUALITY OF DATA AVAILABLE

3.3.1 Continuous Municipal Dischargers

Single grab samples of effluent are collected weekly for aerated stabilization basins. The effluent from mechanical treatment plants (oxidation ditches, activated sludge and rotating biological contactors) must be sampled daily by 24-h composite samples and the samples must be analyzed daily for BOD_5 and TSS. A daily chlorine residual test and a twice-monthly bacteriological analysis was required for the oxidation ditch. Daily flowrate information is required at all continuously discharging plants.

In entering the considerable volume of hardcopy data from the continuous municipal dischargers, SENTAR Consultants Ltd. applied certain conventions and made some assumptions. These are as follows:

1. Monthly averages of flow rate, BOD, TSS, dissolved oxygen, temperature, pH, etc., were entered when daily data were available.
2. Averages of data were rounded up to the next tenth, except temperature, which was rounded up to the next whole number, unless the information on file was already averaged.
3. The first day of each month was entered in the "date" field as the date of the monthly average (unless the sampling was monthly and the sampling date was available).
4. When field daily data and laboratory test data were both available, field daily data were used.
5. Some fields are not numeric, as the results were often given as "less than" or "greater than" a value. These fields were changed to character fields to allow for that symbol.

The type of effluent data that is available is summarized in Table 4. The number of parameters measured is very small for all but a few dischargers. The content of the database is provided in Appendix C.

Of the 16 licensed facilities discharging continuously, the data from four cannot be used for loading estimates because of questionable or missing flow information. These include Barrhead, Ft. Chipewyan, Wabasca and the Town of Peace River. Data from Lac La Biche has been used, based on the assumption that the reported units are incorrect. Due to the quality control concerns described earlier, particularly during sample transportation and data entry, the data would not be suitable for scientific research or study. This is mainly because the information was collected and, The data may be sufficient for this purpose, although the lack of accurate discharge data makes this doubtful.

The reporting requirements were changed about six months ago. Daily monitoring must continue, but the data are now kept at each plant and only exceedances or violations are reported to AEP.

TABLE 4:
Quantity and Quality of Effluent Data Available from Continuous Municipal Dischargers

Description	Units	Dischargers Providing this Data	
Date	MM/DD/YY	All Dischargers	
Effluent Discharge Rate or Volume Discharged	Cubic metres per day Gallons per day Megalitres per day Imperial gallons	All Dischargers	
Biological Oxygen Demand	Milligrams per litre	All Dischargers	
Total Suspended Solids	Milligrams per litre	All Dischargers	
Volatile Suspended Solids	Milligrams per litre	Ft. Chipewyan Manning	Peace River Peace River Correctional Institution
Chemical Oxygen Demand	Milligrams per litre	Ft. McMurray Peace River	Peace River Correctional Institution
pH	No units	Athabasca Barrhead Edson Ft. McMurray Grande Cache Ft. Smith Jasper Lac La Biche	Manning Peace River Peace River Correctional Institution Slave Lake Wabasca Whitecourt
Temperature	Degrees Celsius (°C)	Athabasca Barrhead Edson Ft. McMurray Grande Cache	Jasper Lac La Biche Slave Lake Wabasca Whitecourt
Dissolved Oxygen	Milligrams per litre	Athabasca Barrhead Edson Grande Cache Jasper Lac La Biche	Peace River Correctional Institution Slave Lake Wabasca Whitecourt
Nitrite-Nitrate Nitrogen	Milligrams per litre (as N)	Manning Slave Lake	Peace River
Ammonia-Nitrogen	Milligrams per litre (as N)	Manning	Slave Lake
Organic Nitrogen	Milligrams per litre (as N)	Manning	Slave Lake
Total Phosphorus as Phosphate	Milligrams per litre (as PO_4)	Manning Peace River	Slave Lake
Conductivity	Microsiemens per centimetre	Peace River	
Total Alkalinity	Milligrams ($CaCO_3$) per litre	Peace River	
Phenolphthalein alkalinity	Milligrams ($CaCO_3$) per litre	Peace River	
Bicarbonate	Milligrams per litre	Peace River	
Carbonate	Milligrams per litre	Peace River	
Hydroxide	Milligrams per litre	Peace River	
Total Hardness	Milligrams ($CACO_3$) per litre	Peace River	

(Continued)

TABLE 4: (Concluded)

Chloride	Milligrams per litre	Peace River
Chlorine	Milligrams per litre	Peace River Correctional Institution
Fluoride	Milligrams per litre	Peace River
Total Kjeldahl Nitrogen	Milligrams per litre (as N)	Peace River
Nitrate-Nitrogen	Milligrams per litre (as N)	Peace River
Nitrite-Nitrogen	Milligrams per litre (as N)	Peace River
Sulphate	Milligrams per litre	Peace River
Phenol	Milligrams per litre	Peace River
Calcium	Milligrams per litre	Peace River
Magnesium	Milligrams per litre	Peace River
Sodium	Milligrams per litre	Peace River
Potassium	Milligrams per litre	Peace River
Aluminum	Milligrams per litre	Peace River
Cadmium	Milligrams per litre	Peace River
Chromium	Milligrams per litre	Peace River
Cobalt	Milligrams per litre	Peace River
Copper	Milligrams per litre	Peace River
Iron	Milligrams per litre	Peace River
Lead	Milligrams per litre	Peace River
Manganese	Milligrams per litre	Peace River
Molybdenum	Milligrams per litre	Peace River
Nickel	Milligrams per litre	Peace River
Selenium	Milligrams per litre	Peace River
Vanadium	Milligrams per litre	Peace River
Zinc	Milligrams per litre	Peace River
Reactive Silica Dioxide	Milligrams per litre	Peace River
Oil And Grease	Milligrams per litre	Peace River
Odour Number	Threshold Odor Number (TON)	Peace River
Total Dissolved Solids	Milligrams per litre	Peace River
Total Solids	Milligrams per litre	Peace River
Total Organic Carbon	Milligrams per litre	Peace River
Total Inorganic Carbon	Milligrams per litre	Peace River
Total Carbon	Milligrams per litre	Peace River
Surfactants	Milligrams per litre	Peace River
Cation:Anion Ratio	Dimensionless	Peace River
Total Coliform	Number per 100 mL	Ft. Smith
Fecal Coliform	Number per 100 mL	Ft. Smith

3.3.2 Periodic Municipal Dischargers

These are municipalities, schools and other facilities which discharge on a periodic basis, usually once or twice per year (Appendix D). (Their locations are shown on Figure 2.[a]) Grab samples are collected when the effluent is released. Therefore, one to two samples per year is the maximum amount of data expected for each discharger. The majority of chemical analyses done for the periodic dischargers were BOD_5 and TSS. There are 124 listed in Tables 1 and 2, but only 67 have available effluent data (presented later in Table 7). Data were particularly sketchy for small periodic dischargers filed under county or improvement district.

The flowrate information for periodic lagoon discharges is not adequate for research or study purposes. The majority of locations did not measure the flowrate. Of the 77 locations shown in Table 1, annual flowrate is only shown for 39 (presented later in Table 7). The flowrate data (Appendix Table D.1) did not appear to be "measured" flowrates in all instances. Some locations consecutively reported exactly the same flowrate for several years, suggesting that the measurements were lagoon estimates. Others reported a flowrate based upon the design criteria of the lagoon (i.e. number of people multiplied by a unit flowrate factor). The flowrate, or volume, is "quantified" in a variety of units. These range from the expected cubic metres, gallons and megalitres to the length of time the lagoon was pumped at an undisclosed rate, or the amount of drawdown in the lagoon. These latter two, while not strictly 'volume', are all that was available in the original information and are, therefore, preserved (Appendix Table D.1). In general, the flowrate data should not be used to estimate loadings (e.g. kg/d of BOD).

Nutrient data (generally ammonia, nitrite-nitrate, organic nitrogen and total phosphorus) are available for nine periodic dischargers. Four of these, Berwyn, Mayerthorpe, Sexsmith and Wembley, monitor nutrients regularly. Total and fecal coliforms data are only monitored at Grande Prairie airport. Gregorie Lake Provincial Park was the only discharger to measure a wide range of parameters.

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[a] Some discharges are not shown because their locations are not recorded in the files.

SECTION 4.0

CHARACTERISTICS OF SANITARY WASTEWATER DISCHARGES

4.0 CHARACTERISTICS OF SANITARY WASTEWATER DISCHARGES

4.1 GENERAL CHEMICAL CHARACTERISTICS

The typical constituents found in sanitary wastewater (Table 5) have been summarized by Metcalf and Eddy (1985). Raw sewage contains dissolved and suspended solids that are predominantly organic and have a high biochemical and chemical oxygen demand, as well as a high concentration of ammonia and nutrients generally. Metals and other toxic compounds may be present if a municipality has an industrial sector producing these types of wastes. They are a concern to wastewater treatment operators since all the treatment processes depend on healthy microorganisms. Metals tend to be removed in the settleable solids rather than the liquid effluent.

TABLE 5: Typical Composition of Untreated Domestic Wastewater[a]

Constituent	Concentration[b]		
	Strong (mg/L)	Medium (mg/L)	Weak (mg/L)
Solids, total:	1200	720	350
Dissolved, total	850	500	250
Fixed	525	300	145
Volatile	325	200	105
Suspended, total	350	220	100
Fixed	75	55	20
Volatile	275	165	80
Settleable Solids (mL/L)	20	10	5
Biochemical Oxygen Demand (5-d 20°C)	400	220	110
Total Organic Carbon	290	160	80
Chemical Oxygen Demand	1000	500	250
Nitrogen (total as N)	85	40	20
Organic	35	15	8
Free Ammonia	50	25	12
Nitrites	0	0	0
Nitrates	0	0	0
Phosphorus (total as P)	15	8	4
Organic	5	3	1
Inorganic	10	5	3
Chlorides[c]	100	50	30
Alkalinity (as $CaCO_3$)[c]	200	100	50
Grease	150	100	50

a. From Metcalf and Eddy 1985

b. All values except settleable solids are expressed in mg/L (mg/L = g/m^3)

c. Values should be increased by amount in domestic water supply

Secondary treatment (Table 6) effectively reduces the concentrations of BOD_5 and TSS in the raw sewage, but nutrients (as total N and total P) are not reduced as much. Aerobic processes generally result in a decrease in ammonia.

TABLE 6: Typical Effluent Quality of Sewage Treatment Processes[(a)]

Process	BOD_5 (mg/L)	TSS (mg/L)	Total P (mg/L)	Total N (mg/L)	Total Coliforms per 100 mL
Primary (including anaerobic lagoons)	75 to 150	50 to 110	5 to 7	25 to 45	$>2 \times 10^6$
Secondary					
- Biological (Mechanical)	10 to 25	10 to 25	3.5 to 6.5	15 to 35	$2x10^4$ to $2x10^5$
- Aerated Lagoons	15 to 30	20 to 35	4 to 7	20 to 40	$2x10^3$ to $2x10^5$
- Aerobic Lagoons					
- Spring	25 to 70	20 to 60	3.5 to 7.0	20 to 35	$<2x10^3$ to $2x10^5$
- Late Fall	10 to 30	10 to 40	2 to 5	5 to 20	$2x10^2$ to $2x10^4$

a. From WQB 1989

The biochemical oxygen demand measured over five days (BOD_5) is a general measure of the oxygen requirement to biologically stabilize organic matter in the wastewater. It is commonly used to determine the resulting oxygen demand of the effluent and the potential oxygen depletion in the receiving waterbodies. Three municipalities also measured the chemical oxygen demand (COD) of the effluent.

The TSS is a measure of the total suspended solids in the final effluent from the wastewater treatment plants. The TSS determination is used to evaluate the strength of domestic and industrial wastewater and to determine the efficiency of the wastewater treatment units. The TSS determination is subject to considerable error if proper precautions are not taken (Sawyer and McCarty 1978). In most municipal wastewater treatment plants, the TSS is comprised mainly of organic material. Lagoons, aerated stabilization basins, and holding ponds often have relatively high TSS because of high algal growth in the storage ponds. The TSS is often light compared to inorganic suspended solids and has a specific gravity that is only slightly greater than water. Four municipalities also reported the volatile suspended solids (VSS), a better estimate of the organic component of the suspended solids.

Since secondary treatment effectively reduces instream impacts due to oxygen demand, settleable solids and ammonia-nitrogen, effluent monitoring and discharge limits have been directed towards ensuring the proper operation of the treatment facilities. The majority of chemical analyses done by, or provided by, the periodic and continuous dischargers were BOD_5 and TSS. Continuous dischargers also often reported pH, temperature and dissolved oxygen (Appendix Tables C1.1 to C1.16). The results are summarized in the following sections.

4.1.1 <u>Periodic Discharges</u>

The general chemical characteristics of the periodic discharges are included in Table 7. Although many of the locations had missing information, all but nine locations had some TSS and BOD_5 information.

Note that the flowrate data reported in the information provided by AEP for the periodic dischargers are not completely reliable because of the missing and estimated flowrates. Therefore, the mass loadings for BOD_5 and TSS were not calculated, as it is not possible to obtain an accurate and comprehensive estimate of loading from these sources.

4.1.2 Continuous Discharges

Table 8 is a statistical summary of the general characteristics of effluent from continuous dischargers (Appendix Tables C2.1 to C2.16). Table 9 contains the BOD_5 and TSS mean concentrations from the continuous dischargers and the mean mass loadings from 12 of the 16 continuous discharges. These were based on a mean flow multiplied by a mean concentration for the three years of data.

The mean BOD_5 and TSS mass loadings for the individual facilities on the Athabasca River Basin range from 14 kg/d to 270 kg/d for BOD_5 and 9.5 kg/d to 160 kg/d for TSS. This does not include the municipalities with unknown discharge flowrates (Barrhead, Ft. Chipewyan, and Wabasca). The mean BOD_5 and TSS mass loading for the locations on the Peace River Basin range from 1.7 kg/d to 92 kg/d for BOD_5 and 2.1 kg/d to 55 kg/d for TSS. The Town of Peace River, which has an unknown discharge volume, is not included. The mean BOD_5 and TSS mass loadings (4 kg/d and 25 kg/d, respectively) from Ft. Smith, the only continuous discharge to the Slave River fall within the ranges reported for the other two rivers.

TABLE 7: Statistical Summary of Flowrate, BOD_5 and TSS for Periodic Discharges in the NRBS Area[a]

Name	Discharge Volume (m^3/discharge)				BOD (mg/L)				TSS (mg/L)			
	N	Max	Mean	St. Dev.	N	Max	Mean	St. Dev.	N	Max	Mean	St. Dev.
Atikameg School	-	-	-	-	2	33.00	24.00	12.73	1	21.00	21.00	-
Beaverlodge	-	-	-	-	6	109.00	30.83	38.39	4	23.00	15.75	7.27
Berwyn	4	100,010	48,073	38,855	4	16.00	11.25	5.85	4	31.00	18.75	9.98
Bezanson	2	6,819	4,410	3,408	2	19.00	15.00	5.66	1	59.00	59.00	-
Bishop Routhier School	1	1,771	1,771	-	-	-	-	-	-	-	-	-
Blue Ridge	2	24,070	19,536	6,412	2	36.60	35.10	1.50	2	60.00	45.65	14.35
Bluesky	-	-	-	-	3	5.00	3.33	1.53	3	35.00	15.00	17.44
Boyle	1	80,000	80,000	-	1	4.00	4.00	-	1	6.00	6.00	-
Cleardale	1	455	455	-	3	24.00	11.33	11.68	3	63.00	26.00	32.14
Colinton	3	14,500	8,750	5,166	2	23.00	20.50	3.54	2	79.00	47.50	44.60
Debolt	4	13,640	10,800	2,177	3	20.00	12.33	6.66	1	9.00	9.00	-
Dixonville	3	22,730	15,150	6,944	2	9.00	7.00	2.83	2	7.00	5.50	2.12
Donnelly	-	-	-	-	2	5.00	3.50	2.12	2	7.00	6.00	1.41
Eaglesham	6	27,275[b]	16,668[b]	13,072[b]	6	501.00	138.00	166.41	6	117.00	44.83	36.03
Enilda	3	15,000	15,370	318	3	7.00	4.67	2.52	1	3.00	3.00	-
Entwistle	-	-	-	-	3	162.00	85.00	70.38	3	430.00	165.33	229.70
Evansburg	1	85,000	85,000	-	1	7.00	7.00	-	1	11.00	11.00	-
Fairview	-	500,049	489,442[b]	10,233[b]	6	56.00	20.67	21.61	6	40.00	20.33	13.54
Falher	3	181,800	174,200	13,110	3	9.00	4.67	3.79	3	27.00	17.00	10.54
Faust	5	41,450	37,160	2,633	5	7.00	2.20	2.68	5	13.00	4.00	5.20
Footner Lake Forestry Site	1	14,000	14,000	-	1	5.00	5.00	-	-	-	-	-
Ft. Assiniboine	1	15,910	15,910	-	1	27.00	27.00	-	1	35.00	35.00	-
Ft. McKay	5	27,280	23,460	3,814	5	40.00	24.80	9.20	5	148.00	43.20	59.76
Ft. Vermilion	6	103,524	41,360	48,870	6	54.00	30.83	17.99	6	24.00	17.83	5.19
Fox Creek	2	204,481	204,481	0	2	14.00	7.50	9.19	2	23.00	12.75	14.50
Gift Lake	1	10,000	10,000	-	2	85.00	51.00	48.08	2	155.00	88.00	94.75
Girouxville	3	38,210	15,190	19,940	3	14.00	6.33	6.66	1	9.00	9.00	-
Grande Cache Forest Industries	-	-	-	-	4	2.00	2.00	0.00	-	-	-	-
Grandeview Hutterite Colony	-	-	-	-	2	45.00	80.25	13.44	2	184.00	125.00	83.44
Grassland	2	8,000	6,500	2,121	3	46.00	27.33	20.13	3	84.00	58.33	35.36
Gregoire Lake Provincial Park	-	-	-	-	1	2.40	2.40	-	-	-	-	-
Grimshaw	1	192,700	192,700	-	1	5.00	5.00	-	1	5.00	5.00	-
Grouard	3	64,000	62,580	2,465	3	5.00	3.33	2.08	1	16.00	16.00	-
Guy	-	-	-	-	3	8.00	5.00	2.65	3	10.00	8.00	1.73

(Continued)

TABLE 7: (Concluded)

High Level	4	363,700	295,500	78,750	3	5.00	3.67	2.31	2	5.00	4.00	1.41
High Prairie	5	175,500	46,156	72,305	5	8.00	4.60	2.70	2	38.00	20.50	24.75
Hines Creek	1	90,091	90,091	-	1	4.00	4.00	-	1	6.00	6.00	-
Hythe	-	-	-	-	5	82.20	35.24	33.26	5	14.00	6.48	4.50
Janvier School	-	-	-	-	2	50.00	44.00	8.49	2	138.00	85.00	74.95
Jean Cote	-	-	-	-	2	10.00	10.00	0.00	2	35.00	18.50	23.33
Joussard	3	29,773	26,008	3,261	3	7.00	4.67	2.52	1	5.00	5.00	-
La Glace	3	12,000	11,455	506	3	12.00	6.33	5.13	1	4.00	4.00	-
Loon Lake School	4	4,546	2,501	1,490	4	59.00	22.25	24.78	4	56.00	25.75	21.55
Mayerthorpe	-	-	-	-	3	10.00	9.67	0.58	3	134.00	58.33	67.11
Peace River Airport	-	-	-	-	10	136.00	48.77	34.90	10	200.00	75.20	74.10
Peerless Lake School	1	1,746	1,746	-	1	33.00	33.00	-	1	25.00	25.00	-
Pibroch	1	9,092	9,092	-	1	28	28	-	1	10	10	-
Queen Elizabeth Provincial Park	2	520	515	7	-	-	-	-	-	-	-	-
Ridge Valley	3	9,092	7,577	2,625	2	16.00	15.50	0.71	1	27.00	27.00	-
Rycroft	-	-	-	-	3	10.00	5.67	3.79	3	14.00	8.67	4.73
Sangudo	3	48,096	48,096	0	2	27.00	20.50	9.19	2	18.00	16.00	2.83
Sexsmith	6	81,826	81,826	0	6	27.00	22.17	6.34	6	42.00	19.50	11.59
Shell - Peace River Complex	1	3,000	3,000	-	2	21.00	19.00	2.83	2	22.00	12.60	13.29
Spirit River	3	72,743	54,646	15,673	4	20.00	8.50	7.77	4	120.00	42.25	52.58
St. Isadore	-	-	-	-	3	87.00	44.00	37.24	3	62.00	37.33	22.48
Swan Hills	4	232,409	221,329	12,795	4	51.00	28.20	17.57	4	11.30	7.35	3.69
Triple L Mobile Home Park	-	-	-	-	3	65.00	38.67	22.85	1	32.00	32.00	-
Trout Lake School	-	-	-	-		24.00	24.00	-		22.00	22.00	-
Valleyview	10	345,488	155,652	81,708	10	198.00	51.75	56.79	10	499.00	124.91	143.05
Wandering River	1	1,309	1,309	-	1	17.60	17.60	-	-	-	-	-
Wanham	-	-	-	-	3	30.00	21.67	8.02	3	205.00	95.67	95.21
Wembley	3	149,560	103,498	69,136	3	26.00	19.33	9.07	3	45.00	40.00	7.80
Westlock	4	250,025	149,531	116,041	4	9.00	7.00	2.16	4	23.00	16.00	6.48
Westwind Mobile Home Park	-	-	-	-	1	11.00	11.00	-	-	-	-	-
Whitelaw	-	-	-	-	4	7.00	6.50	3.42	3	31.00	18.00	11.53
Wildwood	-	-	-	-	1	5.00	5.00	-	1	18.00	18.00	-
Woking	1	9,000	9,000	-	1	2.00	2.00	-	1	13.00	13.00	-
Worsley	-	-	-	-	4	25.00	8.75	11.15	4	24.00	10.83	9.09
Young's Point Provincial Park	-	-	-	-	1	81.00	81.00	-	1	22.00	22.00	-

a. The location of the periodic dischargers is shown in Figure 2 which is keyed by number to Tables 1 and 2.

b. units = m^3/y

TABLE 8: Statistical Summary of the General Characteristics of the Effluent from Continuous Discharges

	Flow (m^3/d)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	VSS (mg/L)	pH	Temperature (°C)	Dissolved Oxygen (mg/L)
Athabasca								
(Jan 1990 - Mar 1993)								
Mean	950	14.64		10.17		7.21	10.59	7
Standard Error	9.6	1.66		1.13		0.07	0.77	0
Median	950	12		9		7.3	11	7
Standard Deviation	60	10.40		7.03		0.46	4.78	0
Minimum	810	3		4		5.8	2	7
Maximum	1100	41		40		8.1	19	7
Count	39	39		39		39	39	39
Barrhead								
(Jan 1990 - Mar 1993)								
Mean		18.35		26.00		8.17	8.27	7.05
Standard Error		1.48		3.27		0.10	1.22	0.45
Median		17.00		18.00		8.10	5.00	6.20
Standard Deviation		9.00		19.91		0.47	7.41	2.75
Minimum		5.00		6.00		7.50	1.00	3.60
Maximum		42.00		85.00		9.20	21.00	15.40
Count		37		37		22	37	37
Edson[a]								
(Jan 1990 - Mar 1993)								
Mean	4,000	13.27		15.24		8.03	9.54	7.95
Standard Error	310	1.05		1.92		0.07	2.24	0.29
Median	3,400	12.00		9.00		7.90	6.00	8.10
Standard Deviation	1,800	6.55		11.98		0.44	14.00	1.79
Minimum	1,600	2.30		2.40		7.00	0.20	4.30
Maximum	8,700	33.50		50.20		8.90	81.20	11.20
Count	34	39		39		39	39	39
Ft. Chipewyan								
(Jan 1990 - Nov 1992)								
Mean		38.40		46.20	28.20			
Standard Error		12.01		10.27	10.86			
Median		34.00		48.00	21.00			
Standard Deviation		26.86		22.97	24.28			
Minimum		8.00		25.00	9.00			
Maximum		67.00		82.00	68.00			
Count		5		5	5			
Ft. McMurray[b]								
(Jan 1990 - Mar 1993)								
Mean	13,000	20.38	61.77	12.13		8.07	8.26	
Standard Error	860	0.79	2.70	0.60		0.02	1.29	
Median	14,000	20.00	65.00	12.00		8.10	7.00	
Standard Deviation	3,700	4.95	14.79	3.76		0.15	8.07	
Minimum	0	11.00	0.00	5.00		7.70	-1.00	
Maximum	17,000	29.00	92.00	21.00		8.30	22.00	
Count	18	39	30	39		39	39	

(Continued)

Ft. Smith[a]							
(Jan 1990 - Jan 1993)							
Mean	570	73.08	44.25		7.56		
Standard Error	2.7	6.99	8.05		0.11		
Median	580	71.00	32.00		7.32		
Standard Deviation	16	42.51	55.74		0.79		
Minimum	520	16	5		7		
Maximum	580	200	392		10		
Count	36	37	48		48		
Grande Cache							
(Jan 1990 - Mar 1993)							
Mean	2,000	3.79	1.13		6.98	10.51	2.21
Standard Error	59	0.15	0.08		0.05	0.49	0.11
Median	1,900	3.70	1.00		6.80	10.00	2.00
Standard Deviation	370	0.94	0.52		0.33	3.08	0.71
Minimum	1,600	2.00	1.00		6.70	6.00	1.30
Maximum	3,200	6.00	4.00		7.80	16.00	3.80
Count	39	39	39		39	39	39
Grande Prairie							
(Jan 1990 - Mar 1993)							
Mean	11,000	8.60	5.06				
Standard Error	380	0.61	0.65				
Median	10,000	7.60	3.90				
Standard Deviation	2,400	3.81	4.03				
Minimum	8,100	3.30	1.10				
Maximum	21,000	19.70	20.70				
Count	39	39	39				
Jasper							
(Jan 1990 - Mar 1993)							
Mean	3,900	23.32	34.38		7.67	9.38	8.60
Standard Error	270	3.46	9.77		0.06	1.61	0.91
Median	3,700	20.00	19.50		7.70	9.00	8.20
Standard Deviation	980	11.46	35.21		0.21	5.80	2.72
Minimum	2,100	10.10	11.90		7.30	3.00	4.40
Maximum	5,600	45.50	135.90		8.10	19.00	11.70
Count	13	11	13		13	13	9
Lac La Biche[b]							
(Jan 1990 - Mar 1993)							
Mean	1,400	24.81	17.38		8.05	12.05	9.41
Standard Error	78	2.13	2.67		0.05	1.24	0.36
Median	1,600	20.20	12.00		8.1	10	9.8
Standard Deviation	460	13.11	16.45		0.32	7.55	2.19
Minimum	490	7.00	4.10		7.4	3	0
Maximum	2,200	62.10	77.90		8.7	25	12.8
Count	35	38	38		37	37	37
Manning[a]							
(Jan 1990 - Mar 1993)							
Mean	490	19.55	18.17	13.13	7.53		
Standard Error	14	1.36	1.29	1.11	0.04		
Median	490	18.00	18.20	13.00	7.60		
Standard Deviation	69	7.57	7.19	5.45	0.19		
Minimum	380	8.20	7.60	5.00	7.20		
Maximum	400	51.40	32.60	27.30	7.80		
Count	24	31	31	24	24		

(Continued)

TABLE 8: (Concluded)

Peace River (Jul 1992 - Sep 1992)								
Mean		120.66		142.93	181.14			
Standard Error		13.09		32.86	57.71			
Median		116		137	128			
Standard Deviation		34.63		86.93	152.69			
Minimum		74.2		9.5	66			
Maximum		170		255	496			
Count		7		7	7			
Peace River Correctional Centre (Jan 1990 - Mar 1993)								
Mean	290	6.00	32.46	7.31	7.10	6.61		7.96
Standard Error	21	0.47	3.01	0.60	0.59	0.03		0.17
Median	320	5.50	28.90	6.40	6.50	6.60		8.20
Standard Deviation	130	2.93	14.14	3.77	3.66	0.18		1.08
Minimum	24	2.00	16.80	2.20	0.00	6.10		5.40
Maximum	510	15.00	68.00	19.20	17.20	6.90		9.80
Count	37	39	22	39	39	39		39
Slave Lake (Jan 1990 - Mar 1993)								
Mean	2,700	15.73		22.10		7.47	9.22	5.91
Standard Error	38	1.47		3.21		0.04	1.07	0.49
Median	2,700	12.90		17.80		7.50	7.00	7.15
Standard Deviation	190	8.80		19.29		0.21	6.39	2.97
Minimum	2,300	5.70		4.10		7.00	0.00	0.30
Maximum	3,100	38.00		96.60		8.00	22.00	11.00
Count	25	36		36		36	36	36
Wabasca (Jan 1990 - Mar 1993)								
Mean		6.04		15.96		7.81	8.63	7.39
Standard Error		0.51		3.04		0.04	1.03	0.22
Median		5.10		12.25		7.80	8.40	6.95
Standard Deviation		3.60		21.46		0.29	7.25	1.53
Minimum		2.40		0.01		7.20	0.00	5.20
Maximum		20.90		119.40		8.80	23.00	10.80
Count		49		50		50	50	50
Whitecourt (Jan 1990 - Mar 1993)								
Mean	3,400	9.79		6.37		7.28	13.71	3.31
Standard Error	37	1.01		0.38		0.01	0.44	0.11
Median	3,400	7.20		6.00		7.30	13.00	3.20
Standard Deviation	230	6.33		2.40		0.06	2.72	0.68
Minimum	3,000	2.60		3.40		7.20	10.00	2.40
Maximum	4,000	21.60		16.10		7.40	19.00	4.90
Count	39	39		39		39	39	39

a. Volumes were reported in gallons. Conversion to m^3 assumes that gallons are imperial gallons.
b. Units were usually, but not always, reported as cubic metres per day. Table 8 assumes that the units are incorrect and should be gallons per day because this agrees with the theoretical flowrate and with occasional entries from the plant showing gal./d at the same flowrate. Conversion assumes that gallons are imperial gallons.

TABLE 9: Average Flow, BOD_5 and TSS for Continuous Discharges

No.	River Basin	Discharge Source	Flowrate (m^3/d)	BOD_5 (mg/L)	BOD Load (kg/d)	TSS (mg/L)	TSS Load (kg/d)
1	Athabasca	Barrhead	n/a	18		26	
2	Athabasca	Edson	4,000	13	52	15	60
3	Athabasca	Ft. Chipewyan	n/a	38		46	
4	Athabasca	Ft. McMurray	13,000	20	270	12	160
5	Athabasca	Jasper	3,900	23	92	34	130
6	Athabasca	Lac La Biche	1,400(q)	25	35	17	24
7	Athabasca	Slave Lake	2,700	16	43	22	59
8	Athabasca	Town of Athabasca	950	15	14	10	9.5
9	Athabasca	Wabasca	n/a	6		16	
10	Athabasca	Whitecourt	3,400	10	34	6.4	21
11	Peace	Grande Cache	2,000	3.8	7.7	1.1	2.2
12	Peace	Grande Prairie	11,000	8.8	92	5.1	56
13	Peace	Manning	490	20	9.5	18	8.8
14	Peace	Peace River Correctional Centre	290	6	1.7	7.3	2.1
15	Peace	Town of Peace River	n/a	120		143	
16	Slave	Ft. Smith	570	73	42	44	25

n/a = data not available or inconsistent
(q) = data questionable

4.2 NUTRIENT CHARACTERISTICS

Data on nutrients discharged from the municipalities are available from Manning, the Town of Peace River, and Slave Lake (Appendix Tables C2.11, C2.12 and C2.14). Although nutrient analysis is not required in the licence to operate for these facilities, data were included in the information provided by AEP. The average ammonia, organic nitrogen and total phosphorus concentrations in the effluent from Manning, Peace River and Slave Lake are shown in Table 10.

TABLE 10:
Average Concentrations and Loadings of Nutrients from the Manning, Peace River and Slave Lake Sewage Treatment Plants, 1990 to 1993

	Ammonia		Organic Nitrogen		Total Phosphorus	
	Concentration	Loading	Concentration	Loading	Concentration	Loading
Manning	20	9.8	11	5.4	15	7.4
Peace River	9.4	-	10	-	13	-
Slave Lake	17	46	6.9	19	9.6	26

The Town of Peace River measures total Kjeldahl nitrogen rather than organic nitrogen. The average for TKN is the measure of both ammonia and organic nitrogen. This gives a calculated average organic nitrogen concentration of 10 mg/L as N. The flowrate for Peace River is questionable and loadings have not been calculated.

Untreated domestic sewage contains from 12 mg/L to 50 mg/L of ammonia and the typical concentration of ammonia in sewage of medium concentration is 25 mg/L (Metcalf and Eddy 1985).

Ammonia represents about two-thirds of the typical total nitrogen[1] concentration of about 40 mg/L (range of total nitrogen = 20-85 mg/L). Following secondary treatment from mechanical plants, aerated lagoons and spring-discharging aerobic lagoons, the concentration of total nitrogen is typically 15 mg/L to 40 mg/L (WQB 1989). The three effluents that are monitored (Table 10) have mean total nitrogen concentrations of about 30 mg/L and lie within this range. Although the other effluents have not been analyzed for nitrogen, it is reasonable to expect that they will usually fall within this range.

Untreated domestic sewage contains from 4 mg/L (as P) to 15 mg/L (as P) of total phosphorus and the typical concentration of total phosphorus in sewage of medium concentration is 8 mg/L (as P) (Metcalf and Eddy 1985). Following secondary treatment, the total phosphorus concentration of the effluent would be typically 3.5 mg/L (as P) to 7 mg/L (as P) (WQB 1989). Expressed as phosphate, this range would be 10.7 mg/L (as PO_4) to 21.4 mg/L (as PO_4). The total phosphorus concentrations of effluents that have been monitored (Table 10) fall within the lower end of this range.

When AEP conducts synoptic surveys and analyses split samples, it includes nutrients in the parameters that are analyzed. Data from these sources were summarized in Tables 2.4.2 and 2.4.4 in the Synthesis Report on Nutrient Loading prepared by SENTAR Consultants Ltd. (1993) for NRBS.

4.3 MICROBIAL CHARACTERISTICS

Information regarding the microbial characteristics of the treated effluent discharged from the intermittent and continuous dischargers is very limited. The municipalities that have microbial information include Fox Creek, Grande Prairie Airport, Gregorie Lake (Appendix Table D.1), and Ft. Smith (Appendix Table C1.6). The information available was limited to total and fecal coliform test results. Total and fecal coliforms are used by many regulatory agencies as indicators of the presence of sanitary pollution (Krenkel and Novotny 1980). However, the total microbial loading to the river from wastewater treatment facilities is significantly greater and much more diverse than indicated by total and fecal coliform counts.

The microbial concentrations from the periodic dischargers appear suspect. These include Fox Creek, Grande Prairie Airport, and Gregorie Lake. The concentrations of fecal coliforms ranged from 5 to 70 CFU[2] /100 mL and total coliforms ranged from 40 to 170 CFU/100 mL, unusually low values for lagoon discharges without disinfection. These values are more typical of raw surface water used as a potable water source before treatment (Helmer 1992). Values that are more typical for lagoons range from approximately 100,000 to 500,000 CFU/100 mL (Prosko 1962).

The values from Ft. Smith have a mean total and fecal coliform count of 870,000 CFU/100 mL and 230,000 CFU/100 mL, respectively. These are typical total and fecal coliform counts observed from wastewater treatment facilities (Prosko 1962).

4.4 TOXICOLOGICAL CHARACTERISTICS

Ammonia is commonly present in sewage treatment plant effluent. Ammonia, particularly in its un-ionized form, is toxic to fish and aquatic life at very low concentrations (WPCF 1983). This toxicity increases significantly at higher receiving water pH (>8.0) and temperature (>15°C) values.

1 Total nitrogen contains ammonia nitrogen, organic nitrogen and nitrite-nitrate nitrogen.
2 CFU = colony forming units

Ammonia nitrogen concentrations reported by Manning, Peace River and Slave Lake are appended (Appendix Tables C1.11, C1.12 and C1.14). Only Slave Lake measured ammonia, pH and temperatures. All three parameters are needed to determine the toxicity. Although total ammonia nitrogen is in the range that could be toxic, very little un-ionized ammonia (0.3% - 1.5%) will be present at the mean pH of about 7.5 (assuming a temperature range of 0°C to 23°C) (Thomann and Mueller 1987).

Average total chlorine residual concentrations have been measured at the Peace River Correctional Centre and reported to AEP (Appendix Table C2.13). No other chlorine residual information is in the database.

Other parameters measured at the Town of Peace River include toxic metals, sulphides, and phenols. The average concentration of cadmium, chromium, cobalt, lead, molybdenum, nickel, selenium and vanadium were all consistently less than the detection limits. Following sewage treatment, metals are more likely to be present in the sewage sludge than in the liquid effluent. There were trace amounts of copper, manganese, and zinc (Appendix Table C2.12). The average iron concentration was 0.73 mg/L. The mass loading could not be calculated from any of these parameters due to a lack of flowrate data.

SECTION 5.0

NON-PULP MILL INDUSTRIAL EFFLUENT TREATMENT

5.0 NON-PULP MILL INDUSTRIAL EFFLUENT TREATMENT

5.1 BRIEF SURVEY OF NON-PULP MILL INDUSTRIES IN THE NRBS AREA

The non-pulp mill industries in the northern river basins are related to the regional natural resources including forests, coal, tar sands, oil, gas and gravel. Table 11 summarizes all of the licensed industrial discharges listed by AEP and contained in the source file (Appendix B). They represent the licences issued in the study area up to February 1994. The category "industrial" is used loosely to include a variety of licences. The locations on Figure 6 are keyed to this table by number. The only non-pulp mill industry on this list that is required to submit extensive monitoring data is Suncor Inc. The other industries shown here, although licensed at some time, are apparently not discharging effluent of a quantity or quality requiring monitoring.

Logging is the dominant land use activity in the watershed. The scope of this report does not include pulp mills, but other industries use forest resources. There are many sawmills located throughout the basin (Hamilton et al. 1985); however, most do not discharge effluent to the river. Zeidler Forest Industries Ltd., a wood plant (location shown in Figure 6), discharges effluent once a year from a lagoon which contains sewage and water from log washing. Blue Ridge Lumber (1981), a wood processing plant at Whitecourt (Figure 6), discharges only a small quantity of effluent (Appendix Table E.2).

Coal mining is located in the western region of the Athabasca River basin. Stanley (1987) listed four active coal mines. Two of these, Cardinal River (Luscar) and Gregg River (Manalta) are located in the McCleod River Basin. Coal Valley (Luscar-Sterco) is in the Pembina River basin. Obed Mountain (Obed) is located near the Athabasca River downstream of Hinton. Coal mines do not discharge process wastewaters to surface waters; however, they receive a letter of permission to discharge some of the supernatant from the tailings ponds from time to time (Ian Mackenzie pers. comm.). The surface runoff is released to surface waters and may contain high concentrations of nitrates from explosives (Ian Mackenzie pers. comm.). Three coal mines, Luscar Sterco (1977) Ltd., Cardinal River Coal and Smokey River Coal, are listed in Table 11.

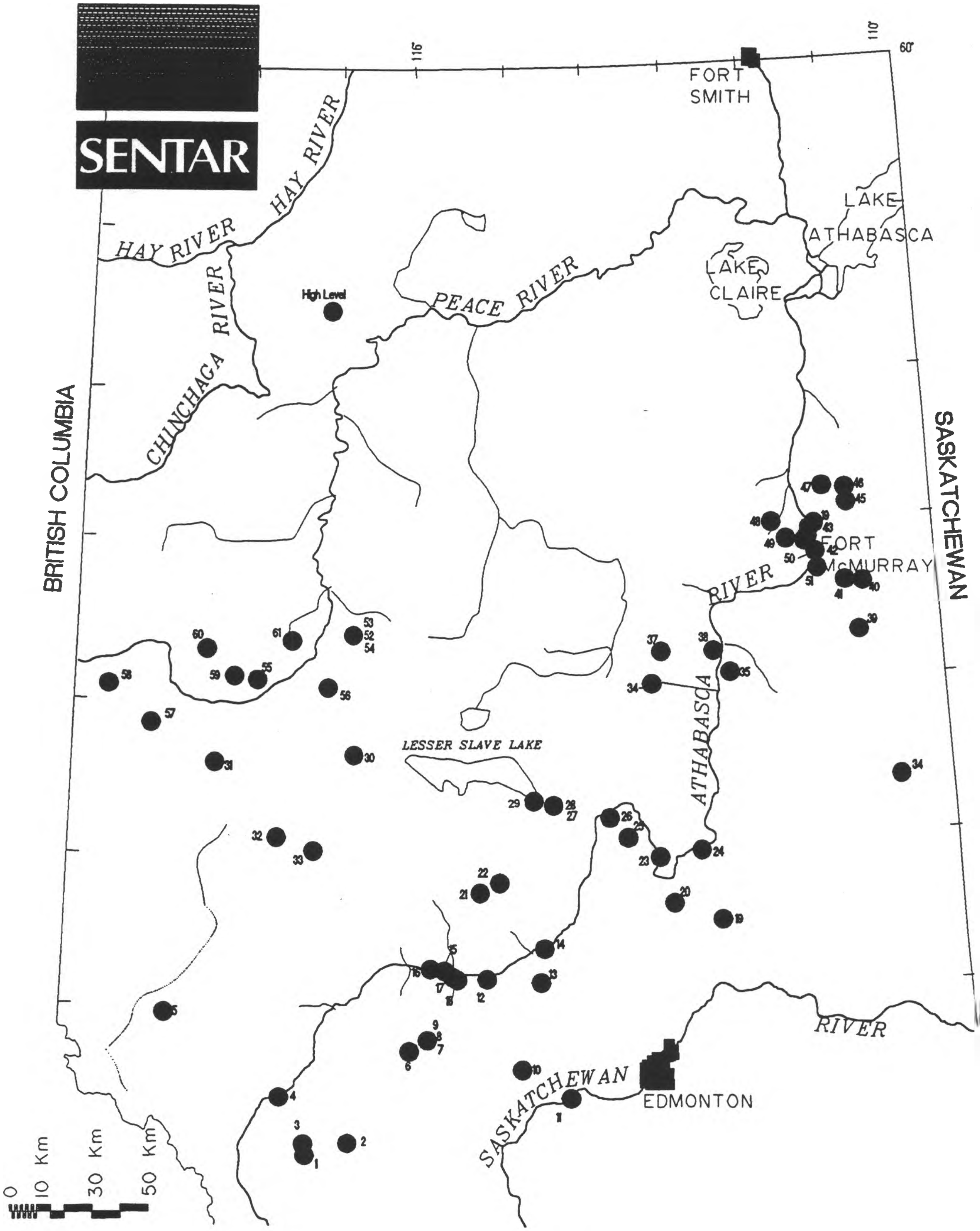
TABLE 11:
Industrial Sites Other than Gas Plants with Licensed Discharges in the NRBS Area

No.	Industrial Site	No.	Industrial Site	No.	Industrial Site
1	Inland Cement Ltd.	22	Chem-Security (Alberta) Ltd.	43	Carbovan Inc.
2	Luscar Sterco (1977) Ltd.	23	Stel-Mar Concrete Ltd.	44	Suncor Inc. Oil Sands Group
3	Cardinal River Coal	24	Albert Stewart	45	Chevron Canada Resources
4	Hinton Heavy Haulers 1978 Ltd.	25	Canadian Crude Separators Ltd.	46	Husky Oil Operations Ltd.
5	British Columbia Forest Products Ltd.	26	Mirror Landing Sand & Gravel	47	OSLO Alberta Ltd.
6	A. Gerling Ranching Ltd.	27	Weldwood of Canada Ltd.	48	Aostra
7	Ledcor Industries Ltd.	28	Zeidler Forest Industries Ltd.	49	Syncrude Canada Ltd.
8	General Gravel Sales Ltd.	29	Shell-Peace River In-Situ	50	Everall Construction Ltd.
9	Grizzly Gold and Gravel	30	Northern Alberta Nitrogen Ltd.	51	Procor Sulphur Services Inc.
10	Dennis McGinn Holdings Ltd.	31	Isaac Farms	52	Shell Canada Products Ltd.
11	E.L.P. Construction Services	32	Stel-Mar Concrete Ltd.	53	Shell Canada Ltd.
12	Blue Ridge Lumber	33	Canadian Crude Separators Ltd.	54	Peace River In-Situ Plant (Shell)
13	Tiger Calcium Inc.	34	Amoco Canada Petroleum Co. Ltd.	55	Burza Resources Ltd.
14	Ed Schulte	35	Rio Alto Exploration Ltd.	56	Village of Nampa
15	Alberta Newsprint Company	36	Amoco Canada Petroleum Co. Ltd.	57	Fimrite Oilfield Services Ltd.
16	Millar Western Industries Ltd.	37	North Peace Asphalt Ltd.	58	Smokey River Coal
17	Power Resource Development Corp.	38	Pensionfund Energy Resources	59	Border Paving Ltd.
18	National Silicates Ltd.	39	Amoco Canada Petroleum Co. Ltd.	60	Canadian Forest Products Ltd.
19	Suncor Inc.	40	Alberta Inc.	61	Superior Rock Products Ltd.
20	Homaid Industries Ltd.	41	Everall Construction Ltd.	62	High Level Forest Products Ltd.
21	Surestart Auto Electric	42	Esso Resources Canada Ltd.		

Note: See Figure 6 for locations.

Gravel and sand washing is a minor water use in the NRBS area. The Alberta Environment Industrial Listing includes twelve gravel washing enterprises in the Athabasca River basin and one in the Peace River basin. These enterprises do not generally discharge effluent, although four are listed in Table 11.

There are many gas plants in the basins. None of the plants discharge process wastewater. A third to a half of the gas plants may have ponds to contain surface runoff; the remainder may allow surface runoff (Ian Mackenzie pers. comm.). Gas plants listed in the source file are summarized in Table 12 which is keyed by number to Figure 7 showing the location of plants with licensed effluent discharge. The runoff would be innocuous except for elevated sulphates at plants with sulphur blocks. A few plants may have sanitary sewage lagoons which discharge in the spring and/or fall. No data on effluent quality are available for gas plants.



• OTHER INDUSTRIAL SITES:

Figure 6
LOCATION OF INDUSTRIAL, OTHER THAN GAS PLANTS, DISCHARGES WITHIN THE NORTHERN RIVER BASINS STUDY AREA

13-089-31-04

SENTAR

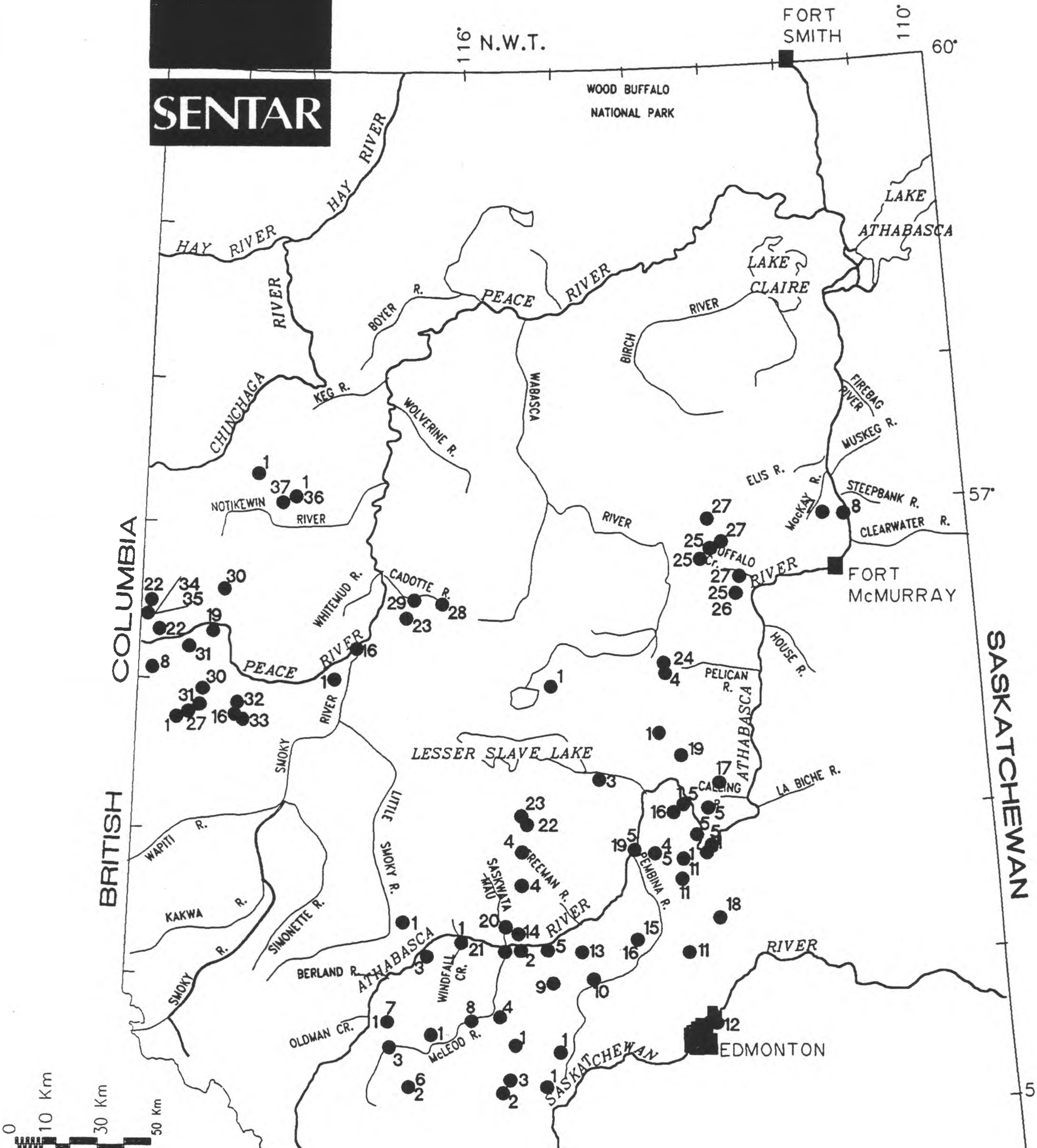


Figure 7
LOCATION OF GAS PLANTS
WITH LICENSED DISCHARGES
WITHIN THE NORTHERN RIVER
BASINS STUDY AREA

13-089-31-04

TABLE 12:
Gas Plants with Licensed Discharges in the NRBS Area

No.	Gas Plant	No.	Gas Plant	No.	Gas Plant
1	Amoco Canada Petroleum Co. Ltd.	14	Mobil Oil Canada	27	North Canadian Oils Ltd.
2	Petro-Canada Resources & Petro Canada Inc.	15	Norwest Oil & Gas Corp.	28	Calcrude Oils Ltd.
3	Chevron Canada Resources Ltd.	16	Norcen Energy Resources Ltd.	29	Ulster Petroleum Ltd.
4	Imperial Oil Resources Ltd.	17	Canada Northwest Energy Ltd.	30	Olympia Energy Ventures Ltd.
5	Canadian Natural Resources Ltd.	18	Morgan Hydrocarbons Inc.	31	Rigel Oil & Gas Ltd.
6	Gulf Canada Resources Ltd.	19	Home Oil Company Ltd.	32	Solex Energy Corp.
7	Talisman Energy Inc.	20	Husky Oil Operations Ltd.	33	Pan Canadian Petroleum Ltd.
8	Suncor Inc.	21	Canterra Energy Ltd.	34	Esso Resources Canada Ltd.
9	Canadian Occidental Petroleum	22	Chauvco Resources Ltd.	35	Inverness Petroleum Ltd.
10	MLC Oil and Gas Ltd.	23	Shell Canada Ltd.	36	Pembina Resources Ltd.
11	Renaissance Energy Ltd.	24	CGGS Canadian Gas Gathering Systems	37	Paloma Petroleum Ltd.
12	Environmental Technologies Inc.	25	Unocal Canada Ltd.		
13	Enron Oil Canada Ltd.	26	Paramount Resources Ltd.		

Note: See Figure 7 for locations.

Water from flowing, abandoned oil wells may also effect surface water quality in the Peace River Basin. One such well, Peace River Oils #1 (Figure 5), was sampled during the 1988-89 synoptic surveys. The Peace River Oils #1 flowing well discharged about 0.04 m^3/s to the Peace River (Alberta Environment 1989); routine monitoring data are not available.

Two oil sand refineries, Syncrude Canada Ltd. and Suncor Inc., are located near Ft. McMurray. Other tar sand operations listed by Alberta Environment, such as Shell Canada Ltd. at Peace River and Amoco Canada Petroleum Company Ltd. at Britnell, have no industrial discharge. Syncrude Canada Ltd. has complete recycle of industrial effluent so it has no industrial effluent that discharges into the Athabasca River Basin. Syncrude Canada Ltd. discharges mine depressurization and runoff water to the Athabasca River via Poplar Creek. Syncrude Canada Ltd. also has a small treated sanitary sewage discharge. The Suncor Inc.'s oil sands project has a continuous discharge to the Athabasca River. Suncor Inc.'s discharge is the only non-pulp mill industrial effluent discharged in substantial volumes to rivers in the NRBS area. The description of this facility is included in more detail in the following sections.

5.2 SUNCOR INC.

5.2.1 Wastewater Treatment System

The industrial wastewater system at Suncor Inc. is comprised of various subsystems which differ in the manner the wastewater is collected, characteristics of the wastewater, the treatment of the wastewater and the route by which the wastewater arrives at the treatment ponds. The oily wastewater is treated using an oil separator. This waste stream is combined with other waste streams (including ash sluicing, coke quenching/cutting, and clean wastewater) in treatment ponds before discharge.

5.2.2 Conditions of the Effluent Licence

The operating licence for Suncor is very precise and descriptive in comparison to the municipal wastewater operating licences. The net release of contaminants contained in the effluent discharged from the outfall weir to the Athabasca River has to comply with the limits indicated in Table 13.

TABLE 13:
Industrial Wastewater Discharge Limits Contained in Suncor Inc.'s Operating Licence

Parameter	Units	Maximum Monthly Load	Peak Daily Load
COD	(kg/d)	1200	3000
Phenols	(kg/d)	2.0	5.0
Sulfide	(kg/d)	3.8	7.0
Ammonia	(kg-N/d)	25.0	70.0
O&G	(kg/d)	150.0	300.0
TSS	(kg/d)	1000.0	1500.0
Acute Lethality Test Using Rainbow Trout	%	> 50% survival in 100% effluent sample at all times	
pH	(pH Units)	6.0 to 9.5	

To determine compliance with the water contaminant and parameter limits set out above:

a) samples must be composite samples for TSS, oil and grease (O&G), and COD; and grab samples for phenols, sulphide, and ammonia;

b) recording of pH must be continuous, and

c) the net release of water contaminants will be based on the difference between the concentrations of water contaminants contained in the effluent and those contained in the Athabasca River (determined from the analysis of a grab sample collected from the plant river water intake within a forty-eight hour period from which a sample of liquid effluent was obtained from the effluent discharge).

The effluent discharged from the mine drainage systems to the Athabasca River must comply with the water contaminant and parameter limits shown in Table 14.

TABLE 14:
Mine Drainage Discharge Limits Contained in Suncor Inc.'s Operating Licence

Parameter	Units	Limits
COD	(mg/L)	200.0
TSS	(mg/L)	100.0
O&G	(mg/L)	10.0
pH	(pH units)	6.0 to 9.5

The flow and pH of the effluent must be monitored continuously. The samples of TSS, COD, and O&G must be composite samples; grab samples are sufficient for sulphide, ammonia, heavy metals and the 48-h acute lethality test using *Daphnia magna*. Either grab or composite samples are acceptable for the 96-h multiple-concentration acute lethality test using rainbow trout

(*Oncorhynchus mykiss*). Monitoring requirements for the pH, COD, O&G and TSS of the mine drainage systems are grab samples.

The operating license stipulates several quality control steps in the reporting mechanisms. These include:

a. exact place and time of sample collection;

b. the type of sample;

c. person(s) who performed the sample collection;

d. the dates when the analysis were performed;

e. the laboratory and person(s) who performed the analysis;

f. the analytical techniques, procedures, or methods used; and

g. the results of the analysis.

In the event that acute lethality (i.e. less than 50% survival) is observed in the 100% test sample of liquid effluent, Suncor must immediately have another grab sample of the liquid effluent taken and submitted for the acute lethality analysis. Additionally, the sampling frequency must be increased to at least once per week, until three consecutive tests demonstrate greater than 50% survival in 100% final effluent. The operating licence indicates specific analysis guidelines for the acute lethality tests (AEP 1990a; 1990b; APHA 1989).

5.2.3 Licensed Release of Treated Effluent

The mean volume discharged daily from Suncor into the Athabasca River Basin is 35,000 m^3/d. The range spanned from 0 m^3/d to 66,000 m^3/d. The flow of 0 m^3/d (Appendix Table E.1) may occur at a scheduled plant maintenance and shutdown period or it may be a blank (i.e. data not available) which became a zero in the dBase IV file. Information contained within the appended database shows approximately daily observations for the flowrate from January 1, 1988 to January 1, 1993, the date this data was retrieved (Appendix Table E.1).

5.2.4 Quality and Quantity of Data Available

The quality of data from Suncor Inc. is improving substantially with time. However, quality control was not a priority when some of the data presented here were collected. The majority of the analyses are done in-house. The laboratory is a member of AWAC and analyses samples for round-robin testing. They do not include blanks or spiked samples in their in-house testing, but duplicate samples are analyzed occasionally.

The quantity of the data submitted to AEP in hard copy from industrial dischargers such as Suncor Inc. is enormous (monthly and annual reports, etc.). Since they have not yet checked for entry errors, AEP is unwilling to release the information to the public in electronic format. Some of the information provided by AEP to SENTAR Consultants Ltd. displayed this entry problem. The data was felt to be correct but with a the negative sign attached to the front of several of the readings.

The parameters with several negative values include TSS, O&G, phenol, ammonia, COD, and arsenic. The negative sign was removed from the data before statistical summaries were done. The balance of the data do not have these inconsistencies.

The quantity of data for the TSS, O&G, pH, phenol, sulphide, threshold odor number (TON), ammonia, COD, and flowrate is considerable (Table 15). For the five year period between January 1, 1988 and January 1, 1993, there was a minimum of 13 samples (for the bioassay) and a maximum of 1459 readings (for the flowrate).

TABLE 15:
Summary Statistics for Industrial Effluent from Suncor Inc.

Parameter	Units	Number	Mean	Median	St. Dev.	St. Error	Min.[b]	Max.
Flowrate	m^3/d	1,459	34,997	33,312	11,346	297	0	66,245
96-h LC_{50} Bioassay	%	13	100	100	0	0	100	100
Ammonia[a]	kg/d-N	237	2.4	0	6.1	0.40	0.0	45.0
Chemical Oxygen Demand[a]	kg/d	470	273	146	337	16.60	0	2417
Oil & Grease[a]	kg/d	699	46.1	36.3	36.2	1.47	0.0	197.7
Phenol[a]	kg/d	704	0.11	0.08	0.12	0.01	0.00	0.87
Total Suspended Solids[a]	kg/d	703	96.1	0	193.8	7.37	0	1,299
Arsenic[a]	kg/d	15	0.01	0	0.04	0.01	0.00	0. 17
Sulphide	kg/d	236	0.06	0	0.31	0.02	0.00	3.97
pH	pH units	691	8.07	8.1	0.33	0.01	5.80	9.20
Threshold Odor Number	TON	201	8.5	4	13.6	0.96	0	128
Total Organic Carbon	mg/L	62	8.4	8.15	3.6	0.46	0.0	24.5

a. data with negative signs reversed to positive.
b. The zeros in this column could be: zero, less than detection which has not been entered as <0.__ kg/d, or blank (i.e. data not available).

The quantity of the metal analysis in the database is limited. The molybdenum (Mo), nickel (Ni), selenium (Se), vanadium (V), zing (Zn), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), and mercury (Hg) have only 10 grab samples from the past five years. Arsenic (As) has 15 samples and silver has nine samples for the same time period.

5.2.5 General Characteristics of the Treated Effluent

The wastewater characteristics of the Suncor industrial effluent are entirely dependent upon the process operation, process upset conditions, mechanical failures, and other aspects that are common to industrial facilities. The summary statistics for the general characteristics of the Suncor Inc. effluent monitored from January 1, 1988 to January 1, 1993 are provided in Table 15.

5.2.6 Metals in the Treated Effluent

The summary statistics for trace metals in the Suncor Inc. effluent are provided in Table 16. The concentrations of metals are generally low. Cadmium, chromium, cobalt, lead, selenium and silver have a mean concentration of 0.00 mg/L (Table 16). These values (taken from the database) do not include "<" signs and do not indicate the detection limit. It is likely that many values should have been reported as non-detectable rather than zero. The mean iron concentration of 4.25 mg/L is skewed by the maximum of 38 mg/L which may be questionable.

TABLE 16:
Summary Statistics for Metals in Industrial Effluent from Suncor Inc.

Metal	Units	Number	Mean	Median	St. Dev.	St. Error	Min.	Max.
Cadmium	mg/L	10	0.00	0.00	0.00	0.01	0.00	0.01
Chromium	mg/L	10	0.00	0.00	0.00	0.001	0.00	0.01
Cobalt	mg/L	10	0.00	0.00	0.00	0.00	0.00	0.00
Copper	mg/L	10	0.01	0.01	0.02	0.01	0.00	0.06
Iron	mg/L	10	4.25	0.47	11.86	3.75	0.03	38.00
Lead	mg/L	10	0.00	0.00	0.00	0.00	0.00	0.01
Manganese	mg/L	10	0.05	0.05	0.02	0.01	0.03	0.08
Mercury	mg/L	10	0.01	0.00	0.03	0.01	0.00	0.10
Molybdenum	mg/L	10	0.15	0.10	0.17	0.05	0.01	0.60
Nickel	mg/L	10	0.03	0.02	0.03	0.01	0.00	0.09
Selenium	mg/L	10	0.00	0.00	0.00	0.00	0.00	0.00
Silver	mg/L	9	0.00	0.00	0.00	0.00	0.00	0.01
Vanadium	mg/L	10	0.11	0.09	0.07	0.02	0.01	0.24
Zinc	mg/L	10	0.01	0.01	0.01	0.00	0.00	0.03

The contaminant loading of the most frequently reported metals (Table 17) were calculated for each day that a sample was collected and analyzed for these metals. The values were obtained by multiplying the measured concentration by the flowrate on each of the days shown (Table 17).

TABLE 17:
Selected Mass Loading of Metals from Suncor Inc.

Date	Flow (m^3/d)	Iron (kg/d)	Manganese (kg/d)	Molybdenum (kg/d)	Nickel (kg/d)	Vanadium (kg/d)
01/01/90	25741	11.33	1.80	1.29	0.26	4.12
07/01/90	30283	33.01	1.82	5.75	0.61	4.54
10/01/90	55267	17.13	3.32	2.76	0.55	2.76
01/01/91	27350	13.40	1.37	0.27		0.27
01/07/91	41166				3.70	
04/01/91	32649	1241	0.98	3.59	0.65	7.84
07/01/91	55740	54.07	4.46	4.46	0.00	4.46
10/01/91	43154	18.12	2.16	8.63	0.86	6.04
03/01/92	26971	0.81	1.08	16.18	1.08	2.43
06/01/92	52049	27.07	2.08	2.60	0.52	3.12
08/01/92	39936	7.59	1.60	5.59	1.60	3.20
Mean	39119	142.34	2.07	5.11	0.98	3.88
Standard Deviation	11447	386.32	1.07	4.57	1.05	2.07
Number	11	10	10	10	10	10

5.2.7 Nutrients in the Treated Effluent

The only nutrient that is routinely monitored by Suncor is ammonia nitrogen (Table 15). There is a long period of record for ammonia nitrogen data beginning in 1973. Suncor does a more complete scan of the constituents in the effluent once annually (Bob Martel pers. comm.). The nutrient data (Table 18) were summarized from Table 2.3.2 in SENTAR (1993).

Noton and Shaw (1989) calculated mass loading values for total phosphorus based on the results of synoptic surveys in the winters of 1988 and 1989 and mass loadings of total nitrogen for two synoptic surveys in the winter of 1989. Table 19 taken from SENTAR (1993) added the results of more recent synoptic surveys to the values from Noton and Shaw (1989).

TABLE 18:
Nutrient Data from Suncor Inc.'s Annual Effluent Monitoring

Date (D/M/Y)	Sample Type	Total Kjeldahl Nitrogen (mg/L)	Dissolved Nitrite-Nitrate Nitrogen (mg/L)	Dissolved Nitrite Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Dissolved Nitrogen (mg/L)	Total Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)
06/03/91	Grab	1.48	0.170	0.024	0.180	1.650	0.106	0.168
25/02/92	Grab	0.50	0.172	0.020	0.020	0.672	0.140	0.200
11/03/93	Grab	1.03	0.977	0.043	0.290[a]	2.007	0.133	0.178
27/11/91	Composite	0.85	1.090	0.257	0.175[a]	2.000	NA	NA
28/04/92	Composite	0.91	0.686	0.072	0.025[a]	1.866	NA	NA
01/10/92	Composite	1.18	NA	NA	0.500[a]	NA	NA	0.171

a. These results are dissolved ammonia nitrogen whereas the other 1991 and 1992 results were total ammonia nitrogen.

NA = not available

TABLE 19:
Mass Loading of Total Phosphorus and Total Nitrogen from the Suncor Inc. Effluent Measured During Synoptic Surveys[a]

Date (D/M/Y)	Discharge (m^3/s)	Total Nitrogen (mg/L)	Total Nitrogen Loading (kg/d)	Total Phosphorus (mg/L)	Total Phosphorus Loading (kg/d)
15/03/88	0.3	0.932	24.2	0.254	6.6
09/02/89	0.289	0.91	22.7	0.174	4.3
08/03/89		1.01[b]	21.0	0.235	4.9
14/03/90	0.303	0.97	25.4		
06/03/91	0.372	1.65	53.0	0.168	5.4
25/02/92	0.280	0.672	16.3	0.2	4.8

a. Data from Alberta Environment

b. Calculated by Noton and Shaw 1989

5.2.8 Toxicity

Suncor Inc. is required to monitor the effluent for toxicity using two tests: the rainbow trout and *Daphnia magna* (an invertebrate) acute lethality tests. The results of the rainbow trout test indicate that the effluent is not acutely toxic since there has been 100% survival in the thirteen tests included in Table 15. Results of the *Daphnia magna* tests are not included in the database. Although monitoring of *Daphnia magna* was required earlier, Suncor Inc. began doing this bioassay in 1994. Data showing that the effluent is non-toxic will be publicly available in March 1995 as part of an application by Suncor Inc. to Alberta Environmental Protection.

SECTION 6.0

DISCUSSION OF IMPACTS ON THE AQUATIC ENVIRONMENT

6.0 DISCUSSION OF IMPACTS ON THE AQUATIC ENVIRONMENT

The combined factors of:

1. a weak effluent data set;

2. lack of in-stream impact monitoring data; and

3. technology-based, rather than environmentally-based licence requirements;

severely constrain a discussion of impacts of these discharges on the aquatic environment. The following sections are therefore limited to relating loading to generally-known impacts and to licence limits. Potential impacts are discussed in the absence of actual measurements.

6.1 RELATIVE IMPORTANCE OF IMPACTS

The most common potential instream impacts resulting from treated sewage discharge are: reduced concentrations of dissolved oxygen due to the oxygen demand of this organic waste; deposition of solids on the streambed; increased growth of algae and aquatic plants due to increased nutrients; and toxicity to fish or invertebrates due to toxic concentrations of ammonia and chlorine. Solids deposited in the receiving stream may result in an accumulation of septic sludge and loss of aquatic habitat (Thomann and Mueller 1987; Krenkel and Novotny 1980).

The objectives for BOD or TSS in the *Alberta Ambient Surface Water Quality Interim Guidelines* (AEP 1993) require further information about the receiving stream. The allowable BOD is dependent on the assimilative capacity of the receiving water. The BOD must not exceed a limit which would create a dissolved oxygen content of less than 5 mg/L. Suspended solids are not to be increased by more than 10 mg/L over the background value. The impact of each sewage treatment plant on water quality and aquatic habitat would have to be considered on an individual basis.

Secondary treatment of sewage, which is required in Alberta, effectively removes BOD and TSS to the concentrations outlined in Section 2.4. Whether potential impacts become actual impacts depends on the capacity of the receiving stream to assimilate the effluent and the sensitivity of the aquatic ecosystem (Thomann and Mueller 1987). Stream characteristics such as discharge volume and velocity, minimum instream dissolved oxygen concentrations, habitat type (e.g. type of substrate, vegetation), presence of sensitive species and other factors will determine the magnitude, if any, of the impact. Monitoring of environmental effects is not required in sewage treatment plant licenses; therefore, instream data are not routinely available. If the sewage treatment plant effluent constitutes a substantial part of the receiving streamflow, instream studies would be required before plant upgrading would be permitted. Instream studies have been required in Alberta, but not in the NRBS area.

Since all major industrial and municipal dischargers have secondary treatment of the effluent, the relative importance of BOD and TSS loading from municipal discharges compared to industrial discharges depends primarily on the volume of discharge. SENTAR (1993) showed daily discharges of approximately 60,000 to 112,000 m^3/d for kraft pulp mills and approximately 4,000 to 16,000 m^3/d for CTMP mills. The mean Suncor Inc. flowrate is approximately 35,000 m^3/d. Therefore, the discharge from the largest municipal continuous sewage treatment plant (Table 8) is

SENTAR

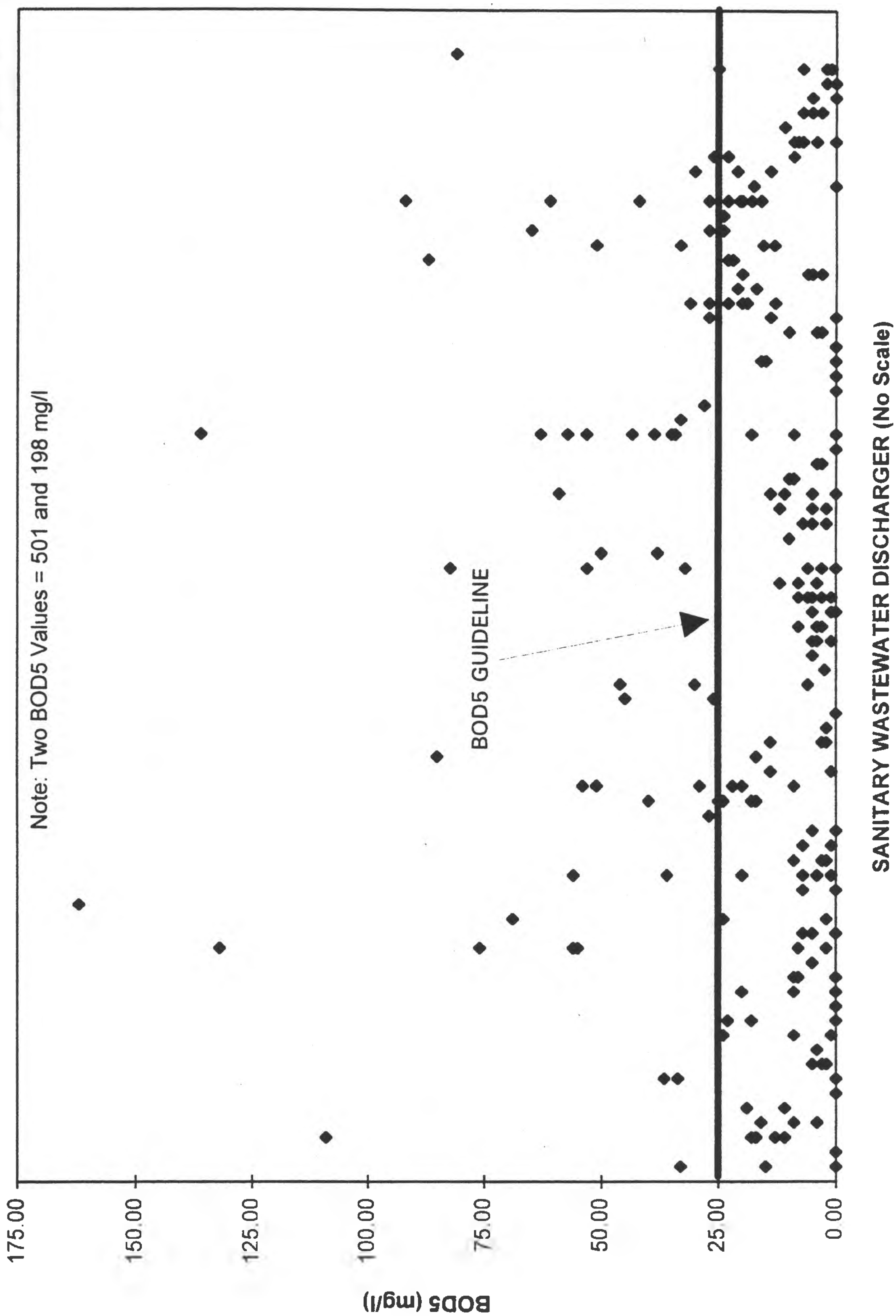


Figure 8
REPORTED BOD_5
CONCENTRATIONS FOR
PERIODIC SANITARY
WASTEWATER DISCHARGERS,
JANUARY 1990 TO MARCH 1993

comparable to the discharge from CTMP pulp mills, but less than discharge from kraft mills and Suncor Inc.

Nitrogen and phosphorus have been identified as two of the most important elements controlling the growth of algae and aquatic plants in surface waters. The addition of treated sewage to nutrient-limited waters may cause eutrophication. Nuisance growth of algae or aquatic plants may result in oxygen depletion in the receiving water, as well as odour problems (WPCF 1983). The data from the synoptic surveys and the split sampling reviewed in SENTAR (1993), although limited, indicate the importance of treated municipal sewage as a point source of nutrients. Municipal sewage treatment plants generally have concentrations of nutrients in their effluent that are as high, or higher, than the concentration of nutrients in pulp mill effluents (SENTAR 1993). The concentration of ammonia in many municipal effluents (Athabasca, Ft. McMurray, Slave Lake, Peace River) is an order of magnitude higher than the concentration in pulp mill effluents (SENTAR 1993). Nutrient loadings from periodic and some continuous municipal effluents are considerably less than those from pulp mills because the volume discharged is less. Nevertheless, Grande Prairie and Ft. McMurray sewage effluent loads are within the range of nutrient loads from pulp mills (SENTAR 1993).

If oil and grease are not removed before discharge of the waste, it can interfere with biological life in the surface waters and create unsightly floating matter and films. These components tend to coat surfaces and interfere with biological processes. Phenols and sulphides will cause taste and odour to water and fish at relatively low concentrations. Taste and odour of the water from phenols will be especially enhanced when the water is chlorinated (Sawyer and McCarty 1978). Phenols also exhibit toxicity at relatively low concentrations. These parameters are not routinely measured by municipalities, but loading limits for these parameters are contained in the Suncor Inc. licence. Phenol and sulphide loads were well below effluent limits. Oil and grease limits were also met.

Trace quantities of many metals, such as nickel (Ni), manganese (Mn), lead (Pb), chromium (Cr), cadmium (Cd), zinc (Zn), copper (Cu), iron (Fe), mercury (Hg) are important constituents of most waters. Some of these metals are necessary for growth of biological life. Nevertheless, the presence of these metals in excessive quantities may interfere with beneficial uses of the water because of their toxicity (Metcalf and Eddy 1985). The concentration of metals is not usually monitored in sewage treatment plant effluents since metals tend to be removed with the sewage solids. Data are available for the Peace River sewage treatment plant effluent and Suncor Inc. effluent (Table 20). A number of parameters including copper, iron, manganese, mercury, mercury, selenium and zinc have exceeded the Alberta guidelines on one or more occasions; however, the guidelines apply to ambient water quality and not effluent quality. When the effluent was mixed in the receiving stream, the guideline concentrations may have been achieved, but this is not monitored. As pointed out earlier, Peace River effluent is atypical; the BOD_5 data indicate that the treatment method is not as effective as the sewage treatment at other municipalities in the NRBS area. Although data on metals are not available for effluents from the other sewage treatment plants, their effluent quality is likely to be better. Wastewater treatment plant sludge residuals would be required to be licensed before discharge into rivers in Alberta. None of the communities discharging into the northern river basins have provision to discharge municipal sludges. Co-disposal of sludge with municipal refuse in landfills is the most common sludge disposal method (Environment Canada 1984).

TABLE 20:
Metal Concentrations Measured in Effluent
Compared to Water Quality Guidelines

Parameter	Suncor		Town of Peace River		Alberta Guidelines
	Median (mg/L)	Maximum (mg/L)	Median (mg/L)	Maximum (mg/L)	(mg/L)
Cadmium	0.00	0.01	0.0015	0.0015	0.01
Chromium	0.00	0.01	0.003	0.005	0.05
Cobalt	0.00	0.00	0.0025	0.005	-
Copper	0.01	0.06	0.051	0.06	0.02
Iron	0.47	38.00	0.52	2	0.3
Lead	0.00	0.01	0.021	0.021	0.05
Manganese	0.05	0.08	0.088	7	0.03
Mercury	0.00	0.10	-	-	0.0001
Molybdenum	0.10	0.60	0.004	0.005	-
Nickel	0.02	0.09	0.0075	0.01	-
Selenium	0.00	0.00	0.0375	0.04	0.01
Silver	0.00	0.01	-	-	0.05
Vanadium	0.09	0.24	0.0045	0.01	-
Zinc	0.01	0.03	0.079	0.1	0.05

Sewage treatment plant effluent could be toxic due to the presence of ammonia and chlorine; however, sufficient data are not available to assess the significance of whole effluent toxicity, or toxicity due to ammonia and chlorine in receiving streams. Data on ammonia-nitrogen loading from the Suncor Inc. plant are available. The maximum load of 45 kg/d (as N) reported in Appendix E (January 1990 to March 1993) occurred at a flow of 32,176 m^3/d and a pH of 8.2 in March 1991. The concentration of un-ionized ammonia in the effluent on this date would have been about 0.02 mg/L (as N). This concentration is below mean acute toxicity values for aquatic species assessed by the U.S. EPA (1985). The Suncor Inc. effluent has not been found to be toxic in routine bioassays.

6.2 COMPLIANCE WITH REGULATIONS

The licensed limits that municipalities must meet are based on the types of sanitary wastewater treatment, not on the capacity of a particular receiving stream to assimilate the remaining BOD. Even when discharges are clearly exceeding the BOD_5 limit of 25 mg/L, such as the Ft. Smith and Peace River discharges, this does not necessarily mean that there are significant impacts (other than possibly a local impact) due to the large volume of water in both the Peace River and Slave River. Basically, the current reporting does not monitor for environmental effect, but rather for failure of the treatment system to treat the sewage to a design standard. First-hand knowledge, or a special study, would be needed to determine whether a discharge was actually causing an impact on the receiving stream.

The guideline for all waste stabilization lagoons is a BOD_5 of less than 25 mg/L in a grab sample collected at the time of discharge. When the periodic municipal dischargers (Appendix Table D.1) were screened, there were 26 dischargers exceeding a BOD_5 of 25 mg/L in effluent released to the environment (Figure 8). Eaglesham, Entwistle, Fairview, Ft. Vermilion, Grandview Hutterite Colony, Grassland, Hythe, Janvier School, Peace River Airport, Sexsmith, Swan Hills, Triple L Mobile Home Park and Valleyview effluents all had BOD_5 concentrations exceeding 25 mg/L on more than one occasion. Three of these, Eaglesham, Peace River airport and Valleyview, have repeated exceedances with at least one reported value over 100 mg/L.

Three of the larger municipalities discharge continuously from waste stabilization lagoons. Peace River and Ft. Smith are routinely discharging sewage with a BOD_5 greater than 100 mg/L. Ft. Chipewyan also discharges sewage that exceeds 25 mg/L of BOD_5.

A BOD_5 of less than 25 mg/L is also required for effluent from aerated stabilization basins, although it is based on a monthly average. The municipalities with aerated stabilization basins are listed in Table 3. Barrhead, Edson, Ft. McMurray and Wabasca all meet the licensed limit. The limit was exceeded in July and August at Jasper, occasionally at Lac La Biche and Manning; but the limit was exceeded more frequently at Slave Lake in 1992 and 1993 (the most recent data in the database).

Mechanical wastewater treatment systems have a maximum limit of 25 mg/L for both BOD and TSS based on monthly averages. Whitecourt, Grande Cache, Grande Prairie and Peace River Correctional Centre all have mechanical systems that produce good quality effluent that is well below the licensed limit for both BOD_5 and TSS.

For wastewater treatment systems that have disinfection, the total chlorine residual must be between 0.5 mg/L and 3.5 mg/L after 20 minutes of contact. Wabasca and the Peace River Correctional Centre disinfect their wastewater, but there are no data to determine whether they are in compliance.

Based on a review of the database (Appendix E), the effluent from Suncor Inc. has been in compliance with licensed limits. The COD load from individual samples never exceeded the allowable peak daily load of 3000 kg/d (Table 13). Also, the maximum monthly COD load of 1200 kg/d was never exceeded, although the results for individual samples exceeded this value on eleven occasions. Similarly, the oil and grease maximum monthly load and peak daily load of 150 kg/d and 300 kg/d, respectively, were not exceeded but the results for individual samples exceeded 150 kg/d on twelve occasions. The maximum ammonia-N load from a single sample was 45.01 g-N/d (Table 15), well below the 70 kg-N/d limit. The maximum monthly mean of 18 kg-N/d was below the maximum monthly load limit of 25.0 kg-N/d (Table 13). Phenol and sulphide loads were generally well below effluent limits and the effluent has not been acutely toxic.

SECTION 7.0

DATA GAPS

7.0 DATA GAPS

Data are generated by sewage treatment plants in response to regulatory requirements to ensure good plant operation and compliance. When these data are reviewed with respect to meeting environmental research objectives, the following data gaps were identified:

1. There is no central database; data are held at each sewage treatment plant.

2. The lack of accurate flow data from some dischargers is an important data gap because, without the rate of flow, the load of all other reported parameters (e.g. BOD_5, TSS, TP, NH_3-N, etc.) discharged to the receiving waters cannot be determined. This one data gap, therefore, renders useless other data.

3. The analyses done routinely are related primarily to monitoring the overall performance of the sewage treatment plant. They are primarily technology-based. Environmentally-based effluent monitoring, such as toxicity testing, fecal coliform tests, total phosphorus, etc., are not required, except for specific dischargers.

4. Industries such as pulp mills are required to monitor for environmental effects through requirements for benthic invertebrate monitoring, acute and chronic toxicity tests, etc., as well as formal environmental effects monitoring (EEM). Municipalities in the NRBS area[1] are generally not required to assess the effects of their effluent on the receiving stream. Since municipalities and industries tend to occur together, the lack of this data makes it difficult to accurately assess cumulative impacts to a river and, generally, places the onus of determining the cumulative impact on only one of the contributors, industry.

5. The range of parameters is generally very restricted so that little data pertaining to major ions, metals, toxicity, etc., are available.

6. Lack of replicate samples and the small number of samples (one or two per year) make an estimate of precision impossible in the periodic discharges database. It is difficult to interpret outliers in the data under these conditions.

7. The database containing the Suncor effluent data should be used with caution because the database contained negative values which are unlikely to be correct.

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[1] Municipalities are required to assess instream impacts when upgrading if the volume of effluent is significant in comparison to the receiving stream. This occurs more frequently in southern Alberta.

SECTION 8.0

RECOMMENDATIONS

8.0 RECOMMENDATIONS

The recommendations arising from this report are as follows:

- It is recommended that a central accessible database for discharge data be retained and properly maintained.

- It is recommended that a quality assurance and quality control (QA/QC) program from sample collection to data entry be considered by AEP. This review found opportunities to improve quality control, particularly at the sample transportation, and data entry steps. As certified operators take on a greater monitoring role under reduced provincial surveillance, it is suggested that greater emphasis on QA/QC be added to their training. This, along with consistent enforcement of licence reporting requirements, would improve data quality.

- It is recommended that effluent data from periodic dischargers should not be used for scientific research due to missing data, estimated data, questionable data, and little assurance of data quality. Flowrate data is the most deficient. Effluent data from continuous dischargers should be used with caution and regard to the comments made throughout this report. The monitoring was not originally designed for research and was intended for regulatory purposes only.

- It is recommended that more attention be given to environmentally-based, rather than technology-based, monitoring so that data become available to assess cumulative effects and total loadings from all point sources on a river. There is currently a substantial gap between the extensive monitoring that industries are required to do and the monitoring done by large municipalities even though the concentrations and loads of some constituents may be in the same order of magnitude.

- It is recommended that NRBS, AEP, and the municipalities involved review the data showing that sanitary wastewater effluents with high BOD concentrations are being discharged at a number of locations in the NRBS area. A review of the potential environmental effects of these effluents in the vicinity of the discharge is recommended, if this information is not already available.

- Because very little data on microbial populations (total coliform, fecal coliform, etc.) and chlorine residuals are available, it is recommended that NRBS, AEP and the municipalities consider the need for instream data and more effluent monitoring data. This is a necessary first step in assessing the adequacy of current disinfection requirements.

DEFINITION OF TERMS

TERM	DEFINITION
AEP	Alberta Environmental Protection
ANC	Alberta Newsprint Company
APHA	American Public Health Association
ASB	aerated stabilization basins
AWAC	Alberta Water Analysts Committee
BOD	biological oxygen demand
BOD_5	biological oxygen demand measured over 5 days
$CaCO_3$	calcium carbonate
CFU	colony forming units
COD	chemical oxygen demand
EEM	environmental effects monitoring
F/M	food to microorganisms ratio
LC_{50}	50% lethal concentration*
N	nitrogen
NH_3-N	ammonia-nitrogen
NRBS	Northern River Basins Study
O&G	oil and grease
P	phosphorus
PO_4	phosphate
QA/QC	quality assurance/quality control
RBC	rotating biological contactors
TKN	total kjeldahl nitrogen
TOC	total organic carbon
TON	threshold odour number
TP	total phosphorus
TSS	total suspended solids
VSS	volatile suspended solids
WPCF	Water Pollution Control Federation
WQB	Water Quality Branch

* concentration at which 50% of the test organisms die.

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APPENDIX A

TERMS OF REFERENCE

SCHEDULE A - TERMS OF REFERENCE

Project 2112-B1: Effluent Characterization, Contaminants in Aquatic Ecosystems and Ecotoxicity of Pulp Mill Effluents

I. Introduction

These Terms of Reference have been developed in support of three projects, which to a certain extent, deal with the ecotoxicity of liquid contaminants released into the aquatic environment by municipalities and industries or that already exist in the ambient aquatic environment. All of the projects will involve compiling and synthesizing existing information on contaminants and their ecotoxicological effects. This background information will be vital to the development of a comprehensive ecotoxicity strategy and aquatic ecosystem risk assessment for the Northern River Basins Study.

Proposals will be judged based on the following criteria:

1. the expertise assigned to the project;
2. the work that can be completed on the project before March 31st, 1993;
3. total cost; and,
4. when the entire project will be completed.

II. Effluent Characterization - Municipal and Non-Pulp Mill Industry Sources

1. Objective

The purposes of this project include the following:

1) to identify the location, treatment technology, types of wastes (ie., liquid, solid, gas) and waste disposal methods of all licensed effluent dischargers in the Peace, Athabasca and Slave river basins: and,

2) to compile and synthesize existing information from government and industry sources on the nature of liquid effluents (ie., nutrients, pathogens, contaminants, toxic compounds, compounds that cause taste and odour problems in fish and water, etc.) from municipal and non-pulp mill industries that are being discharged into the Peace, Athabasca and Slave rivers and their major tributaries.

2. Requirements

1) Identification of Effluent Sources

Compile existing information from government and industry sources pertaining to the location, treatment technology, types of wastes (ie., liquid, solid, gas) and waste disposal methods of all licensed effluent dischargers in the Alberta and Northwest Territories portions of the Peace, Athabasca and Slave river basins. This information is to be compiled in a geo-referenced (to facilitate GIS utilization of the data), electronic database (dBase IV format).

2) Non-Pulp Mill Industry and Municipal Effluent Characterization

a) Based on 1, above, identify those licensed dischargers that release liquid effluents into the Peace, Athabasca and Slave rivers and their major tributaries. From government and industry sources, assemble comprehensive historical data pertaining to the nature and ecotoxicity of these effluents as well as the treatment technology employed.

b) From the above, select one effluent source and enter all relevant data into a prototype geo-referenced (to facilitate GIS utilization of the data), electronic database (dBase IV format), and prepare tables, graphs and statistics of the data. The prototype database is then to be reviewed by the Project Liaison Officer and others associated with the NRBS for its consistency with other NRBS databases and ease of use. The database is to include comprehensive data on nutrients (N, P, C, BOD, etc.), contaminants (metals, organics, sulphides, compounds that cause taste and odour problems, etc.) and pathogens (microbiology) associated with liquid effluent discharges, as well as the results of toxicological tests of these effluents. The database is also to include comprehensive information on the types of treatment systems employed and the physical nature of the discharges (ie., the volume, timing, duration, loading and concentrations of discharges).

c) Review the prototype database with the Project Liaison Officer and modify the format of the database as directed by the Project Liaison Officer. Utilizing the agreed to format, enter all remaining data for all municipal and non-pulp mill effluent sources and prepare appropriate tables, graphs and statistics.

d) Prepare a concise technical report on the database system including a guide for users, dictionary and any other pertinent specifications of the electronic database submission.

3) Synthesis Report

a) Based on the data compiled in 2, above, as well as other information sources, prepare a comprehensive synthesis report discussing the nature of liquid effluents from non-pulp mill and municipal sources and the impacts or potential impacts of these effluents on the aquatic ecosystems of the northern rivers. The report should be similar in style and content, with the exception that it will contain greater discussion on ecotoxicity, to McCubbin and Folke (1992).

b) The synthesis report is to include the following:

- information on the location of non-pulp mill industry and municipal effluent sources in the Study Area and relative to pulp mill effluent sources (include 1:250,000 or greater maps);
- a discussion on the chemistry, ecotoxicology and microbiology of discharges, including a statistical summary of the parameters discussed;
- a discussion of the physical nature of liquid effluent discharges (ie., timing, duration, quantities, loading and concentration of discharges), including a statistical summary of the parameters discussed;
- a discussion of the impacts or potential impacts of non-pulp mill industry and municipal liquid effluent discharges on the aquatic environment;
- a discussion of the Quality Assurance/Quality Control measures imposed on data from various sources;
- to the extent possible, a discussion of licensing requirements for non-pulp mill industry and municipal discharges and compliance with these requirements (regulations);
- identification of information gaps and recommendations as to how information gaps can be resolved; and,
- an assessment of the relative importance of various non-pulp mill industry and municipal liquid effluents with respect to contaminant, pathogen (microbe) and nutrient loading in the Study Area.

c) The data, included in the databases compiled in 1 and 2, above, are to be included as hardcopy appendices to the synthesis report. Reference to these appendices should be made in the main body of the report.

3. Reporting Requirements

1) Submit the initial database format, compiling effluent data from a single source, by a date to be decided upon by the Project Liaison Officer and Scientific Staff in consultation with the contractor.

2) Submit ten copies of the draft technical report for the electronic database and ten copies of the draft synthesis report to the Project Liaison Officer by a date to be decided upon by the Project Liaison Officer and Scientific Staff in consultation with the contractor. Also submit the "draft" electronic database on non-pulp mill industry and municipal effluent characterization and the "draft" electronic database on licensed effluent discharges in the northern river basins along with the draft technical report for the electronic database and the draft synthesis report.

3) Submit final reports of the technical report for the electronic database and the synthesis report to the Project Liaison Officer three weeks after the receipt of the review comments on the draft reports. Five cerlox bound copies and two camera-ready original of each final report are to be submitted to the Project Liaison Officer. Electronic copies, in Word Perfect 5.1 format, of each report are also to be submitted on a 5 1/4 or 3 1/2 inch floppy disk to the Project Liaison Officer. The synthesis report is to include an executive summary.

4) Specific data contained within tables, figures and appendices of the final synthesis report must be placed in a dBase IV file on a 5 1/4 or 3 1/2 inch floppy disk and submitted to the Project Liaison Officer along with the final report.

5) Submit the final electronic databases to the Project Liaison Officer three weeks after receipt of the reviewed databases.

III. Contaminants in Aquatic Ecosystems - Annotated Bibliography and Synthesis Report

1. Objective

The purpose of this project is to prepare an annotated bibliography and expert synthesis report on contaminants found in the ambient aquatic environment of the northern rivers and their potential impacts and ecotoxicological effects on the aquatic ecosystem.

2. Requirements

1. <u>Annotated Bibliography</u>

Prepare an annotated bibliography of databases (indicate whether the database exists in hardcopy or electronic format), government and non-government reports, journal reports, book chapters, student theses, etc. pertaining to chemical and microbial contaminants existing in the aquatic environment (water, sediment, biota) and potential impacts and ecotoxicological effects of these contaminants to aquatic ecosystems. Factors such as loading persistence, bioaccumulation and toxicity should be used as search criteria. Discussion is to be presented regarding the adequacy of Quality Assurance/Quality Control measures imposed on data.

2. Synthesis Report

a) Prepare an expert synthesis report from the information and data assembled in 1, above, on contaminants (chemical and microbial) found in the aquatic environment (water, sediment, biota) of the northern rivers and their potential impacts and ecotoxicological effects.

b) The report is to include the following:

- a comparison of the findings to present trends in effluent quality/quantity in the study area;
- summary statistics about the types and levels of contaminants present;
- a discussion of the ecotoxicological significance, including significance to human health, of contaminants and their concentrations;
- an assessment of the significance of the presence, concentration and distribution of contaminants found in the aquatic environment;
- a discussion of the presence, concentration and distribution of contaminants in the aquatic environment with respect to water quality guidelines and objectives;
- a discussion of information gaps regarding potential toxic effects of contaminants in the study area, including parameters requiring monitoring, etc.; and,
- a discussion of the Quality Assurance/Quality Control measures imposed on data considered in this report.

3. Reporting Requirements

1) Submit ten copies of the draft annotated bibliography and ten copies of the draft synthesis report by a date to be decided upon by the Project Liaison Officer and Scientific Staff in consultation with the contractor.

2) Three weeks after the receipt of review comments on the draft annotated bibliography and draft synthesis report, submit five cerlox bound copies and two camera-ready originals of each final report to the Project Liaison Officer. The synthesis report is to include an executive summary.

3) An electronic copy, in Word Perfect 5.1 format, of both the annotated bibliography and synthesis report are to be submitted to the Project Liaison Officer on 5 1/4 or 3 1/2 inch floppy disk along with the final reports.

4) Specific data contained within tables, figures and appendices of the final annotated bibliography and synthesis report must be placed in dBase IV files and submitted to the Project Liaison Officer at the same time as the final reports.

IV. Ecotoxicity of Pulp Mill Effluents

1. Objective

The purpose of this project is to prepare an annotated bibliography and expert synthesis report pertaining to the acute and chronic toxic effects of pulp mill effluents discharged into the northern rivers.

2. Requirements

1. Annotated Bibliography

Prepare an annotated bibliography of databases (indicate whether the database exist in hardcopy or electronic form), government and non-government reports, journal reports, book chapters, student theses, etc. pertaining to the ecotoxicity of pulp mill effluents. This is to include information specific to the northern rivers, as well as major review papers on pulp mill effluent toxicity.

2. Synthesis Report

a) Prepare an expert synthesis report from the data and information assembled in 1 above, on the ecotoxicity of pulp mill effluents in the Study Area.

b) The report is to include the following:

- consideration of both actual toxicity and the volume of effluent discharges (ie., the "load" of toxicity);
- a comparison of the findings to present trends in effluent quality/quantity in the study area;
- a discussion of the ecotoxicological significance, including significance to human health, of pulp mill effluents and their concentrations; and
- a discussion of information gaps regarding the potential toxic effects of pulp mill effluents in the study area, including recommendations for further monitoring and study, etc.

3. Reporting Requirements

1) Submit ten copies of the draft annotated bibliography and ten copies of the draft synthesis report to the Project Liaison Officer by a date decided upon by the Project Liaison Officer and Scientific Staff in consultation with the contractor.

2) Three weeks after the receipt of review comments on the draft annotated bibliography and draft synthesis report, submit five cerlox bound copies and two camera-ready originals of each final report to the Project Liaison Officer. The synthesis report is to include an executive summary.

3) An electronic copy, in Word Perfect 5.1 format, of both the annotated bibliography and synthesis report are to be submitted to the Project Liaison Officer on 5 1/4 or 3 1/2 inch floppy disk along with the final reports.

4) Specific data contained within tables, figures and appendices of the final annotated bibliography and synthesis report must be placed in dBase IV files and submitted to the Project Liaison Officer at the same time as the final reports.

V. Literature Cited

McCubbin, N. and J. Folke. 1992 (November). Review of literature on characteristics of pulp and paper mills in northern river basins of Alberta, BC and Northwest Territories. Prepared for: Northern River Basins Study. Prepared by: N. McCubbin Consultants Inc.

APPENDIX B

SOURCE FILE FOR LICENSED SEWAGE AND NON-PULP MILL INDUSTRIAL DISCHARGERS IN THE NRBS AREA

DEFINITIONS FOR TABLE B.1*

HEADING	DESCRIPTION
BASIN	Drainage basins of the Peace, Athabasca or Slave rivers
DISCH	Type of discharge denoted as either continuous or periodic discharge
FACILITY	Name of facility
FILE_N	Name of file in which the data for the particular facility is located
FREQ	Allowable frequency of discharge denoted as either once or twice
LATD	Latitude in degrees
LICENSE_NO	Licence number
LONGD	Longitude in degrees (negative denoting west of prime meridian)
LSD	Legal Subdivision
MER	Meridian (W4; W5; W6)
NAME	Name of industry or municipality
PARAMETER	A list of all parameters for which there are data in the effluent database file
RCVNG_W	Name of waterbody which receives effluent
RGE	Range
SEAS*	Seasonal discharge denoted as spring, fall or both
SEC	Section
TREAT	A brief description of the type of treatment the effluent receives before being discharged
TWP	Township
TYPE	Waste type denoted as liquid (L), gaseous (G), or solid waste (S)
TYPE_IND	Either municipal or type of industry

* The contents of Table B.1 have also been provided to NRBS on a computer diskette; however, the dBase IV format has been modified here to condense the file making it more suitable for printing. The headings have been changed to reduce the width of the table.

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

NAME	FACILITY	LICENSE_NO	BASIN	LSD	SEC	TWP	RGE	MER	LATD	LONGD	TYPE_IND	TREAT	DISCH.	PARAMETER	FREQ	SEAS	RCVNG_W	FILE_N	TYPE
A. Gerling Ranching Ltd.	Peers	91-WL-172	A	NW	21	54	15	5	53.64278	-116.16333	gravel washing			no data			No Discharge		L, S
Albert Stewart	Boyle	92-WL-016	A	SE	2	69	20	4	54.89500	-112.93944	gravel washing			no data			No Discharge		L, S
Alberta Energy Company	Ipiatik	87-AL-393	A		1	73	6	4	55.24500	-110.78667	(Shut in)								G
Alberta Energy Company	Hythe	92-AL-031A	A	NW	18	74	12	6	55.36056	-119.84417	Sour Gas			SO2 10.000					G
Alberta Inc.	Lynton	89-WL-027	A	NE	13	88	7	4	56.57306	-110.96556	chemical plant			no data			No Discharge		L
Alberta Municipal Affairs I.D. 21	Royce Modified Landfill	R712	P	SE	11	83	6	6	56.12194	-118.82361	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Bear Canyon Modified Landfill	R709	P	NW	15	84	12	6	56.22667	-119.80583	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Cleardale Modified Landfill	R521	P	SE	13	85	10	6	56.30972	-119.43389	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Cherry Point Modified Landfill	W0001	P	SW	2	84	13	6	56.19417	-119.93722	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Clear Prairie Modified Landfill	R710	P	NE	24	87	10	6	56.50111	-119.44028	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Deerhill Modified Landfill	R476	P	SW	12	84	3	6	56.20861	-118.33222	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Eureka River Modified Landfill	W0520	P	SW	17	86	5	6	56.39639	-118.75639	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Whitelaw Modified Landfill	W0534	P	SW	12	84	2	6	56.20861	-118.17417	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 21	Worsley Modified Landfill	R332	P	SE	25	87	8	6	56.51194	-119.12250	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Sunny Valley Modified Landfill	W0515	P	3	36	90	22	5	56.78250	-117.37639	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	North Star Transfer Station	DI	P	NW	32	90	23	5	56.78972	-117.64306	Transfer Station	Active							S
Alberta Municipal Affairs I.D. 22	Dixonville Modified Landfill	W0525.	P	NE	12	87	24	5	56.47222	-117.66556	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Hawk Hills Modified Landfill	W0520	P	NW	21	94	22	5	57.10722	-117.48750	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Keg River Modified Landfill	W0524	P	NW	31	100	22	5	57.65583	-117.58972	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Manning Modified Landfill	W0527	P	SE	34	91	24	5	56.87278	-117.75139	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Reinwood/ Deadwood Modified Landfill	W0528	P	NW	19	88	21	5	56.58750	-117.33500	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Warrensville Modified landfill	R422	P	SE	23	84	25	5	56.23750	-117.82556	Modified Landfill	Active							S
Alberta Municipal Affairs I.D. 22	Keg River Post Modified Landfill	W0523	P	SE	35	101	24	5	57.73889	-117.80972	Modified Landfill	Active							S
Alberta Newsprint Co	Whitecourt	93-AL-158	A		13	60	13	5	54.14806	-115.81556	Paper			Opacity 20%					G
Alberta Power Ltd.	H. R. Milner	92-AL-388	P	15	10	58	8	6	53.96389	-119.10472	Power Plant			Particulate .2g/kg, SO2 30.000, NOx 18.000					G
Allan & Lorraine Mallock		92-WL-167A	A	SW	7	67	12	4	54.73611	-111.81694	gravel washing			pH, TSS			Unnamed Cree	iscind dbf	

TABLE B 1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Amoco Canada Petroleum	Kirby	91-AL-027A	A	NE	25	73	5	4	55.30278	-110.62611	Compressor			none					G
Amoco Canada Petroleum	Gregoire Lake	89-AL-175	A	12	2	86	7	4	56.37111	-111.00083	Oilsands			200 ppm					G
Amoco Canada Petroleum	Big Bend	93-AL-215	A	5	18	67	22	4	54.75056	-113.34556	Sour Gas			SO2 0.030					G
Amoco Canada Petroleum	Island Lake	92-AL-350	A	8	18	68	23	4	54.83722	-113.48611	Sour Gas			SO2 0.300					G
Amoco Canada Petroleum	Athabasca	92-AL-248	A	10	19	66	24	4	54.68222	-113.62972	Sour Gas			SO2 0.160					G
Amoco Canada Petroleum	Big Coulee		A		23	67	24	4	54.76861	-113.54222	(Shut in)								G
Amoco Canada Petroleum	Marten Hills	92-AL-385	A	12	18	76	25	4	55.53389	-113.87583	Sour Gas			SO2 1.740					G
Amoco Canada Petroleum	Bigoray	93-AL-217	A	6	28	51	8	5	53.39361	-115.11944	Sour Gas			SO2 5.910					G
Amoco Canada Petroleum	Pembalta #8	92-AL-222A	A	4	5	49	9	5	53.15917	-115.29222	Sour Gas			none					G
Amoco Canada Petroleum	Carrot Creek	91-AL-013	A	2	18	52	11	5	53.44778	-115.60750	Sweet Gas			none					G
Amoco Canada Petroleum	Elk River		A	4	6	47	12	5	52.98583	-115.74944	(Shut in)								G
Amoco Canada Petroleum	West Whitecourt	91-AL-409	A	8	17	60	15	5	54.14444	-116.20306	Sour Gas			So2 46.100					G
Amoco Canada Petroleum	Brintnell	92-AL-183	A	12	13	81	23	4	55.96694	-113.47361	Heavy Oil			none					G
Amoco Canada Petroleum	Brintnell	92-AL-183	A	6	13	81	23	4	55.96333	-113.46722	Heavy Oil			none					G
Amoco Canada Petroleum	Nipisi	90-AL-101	A	SE	11	80	8	5	55.86222	-115.13139	Sour Gas			SO2 1.000					G
Amoco Canada Petroleum	Kaybob #1&#2	92-AL-334	A		12	62	20	5	54.30667	-116.87750	Sour Gas			SO2 35.500					G
Amoco Canada Petroleum	Bigstone	91-AL-083	A	SE	10	61	22	5	54.21667	-117.21583	Sour Gas			SO2 32.100					G
Amoco Canada Petroleum	Ante Creek	89-AL-116	P	E	18	65	23	5	54.57750	-117.47028	Sour Gas			none					G
Amoco Canada Petroleum	Tangent	92-AL-349	P		20	80	24	5	55.89472	-117.72056	Sour Gas			SO2 0.610					G
Amoco Canada Petroleum	Hotchkiss II	92-AL-137	P	2	35	94	2	6	57.12889	-118.19833	Sour Gas			SO2 0.254					G
Amoco Canada Petroleum	Chinchaga	90-AL-192	P	1	24	96	5	6	57.27333	-118.65194	Sour Gas			none					G
Amoco Canada Petroleum	Braeburn	89-AL-218A	P	16	19	77	10	6	55.63861	-119.53222	Sour Gas			SO2 0.600					G
Amoco Canada Petroleum	Industrial L.	N00027	A		23	77	9	4	55.70000	-111.30000	Industrial L.	Active							S
Amoco Canada Petroleum	Industrial L.	N00028	A		25	73	5	4	55.30000	-110.60000	Industrial L.	Active							S
Amoco Canada Petroleum	Industrial L.	N00029	A		25	73	5	4	55.30000	-110.60000	Industrial L.	Active							S
Amoco Canada Petroleum Co. Ltd	Bigoray	93-WL-142	A	6	28	51	8	5	53.39361	-115.11944	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Pembalta Station No. 8	93-WL-132	A	8	5	49	9	5	53.16278	-115.27389	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	West Whitecourt	91-WL-180	A		16	60	15	5	54.14806	-116.19056	gas plant			no data			Not Specified		L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Amoco Canada Petroleum Co. Ltd	Marten Hills	92-WL-242	A	12	18	76	25	4	55.53389	-113.87583	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Carrot Creek	91-WL-011	A	2	18	52	11	5	53.44778	-115.60750	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Edson	91-WL-066	A	SW	11	53	18	5	53.52361	-116.55333	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Island Lake	92-WL-216	A	8	18	68	23	4	54.83722	-113.48611	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Athabasca North	93-WL-161	A	5	18	67	22	4	54.75056	-113.34556	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Athabasca Steele	92-WL-163	A	10	19	66	24	4	54.68222	-113.62972	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Sundance	90-WL-130	A	7	9	54	21	5	53.61028	-117.04611	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Bouvier	87-WL-121	A	15	29	70	24	4	55.04667	-113.63500	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Athabasca	87-WL-101	A	10	19	66	24	4	54.68222	-113.62972	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Kaybob South	89-WL-176	A		1	62	20	5	54.29222	-116.87750	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Kaybob South	89-WL-176	A		12	62	20	5	54.30667	-116.87750	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Gregoire Lake	89-WL-097 A	A	12	2	86	7	4	56.37111	-111.00083	tar sand			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Kirby	91-WL-023	A	NE	25	73	5	4	55.30278	-110.62611	compresor station			no data			No Discharge		L, S
Amoco Canada Petroleum Co. Ltd	Nipisi	89-WL-155 A	P	NE	2	80	8	5	55.85139	-115.13139	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Tangent	92-WL-217	P	16	20	80	24	5	55.89833	-117.70750	gas plant			no data			Not Specified		L
Amoco Canada Petroleum Co. Ltd	Hotchkiss II	92-WL-075	P	2	35	94	2	6	57.12889	-118.19833	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Co. Ltd	Industrial L.	N00026			28	77		4			Industrial L.	Active, location questionable							S
Amoco Canada Petroleum Ltd	Braeburn	85-WL-026	P	16	19	77	10	6	55.63861	-119.53222	gas plant			no data			No Discharge		L
Amoco Canada Petroleum Ltd	Brintnell	92-WL-099	P	6	19	81	22	4	55.97778	-113.44111	tar sand			no data			No Discharge		L
Amoco Canada Resources Ltd.	Cranberry Chinchaga	90-WL-122A	P	1	24	96	5	6	57.27333	-118.65194	gas plant		periodic	volume of dicharge, pH, oil & grease, TSS, COD, ammonia nitrogen, Cl, SO4			Not Specified		L
Anderson Explorations	Donnelly	91-AL-096	P	6	1	77	21	5	55.58806	-117.12611	Sour Gas			SO2 1.260					G
Anzac		93-ML-018	A	NE	16	86	7	4	56.40000	-111.04056	municipal sewage	one facultative/storage cell	periodic	no data			slough		L
Aostra	Fort McMurray	92-WL-090	A	N	7	93	12	4	56.99194	-111.92278	tar sand	discharge of oily wastes to land		no data			Not Specified		L
AOSTRA	UTF In-situ	92-AL-167	A	S	18	93	12	4	57.00278	-111.91583	Oilsands			HCl 100 ppm, Particulate 0.6kg/1000kg					G
Atcor Ltd.	Bittern Lake	93-AL-027	A	11	27	46	21	5	52.96417	-116.97861	Sour Gas			SO2 0.620					G

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Athabasca		87-ML-040 R1(9	A	NE	21	66	22	4	57.00278	-111.91583	municipal sewage	aerated lagoon system with one complete mix cell, on mechanically aerated cell and a settling cell with continuous effluent discharge	continuous	BOD, TSS, temperature, pH, dissolved oxygen			Athabasca Riv	thabasc.d	L
Atikameg School		86-ML-043 R1(9	P	NE	8	80	11	5	54.68222	-113.27528	municipal sewage	one facultative cell, one storage cell; flow is from the facultative to the storage cell	periodic	BOD, TSS, volume of discharge; no 1990 data	1	fall	Utikama Lake	unper.d	L
Barrhead		86-ML-064 R1(9	A	NE	16	59	3	5	55.86583	-115.67917	municipal sewage	aerated lagoon system consisting of one complete mix cell, two partial mix cells, one polishing cell, and two storage cells with continuous discharge	continuous	BOD, TSS, temperature, pH, dissolved oxygen			Paddle River	arrhead.d	L
Beaverlodge		86-ML-003 R3(9	P	SW	34	71	10	6	54.06139	-114.38333	municipal sewage	four anaerobic cells, one storage cell; flow is from the anaerobic cells in series to the storage cell	periodic	BOD, TSS, COD, Total Solids, Surfactants, TKN, Ammonia Nitrogen, Total Phosphorus, TDS; volume of discharge	2	spring/fall	averlodge Ri	unper.d	L
Berwyn		81-ML-042 R2(9	P	SE	20	82	24	5	55.14056	-119.44861	municipal sewage	four anaerobic cells, one facultative cell, on storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS, Ammonia Nitrogen, Nitrate plus Nitrite Nitrogen, Organic Nitrogen, Total Phosphate	1	fall	Peace River	unper.d	L
Bezanson		87-ML-129 R1(9	P	NW	10	72	3	6	56.06444	-117.73028	municipal sewage	one facultative-storage cell	periodic	volume of discharge, BOD, TSS	1	spring	Smoky River	unper.d	L
Blue Ridge		81-ML-047 R1(8	A	SW	35	59	10	5	55.17306	-118.37472	municipal sewage	one facultative cell	periodic	volume of discharge, BOD, TSS, temperature, pH	1	fall	Bull Creek	unper.d	L
Blue Ridge Lumber		94- IND-058	A	25	36	59	10	5	54.10111	-115.38750	wood processing plant	active landfill							L
Blue Ridge Lumber		91-WL-103	A	S	36	59	10	5	54.09750	-115.35639	wood processing	landfill		pH, Phenol, NH3-N, BOD5			Athabsca Rive	iscind.d	L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Blue Ridge Lumber (1981) Ltd	Whitecourt	91-WL-103	A	N	25	59	10	5	54.10111	-115.35639	wood processing			no data			Athabasca River		L, S
Blue Ridge Lumber Ltd	Blue Ridge	89-AL-160	A	N	25	59	10	5	54.09028	-115.36278	Sawmill			Particulate 6g/kg					G
Blue Ridge Lumber Ltd	Blue Ridge	91-AL-231	A	SE	36	59	10	5	54.10111	-115.35639	MDF board			Particulate .2g/kg, Formaldehyde 22ppm					G
Bluesky		78-ML-007 R2(9	P	SW	3	82	2	6	54.09028	-115.36278	municipal sewage	one facultative cell, one storage cell	periodic	BOD, TSS; volume of discharge	1	fall	hocolate Cree	unper.d	L
Border Paving Ltd.	Hinton	89-WL-083	A	SE	25	51	25	5	56.02111	-118.22583	asphalt plant			no data			No Discharge		L
Border Paving Ltd.	Hinton	89-AL-155	A	SE	25	51	25	5	53.39361	-117.54278	Asphalt			Particulate 0.2kg/1000g					G
Boyle		81-ML-005 R3(9	A	NW	4	65	19	4	53.39361	-117.54278	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; the flow is from the anaerobic cells to the facultative cell to the storage cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	Flat Lake	unper.dbf	
Boyle	Regional Lagoon	89-ML-003	A	SE	36	64	19	4	54.55222	-112.81972	municipal sewage	one evaporation cell	none	no data			No Discharge		L
Boyle	Transportation Yard	89-ML-004	A	SW	4	65	19	4	54.53417	-112.73194	municipal sewage	disposal field system	none	no data			No Discharge		L
British Columbia Forest Products Ltd		87-WL-109	P	E	9	57	6	6	53.88000	-118.90000	sawmill	three cells, one is aerobic	periodic	BOD, pH, NFR			Not Specified		L
Brownvale		86-MI-055 R1 (9	P	SE	20	82	25	5	54.54861	-112.81972	municipal sewage	one anaerobic cell, one evaporation cell; flow is from the anaerobic cell to the evaporation cell	none	no data					L
Buchanan Lumber	High Prairie	91-AL-140A	P	W	23	74	17	5	55.37500	-116.51389	Sawmill			Particulate 6g/kg					G
Buffalo Lake Metis Settlement	Buffalo Lake	R105	P	SW	23	64	17	4	54.50528	-112.46111	Landfill	Active							S
Burza Resources Ltd.	Whitecourt	89-WL-103	A	5	32	59	11	5	56.06444	-117.88750	storage & handling			no data			No Discharge		L
Burza Resources Ltd.	Whitecourt		A	5	32	59	11	5	54.10111	-115.61833	(Shut in)								G
Cadotte Lake School Div 61		86-ML-060 R1 (9	P	SE	24	86	16	5	54.10111	-115.61833	municipal sewage	one facultative/storage cell	periodic	no discharge in 1990, 1991 and 1992			Marten River		L
Calcrude Oils Ltd.	Cherhill	90-WL-182	A	4	24	56	5	5	56.41083	-116.38861	gas plant			no data			Not Specified		L
Calcrude Oils Ltd.	Cherhill	89-AL-050C	A	4	24	56	5	5	53.80889	-114.61667	Sour Gas			none					G
Calling Lake		86-ML-062 R1(9	A	NW	17	72	21	4	53.80889	-114.61667	municipal sewage	one facultative cell, one storage cell; flow is from the facultative to the storage cell	periodic	no data					L
Calpro Services Ltd.	Pouce Coupe	89-AL-167	P		20	78	12	6	55.72139	-119.83417	Sour Gas			SO2 0.230					G

TABLE B 1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Canada Northwest Energy	Meyer	92-AL-330	A	5	2	70	25	4	54.98167	-113.72444	Sour Gas			SO2 0.106					G
Canada Northwest Energy Ltd.	Meyer	92-WL-207	A	5	2	70	25	4	55.18750	-113.19528	gas plant			no data			No Discharge		L
Canadian Crude Separators Ltd.	Judy Creek	88-WL-127 A	A	NE	16	69	22	5	54.98167	-113.72444	oil reclaimer	landfill, deepwell disposal		no data			Not Specified		L, S
Canadian Crude Separators Ltd.	Mitsue Lake	90-WL-088 A	A	4	29	72	4	5	54.92750	-117.29611	oil reclaimer	landfill, deepwell disposal		no data			No Discharge		L, S
Canadian Forest Products Ltd.	Hines Creek	93-WL-128	P	N	15	84	4	6	56.22667	-118.54250	landfill	landfill		no data			Licence		L, S
Canadian Natural Res. Ltd.	Baptiste	93-AL-245	A	5	28	67	22	4	54.77944	-113.29472	Sour Gas			none					G
Canadian Natural Res. Ltd.	Calling Lake S.	91-AL-006A	A	1	20	70	22	4	55.02139	-113.32222	Sour Gas			SO2 0.380					G
Canadian Natural Res. Ltd.	Island Lake	93-AL-140	A	1	18	68	23	4	54.83361	-113.48611	Sour Gas			SO2 0.200					G
Canadian Natural Res. Ltd.	Bouvier	92-AL-271A	A	15	29	70	24	4	55.04667	-113.63500	Sour Gas			SO2 0.840					G
Canadian Natural Res. Ltd.	Big Bend	93-AL-207	A	13	36	66	27	4	54.71472	-113.97139	Sour Gas			SO2 2.920					G
Canadian Natural Res. Ltd.	Tieland	92-AL-238	A	5	14	67	2	5	54.75056	-114.19972	Sour Gas			SO2 0.056					G
Canadian Natural Res. Ltd.	Greencourt	91-AL-035	A	9	26	59	9	5	54.09028	-115.22556	Sour Gas			S)2 10.000					G
Canadian Natural Resources Ltd	Calling Lake	91-WL-009	A	1	20	70	22	4	55.02139	-113.32222	gas plant			no data			No Discharge		L
Canadian Natural Resources Ltd	Bouvier	92-WL-176	A	15	29	70	24	4	55.04667	-113.63500	gas plant			no data			No Discharge		L
Canadian Natural Resources Ltd	Greencourt	91-WL-018	A	9	26	59	9	5	54.09028	-115.22556	gas plant			no data			No Discharge		L
Canadian Natural Resources Ltd	Tieland	93-WL-126	A	5	14	67	2	5	54.75056	-114.19972	gas plant			no data			No Discharge		L
Canadian Natural Resources Ltd	Island Lake	93-WL-110	A	1	18	68	23	4	54.83361	-113.48611	gas plant			no data			No Discharge		L
Canadian Natural Resources Ltd	Big Bend	93-WL-138	A	13	36	66	27	4	54.71472	-113.97139	gas plant			no data			No Discharge		L
Canadian Natural Resources Ltd	Baptiste	93-WL-160	A	5	28	67	22	4	54.77944	-113.29472	gas plant			no data			No Discharge		L
Canadian Occidental	Paddle River	90-AL-371	A	13	6	57	8	5	53.86278	-115.18917	Sour Gas			SO2 4.210					G
Canadian Occidental Petroleum	Paddle River	91-WL-024	A	13	6	57	8	5	53.86278	-115.18917	gas plant			no data			No Discharge		L
Canfor	High Level	90-AL-125A	P	SW	29	109	19	5	58.41722	-117.13556	Sawmill			none					G
Canfor	Hines Creek	88-AL-095	P	N	15	84	4	6	56.22667	-118.54250	Sawmill			none					G
Canfor	Grande Prairie	91-AL-041	P	W	23	71	6	6	55.11528	-118.80917	Sawmill			Particulate .2g/kg					G
Canterra Energy Ltd	Industrial L.	N00030	A		21	95	7	4	57.30000	-111.20000	Industrial L.	Active							S
Canterra Energy Ltd	Industrial L.	N00031	A		21	95	7	4	57.30000	-111.20000	Industrial L.	Active							S
Canterra Energy Ltd.	Windfall	89-WL-011 A	A	S	17	60	15	5	54.14444	-116.20917	gas plant			no data			Not Specified		L
Carbovan Inc.		91-WL-078	A	SW	12	92	10	4	56.90167	-111.46306	metal product			no data			Fort McMurray		L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Carbovan Inc.	Ft. McMurray	89-AL-303	A	SW	12	92	10	4	56.90167	-111.46306	Metal			Opacity 20%, Particulate .09g/kg, NO2 170ppm					G
Cardinal River Coal		91-WL-191	A		23	47	24	5	53.03639	-117.39833	coal mine	active landfill							L
Cardinal River Coals Ltd.		91-WL-191 F	A	S	23	47	24	5	53.03278	-117.39222	coal processing	landfill		no data			Luscar Creek		L, S
Cardinal River Coals Ltd.	Luscar	91-AL-220	A	SW	23	47	24	5	53.03278	-117.39833	Coal Mine			Particulate .2g/kg, Opactiy 20%					G
Carrier Lumber Ltd.	Trout Lake	93-AL-172	A			86	4	5	56.37111	-114.49222	Sawmill	location questionable		Particulate .6g/kg					G
Carson-Pegasus Prov. Park		92-ML-004	P	SW	23	61	12	5	54.24556	-115.69389	municipal sewage	one facultative/storage cell	periodic	no data			Carson Creek		L
Caslan School		91-ML-037	A	SE	21	65	17	4	54.59194	-112.51028	municipal sewage	one facultative cell, one storage cell; flow is from the facultative to the storage cell	periodic	no data			Buck Creek		L
CGGS Canadian Gas	Hoole	93-AL-153	A	10	24	81	25	4	55.98139	-113.77444	Sour Gas			So2 0.093					G
CGGS Cndian Gas Gthering Systms	Hoole	92-WL-099	P	10	24	81	25	4	55.98139	-113.77444	gas plant			no data					L
Chauvco Oil and Gas Ltd.	Neptune	90-AL-173	P	10	13	86	13	6	56.40000	-119.91278	Sour Gas			SO2 4.42					G
Chauvco Resources	Cherhill	93-AL-090	A	2	25	56	6	5	53.82306	-114.75306	Sour Gas			SO2 1.760					G
Chauvco Resources	Swan Hills	92-AL-348	A	10	28	69	10	5	54.95639	-115.46167	Sour Gas			none					G
Chauvco Resources	Boundary Lake S.	92-AL-400	P	10	10	84	12	6	56.21222	-119.79917	Sour Gas			none					G
Chauvco Resources Ltd.	Swan Hills	92-WL-218	A	10	28	69	10	5	54.95639	-115.46167	gas plant			no data			No Discharge		L
Chauvco Resources Ltd.	Boundary Lake - Neptune	92-WL-017 A	P	10	13	86	13	6	56.40000	-119.91278	gas plant			no data			No Discharge		L
Chauvco Resources Ltd.	Boundary Lake - South	92-WL-250	P	10	10	84	12	6	56.21222	-119.79917	gas plant			no data			Sewage Lagoon		L
Chem Security Ltd.	Swan Hills	93-AL-282	A	NW	6	67	8	5	54.72556	-115.20806	Haz. Waste			various					G
Chem-Security (Alberta) Ltd.	Swan Hills	91-WL-036 A	A	NW	6	67	8	5	54.72556	-115.20806	waste storage	hazardous waste throughout plant		no data			No Discharge		L
Cherhill		86-ML-05 1R1(9	A	NE	4	56	5	5	53.77278	-114.67861	municipal sewage	one facultative cell	periodic	no data	1	fall	Paddle River		L
Chevron Canada	Steepbank	91-AL-130	A	E	22	94	7	4	57.10361	-111.03250	Oilsands			none					G
Chevron Canada	Mitsue	92-AL-097	A	NE	30	72	4	5	55.21611	-114.59917	Sour Gas			SO2 1.500					G
Chevron Canada	Bigoray	89-AL-065A	A	10	7	51	9	5	53.35417	-115.30972	Sour Gas			SO2 6.328					G
Chevron Canada	West Pembina	90-AL-029B	A	16	35	48	12	5	53.15556	-115.63694	Sour Gas			none					G
Chevron Canada	West Pembina	90-AL-029B	A	7	35	48	12	5	53.14833	-115.64306	Sour Gas			none					G
Chevron Canada	West Pembina	90-AL-325	A	11	22	49	12	5	53.20972	-115.67694	Sour Gas			SO2 10.200					G
Chevron Canada	Kaybob #3	92-AL-266	A		15	59	18	5	54.06139	-116.61000	Sour Gas			SO2 144.500					G
Chevron Canada	Medicine Lodge	92-AL-002	A	9	9	52	21	5	53.44056	-117.02750	Sour Gas			SO2 3.400					G
Chevron Canada Resources	Steepbank	91-WL-058	A	E	22	94	7	4	57.10722	-111.03250	tar sand			no data			No Discharge		L
Chevron Canada Resources	Industrial L.	N00032	A		1	82	17	4	56.00000	-112.50000	Industrial L.	Active							S

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Chevron Canada Resources Ltd.	Kaybob South-Beaverhill Lake Gas Unit #3	89-WL-174 B	A		11	59	18	5	54.04694	-116.58500	gas plant	landfill		no data			Not Specified		L, S
Chevron Canada Resources Ltd.	Kaybob gas plant	94-WL-151	A		14	59	18	5	54.06139	-116.58500	gas plant	active off-site landfill, on-site closed landfills					Not Specified		L
Chevron Canada Resources Ltd.	Mitsue	92-WL-059 A	A	NE	30	72	4	5	55.21611	-114.59917	gas plant			no data			No Discharge		L
Chevron Canada Resources Ltd.	West Pembina	90-WL-131	A	11	22	49	12	5	53.20972	-115.67694	gas plant			no data			No Discharge		L
Chevron Canada Resources Ltd.	Medicine Lodge	91-WL-185	A	9	9	52	21	5	53.44056	-117.02750	gas plant			no data			Not Specified		L
City of Fort McMurray	Sanitary Landfill	N00021	A	22	17	88	9	4			Landfill	Active, location questionable							S
City of Grande Prairie	Sanitary Landfill	W0646	P	NE	2	71	6	6	55.07194	-118.80250	Sanitary L.	Active							S
Clairmont		86-ML-013 R1(9	P	NW	27	72	6	6	55.21611	-118.83639	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	not discharged in 1990, 1991, or 1992			Unnamed Creek		L
Cleardale		91-ML-046	P	NE	10	85	10	6	56.30000	-119.50000	municipal sewage	one facultative/storage cell	periodic	BOD, TSS	1	fall	Clear River	unper.d	L
Cleardale		91-ML-046	P	NW	11	85	10	6	56.30000	-119.50000	municipal sewage	one facultative/storage cell	periodic	BOD, TSS	1	fall	Clear River	unper.d	L
Colinton		80-ML-028 R2(9	A	NW	10	65	22	4	54.56667	-113.24944	municipal sewage	one storage cell	periodic	volume of discharge, BOD, TSS	1	fall	awatinaw River		S
Cooperative Energy	Roxanna	83-AL-128	A		27	78	19	5	55.73583	-116.87333	(Shut in)								S
County of Athabasca	Boyle	F900006	A	SE	36	64	19	4	54.53417	-112.73194	WMF	Active							L
County of Athabasca	Colinton	F900011	A	NE	24	68	24	4	54.85528	-113.51778	WMF	Active							G
County of Athabasca	Ellscott	F900012	A	NE	1	64	20	4	54.46556	-112.88333	WMF	Active							S
County of Athabasca	Grassland	F900016	A	SW	10	68	18	4	54.82278	-112.65972	WMF	Active							S
County of Athabasca	North Buck Lake	F90020	A	SE	23	66	18	4	54.67861	-112.61694	WMF	Active							S
County of Athabasca	Perryvale	F900021	A	SW	27	63	23	4	54.43306	-113.38667	WMF	Active							S
County of Athabasca	Rochester	F900022	A	SW	29	62	23	4	54.34639	-113.42972	WMF	Active							S
County of Athabasca	Whispering Hills	F900004	A	NW	35	66	24	4	54.71111	-113.53472	WMF	Active							S
County of Athabasca	God's Lake	F900015	A	NW	31	62	24	4	54.36444	-113.60556	WMF	Active							S
County of Athabasca	Athabasca	F900001	A	SE	28	66	22	4	54.69306	-113.27528	WMF	Active							S
County of Athabasca	Atmore	F900002	A	NW	22	67	17	4	54.76861	-112.50194	WMF	Active							S

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County of Athabasca	Whispering Hills	R647	A	NW	35	66	24	4	54.71111	-113.53472	WMF	Active							S
County of Athabasca	Atmore	W0733	A	NW	22	67	17	4	54.76861	-112.50194	WMF	Active							S
County of Athabasca	Grassland	W0731	A	SW	10	68	18	4	54.82278	-112.65972	WMF	Active							S
County of Athabasca	Narrow Lake	X0844	A	SW	17	65	24	4	54 57750	-113.60306	Modified Landfill	Active							S
County of Athabasca	Poacher's Landing	X0846	A	NE	4	69	19	4	54.89861	-112.83750	Modified Landfill	Active							S
County of Athabasca	Lawrence Lake	W0697	A	6	36	69	25	4	54 96722	-113.68444	WMF	Active							S
County of Athabasca #12	Colinton	X0851	A	NE	7	65	22	4	54 56667	-113.31889	Modified Landfill	Active							S
County of Barrhead	Meadowview Transfer Station	W0699	A	NW	3	58	5	5	53.94583	-114.66278	Transfer Station	Active							S
County of Barrhead	Tiger Lily Transfer Station	W0700	A	NW	31	60	5	5	54.19139	-114.74056	Transfer Station	Active							S
County of Barrhead	Vega Transfer Station	W0702	A	NW	20	62	3	5	54.33556	-114.41722	Transfer Station	Active							S
County of Barrhead	Dunstable Transfer Station	W0703	A	SW	25	57	2	5	53 91333	-114.16444	Transfer Station	Active							S
County of Grande Prairie	MSL	N00002	P	NE	26	72	12	6	55.21611	-119.72750	MSL	Active							S
County of Grande Prairie	MSL	W0650	P	NE	8	75	7	6	55 43278	-119.05000	MSL	Active							S
County of Grande Prairie	MSL	W0638	P	NW	13	74	14	6	55 36056	-120.02444	MSL	Active							S
County of Grande Prairie	MSL	W1525	P	NE	8	75	8	6	55.43278	-119.19667	MSL	Active							S
County of Grande Prairie	MSL	W0526	P	NW	12	74	10	6	55.34611	-119.40639	MSL	Active							S
County of Grande Prairie	MSL	R0580	P	NE	33	74	3	6	55.40389	-118 39583	MSL	Active							S
County of Grande Prairie	MSL	R0699	P	NW	27	72	6	6	55.21611	-118.83639	MSL	Active							S
County of Thorhild	Thorhild Pesticide Con. Site	W0732		NE	5	60	21	4	54.11917	-113 10917		Active							S
County of Thorhild	Newbrook Modified Landfill	R360		NE	35	61	21	4	54.27778	-113.04056	Modified Landfill	Active							S
CS Resources	Pelican Lake	89-AL-221	A	12	9	81	22	4	55.95250	-113 39528	Heavy Oil			none					G
Cynthia		92-ML-023	A	SW	4	50	10	5	53 24944	-115.41111	municipal sewage	one facultative/storage cell	periodic	no data available in files			Unnamed Creek		L
D. M Wolcott and Assoc.	McLennan	89-AL-014	A	NE	23	76	19	5	55.54833	-116.82861	Fertilizer			Ammonia negligible					G
Deadwood School		80-ML-084	P								municipal sewage	two cells, location not specified	continuous	flow data, 1991 sampling data not in files				munper.d	L
Debolt		81-ML-008 R1 (8	P	NE	2	72	1	6	55 15861	-118 03500	municipal sewage	one facultative cell	periodic	volume of discharge, BOD, NFR, TSS	1	fall	Debolt Creek	unper.d	L
Dennis McGinn Holdings Ltd.	Entwistle	89-WL-115	A	NE	5	53	7	5	53.51278	-114 99472	gravel washing			no data			No Discharge		L, S

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Desmarais	see Wabasca	90-ML-048	P								municipal sewage	six lift stations and forcemains discharging to the Wabasca wastewater treatment plant, location not specified	none	no data					L
Diashowa Canada Ltd.	Industrial Landfill	W000542	P	NW	11	85	21	5 ,	56.29889	-117.20750	Industrial Landfill	Active							S
Dixonville		85-ML-046 R1(9	P	SE	12	87	24	5	56.46861	-117.66556	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, TSS	1	fall	d River via di	unper.d	L
Donelly		86-ML-039 R1(9	P	NE	1	78	21	5	55.67806	-117.12639	municipal sewage	two anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	BOD, TSS, volume of discharge	1	fall	Peavine Cree	unper.d	L
Dr. Ellie Prepas		92-WL-110	A								miscellaneous	location not specified		no data			Figure Eight Lake		L
Dr. Mary Jackson(Keg R) School		91-ML-012	P	NW	1	101	23	5	57.67028	-117.62500	municipal sewage	one evaporation lagoon	none	no data					L
Drayton Valley	Regional Sanitary Landfill	R635		SE	20	49	7	5	53.20611	-114.96667	Landfill	Active							S
E.L.P. Construction Services	Sangudo Wohlers Pit	92-WL-141	A	SE	36	50	4	5	53.32167	-114.45000	gravel washing			no data			No Discharge		L, S
Eaglesham		89-ML-035	P	SE	36	78	26	5	55.74667	-117.90583	municipal sewage	one storage cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	iver - via far	unper.d	L
East Prairie Metis STLMT		88-ML-016	A	NW	6	72	15	5	55.15861	-116.29806	municipal sewage	2 anaerobic cells, one storage cell	periodic	no data	1	fall	Devil Creek		L
East Prairie Settlement	Modified Landfill Waste Management	R000439	P	NE	32	90	23	5	56.78972	-117.63639	Modified Landfill Waste Management	Active							S
Ed Schulte	Fort Assiniboine	93-WL-111	A	SW	4	62	5	5	54.28861	-114.69333	gravel washing			no data			No Discharge		L
Edson		80-ML-082 R2(9	A	W	24	53	17	5	53.55611	-116.38083	municipal sewage	four anaerobic cells, two aerated cells, one polishing cell; flow is from the anaerobic to the facultative to the polishing cell with continuous discharge; one facultative/storage cell is available for emergency overflow municipal sewer	continuous	volume of discharge, BOD, TSS, temperature, pH, dissolved oxygen	na	na	McLeod Rive	edson.db	L
Encor	Teepee Creek	91-AL-413	P	SE	2	74	4	6	55.32806	-118.49889	Sour Gas			SO2 4,000					G

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Enilda		89-ML-064	A	SW	7	74	15	5	55.34250	-116.30778	municipal sewage	one facultative cell, one storage cell; discharge to Arcadia Creek to Lesser Slave Lake	periodic	volume of discharge, BOD, TSS	1	fall	Arcadia Cree	unper.d	L
Enron	Greencourt East	91-AL-030	A	9	20	59	6	5	54.07583	-114.85111	Sour Gas			SO2 0.470					G
Enron Oil Canada Ltd.	Greencourt East Field	91-WL-021	A	9	20	59	6	5	54.07583	-114.85111	gas plant			no data			Not Specified		L
Entwistle		78-ML-053 R2(9	A	SW	28	53	7	5	53.56694	-114.97611	municipal sewage	four anaerobic cells, one facultative cell, one storage cell	periodic	BOD, TSS	2	spring/fall	embina Rive	unper.d	L
Environmental Technologies Inc	Edmonton	91-WL-143	A	S	28	53	23	4	53.56694	-113.34167	gas plant			no data			Clover Bar Lagoon		L
ESSO Resources Canada Ltd.	Oslo Lease 41	88-WL-113 C	A	NW	6	91	9	4	56.80417	-111.43306	tar sand			no data			Not Specified		L
ESSO Resources Canada Ltd	Athabasca Borehole Mining	92-WL-133 A	A	NW	33	91	10	4	56.87639	-111.54000	tar sand			no data			No Discharge		L
Esso Resources Canada Ltd.	Boundary Lake	90-WL-092 A	P	SE	14	85	13	6	56.30972	-119.93500	gas plant			no data			No Discharge		L
Evansburg		80-ML-077 R2(9	A	SW	35	54	8	5	53.66806	-115.07694	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic cells in series to the facultative to the storage cell	periodic	BOD, TSS	2	spring/fall	Lobstick Rive	unper.d	L
Everall Construction Ltd.	Ft. McMurray	92-WL-130	A	SE	31	89	9	4	56.69944	-111.42000	asphalt plant			no data			No Discharge		L
Everall Construction Ltd.	Ft. McMurray	92-AL-214	A	SE	31	89	9	4	56.69944	-111.42000	Asphalt			Particulate 0.2kg/1000kg					G
Everall Construction Ltd.	Slave Lake	93-AL-042	A			73	5	5			Asphalt	location questionable		Particulate 0.2kg/1000kg					G
Evergreen Park (Gr. Prairie)		90-ML-002	P								municipal sewage	one evaporation cell, three lift stations throughout the grounds, location not specified	periodic	discharged 1990, 1991 and 1992; sampling data from 1990 not submitted; volume of discharge	1	fall	Unknown	unper.d	L
Fairview		80-ML-044 R2(9	P	NW	27	81	3	6	55.99583	-118.38222	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	oucher Cree	unper.d	L

TABLE B 1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Falher		78-ML-015 R2(9	P	NE	33	77	21	5	55.66361	-117.19750	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	Peavine Cree	unper.d	L
Faust		78-ML-038 R1(8	A	SW	15	73	11	5	55.27028	-115.60917	municipal sewage	four anaerobic cells, one facultative cell, two storage cells	periodic	volume of discharge, BOD, TSS	1	fall	nnamed Cree	unper.d	L
Fawcett		90-ML-062	A	SE	19	64	1	5	54.50528	-114.13528	municipal sewage	one facultative cell	periodic	no discharge in 1991, no data for 1990 or 1992			Athabasca River		L
Fimrite Oilfield Services Ltd.	Spirit River	92-WL-202	P	SE	34	78	8	6	55.74667	-119.15250	storage & handling			no data			No Discharge		L
Flatbush		92-ML-036	A	NE	6	66	1	5	54.63889	-114.13583	municipal sewage	one facultative cell, one storage cell; flow is from the facultative to the storage cell	periodic	no data			Pembina River		L
Footner Lake Forestry Site		87-ML-010 R1(9	P	S	8	111	19	5	58.54722	-117.14333	municipal sewage	one facultative cell, one storage cell	periodic	volume of discharge, BOD, TSS, NFR	1	fall	Footner Lake	unper.d	L
Fort Assiniboine		78-ML-006 R1(9	A	NE	1	62	6	5	54.29222	-114.76250	municipal sewage	one treatment cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	thabasca Riv	unper.d	L
Fort Chipewyan		87-ML-046 R1(9	A	SE	18	112	7	4	58.64833	-111.16000	municipal sewage	two facultative cells with continous discharge from the final facultative cell	continuous	BOD, TSS			Lake Athabasc	ftchip.db	L
Fort McKay		89-ML-072	A	L 1	23	94	11	4	57.10722	-111.65806	municipal sewage	two anaerobic cells, one facultative storage cell	periodic	volume of discharge, BOD, TSS	1	fall	thabasca Riv	unper.d	L
Fort McMurray		80-ML-092 R1(9	A	NW	32	89	9	4	56.70306	-111.40000	municipal sewage	an aerated lagoon system with six aerated cells with continuous effluent discharge	continuous	BOD, TSS, temperature, pH			Athabasca Riv	mcmur.d	L
Fort Smith		N1L4-0567	Slave						60.00000	-111.88000	municipal sewage	two primary faculative cells, one secondary faculative cell	continuous	volume of discharge, pH, TSS, total coliform, fecal coliform, BOD5			Slave River		L
Fort Vermillion		80-ML-013 R2(9	P	7A	24	108	13	5	58.32000	-116.01722	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	Peace River	unper.d	L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Fox Creek		86-ML-068 R1(9	P	NE	32	62	19	5	54.36444	-116.82111	municipal sewage	four anaerobic cells, one facultative cell, three storage cells; flow is from the anaerobic to the facultative to the storage cells	periodic	volume of discharge, BOD, TSS, pH, dissolved oxygen	2	spring/fall	Iosegun Lake	unper d	L
General Gravel Sales Ltd.	Peers	91-WL-049	A	3	3	55	14	5	53.67889	-115.99472	gravel washing			no data			Not Specified		L, S
Gift Lake		86-M2-054	P		28	79	12	5	55.82250	-115.81222	municipal sewage		periodic	BOD, TSS		unknown	Unknown	unper d	L
Gift Lake Metis Settlement	Modified Landfill Waste Management	R000438	P	NE	26	79	12	5	55.82250	-115.75361	Modified Landfill	Active							S
Girouxville		85-ML-051 R1(9	P	NW	9	78	22	5	55.69250	-117.36667	municipal sewage	two anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	nnamed Cree	unper d	L
Grande Cache		87-ML-043 R1(9	P	W	29	56	8	6	53.83028	-119.15583	municipal sewage	extended aeration plant with grit removal, aeration, secondary settling and sludge digestion with continuous effluent discharge	continuous	volume of discharge, BOD, TSS, temperature, pH, dissolved oxygen			Smoky River	rcache d	L
Grande Prairie		85-ML-009 R1(9	P	SE	11	71	6	6	55.08278	-118.80250	municipal sewage	grit removal with aeration, primary settling, rotating biological contactors, secondary clarification, a polishing cell and aerobic sludge digestion	continuous	BOD, TSS			Wapiti River	rprair db	L
Grande Prairie Airport		88-ML-029 R1 (9	P	SE	29	71	6	6	55.12611	-118.87944	municipal sewage	four anaerobic cells, one facultative cell, one storage cell	periodic	no discharge in 1991 and 1992, bacteriological analysis in 1991.			Flying Hut Lak	unper d	L
Grassland		80-ML-012 R3(9	A	S	28	67	18	4	54.77944	-112.67333	municipal sewage	one facultative cell, one storage cell, flow is from the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	nnamed Cree	unper d	L
Greencourt		86-ML-02 0R1(9	A	SE	14	58	9	5	53.97111	-115.22917	municipal sewage	stabilization pond, 1 facultative cell, 1 evaporation cell	evap	no data					L
Greg River Resources Ltd.		92-WL-031 D	A		21	47	24	5	53.03639	-117.44722	coal processing	landfill		no data			Not specified		S, L

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Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Gregg River Resources	Gregg River	89-AL-103	A		28	47	24	5	53.05083	-117.44722	Coal Mine			Particulate .2g/kg, Opacity 20%					G
Gregoire Lake Prov. Park		81-ML-009 R1 (8	A	SW	4	86	8	4	56.36750	-111.20583	municipal sewage	two anaerobic cells, one facultative cell, one storage cell	periodic	pH, Fe, Ca, total hardness, K, NO2 + NO3, fluoride, sulfate, carbonate, BOD, NFR, total phosphorous, cond., TDS, Mg, Na, Si, nitrite, chloride, bicarbonate, total alkalinity, COD, NH3, TKN, bacteriological analysis	1	fall	Gregoire Lak	unper.d	L
Grimshaw		86-ML-041 A1(87) R	P	N	9	83	23	5	56.12556	-117.56111	municipal sewage	eight anaerobic cells, two facultative cells, three storage cells; four anaerobic cells are for the north side of town and the other four are for the south side; flow is from the anaerobic to the facultative to the storage cells	periodic	volume of discharge, BOD, TSS	1	fall	Peace River	unper.d	L
Grizzly Gold and Gravel	Peers	92-WL-126	A	W	4	55	14	5	53.68611	-116.01944	gravel washing			no data			No Discharge		L
Grouard		87-ML-024 R1(9	A	SW	29	75	14	5	55.47250	-116.13222	municipal sewage	two anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic cells in series to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	sser Slave Lake		L
Grovedale		93-ML-006	P	SE	4	70	6	6	54.98167	-118.85194	municipal sewage	two evaporation cells	none	no data					L
Gulf Canada	Baptiste Lake Gas	F900003	A	5	26	67	22	4	54.77944	-113.24417	WMF	Active							S
Gulf Canada Corporation	Peerless Lake	92-WL-175	P	SW	24	90	3	5	56.75722	-114.33639	landfill	landfill		no data			No Discharge		S, L
Gulf Canada Resources Ltd	Hanlon-Robb	88-WL-025 A	A	NE	2	49	20	5	53.16639	-116.81972		surface water run-off pond	periodic				Athabasca River		
Gulf Canada Resources Ltd	Hanlon-Robb	88-WL-025 A	A	E	11	49	20	5	53.17722	-116.81972		surface water run-off pond	periodic				Athabasca River		
Gulf Canada Resources Ltd	Hanlon-Robb	88-WL-025 A	A	SW	12	49	20	5	53.17722	-116.80139	gas plant	surface water run-off pond	periodic	no data			Athabasca River		L

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Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Guy		87-ML-007 R1(9	P	NW	36	75	21	5	55.49056	-117.11278	municipal sewage	one facultative cell, one storage cell; flow from the facultative to the storage cell	periodic	BOD, TSS	1	fall	tle Smoky River		L
High Level		81-ML-034 R2(9	P	SE	33	109	19	5	58.43167	-117.10083	municipal sewage	four anaerobic cells, one facultative cell, and one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS, Nitrate Nitrogen, Total Dissolved Phosphorus, Ammonia Nitrogen, Filterable Residue	2	spring/fall	Bushe River		L
High Level Forest Products		90-WL-125	P	W	29	109	19	5	58.42083	-117.13556	Wood processing	landfill							
High Level Forest Products		90-WL-126	P	S	32	109	19	5	58.43167	-117.12861	Wood processing	landfill							
High Level Forest Products Ltd	High Level	90-WL-125	P	NE	29	109	19	5	58.42083	-117.12861	wood processing	landfill		no data					L, S
High Prairie		78-ML-041 R2(9	A	N	2	75	17	5	55.41833	-116.51917	municipal sewage	four anaerobic cells, one facultative cell, two storage cells; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	est Prairie Ri	unper.d	L
Hines Creek		80-ML-085 R2(9	P	NE	5	84	4	6	56.19778	-118.58861	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	Jack Creek	unper.d	L
Hinton		90-ML-010	A		27	51	25	5	53.34000	-117.64000	municipal sewage	Hinton sewage goes into Weldwood of Canada Ltd wastewater treatment facility and is treated and discharged from there.	continuous	no data			Athabasca Riv	inton db	L
Hinton Heavy Haulers 1978 Ltd.	Muldoon	89-WL-198	A	NE	5	51	25	5	53.33972	-117.64083	gravel washing			no data			No Discharge		L, S
Hinton Reg. Sanitary L.	Regional S.L.	W107	A	SW	33	50	25	5	53.36000	-117.61000	Sanitary Landfill	Active, location questionable							S
Homaid Industries Ltd.	Colinton	91-WL-016	A	NE	9	65	22	4	54.56667	-113.26833	meat processing			no data			Land Spreading		L
Home Oil	Marten Hills #1	92-AL-209	A	14	22	74	24	4	55.37861	-113.62111	Sweet Gas			none					G
Home Oil	Marten Hills #2	87-AL-287	A	NW	29	74	25	4	55.38944	-113.82722	(Shut in)								G
Home Oil	Cecil	90-AL-253A	P	8	15	84	8	6	56.22306	-119.16111	Sour Gas			SO2 1.560					G

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Home Oil Company Ltd.	Tieland	92-WL-129	A	5	14	67	2	5	54.75056	-114.19972	gas plant			no data			No Discharge		L
Home Oil Company Ltd	Marten Hills No. 1	92-WL-108	A	14	22	74	24	4	55.37861	-113.62111	gas plant			no data			Not Specified		L
Home Oil Company Ltd.	Cecil	90-WL-142 A	P	8	15	84	8	6	56.22306	-119.16111	gas plant			no data			No Discharge		L
Home Oil Leismer Gas Plant		80-ML-024 R2(92) A	A	3	7	77	7	4	55.59889	-111.07861	municipal sewage	one facultative/storage cell	periodic	flow; no discharge in 1989 or 1990	1	fall	Jackfish River		L
Husky Oil	West Whitecourt	93-AL-171	A	S	17	60	15	5	54.14444	-116.20917	Sulphur			none					G
Husky Oil Operations	Kearl Lake	90-AL-380	A	NW	10	95	7	4	57.16500	-111.04139	Oilsands			none					G
Husky Oil Operations Ltd.	Windfall	91-WL-186	A	S	17	60	15	5	54.14444	-116.20917	gas plant			no data			Not specified		L
Husky Oil Operations Ltd.	Kearl Lake	91-WL-012	A	NW	10	95	7	4	57.16500	-111.04139	tar sand			no data			No Discharge		L
Hythe		78-ML-039 R2(9	P	NE	14	73	11	6	55.27389	-119.57694	municipal sewage	two anaerobic cells, one facultative cell, two storage cells; flow is from the anaerobic to the facultative to the storage cells	periodic	BOD, TSS, Total Phosphorus, volume of discharge	2	spring/fall	averlodge Ri	unper.d	L
I.D. 17	MSL	R355	A	NW	7	73	10	5	55.25944	-115.53194	MSL	Active							S
I.D. 17	Waste Transfer S.	W863	A	16	30	75	6	5	55.47972	-114.90639	Waste Transfer S.	Active							S
I.D. 17	MSL	R259	A	NW	33	73	13	5	55.31722	-115.94306	MSL	Active							S
I.D. 17	Waste Transfer S.	W1170	A	NW	34	86	4	5	56.44333	-114.54500	Waste Transfer S.	Active							S
I.D. 17	Waste Transfer S.	W1165	A	10	33	88	4	5	56.61639	-114.56722	Waste Transfer S.	Active							S
I.D. 17	MSL	W860	A	N	13	73	7	5	55.27389	-114.94111	MSL	Active							S
I.D. 17E	Calling Lake S.	F900008	A	SE	30	71	21	4	55.12611	-113.20778	WMF	Active							S
I.D. 17E	Chipewyan Lake	F900010	A	SW	32	91	22	4	56.87278	-113.49083	WMF	Active							S
I.D. 17E	Wabasca	F900025	A	SW	36	78	23	4	55.74667	-113.44472	WMF	Active							S
I.D. 17E	Wabasca	R138	A	SW	36	78	23	4	55.74667	-113.44472	WMF	Active							S
I.D. 17E	Modified Landfill	W0701	A	NE	36	78	23	4	55.75028	-113.43806	ML	Active							S
I.D. 14	Waste Transfer Station	W113	A	SE	22	47	23	5	53.03278	-117.27056	Waste Transfer	Active							S
I.D. 14	Waste Transfer Station	W112	A	SW	14	49	21	5	53.19167	-116.97250	Waste Transfer	Active							S
I.D. 14	Waste Transfer Station	W108	A	NW	1	51	26	5	53.33972	-117.69611	Waste Transfer	Active							S
I.D. 14	Waste Transfer Station	W109	A	SE	22	50	27	5	53.29278	-117.87833	Waste Transfer	Active							S
I.D. 14	Waste Transfer Station	W110	A	NW	25	52	23	5	53.48389	-117.26111	Waste Transfer	Active							S
I.D. 14	MSL	X075	A	NW	7	53	19	5	53.52722	-116.79972	MSL	Active							S
I.D. 14	MSL	X076	A	NW	10	54	14	5	53.61389	-115.99056	MSL	Active							S
I.D. 14	MSL	X077	A	NW	36	53	13	5	53.58500	-115.78944	MSL	Active							S
I.D. 14	MSL	R275	A	SE	11	54	16	5	53.61028	-116.25611	MSL	Active							S
I.D. 14	Transfer Station	R256	A	13	10	55	12	5	53.70417	-115.70389	Transfer Station	Active							S
I.D. 14	MSL	R274	A	10	3	55	15		53.68611	-116.13694	MSL	Active							S
I.D. 14	MSL	R289	A	NE	16	53	9	5	53.54167	-115.26583	MSL	Active							S
I.D. 14	MSL	X078	A	SW	32	53	11	5	53.58139	-115.59222	MSL	Active							S

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I.D. 14	MSL	R230	A	SE	35	54	8	5	53.66806	-115.07083	MSL	Active							S
I.D. 15	Topland Modified Landfill	R296	A	NW	16	62	7	5	54.32111	-114.99472	Modified Landfill	Active							S
I.D. 16	MSL	W106	P	14	18	57	5	6	53.89167	-118.73583	MSL	Active							S
I.D. 16	MSL	W0659	P	NE	23	70	21	5	55.02861	-117.09889	MSL	Active							S
I.D. 16	MSL	W0653	A	SW	34	69	8	5	54.96722	-115.13667	MSL	Active							S
I.D. 16	MSL	W0655	P	NE	36	74	26	5	55.40389	-117.87222	MSL	Active							S
I.D. 16	MSL	R0544	P	NW	13	70	25	5	55.01417	-117.69250	MSL	Active							S
I.D. 16	MSL	R0532	P	NW	9	71	23	5	55.08639	-117.47000	MSL	Active							S
I.D. 16	MSL	W0654	P	5	22	69	6	6	54.93833	-118.83750	MSL	Active							S
I.D. 16	MSL	R0556	P	NW	30	71	25	5	55.12972	-117.82833	MSL	Active							S
I.D. 16	MSL	W0657	P	SE	2	72	1	6	55.15500	-118.03500	MSL	Active							S
I.D. 16	MSL	W0648	P	NW	13	66	22	5	54.66778	-117.20556	MSL	Active							S
I.D. 16	Waste Transfer Station	W0842	P	12	16	72	21	5	55.18750	-117.17611	Waste Transfer	Active							S
I.D. 16	MSL	W0647	P	NW	3	77	2	6	55.59167	-118.22333	MSL	Active							S
I.D. 16	MSL	W0649	P	SW	28	78	24	5	55.73222	-117.67833	MSL	Active							S
I.D. 16	MSL	W0635	P	SW	4	70	19	5	54.98167	-116.84972	MSL	Active							S
I.D. 17 C	Modified Landfill	R000720	A	SW	9	87	9	5	56.46861	-115.36750	Modified Landfill	Active							S
I.D. 17 W	Transfer Station	W000539	A	NW	16	86	5	5	56.40000	-114.73000	Transfer Station	Active							S
I.D. 17 W	Transfer Station	W000538		NW	31	81		5			Transfer Station	Active, location questionable							S
I.D. 17 W Municipal Affairs	Three Creeks/St. Isidore	W000529	P	SW	2	84	20	5	56.19417	-117.04250		Active							S
I.D. 17E	Calling Lake S.	R648	A	SE	30	71	21	4	55.12611	-113.20778	WMF	Active							S
I.D. 17E	Calling Lake N.	R569	A	4	29	72	21	4	55.20889	-113.20167		Active							S
I.D. 17E	Chipewyan Lake	W0692	A	SW	32	91	22	4	56.87278	-113.49083	WMF	Active							S
I.D. 17E	Chisholm	R718	A	16	24	68	2	5	54.85889	-114.15556	WMF	Active							S
I.D. 17E	Fawcett Lake	X0843	A	NW	16	65	1	5	54.58111	-114.09139	Modified Landfill	Active							S
I.D. 18 N.	MSL	N00014	A		9	86	8	4	56.44000	-111.20000	MSL	Active, location questionable							S
I.D. 18 N.	Dry Waste Site	N00015	A	7	28	125	10	4	59.88000	-111.67000	Dry Waste Site	Active, location questionable							S
I.D. 18 N.	MSL	N00016	A	13		80	14	4			MSL	Active, location questionable							S
I.D. 18 N	MSL	N00018	A		35	94	11	4	57.18000	-111.63000	MSL	Active, location questionable							S
I.D. 18 N.	MSL	N00019	A	10		77	8	4			MSL	Active, location questionable							S
I.D. 18 N.	MSL	N00020	A	6	27	112	7	4	58.72000	-111.15000	MSL	Active, location questionable							S
I.D. 18 N.	Dry Waste Disposal Site	N00024	A	16	15	74	4	4	55.43000	-110.52000	Dry Waste D	Active, location questionable							S
I.D. 20	Waste Transfer Station	R0598	P	SW	18	76	5	6	55.53028	-118.76611	Waste Transfer	Active							S
I.D. 20	MSL	R0638	P	SW	32	76	13	6	55.57361	-119.98167	MSL	Active							S
I.D. 20	MSL	R0615	P	NW	13	82	12	6	56.05361	-119.74556	MSL	Active							S
I.D. 20	MSL	R0600	P	NE	8	82	8	6	56.03917	-119.21500	MSL	Active							S
I.D. 20	MSL	R0457	P	SE	3	80	8	6	55.84778	-119.15750	MSL	Active							S
I.D. 20	MSL	R0579	P	SE	25	79	11	6	55.81889	-119.57139	MSL	Active							S
I.D. 20	MSL	R0558	P	NW	33	79	12	6	55.83694	-119.81222	MSL	Active							S
I.D. 20	MSL	R0676	P	NE	20	79	6	6	55.80806	-118.89472	MSL	Active							S
I.D. 20	MSL	R0466	P	NW	9	81	13	6	55.95250	-119.97694	MSL	Active							S
I.D. 23	Modified Landfill	R380	P	NE	35	107	14	5	58.26222	-116.19972	ML	Active							S

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

I.D. 23	Modified Landfill	R151	P	SE	34	125	18	5	59.81750	-117.01806	ML	Active							S
I.D. 23	Modified Landfill	N00003	P	2	29	105	15	5	58.06722	-116.43778	ML	Active							S
I.D. 23	Modified Landfill	N00003	P	4	29	105	15	5	58.06722	-116.45167	ML	Active							S
I.D. 23	Modified Landfill	R158	P	SW	22	109	14	5	58.40278	-116.24472	ML	Active							S
I.D.14	Waste Transfer Station	W111	A	SW	29	49	26	5	53.22056	-117.77889	Waste Transfer	Active							S
I.D.18 N	MSL	N00023	A	10	32	79	5	4	55.90000	-110.72000	MSL	Active, location questionable							S
I.D 18 S. & Town of Lac La Biche	Beaver Lake	W0730	A	NW	36	66	13	4	54.71111	-111.83833	Landfill	Active							S
Imperial Oil Ltd.	Cynthia	89-AL-260B	A		22	49	10	5	53.20972	-115.38389	Sour Gas			none					G
Imperial Oil Ltd.	Swan Hills	92-AL-043B	A	3	18	67	10	5	54.74694	-115.51250	Sour Gas			SO2 2.900					G
Imperial Oil Ltd.	Judy Creek	92-AL-070A	A	NE	25	64	11	5	54.52333	-115.52194	Sour Gas			SO2 4.460					G
Imperial Oil Ltd.	Niton	92-AL-236	A	14	18	54	12	5	53.63194	-115.76833	Sour Gas			none					G
Imperial Oil Ltd.	Hoole	90-AL-213A	A	16	36	80	25	4	55.92722	-113.75972	Sour Gas			SO2 0.500					G
Imperial Oil Resources Ltd	Judy Creek	92-WL-018 A	A	NE	25	64	11	5	54.52333	-115.52194	gas plant			no data			Not Specified		L
Imperial Oil Resources Ltd.	Niton	92-WL-142	A	14	18	54	12	5	53.63194	-115.76833	gas plant			no data			Not Specified		L
Imperial Oil Resources Ltd.	Swan Hills	92-WL-003 A	A	3	18	67	10	5	54.74694	-115.51250	gas plant			no data			Not Specified		L
Imperial Oil Resources Ltd.	Big Bend	91-WL-156 A	A	13	36	66	27	4	54.71472	-113.97139	gas plant			no data			No Discharge		L
Imperial Oil Resources Ltd	Hoole	90-WI-165 A	P	16	36	80	25	4	55.92722	-113.75972	gas plant			no data			No Discharge		L
Inland Cement Ltd.	Cadomin	92-WL-125	A	13	30	46	23	5	52.96778	-117.34917	gravel washing			no data			No Discharge		L
Inverness Petroleum	Boundary Lake	91-AL-064A	P	SE	14	85	13	6	56.30972	-119.93500	Sour Gas			SO2 3.8					G
Inverness Petroleum Ltd	Boundary Lake Floral	92-WL-215	P	SE	14	85	13	6	56.30972	-119.93500	gas plant			no data			Not Specified		L
Isaac Farms	Wanham	92-WP-044	P	NW	32	75	3	6	55.49056	-118.42889	meat processing			no data			No Discharge		L
Janvier School		86-MP-048 R1 (9	A	SW	8	80	5	4	55.86222	-110.74667	municipal sewage	two anaerobic cells, one storage cell; flow is from the anaerobic cells to the storage cell; discharge to Christina River	periodic	BOD, TSS				munper.d	L
Jarvie		78-ML-008 R2(9	A	SE	24	63	1	5	54.41861	-114.00917	municipal sewage	one facultative cell	periodic	no discharge 1991 or 1992, no data for 1990					L
Jean Cote		87-ML-006 R1(9	P	NW	36	79	22	5	55.83694	-117.29583	municipal sewage	one facultative cell, one storage cell; flows are from the facultative to the storage cell	periodic	BOD, TSS, volume of discharge	1	fall	ttle Smoky Ri	unper.d	L
Joussard		85-ML-043 R1(9	A	SW	8	74	13	5	55.34250	-115.97306	municipal sewage	two anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cells	periodic	volume of discharge, BOD, TSS	1	fall	Mission Cree	unper.d	L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Kinuso		86-ML-040 R1(9	A	NE	15	73	10	5	55.27389	-115.44833	municipal sewage	one facultative/storage cell	periodic	has never been discharged			Unnamed Creek			L
La Crete		86-ML-061 R1(9	P	SE	15	106	15	5	58.12861	-116.38806	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	BOD, TSS	1	fall	e course to a s	unper.d		L
La Glace		86-ML-006 R1(9	P	NE	10	74	8	6	55.34611	-119.14250	municipal sewage	two facultative treatment cells, one storage cell; flows in series from the facultative cells to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	ulligan Cree	unper.d		L
Lac La Biche		85-ML-020 R1(9	A	NE	26	66	14	4	54.69667	-112.00944	municipal sewage	a three cell aerated lagoon system with continuous discharge to Field Lake which flows into Lac La Biche	continuous	volume of discharge, BOD, TSS, temperature, pH, dissolved oxygen			Field Lake	aclabic.d		L
Lac Ste Anne Solid Waste Authority	Regional Sanitary Landfill	W0680	A	NE	18	55	3	5	53.71500	-114.42972	Regional Sanitary Landfill	Active								S
Lac Ste Anne Solid Waste Authority	Transfer Station	W0665	A	NW	17	54	4	5	53.62833	-114.55861	Transfer Station	Active								S
Lac Ste Anne Solid Waste Authority	Transfer Station	W0663	A	NE	12	55	2	5	53.70056	-114.15750	Transfer Station	Active								S
Lac Ste Anne Solid Waste Authority	Transfer Station	W0662	A	SW	35		3	5			Transfer Station	Active								S
Lac Ste Anne Solid Waste Authority	Waste Transfer Station	W0661	A	SE	31	56	6	5	53.84111	-114.87694	Transfer Station	Active								S
Lac Ste Anne Solid Waste Authority	Waste Transfer Station	W0676	A	SE	23	57	9	5	53.89889	-115.22667	Transfer Station	Active								S
Lac Ste Anne Solid WAste Authority	Waste Transfer Station	W0666	A	NE	4	56	5	5	53.77278	-114.67861	Transfer Station	Active								S
Lace Ste Anne Solid Waste Authority	Waste Transfer Station	W0664	A	SW	25	57	8	5	53.91333	-115.05889	Transfer Station	Active								S
Ledcor Industries Ltd.	Testo Pit	91-WL-034	A	W	4	55	14	5	53.68611	-116.01944	gravel washing			no data			McLeod River			L, S
Little Buffalo		86-ML-053 R1(92) A	P		3	86	14	5	56.37111	-116.13083	municipal sewage	one storage cell	periodic	no discharge in 1990, 1991, or 1992			Oxbow Channel			L
Little Smoky		88-ML-081	P	SW	30	66	21	5	54.69306	-117.18028	municipal sewage	one facultative cell; no discharge 1991	periodic	no data	1	fall	Iosegun River			L
Long Lake Regional Solid Waste Mgmt.	Long Lake Regional Landfill	D2	A	10	3	86	24	5	56.37111	-117.71028	Landfill	Active								S
Loon Lake School		93-ML-031	P	NE	8	87	9	5	56.47222	-115.38722	municipal sewage	one facultative cell, [1 storage cell after 10/94]	periodic	volume of discharge, BOD, TSS	1	fall	Loon River	unper.d		L
Luscar Sterco	Coal Valley	88-AL-307	A	NE	24	47	20	5	53.03639	-116.78389	Coal Mine			Opactiy 20%						G
Luscar Sterco (1977) Ltd	Coal Valley	92-WL-037 C	A	W	19	47	20	5	53.03639	-116.91167	coal processing	landfill		no data			File Not Available			L, S

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Manning		86-ML-022 R1(9	P	NW	27	91	23	5	56.86194	-117.59778	municipal sewage	two aerated cells with continuous effluent discharge	continuous	BOD, TSS, Nitrate plus Nitrite Nitrogen, Ammonia Nitrogen, Organic Nitrogen, Total Phosphate, pH			Notikewin Riv	anning.d	L
Manola		81-ML-006 R2(9	A	NE	9	59	2	5	54.04694	-114.23361	municipal sewage	one facultative-storage cell	periodic	no discharge 1990, no data for 1991 or 1992					L
Marie-Reine		91-ML-026	P	NW	6	82	21	5	56.02472	-117.29139	municipal sewage	one facultative cell, one storage cell	periodic	no discharge for 1991, no data for other years					L
Mayerthorpe		78-ML-042 R2(9	A	SW	23	57	8	5	53.89889	-115.08361	municipal sewage	four anaerobic cells, one facultative cell, two storage cells; flow is from the anaerobic cells in series to the facultative to the storage cell	periodic	BOD, TSS, Total Phosphorus, Nitrite Nitrogen, Nitrate plus Nitrite Nitrogen, Ammonia Nitrogen	2	spring/fall	Little Paddle	unper.d	L
McLennan		86-ML-007 R1(9	P	NW	29	77	19	5	55.64917	-116.91889	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flows from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	2	spring/fall	Kimiwan Lak	unper.d	L
MD of Smoky River #130	Modified Landfill Waste Management	R000047	P	NE	33	74	22	5	55.40389	-117.33139	Modified Landfill	Active							S
MD of Smoky River #130	Modified Landfill Waste Management	R000517	P	SW	25	79	22	5	55.81889	-117.29583	Modified Landfill	Active							S
MD of Smoky River #130	Modified Landfill Waste management	R000532	P	SE	4	76	20	5	55.50139	-117.03556	Modified Landfill	Active							S
MD of Westlock	Busby Modified Landfill	R435	A	NW	27	57	27	4	53.91694	-113.94083	Modified Landfill	Active							S
MD of WEstlock	Jarvie Modified Landfill	R395	A	SE	30	63	26	4	54.43306	-113.90861	Modified landfill	Active							S
MD of Westlock	Long Island Lake Modified landfill	M133	A	NE	30	63	25	4	54.43667	-113.75778	Modified landfill	Active							S
MD of Westlock	Fawcett Modified Landfill	R719	A	SE	17	64	1	5	54.49083	-114.11028	Modified landfill	Active							S
Meadowview School		86-ML-04 9R1(9	A	NE	4	58	5	5	53.94583	-114.68139	municipal sewage	one facultative cell	periodic	no data	1	fall	embina River		L
Meekwap Work Camp		89-ML-016	P	5	15	66	17	5	54.66417	-116.50306	municipal sewage	one facultative cell, one storage cell	periodic	no discharge in 1990, no data for other years			Goose River		L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Millar Western	Whitecourt	90-AL-312	A	SW	35	59	12	5	54.10111	-115.68694	Sawmill			none					G
Millar Western Industries Ltd.	Whitecourt	92-WL-203 A	A		24	60	14	5	54.16250	-115.96556	wood processing			no data					L, S
Municipal Affairs I.D. 17E	MSL	W0729	A	N	13	73	7	5	55.27389	-114.94111	MSL	Active							S
Mirror Landing Sand & Gravel	Smith	93-WL-127	A	NW	20	71	26	4	55.11528	-113.95611	gravel washing			no data			No Discharge		L
MLC Oil and Gas Ltd.	Cherhill	90-WL-178	A	4	17	57	5	5	53.88083	-114.71722	gas plant			no data			No Discharge		L
Mobil Oil Canada	Carson Creek	90-WL-194 B	A	SW	23	61	12	5	54.24556	-115.69389	gas plant			no data			Not Specified		L
Mobil Oil Canada Ltd.	Pembalta	92-AL-255	A	NE	16	49	8	5	53.19528	-115.10889	Sour Gas			SO2 0.050					G
Mobil Oil Canada Ltd.	Carson Creek	90-AL-354	A	SW	23	61	12	5	54.24556	-115.69389	Sour Gas			SO2 1.660					G
Moonshine Lake Prov. Park		92-ML-001	P	NW	4	80	8	6	55.85139	-119.19000	municipal sewage	one facultative cell, one storage cell; flow is from facultative cell to storage cell; truck sewage to lagoon	periodic	no discharge in 1991 or 1992, no data for other years					L
Morgan Hydrocarbons	Abee	92-AL-149	A	1	32	61	22	4	54.27083	-113.25972	Sour Gas			SO2 0.270					G
Morgan Hydrocarbons Inc.	Abee	92-WL-083	A	1	32	61	22	4	54.27083	-113.25972	gas plant			no data			No Discharge		L
Mostowich Lumber Ltd.	Fox Creek	92-AL-033	A	SW	18	62	18	5	54.31750	-116.70167	Sawmill			Particulate .6g/kg					G
Municipal Affairs I.D. 17E	Waste Transfer S	W0728	A	NW	36	65	2	5	54.62444	-114.16722	Waste Transfer S	Active							S
Municipal Affairs I. D. 17E	Modified Landfill	R649	A	SW	18	70	26	4	55.01056	-113.97333	ML	Active							S
Municipal Affairs I.D. 17	MSL	W0696	A	SE	8	73	11	5	55.25583	-115.65417	MSL	Active							S
Municipal Affairs I.D. 17 (C)	Modified Sanitary L.	R644	A	NW	33	73	13	5	55.31722	-115.94306	MSL	Active							S
Municipal Affairs I.D. 17C	Waste Transfer Station	W0980	A	10	33	88	4	5	56.61639	-114.56722	Waste Transfer S.	Active							S
Municipal Affairs I.D. 17	Modified Landfill Waste Management	R000721	A	NE	32	75	14	5	55.49056	-116.12556	Modified Landfill	Active							S
Municipal Affairs I.D. 17, Central	Modified Landfill Waste management	R000627	A	NE	31	76	17	5	55.57722	-116.62167	Modified Landfill	Active							S
Municipal Affairs I.D. 17C	Waste Transfer S.	W0981	A	NW	34	86	4	5	56.44333	-114.54500	Waste Transfer S.	Active							S
Municipal Affairs I.D. 17E	MSL	F900005	A	N	13	73	7	5	55.25944	-114.94111	MSL	Active							S
Municipal Affairs I.D. 17E	MSL	M132	A	SW	2	72	1	5	55.15500	-114.04139	MSL	Active							S
Municipal District of Fairview #126	Whitelaw Modified Landfill	R381	P	NE	15	82	1	6	56.05361	-118.06222	Modified Landfill	Active							S
Municipal District of Fairview #126	Highland Park Modified Landfill	R581	P	NW	30	81	5	6	55.99583	-118.77444	Modified Landfill	Active							S
Municipal District of Peace #135	Griffin Creek Modified Landfill	R660	P	SW	18	81	25	5	55.96333	-117.91167	Modified Landfill	Active							S

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Nampa		85-ML-016 R1(9	P	NE	18	81	20	5	55.96694	-117.12083	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flows are from the anaerobic to the facultative to the storage cell	periodic	no discharge 1990, 1991, or 1992; volume of discharge in 1988				munper.d	L
National Silicates Ltd.	Whitecourt	92-AL-407	A	NE	34	59	12	5	54.10472	-115.70556	Silicate			Particulate 0.2g/kg, Opacity 20%					G
National Slilicates Ltd.	Whitecourt	93-WL-037	A	NE	34	59	12	5	54.10472	-115.70556	earth product			no data			No Discharge		L
Neerlandia		87-ML-126 R1(9	A	NE	28	61	3	5	54.26361	-114.38500	municipal sewage	one facultative storage cell	periodic	no discharge 1990 or 1991, no data for 1992					L
Niton Junction		81-ML-04 9R3(9	A	NE	31	53	12	5	53.58500	-115.75861	municipal sewage	one facultative cell	periodic	no data (note: other discharge location = NW-30-53-7-W5)	1	fall	embina River		L
Norcen Energy Resources	Meyer	92-AL-375	A	12	2	70	25	4	54.98528	-113.72444	Sour Gas			SO2 0.106					G
Norcen Energy Resources	Grimshaw	90-AL-232	A	11	23	83	23	5	56.15444	-117.50861	Sour Gas			SO2 0.214					G
Norcen Energy Resources	Spirit River	92-AL-136	P	8	34	77	6	6	55.66000	-118.83250	Sour Gas			SO2 5.200					G
Norcen Energy Resources Ltd.	Meyer	92-WL-228 A	A		2	70	25	4	54.98528	-113.71806	gas plant			no data			No Discharge		L
Norcen Energy Resources Ltd.	Westlick/Jarvie	92-WL-113 A	A	7	15	60	2	5	54.14444	-114.20917	gas plant			no data			Not Specified		L
Norcen Energy Resources Ltd.	Grimshaw	90-WL-129	P	11	23	83	23	5	56.15444	-117.50861	gas plant			no data			No Discharge		L
Norcen Energy Resources Ltd	Spirit River	92-WL-076	P	8	34	77	6	6	55.66000	-118.83250	gas plant			no data			Not Specified		L
North Canadian Oils Ltd.	Carson Creek	91-WL-048	A	2	3	61	11	5	54.19861	-115.56250	gas plant			no data			Not Specified		L
North Canadian Oils Ltd	Saleski	93-WL-130	A	5	8	88	18	4	56.55528	-112.83722	gas plant			no data			No Discharge		L
North Canadian Oils Ltd.	Progress	92-WL-249	P	SE	1	78	10	6	55.67444	-119.41222	gas plant			no data			Not Specified		L
North Canadian Oils Ltd.	Saleski	93-AL-187	A	5	8	88	18	4	56.55528	-112.83722	Sour Gas			SO2 0.140, HCl 100 ppm					G
North Canadian Oils Ltd	Westlock	90-AL-009A	P	13	24	60	26	4	54.16611	-113.77167	Sour Gas			SO2 0.400					G
North Canadian Oils Ltd.	Carson Creek	91-AL-090	A	2	3	61	11	5	54.19861	-115.56250	Sour Gas			SO2 1.840					G
North Canadian Oils Ltd.	Progress	92-AL-379	A	SE	1	78	10	6	55.67444	-119.41222	Sour Gas			SO2 1.050					G
North Peace Asphalt Ltd	Peace River	92-WL-158	P	NW	31	83	21	4	56.18333	-113.29861	asphalt plant			no data			No Discharge		L
North Peace Asphalt Ltd.	Peace River	92-AL-259	P			83	21	5	56.11111	-117.16722	Asphalt	location questionable		Particulate 0.2kg/1000kg					G
Northern Alberta Nitrogen Ltd.	McLennan	91-WL-108	A	NE	23	76	19	5	55.54833	-116.82861	fertilizers			no data			Liscence		L
Northlands Forests	Ft. McMurray	87-AL-085	P	S	7	91	9	4	56.81500	-111.42639	Sawmill			none					G

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Northlands Forests	Ft. McMurray	87-AL-085	P	N	6	91	9	4	56.80417	-111.43306	Sawmill			none					G
Northstar		93-ML-017	P	NW	32	90	23	5	56.78972	-117.64306	municipal sewage	1 facultive'l storage cell has been in operation since the fall of 1992; no discharge as yet to date	periodic	no data (Note: other discharge location = SW-14-91-21-W5).	1	fall	uchanan Creek		L
Norwest Oil & Gas Corp.	Westlock/Jarvie	92-WL-113	A	7	15	60	2	5	54.14444	-114.20917	gas plant			no data			Not Specified		L
Numac Oil and Gas Ltd.	Tangent	90-AL-031	P		29	80	23	5	55.90917	-117.56389	Sour Gas			SO2 0.960					G
Obed Mountain Coal	Obed Marsh	89-AL-171	A		22	53	24	5	53.55611	-117.46500	Coal Mine			Particulate .2g/kg, Opacity 20%					G
Obed Mountain Coal Ltd.		92-WL-042 C	A			52	23	5			coal processing	landfill, location questionable		no data			File Not Available		S, L
Olympia Energy Ventures Ltd.	Gordondale	93-WL-098	P	11	26	79	9	6	55.82250	-119.29167	gas plant			no data			No Discharge		L
Olympia Energy Ventures Ltd.	Worsley	93-WL-097	P	11	22	87	7	6	56.50111	-119.02306	gas plant			no data			Liscence		L
OSLO Alberta Ltd.	Kearl Lake Lease 31	90-WL-119	A	NE	20	95	8	4	57.19389	-111.25056	tar sand			no data			Not Specified		L
Paddle Prairie Metis STLM		87-ML-022	P	SW	20	103	22	5	57.88333	-117.58694	municipal sewage	one facultative, one storage	periodic	has never been discharged	1	fall	Boyer River		L
Paloma Petroleum Ltd.	Hotchkiss	93-WL-024	P	7	13	94	3	6	57.08917	-118.33278	gas plant			no data			No Discharge		L
Paloma Petroleum Ltd	Hotchkiss	93-AL-030	P	7	13	94	3	6	57.08917	-118.33278	Sour Gas			none					G
Pan Canadian Petroleum Ltd.	Rycroft	92-WL-205	P	8	25	77	6	6	55.64583	-118.78056	gas plant			no data			No Discharge		L
PanCanadian Petroleum	Rycroft	92-AL-328	P	8	25	77	6	6	55.64583	-118.78056	Sour Gas			SO2 0.300					G
Paramount Resources	Saleski	93-AL-112	A	8	36	86	19	4	56.43972	-112.85778	Sour Gas			SO2 0.052					G
Paramount Resources	South Liege	91-AL-322	A	15	30	90	19	4	56.77889	-113.02306	Sour Gas			none					G
Paramount Resources	Liege	90-AL-377	A	6	29	92	20	4	56.94500	-113.17722	Sour Gas			none					G
Paramount Resources Ltd.	Saleski	92-WL-186	A	SW	36	86	19	4	56.43972	-112.87111	gas plant			no data			No Discharge		L
Paramount Resources Ltd.	Saleski	93-WL-086 A	A	SE	36	86	19	4	56.43972	-112.86444	gas plant			no data			No Discharge		L
Paramount Resources Ltd.	Liege	91-WL-002	P	6	29	92	20	4	56.94500	-113.17722	gas plant			no data			No Discharge		L
Paramount Resources Ltd.	South Liege	91-WL-165	P	15	30	90	19	4	56.77889	-113.02306	gas plant			no data			No Discharge		L
Paramount Resources Ltd.	Industrial L.	N00033	A		31	94	18	4	57.20000	-112.70000	Industrial L.	Active							S
Paramount Resources Ltd.	Industrial L.	N00034	A		36	86	19	4	56.40000	-112.80000	Industrial L.	Active							S
Peace R. In-Situ Plnt (Shell)		89-WL-030 A (clos	P	13	24	85	19	5	56.33139	-116.87139	industrial	one evaporation cell		no data			Not Specified		L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Peace River		92-ML-024 A1(9	P	N	6	84	21	5	56.19778	-117.47000	municipal sewage	four anaerobic cells located on Lees Island in the Peace River, with continuous effluent discharge to the Peace River, in the fall of 1992 a sampling program was carried out in regards to building a secondary treatment facility (target date'municipal se	continuous	No sampling program for wastewater. In July and Sept of 1992 on 7 occasions the wastewater was analyzed for: physical parameters, major ions, nutrients, metals, solids, BOD, COD, oil & grease, anion/cation ratio, reactive silica, surfa'continuous			Peace River	eacer.db	L
Peace River Airport			P	SW	8	84	21	5	56.20861	-117.27944	municipal sewage	unknown	periodic	1991 and 1992 data		unknown	Unknown	unper.d	L
Peace River Corrections		88-ML-072 R1(9	P	NW	31	82	27	5	56.09694	-118.23444	municipal sewage	oxidation ditch treatment process with two clarification units, effluent disinfection with chlorine gas and sludge dewatering with continuous effluent discharge	continuous	volume of discharge, BOD, TSS, COD, pH, dissolved oxygen			Peace River	rcorrec.d	L
Peavine Metis Settlement	Modified Landfill Waste Management	R000437	A	SW	5	79	15	5	55.76111	-116.30667	Modified Landfill Waste Management	Active							S
Peerless Lake School		87-ML-111 R1(9	P	NW	28	88	4	5	56.60194	-114.57389	municipal sewage	one aerobic unit/evaporative	periodic	not discharged 1990; discharged in Oct. of 1992 - BOD, TSS; 1991 ???; volume of discharge in 1988				munper.d	L
Peers		85-ML-014 R1(9	A	E	16	54	14	5	53.62472	-116.00917	municipal sewage	one facultative cell	periodic	no data	1	fall	January Creek		L
Pembina Resources Ltd	Hotchkiss North	91-WL-140	P	SW	35	94	2	6	57.13250	-118.20500	gas plant			no data			No Discharge		L
Pembina Resources Ltd.	Hotchkiss	91-AL-282	P	SW	35	94	2	6	57.13250	-118.20500	Sour Gas			SO2 0.112					G
Pensionfund Energy	Granor	93-AL-162	A	7	25	83	18	4	56.16528	-112.68806	Incinerator			HCl 100 ppm					G
Pensionfund Energy Resources	Granor	93-WE-009	A	7	25	83	18	4	56.16528	-112.68806	compresor station			no data					L, S

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Peoria		87-ML-009 R1(9	P	NE	25	76	3	6	55.56278	-118.32000	municipal sewage	one facultative/storage cell	periodic	volume of discharge in 1988; no discharge 1990, 1991, or 1992				munper.d	L
Petro-Canada	Swan Hills	87-AL-345	A		32	67	9	5	54.79750	-115.33500	Sweet Gas			none					G
Petro-Canada	Hanlan-Robb	93-AL-015	A	NE	2	49	20	5	53.16639	-116.81972	Sour Gas			SO2 40.100					G
Petro-Canada Exploration	Whitecourt	91-AL-123	A	12	26	59	11	5	54.09028	-115.54361	Sour Gas			SO2 15.000					G
Petro-Canada Exploration	Brazeau River	93-AL-165	A	4	31	48	12	5	53.14472	-115.75278	Sour Gas			SO2 14.600					G
Petro-Canada Exploration	Kaybob	93-AL-057	A	8	9	64	19	5	54.47639	-116.80139	Sour Gas			SO2 10.300					G
Petro-Canada Exploration	Gold Creek	91-AL-243	P	NW	26	67	5	6	54.78306	-118.65000	Sour Gas			SO2 6.000					G
Petro-Canada Inc.	Brazeau River	90-WL-106 A	A	NW	30	48	12	5	53.13750	-115.74694	gas plant			no data			Not Specified		L
Petro-Canada Inc.	Hanlon-Robb	93-WL-010	A	NE	2	49	20	5	53.16639	-116.81972	gas plant			no data			Not Specified		L
Petro-Canada Resources	Whitecourt	91-WL-121	A	12	26	59	11	5	54.09028	-115.54361	gas plant			no data			Not Specified		L
Pibroch		85-ML-015 R1(9	A	SE	6	61	26	4	54.20222	-113.89222	municipal sewage	one storage cell	periodic	volume of discharge, BOD, TSS	1	spring	Bath Creek	unper.d	L
Pine Shadow Estates		88-ML-092	A	SW	28	53	16	5	53.56694	-116.30694	municipal sewage	one facultative cell	periodic	discharged in 1991 but no sampling data, no data at all for other years	1	fall	nnamed Cree	unper.d	L
Plamondon		88-ML-050 R1(9	A		2	68	16	4	54.81194	-112.32944	municipal sewage	four anaerobic cells, one facultative cell, one storage cell	periodic	no discharge in 1991, no data for 1990 or 1992					L
Poco Petroleums Ltd.	Sturgeon Lake S.	92-AL-020	P	SE	2	69	22	5	54.89500	-117.24500	Sour Gas			SO2 12.480					G
Power Resource Development Crp	Whitecourt	90-WP-032 B	A	NE	4	60	12	5	54.11917	-115.73417	co-generation power plant			no data			No Discharge		L
Procor Limited	Lynton	92-AL-048A	A	NW	18	88	7	4	56.57306	-111.10500	Sulphur			none					G
Procor Sulpher Services Inc.	Lynton	92-WL-128 C	A	NE	13	88	8	4	56.57306	-111.12472	storage & handling			no data			No Discharge		L
Procter & Gamble Cellulose	Sanitary Landfill	R0248	A	W	23	70	5	5	55.05000	-118.63000	Sanitary L.	Active, location questionable							S
Ranchmen's Resources	Whitecourt	93-AL-280	A	10	36	59	13	5	54.10472	-115.80556	Sour Gas			SO2 0.140					G
Ranchmen's Resources Ltd.	Whitecourt	92-WL-107	A	10	36	59	13	5	54.10472	-115.80556	gas plant			no data			No Discharge		L
Ranger Oil Ltd.	Galloway	92-AL-390	A	14	14	53	20	5	53.54528	-116.84889	Sour Gas			SO2 2.800					G
Redearth Creek		89-ML-023	P	SE	26	87	9	5	56.51194	-115.30778	municipal	one facultative cell	periodic	no data	1	fall	Loon River		L
Redearth Creek-AB Forest Serv		87-ML-128 R1(9	P	4	13	87	9	5	56.47944	-115.29444	municipal sewage	two aerobic cells; disposal by evaporation	none	no data					L
Redearth Creek-AB Forest Serv		87-ML-128 R1(9	P	5	13	87	9	5	56.48306	-115.29444									L
Renaissance Energy Ltd.	Bolloque	90-WL-068	A	16	2	65	25	4	54.55583	-113.66611	gas plant			no data			No Discharge		L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Renaissance Energy Ltd.	Westlock Clyde	92-WL-229	A	15	11	59	25	4	54.05056	-113.62667	gas plant			no data			No Discharge		L
Renaissance Energy Ltd.	Baptiste Lake	93-WL-076	A	14	34	65	24	4	54.62806	-113.55250	gas plant			no data			No Discharge		L
Renaissance Energy Ltd.	Baptiste Lake	93-AL-099	A	14	34	65	24	4	54.62806	-113.55250	Sour Gas			SO2 0.584					G
Renaissance Energy Ltd.	Westlock	92-AL-357	A	15	11	59	25	4	54.05056	-113.62667	Sour Gas			SO2 0.440					G
Renaissance Energy Ltd.	Bolloque	90-AL-109A	A	16	2	65	25	4	54.55583	-113.66611	Sour Gas			SO2 0.400					G
Ridge Valley		86-ML-050 R1(91) A	P	NW	14	71	26	5	55.10083	-117.87944	municipal sewage	one facultative cell, one storage cell; flow is from the facultative cell to the storage cell	periodic	volume of discharge, BOD, NFR, TSS	1	fall	ornwall Cree	unper.d	L
Rigel Oil & Gas Ltd	Progress	93-WL-059	P	7	22	78	9	6	55.71778	-119.30833	gas plant			no data			Not Specified		L
Rigel Oil & Gas Ltd.	Josephine	90-WL-172 A	P	NE	1	83	10	6	56.11111	-119.42778	gas plant			no data			Not Specified		L
Rio Alto Exploration Ltd.	South Algar	93-WE-012	A	16	1	82	17	4	56.02833	-112.51833	compresor station			no data					L, S
Rio Alto Exploration Ltd.	South Algar	93-AL-145	A	16	1	82	17	4	56.02833	-112.51833	Compressor			none					G
Robb		80-ML-076 R2(9	A	NW	23	49	21	5	53.20972	-116.97250	municipal sewage	two anaerobic cells, on facultative cell, two storage cells; flow is from the anaerobic to the facultative to the storage cells	periodic	discharged May 1991, no data. Letter says last prior discharge was 5 years ago	2	spring/fall	Hay Creek	unper.d	L
Rochester		91-ML-050	A	NE	13	62	24	4	54.32111	-113.47361	municipal sewage	two anaerobic cells, one storage cell		no data			No Discharge		L
Rochfort Bridge		90-ML-031	A	SW	18	57	7	5	53.88444	-115.03389	municipal sewage		periodic	no data	1	fall	Paddle River		L
Rycroft		80-ML-033 R1(9	P	NE	16	78	5	6	55.70694	-118.71083	municipal sewage	two anaerobic cells, one facultative cell, on storage cell, flow is from the anaerobic cells, in series, to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	Spirit River	unper.d	L
Sandy Lake		90-ML-014	P	SE	6	79	22	4	55.76111	-113.41972	municipal sewage	one evaporation cell	none	no data					L
Sangudo		80-ML-050 R1(89) A	A	SE	36	56	7	5	53.84111	-114.90167	municipal sewage	four anaerobic cells, one facultative cell, two storage cells; flow is from the anaerobic to the facultative to the storage cell	periodic	BOD, TSS, colour, turbidity	2	spring/fall	embina Rive	unper.d	L
Scot Ltd.	Edmonton	66-WL-666	A								industrial	location not specified		no data			No Information		L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Sexsmith		78-ML-037 R1(9	P	SE	30	73	5	6	54.49444	-115.92528	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; are proposing as of Feb 1993 to upgrade the facility as retention time is down to 4.5 months	periodic	volume of discharge, BOD, TSS, pH, Ammonia Nitrogen, Nitrate plus Nitrite Nitrogen, Organic Nitrogen, Total Phosphate	2	spring/fall	Unknown	unper.d	L
Shell Canada	PREP	92-AL-166B	P	SE	21	85	18	5	56.32417	-116.77889	Heavy Oil			SO2 14.000					G
Shell Canada Ltd.	Hope Creek	90-WL-181	A	10	17	64	13	5	54.99611	-115.49028	gas plant			no data			No Discharge		L
Shell Canada Ltd.	House Mountain	90-WL-145	A	SE	8	70	10	5	56.32778	-116.83833	gas plant			no data			No Discharge		L
Shell Canada Ltd.	Peace River	92-WL-035	P		19	85	18	5	56.32417	-116.84500	oil collection/processing site	inactive on-site landfill							L
Shell Canada Ltd.	Peace River	92-WL-035 A	P	5	19	85	18	5	55.67444	-119.41222	tar sand	landfill		no data			File Not Available		S, L
Shell Canada Ltd.	Progress	90-WL-123	P	SE	1	78	10	6	54.09028	-115.68694	gas plant			no data			Not Specified		L
Shell Canada Products Ltd.		91-WL-017	A		26	59	12	5	56.33139	-116.87139	miscellaneous			no data			McLeod River		L
Shell Canada Resources	House Mnt.	90-AL-315	A	SE	8	70	10	5	54.99611	-115.49028	Sour Gas			SO2 0.076					G
Shell Canada Resources	Hope Creek	91-AL-045	A	10	17	64	13	5	54.49444	-115.92528	Sour Gas			SO2 19.600					G
Shell-Peace River In-Situ		89-WL-030 (Close	P	13	24	85	19	5	55.23056	-114.75306	industrial sewage	lagoon - discharge to surrounding watershed	periodic	BOD,TSS			Unknown		L
Slave Lake		80-ML-053 R1(8	A	NE	31	72	5	5	55.11528	-114.03500	municipal sewage	aerated lagoon system with three aerated cells	continuous	BOD, TSS, temperature, pH, dissolved oxygen			Sawridge Cree	lavelke.d	L
Smith	Athabasca River	6-ML-052 R1(9	A	NE	23	71	1	5	53.95667	-119.12944	municipal sewage	two anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic cells in series to the facultative to the storage cell	periodic	has not been discharged to this date					L
Smokey River Coal		92-WL-126	A	E	9	58	8	6	55.98139	-119.63722	coal mine	active landfill							L
Smoky River Coal Ltd.	Grande Cache	92-AL-247	A	15	10	58	8	6	53.96389	-119.10472	Coal Mine			Particulate .2g/kg					G
Smoky River Coal Ltd.	Grande Cache	92-AL-247	A	20	10	58	8	6	53.95306	-119.10472	Coal Mine			Particulate .2g/kg					G
Solex Energy	Bonanza	93-AL-115	P	11	22	81	11	6	55.98139	-119.63722	Sour Gas			H2S negligible					G
Solex Energy Corp.	Bonanza	93-WL-085	P	11	22	81	11	6	55.73222	-118.84083	gas plant			no data			No Discharge		L
Spirit River		80-ML-043 R2(9	P	SE	27	78	6	6	56.15083	-117.10806	municipal sewage	three anaerobic cells, two facultative cells, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS	1	fall	Rat Creek	unper.d	L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

St. Isadore		89-ML-007	P	SE	20	83	20	5	54.71111	-113.25611	municipal sewage	two facultative cells	periodic	volume of discharge, BOD, TSS	1	fall	nnamed Cree	unper.d	L
Stel-Marr Concrete Ltd.	Athabasca	90-WL-066	A	NW	34	66	22	4	54.85167	-113.39083	gravel washing			no data			No Discharge		L, S
Stel-Marr Concrete Ltd.	Athabasca, Baron Pit	91-WL-144	A	SE	23	68	23	4	55.01778	-117.69889	gravel washing			no data			No Discharge		L, S
Sturgeon Heights Community		88-ML-057	P	13	13	70	25	5	53.67167	-116.15722	municipal sewage	one evaporation cell	none	no data					L
Summer Village of Sandy Beach	Modified Sanitary Landfill	R175		SE	9	56	1	5	53.78361	-114.08361	MSL	Active							S
Summer Village of Silver Sands	Modified Sanitary Landfill	W0669		NW	34	53	5	5	53.58500	-114.65583	MSL	Active							S
Suncor Inc.	North Rosevear	91-WL-118	A	NE	33	54	15	5	53.61389	-116.10778	gas plant			no data			Not Specified		L
Suncor Inc.	South Rosevear	91-WL-187	A	NE	11	54	15	5	55.96333	-119.86583	gas plant			no data			Not Specified		L
Suncor Inc.	Boundary Lake - South	93-WL-190	P	SE	18	81	12	6	56.93417	-111.48972	gas plant			no data			Not Specified		L
Suncor Inc.	Fort McMurray	92-WL-147	A	8	25	92	10	4	54.46194	-112.73194	oil snads extraction plant	landfill							L
Suncor Inc.	Ft. McMurray	92-AL-359D	A		23	92	10	4	56.93417	-111.48972	Oilsands			SO2 360.000, Particulate 0.2kg/1000kg					G
Suncor Inc.	Rosevear S.	91-AL-392A	A	NE	11	54	15	5	53.61389	-116.10778	Sour Gas			SO2 15.800					G
Suncor Inc.	Rosevear N.	92-AL-170	A	NE	33	54	15	5	53.67167	-116.15722	Sour Gas			SO2 9.000					G
Suncor Inc.	Simonette	92-AL-346	P	NW	6	63	25	5	54.37889	-117.76389	Sour Gas			SO2 10.000					G
Suncor Inc.	Bear Canyon	93-AL-275	A	SE	18	84	12	6	56.22306	-119.87806	Sour Gas			SO2 1					G
Suncor Inc.	Industrial L.	N00035	A			92	1	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00037	A		24	92	10	4	57.00000	-111.40000	Industrial L.	Active							S
Suncor Inc.	Industrial L.	N00038	A		13	92	10	4	56.90000	-111.50000	Industrial L.	Active							S
Suncor Inc.	Industrial L.	N00039	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00040	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00041	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00042	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00043	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00044	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc.	Industrial L.	N00045	A			92	10	4			Industrial L.	Active, location questionable							S
Suncor Inc. Oil Sands Group		92-WL-147A	A		23	92	10	4	56.93056	-111.50333	tar sand			NH3, AS, CD, COD, CR, CO, CU, FE, PB, MN, HG, MO, NI, TSS, O&G, PH, PHENOLS, SE, AG, SULPHIDE, TON, TOC, V, ZN			Athabasca Riv	uncor.db	L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Suncor Inc. Oil Sands Group	Fort McMurray	92-WL-147 B	A	8	22	92	10	4	56.94500	-111.44972	tar sand	landfill		no data			Athabasca River		L, S
Superior Rock Products Ltd	Boyle	91-WL-139	A	SE	1	64	19	4	56.16528	-117.45611	gravel washing			no data			No Discharge		L, S
Surestart Auto Electric	Peace River	92-WL-012	P	SW	30	83	22	5	54.66417	-115.42694	metal product			no data			No Discharge		L
Swan Hills		80-ML-004 R3(9	A	S	15	66	10	5	56.94861	-111.73083	municipal sewage	four anaerobic cells, one facultative cell, five storage cells; flow is from the anaerobic cells in series to the facultative to the storage cells	periodic	volume of discharge, BOD, TSS, temperature, pH	2	spring/fall	Morse Creek	unper.d	L
Syncrude	Ft. McMurray	89-AL-174D	A			93	10	4			Oilsands	location questionable		SO2 292.000, Particulate 0.2kg/1000kg, NOx 51.600					G
Syncrude Canada Ltd.	Fort McMurray	92-WL-146	A		29	92	11	4	56.87639	-111.75389	Oil sands extraction plant	2 on-site landfills							L
Syncrude Canada Ltd	Mildred Lake	92-WL-146 C	A			92	10	4			tar sand	landfill, location questionable		no data			Beaver Creek Ruth Lake		L, S
Syncrude Canada Ltd.	Industrial L.	N00046	A			93	10	4			Industrial L.	Active location questionable							S
Syncrude Canada Ltd.	Industrial L.	N00047	A		2	93	11	4	57.10000	-111.60000	Industrial L.	Active							S
Syncrude Canada Ltd	Industrial L.	N00048	A		34	92	11	4	57.05000	-111.60000	Industrial L.	Active							S
Talisman Energy Inc.	Sundance	92-WL-178 A	A	7	9	54	21	5	56.94861	-111.78444	gas plant			no data			No Discharge		L
Talisman Energy Inc.	Edson	92-WL-177 A	A	SW	11	53	18	5	53.61028	-117.04611	gas plant			no data			Not Specified		L
Talisman Energy Inc.	Edson	93-AL-241	A	SW	11	53	18	5	53.52361	-116.55333	Sour Gas			SO2 24.300					G
Talisman Energy Inc.	Sundance	92-AL-284	A	7	9	54	21	5	53.61028	-117.04611	Sour Gas			none					G
Tangent		87-ML-031 R1(9	P	SW	33	78	24	5	53.52361	-116.55333	municipal sewage	one facultative/storage cell	periodic	no data as no discharge in 1990, 1991, or 1992					L
Thunder Lake Recr Subd.		87-ML-125 R1(9	A	NW	19	59	5	5	55.74667	-117.67833	municipal sewage	one evaporation cell	none	no data					L
Tiger Calcium Inc.	Slave Lake	92-WL-050	A	5	29	72	4	5	54.07583	-114.73889	chemical plant			no data			File Not Available		L
Tiger Calcium Inc.	Slave Lake	90-AL-349	A	5	29	72	4	5	55.21250	-114.58639	Calcium			Particulate 0.2kg/1000kg					G
Timmerman Alta Stone Processor	Nisku	93-WE-005	A								earth product	location not specified		no data					L
Total Petroleum	Progress	93-AL-077	P	NE	1	83	10	6	56.11111	-119.42778	Sour Gas			H2S negligible					G
Total Petroleum Ltd	Progress	93-AL-077	P	7	22	78	9	6	55.71778	-119.30833	Sour Gas			H2S negligible					G
Town of Athabasca	Athabasca	R394	A	SE	28	66	22	4	54.69306	-113.27528	WMF	Active							S
Town of Edson	MSL	X068	A	NE	9	53	17	5	53.52722	-116.44861	MSL	Active							S

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Town of Fairview	Fairview Dry Disposal	P1	P	SW	10	82	3	6	56.03556	-118.38306	Dry Disposal	Active							S
Town of Fairview	Fairview Modified Landfill	R545	P	SW	27	82	3	6	56.07889	-118.38306	Modified Landfill	Active							S
Town of Falher	Modified Landfill Wste Management	R000702	P	NW	15	78	21	5	55.70694	-117.18500	Modified Landfill	Active							S
Town of Girouxville	Modified landfill Waste management	R000541	P	SE	17	78	22	5	55.70333	-117.38611	Modified Landfill	Active							S
Town of Grande Cache	MSL	R195	P			57	8	5			MSL	Active, location questionable							S
Town of High Level	Landfill	W0379	P	SE	1	110	20	5	58.44611	-117.19167	Landfill	Active							S
Town of High Prairie	Modified landfill Waste Management	R000522	P	NW	24	74	18	5	55.37500	-116.64250	Modified Landfill	Active							S
Town of McLennan	Modified Landfill Waste Management	R000645	P	NE	23	77	19	5	55.63500	-116.83472	Modified Landfill	Active							S
Town of Peace River	Transfer Station	R000572	P	SW	30	84	21	5	56.25194	-117.30583	Transfer Station								S
Town of Sexsmith	MSL	W0840	P	SE	26	73	6	6	55.29917	-118.80611	MSL	Active							S
Town of Slave Lake	MSL	R333	A	13	17	72	5	5	55.19083	-114.74028	MSL	Active							S
Town of Slave Lake	MSL	R333	A	14	17	72	5	5	55.19083	-114.73389	MSL	Active							S
Town of Slave Lake	MSL	W0726	A	13	17	72	5	5	55.19083	-114.74028	MSL	Active							S
Town of Slave Lake	MSL	W0726	A	14	17	72	5	5	55.19083	-114.73389	MSL	Active							S
Town of Slave Lake	MSL	R141	A	13	17	72	5	5	55.19083	-114.74028	MSL	Active							S
Town of Slave Lake	MSL	R141	A	14	17	72	5	5	55.19083	-114.73389	MSL	Active							S
Town of Spirit River	MSL	W0058	P			78	6	6			MSL	Active, location questionable							S
Town of Stony Plain	Sanitary Landfill	W1196			35	52	1	5	53.49833	-114.03972	Sanitary Landfill	Active							S
Town of Valleyview	MSL	W0652	P	NE	35	70	23	5	55.05750	-117.40528	MSL	Active							S
Town of Vulcan	Dry Disposal Site	X066	P	SW	4	17	24	4	50.39111	-113.24944	Dry Disposal Site	Active							S
Town of Wembley	MSL	W0841	P	NW	4	72	8	6	55.15861	-119.16972	MSL	Active							S
Triple L Mobile Home Park		87-ML-133 R1 (9	P	NE	23	71	5	6	55.11528	-118.64917	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, TSS, NFR	1	fall	ive Mile Cree	unper d	L
Ulster Petroleum Ltd	Cadotte	93-WL-179	P	10	34	86	18	5	56.44333	-116.75861	gas plant			no data			No Discharge		L
Ulster Petroleums Ltd	Cadotte	93-AL-267	P	10	34	86	18	5	56.44333	-116.75861	Sour Gas			SO2 0 060					G
Ultramar Oil and Gas	Nosehill	84-AL-261	A		19	55	20	5	53.72944	-116.95972	(Shut in)								G
Union Oil	Industrial L.	N00013	A		31	87	19	4	56.58000	-113.02000	Industrial L	Active, location questionable							S

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Unocal Canada Ltd.	Saleski	92-WL-098	A	8	36	86	19	4	56.43972	-112.85778	gas plant			no data			No Discharge		L
Unocal Canada Ltd.	Liege	92-WL-010	P	14	21	89	21	4	56.67778	-113.28917	gas plant			no data			No Discharge		L
Unocal Canada Ltd.	East Liege Crow Lake	92-WL-097	P	7	17	90	20	4	56.74278	-113.15639	gas plant			no data			No Discharge		L
Unocal Canada Ltd.	East Liege	92-AL-022	P	7	17	90	20	4	56.72833	-113.18306	(Shut in)								G
Unocal Canada Ltd.	West Leige	91-AL-383	P	14	21	89	21	4	56.67778	-113.28917	Sour Gas			SO2 0.162					G
Unocal Canada Ltd.	Industrial L.	N00049	A		5	88	19	4	56.60000	-112.90000	Industrial L.	Active							S
Valleyview		86-ML-021 R2(9	P	SE	21	70	22	5	55.02500	-117.30306	municipal sewage	four anaerobic cells, one facultative cell, one storage cell	periodic	volume of discharge, BOD, TSS	1	fall	nnamed Cree	unper.d	L
Village of Beiseku	Tansfer Station	X004		NW	31	81		5			Transfer Station	Active, location questionable							S
Village of Boyle	Boyle	W0724	A	SE	36	64	19	4	54.53417	-112.73194	WMF	Active							S
Village of Donnelly	Modified Landfill Waste Management	R000519	P	NE	1	78	21	5	55.67806	-117.12639	Modified Landfill	Active							S
Village of Eaglesham	MSL	W0637	P	SE	36	78	26	5	55.74667	-117.90583	MSL	Active							S
Village of Hines Creek	Hines Creek Modified Landfill	W0518	P	SE	12	84	5	6	56.20861	-118.64139	Modified Landfill	Active							S
Village of Hythe	MSL	R0594	P	SW	30	74	10	6	55.38583	-119.53528	MSL	Active							S
Village of Kinuso	MSL	R431	P	E	9	73	10	5	55.25583	-115.47417	MSL	Active							S
Village of Nampa	Nampa	92-WL-169	P	NW	19	81	20	5	55.98139	-117.12722	asphalt plant			no data			No Discharge		L
Village of Nampa	Nampa	92-AL-282	P	NW	19	81	20	5	55.98139	-117.12722	Asphalt			Particulate 1.2/1000kg					G
Village of Nampa	Modified Landfill	R000632	P	SE	19	81	21	5	55.97778	-117.27750	Modified Landfill	Active							S
Village of Plamondon	Plamondon Landfill	W0721	A	NW	36	67	16	4	54.79750	-112.29889	Landfill	Active							S
Village of Rycroft	MSL	W0645	P	SE	29	78	5	6	55.73222	-118.73694	MSL	Active							S
Village of Wanham	MSL	W0641	P	SW	13	78	3	6	55.70333	-118.32778	MSL	Active							S
Wabasca		90-ML-051 R1(9	P	NE	32	80	25	4	55.92361	-113.87056	municipal sewage	two aerated lagoon cells, effluent disinfection with chlorine gas with continuous effluent discharge	continuous	BOD, TSS, temperature, pH, dissolved oxygen			Unnamed Cree	abasca.d	L
Wagner		93-ML-016	A	3	24	73	7	5	55.28111	-114.94111	municipal sewage	one evaporation pond	none	no data					L
Wandering River		86-ML-009 R1(9	A	SW	1	72	17	4	55.15500	-112.47750	municipal sewage	one facultative cell, one storage cell; flow is from the facultative to the storage cell	periodic	BOD, TSS, dissolved oxygen, pH	1	fall	a Biche Rive	unper.d	L
Wanham	Saddle River	6-ML-044 R1(9	P	SE	10	78	3	6	55.68889	-118.37333	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, TSS	1	fall		munper.d	L
Watino		87-ML-030 R1(9	P	SW	2	78	24	5	55.67444	-117.62639	municipal sewage	one facultative/storage cell	periodic	no discharge 1990, 1991, 1992					L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Weldwood of Canada Ltd.	Slave Lake	91-WL-001	A	NW	29	72	4	5	55.21611	-114.58000	wood processing			no data					L, S
Wembley		80-ML-040 R2(9	P	SE	22	71	8	6	55.11167	-119.13528	municipal sewage	four anaerobic cells, one facultative cell, one storage cell; flow is from the anaerobic to the facultative to the storage cell	periodic	volume of discharge, BOD, TSS, pH, Ammonia Nitrogen, Nitrate plus Nitrite Nitrogen, Organic Nitrogen, Total Phosphate	2	spring/fall	nnamed Cree	unper.d	L
Westlock		80-ML-052 R2(9	A	NW	12	60	27	4	54.13361	-113.91556	municipal sewage	four anaerobic cells, two facultative cells, three storage cells; flow is from the anaerobic to the facultative to the storage cells	periodic	volume of discharge, BOD, TSS, pH, Nitrate and Nitrite Nitrogen, Total Phosphate	1	fall	Wabash Cree	unper.d	L
Westwind Mobile Home Park		92-ML-046	A	SW	6	66	22	4	54.63528	-113.33222	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, NFR	1	fall	Muskeg Cree	unper.d	L
Weyerhaeuser	Slave Lake	93-AL-025	A	NW	29	72	4	5	55.21611	-114.58000	OSB			Particulate .2, .6g/kg					G
Weyerhaeuser	Edson	89-AL-196	A	NE	23	53	17	5	53.55611	-116.39917	OSB			Particulate .2g/kg					G
Weyerhaeuser	Grande Cache	92-AL-397	P	10	9	57	6	6	53.87361	-118.82917	Sawmill			none					G
Weyerhaeuser Canada Ltd.	Slave Lake	93-WL-020	A	NW	29	72	4	5	55.21611	-114.58000	wood processing			no data			Not Specified		L, S
Whitecourt		79-ML-001 R2(9	A	SE	1	60	12	5	54.11556	-115.65917	municipal sewage	extended aeration plant with grit removal, an aeration section and secondary clarification with continuous	continuous	volume of discharge, BOD, TSS, BOD loading, TSS loading, pH, dissolved oxygen, temperature			Athabasca Riv	whtcrt.db	L
Whitecourt Regional Solid Waste	Sanitary Landfill	W1194	A	NW	29	58	10	5	54.00361	-115.45944	Sanitary Landfill	Active							S
Whitecourt Regional Solid Waste	Waste Transfer Station	W1195	A	SW	30	59	11	5	54.08667	-115.63694	Transfer Station	Active							S
Whitelaw		81-ML-033 R2(9	P	NW	15	82	1	6	56.05361	-118.06861	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, TSS	1	fall	Leith River	unper.d	L
Wildwood		81-ML-048 R1(89) A	A	NW	34	53	9	5	53.58500	-115.24722	municipal sewage	two anaerobic cells, one facultative cell, two storage cells; flow is from the anaerobic to the facultative to the storage cells	periodic	BOD, TSS, Ammonia Nitrogen, Nitrate plus Nitrite Nitrogen, Organic Nitrogen, Total Phosphate	1	fall	Lobstick Rive	unper.d	L

TABLE B.1

Source File for Licenced Sewage and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

Woking		81-ML-046 R2(9	P	SW	19	76	5	6	55.54472	-118.76611	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, TSS	1	fall	raeburn Cree	unper.d	L
Woodland Cree Band No. 474		93-ML-012	P	SE	19	86	15	5	56.41083	-116.36222	municipal sewage	one facultative cell, one storage cell	periodic	no data	1	fall	Martin River		L
Worsley		86-ML-019 R1(9	P	SW	36	86	8	6	56.43972	-119.12639	municipal sewage	one facultative/storage cell	periodic	volume of discharge, BOD, TSS	1	fall	nnamed Cree	unper.d	L
Young's Point Provincial Park		81-ML-025 R1(9	P	SW	14	71	24	5	55.09722	-117.57222	municipal sewage	one facultative cell, one storage cell; flow is from the facultative to the storage cell	periodic	BOD, TSS	1	fall	Eagle Creek	unper.d	L
Zeidler Forest Industries Ltd.	Slave Lake	92-WL-060	A		30	72	4	5	55.21611	-114.60556	wood processing			no data			No Discharge		L, S
Ziedler Forest	Mitsue Lake	89-AL-109	A	SE	31	72	4	5	55.22694	-114.59917	Sawmill			Particulate 6g/kg					G
Penzoil Petroleum		X0845	A	13	36	66	27	4	54.71472	-113.97139	Modified Landfill	Active							S
	Industrial Landfill	N00012	A	28	33	95	7	4	57.21917	-111.05500	Industrial Land.	Active							S
	Industrial L.	N00017	A	14	31	94	18	4	57.20000	-112.87000	Industril L.	Active, location questionable							S
	Industrial L.	N00022	A	2		74	8	4			Industrial L.	Active, location questionable							S
	Industrial L.	N00025	A		2	73	6	4	55.20000	-110.80000	Industrial L.	Active							S
	Industrial L.	N00036	A			92	10	4			Industrial L.	Active, location questionable							S
		W0005	A	NE	1	78	21	5	55.67806	-117.12639		Active							S

APPENDIX C

LIQUID EFFLUENT DATABASE FOR CONTINUOUSLY DISCHARGING SEWAGE TREATMENT PLANTS

TABLE C1.1:*
Liquid Effluent Database for Athabasca, January 1990 to March 1993

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
1/1/90	861	13.0	11.0	7.3	6.0	7
2/1/90	902	17.0	8.0	7.2	4.0	7
3/1/90	953	20.0	11.0	7.2	7.0	7
4/1/90	811	15.0	8.0	7.4	9.0	7
5/1/90	896	34.0	40.0	8.1	13.0	7
6/1/90	942	40.0	28.0	7.3	17.0	7
7/1/90	1020	41.0	10.0	7.5	18.0	7
8/1/90	990	11.0	7.0	7.2	17.0	7
9/1/90	986	8.0	5.0	7.4	13.0	7
10/1/90	989	12.0	5.0	7.3	9.0	7
11/1/90	897	11.0	9.0	7.4	6.0	7
12/1/90	843	38.0	9.0	7.3	5.0	7
1/1/91	895	20.0	6.0	6.6	5.0	7
2/1/91	867	20.0	9.0	6.9	5.0	7
3/1/91	939	12.0	8.0	7.2	5.0	7
4/1/91	849	12.0	5.0	5.8	6.0	7
5/1/91	955	37.0	23.0	7.7	14.0	7
6/1/91	1075	20.0	10.0	7.1	16.0	7
7/1/91	1004	17.0	7.0	7.2	19.0	7
8/1/91	938	4.0	7.0	7.1	19.0	7
9/1/91	990	5.0	6.0	7.0	15.0	7
10/1/91	954	5.0	5.0	7.2	9.0	7
11/1/91	975	18.0	6.0	7.1	7.0	7
12/1/91	941	11.0	11.0	6.9	5.0	7
1/1/92	884	6.0	11.0	6.9	2.0	7
2/1/92	928	13.0	13.0	7.1	5.0	7
3/1/92	909	9.0	10.0	7.8	8.0	7
4/1/92	953	8.0	13.0	7.8	11.0	7
5/1/92	942	9.0	8.0	6.2	10.0	7
6/1/92	1007	4.0	11.0	6.0	12.0	7
7/1/92	1002	3.0	4.0	7.3	15.0	7
8/1/92	1029	7.0	4.6	7.2	17.0	7
9/1/92	1016	5.0	4.0	7.3	14.0	7
10/1/92	1002	5.0	4.0	7.4	15.0	7
11/1/92	975	9.0	21.0	7.5	12.0	7
12/1/92	967	8.0	12.0	7.4	11.0	7
1/1/93	1007	10.0	10.0	7.4	13.0	7
2/1/93	1011	20.0	8.0	7.5	11.0	7
3/1/93	1035	14.0	9.0	7.9	8.0	7

*** Please note that all files in Appendix C have also been provided to NRBS on a computer diskette; however, the dBase IV format has been modified here for better presentation.**

TABLE C1.2:
Liquid Effluent Database for Barrhead, January 1990 to March 1993

DATE (M/D/Y)	BOD (M/D/Y)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
1/1/90	11.0	15.0	8.3	1.0	5.1
2/1/90	13.0	12.0	8.3	1.0	3.9
3/1/90	18.0	12.0	8.1	2.0	4.7
4/1/90	23.0	23.0	7.9	5.0	9.6
5/1/90	38.0	85.0	8.4	13.0	9.1
6/1/90	23.0	34.0	7.8	17.0	5.7
7/1/90	13.0	19.0	7.9	19.0	5.6
8/1/90	30.0	61.0	9.0	21.0	15.4
9/1/90	29.0	59.0	9.0	15.0	7.0
10/1/90	14.0	21.0	8.0	5.0	7.5
11/1/90	14.0	18.0	8.4	3.0	10.3
12/1/90	17.0	12.0	7.5	1.0	5.2
1/1/91	20.0	7.0	7.6	2.0	5.2
2/1/91	20.0	6.0	7.9	1.0	6.2
3/1/91	20.0	9.0	8.1	2.0	4.8
4/1/91	21.0	11.0	7.5	3.0	6.0
5/1/91	19.0	23.0	8.5	12.0	8.4
6/1/91	11.0	16.0	7.7	16.0	6.2
7/1/91	25.0	21.0	8.0	21.0	6.2
8/1/91	42.0	47.0	9.2	20.0	9.3
9/1/91	12.0	17.0	8.5	14.0	5.8
10/1/91	16.0	13.0	8.2	7.0	6.3
11/1/91	21.0	24.0	*	3.0	7.9
12/1/91	15.0	15.0	*	2.0	5.7
1/1/92	11.0	8.0	*	1.0	3.6
2/1/92	13.0	7.0	*	1.0	4.7
3/1/92	16.0	7.0	*	2.0	4.9
5/1/92	38.0	63.0	*	13.0	10.1
6/1/92	24.0	31.0	*	18.0	4.2
7/1/92	28.0	46.0	*	20.0	6.5
8/1/92	19.0	56.0	*	19.0	13.6
9/1/92	13.0	53.0	*	11.0	10.0
10/1/92	8.0	43.0	*	6.0	10.2
11/1/92	6.0	30.0	*	3.0	10.8
12/1/92	5.0	16.0	*	2.0	6.6
1/1/93	7.0	11.0	*	2.0	4.2
2/1/93	6.0	11.0	*	2.0	4.3
3/1/93	9.0	11.0	*	3.0	5.9

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.3:
Liquid Effluent Database for Edson, January 1990 to March 1993

DATE (M/D/Y)	FLOW (gal./d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
1/1/90	504847.00	11.40	3.90	7.70	1.00	9.50
2/1/90	418455.00	9.80	5.40	7.60	1.00	7.70
3/1/90	687317.00	12.80	8.30	7.60	2.00	11.20
4/1/90	686976.00	19.90	24.80	7.90	7.00	10.00
5/1/90	842113.00	33.50	44.30	8.50	81.20	9.90
6/1/90	1523716.00	19.30	50.20	8.80	17.00	8.50
7/1/90	1334695.00	10.40	11.50	7.80	21.00	4.50
8/1/90	888750.00	12.00	14.50	8.30	20.00	5.90
9/1/90	769241.00	13.40	24.20	8.50	15.00	8.60
10/1/90	741306.00	8.50	22.90	8.20	6.00	7.90
11/1/90	550567.00	5.90	6.60	8.20	1.00	9.70
12/1/90	741725.00	16.30	5.60	8.10	0.40	8.90
1/1/91	754282.00	19.40	8.80	7.70	0.30	8.10
2/1/91	763000.00	16.10	8.30	7.70	0.20	7.70
3/1/91	977282.00	15.20	8.30	7.50	0.20	4.80
4/1/91	1515950.00	24.60	12.60	7.60	4.00	8.40
5/1/91	1589104.00	25.00	44.00	8.70	14.00	9.30
6/1/91	1185491.00	21.60	32.90	8.90	16.00	7.70
7/1/91	957815.00	16.20	16.00	8.00	19.00	4.50
8/1/91	1911592.00	20.50	24.10	8.50	20.00	8.00
9/1/91	1557500.00	12.00	22.90	8.50	14.00	7.20
10/1/91	1183298.00	9.50	7.70	7.60	8.30	7.80
11/1/91	640550.00	9.60	2.40	7.70	0.40	9.80
12/1/91	343637.00	6.50	6.00	7.70	0.60	9.00
1/1/92	341718.00	11.30	6.20	7.70	0.40	7.60
2/1/92	396647.00	15.00	8.00	7.00	0.60	7.30
3/1/92	505024.00	11.70	8.30	7.50	1.00	8.90
4/1/92	511025.00	12.70	23.10	8.10	12.00	7.10
5/1/92	*	19.50	29.80	8.60	13.00	9.30
6/1/92	*	4.80	21.30	8.30	18.00	4.80
7/1/92	1041975.00	11.80	15.90	8.40	19.00	4.30
8/1/92	673960.00	5.20	14.30	8.80	19.00	8.20
9/1/92	774192.00	3.50	6.60	8.10	7.60	4.80
10/1/92	614693.00	2.30	4.00	8.10	6.00	8.80
11/1/92	574708.00	5.00	4.70	7.90	2.00	10.60
12/1/92	1072600.00	9.00	10.80	7.90	0.80	9.90
1/1/93	*	10.30	7.30	7.80	1.00	9.10
2/1/93	*	10.90	8.70	7.80	1.00	7.40
3/1/93	*	15.00	9.00	7.80	1.00	7.40

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.4:
Liquid Effluent Database for Fort Chipewyan, January 1990 to November 1992

DATE (M/D/Y)	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)
4/1/90	18.0	25.0	9.0
7/1/90	8.0	27.0	10.0
12/1/91	34.0	49.0	33.0
9/1/92	67.0	48.0	21.0
11/1/92	65.0	82.0	68.0

TABLE C1.5:
Liquid Effluent Database for Fort McMurray, January 1990 to March 1993

DATE (M/D/Y)	FLOW (mg/d)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)
1/1/90	14.000	19.0	*	14.0	7.9	1.0
2/1/90	14.000	22.0	65.0	9.0	8.1	1.0
3/1/90	15.000	20.0	68.0	11.0	8.0	2.0
4/1/90	16.000	23.0	73.0	10.0	8.1	4.0
5/1/90	16.000	20.0	92.0	21.0	8.1	13.0
6/1/90	17.000	29.0	63.0	13.0	8.1	20.0
7/1/90	14.000	28.0	64.0	10.0	8.3	22.0
8/1/90	14.000	28.0	65.0	12.0	8.3	20.0
9/1/90	15.000	25.0	54.0	10.0	8.2	14.0
10/1/90	14.000	20.0	46.0	13.0	8.2	7.0
11/1/90	13.000	19.0	54.0	8.0	8.1	1.0
12/1/90	13.000	17.0	*	14.0	7.9	1.0
1/1/91	0.000	23.0	68.0	12.0	7.9	1.0
2/1/91	11.000	22.0	71.0	12.0	7.9	1.0
3/1/91	13.000	22.0	70.0	14.0	8.0	2.0
4/1/91	13.000	22.0	70.0	10.0	8.0	8.0
5/1/91	11.000	15.0	50.0	21.0	8.2	15.0
6/1/91	15.000	27.0	*	12.0	8.2	19.0
7/1/91		26.0	*	9.0	8.2	21.0
8/1/91		29.0	*	15.0	8.3	21.0
9/1/91		17.0	*	8.0	8.2	15.0
10/1/91		15.0	*	8.0	8.3	7.0
11/1/91		26.0	*	9.0	8.2	1.0
12/1/91		12.0	*	9.0	8.0	1.0
1/1/92		16.0	65.0	11.0	7.9	0.0
2/1/92		18.0	80.0	11.0	7.9	1.0
3/1/92		16.0	65.0	11.0	7.9	2.0
4/1/92		17.0	60.0	17.0	8.0	7.0
5/1/92		26.0	65.0	21.0	8.3	14.0
6/1/92		25.0	65.0	11.0	8.1	18.0
7/1/92		11.0	60.0	8.0	8.1	20.0
8/1/92		16.0	60.0	8.0	8.1	20.0
9/1/92		11.0	50.0	5.0	8.1	13.0
10/1/92		15.0	55.0	12.0	8.1	7.0
11/1/92		18.0	60.0	18.0	8.1	2.0
12/1/92		17.0	60.0	12.0	8.0	-1.0
1/1/93		23.0	65.0	15.0	7.8	0.0
2/1/93		19.0	*	13.0	7.7	0.0
3/1/93		21.0	70.0	16.0	7.9	1.0

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.6:
Liquid Effluent Database for Fort Smith, January 1990 to December 1993

DATE (M/D/Y)	FLOW (Imp. gal./mon.)	BOD (mg/L)	TSS (mg/L)	pH	TOTAL COLIFORMS (NPDL)	FECAL COLIFORMS (NPDL)
1/3/90	(a)	72.0	21.0	6.90	1300000.00	290000.00
2/7/90	(a)	98.0	14.0	6.98	*	600000.00
3/7/90	(a)	104.0	25.0	6.98	*	380000.00
4/4/90	(a)	101.0	22.0	7.32	*	900000.00
5/2/90	(a)	71.0	30.0	7.02	900000.00	110000.00
6/6/90	(a)	37.0	60.0	7.54	500000.00	27000.00
7/11/80	(a)	33.0	41.0	8.82	2000.00	260.00
8/1/90	(a)	25.0	59.0	8.61	1000.00	5.00
9/5/90	(a)	29.0	50.0	7.68	25000.00	2900.00
10/3/90	(a)	16.0	43.0	7.85	160000.00	15000.00
11/7/90	(a)	75.0	26.0	7.00	2500000.00	35000.00
12/5/90	(a)	71.0	17.0	7.34	1900000.00	630000.00
1/9/91	3877728	99.0	37.0	7.61	1400000.00	280000.00
2/6/91	3502464	120.0	38.0	7.16	2300000.00	480000.00
3/6/91	3877728	113.0	35.0	6.80	1300000.00	280000.00
4/10/91	3752640	124.0	39.0	7.06	1900000.00	220000.00
5/1/91	3877728	95.0	28.0	6.90	900000.00	170000.00
6/5/91	3752640	31.0	65.0	7.90	300000.00	8000.00
7/3/91	3877728	43.0	101.0	7.58	*	23000.00
8/7/91	3877728	30.0	59.0	9.38	*	*
9/11/91	3752640	37.0	38.0	7.40	*	290.00
10/1/91	3877728	49.0	5.0	7.70	*	4000.00
11/6/01	3752640	47.0	18.0	7.21	*	440000.00
12/1/91	3877728	115.0	20.0	7.60	*	390000.00
1/8/92	3877728	*	28.0	6.58	*	100000.00
2/5/92	3502464	122.0	24.0	7.04	*	270000.00
3/4/92	3877728	200.0	28.0	7.17	1400000.00	130000.00
4/8/92	3752640	127.0	26.0	6.92	*	240000.00
5/13/92	3877728	40.0	20.0	7.12	570000.00	370000.00
6/3/92	3752640	*	50.0	7.35	*	*
7/8/92	3877728	47.2	392.0	7.25	380000.00	107000.00
8/5/92	3877728	25.2	44.0	10.01	2000.00	100.00
9/2/92	3752640	33.0	72.0	9.58	34000.00	800.00
10/7/92	3877728	18.0	32.0	8.05	113000.00	16000.00
11/4/92	3752640	36.0	32.0	7.25	1400000.00	300000.00
12/9/92	3877728	96.0	42.0	6.89	1700000.00	900000.00
1/7/93	3877728	106.0	27.0	6.91	1600000.00	700000.00
2/3/93	3502464	118.0	25.0	6.85	1600000.00	500000.00
3/3/93	3877728	*	25.0	8.64	*	*
4/7/93	3752640	*	38.0	7.31	*	610000.00
5/5/93	3877728	*	8.0	7.07	430000.00	70000.00
6/2/93	3752640	*	56.0	7.35	32000.00	2200.00
7/7/93	3877728	*	117.0	8.46	22000.00	21000.00
8/4/93	3877728	*	45.0	8.72	5750.00	3650.00
9/8/93	3752640	*	60.0	8.76	*	4450.00
10/13/93	3877728	*	17.0	7.13	600000.00	83000.00
11/3/93	3752640	*	11.0	7.38	1000000.00	290000.00
12/1/93	3877728	100.5	14.0	6.92	1600000.00	410000.00

* = zeros in original dBase IV are believed to be "no data".

(a) The total annual discharge for 1990 was 45,657,120 Imperial gallons. The mean total discharge would be 3,804,760 Imperial gallons per month.

TABLE C1.7:
Liquid Effluent Database for Grande Cache, January 1990 to March 1993

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
1/1/90	1824	6.0	1.0	7.3	8.0	1.5
2/1/90	1849	5.0	1.0	7.5	7.0	1.6
3/1/90	1859	5.0	1.0	7.7	8.0	1.3
4/1/90	1873	5.0	1.0	7.8	9.0	1.6
5/1/90	2176	5.0	1.0	7.3	11.0	1.3
6/1/90	2869	4.8	1.1	7.6	12.0	1.6
7/1/90	2852	4.0	1.0	7.3	14.0	2.0
8/1/90	2326	4.2	1.0	7.2	16.0	1.8
9/1/90	2402	4.0	1.0	7.3	15.0	1.5
10/1/90	2183	3.7	1.1	7.1	12.0	2.5
11/1/90	1979	3.4	1.0	7.2	9.0	3.4
12/1/90	1980	3.1	1.0	7.2	7.0	2.5
1/1/91	1940	4.2	1.0	7.3	8.0	1.7
2/1/91	2247	5.0	1.0	7.5	6.0	2.7
3/1/91	2077	4.0	1.0	6.9	7.0	2.5
4/1/91	2429	4.0	1.0	6.8	9.0	2.0
5/1/91	3190	3.5	1.0	6.8	10.0	2.8
6/1/91	2502	3.7	1.0	6.8	13.0	1.8
7/1/91	2295	4.0	1.0	6.9	14.0	3.8
8/1/91	2468	3.0	1.0	6.8	15.0	3.2
9/1/91	2025	3.0	1.0	6.7	15.0	2.3
10/1/91	1895	3.0	1.0	6.7	12.0	3.0
11/1/91	1917	3.4	1.0	6.7	10.0	3.4
12/1/91	1762	3.0	1.0	6.7	9.0	3.3
1/1/92	1734	3.3	1.0	6.8	8.0	2.5
2/1/92	1822	3.0	1.0	6.7	8.0	3.7
3/1/92	1813	4.0	1.0	6.7	9.0	1.7
4/1/92	1689	5.0	1.0	6.7	9.0	1.8
5/1/92	1773	5.0	1.0	6.7	11.0	1.7
6/1/92	1859	4.0	1.0	6.7	14.0	1.8
7/1/92	1828	3.0	1.0	6.7	15.0	2.2
8/1/92	1816	2.4	1.0	6.7	16.0	2.9
9/6/92	1762	2.5	1.0	6.7	14.0	2.6
10/1/92	1730	3.3	1.0	6.8	12.0	1.4
11/1/92	1689	3.0	1.0	6.8	10.0	1.6
12/1/92	1607	2.4	1.0	6.8	7.0	2.0
1/1/93	1700	5.0	4.0	6.7	6.0	1.6
2/1/93	1700	3.0	2.0	6.7	7.0	1.8
3/1/93	1815	2.0	2.0	6.8	8.0	1.6

TABLE C1.8:
Liquid Effluent Database for Grande Prairie, January 1990 to March 1993

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)
1/1/90	8484	5.4	2.7
2/1/90	8925	7.3	2.2
3/1/90	10401	6.3	3.7
4/1/90	9885	8.6	6.3
5/1/90	11813	10.9	10.5
6/1/90	15483	7.3	4.0
7/1/90	11176	7.9	3.9
8/1/90	10309	6.3	7.6
9/1/90	10303	5.1	11.6
10/1/90	9371	3.6	3.0
11/1/90	8769	3.3	1.7
12/1/90	8260	5.2	1.2
1/1/91	9227	6.1	1.7
2/1/91	9231	7.6	1.8
3/1/91	10498	5.4	1.1
4/1/91	11959	7.6	2.7
5/1/91	11920	14.7	12.6
6/1/91	11489	10.0	6.5
7/1/91	10533	7.1	2.9
8/1/91	10751	9.1	6.6
9/1/91	11748	9.8	7.7
10/1/91	9638	8.6	7.2
11/1/91	9035	6.7	2.3
12/1/91	8135	9.2	1.8
1/1/92	8333	11.1	3.9
2/1/92	10496	8.7	6.1
3/1/92	11794	13.0	4.5
4/1/92	10203	12.2	5.3
5/1/92	10823	19.7	20.7
6/1/92	11153	19.0	10.4
7/1/92	10795	14.7	5.0
8/1/92	10279	12.5	2.9
9/1/92	9871	6.6	4.7
10/1/92	9026	8.7	10.0
11/1/92	10044	7.0	2.5
12/1/92	8269	4.3	2.1
1/1/93	12988	6.0	1.9
2/1/93	20536	3.6	1.3
3/1/93	16426	9.2	2.6

TABLE C1.9:
Liquid Effluent Database for Jasper, December 1991 to December 1992

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXGYEN (mg/L)
12/1/91	3719	15.4	13.4	7.9	4.0	11.4
1/1/92	3708	*	12.1	7.4	3.0	*
2/1/92	3719	*	16.8	7.5	3.0	*
3/1/92	3830	20.0	19.5	7.7	6.0	10.9
4/1/92	3616	26.9	74.4	8.1	10.0	10.6
5/1/92	2107	33.1	135.9	7.7	13.0	8.2
6/1/92	4852	23.0	21.0	7.6	17.0	7.2
7/1/92	5471	38.3	47.3	7.3	19.0	5.1
8/1/92	5598	45.5	33.6	7.5	17.0	11.7
9/1/92	4771	13.9	26.4	7.7	12.0	7.9
10/1/92	3590	10.1	16.1	7.8	9.0	4.4
11/1/92	3166	12.1	18.5	7.8	6.0	*
12/1/92	3183	18.2	11.9	7.7	3.0	*

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.10:
Liquid Effluent Database for Lac La Biche, January 1990 to March 1993

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERTAURE (°C)	DISSOLVED OXYGEN (mg/L)
1/1/90	366090	62.1	60.2	8.1	6.0	9.0
2/1/90	345203	40.8	11.6	7.4	3.0	10.4
3/1/90	368606	41.4	8.8	8.0	4.0	10.7
4/1/90	341993	51.2	8.9	7.7	5.0	10.8
5/1/90	378435	24.9	14.2	8.1	14.0	9.8
6/1/90	374553	32.2	15.2	7.6	20.0	5.7
7/1/90	380745	7.0	13.0	*	*	*
8/1/90	331896	15.3	12.2	7.9	23.0	0.0
9/1/90	346198	29.5	9.8	7.7	20.0	7.5
10/1/90	352200	44.4	11.2	7.8	12.0	9.2
11/1/90	331883	29.9	7.1	8.1	5.0	11.3
12/1/90	313203	27.8	7.9	8.0	5.0	10.5
1/1/91	296890	12.6	9.6	7.8	4.0	11.2
2/1/91	305300	20.5	8.8	7.4	6.0	12.2
3/1/91	305346	19.2	9.0	7.8	19.0	10.2
4/1/91	281813	18.8	11.3	7.9	5.0	10.8
5/1/91	286403	13.6	15.1	7.8	15.0	8.2
6/1/91	293520	25.7	25.6	7.6	21.0	9.2
7/1/91	208700	49.7	21.1	8.2	23.0	7.9
8/1/91	106725	32.1	15.1	8.1	25.0	6.9
9/1/91	142280	15.8	8.6	8.2	17.0	8.5
10/1/91	149464	32.3	33.1	8.1	9.0	9.8
11/1/91	140547	20.6	22.1	8.1	4.0	11.8
12/1/91	127839	19.9	10.4	7.9	4.0	11.5
1/1/92	137394	19.2	10.9	7.7	5.0	10.2
3/1/92	208416	12.5	7.5	8.2	4.0	10.8
4/1/92	*	12.5	7.4	8.4	10.0	10.1
5/1/92	*	12.2	15.8	8.5	18.0	8.9
6/1/92	*	36.8	68.1	8.7	21.0	8.6
7/1/92	480278	13.8	77.9	8.5	24.0	7.9
8/1/92	484677	18.0	12.4	8.5	22.0	8.1
9/1/92	432960	11.3	11.8	8.4	15.0	8.6
10/1/92	432000	17.4	13.4	8.4	11.0	9.2
11/1/92	370780	18.5	15.2	8.3	7.0	9.3
12/1/92	372248	10.5	4.1	8.1	4.0	9.5
1/1/93	394029	11.5	12.4	8.0	8.0	9.9
2/1/93	387521	37.4	25.8	8.4	22.0	12.8
3/1/93	397168	24.0	8.0	8.4	6.0	11.0

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.11:
Liquid Effluent Database for Manning, September 1990 to March 1993

DATE (M/D/Y)	FLOW (gal./d)	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)	pH	NINA (mg/L)	NH_3 (mg/L)	ORGANIC N (mg/L)	TOTAL PO_4 (mg/L)
9/1/90	*	16.80	12.80	10.50	7.70	0.70	7.10	35.40	12.80
10/1/90	*	19.80	31.80	20.80	7.80	0.70	18.30	9.70	19.50
11/1/90	*	14.80	10.30	5.00	7.60	0.50	19.30	11.90	13.80
12/1/90	*	17.00	20.30	16.30	7.60	<0.2**	21.20	7.80	15.00
1/1/91	107270.00	25.80	24.60	17.80	7.60	<0.2**	22.00	10.50	17.20
2/1/91	111887.00	29.30	26.00	19.00	7.40	<0.2**	24.20	17.80	18.00
3/1/91	121398.00	25.80	21.00	18.30	7.50	<0.2**	22.80	10.10	16.60
4/1/91	122086.00	19.60	20.40	17.60	7.50	<0.2**	20.00	4.80	14.60
5/1/91	120710.00	13.80	12.00	11.30	7.60	<0.2**	22.20	8.60	13.00
6/1/91	124033.00	16.80	20.00	13.00	7.60	<0.2**	19.30	4.10	12.60
7/1/91	116104.00	11.20	9.60	6.00	7.70	<0.2**	24.00	6.00	13.60
8/1/91	103572.00	17.30	13.50	8.50	7.60	<0.2**	21.90	8.70	13.10
9/1/91	.106976.00	13.80	8.50	7.50	7.80	<0.2**	17.00	8.70	12.80
10/1/91	95658.00	8.20	7.60	6.40	7.70	<0.2**	18.30	0.60	12.70
11/1/91	86334.00	19.50	14.80	7.50	7.60	<0.2**	16.20	6.30	12.90
12/1/91	88537.00	51.40	32.60	17.40	7.40	<0.2**	21.90	2.30	13.70
1/1/92	84655.00	22.80	21.80	15.00	7.40	<0.2**	14.60	14.00	19.40
2/1/92	95275.00	24.00	8.30	13.00	7.30	<0.2**	20.90	9.40	14.50
3/1/92	131329.00	14.60	18.20	14.00	7.40	<0.2**	16.50	15.20	13.40
4/1/92	128594.00	15.50	16.30	10.50	7.60	0.20	15.10	14.70	11.50
5/1/92	125232.00	17.50	29.30	27.30	7.80	<0.2**	12.90	15.70	12.90
6/1/92	123772.00	14.30	22.50	*	*	*	*	*	*
7/1/92	110487.00	26.20	32.40	*	*	*	*	*	*
8/1/92	98460.00	23.50	19.50	*	*	*	*	*	*
9/1/92	95215.00	18.00	18.60	*	*	*	*	*	*
10/1/92	93688.00	14.00	9.50	*	*	*	*	*	*
11/1/92	92323.00	21.00	18.00	*	*	*	*	*	*
12/1/92	85824.00	15.20	12.20	*	*	*	*	*	*
1/1/93	*	19.80	14.30	9.00	7.20	<0.2**	24.70	11.90	16.00
2/1/93	*	20.30	16.50	10.50	7.20	<0.2**	28.10	12.00	15.60
3/1/93	*	18.50	20.00	13.00	7.20	<0.2**	25.10	10.20	14.70

* = zeros in original dBase IV are believed to be "no data".
** = <0.02 replaced with 0.1 for statistical analyses on Table C2.11

TABLE C1.12:
Liquid Effluent Database forPeace River, July and September, 1992

DATE (M/D/Y)	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)	COD (mg/L)	pH	NH_3 (mg/L)	T PO_4 (mg/L)	COND (mg/L)
7/20/92	134.0	194.0	136.0	770.0	7.1	14.00	7.06	1000.00
7/21/92	116.0	102.0	100.0	754.0	7.2	14.00	8.90	1030.00
7/23/92	152.0	9.5	260.0	334.0	8.5	11.00	11.00	1100.00
7/24/92	115.0	79.0	66.0	470.0	7.8	9.00	56.40	1050.00
7/25/92	74.2	224.0	82.0	899.0	8.0	9.10	2.99	897.00
9/13/92	170.0	255.0	496.0	293.0	7.1	0.94	1.51	936.00
9/16/92	83.4	137.0	128.0	336.0	7.0	7.84	5.50	873.00

DATE (M/D/Y)	T ALK (mg/L)	P ALK (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	OH (MGPL)	HARD (MGPL)	Cl (mg/L)	Fl (mg/L)
7/20/92	237.00	<10.0	289.00	<1.0	<1.0	192.00	39.20	0.86
7/21/92	245.00	<10.0	299.00	<1.0	<1.0	215.00	45.60	1.05
7/23/92	312.00	<25.0	320.00	30.0	<1.0	439.00	66.90	1.23
7/24/92	250.00	<10.0	305.00	<1.0	<1.0	202.00	48.40	1.23
7/25/92	250.00	<10.0	305.00	<1.0	<1.0	210.00	36.40	1.23
9/13/92	267.00	<10.0	325.00	<1.0	<1.0	199.00	38.70	0.65
9/16/92	243.00	<10.0	296.00	<1.0	<1.0	160.00	38.50	0.70

DATE (M/D/Y)	TKN (mg/L)	NO_3 (mg/L)	NO_2 (mg/L)	SULP (mg/L)	PHEN (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)
7/20/92	18	0.89	<0.33	152.00	83.00	46.40	18.60	83.60
7/21/92	13	<0.44	<0.33	157.00	29.00	54.60	19.00	92.00
7/23/92	11	<0.44	<0.33	141.00	46.00	113.00	38.20	105.00
7/24/92	35.0	0.89	<0.33	137.00	57.00	48.60	19.60	90.10
7/25/92	34.0	0.44	<0.33	112.00	63.00	48.50	21.60	74.90
9/13/92	<1.0	<0.10	<0.10	108.00	3.07	47.60	19.50	83.70
9/16/92	26.7	<0.10	<0.10	102.00	55.00	40.00	14.50	81.80

DATE (M/D/Y)	K (mg/L)	Al (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)
7/20/92	10.10	0.080	<0.003	<0.01	<0.01	0.06	0.37	<0.04
7/21/92	10.60	0.080	<0.003	<0.01	<0.01		0.52	<0.04
7/23/92	9.25	0.120	<0.003	<0.006	<0.007	0.05	0.44	<0.042
7/24/92	27.60	0.106	<0.003	<0.006	<0.007	0.039	0.766	<0.042
7/25/92	21.10	0.170	<0.003	<0.006	<0.007	0.056	0.431	<0.042
9/13/92	10.60	0.317	<0.003	<0.006	<0.007	0.052	0.587	<0.042
9/16/92	13.50	0.176	<0.003	<0.006	<0.007	0.040	2.00	<0.042

DATE (M/D/Y)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	V (mg/L)	Zn (mg/L)	RSIO2 (mg/L)	O G M (mg/L)
7/20/92	0.07	<0.01	<0.02	<0.08	<0.01	0.04	3.90	26.80
7/21/92	0.13	<0.01	<0.02	<0.08	0.01	0.05	8.40	20.80
7/23/92	0.08	<0.008	<0.015	<0.075	<0.009	0.10	7.80	5.60
7/24/92	0.057	<0.008	<0.015	<0.075	<0.009	0.093	12.00	23.20
7/25/92	0.066	<0.008	<0.015	<0.075	<0.009	0.086	10.00	50.90
9/13/92	0.088	<0.008	<0.015	<0.075	<0.009	0.032	8.05	12.00
9/16/92	0.152	<0.008	<0.015	<0.075	<0.009	0.079	8.37	23.40

DATE (M/D/Y)	OD NO (mg/L)	TDS (mg/L)	TS (mg/L)	TOC (mg/L)	TIC (mg/L)	TC (mg/L)	SURF (mg/L)
7/20/92	20	641.00	971.00	33.00	58.00	91.00	4.05
7/21/92	3	679.00	881.00	37.50	43.90	81.40	0.00
7/23/92	3	825.00	1090.00	64.30	64.60	129.00	2.75
7/24/92	2	472.00	551.00	56.40	5.70	62.10	4.30
7/25/92	10	428.00	652.00	40.20	3.89	44.10	5.00
9/13/92	10	733.00	983.00	26.10	55.20	81.30	14.80
9/16/92	>100	588.00	725.00	42.70	55.00	97.70	15.10

"<" values were halved for statistical analyses on Table C2.12.

TABLE C1.13:
Liquid Effluent Database for Peace River Correctional Centre, January 1990 to March 1993

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	VSS (mg/L)	pH	DISSOLVED OXYGEN (mg/L)	CL_2 (kg/d)
1/1/90	324	10.9	19.0	10.9	9.7	6.8	9.5	1.18
2/1/90	324	10.6	34.7	9.3	9.7	6.6	8.2	2.18
3/1/90	376	8.7	32.3	9.5	10.0	6.4	8.1	1.38
4/1/90	508	7.2	25.7	11.3	11.2	6.6	7.7	1.40
5/1/90	480	9.8	40.0	19.2	14.3	6.7	6.0	1.57
6/1/90	431	5.9	24.7	6.0	7.8	6.5	6.4	0.99
7/1/90	419	4.0	21.8	6.0	6.5	6.5	7.2	1.07
8/1/90	375	4.0	19.5	6.5	5.0	6.6	8.7	1.03
9/1/90	314	4.6	21.0	6.9	5.8	6.6	9.0	1.09
10/1/90	323	7.6	23.0	3.8	4.4	6.5	9.1	1.26
11/1/90	309	9.6	38.8	10.5	7.5	6.3	9.0	1.60
12/1/90	320	10.9	68.0	16.4	17.2	6.4	8.7	4.10
1/1/91	281	9.0	63.3	9.4	12.1	6.4	8.4	2.20
2/1/91	296	6.1	53.0	7.0	8.9	6.7	8.6	1.10
3/1/91	323	6.0	46.0	7.0	8.2	6.7	8.6	1.10
4/1/91	325	6.3	32.6	3.1	5.3	6.8	8.5	1.13
5/1/91	366	4.6	28.1	3.8	4.0	6.8	7.4	1.16
6/1/91	353	4.2	29.4	3.8	1.7	6.7	6.9	1.19
7/1/91	391	5.5	29.0	3.4	4.7	6.8	6.6	1.60
8/1/91	446	3.7	16.8	2.2	2.1	6.8	7.1	1.50
9/1/91	356	3.8	18.7	3.8	3.3	6.7	9.1	1.51
10/1/91	332	3.1	28.8	6.4	6.7	6.5	9.1	1.30
11/1/91	347	3.6	*	4.7	6.0	6.6	9.8	1.36
12/1/91	255	4.5	*	3.7	4.6	6.6	9.3	1.32
1/1/92	264	3.6	*	9.3	9.2	6.4	8.4	1.21
2/1/92	306	4.2	*	8.2	7.7	6.4	8.2	1.33
3/1/92	325	6.5	*	10.0	8.9	6.4	6.9	1.45
4/1/92	326	7.3	*	12.5	13.1	6.5	6.3	1.10
5/1/92	*	6.2	*	13.4	11.3	6.1	7.2	1.60
6/1/92	*	3.7	*	8.2	6.0	6.4	7.0	1.80
7/1/92	84	2.4	*	4.8	4.9	6.8	7.0	1.52
8/1/92	71	2.0	*	4.0	3.2	6.8	7.4	1.33
9/1/92	100	3.2	*	5.0	3.0	6.9	7.6	1.42
10/1/92	56	3.2	*	4.4	0.0	6.8	8.3	1.83
11/1/92	91	2.7	*	4.1	4.7	6.7	8.1	1.61
12/1/92	70	4.0	*	5.7	4.2	6.5	8.7	2.07
1/1/93	24	6.7	*	5.4	5.4	6.8	9.5	2.38
2/1/93	113	9.0	*	5.9	9.0	6.7	7.4	2.09
3/1/93	188	15.0	*	9.5	9.7	6.8	5.4	1.64

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.14:
Liquid Effluent Database for Slave Lake, January 1990 to March 1993

DATA (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXGYEN (mg/L)	NINA (mg/L)	NH_3 (mg/L)	ORGANIC N (mg/L)	TOTAL PO_4 (mg/L)
1/1/90	*	10.1	19.0	7.3	0.0	7.8	<0.2**	17.40	1.80	14.30
2/1/90	*	14.3	24.0	7.5	2.0	8.3	<0.2**	21.80	10.20	11.20
3/1/90	*	14.0	23.9	7.4	3.0	7.8	<0.2**	20.50	31.50	18.00
4/1/90	*	9.4	20.0	7.5	6.0	8.5	<0.2**	16.90	11.90	11.70
5/1/90	*	14.0	17.2	7.6	11.0	7.6	<0.2**	18.70	2.90	10.40
6/1/90	*	12.0	69.3	8.0	18.0	8.0	<0.2**	7.20	12.80	14.00
8/1/90	*	9.2	14.7	7.5	17.0	6.0		0.00	0.00	0.00
9/1/90	*	8.6	26.4	7.5	9.0	7.0	<0.2**	13.40	1.00	22.40
10/1/90	*	7.0	20.5	7.5	7.0	9.0	*	*	*	*
11/1/90	*	6.3	16.0	7.5	3.0	9.4	*	*	*	*
12/1/90	*	5.7	18.4	7.4	3.0	7.5	*	*	*	*
1/1/91	2699	14.0	15.5	7.0	5.0	7.5	*	*	*	*
2/1/91	2628	12.8	20.4	7.4	4.0	7.4	*	*	*	*
3/1/91	2846	12.4	22.8	7.2	5.0	7.3	*	*	*	*
4/1/91	2497	10.7	11.4	7.4	5.0	7.8	*	*	*	*
5/1/91	2970	13.0	28.6	7.8	14.0	10.3	*	*	*	*
6/1/91	3088	6.8	19.9	7.5	17.0	6.0	*	*	*	*
7/1/91	3035	9.8	14.7	7.1	22.0	6.8	*	*	*	*
8/1/91	2834	10.5	12.9	7.6	21.0	7.3	*	*	*	*
9/1/91	2792	7.4	7.4	7.5	14.0	7.0	*	*	*	*
10/1/91	2788	10.5	12.1	7.7	6.0	7.4	*	*	*	*
11/1/91	2603	9.2	14.5	7.8	10.0	8.0	*	*	*	*
12/1/91	2467	19.1	15.4	7.3	11.0	6.8	*	*	*	*
1/1/92	2315	22.9	20.3	7.5	3.0	2.4	*	*	*	*
2/1/92	2835	24.5	23.4	7.1	1.0	0.3	<0.2**	22.80	3.10	9.90
3/1/92	2906	30.7	8.9	7.5	7.0	0.3	*	*	*	*
4/1/92	2751	36.5	13.4	7.5	7.0	1.4	*	*	*	*
5/1/92	2902	25.1	23.3	7.6	12.0	11.0	<0.2**	16.30	9.50	5.40
6/1/92	2864	27.3	18.1	7.6	17.0	2.0	<0.2**	16.00	2.70	3.80
7/1/92	2722	16.6	78.0	7.5	19.0	1.8		18.20	0.90	3.70
8/1/92	2640	13.0	5.3	7.5	18.0	1.4	<0.2**	19.20	4.60	4.50
9/1/92	2818	11.4	7.1	7.1	12.0	2.6	*	23.1	2.6	6.0
10/1/92	2595	14.5	4.1	7.3	6.0	2.9	*	*	*	*
11/1/92	2530	28.5	96.6	7.4	2.0	3.6	<0.2**	25.00	4.40	8.70
12/1/92	2479	38.0	14.7	7.5	1.0	4.5	*	*	*	*
3/1/93	2613	30.4	17.5	7.8	14.0	2.2	<0.2**	19.90	10.60	10.10

* = zeros in original dBase IV are believed to be "no data".
** = <0.2 replaced with 0.1 for statistical analyses on Table C2.14

TABLE C1.15:
Liquid Effluent Database for Wabasca, February 1989 to March 1993

DATE (M/D/Y)	BOD (MG/L)	TSS (MG/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
2/1/89	11.1	2.10	7.2	9.0	6.5
3/1/89	2.8	0.10	7.4	8.0	6.4
4/1/89	4.4	0.02	7.3	14.0	6.7
5/1/89	4.8	0.02	7.2	20.0	7.0
6/1/89	3.4	0.03	7.4	0.0	6.9
7/1/89	3.4	0.03	8.0	23.0	6.4
8/1/89	7.2	0.05	8.4	21.0	5.2
9/1/89	5.6	0.01	7.6	14.0	6.4
10/1/89	3.1	0.05	7.4	8.8	8.8
11/1/89	5.3	14.60	7.7	3.0	9.9
12/1/89	5.5	28.00	7.6	2.0	10.8
1/1/90	5.1	13.50	7.7	1.0	10.0
2/1/90	4.0	4.30	8.8	1.0	9.9
3/1/90	10.2	12.50	8.1	1.0	10.0
4/1/90	11.2	2.90	8.2	3.0	9.1
5/1/90	5.5	16.80	8.0	9.0	9.6
6/1/90	5.3	30.00	7.8	11.0	6.2
7/1/90	2.5	12.00	8.0	18.0	6.3
8/1/90	*	28.90	7.9	17.0	7.7
9/1/90	3.7	10.40	7.8	17.0	5.8
10/1/90	2.9	13.30	7.9	9.0	6.8
11/1/90	2.6	12.80	8.0	2.0	7.8
12/1/90	3.2	12.70	7.8	1.0	7.5
1/1/91	2.8	8.30	7.7	1.0	7.6
2/1/91	5.6	6.30	7.9	1.0	7.4
3/1/91	9.5	8.80	7.9	1.0	9.7
4/1/91	5.0	4.40	7.5	7.0	8.4
5/1/91	8.8	5.80	7.8	12.0	8.3
6/1/91	10.4	9.60	8.0	16.0	5.5
7/1/91	4.6	14.40	8.3	20.0	5.8
8/1/91	6.1	8.60	7.7	19.0	5.3
9/1/91	4.3	11.30	7.8	15.0	5.7
10/1/91	4.1	15.00	7.7	7.0	6.6
11/1/91	5.4	14.60	7.8	2.0	7.2
12/1/91	2.4	12.70	7.7	2.0	9.8
1/1/92	4.3	14.20	7.7	2.0	9.1
2/1/92	5.5	14.20	7.7	3.0	8.0
3/1/92	5.6	12.90	7.8	9.0	6.5
4/1/92	5.2	7.10	7.9	14.0	6.4
5/1/92	4.9	12.50	7.8	15.0	5.6
6/1/92	5.1	17.50	7.9	16.2	6.2
7/1/92	9.6	54.90	8.1	17.0	8.6
8/1/92	20.9	80.80	8.2	17.0	8.5
9/1/92	15.3	63.00	8.0	15.0	7.9
10/1/92	12.8	119.40	7.9	5.0	8.2
11/1/92	7.2	13.00	7.8	0.6	5.9
12/1/92	6.0	10.00	7.7	0.5	5.5
1/1/93	3.2	10.30	7.8	0.5	5.7
2/1/93	4.1	11.80	7.6	0.5	6.0
3/1/93	4.3	21.60	7.5	0.5	6.4

* = zeros in original dBase IV are believed to be "no data".

TABLE C1.16:
Liquid Effluent Database for Whitecourt, January 1990 to March 1993

DATE (M/D/Y)	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED 0XYGEN (mg/L)
1/1/90	3278	12.2	3.6	7.3	10.0	2.4
2/1/90	3373	18.3	4.7	7.3	10.0	2.4
3/1/90	3974	16.1	4.1	7.2	11.0	2.6
4/1/90	3355	18.3	6.1	7.3	12.0	2.5
5/1/90	3399	18.5	5.9	7.2	13.0	2.5
6/1/90	3667	13.9	6.0	7.2	16.0	2.9
7/1/90	3892	9.5	5.6	7.3	18.0	3.6
8/1/90	3668	6.0	3.4	7.4	18.0	3.4
9/1/90	3477	9.5	4.3	7.3	16.0	2.9
10/1/90	3411	9.6	5.3	7.3	13.0	3.0
11/1/90	3376	14.9	6.0	7.3	10.0	2.4
12/1/90	3722	13.6	6.8	7.3	10.0	2.9
1/1/91	3536	16.3	5.6	7.3	11.0	2.8
2/1/91	3319	20.6	7.0	7.3	12.0	2.8
3/1/91	3479	21.6	10.1	7.3	12.0	2.8
4/1/91	3750	19.2	8.0	7.3	13.0	3.0
5/1/91	3876	18.7	16.1	7.2	14.0	3.7
6/1/91	3643	20.8	6.9	7.3	15.0	3.5
7/1/91	3449	13.0	6.4	7.3	17.0	4.1
8/1/91	3480	2.6	5.8	7.4	19.0	3.2
9/1/91	3263	3.5	6.9	7.3	16.0	3.0
10/1/91	3238	4.0	6.9	7.4	15.0	2.6
11/1/91	3112	7.2	12.8	7.4	13.0	2.9
12/1/91	3038	4.4	8.0	7.4	12.0	3.5
1/1/92	3107	4.8	6.3	7.3	12.0	3.0
2/1/92	3386	5.0	6.7	7.3	12.0	3.2
3/1/92	3609	3.8	5.7	7.2	13.0	3.7
4/1/92	3270	4.6	4.7	7.3	14.0	3.3
5/1/92	3312	3.6	5.1	7.2	16.0	3.2
6/1/92	3429	4.5	5.7	7.2	18.0	3.2
7/1/92	3285	3.3	4.2	7.2	18.0	4.2
8/1/92	3343	2.6	4.6	7.2	19.0	4.9
9/1/92	3291	3.2	4.0	7.2	14.8	4.7
10/1/92	3147	4.7	5.1	7.2	14.0	4.0
11/1/92	3046	4.3	4.6	7.3	13.0	4.4
12/1/92	3079	7.6	7.2	7.3	11.0	4.5
1/1/93	3383	7.0	8.5	7.3	11.0	3.9
2/1/93	3377	4.5	7.3	7.3	11.0	4.4
3/1/93	3414	6.1	6.6	7.3	12.0	3.2

TABLE C2.1:
Statistical Summary of Effluent Data for Athabasca, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXGYEN (mg/L)
Mean	952.28	14.64	10.17	7.21	10.59	7
Standard Error	9.65	1.66	1.13	0.07	0.77	0
Median	954	12	9	7.3	11	7
Standard Deviation	60.29	10.40	7.03	0.46	4.78	0
Minimum	811	3	4	5.8	2	7
Maximum	1075	41	40	8.1	19	7
Count	39	39	39	39	39	39

TABLE C2.2:
Statistical Summary of Effluent Data for Barrhead, January 1990 to March 1993

	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
Mean	18.35	26.00	8.17	8.27	7.05
Standard Error	1.48	3.27	0.10	1.22	0.45
Median	17.00	18.00	8.10	5.00	6.20
Standard Deviation	9.00	19.91	0.47	7.41	2.75
Minimum	5.00	6.00	7.50	1.00	3.60
Maximum	42.00	85.00	9.20	21.00	15.40
Count	37	37	22	37	37

TABLE C2.3:
Statistical Summary of Effluent Data for Edson, January 1990 to March 1993

	FLOW (gal/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
Mean	869875.03	13.27	15.24	8.03	9.54	7.95
Standard Error	68683.43	1.05	1.92	0.07	2.24	0.29
Median	758641.00	12.00	9.00	7.90	6.00	8.10
Standard Deviation	400489.75	6.55	11.98	0.44	14.00	1.79
Minimum	341718.00	2.30	2.40	7.00	0.20	4.30
Maximum	1911592.00	33.50	50.20	8.90	81.20	11.20
Count	34	39	39	39	39	39

TABLE C2.4:
Statistical Summary of Effluent Data for Fort Chipewyan, January 1990 to November 1992

	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)
Mean	38.40	46.20	28.20
Standard Error	12.01	10.27	10.86
Median	34.00	48.00	21.00
Standard Deviation	26.86	22.97	24.28
Minimum	8.00	25.00	9.00
Maximum	67.00	82.00	68.00
Count	5	5	5

TABLE C2.5:
Statistical Summary of Effluent Data for Fort McMurray, January 1990 to March 1993

	FLOW (mL/d)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)
Mean	13.22	20.38	61.77	12.13	8.07	8.26
Standard Error	0.86	0.79	2.70	0.60	0.02	1.29
Median	14.00	20.00	65.00	12.00	8.10	7.00
Standard Deviation	3.66	4.95	14.79	3.76	0.15	8.07
Minimum	0.00	11.00	0.00	5.00	7.70	-1.00
Maximum	17.00	29.00	92.00	21.00.	8.30	22.00
Count	18	39	30	39	39	39

TABLE C2.6:
Statistical Summary of Effluent Data for Fort Smith, January 1990 to December 1993

	FLOW (Imp. gal./mon.)	BOD (mg/L)	TSS (mg/L)	pH	TOTAL COLIFORMS (NPDL)	FECAL COLIFORMS (NPDL)
Mean	3804760.00	73.08	44.25	7.56	871148.44	231414.56
Standard Error	18226.04	6.99	8.05	0.11	135900.20	37559.37
Median	3877728.00	71.00	32.00	7.32	750000.00	130000.00
Standard Deviation	109356.23	42.51	55.74	0.79	768767.61	251955.93
Minimum	3502464	16	5	7	1000	5
Maximum	3877728	200	392	10	2500000	900000
Count	36	37	48	48	32	45

TABLE C2.7:
Statistical Summary of Effluent Data for Grande Cache, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXGYEN (mg/L)
Mean	2032.21	3.79	1.13	6.98	10.51	2.21
Standard Error	58.84	0.15	0.08	0.05	0.49	0.11
Median	1873.00	3.70	1.00	6.80	10.00	2.00
Standard Deviation	367.47	0.94	0.52	0.33	3.08	0.71
Minimum	1607.00	2.00	1.00	6.70	6.00	1.30
Maximum	3190.00	6.00	4.00	7.80	16.00	3.80
Count	39	39	39	39	39	39

TABLE C2.8:
Statistical Summary of Effluent Data for Grande Prairie, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)
Mean	10727.67	8.60	5.06
Standard Error	382.35	0.61	0.65
Median	10309.00	7.60	3.90
Standard Deviation	2387.76	3.81	4.03
Minimum	8135.00	3.30	1.10
Maximum	20536.00	19.70	20.70
Count	39	39	39

TABLE C2.9:
Statistical Summary of Effluent Data for JasperDecember 1991 to December 1992

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXGYEN (mg/L)
Mean	3948.46	23.32	34.38	7.67	9.38	8.60
Standard Error	271.95	3.46	9.77	0.06	1.61	0.91
Median	3719.00	20.00	19.50	7.70	9.00	8.20
Standard Deviation	980.54	11.46	35.21	0.21	5.80	2.72
Minimum	2107.00	10.10	11.90	7.30	3.00	4.40
Maximum	5598.00	45.50	135.90	8.10	19.00	11.70
Count	13	11	13	13	13	9

TABLE C2.10:
Statistical Summary of Effluent Data for Lac La Biche, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
Mean	313522.94	24.81	17.38	8.05	12.05	9.41
Standard Error	17233.04	2.13	2.67	0.05	1.24	0.36
Median	341993.00	20.20	12.00	8.1	10	9.8
Standard Deviation	101952.05	13.11	16.45	0.32	7.55	2.19
Minimum	106725.00	7.00	4.10	7.4	3	0
Maximum	484677.00	62.10	77.90	8.7	25	12.8
Count	35	38	38	37	37	37

TABLE C2.11:
Statistical Summary of Effluent Data for Manning, September 1990 to March 1993

	FLOW (gal./d)	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)	pH	NITRITE - NITRATE (mg/L)	NH_3 (mg/L)	ORGANIC N (mg/L)	TOTAL PO_4 (mg/L)
Mean	107059.13	19.55	18.17	13.13	7.53	0.17	19.73	10.68	14.58
Standard Error	3099.15	1.36	1.29	1.11	0.04	0.04	0.94	1.38	0.45
Median	107123.00	18.00	18.20	13.00	7.60	0.10	20.45	9.90	13.75
Standard Deviation	15182.65	7.57	7.19	5.45	0.19	0.18	4.59	6.77	2.19
Minimum	84655.00	8.20	7.60	5.00	7.20	0.10	7.10	0.60	11.50
Maximum	131329.00	51.40	32.60	27.30	7.80	0.70	28.10	35.40	19.50
Count	24	31	31	24	24	24	24	24	24

TABLE C2.12:
Statistical Summary of Effluent Data for Peace River, July and September 1992

	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)	COD (mg/L)	pH	NH_3 (mg/L)	T PO_4 (mg/L)	COND (mS/cm)
Mean	120.66	142.93	181.14	550.86	7.53	9.41	13.34	983.71
Standard Error	13.09	32.86	57.71	94.71	0.22	1.68	7.28	31.76
Median	116	137	128	470	7.2	9.1	7.06	1000
Standard Deviation	34.63	86.93	152.69	250.57	0.58	4.46	19.27	84.04
Minimum	74.2	9.5	66	293	7	0.94	1.51	873
Maximum	170	255	496	899	8.5	14	56.4	1100
Count	7	7	7	7	7	7	7	7
	T ALK (mg/L)	**P ALK (mg/L)**	**HCO_3 (mg/L)**	**CO_3 (mg/L)**	**OH (mg/L)**	**HARD (mg/L)**	**Cl (mg/L)**	**Fl (mg/L)**
Mean	257.71	6.07	305.57	2.57	0.5	231	44.81	0.99
Standard Error	9.71	1.07	4.87	2.07	0	35.32	4.03	0.10
Median	250	5	305	0.5	0.5	202	39.2	1.05
Standard Deviation	25.69	2.83	12.88	5.48	0	93.44	10.65	0.26
Minimum	237	5	289	0.5	0.5	160	36.4	0.65
Maximum	312	12.5	325	15	0.5	439	66.9	1.23
Count	7	7	7	7	7	7	7	7
	TKN (mg/L)	**NO_3 (mg/L)**	**NO_2 (mg/L)**	**SULP (mg/L)**	**PHEN (mg/L)**	**Ca (mg/L)**	**Mg (mg/L)**	**Na (mg/L)**
Mean	19.74	0.39	0.13	129.86	48.01	56.96	21.57	87.3
Standard Error	4.83	0.14	0.02	8.42	9.71	9.48	2.89	3.63
Median	18	0.22	0.16	137	55	48.5	19.5	83.7
Standard Deviation	12.78	0.36	0.05	22.27	25.70	25.08	7.64	9.61
Minimum	0.5	0.05	0.05	102	3.07	40	14.5	74.9
Maximum	35	0.89	0.17	157	83	113	38.2	105
Count	7	7	7	7	7	7	7	7
	K (mg/L)	**Al (mg/L)**	**Cd (mg/L)**	**Cr (mg/L)**	**Co (mg/L)**	**Cu (mg/L)**	**Fe (mg/L)**	**Pb (mg/L)**
Mean	14.68	0.15	0.0015	0.0036	0.0032	0.0495	0.7306	0.0209
Standard Error	2.64	0.03	8.98E-1	0.0004	0.0005	0.0035	0.2172	0.0001
Median	10.6	0.12	0.0015	0.003	0.0025	0.051	0.52	0.021
Standard Deviation	6.99	0.08	2.38E-1	0.0010	0.0012	0.0085	0.5747	0.0004
Minimum	9.25	0.08	0.0015	0.003	0.0025	0.039	0.37	0.02
Maximum	27.6	0.32	0.0015	0.005	0.005	0.06	2	0.021
Count	7	7	7	7	7	6	7	7
	Mn (mg/L)	**Mo (mg/L)**	**Ni (mg/L)**	**Se (mg/L)**	**V (mg/L)**	**Zn (mg/L)**	**RSIO2 (mg/L)**	**O&G (mg/L)**
Mean	1.0819	0.0043	0.0082	0.0382	0.0054	0.0686	8.36	23.2429
Standard Error	0.9864	0.0002	0.0005	0.0005	0.0008	0.0103	0.9289	5.3923
Median	0.088	0.004	0.0075	0.0375	0.0045	0.079	8.37	23.2
Standard Deviation	2.6099	0.0005	0.0012	0.0012	0.0021	0.0274	2.4577	14.2667
Minimum	0.057	0.004	0.0075	0.0375	0.0045	0.032	3.9	5.6
Maximum	7	0.005	0.01	0.04	0.01	0.1	12	50.9
Count	7	7	7	7	7	7	7	7
	OD NO (TON)	**TDS (mg/L)**	**TS (mg/L)**	**TOC (mg/L)**	**TIC (mg/L)**	**TC (mg/L)**	**SURF (mg/L)**	
Mean	14	623.7143	836.1429	42.8857	40.8986	83.8	6.5714	
Standard Error	6.4550	53.0972	74.6064	5.0165	9.6055	10.1736	2.2479	
Median	10	641	881	40.2	55	81.4	4.3	
Standard Deviation	17.0783	140.4822	197.39	13.2725	25.4138	26.9168	5.9473	
Minimum	2	428	551	26.1	3.89	44.1	0	
Maximum	50	825	1090	64.3	64.6	129	15.1	
Count	7	7	7	7	7	7	7	

TABLE C2.13:
Statistical Summary of Effluent Data for Peace River Correctional Centre, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	VSS (mg/L)	pH	DISSOLVED OXGYEN (mg/L)	CL_2 (kg/d)
Mean	286.27	6.00	32.46	7.31	7.10	6.61	7.96	1.53
Standard Error	20.90	0.47	3.01	0.60	0.59	0.03	0.17	0.09
Median	323.00	5.50	28.90	6.40	6.50	6.60	8.20	1.40
Standard Deviation	127.15	2.93	14.14	3.77	3.66	0.18	1.08	0.55
Minimum	24.00	2.00	16.80	2.20	0.00	6.10	5.40	0.99
Maximum	508.00	15.00	68.00	19.20	17.20	6.90	9.80	4.10
Count	37	39	22	39	39	39	39	39

TABLE C2.14
Statistical Summary of Effluent Data for Slave Lake, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMP (°C)	DISS. OXGYEN (mg/L)	NITRITE-NITRATE (mg/L)	NH_3 (mg/L)	ORGANIC N (mg/L)	TOTAL PO_4 (mg/L)
Mean	2728.68	15.73	22.10	7.47	9.22	5.91	0.10	17.28	6.91	9.63
Standard Error	38.17	1.47	3.21	0.04	1.07	0.49	0.00	1.56	1.96	1.45
Median	2751.00	12.90	17.80	7.50	7.00	7.15	0.10	18.45	3.75	10.00
Standard Deviation	190.85	8.80	19.29	0.21	6.39	2.97	0.00	6.25	7.83	5.78
Minimum	2315.00	5.70	4.10	7.00	0.00	0.30	0.10	0.00	0.00	0.00
Maximum	3088.00	38.00	96.60	8.00	22.00	11.00	0.10	25.00	31.50	22.40
Count	25	36	36	36	36	36	13	16	16	16

TABLE C2.15:
Statistical Summary of Effluent Data for Wabasca, February 1989 to March 1993

	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXGYEN (mg/L)
Mean	6.04	15.96	7.81	8.63	7.39
Standard Error	0.51	3.04	0.04	1.03	0.22
Median	5.10	12.25	7.80	8.40	6.95
Standard Deviation	3.60	21.46	0.29	7.25	1.53
Minimum	2.40	0.01	7.20	0.00	5.20
Maximum	20.90	119.40	8.80	23.00	10.80
Count	49	50	50	50	50

TABLE C2.16:
Statistical Summary of Effluent Data for Whitecourt, January 1990 to March 1993

	FLOW (m^3/d)	BOD (mg/L)	TSS (mg/L)	pH	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
Mean	3416.74	9.79	6.37	7.28	13.71	3.31
Standard Error	36.88	1.01	0.38	0.01	0.44	0.11
Median	3383.00	7.20	6.00	7.30	13.00	3.20
Standard Deviation	230.32	6.33	2.40	0.06	2.72	0.68
Minimum	3038.00	2.60	3.40	7.20	10.00	2.40
Maximum	3974.00	21.60	16.10	7.40	19.00	4.90
Count	39	39	39	39	39	39

APPENDIX D

LIQUID EFFLUENT DATA FOR PERIODICALLY DISCHARGING SEWAGE TREATMENT PLANTS

NAME	DRAIN BAS	DATE	VOLUME	BOD (MGPL)	TSS (MGPL)	NFR (MGPL)	PH	DISOX (MGPL	TEMP C	CA (MGPL	CL (MGPL	CO3 (MGPL	HCO3 (MGPL)	COD (MGPL	COLOR (TCU)	COND (MSPCM)	FECAL (NPDL
Atikameg School	P	1//92	unknown	15	21												
Atikameg School	P	9//89	unknown														
Atikameg School	P	1/28/91	unknown	33		122											
Bear Canyon	P	31233	(2 feet)														
Beaverlodge	P	33635	unknown	13		17											
Beaverlodge	P	2/19/92	5 days	19	9									197			
Beaverlodge	P	11/22/89	unknown	11	1												
Beaverlodge	P	4/19/9	unknown	17	21												
Beaverlodge	P	1/23/9	unknown	18	23												
Beaverlodge	P	4/13/92	5 days	17		17											
Berwyn	P	4/24/9	22., gal	16	22												
Berwyn	P	33486	11,15. gal	16	31												
Berwyn	P	33762	7,43. gal	4	14												
Berwyn	P	33825	17,197. gal	9	8		7.94										
Bezanson	P	33609	44. gal	19		63											
Bezanson	P	40061	1,5. gal	11	59												
Bishop Routhier School	P	1//92	389,6 gal														
Blue Ridge	A	33301	3,3 gal	36.6	31.3		7.4		21								
Blue Ridge	A	33339	* see comments														
Blue Ridge	A	33725	247 m3	33.6	6		8.3		15								
Bluesky	P	1/15/9	4 days - lowered ~18 in.	5	35												
Bluesky	P	1/21/92	4 days - lowered ~3 ft.	3	7												
Bluesky	P	1/21/91	4 days - lowered ~2 in.	2	3												
Boyle	A	33461	8, m3	4	6												
Cleardale	P	1/13/92		1	5												
Cleardale	P	1/22/91	(12 hours)	9	63												
Cleardale	P	34124	1, gal	24	1												
Colinton	A	33306	7,25 m3														
Colinton	A	5/27/9	4,5 m3	18	16												

BLE D.1
lic Discharging Sewage Treatment Plants

L .)	FE (MGPL)	F_RES (MGPL)	FL (MGPL)	K (MGPL)	MG (MGPL)	NA (MGPL)	NH3 (MGPL)	NO2 (MGPL)	NO3 (MGPL)	NINA (MGPL)	ORG_N (MGPL)	SI (MGPL)	SO4 (MGPL)	SURF (MGPL)	T_ALK (MGPL)	HARD (MGPL)	TDS (MGPL)	TS (MGPL)	TKN (MGPL)	T_PO4 (MGPL)	TURB (MGPL)	COMMENTS
																						the flow data provided in the discharge reports appears to be of flows into the storage cell and not the actual discharge volume
																						the flow data provided in the discharge reports appears to be of flows into the storage cell and not the actual discharge volume
																						the flow data provided in the discharge reports appears to be of flows into the storage cell and not the actual discharge volume
							27.8							3.66			845	854	31.6	3.8		no 1991 data
							7.1			0.2	0.4									11.2		Acti-zyme was added to lagoon; NO2+NO3 is below detection limit
							5.6			0.2	1.8									1.3		Actizyme was added to lagoon; algae was present in the lagoon sample; NO2+NO3 was below detection limit
							1.3			0.2	2									3.8		Actizyme was added to lagoon; NO2+NO3 was below detection limit
							0.4			0.23	1.4									5.4		Actizyme was added to lagoon
																						no discharge in 1991; one lb/week of Acti-zyme added in 199, 1991 and 1992
																						no discharge in 1991; one lb/week of Acti-zyme added in 199, 1991 and 1992
																						test results missing from files
																						unknown amounts of Acti-zyme added weekly in 199, 1991 and 1992
																						unknown amounts of Acti-zyme added weekly in 199, 1991 and 1992
																						unknown amounts of Acti-zyme added weekly in 199, 1991 and 1992
																						1991 sampling results not in files; 199 sampling results also include BOD and TSS of the Tawatinaw River water upstream of the drainage
																						1991 sampling results not in files; 199 sampling results also include BOD and TSS of the Tawatinaw River water upstream of the drainage

Colinton	A	5/27/9	4.5 m3	18	16												
Colinton	A	39814	14.5 m3	23	79												
Deadwood School	P	//91	unknown														
Debolt	P	32519	3_ gal	2		12											
Debolt	P	39873	2.5, gal														
Debolt	P	33430	2_ gal	9		16											
Debolt	P	33674	2_ gal	8	9												
Dixonville	P	33635	3_ gal	9	7												
Dixonville	P	1/17/91	~5_ gal														
Dixonville	P	7/21/92	2_ gal	5	4												
Donnelly	P	1/16/9	unknown	5	7												
Donnelly	P	1/13/92	8" valve open for 8 days	2	5												
Eaglesham	P	33735	part of a 6 mgal/yr total	55	117												
Eaglesham	P	34154		51	65												
Eaglesham	P	4/16/9	part of a 3.5 mga/yr tota	56	16												
Eaglesham	P	33454	part of a 5 mga/yr total	132	24												
Eaglesham	P	1/15/91	part of a 5 mga/yr total	8	24												
Eaglesham	P	33607	part of a 6 mgal/yr total	76	23												
Eaglesham	P	11/14/9	part of a 3.5 mga/yr tota														
Enilda	LS	1/29/9	~3.3, gal	7	3												
Enilda	LS	33420	15.551 m3	5		13											
Enilda	LS	1/19/92	15.551 m3	2		[illegible]											
Entwistle	A	6//9	unknown	24	48												
Entwistle	A	5//91	unknown	69	18												
Entwistle	A	11//911	unknown	162	43												
Evansburg	A	1/16/91	~85_ l	7	11												
Evergreen Park (Gr. Prairie)	P	33298	2 days														
Evergreen Park (Gr. Prairie)	P	8/15/9	5 days														
Evergreen Park (Gr. Prairie)	P	33611	2 days														
Fairview	P	9/21/92	part of 11 mgal/yr total	4	3												
Fairview	P	39818	part of 18 mgal/yr total	2	4												
Fairview	P	9/24/9	part of 18 mgal/yr total	1	18												
Fairview	P	4/15/91	part of 15 mgal/yr total	56	3												
Fairview	P	9/25/91	part of 15 mgal/yr total	7	22												
Fairview	P	33607	part of 11 mgal/yr total	36	9												
Falher	P	1/19/92	35_ gal	3	18												
Falher	P	1/22/9	4_ gal	9	27												
Falher	P	1/16/91	4_ gal	2	6												
Faust	LS	1/29/9	9,118,494 gal	7	13												
Faust	LS	6/25/92	35, m3	1	1												
Faust	LS	9/21/91	37,185 m3	1	1												
Faust	LS	6/25/92	35, m3	1	1												
Faust	LS	1/19/92	37,185 m3	1	4												

LE D.1
Discharging Sewage Treatment Plants

																					1991 sampling results not in files; 199 sampling results also include BOD and TSS of the Tawatinaw River water upstream of the drainage
																					1991 sampling results not in files; 199 sampling results also include BOD and TSS of the Tawatinaw River water upstream of the drainage
																					minimal data... details unclear.
																					no data
																					no discharge in 199; no 1991 data in files
																					no discharge in 199; no 1991 data in files
																					no discharge in 199; no 1991 data in files
																					1/2 gallon Acti-zyme added weekly in 1991 and 1992; unknown amount of Acti-zyme added in 199; no discharge in 1991
																					1/2 gallon Acti-zyme added weekly in 1991 and 1992; unknown amount of Acti-zyme added in 199; no discharge in 1991
																					Actizyme added
																					no discharge report found so just sample date given
																					Acti-zyme added
																					Actizyme
																					Actizyme added
																					Actizyme added
																					Actizyme added
																					no discharge reports
																					no discharge reports
																					no discharge reports
																					no discharge report for 199 or 1992
																					199 lagoon sample results not in files
																					199 lagoon sample results not in files
																					199 lagoon sample results not in files
																					ActiZyme added
																					ActiZyme added
																					ActiZyme added
																					ActiZyme added
																					ActiZyme added
																					ActiZyme added

Footner Lake Forestry Site	P	9/17/91	unknown														
Footner Lake Forestry Site	P	9/14/92	14. m3	5		3											
Fort Assiniboine	A	4/23/91	3,5. gal	27	35												
Fort McKay	A	32550	3,8. gal	18	4												
Fort McKay	A	33430	5.. gal	17	7												
Fort McKay	A	4/18/91	5,5. gal	24	32												
Fort McKay	A	39945	6.. gal	25	25												
Fort McKay	A	4/26/9	5,5. gal	4	148												
Fort Vermillion	P	12/16/92	13,523.9 m3	2	1												
Fort Vermillion	P	6/24/91	89,295 gal	9	14												
Fort Vermillion	P	12/18/91	89,5 gal	51	17												
Fort Vermillion	P	4/28/92	13,21.8 m3	22	21												
Fort Vermillion	P	12/13/9	3,96,15 gal	29	21												
Fort Vermillion	P	39849	5,35,54 gal	54	24												
Fox Creek	P	4/14/91	24,481 m3	14	23		7.23	6									
Fox Creek	P	1/21/91	24,481 m3	1	2.5												5 per 1 mls
Gift Lake	P	33579	1. m3	85	155												
Gift Lake	P	1//92	unknown	17	21												
Girouxville	P	1/15/9	~449 gal/min for 3 hrs	3	9												
Girouxville	P	4/28/92	~449 gal/min for 3 hrs	14		11											
Girouxville	P	1/13/92	~449 gal/min for 312 hrs	2		9											
Grande Cache Forest Industries	P	39819	unknown	2			8.1										
Grande Cache Forest Industries	P	39819	unknown	2		6	8.2										
Grande Cache Forest Industries	P	39819	unknown	2			8.2										
Grande Cache Forest Industries	P	39819	unknown	2		4	8.2										
Grande Prairie Airport	P	33458	n/a														7 per 1 ml
Grande Prairie Airport	P	33458	n/a														3 per 1 ml
Grandview Hutterite Colony	P	1//9	unknown	26	66												
Grandview Hutterite Colony	P	11/15/91	5 days	45	184												

																					no results from 1991 sampling in files
																					no results from 1991 sampling in files
																					5 lbs. Acti-Zyme added
																					algae in October 1992 lagoon sample would affect the TSS giving higher than normal results
																					algae in October 1992 lagoon sample would affect the TSS giving higher than normal results
																					2 454 kg of Chemzyme II added 2x/month in 199 and 1991; 5 mL Hyro-zyme weekly in 1992
																					2 454 kg of Chemzyme II added 2x/month in 199 and 1991; 5 mL Hyro-zyme weekly in 1992
																					2 454 kg of Chemzyme II added 2x/month in 199 and 1991; 5 mL Hyro-zyme weekly in 1992
																					sample 2 of 4; sample description = NE; NFR = <1
																					sample 4 of 4; sample description = SE
																					sample 3 of 4; sample description = SW; NFR = <1
																					sample 1 of 4 taken in June 199; sample description = NW
																					no discharge; these samples are from the 2nd cell final effluent
																					no discharge; these samples are from the 1st storage cell
																					1991 lagoon sample were taken in October, and it contained algae which would affect the TSS, giving higher than normal results; no license to be found
																					1991 lagoon sample were taken in October, and it contained algae which would affect the TSS, giving higher than normal results; no license to be found

Grassland	A	5/23/9	8, m3	46	73												
Grassland	A	39814	5, m3	6	18												
Grassland	A	5//91	unknown	3	84												
Gregoire Lake Prov. Park	A	31667	n/a	2.4		5	8.5			22	11	11	35	85.4		839	<1 per ml
Grimshaw	P	1/21/91	192.7 m3	5	5												
Grouard	LS	33420	64. m3	5		1											
Grouard	LS	1/29/9	~13.14. gal	4	16												
Grouard	LS	1/19/92	64. m3	1		1											
Guy	P	33420	(5 hours)	3	1												
Guy	P	39814	(42 hours)	4	7												
Guy	P	9/29/92	(5 hours)	8	7												
High Level	P	1/28/91	8.. gal	5		17											
High Level	P	33939	8.. gal	5	5												
High Level	P	39999	5.. gal														
High Level	P	40158	5.. gal	1	3												
High Prairie	LS	39975	38.6. gal	3	3												
High Prairie	LS	5/31/91	3,4. gal	8	38												
High Prairie	LS	33298	3,4. gal	5		25											
High Prairie	LS	4/13/92	3,4. gal	6		4											
High Prairie	LS	33756	3,4. gal	1		[illegible]											
Hines Creek	P	5/31/9	23.. gal	8	35												
Hines Creek	P	4//92	3 gal/min for 816 hrs	12	17												

																					the spring samples from both 199 and 1991 contained algae which would affect the TSS and give higher than normal results; no discharge report for 1991 in files; no discharge in 1992 due to construction of new lagoon
																					the spring samples from both 199 and 1991 contained algae which would affect the TSS and give higher than normal results; no discharge report for 1991 in files; no discharge in 1992 due to construction of new lagoon
																					the spring samples from both 199 and 1991 contained algae which would affect the TSS and give higher than normal results; no discharge report for 1991 in files; no discharge in 1992 due to construction of new lagoon
0.39		0.68	7.4	19	134	0.24	0.5		0.5		3.9	5		268	133	458		2.8	0.75		SO4, NO2, NO2+NO3 are below detection limit listed
																					Actizyme was added in 1991 (exact amount unknown) and 1992 (6 - 2 L pails); no discharge in 199 and 1992
																					2 cups/week of Actizyme added in 199 and 1991
																					2 cups/week of Actizyme added in 199 and 1991
																					2 cups/week of Actizyme added in 199 and 1991
	964					0.16		0.17											0.55		
																					BOD and TSS results were below detection limit (5. mg/l)
																					no sample data
																					8 lb. of Acti-zyme added
																					Acti-zyme added (no amount given)
																					Acti-zyme added (no amount given)
																					Acti-zyme added (no amount given)
																					Acti-zyme added (no amount given)
																					7 lbs Actizyme added in 199; 9-1 lbs Actizyme added in 1991; 6 lbs Actizyme added in 1992; invertebrates were present in the 199 lagoon effluent sample thus TSS results would be higher than usual
																					7 lbs Actizyme added in 199; 9-1 lbs Actizyme added in 1991; 6 lbs Actizyme added in 1992; invertebrates were present in the 199 lagoon effluent sample thus TSS results would be higher than usual

Hines Creek	P	1//92	3 gal/min for 111 hrs	4	6												
Hythe	P	2/26/92		82.2	3									165			
Hythe	P	5//9	n/a														
Hythe	P	1//9	n/a														
Hythe	P	5//91	n/a	53	6.4												
Hythe	P	1//91	n/a														
Hythe	P	5//92	n/a	6	14												
Hythe	P	1//92	n/a	3	6												
Hythe	P	3//93	7 days	32	3												
Janvier School	A	5//9	unknown	38	138												
Janvier School	A	4//91	unknown	5	32												
Jean Cote	P	39814	(41 hours)	1	35												
Jean Cote	P	33725	(31 hours)	1	2												
Joussard	LS	1/29/9	6,549,444 gal	7	5												
Joussard	LS	33420	24,125 m3	5		7											
Joussard	LS	1/19/92	24,125 m3	2		4											
La Glace	P	11/13/9	~2.5. gal	12	4												
La Glace	P	33400	11. m3	5		3											
La Glace	P	1/13/92	12. m3	2		3											
Loon Lake School	P	6/18/9	1.. gal	11	56												
Loon Lake School	P	1//91	75. gal	14	22												
Loon Lake School	P	6/24/92	2. gal	5	5												
Loon Lake School	P	1/23/92	5. gal														
Loon Lake School	P	11/16/92	3. gal	59	2												
Mayerthorpe	A	40121	6 days	9	35												
Mayerthorpe	A	12/14/9	4 days	1	134												
Mayerthorpe	A	33551	7 days	1	6												
McLennan	P	1//91	unknown	3	8												
McLennan	P	1/28/9	2. m3	4	21												
McLennan	P	1//92	unknown	3	1												

TABLE D.1
riodic Discharging Sewage Treatment Plants

																						7 lbs Actizyme added in 199; 9-1 lbs Actizyme added in 1991; 6 lbs Actizyme added in 1992; invertebrates were present in the 199 lagoon effluent sample thus TSS results would be higher than usual
							22.8							2.97			1638	1641	25.5	6.85		Acti-zyme added
																						Acti-zyme added; no data
																						Act-zyme added; no data
																				1.79		Actizyme added
																						Acti-zyme added; no data
																						Actizyme added
																						Acti-zyme added
																						no license in files; no discharge report for 199 and 1991; inspection letter in file indicates that a discharge in 1992 is not necessary
																						no license in files; no discharge report for 199 and 1991; inspection letter in file indicates that a discharge in 1992 is not necessary
																						2 cups/week of Actizyme added in 199
																						2 cups/week of Actizyme added in 199
																						addition of one lb/week of Acti-zyme added each year from 199 1992
																						addition of one lb/week of Acti-zyme added each year from 199 1992
																						addition of one lb/week of Acti-zyme added each year from 199 1992
																						sample was green indicating algae; sample also taken before (April 2); another sample taken at Loon River on June 25, 199
																						waste water analysis not included
							2.1	1.4		4.8										3.48		
							2.6	0.4		0.8										6.5		
							0.46	0.1		0.7										2.9		
																						65 lbs of actizyme reported added in 199; no discharge reports for 1991 and 1992, only sampling results are provided
																						65 lbs of actizyme reported added in 199; no discharge reports for 1991 and 1992, only sampling results are provided
																						65 lbs of actizyme reported added in 199; no discharge reports for 1991 and 1992, only sampling results are provided

Nose Creek School	P	1991	63. (units unknown)														
Nose Creek School	P	1992	3. (units unknown)														
Peace River Airport	P	12/15/92	unknown		8												
Peace River Airport	P	//91	unknown														
Peace River Airport	P	7/14/92	n/a	38.7	84												
Peace River Airport	P	4/14/92	n/a	9	4												
Peace River Airport	P	8/17/92	n/a	63	125												
Peace River Airport	P	3/24/92	n/a	34.2	2												
Peace River Airport	P	11/17/92	n/a	53.1	42												
Peace River Airport	P	1/14/92	n/a	35	26												
Peace River Airport	P	33943	n/a	18	21												
Peace River Airport	P	9/15/92	n/a	136	197												
Peace River Airport	P	33853	n/a	43.5	36												
Peace River Airport	P	2//92	n/a	57.2	17												
Peerless Lake School	P	1//92	384. gal/year	33	25												
Pibroch	A	33301	2., gal	28	1												
Pine Shadow Estates MHP	A	33459	unknown														
Queen Elizabeth Prov. Park	P	//92	519.75 litres														
Queen Elizabeth Prov. Park	P	//91	59.85 litres]														
Ridge Valley	P	1/31/9	2., gal														
Ridge Valley	P	33430	1., gal	16		48											
Ridge Valley	P	33674	2., gal	15	27												
Robb	A	5/29/91	unknown														
Rycroft	P	11/28/9	unknown	3	7												
Rycroft	P	11/12/91	unknown	4	14												
Rycroft	P	11/16/92	unknown	1	5												
Sangudo	A	7/16/91	1.58. gal	14	14										6		
Sangudo	A	40124	1.58. gal														
Sangudo	A	39912	1.58. gal	27	18												

BLE D.1
ic Discharging Sewage Treatment Plants

																						no sampling done
																						no sampling done
																						discharge reports from 1991 & 1992 state that discharge runs through an overflow pipe all year long once the sewar level reaches the height of the overflow; all dates given for Peace River Airport are sampling dates only
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						discharge through overflow pipe all year long
																						no data or discharge reports in files for 199 and 1992; 1991 discharge report indicates Wabash Creek as the receiving body instead of Bath Creek stated in the license
																						no BOD or TSS results in file for 1991
																						volume is of liquid waste that was pumped out of the cisterns over the course of the year; no discharge to a waterbody
																						volume is of liquid waste that was pumped out of cisterns over the course of the year; no discharge to a waterbody
																						no results from 199 lagoon sampling in files
																						no results from 199 lagoon sampling in files
																						no results from 199 lagoon sampling in files
																						May 1991 letter says that the lagoon was bieng discharged at that time and that it had also been drained five years prior to that
																						4-5 lbs of Acti-zyme added each year from 199 - 1992
																						4-5 lbs of Acti-zyme added each year from 199 - 1992
																						4-5 lbs of Acti-zyme added each year from 199 - 1992
																					7.1	1 lbs of Septo-zyme added
																						15 lbs of Septo-zyme added
																						3 lbs of Septo-zyme added

Sangudo	A	5/19/92	unknown														
Sangudo	A	1/14/92	unknown														
Sexsmith	P	4/23/9	18,, gal	27	14		7.82										
Sexsmith	P	39975	18,, gal	23	18		8.7										
Sexsmith	P	33454	18,, gal	31	1		7.75										
Sexsmith	P	33400	18,, gal	13	2		7.71										
Sexsmith	P	33728	18,, gal	19	13		7.4										
Sexsmith	P	33705	18 million gallons	2	42		8.6										
Shell - Peace River Complex	P	33729	unknown	17	3.2												
Shell - Peace River Complex	P	33394	3 m3	21	22												
Spirit River	P	5/15/91	~45,736 m3	2	12												
Spirit River	P	5/19/92	~1,, gal	6	24												
Spirit River	P	1/15/92	16,, gal	3	4												
Spirit River	P	9/25/9	not given	5	21												
St. Isadore	P	40057	unknown	22	32												
St. Isadore	P	1/15/91	8" pipe drained 48 hrs	87	62												
St. Isadore	P	1//92	unknown	23	18												
Swan Hills	A	5/29/91	46,25, gal	15.6	11.3												
Swan Hills	A	11/18/91	46,25, gal	13.2	2.5												

BLE D.1
dic Discharging Sewage Treatment Plants

																						1992 discharge information was obtained from letter of intent written to Alberta Environment - no actual discharge report for 1992.
																						1992 discharge information was obtained from letter of intent written to Alberta Environment - no actual discharge report for 1992.
							15.8			0.2	0.6									18.8		NO2+NO3 was below detection limit
							5.3			0.2	7.7									12.1		NO2+NO3 was below detection limit
							13.9			0.26	3.8									12		
							15.4			0.2	2.1									14.3		
							1.4			0.2	12.1									1.6		NO2+NO3 was below detection limit
							6.4			0.2	7.2									14.4		NO2+NO3 was below detection limit
																						limited data available
																						25 kg of Acti-zyme added May 19/91; 25 kg Biozyme added May 25/91
																						25 kg Acti-zyme added to sewer lines June 1/92, 25 kg Biozyme to sewer inlet June 1/92
																						discharge in license given as once per year; is twice per year in practice
																						2 lbs. Acti-zyme added June 4/9; 5 lbs. Acti-zyme added July 1-31/9
																						the presence of algae in the 199 and 1992 lagoon samples would affect the TSS giving higher than normal results; no discharge report for 1992; addition of 2 lbs of Acti-zyme reported in 199 and 1991
																						the presence of algae in the 199 and 1992 lagoon samples would affect the TSS giving higher than normal results; no discharge report for 1992; addition of 2 lbs of Acti-zyme reported in 199 and 1991
																						the presence of algae in the 199 and 1992 lagoon samples would affect the TSS giving higher than normal results; no discharge report for 1992; addition of 2 lbs of Acti-zyme reported in 199 and 1991
																						1 lbs. Acti-zyme added during year; 3 samples taken prior to discharge - sample results closest to date of discharge are given.
																						1 lbs. Acti-zyme added during year; 3 samples taken prior to discharge - sample results taken closest to discharge date given.

Swan Hills	A	39970	51,125, gal	33	8.6												
Swan Hills	A	12/28/9	51,125, gal	51	7												
Triple L Mobile Home Park	P	4//9	unknown	65	32												
Triple L Mobile Home Park	P	1/19/91	4 acre lagoon lowered 2'	27		44											
Triple L Mobile Home Park	P	5//92	unknown	24		25											
Trout Lake School	P	1//92	unknown	24	22												
Valleyview	P	7/23/91	25,3, gal	61	159												
Valleyview	P	3/25/91	25,3, gal	18	134												
Valleyview	P	11/14/91	25,3, gal	92	45												
Valleyview	P	2/28/92	25,, gal	198	35												
Valleyview	P	33914	3,, gal	42	499												
Valleyview	P	33917	15,, gal	27	58.6												
Valleyview	P	11/12/92	25,, gal	23	17												
Valleyview	P	11/15/9	47,75, gal	2	26												
Valleyview	P	5//9	47,75, gal	2.5	15.5												
Valleyview	P	9/18/89	76,, gal	16	17												
Wandering River	A	39915	288, gal	17.6			7.78	9									
Wandering River	A	//89	none														
Wandering River	A	//91	none														
Wanham	P	1//92	unknown	3	25												
Wanham	P	1//9	unknown	14	31												
Wanham	P	6//92	unknown	21	51												
Wembley	P	9/14/92	32,9, gal	26	45		9.26										
Wembley	P	39814	24, m3 (28,873.68 g)	9	31		9.18										
Wembley	P	9/17/91	3,122.4 gal	23	44		9.21										
Westlock	A	40153	1,787, gal	8	23		8.25										
Westlock	A	1/18/9	1,787, gal	7	11												

BLE D.1
ic Discharging Sewage Treatment Plants

																					1 lbs. Acti-zyme added during year; 4 samples taken prior to discharge - sample results closest to discharge date given.
																					1 lbs. Acti-zyme added during year; 1 sample taken prior, 2 during discharge - sample results closest to discharge date given.
																					unknown if discharged in 199 or 1992, only lagoon sample data from spring were in files
																					unknown if discharged in 199 or 1992, only lagoon sample data from spring were in files
																					unknown if discharged in 199 or 1992, only lagoon sample data from spring were in files
																					8 kg Trizyme added during year
																					8 kg Trizyme added during year
																					8 kg Trizyme added during year
																					5 lagoons sampled - average sample results given; samples were green indicating possible presence of algae - TSS higher than normal.
																					all discharges for 1992 come from west storage cell
																					sample taken prior to discharge; 5 lbs. Acti-zyme in each of 2 cells added during year
																					2 samples taken - average results given; sample taken May 22, 199; 5 lbs. Acti-zyme in each of two cells added during year
																					75 lbs. Acti-zyme added to each of 2 cells
																					8" pipe flowing full for 48 hrs.
																					16.8 m3 treated water to hamlet in 1989; waste water not metered in 1989.
																					no discharge
																					one lb./day of actizyme added for each discharge
																					one lb./day of actizyme added for each discharge
																					one lb./day of actizyme added for each discharge
						0.4			0.2	5.4									18.1		sample was pale green indicating presence of algae.
						1.6			0.2	6.8									19		1 lb/week of Acti-zyme; sewage flow through lift station was 3,284.64 gal.
						1.4			0.2	5.6									17.9		1 lb/week of Acti-zyme; sewage flow through lift station was 32,176. gal.
									1.2										14		1.5 lbs. Acti-zyme added daily from May 15 to July 2, 199

Westlock	A	6/19/91	55,, gal	9	2		7.78										
Westlock	A	1/28/91	55,, gal	4	1												
Westlock	A	40152	unknown														
Westwind Mobile Home Park	A	1//9	unknown if discharged	11		16											
Whitelaw	P	1/21/92	3 days - lowered ~2 in.	5	14												
Whitelaw	P	1/15/9	3 days - lowered ~3 ft.	7	31												
Whitelaw	P	1/21/91	3 days - lowered ~3 ft.	3	9												
Wildwood	A	9/14/92	unknown														
Wildwood	A	9/16/91	unknown														
Wildwood	A	39814	unknown	5	18												
Woking	P	1//92	7 days	2	13												
Woking	P	1//91	9. m3														
Worsley	P	39907	unknown	25	24												
Worsley	P	33394	unknown	7	9.7												
Worsley	P	1/22/91	unknown	2	5.2												
Worsley	P	1/13/92	unknown	1	4.4												
Young's Point Provincial Park	P	33339	7 hrs	81	22												

LE D.1
c Discharging Sewage Treatment Plants

									0.2										18.7		1. lbs. Acti-zyme added daily for 15 days starting May 15, 1991
																					farmers complaining of poor water quality in Wabash Creek; no 1992 discharge reports or TSS/BOD results in files
																					no 199 discharge report
																					Acti-zyme was added weekly each year from 199 - 1992
																					Acti-zyme was added weekly each year from 199 - 1992
																					Acti-zyme was added weekly each year from 199 - 1992
																					correspondence file has a notification of intent to discharge on date given - no data at all on scheduled discharges
																					correspondence file has a notification of intent to discharge on date given - no data at all on scheduled discharges
						4.7			0.2	2.9									5.7		I.D. #14 took reponsibility for this system on January 1, 1991. A lack of service and maintenance records have made it difficult to properly report on this system.
																					no discharge in 1991; unknown amounts of Septo-zyme added in 199, 1991 and 1992
																					no discharge in 1991; unknown amounts of Septo-zyme added in 199, 1991 and 1992
																					sample taken on May 24, 1991; discharge period from May 6-8, 1991
																					minimal amount of Dynakil Plus

APPENDIX E

LIQUID EFFLUENT DATABASE FOR NON-PULP MILL INDUSTRIAL EFFLUENTS

DEFINITIONS FOR TABLE E.1*

HEADING	DESCRIPTION
AG_	Silver
AS_	Arsenic
BIOASSAY	Bioassay (% survival of rainbow trout in 100% effluent over 96-h)
CD_	Cadmium
CO_	Cobalt
COD_	Chemical Oxygen Demand
CR_	Chromium
CU_	Copper
DATE	Date (Month/Day/Year)
FE_	Iron
FLOW_	Effluent discharge
HG_	Mercury
KGPD	Kilograms per Day
M3PD	Cubic Metres per Day
MGPL	Milligrams per Litre
MN_	Manganese
MO_	Molybdenum
NFR_	Non-filterable Residue
NH3_	Ammonia (as N)
NI_	Nickel
O_G_	Oil and Grease
PB_	Lead
PH	pH
PHNOL_	Phenol
SE_	Selenium
SLPHD_	Sulphide
TOC_	Total Organic Carbon
TON	Threshold Odour Number
V_	Vanadium
ZN_	Zinc

* The contents of Table E.1 have also been provided to NRBS on a computer diskette; however, the dBase IV format has been modified here to condense the file making it more suitable for printing. The headings have been changed to reduce the width of the table.

TABLE E.1
Database for Suncor Inc. Industrial Effluent

DATE	NH3 (KGPD)	AS (KGPD)	CD (MGPL)	COD (KGPD)	CR (MGPL)	CO (MGPL)	CU (MGPL)	BIOASSAY	FLOW (M3PD)	FE (MGPL)	PB (MGPL)	MN (MGPL)	HG (MGPL)	MO (MGPL)	NI (MGPL)	NFR (KGPD)	O &G (KGPD)	PH	PHNOL (KGPD)	SE (MGPL)	AG (MGPL)	SLPHD (KGPD)	TON	TOC (MGPL)	V(MGPL)	ZN (MGPL)
1/3/88																70.00	112.20	7.80	0.09							
1/5/88	0.00															49.00	102.00	8.10	0.08			0.00				
1/7/88																45.00	119.00	8.10	0.13							
1/10/88																0.00	85.00	8.00	0.26							
1/12/88	0.00															0.00	66.00	7.90	0.21			0.00	4.00	10.60		
1/14/88																44.00	83.00	7.90	0.11							
1/17/88																89.00	68.00	7.70	0.40							
1/19/88	0.00															0.00	88.00	7.70	0.86			0.00	32.00			
1/21/88																0.00	103.00	7.20	0.69							
1/24/88																0.00	97.00	7.70	0.36							
1/26/88	6.50															0.00	97.00	7.80	0.48			0.00	128.00			
1/28/88																4.40	60.30	7.90	0.20							
1/31/88																52.00	166.00	8.20	0.24							
2/1/88								100.00																		
2/2/88	0.00															0.00	70.00	8.10	0.11			0.16	64.00			
2/4/88																118.00	78.00	8.20	0.18							
2/7/88																0.00	64.90	8.20	0.14							
2/9/88	3.10															0.00	37.00	8.10	0.11			0.30	25.00			
2/11/88																35.00	128.00	8.20	0.21							
2/14/88																0.00	44.00	8.00	0.28							
2/16/88	5.10															68.00	111.00	8.20	0.48			0.70	25.00			
2/17/88																	43.40	8.30	0.15							
2/18/88																0.00										
2/21/88																0.00	29.00	8.10	0.06							
2/23/88	12.80															0.00	120.60	7.80	0.31			0.38	25.00	14.20		
2/25/88																0.00	83.40	7.80	0.30							
2/28/88																0.00	59.40	7.80	0.15							
3/1/88	2.30															0.00	69.00	7.90	0.11			0.00				
3/3/88																10.00	113.90	8.10	0.10							
3/6/88																0.00	117.60	8.20	0.06							
3/8/88	2.70															0.00	64.00	8.00	0.06			0.00	32.00	7.30		
3/10/88																49.00	74.70	7.80	0.17							
3/13/88																46.00	45.70	7.60	0.03							
3/15/88	0.00															0.00	42.00	7.80	0.09			0.00	32.00			
3/17/88																44.00	39.60	7.80	0.09							
3/20/88																48.00	11.50	8.10	0.10							
3/22/88	2.30															36.00	25.00	8.00	0.09			0.00	32.00			
3/24/88																0.00	48.00	8.00	0.07							
3/27/88																0.00	31.00	8.10	0.07							
3/29/88	0.70															0.00	38.70	8.10	0.02			0.00	32.00			
3/31/88																41.00	29.30	8.30	0.04							
4/3/88																0.00	52.00	8.10	0.11							
4/5/88	2.70															0.00	129.00	8.20	0.06			0.00	64.00	9.30		
4/7/88																0.00	45.00	8.20	0.00							
4/10/88																0.00	50.00	8.30	0.08							
4/12/88	0.20															0.00	56.00	8.10	0.06			0.00	32.00			
4/14/88																0.00	22.60	8.20	0.09							
4/17/88																0.00	23.00	8.30	0.04							
4/19/88	0.00															0.00	101.80	8.00	0.00			0.72	8.00			
4/21/88																0.00	70.00	7.80	0.18							
4/24/88																0.00	53.00	8.00	0.04							
4/26/88	0.00															0.00	26.00	7.90	0.07			0.00	32.00			
4/28/88																0.00	40.00	7.80	0.11							
5/1/88								100.00								0.00	31.40	8.00	0.05							
5/3/88	0.00															0.00	29.00	8.10	0.05			0.00				
5/5/88																0.00	15.00	8.20	0.06							
5/8/88																105.00	68.00	8.20	0.00							
5/10/88	0.00															0.00	103.00	7.90	0.12			0.00	64.00	9.70		
5/12/88																354.00	62.00	8.00	0.03							
5/15/88																0.00	42.10	7.50	0.00							
5/17/88	0.30															0.00	5.50	7.70	0.00			0.00	32.00			
5/19/88																16.00	2.60	7.60	0.00							
5/22/88																12.30	17.20	8.30	0.02							
5/24/88	0.00															0.00	5.50	8.50	0.00			0.00				
5/26/88																0.00	5.60	8.10	0.06							
5/29/88																0.00	13.20	8.10	0.00							
5/31/88	0.00															0.00	46.10	7.40	0.12			0.00				
6/1/88	0.00															218.00	119.00	7.70	0.00			0.00	16.00	4.70		
6/3/88																0.00	96.70	7.40	0.41							
6/5/88																0.00	22.30	7.60	0.12							
6/8/88	0.00															0.00	0.00	7.70	0.00			0.00	4.00			
6/10/88																0.00	0.00	7.80	0.10							
6/13/88																0.00	62.00	7.60	0.00							
6/15/88	0.00															0.00	0.00	7.50	0.00			0.00	8.00			
6/17/88																0.00	35.00	7.80	0.06							
6/20/88																0.00	34.10	8.00	0.02							
6/22/88	0.00															0.00	19.90	7.60	0.03			0.00	16.00			
6/24/88																0.00	17.40	7.80	0.06							
6/27/88																0.00	5.70	8.20	0.00							
6/29/88	0.00															0.00	6.40	8.20	0.00			0.24	8.00	9.70		
1/1/89									34447.00																	
1/2/89									33122.00							198.60	51.30	8.00	0.20							
1/3/89									32365.00																	
1/4/89	0.00								31987.00							384.00	76.80	8.60	0.04			0.64				
1/5/89									31797.00																	
1/6/89									32176.00							354.20	106.30	8.00	0.08							
1/7/89									33312.00																	
1/8/89									24794.00																	
1/9/89									17034.00							256.00	98.60	8.20	0.04							
1/10/89									17413.00																	
1/11/89	1.90								17224.00							86.00	96.30	7.90	0.09			0.00	8.00	10.20		
1/12/89								100.00	17034.00																	
1/13/89									22334.00							0.00	124.20	8.00	0.27							
1/14/89									24227.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

1/15/88									32933.00								38.20									
1/16/88									16656.00							83.00		8.10	0.12							
1/17/88									16656.00																	
1/18/88	0.00								18170.00							164.00	121.00	8.10	0.11			0.00	8.00			
1/19/88									19684.00																	
1/20/88									21577.00							193.50	162.30	8.20	0.16							
1/21/88									20820.00																	
1/22/88									22712.00																	
1/23/88									26498.00							186.50	140.50	8.30	0.16							
1/24/88									38747.00																	
1/25/88	2.78								37097.00							277.90	91.30	8.10	0.12			0.00	16.00			
1/26/88									27633.00																	
1/27/88									33312.00							249.80	146.50	8.10	0.01							
1/28/88									31987.00																	
1/29/88									24227.00																	
1/30/88									25362.00							404.80	106.80	8.00	0.15							
1/31/88									22712.00																	
2/1/88									24227.00							194.00	151.00	8.00	0.10							
2/2/88									27539.00																	
2/3/88	0.00								18648.00							296.00	90.70	8.00	0.00			0.00				
2/4/88									19306.00																	
2/5/88									27256.00																	
2/6/88									29905.00							0.00	197.70	7.60	0.27				8.00	6.20		
2/7/88									28769.00																	
2/8/88									37475.00							0.00	142.50	8.30	0.00							
2/9/88									24983.00																	
2/10/88	0.00								25173.00							0.00	81.60	7.70	0.06			0.00				
2/11/88									42018.00																	
2/12/88									36340.00																	
2/13/88									26876.00							0.00	82.00	7.90	0.03				2.00			
2/14/88									26498.00																	
2/15/88									29526.00							0.00	163.40	8.10	0.27							
2/16/88									23469.00																	
2/17/88	38.90								25362.00							0.00	116.80	7.80	0.08			0.00				
2/18/88									34069.00																	
2/19/88									31797.00																	
2/20/88									26801.00							26.80	108.50	7.50	0.08				16.00			
2/21/88									26876.00																	
2/22/88									25362.00							0.00	104.50	7.80	0.18							
2/23/88									26119.00																	
2/24/88	4.30								23848.00							0.00	57.10	7.90	0.14			0.00				
2/25/88									20441.00																	
2/26/88									21198.00																	
2/27/88									19306.00							540.40	32.80	8.00	0.23							
2/28/88									18927.00																	
3/1/88									20365.00							136.70	38.30	7.50	0.06							
3/2/88									19306.00																	
3/3/88	1.10								22523.00							90.00	38.00	8.00	0.11			0.00				
3/4/88									17981.00																	
3/5/88									23848.00																	
3/6/88									24608.00							12.30	139.00	7.80	0.12				16.00	9.00		
3/7/88									21786.00																	
3/8/88									20820.00							291.00	112.00	7.80	0.15							
3/9/88									20441.00																	
3/10/88	0.70								23091.00							0.00	81.30	7.60	0.14			0.00				
3/11/88									21956.00																	
3/12/88									23470.00																	
3/13/88									20820.00							0.00	62.00	7.70	0.05				16.00			
3/14/88									26119.00																	
3/15/88									13060.00							138.00	64.10	8.10	0.14							
3/16/88									16277.00																	
3/17/88	1.20								24227.00							0.00	81.10	7.90	0.30			0.00				
3/18/88									20665.00																	
3/19/88									20441.00																	
3/20/88									22712.00							0.00	42.20	7.90	0.07				32.00			
3/21/88									21956.00																	
3/22/88									20063.00							0.00	153.00	8.10	0.08							
3/23/88									23091.00																	
3/24/88	0.30								24416.00							24.40	92.70	7.80	0.02			0.00				
3/25/88									21956.00																	
3/26/88									20820.00																	
3/27/88									19987.00							99.50	40.80	7.90	0.00							
3/28/88									22712.00																	
3/29/88									18927.00							0.00	61.80	8.10	0.09							
3/30/88									17034.00																	
3/31/88	0.00								15899.00							238.00	66.30	8.00	0.06			0.00				
4/1/88									27256.00																	
4/2/88									28580.00																	
4/3/88									28201.00							574.20	83.70	7.70	0.06							
4/4/88									27256.00																	
4/5/88	0.00								26801.00							258.90	88.70	7.80	0.07			0.00				
4/6/88									27558.00																	
4/7/88									28769.00							381.60	121.00	7.50	0.11				4.00	9.70		
4/8/88									27823.00																	
4/9/88									27256.00																	
4/10/88									27256.00							47.60	42.40	8.00	0.00							
4/11/88									26687.00																	
4/12/88	0.24								26498.00							95.40	49.80	7.50	0.12			0.00				
4/13/88									27936.00																	
4/14/88									23693.00							100.00	66.40	7.20	0.00				16.00	8.10		
4/15/88									26362.00																	
4/16/88									36318.00																	
4/17/88									34826.00							0.00	18.30	8.10	0.11							
4/18/88									21388.00																	
4/19/88	0.00								20933.00							381.60	14.60	7.80	0.08			0.00				
4/20/88									23659.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

4/21/89									21008.00							0.00	0.00	8.60	0.64				2.00			
4/22/89									22523.00																	
4/23/89									24321.00																	
4/24/89									28769.00							0.00	30.90	7.80	0.25							
4/25/89									22826.00																	
4/26/89	0.00								27823.00							0.00	10.80	7.90	0.00			0.00				
4/27/89									26971.00																	
4/28/89									24529.00							0.00	36.40	7.70	0.09				16.00			
4/29/89									25930.00																	
4/30/89									25741.00																	
5/1/89									27256.00							0.00	17.50	8.00	0.06							
5/2/89									28580.00																	
5/3/89	0.00								28201.00							0.00	52.20	8.00	0.06			0.00				
5/4/89									27256.00																	
5/5/89									26801.00							0.00	70.50	7.80	0.05				8.00	11.50		
5/6/89									27568.00																	
5/7/89									28769.00																	
5/8/89									27823.00							0.00	1.10	8.10	0.22							
5/9/89									27256.00																	
5/10/89	1.10								27256.00							0.00	12.00	7.70	0.00			0.00				
5/11/89									26687.00																	
5/12/89									26498.00							0.00	6.80	7.90	0.00							
5/13/89									27936.00																	
5/14/89									23593.00																	
5/15/89									25362.00							0.00	0.00	7.70	0.00							
5/16/89									35318.00																	
5/17/89	11.80								34826.00							0.00	63.70	8.30	0.24			1.39				
5/18/89									21388.00																	
5/19/89									20833.00							0.00	29.00	8.20	0.13					2.00		
5/20/89									23669.00																	
5/21/89									21009.00																	
5/22/89									22523.00							0.00	18.00	8.10	0.07							
5/23/89									24321.00																	
5/24/89	7.80								28769.00							0.00	51.00	8.00	0.03			0.00				
5/25/89									22826.00																	
5/26/89									27823.00							0.00	82.30	7.90	0.00					8.00		
5/27/89									26971.00																	
5/28/89									24529.00																	
5/29/89									25930.00							0.00	11.10	7.90	0.03							
5/30/89									25741.00																	
5/31/89	0.00								29906.00							0.00	37.70	8.00	0.00			0.00				
6/1/89									29626.00																	
6/2/89	3.60								29715.00							0.00	33.80	7.70	0.12			0.00				
6/3/89									26611.00																	
6/4/89									25661.00																	
6/5/89									36629.00							0.00	75.20	7.40	0.07							
6/6/89									44592.00																	
6/7/89									42510.00							0.00	88.30	7.50	0.13				4.00	12.10		
6/8/89									40428.00																	
6/9/89									38990.00							0.00	9.00	7.90	0.00							
6/10/89									36832.00																	
6/11/89									41072.00																	
6/12/89	4.40								44024.00							0.00	78.80	7.40	0.04			0.00				
6/13/89									42586.00																	
6/14/89									43721.00							0.00	48.50	7.60	0.00				4.00			
6/15/89									43532.00																	
6/16/89									43911.00							0.00	0.00	7.80	0.11							
6/17/89									44100.00																	
6/18/89									43632.00																	
6/19/89	0.00								42396.00							0.00	56.40	7.70	0.17			0.00				
6/20/89									42321.00																	
6/21/89									44962.00							0.00	64.70	7.80	0.09				4.00	8.70		
6/22/89									49967.00																	
6/23/89									44971.00							0.00	155.70	7.30	0.14							
6/24/89									42775.00																	
6/25/89									43456.00																	
6/26/89	3.50								43164.00							0.00	41.90	8.00	0.04			0.00				
6/27/89									43911.00																	
6/28/89									41374.00							0.00	33.50	7.90	0.04							
6/29/89									42018.00																	
6/30/89									42964.00							0.00	10.80	7.50	0.13							
7/1/89									43078.00																	
7/2/89									42397.00																	
7/3/89									39292.00							0.00	9.80	7.50	0.00							
7/4/89									37286.00																	
7/5/89	0.00							100.00	37097.00							0.00	7.80	7.80	0.00			0.00				
7/6/89									40239.00																	
7/7/89									44478.00							0.00	34.70	7.80	0.04							
7/8/89									43911.00																	
7/9/89									44005.00																	
7/10/89									44289.00							0.00	9.70	7.40	0.00							
7/11/89									42686.00																	
7/12/89	3.30								41261.00							0.00	19.00	7.70	0.00			0.00				
7/13/89									39274.00																	
7/14/89									37097.00							0.00	0.00	7.60	0.18							
7/15/89									36718.00																	
7/16/89									36861.00																	
7/17/89									36340.00							0.00	0.00	8.10	0.07							
7/18/89									35583.00																	
7/19/89	0.00								35204.00							0.00	22.90	8.00	0.11			0.00	8.00	12.40		
7/20/89									36908.00																	
7/21/89									40000.00																	
7/22/89									40315.00							0.00	0.00	8.30	0.08							
7/23/89									39179.00																	
7/24/89									43154.00							0.00	0.00	8.10	0.00							
7/25/89									32564.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

7/26/89	0.79								39652.00							0.00	115.10	8.00	0.20			3.97	4.00			
7/27/89									45420.00																	
7/28/89									42680.00							0.00	19.20	8.00	0.00							
7/29/89									42207.00																	
7/30/89									40125.00							0.00	76.20	8.10	0.49							
7/31/89									39274.00																	
8/1/89									40603.00																	
8/2/89	0.00								43163.00							0.00	39.20		0.04			0.00				
8/3/89									43163.00																	
8/4/89									43910.00							0.00	56.70		0.04							
8/5/89									43910.00																	
8/6/89									42017.00																	
8/7/89									43163.00							0.00	0.00		0.13							
8/8/89									43910.00																	
8/9/89	0.00								43910.00							0.00	61.90		0.00			0.00				
8/10/89									44478.00																	
8/11/89									39746.00							0.00	12.70		0.39							
8/12/89									39368.00																	
8/13/89									36109.00																	
8/14/89									34088.00							0.00	0.00		0.00							
8/15/89									36339.00																	
8/16/89	0.00								39084.00							0.00	3.90		0.23			0.00				
8/17/89									43532.00																	
8/18/89									42396.00							0.00	34.30		0.04							
8/19/89									44005.00																	
8/20/89									44383.00																	
8/21/89									43532.00							0.00	0.00		0.00							
8/22/89									41450.00																	
8/23/89	0.00								44762.00							0.00	106.10		0.00			0.00				
8/24/89									43910.00																	
8/25/89									44099.00							0.00	0.00		0.00							
8/26/89									42686.00																	
8/27/89									47885.00																	
8/28/89									47979.00							0.00	53.20		0.00							
8/29/89									43632.00																	
8/30/89	0.00								42586.00							0.00	57.90		0.13			0.86				
8/31/89									42017.00																	
9/1/89									40598.00							0.00	30.00	7.70	0.00							
9/2/89									43343.00																	
9/3/89									44667.00																	
9/4/89									42775.00							0.00	16.20	7.90	0.04							
9/5/89									41355.00																	
9/6/89	0.00								41923.00							0.00	38.90	8.00	0.04			0.00	4.00	12.80		
9/7/89									41261.00																	
9/8/89									42964.00							0.00	105.70	7.90	0.26							
9/9/89									42775.00																	
9/10/89									41639.00																	
9/11/89									42775.00							0.00	76.00	8.00	0.13							
9/12/89									44289.00																	
9/13/89	0.00								43058.00							0.00	29.00	8.10	0.17			0.00	4.00			
9/14/89									46182.00																	
9/15/89									46993.00							0.00	73.10	7.90	0.00							
9/16/89									46182.00																	
9/17/89									44289.00																	
9/18/89									44289.00							0.00	42.80	7.70	0.04							
9/19/89									43911.00																	
9/20/89	1.31								43911.00							0.00	23.70	7.30	0.13			0.00				
9/21/89									43911.00																	
9/22/89									44384.00							0.00	14.20	7.40	0.00							
9/23/89									44289.00																	
9/24/89									43767.00																	
9/25/89									43721.00							0.00	32.70	7.20	0.09							
9/26/89									42775.00																	
9/27/89	0.00								43911.00							0.00	133.00	6.80	0.22			0.00	8.00			
9/28/89									40882.00																	
9/29/89									43154.00							0.00	89.40	7.40	0.09							
9/30/89									46560.00																	
10/1/89									42529.00																	
10/2/89									34617.00							0.00	106.60	8.10	0.10							
10/3/89									28163.00																	
10/4/89									30946.00							0.00	84.70	7.80	0.03							
10/5/89									32176.00																	
10/6/89	0.00								31230.00							0.00	72.60	7.40	0.08			0.00	8.00	11.00		
10/7/89									32933.00																	
10/8/89									29906.00																	
10/9/89									27633.00							0.00	103.50	7.70	0.11							
10/10/89									31419.00																	
10/11/89									30851.00							0.00	69.80	7.90	0.12							
10/12/89									31230.00																	
10/13/89	0.00								31797.00							0.00	59.80	8.00	0.54			0.00	32.00			
10/14/89									31230.00																	
10/15/89									27066.00																	
10/16/89									35204.00							0.00	67.40	7.80	0.36							
10/17/89									29223.00																	
10/18/89									28692.00							57.00	36.30	7.50	0.29							
10/19/89									32664.00																	
10/20/89	0.00								30283.00							242.00	67.00	7.40	0.27			0.00	16.00			
10/21/89									26876.00																	
10/22/89									26876.00																	
10/23/89									26877.00							27.00	79.40	7.60	0.00							
10/24/89									26308.00																	
10/25/89									24605.00							49.00	60.30	8.00	0.12							
10/26/89									24984.00																	
10/27/89	0.00								26876.00							27.00	63.80	8.00	0.27			0.00	16.00			
10/28/89									20347.00																	
10/29/89									26173.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

10/30/89									27003.00							0.00	45.40	7.70	0.24							
10/31/89									24363.00																	
11/1/89	0.00	0.00							26498.00							0.00	18.00	7.10	0.24			0.00	16.00	6.70		
11/2/89									25741.00																	
11/3/89									24984.00							0.00	19.50	6.90	0.00							
11/4/89									27728.00																	
11/5/89									29148.00																	
11/6/89									30662.00							0.00	37.10	6.90	0.40							
11/7/89									25173.00																	
11/8/89	0.00	0.00							20820.00							62.40	40.90	7.00	0.21			0.00	8.00			
11/9/89									20063.00																	
11/10/89									23849.00							126.10	22.10	7.40	0.00							
11/11/89									20441.00																	
11/12/89									19684.00																	
11/13/89									23659.00							450.30	36.00	8.10	0.00							
11/14/89									18369.00																	
11/15/89	0.00	0.00							22902.00							366.40	133.30	8.20	0.23			0.12				
11/16/89									16277.00																	
11/17/89									15633.00							364.30	153.50	8.40	0.26							
11/18/89									26498.00																	
11/19/89									38516.00																	
11/20/89									22712.00							771.80	63.80	8.30	0.11							
11/21/89									19684.00																	
11/22/89	0.00	0.00							17791.00							0.00	105.00	8.30	0.07			0.00				
11/23/89									24984.00																	
11/24/89									23564.00							472.00	56.90	8.40	0.00							
11/25/89									25362.00																	
11/26/89									21198.00																	
11/27/89									31135.00							653.00	139.00	8.30	0.06							
11/28/89									24984.00																	
11/29/89	0.00	0.00							20820.00							603.00	57.60	8.40	0.00			0.00				
11/30/89									32649.00																	
12/1/89									30283.00							757.00	41.20	8.20	0.00							
12/2/89									29526.00																	
12/3/89									28769.00																	
12/4/89									27256.00							0.00	108.00	8.10	0.16							
12/5/89									32176.00																	
12/6/89	0.00								37097.00							278.00	112.80	8.10	0.00			0.00	2.00			
12/7/89									29905.00																	
12/8/89									28769.00							0.00	44.60	8.60	0.00							
12/9/89									24227.00																	
12/10/89									24984.00																	
12/11/89									25362.00							254.00	10.70	8.50	0.13							
12/12/89									25362.00																	
12/13/89	1.30								21577.00							206.00	44.90	8.50	0.17			0.00	32.00			
12/14/89									22712.00																	
12/15/89									23469.00							0.00	33.60	8.40	0.17							
12/16/89									21956.00																	
12/17/89									22334.00																	
12/18/89									20820.00							166.00	43.70	9.20	0.19							
12/19/89									18927.00																	
12/20/89	0.00								18170.00							145.00	36.00	9.10	0.18			0.00	2.00	13.00		
12/21/89									20441.00																	
12/22/89									29148.00							0.00	28.50	9.10	0.26							
12/23/89									25741.00																	
12/24/89									26498.00																	
12/25/89									23091.00							439.00	45.00	9.00	0.12							
12/26/89									22712.00																	
12/27/89	0.70								23091.00							393.00	52.00	8.80	0.28			0.00	2.00			
12/28/89									24984.00																	
12/29/89									23469.00							446.00	32.00	8.60	0.17							
12/30/89									24227.00																	
12/31/89									24227.00																	
1/1/90		0.00	0.00	616.00	0.00	0.00	0.00		25741.00	0.44	0.01	0.07	0.00	0.05	0.01	0.00	25.40	8.60	0.23	0.00					0.16	0.02
1/2/90									26119.00																	
1/3/90	0.00			52.00					26119.00							130.00	61.00	8.90	0.08			0.00	8.00			
1/4/90									26498.00																	
1/5/90				48.00					24227.00							157.00	50.80	8.70	0.10							
1/6/90									32933.00																	
1/7/90									42586.00																	
1/8/90				148.00					42425.00							1293.00	106.00	8.50	0.38							
1/9/90									37854.00																	
1/10/90	0.00			469.00					25363.00							255.00	63.00	8.10	0.46			0.00	4.00	9.00		
1/11/90									23091.00																	
1/12/90				329.00					23469.00							165.00	35.00	8.00	0.56							
1/13/90									21956.00																	
1/14/90									21577.00																	
1/15/90				583.00					26498.00							238.00	37.60	8.20	0.21							
1/16/90									24984.00																	
1/17/90	0.00			128.00					25741.00							103.00	19.00	7.90	0.15			0.00	4.00			
1/18/90									25741.00																	
1/19/90				578.00				100.00	26309.00							710.00	53.00	8.20	0.16							
1/20/90									24984.00																	
1/21/90									24984.00																	
1/22/90				750.00					24227.00							702.00	23.90	8.20	0.19							
1/23/90									23091.00																	
1/24/90	1.17			211.00					23469.00							305.00	37.60	8.30	0.14			0.00	8.00			
1/25/90									25173.00																	
1/26/90				706.00					21350.00							0.00	52.00	6.80	0.11							
1/27/90									21198.00																	
1/28/90									24227.00																	
1/29/90				203.80					25362.00							127.00	39.10	8.00	0.00							
1/30/90									27256.00																	
1/31/90	0.43			0.00					21482.00				-			0.00	45.10	8.20	0.02							
2/1/90									24894.00																	
2/2/90				533.00					33312.00							166.00	150.00	8.30	0.17							

TABLE E.1
Database for Suncor Inc. Industrial Effluent

2/3/80									34069.00																	
2/4/80									28391.00																	
2/5/80				0.00					28012.00							644.00	88.00	8.00	0.02							
2/6/80									22712.00																	
2/7/80	0.00			0.00					23469.00							0.00	96.50	8.20	0.09			0.00	16.00			
2/8/80									24984.00																	
2/9/80				0.00					22712.00							0.00	63.50	8.20	0.14							
2/10/80									22712.00																	
2/11/80									20441.00																	
2/12/80				146.00					20820.00							10.00	47.80	8.30	0.10							
2/13/80									24227.00																	
2/14/80	0.00			0.00					25930.00							52.00	30.80	8.30	0.10			0.00	32.00	8.80		
2/15/80									22712.00																	
2/16/80				266.00					24227.00							169.00	45.20	8.20	0.17							
2/17/80									24227.00																	
2/18/80									21955.00																	
2/19/80				157.00					19684.00							366.00	9.60	8.20	0.18							
2/20/80									21966.00																	
2/21/80	17.30			291.00					20820.00							136.00	29.00	8.20	0.13			0.00	16.00			
2/22/80									20630.00																	
2/23/80				683.00					20063.00							1048.00	53.40	8.20	0.20							
2/24/80									18170.00																	
2/25/80									18927.00																	
2/26/80				487.00					20252.00							1299.00	47.70	8.30	0.08							
2/27/80									19496.00																	
2/28/80	3.90			426.00					18648.00							130.00	8.90	8.10	0.00			0.00	16.00			
3/1/80									20441.00																	
3/2/80				221.00					20063.00							60.30	23.90	8.00	0.10							
3/3/80									20063.00																	
3/4/80									20820.00																	
3/5/80				136.00					22712.00							45.40	21.00	8.20	0.23							
3/6/80									24605.00																	
3/7/80	0.00			0.00					24605.00							443.00	35.70	8.10	0.22			0.00	16.00			
3/8/80									25362.00																	
3/9/80				540.00					25741.00							822.00	63.00	8.10	0.28							
3/10/80									25741.00																	
3/11/80									25741.00																	
3/12/80				387.00					24227.00							0.00	13.00	8.10	0.19							
3/13/80									24984.00																	
3/14/80	0.00			231.00					25741.00							26.00	32.00	8.20	0.18			0.00	16.00	8.10		
3/15/80									26498.00																	
3/16/80				313.00					26119.00							157.00	61.00	8.20	0.18							
3/17/80									24605.00																	
3/18/80									23848.00																	
3/19/80				404.00					23848.00							285.00	18.00	8.10	0.11							
3/20/80									22712.00																	
3/21/80	2.50			207.00					23091.00							46.20	35.50	8.20	0.11			0.00				
3/22/80									21955.00																	
3/23/80				567.00					22712.00							0.00	63.00	8.20	0.07							
3/24/80									23091.00																	
3/25/80									23469.00																	
3/26/80				266.00					24227.00							121.00	30.90	8.00	0.19							
3/27/80									24984.00																	
3/28/80	3.30			482.00					25362.00							0.00	82.30	8.20	0.06			0.00	8.00			
3/29/80									24984.00																	
3/30/80				230.00					25661.00							358.00	25.30	8.20	0.15							
3/31/80									26119.00																	
4/1/80									26498.00																	
4/2/80				0.00					26498.00							530.00	15.60	8.10	0.16							
4/3/80									25930.00																	
4/4/80	0.00			0.00					25930.00							0.00	1.30	7.90	0.18			0.00				
4/5/80									25741.00																	
4/6/80				490.00					24605.00							0.00	2.20	7.90	0.06							
4/7/80									24416.00																	
4/8/80									26498.00																	
4/9/80				475.00					29715.00							59.00	57.60	8.10	0.06							
4/10/80									28390.00																	
4/11/80	0.00			32.00					32176.00							354.00	109.00	8.10	0.03			0.00	4.00			
4/12/80									24984.00																	
4/13/80				344.00					26498.00							13.00	56.30	8.00	0.03							
4/14/80									26498.00																	
4/15/80									26362.00																	
4/16/80				516.00					24605.00							209.00	73.50	7.80	0.27							
4/17/80									29148.00																	
4/18/80	0.89			631.00					29526.00							442.00	46.90	8.20	0.00			0.00				
4/19/80									29905.00																	
4/20/80				0.00					28769.00							0.00	36.30	8.10	0.03							
4/21/80									29148.00																	
4/22/80									29526.00																	
4/23/80				0.00					29526.00							0.00	36.50	8.00	0.00							
4/24/80									30283.00																	
4/25/80	1.03			0.00					34447.00							0.00	12.70	7.90	0.00			0.00	4.00	0.00		
4/26/80									33690.00																	
4/27/80				0.00					32933.00							0.00	26.00	8.00	0.10							
4/28/80									31040.00																	
4/29/80									30662.00																	
4/30/80				0.00					31797.00							0.00	50.60	7.90	0.19							
5/1/80									30280.00																	
5/2/80	1.90			0.00					31130.00							0.00	68.80	8.10	0.00			0.00	4.00	10.70		
5/3/80									29900.00																	
5/4/80				0.00					28010.00							0.00	22.10	7.80	0.08							
5/5/80									25270.00																	
5/6/80									27160.00																	
5/7/80				0.00					30000.00							0.00	30.00	7.80	0.00							
5/8/80									30380.00																	
5/9/80	0.30			0.00					30380.00							0.00	71.70	8.00	0.10			0.00	2.00	13.60		

TABLE E.1
Database for Suncor Inc. Industrial Effluent

5/10/90									30660.00																	
5/11/90				32.80					32650.00							0.00	44.70	8.00	0.00							
5/12/90									33600.00																	
5/13/90									31760.00																	
5/14/90				0.00					30740.00							0.00	48.60	7.80	0.20							
5/15/90									30090.00																	
5/16/90	3.50			0.00					35260.00							0.00	42.70	7.80	0.07			0.00	4.00	24.50		
5/17/90									31700.00																	
5/18/90				20.60					25740.00							0.00	9.50	7.90	0.06							
5/19/90									24730.00																	
5/20/90									21700.00																	
5/21/90				0.00					17920.00							0.00	5.20	7.80	0.04							
5/22/90									17160.00																	
5/23/90	1.10			0.00					15610.00							0.00	2.50	7.60	0.00			0.00	2.00			
5/24/90									15100.00																	
5/25/90				0.00					10980.00							0.00	3.50	7.60	0.00							
5/26/90									11230.00																	
5/27/90									11480.00																	
5/28/90				97.00					10790.00							0.00	22.00	7.70	0.04							
5/29/90									8610.00																	
5/30/90	0.98			84.00					7000.00							0.00	0.42	7.50	0.00			0.00	8.00			
5/31/90									5110.00																	
6/1/90				0.00				100.00	4730.00							0.00	0.00	7.70	0.00							
6/4/90				78.80					3030.00							0.00	1.80	6.70	0.01							
6/5/90									8710.00																	
6/6/90	4.90			0.00					13000.00							0.00	40.70	7.30	0.10			0.00	16.00	11.00		
6/7/90									11360.00																	
6/8/90									10410.00																	
6/9/90									9940.00																	
6/10/90									9180.00																	
6/11/90				0.00					13720.00							0.00	24.60	7.80	0.01							
6/12/90									14860.00																	
6/13/90	2.20			0.00					18420.00							0.00	20.60	8.10	0.00			0.00				
6/14/90									16020.00																	
6/15/90				0.00					16560.00							0.00	33.00	7.90	0.00							
6/16/90									18260.00																	
6/17/90									17320.00																	
6/18/90				0.00					20160.00							0.00	16.90	8.00	0.00							
6/19/90									20540.00																	
6/20/90	0.00			0.00					20350.00							0.00	32.20	7.70	0.18			0.00				
6/21/90									18640.00																	
6/22/90				0.00					16750.00							0.00	30.30	7.70	0.08							
6/23/90									18830.00																	
6/24/90									20440.00																	
6/25/90				154.00					19210.00							0.00	11.90	7.90	0.00							
6/26/90									18830.00																	
6/27/90	1.50			404.00					18360.00							0.00	9.50	7.80	0.02			0.00	4.00			
6/28/90									19400.00																	
6/29/90				184.00					20440.00							0.00	6.90	8.10	0.10							
6/30/90									24230.00																	
7/1/90		0.00	0.00		0.00	0.00	0.01	100.00	30283.00	1.09	0.00	0.06	0.00	0.19	0.02					0.00	0.00				0.15	0.01
7/2/90				1113.00					26498.00							0.00	14.00	7.80	0.00							
7/3/90									28012.00																	
7/4/90	27.00			1378.00					26498.00							0.00	52.70	7.90	0.84			0.00	8.00	7.00		
7/5/90									29148.00																	
7/6/90				1.00					26498.00							0.00	32.80	8.00	0.66							
7/7/90									24227.00																	
7/8/90									29906.00																	
7/9/90				869.00					30662.00							0.00	4.00	7.80	0.30							
7/10/90									31797.00																	
7/11/90	36.30			182.00					30283.00							0.00	13.00	7.70	0.21			0.00	16.00			
7/12/90									31797.00																	
7/13/90				0.00					31797.00							0.00	20.90	7.90	0.16							
7/14/90									27256.00																	
7/15/90									29626.00																	
7/16/90				145.00					28958.00							0.00	20.00	8.20	0.00							
7/17/90									31040.00																	
7/18/90	6.70			0.00					36583.00							0.00	24.00	7.30	0.36			0.00	8.00			
7/19/90									38990.00																	
7/20/90				340.00					41639.00							0.00	151.00	7.70	0.08							
7/21/90									40504.00																	
7/22/90									35204.00																	
7/23/90				399.00					33312.00							0.00	29.90	8.00	0.00							
7/24/90									32933.00																	
7/25/90	1.90			0.00					32176.00							0.00	14.80	8.30	0.19			0.00	8.00			
7/26/90									31419.00																	
7/27/90				260.00					32554.00							0.00	16.00	8.40	0.20							
7/28/90									35204.00																	
7/29/90									31412.00																	
7/30/90				0.00					28012.00							0.00	2.80	8.50	0.14							
7/31/90									30283.00																	
8/1/90	0.00			0.00					30000.00							0.00	5.40	8.30	0.12			0.03	4.00			
8/2/90									30860.00																	
8/3/90				0.00					32380.00							0.00	8.70	8.40	0.13							
8/4/90									34840.00																	
8/5/90									35960.00																	
8/6/90				0.00					32740.00							0.00	10.80	8.30	0.20							
8/7/90									29400.00																	
8/8/90	0.00			83.00					27730.00							0.00	6.70	8.40	0.14			0.00	4.00			
8/9/90									28390.00																	
8/10/90				0.00					34070.00							0.00	10.20	8.50	0.14							
8/11/90									41920.00																	
8/12/90									39780.00																	
8/13/90				0.00					41130.00							0.00	10.70	8.50	0.12							
8/14/90									45560.00																	
8/15/90	0.00			0.00					45930.00							0.00	11.00	8.50	0.14			0.00	2.00	6.10		

TABLE E.1
Database for Suncor Inc. Industrial Effluent

8/16/80									45990.00																	
8/17/80				422.00					42210.00							0.00	11.00	8.00	0.00							
8/18/80									29650.00																	
8/19/80									40220.00																	
8/20/80				0.00					40410.00							0.00	19.40	8.20	0.00							
8/21/80									41260.00																	
8/22/80	0.00			0.00					42210.00							0.00	5.50	8.20	0.58			0.00	8.00			
8/23/80									43720.00																	
8/24/80				256.00					42650.00							0.00	13.60	8.90	0.09							
8/25/80									38610.00																	
8/26/80									44760.00																	
8/27/80				0.00					41730.00							0.00	18.40	8.30	0.04							
8/28/80									41260.00																	
8/29/80	0.00			1191.00					38420.00							0.00	20.00	7.90	0.12			0.00	2.00			
8/30/80									43440.00																	
8/31/80				217.00					43410.00							0.00	11.70	8.10	0.26							
9/1/80									43600.00																	
9/2/80									43900.00																	
9/3/80				0.00					45600.00							0.00	20.10	8.20	0.00							
9/4/80									41400.00																	
9/5/80	0.00			0.00					44000.00							0.00	19.40	8.20	0.00			0.00	8.00	5.90		
9/6/80									39200.00																	
9/7/80				262.00					43600.00							0.00	24.00	8.20	0.30							
9/8/80									44900.00																	
9/9/80									42600.00																	
9/10/80				0.00					41900.00							0.00	25.60	8.40	0.00							
9/11/80									43000.00																	
9/12/80	0.00			0.00					39100.00							0.00	36.40	8.40	0.00			0.00	4.00			
9/13/80									39200.00																	
9/14/80				1800.00					40900.00							0.00	11.00	8.20	0.00							
9/15/80									44300.00																	
9/16/80									43300.00																	
9/17/80				1268.00					40800.00							0.00	25.30	8.30	0.00							
9/18/80									41200.00																	
9/19/80	0.00			0.00					42900.00							86.00	31.30	8.30	0.26			0.00				
9/20/80									41400.00																	
9/21/80				0.00					41800.00							0.00	32.20	8.30	0.00							
9/22/80									41000.00																	
9/23/80									43600.00																	
9/24/80				0.00					41400.00							168.00	38.20	8.20	0.66							
9/25/80									49000.00																	
9/26/80	0.00			0.00					52400.00							0.00	45.10	8.10	0.00			0.00	4.00			
9/27/80									56100.00																	
9/28/80				0.00					53900.00								97.60	8.10	0.00							
9/29/80									56800.00																	
9/30/80									56300.00																	
10/1/80		0.00	0.00	56.00	0.00	0.00	0.01	100.00	66267.00	0.31	0.01	0.06	0.00	0.05	0.01	0.00	46.40	8.10	0.00	0.00	0.00				0.05	0.01
10/2/80									49210.00																	
10/3/80	0.00			602.00					60188.00							0.00	60.00	8.00	0.12			0.00	2.00	6.70		
10/4/80									64352.00																	
10/5/80				510.00					63784.00							0.00	45.30	8.10	0.00							
10/6/80									63595.00																	
10/7/80									62838.00																	
10/8/80				310.00					62081.00							0.00	68.30	8.00	0.00							
10/9/80									61702.00																	
10/10/80	3.65			670.00					60946.00							0.00	87.10	7.90	0.00			0.00	4.00			
10/11/80									60568.00																	
10/12/80				336.00					42018.00							798.00	45.80	8.00	0.00							
10/13/80									34069.00																	
10/14/80									35204.00																	
10/15/80				356.00					35583.00							142.00	19.60	8.10	0.00							
10/16/80									36961.00																	
10/17/80	0.00			204.00					34089.00							0.00	2.10	8.20	0.00			0.00	8.00			
10/18/80									30283.00																	
10/19/80				97.00					32176.00							32.00	23.50	8.00	0.00							
10/20/80									32564.00																	
10/21/80									42018.00																	
10/22/80				144.00					48075.00							120.00	31.80	8.00	0.00							
10/23/80									50724.00																	
10/24/80	0.00			406.00					50724.00							0.00	36.50	8.20	0.00			0.00	1.00			
10/25/80									51103.00																	
10/26/80				541.00					49210.00							640.00	27.10	8.20	0.00							
10/27/80									45803.00																	
10/28/80									46182.00																	
10/29/80				189.00					47318.00							0.00	25.50	8.30	0.00							
10/30/80									48075.00																	
10/31/80	0.92			687.00					45803.00							1145.00	12.80	8.20	0.06			0.00	2.00			
11/1/80									39747.00																	
11/2/80				420.00					36016.00							368.00	24.20	7.80	0.14							
11/3/80									36204.00																	
11/4/80									40882.00																	
11/5/80				130.00					32584.00							0.00	14.60	8.40	0.19							
11/6/80									40882.00																	
11/7/80	0.00			0.00					43154.00							86.00	27.60	8.30	0.13			0.00	4.00	9.70		
11/8/80									42775.00																	
11/9/80				88.00					43911.00							220.00	90.90	8.20	0.00							
11/10/80									42776.00																	
11/11/80									42207.00																	
11/12/80				380.00					45046.00							450.00	72.00	8.40	0.05							
11/13/80									43532.00																	
11/14/80	0.46			277.00					46182.00							347.00	7.40	8.30	0.19			0.00	4.00			
11/15/80									43911.00																	
11/16/80				866.00					45046.00							270.00	19.80	8.20	0.14							
11/17/80									46560.00																	
11/18/80									44289.00																	
11/19/80				0.00					44668.00							626.00	169.40	8.40	0.09							

TABLE E.1

Database for Suncor Inc: Industrial Effluent

11/20/90									44867.00																	
11/21/90	0.90			0.00					45046.00							113.00	46.30	8.20	0.18			0.00	8.00			
11/22/90									41261.00																	
11/23/90				734.00					40882.00							0.00	86.70	7.90	0.12							
11/24/90									42018.00																	
11/25/90									41639.00																	
11/26/90				0.00					44289.00							89.00	89.50	8.10	0.00							
11/27/90									36718.00																	
11/28/90	0.00			296.00					26876.00							242.00	35.80	8.10	0.03			0.00	4.00			
11/29/90									28391.00																	
11/30/90				194.00					24227.00							847.00	15.30	8.20	0.15							
12/1/90									31797.00																	
12/2/90									32744.00																	
12/3/90				340.00					33974.00							306.00	75.50	7.90	0.20							
12/4/90									31703.00																	
12/5/90	1.56			406.80					31230.00							624.00	57.70	7.80	0.12			0.00	8.00	7.70		
12/6/90									31892.00																	
12/7/90				381.70					34700.00							0.00	130.10	8.00	0.24							
12/8/90									32271.00																	
12/9/90									30662.00																	
12/10/90				0.00					29715.00							356.60	41.30	7.80	0.12							
12/11/90									26498.00																	
12/12/90	0.00			410.00					27266.00							27.30	53.00	8.50	0.16			0.00	8.00			
12/13/90									28107.00																	
12/14/90				250.00					31283.00							0.00	59.50	8.30	0.00							
12/15/90									28769.00																	
12/16/90									29148.00																	
12/17/90				0.00					29337.00							380.90	39.90	8.20	0.09							
12/18/90									30018.00																	
12/19/90	1.19			0.00					23659.00							237.00	30.10	7.90	0.09			0.00	2.00			
12/20/90									24794.00																	
12/21/90				473.00					26309.00							368.00	22.10	8.40	0.21							
12/22/90									28391.00																	
12/23/90									27917.00																	
12/24/90				116.40					29053.00							0.00	29.70	8.00	0.12							
12/25/90									25741.00																	
12/26/90	0.00			864.00					28769.00							345.60	34.60	7.80	0.00			0.00				
12/27/90									28580.00																	
12/28/90				0.00					29526.00							0.00	55.20	8.40	0.30							
12/29/90									29242.00																	
12/30/90									21482.00																	
12/31/90				109.50					21917.00							0.00	40.30	8.10	0.00							
1/1/91		0.00	0.00		0.01	0.00	0.01	100.00	27360.00	0.49	0.00	0.05	0.00	0.01						0.00	0.00				0.01	0.03
1/2/91	0.00			297.00					26971.00							378.00	50.80	8.10	0.11			0.00	2.00	4.70		
1/3/91									28391.00																	
1/4/91				624.00					29715.00							0.00	76.60	8.10	0.21							
1/5/91									29337.00																	
1/6/91									38043.00																	
1/7/91				206.00					41166.00						0.09	432.60	26.10	8.00	0.41							
1/8/91									35772.00																	
1/9/91	0.00			210.00					30000.00							60.00	42.30	8.30	0.21			0.00	4.00			
1/10/91									33879.00																	
1/11/91				261.90					29148.00							101.90	37.50	8.30	0.67							
1/12/91									32933.00																	
1/13/91									35867.00																	
1/14/91				565.50					37703.00							490.10	39.20	8.00	0.26							
1/15/91									30473.00																	
1/16/91	0.43			255.60					21388.00							10.70	37.70	8.00	0.13			0.00	4.00			
1/17/91									31703.00																	
1/18/91				270.00					30000.00							195.00	60.40	8.10	0.12							
1/19/91									33879.00																	
1/20/91									35583.00																	
1/21/91				183.00					30510.00							488.00	45.40	8.10	0.09							
1/22/91									30283.00																	
1/23/91	0.87			317.90					28958.00							404.60	44.50	7.90	0.00			0.00	4.00	7.40		
1/24/91									20630.00																	
1/25/91				267.30					29715.00							0.00	52.60	8.00	0.09							
1/26/91									32933.00																	
1/27/91									24302.00																	
1/28/91				198.20					24899.00							0.00	38.80	8.00	0.16							
1/29/91									26725.00																	
1/30/91	0.00			137.00					27444.00							0.00	28.50	8.20	0.00			0.00	4.00			
1/31/91									21766.00																	
2/1/91				239.80					21956.00							0.00	24.00	7.90	0.11							
2/2/91									26373.00																	
2/3/91									29791.00																	
2/4/91				686.40					21766.00							0.00	12.80	8.30	0.18							
2/5/91									21671.00																	
2/6/91	2.60			217.00					23280.00							271.30	11.10	8.00	0.11			0.00	8.00	6.10		
2/7/91									22523.00																	
2/8/91				382.50					28012.00							315.00	9.20	8.20	0.13							
2/9/91									20157.00																	
2/10/91									24974.00																	
2/11/91				248.00					26119.00							496.00	11.40	8.40	0.22							
2/12/91									20820.00																	
2/13/91	0.62			0.00					21671.00							0.00	13.70	8.20	0.29			0.00	4.00			
2/14/91									17886.00																	
2/15/91				179.00					18454.00							0.00	30.10	8.30	0.16							
2/16/91									20725.00																	
2/17/91									28504.00																	
2/18/91				342.00					28012.00							0.00	26.80	8.30	0.17							
2/19/91									31797.00																	
2/20/91	3.50			477.00					33425.00							397.50	17.80	8.10	0.22			0.00	8.00			
2/21/91									26309.00																	
2/22/91				526.00					26498.00							368.00	14.20	8.30	0.13							
2/23/91									30567.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

2/24/81									16666.00																	
2/25/81				162.00					27028.00							54.00	4.10	7.80	0.03							
2/26/81									31987.00																	
2/27/81	0.00			448.00					26971.00							0.00	16.60	8.20	0.03			0.00	8.00			
2/28/81									23470.00																	
3/1/81				0.00					28674.00							0.00	41.10	7.90	0.14							
3/2/81									27538.00																	
3/3/81									29626.00																	
3/4/81				1475.00					33122.00							620.00	62.20	8.30	0.27							
3/5/81									32564.00																	
3/6/81	46.00			0.00					32176.00							293.40	47.90	8.20	0.39			0.00	2.00	9.80		
3/7/81									29242.00																	
3/8/81				0.00					30472.00							29.20	41.80	7.80	0.06							
3/9/81									36204.00																	
3/10/81									42870.00																	
3/11/81				257.40					37570.00							0.00	37.80	7.90	0.04							
3/12/81									36110.00																	
3/13/81	2.81			106.30					31808.00							0.00	40.00	8.00	0.18			0.00	8.00			
3/14/81									32271.00																	
3/15/81				258.40					35683.00							193.80	54.30	7.80	0.06							
3/16/81									34069.00																	
3/17/81									32933.00																	
3/18/81				296.10					29626.00							411.30	49.40	7.90	0.23							
3/19/81									28296.00																	
3/20/81	0.00			481.10					32176.00							452.80	25.20	8.10	0.08			0.00	4.00			
3/21/81									31230.00																	
3/22/81				468.00					30662.00							312.00	68.30	7.80	0.26							
3/23/81									32649.00																	
3/24/81									29337.00																	
3/25/81				588.00					28012.00							615.30	29.00	7.80	0.18							
3/26/81									26971.00																	
3/27/81	1.08			243.00					25078.00							108.00	34.80	7.30	0.16			0.00	8.00			
3/28/81									21956.00																	
3/29/81				132.00					25646.00							308.00	14.50	7.40	0.04							
3/30/81									21671.00																	
3/31/81									30283.00																	
4/1/81		0.00	0.00	0.00	0.00	0.00	0.01	100.00	32649.00	38.00	0.00	0.03	0.00	0.11	0.02	0.00	19.70	7.80	0.00	0.00	0.00				0.24	0.01
4/2/81									34069.00																	
4/3/81	0.00			443.00					36529.00							0.00	22.50	8.10	0.14			0.00	4.00	6.80		
4/4/81									36226.00																	
4/5/81				36.20					38233.00							217.20	23.50	8.00	0.14							
4/6/81									38990.00																	
4/7/81									38800.00																	
4/8/81				0.00					37854.00							543.20	0.00	7.60	0.16							
4/9/81									34788.00																	
4/10/81	0.00			0.00					36718.00							174.00	10.80	7.60	0.04			0.00	4.00			
4/11/81									36416.00																	
4/12/81				436.80					39747.00							618.80	0.00	8.30	0.15							
4/13/81									35961.00																	
4/14/81									34731.00																	
4/15/81				0.00					36434.00							0.00	18.00	8.10	0.00							
4/16/81									36529.00																	
4/17/81	0.00			146.00					53942.00							0.00	23.70	7.60	0.07			0.00	8.00			
4/18/81									54888.00																	
4/19/81				164.70					49589.00							0.00	65.30	8.20	0.17							
4/20/81									49210.00																	
4/21/81									52428.00																	
4/22/81				314.40					42586.00							0.00	9.40	7.90	0.11							
4/23/81									44289.00																	
4/24/81	9.75			575.80					48453.00							0.00	15.50	7.60	0.09			0.00	2.00			
4/25/81									38327.00																	
4/26/81				488.60					32744.00							0.00	31.40	7.60	0.00							
4/27/81									30861.00																	
4/28/81									31797.00																	
4/29/81				96.40					32176.00							0.00	7.30	8.20	0.03							
4/30/81									29810.00																	
5/1/81	1.24			0.00					38861.00							0.00	20.70	8.30	0.15			0.00	4.00	7.40		
5/2/81									33061.00																	
5/3/81				0.00					42018.00							0.00	0.00	8.20	0.00							
5/4/81									49683.00																	
5/5/81									43632.00																	
5/6/81				130.60					52049.00							0.00	0.00	8.30	0.22							
5/7/81									37286.00																	
5/8/81	2.24			111.90					34334.00							0.00	11.20	8.30	0.15			0.00	2.00			
5/9/81									33436.00																	
5/10/81				0.00					32460.00							0.00	21.46	8.10	0.00							
5/11/81									30662.00																	
5/12/81									30472.00																	
5/13/81				0.00					44006.00							0.00	20.70	8.10	0.12							
5/14/81									50630.00																	
5/15/81	0.00			364.20					49210.00							0.00	36.41	8.30	0.25			0.00	8.00			
5/16/81									49683.00																	
5/17/81				0.00					49589.00							0.00	21.40	8.40	0.00							
5/18/81									64131.00																	
5/19/81									52522.00																	
5/20/81				0.00					50157.00							0.00	2.60	8.50	0.00							
5/21/81									49967.00																	
5/22/81	0.50			0.00					49494.00							0.00	19.50	8.40	0.25			0.00	4.00			
5/23/81									53468.00																	
5/24/81				309.50					63942.00							0.00	98.41	8.30	0.16							
5/25/81									54888.00																	
5/26/81				648.00					53980.00																	
5/27/81									54604.00							0.00	18.40	8.20	0.16							
5/28/81				0.00					53753.00																	
5/29/81	8.61								56361.00							0.00	15.60	8.30	0.00			0.00	2.00			
5/30/81									56781.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

5/31/91				908.00					53628.00							0.00	39.23	8.50	0.00							
6/1/91									39606.00																	
6/2/91									43816.00																	
6/3/91				0.00					44289.00							0.00	23.70	8.40	0.00							
6/4/91									42396.00																	
6/5/91	0.00			0.00					36718.00							0.00	23.30	8.50	0.21			0.00	8.00	6.90		
6/6/91									36908.00																	
6/7/91				0.00					34069.00							0.00	10.00	8.30	0.07							
6/8/91									40698.00																	
6/9/91									51103.00																	
6/10/91				0.00					48169.00							0.00	21.00	8.50	0.00							
6/11/91									50630.00																	
6/12/91	0.00			0.00					52712.00							0.00	53.10	8.30	0.06			0.00	2.00			
6/13/91									57066.00																	
6/14/91				800.00					56497.00							0.00	42.80	7.80	0.17							
6/15/91									56078.00																	
6/16/91									54794.00																	
6/17/91				0.00					54610.00							0.00	21.40	8.20	0.00							
6/18/91									54434.00																	
6/19/91	0.00			0.00					54320.00							0.00	14.10	8.10	0.00			0.00	1.00			
6/20/91									52996.00																	
6/21/91				424.00					54899.00							0.00		8.20	0.06							
6/22/91									51103.00																	
6/23/91									49841.00																	
6/24/91				747.00					55645.00							0.00		8.10	0.15							
6/25/91									52368.00																	
6/26/91	17.30			0.00					52239.00							0.00		7.90	0.11			0.00	4.00			
6/27/91									52617.00																	
6/28/91				737.00					52522.00							0.00		7.70	0.26							
6/29/91									48264.00																	
6/30/91									52712.00																	
7/1/91		0.00	0.00	527.00	0.00	0.00	0.01	100.00	56740.00	0.97	0.00	0.08	0.00	0.08	0.00	0.00	22.70	7.90	0.11	0.00	0.00				0.08	0.01
7/2/91									56308.00																	
7/3/91	0.00			563.00					50251.00							0.00	22.00	8.10	0.17			0.00	1.00	7.70		
7/4/91									50346.00																	
7/5/91				0.00					49683.00							0.00	11.60	7.90	0.00							
7/6/91									49589.00																	
7/7/91									48328.00																	
7/8/91				0.00					47601.00							0.00	17.40	8.00	0.15							
7/9/91									48737.00																	
7/10/91	0.00			97.00					53374.00							0.00	31.70	8.10	0.00			0.00	1.00			
7/11/91									52333.00																	
7/12/91				0.00					52522.00							0.00	49.70	7.90	0.06							
7/13/91									53942.00																	
7/14/91									54037.00																	
7/15/91				432.00					53469.00							0.00	17.80	8.10	0.11							
7/16/91									49589.00																	
7/17/91	0.00			0.00					49210.00							0.00	21.30	8.00	0.10			0.00	2.00			
7/18/91									45993.00																	
7/19/91				184.00					47412.00							0.00	7.80	8.00	0.18							
7/20/91									47128.00																	
7/21/91									47507.00																	
7/22/91				0.00					49967.00							0.00	7.10	7.90	0.05							
7/23/91									44100.00																	
7/24/91	0.00			0.00					43721.00							0.00	0.00	8.20	0.00			0.00	2.00			
7/25/91									43437.00																	
7/26/91				0.00					48075.00							0.00	8.30	8.30	0.13							
7/27/91									45993.00																	
7/28/91									44478.00																	
7/29/91				0.00					44289.00							0.00	28.50	8.40	0.00							
7/30/91									49210.00																	
7/31/91	0.00			298.00					52049.00							0.00	22.60	7.90	0.00			0.00	4.00			
8/1/91									55740.00																	
8/2/91				0.00					50630.00							0.00	28.40	8.20	0.00							
8/3/91									50724.00																	
8/4/91									48075.00																	
8/5/91				0.00					52996.00							0.00	25.40	8.50	0.20							
8/6/91									56835.00																	
8/7/91	0.00			563.00					56308.00							0.00	7.90	8.40	0.00			0.00	1.00			
8/8/91									56802.00																	
8/9/91				209.00					52239.00							0.00	13.30	8.50	0.00							
8/10/91									51966.00																	
8/11/91									50630.00																	
8/12/91				0.00					48264.00							0.00	15.90	8.50	0.00							
8/13/91									49778.00																	
8/14/91	0.00			53.00					53469.00							0.00	14.40	8.40	0.10			0.00	1.00			
8/15/91									54888.00																	
8/16/91				0.00					51198.00							0.00	18.90	8.30	0.10							
8/17/91									51103.00																	
8/18/91									52712.00																	
8/19/91				0.00					52712.00							0.00	20.00	8.20	0.30							
8/20/91									52049.00																	
8/21/91	0.00			51.00					50724.00							0.00	20.30	8.40	0.10			0.00	1.00			
8/22/91									49210.00																	
8/23/91				0.00					48958.00							0.00	25.50	8.50	0.10							
8/24/91									58201.00																	
8/25/91									55361.00																	
8/26/91				158.00					52806.00							0.00	35.40	8.20	0.10							
8/27/91									52996.00																	
8/28/91	0.00			0.00					57254.00							0.00	80.20	8.20	0.00			0.00	4.00			
8/29/91									58201.00																	
8/30/91				0.00					57254.00							0.00	88.70	8.30	0.10							
8/31/91									56781.00																	
9/1/91									60000.00																	
9/2/91				1018.00					53563.00							0.00	100.20	8.10	0.06							
9/3/91									46750.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

9/4/81	3.60			0.00					51387.00							0.00	24.70	8.30	0.00			0.51	1.00	5.50		
9/5/81									52239.00																	
9/6/81				112.80					56402.00							0.00	7.90	8.30	0.00							
9/7/81									56781.00																	
9/8/81									58106.00																	
9/9/81				0.00					61513.00							369.10	60.90	8.20	0.06							
9/10/81									58674.00																	
9/11/81	0.00			0.00					61229.00							0.00	48.40	8.60	0.31			0.00	4.00			
9/12/81									60453.00																	
9/13/81				0.00					61986.00							0.00	21.70	8.10	0.00							
9/14/81									66245.00																	
9/15/81									64352.00																	
9/16/81				0.00					56876.00							0.00	35.80	8.10	0.48							
9/17/81									59904.00																	
9/18/81	0.00			0.00					51481.00							0.00	11.30	8.10	0.06			0.00	1.00			
9/19/81									53618.00																	
9/20/81				368.10					61513.00							0.00	57.80	8.20	0.12							
9/21/81									56316.00																	
9/22/81									58127.00																	
9/23/81				0.00					67086.00							228.30	42.20	8.20	0.00							
9/24/81									57019.00																	
9/25/81	0.00			603.80					60377.00							543.40	36.80	8.30	0.08			0.60	2.00			
9/26/81									59431.00																	
9/27/81				0.00					59696.00							0.00	39.40	8.20	0.24							
9/28/81									64352.00																	
9/29/81									61513.00																	
9/30/81				0.00					47791.00							191.20	24.90	8.20	0.06							
10/1/81		0.00	0.00		0.01	0.00	0.06		43154.00	0.42	0.01	0.06	0.10	0.20	0.02					0.00	0.00				0.14	0.02
10/2/81	0.00			0.00					47601.00							380.80	40.90	8.10	0.00			0.00	2.00	4.70		
10/3/81									44628.00																	
10/4/81				46.10					46138.00							138.40	23.50	8.00	0.00							
10/5/81									52239.00																	
10/6/81									53611.00																	
10/7/81				0.00					52324.00							680.20	34.00	8.10	0.00							
10/8/81									53658.00																	
10/9/81	0.00			0.00					57349.00							172.00	18.90	8.40	0.00			0.00	1.00	3.80		
10/10/81									53942.00																	
10/11/81				0.00					51216.00							102.40	47.10	8.20	0.00							
10/12/81									46087.00																	
10/13/81									47791.00																	
10/14/81				0.00					49021.00							0.00	21.60	8.50	0.06							
10/15/81									54416.00																	
10/16/81	0.00			118.30					59147.00							0.00	68.60	8.30	0.18			0.00	8.00			
10/17/81									57254.00																	
10/18/81				0.00					56308.00							0.00	59.70	8.20	0.00							
10/19/81									49073.00																	
10/20/81									49689.00																	
10/21/81				260.70					52144.00							651.80	76.70	8.00	0.21							
10/22/81									49021.00																	
10/23/81	0.00			47.70					47696.00							0.00	47.70	8.30	0.19			0.00	4.00			
10/24/81									47601.00																	
10/25/81				379.30					47412.00							47.40	11.90	8.30	0.00							
10/26/81									49778.00																	
10/27/81									48075.00																	
10/28/81				809.50					47620.00							0.00	44.30	8.40	0.05							
10/29/81									46750.00																	
10/30/81	0.00			0.00					44668.00							178.70	60.70	8.20	0.09			0.00	1.00			
10/31/81									46939.00																	
11/1/81				817.60					51103.00							0.00	82.30	8.10	0.10							
11/2/81									51481.00																	
11/3/81									33312.00																	
11/4/81				644.40					25173.00							50.30	26.70	7.80	0.26							
11/5/81									26309.00																	
11/6/81	1.04			26.00					25994.00							389.90	22.90	8.00	0.13			0.00	8.00	6.60		
11/7/81									28012.00																	
11/8/81				624.60					26026.00							182.20	32.50	8.10	0.00							
11/9/81									23459.00																	
11/10/81									29483.00																	
11/11/81				106.60					36488.00							0.00	136.30	8.10	0.28							
11/12/81									36151.00																	
11/13/81	0.00			698.40					34920.00							174.60	61.10	8.10	0.21			0.00	16.00			
11/14/81									35753.00																	
11/15/81				79.50					39747.00							556.50	103.30	7.10	0.12							
11/16/81									47696.00																	
11/17/81				277.70					43154.00										0.04							
11/18/81									39670.00							0.00	58.70	7.90								
11/19/81				0.00					48046.00																	
11/20/81	1.08								35867.00							0.00	65.60	8.30	0.11			1.08	8.00			
11/21/81									40125.00																	
11/22/81				38.30					38327.00							0.00	35.60	8.40	0.27							
11/23/81									33648.00																	
11/24/81									30122.00																	
11/25/81				212.70					26592.00							186.10	37.80	8.20	0.05							
11/26/81									27917.00																	
11/27/81	0.00			254.40					36340.00							181.70	62.50	8.20	0.04			0.00	16.00			
11/28/81									25230.00																	
11/29/81				31.10					31136.00							31.10	40.80	8.40	0.09							
11/30/81									29053.00																	
12/1/81									26006.00																	
12/2/81				387.60					24227.00							145.40	49.70	8.40	0.06							
12/3/81									23848.00																	
12/4/81	1.64			328.60					23470.00							0.00	49.10	8.10	0.05			0.00	1.00	4.60		
12/5/81									21577.00																	
12/6/81				0.00					21198.00							190.80	19.30	8.20	0.06							
12/7/81									20631.00																	
12/8/81									20441.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

12/9/81				361.30					21966.00							43.90	66.10	8.00	0.04							
12/10/81									22429.00																	
12/11/81	3.91			73.20					24416.00							0.00	47.10	8.20	0.17			0.00	2.00	6.10		
12/12/81									17148.00																	
12/13/81				563.60					18484.00							0.00	107.80	8.10	0.19							
12/14/81									21198.00																	
12/15/81									22148.00																	
12/16/81				449.70					24984.00							149.90	66.70	8.20	0.23							
12/17/81									32564.00																	
12/18/81	0.79			528.10					26403.00							106.60	113.30	8.00	0.08			0.00	1.00			
12/19/81									21777.00																	
12/20/81				148.40					12113.00							0.00	33.80	8.10	0.07							
12/21/81									13249.00																	
12/22/81									21388.00																	
12/23/81				492.90					39747.00							0.00	84.70	7.90	0.08							
12/24/81									44198.00																	
12/25/81	0.25			694.20					24794.00							0.00	78.30	8.10	0.03			0.00	2.00			
12/26/81									20983.00																	
12/27/81				278.30					21406.00							0.00	27.60	8.10	0.02							
12/28/81									22902.00																	
12/29/81									25078.00																	
12/30/81				412.60					20631.00							0.00	35.70	8.10	0.00							
12/31/81									26498.00																	
1/1/92	1.33			503.50					24984.00							0.00	59.40	8.00	0.08			0.00	8.00			
1/2/92									24869.00																	
1/3/92				98.60					25249.00							722.10	49.60	7.40	0.10							
1/4/92									26498.00																	
1/5/92									23186.00																	
1/6/92				343.40					50062.00							0.00	70.80	8.60	0.07							
1/7/92									52239.00																	
1/8/92	0.52			104.40					47412.00							365.40	125.80	9.00	0.05			0.00	4.00			
1/9/92									38611.00																	
1/10/92				849.20					35488.00							0.00	170.20	8.40	0.00							
1/11/92									40409.00																	
1/12/92									33217.00																	
1/13/92				298.80					34258.00							0.00	142.80	8.10	0.13							
1/14/92									39133.00																	
1/15/92	0.00			1329.40					40807.00							547.40	89.60	8.10	0.00			0.00	16.00			
1/16/92									38422.00																	
1/17/92				625.60					40315.00							0.00	91.50	8.10	0.19							
1/18/92									38649.00																	
1/19/92									39841.00																	
1/20/92				1034.80					40996.00							0.00	62.90	8.10	0.04							
1/21/92									43632.00																	
1/22/92	14.79			0.00					43343.00							0.00	53.90	8.50	0.00			0.00	0.00			
1/23/92									45311.00																	
1/24/92				0.00					47961.00							0.00	35.30	8.50	0.18							
1/25/92									50157.00																	
1/26/92									47791.00																	
1/27/92				334.60					48075.00							0.00	82.20	8.20	0.29							
1/28/92									47829.00																	
1/29/92	0.00			191.20					46277.00							95.60	120.90	8.20	0.00			0.00	0.00			
1/30/92									41923.00																	
1/31/92				377.10					44178.00							125.70	116.10	8.10	0.00							
2/1/92									44971.00																	
2/2/92									44895.00																	
2/3/92				134.70					46939.00							89.80	97.40	8.00	0.00							
2/4/92									47318.00																	
2/5/92	0.00			37.80					45898.00							0.00	174.10	8.20	0.10			0.00	1.00	7.50		
2/6/92									39747.00																	
2/7/92				682.80					36434.00							0.00	90.90	8.10	0.00							
2/8/92									34258.00																	
2/9/92									34069.00																	
2/10/92				0.00					33690.00							0.00	78.90	8.10	0.00							
2/11/92									43456.00																	
2/12/92	0.00			1173.30					43343.00							608.40	64.40	8.00	0.00			0.00	4.00			
2/13/92									43721.00																	
2/14/92				131.10					41829.00							0.00	50.30	8.00	0.04							
2/15/92									43532.00																	
2/16/92									42775.00																	
2/17/92				298.40					43154.00							0.00	58.20	7.90	0.09							
2/18/92									43069.00																	
2/19/92	0.00			344.50					41639.00							86.10	36.20	7.90	0.04			0.00	0.00			
2/20/92									40882.00																	
2/21/92				490.80					42018.00							696.00	159.10	7.30	0.00							
2/22/92									42680.00																	
2/23/92									29337.00																	
2/24/92				586.70					28674.00							0.00	116.90	7.00	0.00							
2/25/92									24606.00																	
2/26/92	0.00			393.70					23973.00							24.60	80.70	8.10	0.00			0.00	4.00			
2/27/92									30283.00																	
2/28/92				484.60					28884.00							60.60	35.80	8.40	0.12							
2/29/92									28391.00																	
3/1/92		-0.17	0.00		0.00	0.00	0.01	100.00	26971.00	0.03	0.00	0.04	0.00	0.60	0.04					0.00	0.00				0.09	0.01
3/2/92				486.50					27256.00							242.70	32.70	8.10	0.05							
3/3/92									27506.00																	
3/4/92	0.83			165.00					24606.00							110.00	22.60	8.20	0.03			0.00	1.00			
3/5/92									26119.00																	
3/6/92				366.70					24889.00							182.80	30.30	8.00	0.10							
3/7/92									22239.00																	
3/8/92									18296.00																	
3/9/92				567.10					19400.00							164.70	54.90	8.00	0.04							
3/10/92									20347.00																	
3/11/92	2.24			643.00					21198.00							0.00	89.10	8.00	0.00			0.00	4.00			
3/12/92									31230.00																	
3/13/92				906.70					34069.00							327.90	108.40	8.00	0.13							

TABLE E.1
Database for Suncor Inc. Industrial Effluent

3/14/82									29715.00																	
3/15/82									29337.00																	
3/16/82				0.00					28674.00							0.00	37.80	8.20	0.09							
3/17/82									25612.00																	
3/18/82	5.88			563.50					20820.00							0.00	26.20	8.20	0.00			0.00	2.00	10.40		
3/19/82									21966.00																	
3/20/82				68.90					24606.00							0.00	16.20	8.10	0.00							
3/21/82									27444.00																	
3/22/82									47960.00																	
3/23/82				0.00					45993.00							0.00	86.80	8.10	0.10							
3/24/82									42586.00																	
3/25/82	1.28			1406.30					43532.00							511.00	77.90	8.20	0.00			0.00	1.00			
3/26/82				91.40					45690.00							0.00	94.10		0.00							
3/27/82									47318.00									8.20								
3/28/82									47128.00																	
3/29/82									45046.00																	
3/30/82				0.00					40882.00							0.00	59.00	8.20	0.18							
3/31/82									43911.00																	
4/1/82	0.00			0.00					43532.00							219.60	43.10	8.30	0.00			0.00	16.00	9.20		
4/2/82									46182.00																	
4/3/82				1200.70					0.00							92.40	104.90	8.40	0.00							
4/4/82									5678.00																	
4/5/82									22239.00																	
4/6/82				333.60					9653.00							0.00	46.70	8.20	0.00							
4/7/82									4732.00																	
4/8/82	0.00			18.90					31324.00							0.00	14.00	8.00	0.04			0.00	1.00			
4/9/82									34788.00																	
4/10/82				361.60					33425.00							0.00	92.20	8.30	0.00							
4/11/82									34731.00																	
4/12/82									38043.00																	
4/13/82				1027.20					32176.00							228.30	121.20	8.00	0.08							
4/14/82									51860.00																	
4/15/82	10.90			1067.70					43532.00							0.00	23.90	8.50	0.05			0.00	4.00			
4/16/82									42018.00																	
4/17/82				0.00					42113.00							0.00	62.70	8.30	0.00							
4/18/82									41639.00																	
4/19/82									40598.00																	
4/20/82				406.00					40031.00							0.00	53.20	8.40	0.12							
4/21/82									42265.00																	
4/22/82	0.00			0.00					51576.00							0.00	0.00	8.50	0.17			0.00	2.00			
4/23/82									45098.00																	
4/24/82				0.00					42964.00							0.00	0.00	8.40	0.00							
4/25/82									35961.00																	
4/26/82									31230.00																	
4/27/82				124.90					30662.00							0.00	49.00	8.80	0.00							
4/28/82									32176.00																	
4/29/82	0.00			386.10					34447.00							0.00	67.30	8.70	0.13			0.00	4.00			
4/30/82									34069.00																	
5/1/82				374.80					35204.00							0.00	55.20	8.40	0.00							
5/2/82									46466.00																	
5/3/82									44100.00																	
5/4/82				0.00					42870.00							485.10	30.00	8.20	0.22							
5/5/82									43343.00																	
5/6/82	0.00			0.00					43532.00							260.10	55.00	8.20	0.04			0.00				
5/7/82									43154.00																	
5/8/82				776.80					43721.00							0.00	49.20	8.40	0.17							
5/9/82									37665.00																	
5/10/82									36340.00																	
5/11/82				407.00					35063.00							0.00	30.90	8.30	0.00							
5/12/82									34826.00																	
5/13/82	0.00			139.30					35772.00							0.00	95.40	8.50	0.07			0.00	4.00	11.30		
5/14/82									35583.00																	
5/15/82				0.00					35961.00							0.00	0.00	8.00	0.07							
5/16/82									36340.00																	
5/17/82									35677.00																	
5/18/82				463.80					34636.00							0.00	45.00	8.30	0.11							
5/19/82									33501.00																	
5/20/82	0.00			670.00					32176.00							0.00	12.70	8.30	0.00			0.00	0.00			
5/21/82									38015.00																	
5/22/82				0.00					34826.00							0.00	26.60	8.40	0.00							
5/23/82									28674.00																	
5/24/82									49494.00																	
5/25/82				198.00					49021.00							0.00	63.80	8.60	0.00							
5/26/82									47980.00																	
5/27/82	0.00			816.70					47791.00							0.00	71.00	8.50	0.00			0.00	0.00			
5/28/82									49683.00																	
5/29/82				248.40					51103.00							0.00	49.20	8.40	0.15							
5/30/82									53663.00																	
5/31/82									48453.00																	
6/1/82		0.00	0.00	1211.30	0.00	0.00	0.01	100.00	52049.00	0.52	0.00	0.04	0.00	0.06	0.01	0.00	58.10	8.60	0.10	0.00	0.01				0.06	0.01
6/2/82									56361.00																	
6/3/82	0.00			830.40					57727.00							0.00	59.20	8.50	0.28			0.00	1.00			
6/4/82									55078.00																	
6/5/82				660.90					53280.00							0.00	94.70	8.30	0.00							
6/6/82									49210.00																	
6/7/82									49967.00																	
6/8/82				0.00					48264.00							0.00	36.90	8.40	0.00							
6/9/82									47696.00																	
6/10/82	0.00			0.00					42870.00							0.00	9.10	8.50	0.14			0.00	2.00	13.50		
6/11/82									44006.00																	
6/12/82				92.40					36908.00							0.00	28.20	8.50	0.13							
6/13/82									35583.00																	
6/14/82									34826.00																	
6/15/82				0.00					42018.00							0.00	14.30	8.50	0.14							
6/16/82									50062.00																	
6/17/82	0.00			160.20					62175.00							0.00	13.00	8.40	0.00			0.00	0.00			

TABLE E.1
Database for Suncor Inc. Industrial Effluent

6/18/92									56456.00																	
6/19/92				0.00					53688.00							0.00	39.40	8.20	0.00							
6/20/92									54415.00																	
6/21/92									53847.00																	
6/22/92				1777.00					22618.00							0.00	75.40	8.10	0.11							
6/23/92									38896.00																	
6/24/92	0.00			77.80					36718.00							0.00	14.80	8.20	0.08			0.00	1.00			
6/25/92									38516.00																	
6/26/92				77.00					39747.00							0.00	23.90	8.40	0.00							
6/27/92									56497.00																	
6/28/92									36813.00																	
6/29/92				220.90					21482.00							0.00	7.40	8.50	0.11							
6/30/92									35393.00																	
7/1/92	0.00			991.00					62459.00							0.00	18.40	8.60	0.00			0.00	1.00	8.60		
7/2/92									35961.00																	
7/3/92				0.00					56213.00							0.00	36.60	8.60	0.00							
7/4/92									54888.00																	
7/5/92									54131.00																	
7/6/92				0.00					38422.00							0.00	54.10	8.10	0.00							
7/7/92									39274.00																	
7/8/92	0.00			274.90					36813.00							0.00	24.00	8.30	0.08			0.00	2.00	6.10		
7/9/92									38811.00																	
7/10/92				193.10					37475.00							0.00	18.50	8.60	0.08							
7/11/92									38529.00																	
7/12/92									38896.00																	
7/13/92				272.30					35867.00							622.30	19.10	8.50	0.16							
7/14/92									36718.00																	
7/15/92	0.00			183.60					31230.00							0.00	16.90	8.20	0.07			0.00	1.00			
7/16/92									31703.00																	
7/17/92				263.80					34731.00							0.00	13.60	8.10	0.13							
7/18/92									40693.00																	
7/19/92									43911.00																	
7/20/92				87.80					52428.00							0.00	18.40	8.40	0.09							
7/21/92									49305.00																	
7/22/92	0.00			0.00					45425.00							0.00	27.10	8.20	0.00			0.00	4.00			
7/23/92									47507.00																	
7/24/92				1710.30					48642.00							95.00	16.20	8.30	0.24							
7/25/92									46598.00																	
7/26/92									43721.00																	
7/27/92				174.90					41168.00							0.00	39.40	8.00	0.00							
7/28/92									25646.00																	
7/29/92	0.00			128.20					23280.00							0.00	30.50	7.40	0.05			0.00	1.00			
7/30/92									27066.00																	
7/31/92				433.10					36066.00							0.00	5.10	8.50	0.03							
8/1/92		0.00	0.01		0.00	0.00	0.01		39936.00	0.19	0.00	0.04	0.00	0.14	0.04					0.00	0.01				0.06	0.00
8/2/92									39747.00																	
8/3/92				-79.50					41007.00							0.00	-27.00	8.20	-0.04							
8/4/92									45619.00																	
8/5/92	0.00			-728.30					49210.00							0.00	-44.60	8.50	-0.05			0.00	1.00	9.00		
8/6/92									48163.00																	
8/7/92				0.00					51292.00							0.00	-14.90	8.20	-0.06							
8/8/92									55836.00																	
8/9/92									52333.00																	
8/10/92				-366.30					44648.00							0.00	-30.90	8.20	-0.05							
8/11/92									30472.00																	
8/12/92	0.00			-398.10					29337.00							-30.50	-27.40	8.20	-0.06			0.00	1.00			
8/13/92									28580.00																	
8/14/92				-171.50					37570.00							0.00	-23.10	7.90	0.00							
8/15/92									39274.00																	
8/16/92									44196.00																	
8/17/92				-163.50					44100.00							0.00	-43.30	8.20	-0.08							
8/18/92									44478.00																	
8/19/92	0.00			-89.00					44782.00							0.00	-32.50	8.00	-0.09			0.00	2.00			
8/20/92									44673.00																	
8/21/92				-44.60					42397.00							0.00	0.00	7.90	0.00							
8/22/92									41545.00																	
8/23/92									41734.00																	
8/24/92				-250.00					40804.00							0.00	-15.40	8.20	-0.04							
8/25/92									42207.00																	
8/26/92	0.00			0.00					41639.00							0.00	-16.60	7.70	-0.08			0.00	2.00			
8/27/92									38043.00																	
8/28/92				-190.20					37854.00							0.00	-22.40	8.00	-0.15							
8/29/92									39936.00																	
8/30/92									38517.00																	
8/31/92				0.00					37381.00							-654.80	-85.10	8.20	-0.04							
9/1/92									37570.00																	
9/2/92	-4.80			0.00					36908.00							0.00	-26.70	7.80	0.00			0.00	1.00	0.60		
9/3/92									38516.00																	
9/4/92				0.00					40315.00							0.00	-14.30	8.30	0.00							
9/5/92									42606.00																	
9/6/92									42396.00																	
9/7/92				0.00					42586.00							0.00	0.00	8.40	-0.09							
9/8/92									42870.00																	
9/9/92	-2.10			-85.70					43097.00							-171.50	-8.60	8.50	0.00			0.00	2.00	5.00		
9/10/92									43026.00																	
9/11/92				-430.30					50692.00							0.00	-15.50	8.40	-0.04							
9/12/92									50422.00																	
9/13/92									43419.00																	
9/14/92				-43.40					32138.00							0.00	-19.10	7.00	-0.04							
9/15/92									24484.00																	
9/16/92	-2.40			-1222.70					33122.00							-220.10	-40.40	8.20	-0.12			0.00	1.00			
9/17/92									34083.00																	
9/18/92				-149.90					32933.00							-102.20	-63.00	8.30	-0.14							
9/19/92									27539.00																	
9/20/92									26592.00																	
9/21/92				0.00					26403.00							0.00	-20.20	7.90	-0.08							

TABLE E.1
Database for Suncor Inc. Industrial Effluent

9/22/82									16838.00																	
9/23/82	-3.20			-161.00					14479.00							-40.30	-44.80	8.50	-0.05			0.00	1.00			
9/24/82									42396.00																	
9/25/82				-2416.80					40409.00							0.00	-9.30	8.40	-0.13							
9/26/82									37949.00																	
9/27/82									36340.00									8.20								
9/28/82				-109.00					35677.00							0.00	-34.20		-0.15							
9/29/82									36299.00									8.00								
9/30/82	-9.80			-141.20					37381.00							0.00	-40.20		-0.14			0.00	2.00			
10/1/82	21.52			1536.88					38422.00							576.33		8.10	0.31			0.77				
10/2/82				499.50					38157.00							0.00	104.90		0.00							
10/3/82									37475.00																	
10/4/82									34826.00									7.90								
10/5/82				243.80					35772.00							313.40	87.10	8.20	0.58							
10/6/82									33601.00																	
10/7/82	5.70			301.50					28580.00							33.50	8.70	8.30	0.00			0.00	2.00	8.20		
10/8/82									29999.00																	
10/9/82				120.00					29718.00							0.00	0.90	8.20	0.00							
10/10/82									31040.00																	
10/11/82									31513.00																	
10/12/82				408.70					30861.00							0.00	11.70	8.10	0.16							
10/13/82									31136.00																	
10/14/82	14.60			581.60					27444.00							0.00	32.40	8.10	0.16			0.00	2.00			
10/15/82									28845.00																	
10/16/82				0.10					29715.00							28.80	13.30	8.00	0.12							
10/17/82									30094.00																	
10/18/82									30018.00																	
10/19/82				390.20					43191.00							480.30	19.20	8.30	0.18							
10/20/82									34089.00																	
10/21/82	18.10			843.90					28996.00							306.60	27.30	8.10	0.07			0.00	1.00			
10/22/82									36136.00																	
10/23/82				108.40					26233.00							0.00	26.00	8.10	0.00							
10/24/82									21349.00																	
10/25/82									21204.00																	
10/26/82				563.40					21469.00							148.40	38.20	8.20	0.08							
10/27/82									21198.00																	
10/28/82	21.60			563.90					25835.00							254.40	81.60	8.10	0.04			0.42	1.00			
10/29/82									30662.00																	
10/30/82				276.00					34826.00							0.00	38.90	8.30	0.25							
10/31/82									34144.00																	
11/1/82									31728.00																	
11/2/82				0.00					31019.00							190.40	73.30	8.80	0.10							
11/3/82									32369.00																	
11/4/82	16.50			194.20					31068.00							0.00	36.30	8.40	0.16			0.00	2.00			
11/5/82									27448.00																	
11/6/82				301.80					34509.00							0.00	28.00	8.20	0.06							
11/7/82									34061.00																	
11/8/82									33849.00																	
11/9/82				473.90					45179.00							33.80	16.90	8.20	0.07							
11/10/82									52754.00																	
11/11/82	8.40			790.90					44539.00							633.00	0.10	8.40	0.11			0.53	1.00			
11/12/82									22586.00																	
11/13/82				0.00					21762.00							158.10	39.80	8.20	0.07							
11/14/82									20976.00																	
11/15/82									36067.00																	
11/16/82				288.50					38987.00							180.30	121.20	7.90	0.14							
11/17/82									40712.00																	
11/18/82	23.60			16.30					27766.00							325.70	79.40	8.20	0.12			0.00	1.00			
11/19/82									19837.00																	
11/20/82				158.70					22860.00							0.00	23.60	8.10	0.12							
11/21/82									23703.00																	
11/22/82									23689.00																	
11/23/82				495.40					20962.00							0.00	5.40	7.90	0.02							
11/24/82									25282.00																	
11/25/82	9.40			363.90					28320.00							101.10	28.60	8.40	0.03			0.00	0.00			
11/26/82									30250.00																	
11/27/82				0.00					31338.00							484.00	4.50	8.40	0.00							
11/28/82									23618.00																	
11/29/82									24097.00																	
11/30/82				98.40					27758.00							0.00	12.00	7.90	0.00							
12/1/82									40644.00																	
12/2/82	0.00			528.48					40176.00							0.00	35.80	8.50	0.33			0.00	1.00			
12/3/82									40227.00																	
12/4/82				241.40					31490.00							120.70	44.70	8.40	0.16							
12/5/82									27574.00																	
12/6/82									27120.00																	
12/7/82				461.00					28892.00							0.00	22.20	8.20	0.24							
12/8/82									29190.00																	
12/9/82	1.20			0.00					29756.00							0.00	66.60	8.20	0.03			0.00	1.00	10.50		
12/10/82									29997.00																	
12/11/82				479.90					30461.00							390.00	11.70	8.20	0.12							
12/12/82									30804.00																	
12/13/82									30910.00																	
12/14/82				92.70					30162.00							0.00	16.10	5.80	0.00							
12/15/82									30148.00																	
12/16/82	0.00			301.60					39322.00							90.40	103.70	8.30	0.12			0.00	0.00			
12/17/82									30815.00																	
12/18/82				123.30					31481.00							1016.90	31.10	8.40	0.09							
12/19/82									31491.00																	
12/20/82									32069.00																	
12/21/82				84.10					31412.00							817.80	33.80	7.90	0.03							
12/22/82									31367.00																	
12/23/82	5.00			313.70					31568.00							0.00	42.30	8.10	0.09			0.00				
12/24/82									31330.00																	
12/25/82				0.00					30605.00							0.00	0.00	8.20	0.00							
12/26/82									31419.00																	

TABLE E.1
Database for Suncor Inc. Industrial Effluent

12/27/92									31826.00																	
12/28/92				604.70					31239.00							0.00	82.70	8.20	0.03							
12/29/92									31964.00																	
12/30/92	5.10			383.60					32797.00							0.00	99.40	8.00	0.19			0.00	0.00			
12/31/92									34011.00																	
1/1/93																										

TABLE E.2: CHARACTERISTICS OF MISCELLANEOUS INDUSTRIAL EFFLUENTS

NAME	DRAINAGE BASIN	DATE (M/D/Y)	FLOW (M3PD)	BOD (MGPL)	TSS (MGPL)	PH	NH_3 (MGPL)
Allan and Lorraine Mallock	Athabasca	09/00/92	8084.45[1]			7.4[1]	
Blue Ridge Lumber	Athabasca	04/00/92		2.5		8.5	15.10
Blue Ridge Lumber	Athabasca	09/11/92		14.0		8.5	8.50
Mildred L. Campsite (Syncrude)	Athabasca	11/10/92		4.0	2.0		
Mildred L. Campsite (Syncrude)	Athabasca	11/18/92		4.0	3.5		
Mildred L. Campsite (Syncrude)	Athabasca	11/25/92		4.0	4.4		

Note: 1 = Mean Value for September 1992.

APPENDIX F

A USER'S GUIDE AND GLOSSARY TO THE MUNICIPAL AND NON-PULP MILL INDUSTRIAL EFFLUENTS DATABASE

Appendix F: A User's Guide and Glossary to the Municipal and Non-pulp Mill Industrial Effluents Database

This appendix is provided on the disk bound as the last page of this report; it contains data files of municipal and non-pulp mill industrial discharges in the Northern River Basins Study area. Data entry and coding responses to the database is described in NRBS Project Report No. 79.

The disk comprising this Appendix contains three files, using 248,193 bytes.

1. INSTALL.BAT; being 72 bytes in size.
2. PR79.EXE; being 247,635 bytes in size.
3. DISCLAIM.TXT; being 486 bytes in size.

To install the database copy the three files on this disk to a directory on your hard drive and type install.bat. The result will be 19 files totalling 1,143,852 bytes. To use the files with extension .DBF requires d-Base IV.

There is no warranty expressed or implied for the use of this database; the Northern River Basins Study does not guarantee the accuracy of the data. The NRBS does not assume any liability for actions or consequences resulting from the use of the dat; individuals using this data do so entirely at their own risk. The NRBS will not update the data except as deemed necessary for its own purpose.

USER'S GUIDE AND GLOSSARY TO THE MUNICIPAL AND NON-PULP MILL INDUSTRIAL EFFLUENTS DATABASE

APRIL 1995

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1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

The Northern Rivers Basin Study (NRBS) awarded a contract to SENTAR Consultants Ltd. in March, 1993 to characterize effluent from municipal and non-pulp mill industrial sources, using existing government information. The study area includes three river basins within Alberta and the Northwest Territories: the Peace River Basin, the Athabasca River Basin and the Slave River Basin. Specifically, the terms of reference called for four tasks as follows:

1. Identify all licensed effluent dischargers from municipalities and non-pulp mill industries and compile these sources in a dBase IV file containing the following information:

    a) location (geo-referenced),
    b) treatment technology,
    c) waste type (liquid, solid, gaseous), and
    d) disposal method.

2. Compile the following information on the nature of the liquid effluents from the licensed sources in a dBase IV format:

    a) nutrients,
    b) pathogens,
    c) contaminants,
    d) toxic compounds, and
    e) volume, timing, duration, loading and concentrations of discharges.

3. Prepare a user's guide for the database including a glossary and other pertinent specifications.

4. Prepare a comprehensive synthesis report discussing the nature of liquid effluents from non-pulp mill industrial and municipal sources and the impacts, or potential impacts of these effluents on the aquatic ecosystems of the northern rivers.

This technical report responds to the third task. It provides a description of data sources and quality, a description of the data within each database file, tables showing each file name and structure, figures that illustrate two file records, and a glossary of database acronyms. The data compiled under the first two tasks may be found on one diskette in Appendix A. The synthesis report is a separate document. The database files are included as hardcopy appendices to the synthesis report.

The reader is encouraged to read the entire guide before entering dBase IV and opening files. This guide assumes that the user has a working knowledge of dBase IV (Version 1.1).

1.2 DATA SOURCES

Listings and software files were kindly supplied by Alberta Environmental Protection (H.E.L.P. PROGRAM, Industrial and Municipal Waste Branches) and Alberta Health. Listings of liquid and gaseous licenses were available in a mixture of hard and soft copy. They represent the state of licenses in the study area until the cut-off date of the contract, February, 1994. Licenses issued after February, 1994 were not included; however some new licenses may have been added if they were discovered during the course of checking the validity of information for licenses issued prior to that date.

Municipal and regional landfills are licensed by Alberta Health. A list of these (solid waste) landfills was provided to SENTAR Consultants Ltd.

Industrial landfills are licensed in a variety of ways depending upon use and age. In the past, many landfills were licensed within the context of the "Water Licence". These licenses were captured through a listing provided by the H.E.L.P. Program. The H.E.L.P. Program list of industrial landfills is acknowledged to be incomplete and somewhat dated with respect to the February 1994 cut-off date.

Data for industrial sites were provided by NRBS. The lists that were supplied contained only basic information (usually only the name of the industry and it's geographic location, nearby town and legal land description). These lists did not contain information on effluents. NRBS requested that the given information be added to the database, but specified that a search for further information was specifically not required in the contract.

Compilation of existing data identified a number of data gaps. Missing locations, partially missing locations, and missing licence numbers were found in the liquid and gaseous licence information provided. Because industrial landfills were not licensed in a uniform manner in the past, industrial landfill data are also incomplete. Because the licence information was gathered for other (usually regulatory) purposes by different departments and branches, quality control is variable and may not meet the requirements of scientific research. This aspect is addressed in greater detail in the synthesis report.

Nevertheless, as a result of this NRBS contract, a comprehensive database of solid, liquid and gaseous effluents is available for the first time. Key information on paper or microfiche from licenses stored in filing cabinets and storage boxes has now been entered in electronic format. Hardcopy data were located in four places in the Alberta government files:

(1) file folders in filing cabinets,
(2) microfiche in film boxes,
(3) file folders in boxes located elsewhere waiting to be microfilmed, and
(4) microfiche in boxes located elsewhere, freshly filmed, waiting to be transferred to the main microfiche files.

If relevant data were in the files, they were retrieved by SENTAR Consultants Ltd.; however, data available, whether in file folders or microfiche, were not always complete.

We have noted numerous errors in the various sources of the information in the database. These have usually been associated with location (for instance -- impossible land locations). It was beyond our scope to refer to original licenses to correct these, therefore we first checked our entry and then replaced these obvious errors with the entry N/A (not available). The user should remain aware that non-obvious errors probably remain.

2.0 DESCRIPTIONS OF DATA WITHIN EACH DATABASE FILE

2.1 DATABASE FILE NAMES

The database is split into two parts: one source file and nineteen effluent files. Table 2.1 lists the names of these files and a description of their contents.

TABLE 2.1
Database Files of Municipal and Non-Pulp Mill Industrial Dischargers in the Northern River Basins Study Area

DATABASE FILE NAME	DESCRIPTION OF FILE
NRBS.DBF	Source Database
	Effluent Databases:
ATHABASC.DBF	Athabasca Continuous Municipal Discharge Data
BARRHEAD.DBF	Barrhead Continuous Municipal Discharge Data
EDSON.DBF	Edson Continuous Municipal Discharge Data
FTCHIP.DBF	Fort Chipewyan Continuous Municipal Discharge Data
FTMCMUR.DBF	Fort McMurray Continuous Municipal Discharge Data
FTSMITH.DBF	Fort Smith Continuous Municipal Discharge Data
GRCACHE.DBF	Grande Cache Continuous Municipal Discharge Data
GRPRAIRI.DBF	Grande Prairie Continuous Municipal Discharge Data
JASPER.DBF	Jasper Continuous Municipal Discharge Data
LACLABIC.DBF	Lac La Biche Continuous Municipal Discharge Data
MANNING.DBF	Manning Continuous Municipal Discharge Data
PEACER.DBF	Peace River Continuous Municipal Discharge Data
PRCORREC.DBF	Peace River Correctional Institution Continuous Municipal Discharge Data
SLAVELKE.DBF	Slave Lake Continuous Municipal Discharge Data
WABASCA.DBF	Wabasca Continuous Municipal Discharge Data
WHTCRT.DBF	Whitecourt Continuous Municipal Discharge Data
MUNPER.DBF	Periodic Municipal Discharge Data
MISCIND.DBF	Miscellaneous Non-pulp Mill Industrial Discharge Data
SUNCOR.DBF	Non-pulp Mill Industrial Discharge Data For Suncor

2.2 CONTENTS OF SOURCE FILE

The source file (NRBS.DBF) contains a list of all licensed municipal and non-pulp mill industrial dischargers in the NRBS area. It is an index to show the user what dischargers exist and in which files to look for monitoring data. The field structure and definition of contents are shown in Table 2.2. There are slight differences in field definition depending upon whether the facility discharges liquid, gaseous or solid effluent (refer to Table 2.2 footnotes). The file has been arranged alphabetically by "NAME".

TABLE 2.2
File Structure for Source Database

FIELD NAME IN FILE	DESCRIPTION OF FIELD
NAME	Name of industry or municipality
FACILITY	Name of facility
LICENSE_NO	Licence number
DRAIN_BAS	Drainage basins of the Peace, Athabasca or Slave rivers
LSD	Legal Subdivision
SEC	Section
TWP	Township
RGE	Range
MER	Meridian (W4; W5; W6)
LATD	Latitude in degrees
LONGD	Longitude in degrees (negative denoting west of prime meridian)
TYPE_IND*	Either municipal or type of industry
TREAT*	A brief description of the type of treatment the effluent receives before being discharged
DISCHARGE*	Type of discharge denoted as either continuous or periodic discharge
PARAMETER**	A list of all parameters for which there are data in the effluent database file
ALL_DISCH*	Allowable frequency of discharge denoted as either once or twice
SEAS_DISCH*	Seasonal discharge denoted as spring, fall or both
RCVNG_W*	Name of waterbody which receives effluent
FILE_N*	Name of file in which the data for the particular facility is located
WASTE_T	Waste type denoted as liquid (L), gaseous (G), or solid waste (S)

* Not applicable to gaseous emissions and solid waste.

** Daily limits are given for gaseous emissions. This field is not applicable to solid waste.

It should be noted that all location information was entered as legal land description to the accuracy noted in the government files. These locations were subsequently converted to latitude and longitude. The bulk of the conversion was done by NRBS however, a few late entries were done manually from 1:50,000 maps. The legal description is more accurate than latitude and longitude due to the nature of the conversion program. Note that longitude is negative denoting west of the prime meridian.

Information which was not present, or obviously in error, has the entry "N/A" indicating "not available".

It will be noted that there is some variation within the name used in the Source Database for certain companies. For instance, Amoco Canada Petroleum Company Ltd., Amoco Canada Petroleum and Amoco Canada Petroleum Ltd. are all used. This variation in entry comes from the fact that different data sources used these different names. We elected to remain consistent with our information source and NRBS agreed.

2.3 CONTENTS OF EFFLUENT FILES

2.3.1 Continuous Municipal Dischargers

The 16 municipal sewage treatment facilities which discharge effluent on a continuous basis are shown under the headings of ATHABASC.DBF through WHITCRT.DBF in Table 2.1. The structure of the individual files is shown in Table 2.3. This table gives field names, a description of the contents of the field, units and a listing of file names in which that particular constituent appears.

In entering the considerable volume of data from the continuous municipal dischargers, certain conventions and assumptions had to be made. These are as follows:

1. Monthly averages of flow rate, BOD, TSS, DO, temperature, pH, etc., were entered when daily data were available.

2. Averages of data were rounded up to the next tenth, except temperature, which was rounded up to the next whole number, unless the information on file was already averaged.

3. The first day of each month was entered in the "date" field as the date of the monthly average (unless the sampling was monthly and the sampling date was available).

4. When field daily data and laboratory test data were both available, field daily data were used.

5. Some fields are not numeric, as the results were often given as "less than" or "greater than" a value. These fields were changed to character fields to allow for that symbol.

6. Where data are "not available" the entry was N/A.

The synthesis report, which addresses data gaps, will described the frequency and extent of "daily" and "monthly" sampling in more detail.

TABLE 2.3
File Structure for All Continuous Municipal Discharger Database

FIELD NAME IN FILE	DESCRIPTION	UNITS	FILE NAME CONTAINING THE DATA
DATE	Date	MM/DD/YY	All files
FLOW	Effluent Discharge Rate or Volume Discharged	Cubic metres per day - M3PD Gallons per day - GPD Megalitres per day - MLPD Imperial gallons - G	All files
BOD_MGPL	Biological Oxygen Demand	Milligrams per litre	All files
TSS_MGPL	Total Suspended Solids	Milligrams per litre	All files
VSS_MGPL	Volatile Suspended Solids	Milligrams per litre	FTCHIP.DBF PEACER.DBF MANNING.DBF PRCORRECT.DBF
COD_MGPL	Chemical Oxygen Demand	Milligrams per litre	FTMCMUR.DBF PRCORRECT.DBF PEACER.DBF
PH	pH	No units	ATHABASC.DBF LACLABIC.DBF BARRHEAD.DBF MANNING.DBF EDSON.DBF PEACER.DBF FTMCMUR.DBF PRCORRECT.DBF GRCACHE.DBF SLAVELKE.DBF FTSMITH.DBF WABASCA.DBF JASPER.DBF WHTCRT.DBF
TEMP_C	Temperature	Degrees Celsius (ºC)	ATHABASC.DBF JASPER.DBF BARRHEAD.DBF LACLABIC.DBF EDSON.DBF SLAVELKE.DBF FTMCMUR.DBF WABASCA.DBF GRCACHE.DBF WHTCRT.DBF
DISOX_MGPL	Dissolved Oxygen	Milligrams per litre	ATHABASC.DBF LACLABIC.DBF BARRHEAD.DBF PRCORRECT.DBF EDSON.DBF SLAVELKE.DBF GRCACHE.DBF WABASCA.DBF JASPER.DBF WHTCRT.DBF
NINA_MGPL	Nitrite-Nitrate Nitrogen	Milligrams per litre (as N)	MANNING.DBF PEACER.DBF SLAVELKE.DBF
NH3_MGPL	Ammonia-Nitrogen	Milligrams per litre (as N)	MANNING.DBF SLAVELKE.DBF
ORG_N_MGPL	Organic Nitrogen	Milligrams per litre (as N)	MANNING.DBF SLAVELKE.DBF
T_PO4_MGPL	Total Phosphorus as Phosphate	Milligrams per litre (as PO_4)	MANNING.DBF SLAVELKE.DBF PEACER.DBF
COND_MSPCM	Conductivity	Microsiemens per centimetre	PEACER.DBF
T_ALK_MGPL	Total Alkalinity	Milligrams ($CaCO_3$) per litre	PEACER.DBF
P_ALK_MGPL	Phenolphthalein alkalinity	Milligrams ($CaCO_3$) per litre	PEACER.DBF
HCO3_MGPL	Bicarbonate	Milligrams per litre	PEACER.DBF
CO3_MGPL	Carbonate	Milligrams per litre	PEACER.DBF
OH_MGPL	Hydroxide	Milligrams per litre	PEACER.DBF
HARD_MGPL	Total Hardness	Milligrams ($CACO_3$) per litre	PEACER.DBF
CL_MGPL	Chloride	Milligrams per litre	PEACER.DBF

TABLE 2.3 (continued)

FIELD NAME IN FILE*	DESCRIPTION	UNITS	FILE NAME CONTAINING THE DATA
CL2_MGPL	Chlorine	Milligrams per litre	PRCORRECT.DBF
FL_MGPL	Fluoride	Milligrams per litre	PEACER.DBF
TKN_MGPL	Total Kjeldahl Nitrogen	Milligrams per litre (as N)	PEACER.DBF
NO3_MGPL	Nitrate-Nitrogen	Milligrams per litre (as N)	PEACER.DBF
NO2_MGPL	Nitrite-Nitrogen	Milligrams per litre (as N)	PEACER.DBF
SULP_MGPL	Sulphate	Milligrams per litre	PEACER.DBF
PHEN_MGPL	Phenol	Milligrams per litre	PEACER.DBF
CA_MGPL	Calcium	Milligrams per litre	PEACER.DBF
MG_MGPL	Magnesium	Milligrams per litre	PEACER.DBF
NA_MGPL	Sodium	Milligrams per litre	PEACER.DBF
K_MGPL	Potassium	Milligrams per litre	PEACER.DBF
AL_MGPL	Aluminum	Milligrams per litre	PEACER.DBF
CD_MGPL	Cadmium	Milligrams per litre	PEACER.DBF
CR_MGPL	Chromium	Milligrams per litre	PEACER.DBF
CO_MGPL	Cobalt	Milligrams per litre	PEACER.DBF
CU_MGPL	Copper	Milligrams per litre	PEACER.DBF
FE_MGPL	Iron	Milligrams per litre	PEACER.DBF
PB_MGPL	Lead	Milligrams per litre	PEACER.DBF
MN_MGPL	Manganese	Milligrams per litre	PEACER.DBF
MO_MGPL	Molybdenum	Milligrams per litre	PEACER.DBF
NI_MGPL	Nickel	Milligrams per litre	PEACER.DBF
SE_MGPL	Selenium	Milligrams per litre	PEACER.DBF
V_MGPL	Vanadium	Milligrams per litre	PEACER.DBF
Z_MGPL	Zinc	Milligrams per litre	PEACER.DBF
RSIO2_MGPL	Reactive Silica Dioxide	Milligrams per litre	PEACER.DBF
O_G_MGPL	Oil And Grease	Milligrams per litre	PEACER.DBF
OD_NO_	Odour Number	Threshold Odor Number (TON)	PEACER.DBF
TDS_MGPL	Total Dissolved Solids	Milligrams per litre	PEACER.DBF
TS_MGPL	Total Solids	Milligrams per litre	PEACER.DBF
TOC_MGPL	Total Organic Carbon	Milligrams per litre	PEACER.DBF
TIC_MGPL	Total Inorganic Carbon	Milligrams per litre	PEACER.DBF
TC_MGPL	Total Carbon	Milligrams per litre	PEACER.DBF
SURF_MGPL	Surfactants	Milligrams per litre	PEACER.DBF
CAT_AN	Cation:Anion Ratio	Dimensionless	PEACER.DBF
T_COL_NPDL	Total Coliform	Number per 100 mL	FTSMITH.DBF
FECAL_NPDL	Fecal Coliform	Number per 100 mL	FTSMITH.DBF

* Field name = parameter abbreviation and unit abbreviation.

2.3.2 Periodic Municipal Dischargers

These are municipalities, schools and other facilities which discharge on a periodic basis, usually once or twice per year. There are in excess of 200 of these types of systems and there are 69 which have available effluent data. These data are found in the file MUNPER.DBF. The structure of this file is shown in Table 2.4.

The field 'VOLUME' in this file contains a variety of units. These range from the expected cubic metres, gallons and megalitres to length of time pumping at an undisclosed rate or amount of drawdown in the lagoon. These latter two, while not strictly 'volume', are all that was available in the original information and are, therefore, preserved.

The are also a large number of periodic municipal dischargers for which there are no effluent monitoring data on file in Alberta Environmental Protection. Their names, locations and other information appear in NRBS.DBF; however, there are no corresponding effluent data files. Data were particularly sketchy for small periodic dischargers filed under county or improvement district.

TABLE 2.4
File Structure for Periodic Municipal Discharger Database

FIELD NAME IN FILE	DESCRIPTION	UNITS
DATE	Date	MM/DD/YY
VOLUME	Volume	Cubic metres - (M^3) Imperial gallons - (G) Megalitres - (ML) Other
BOD_MGPL	Biological Oxygen Demand	Milligrams per litre
TSS_MGPL	Total Suspended Solids	Milligrams per litre
NFR_MGPL	Non-Filterable Residue	Milligrams per litre
PH	pH	No Units
DISOX_MGPL	Dissolved Oxygen	Milligrams per litre
TEMP_C	Temperature	Degrees Celsius (ºC)
CA_MGPL	Calcium	Milligrams per litre
CL_MGPL	Chloride	Milligrams per litre
CO3_MGPL	Carbonate	Milligrams per litre
HCO3_MGPL	Bicarbonate	Milligrams per litre
COD_MGPL	Chemical Oxygen Demand	Milligrams per litre
COLOR_TCU	Colour	True color units (TCU)
COND_MSPCM	Conductivity	Microsiemens per centimetre (MCPCM)
FECAL_NPDL	Fecal Coliform	Number per 100 mL
T_COL_NPDL	Total Coliform	Number per 100 mL
FE_MGPL	Iron	Milligrams per litre
F_RES_MGPL	Filterable Residue	Milligrams per litre
FL_MGPL	Fluoride	Milligrams per litre
K_MGPL	Potassium	Milligrams per litre
MG_MGPL	Magnesium	Milligrams per litre
NA_MGPL	Sodium	Milligrams per litre
NH3_MGPL	Ammonia-Nitrogen	Milligrams per litre (as N)
NO2_MGPL	Nitrite-Nitrogen	Milligrams per litre (as N)
NO3_MGPL	Nitrate-Nitrogen	Milligrams per litre (as N)
NINA_MGPL	Nitrite-Nitrate-Nitrogen	Milligrams per litre (as N)
ORG_N_MGPL	Organic Nitrogen	Milligrams per litre (as N)
SI_MGPL	Silicon	Milligrams per litre
SO4_MGPL	Sulphate	Milligrams per litre
SURF_MGPL	Surfactants	Milligrams per litre
T_ALK_MGPL	Total Alkalinity	Milligrams ($CaCO_3$) per litre
HARD_MGPL	Total Hardness	Milligrams per litre
TDS_MGPL	Total Dissolved Solids	Milligrams per litre
TS_MGPL	Total Solids	Milligrams per litre
TKN_MGPL	Total Kjeldahl Nitrogen	Milligrams per litre (as N)
T_PO4_MGPL	Total Phosphate	Milligrams per litre (as PO_4)
TURB_NTU	Turbidity	Nephelometer turbidity unit (NTU)
COMMENTS	Comments	Comments about the data

2.3.3 Non-Pulp Mill Industrial Dischargers

File NRBS.DBF also contains entries for industries licensed to discharge liquid, solid or gaseous effluent. The effluent SUNCOR.DBF contains a relatively large amount of liquid effluent data from that operation located at Fort McMurray. The structure of this file is shown in Table 2.5.

TABLE 2.5
File Structure for Non-Pulp Mill Industrial Discharger Database

FIELD NAME IN FILE	DESCRIPTION	UNIT
DATE	Date	MM/DD/YY
NH3_KGPD	Ammonia-Nitrogen	Kilograms per day (as N)
AS_KGPD	Arsenic	Kilograms per day
CD_MGPL	Cadmium	Milligrams per litre
COD_KGPD	Chemical Oxygen Demand	Kilograms per day
CR_MGPL	Chromium	Milligrams per litre
CO_MGPL	Cobalt	Milligrams per litre
CU_MGPL	Copper	Milligrams per litre
BIOASSAY	Fish Bioassay (LC_{50})	Percent
FE_MGPL	Iron	Milligrams per litre
PB_MGPL	Lead	Milligrams per litre
MN_MGPL	Manganese	Milligrams per litre
HG_MGPL	Mercury	Milligrams per litre
MO_MGPL	Molybdenum	Milligrams per litre
NI_MGPL	Nickel	Milligrams per litre
NFR_KGPD	Non-Filterable Residue	Kilograms per day
O_G_KGPD	Oil And Grease	Kilograms per day
PH	pH	No units
PHNOL_KGPD	Phenols	Kilograms per day
SE_MGPL	Selenium	Milligrams per litre
AG-MGPL	Silver	Milligrams per litre
SLPHD_KGPD	Sulphide	Kilograms per day
TON	Threshold Odour Number	Threshold odor number
TOC_MGPL	Total Organic Carbon	Milligrams per litre
V_MGPL	Vanadium	Milligrams per litre
ZN_MGPL	Zinc	Milligrams per litre

The effluent database MISCIND.DBF contains the relatively small amount of liquid effluent data from Blue Ridge Lumber, Mallock Gravel and Mildred Lake Campsite. The structure of this file is shown in Table 2.6. No liquid effluent monitoring data are available for most non-pulp mill industrial dischargers in the NRBS area.

TABLE 2.6
File Structure for Miscellaneous Non-Pulp Mill Industrial Discharger Database

FIELD NAME IN FILE	DESCRIPTION	DESCRIPTION OF FIELD UNIT
NAME	Name	Name of industry
DATE	Date	MM/DD/YY
FLOW	Flow	Cubic metres - M^3 Imperial gallons - G Megalitres - ML
BOD_MGPL	Biological Oxygen Demand	Milligrams per litre
TSS_MGPL	Total Suspended Solids	Milligrams per litre
PH	pH	No units
PHENOL_MGPL	Phenol	Milligrams per litre
NH3_MGPL	Ammonia-Nitrogen	Milligrams per litre (as N)

2.3.4 Data Limitations and Inconsistencies

The information contained in the database was not prepared under a consistent protocol. It must not be considered to be rigorously scientific. Rigorous definitions of the units and analytical techniques are not possible. The database user should exercise caution.

2.3.4.1 Missing or Incomplete Data

The data (files, licenses) provided to SENTAR Consultants Ltd. were developed for purposes other than the development of a comprehensive database and contained frequent omissions (such as licenses with no location, locations with no licence number, missing portions of locations or incomplete locations). It was beyond the terms of reference to undertake the extensive checking necessary to fill in missing information.

2.3.4.2 Units of Measurement

The user should be aware that reporting units are consistent through time for each municipality or industry, but may not be consistent from one municipality or industry to another. For instance, the Town of Athabasca reports discharge rate in cubic metres per day, while Fort McMurray reports discharge in megalitres per day. Units are specified in the field name.

It should be recognized that dBase IV placed limitations on the symbols that can be employed in field names and presents field labels entirely in capitals (see Section 3.0). Therefore, abbreviations of units cannot be to conventional usage. Abbreviations are part of the field name in the effluent databases for purposes of clarity.

2.3.4.3 Reporting Results of Chemical Analyses

The user of the database files should be aware that significant limitations exist to the use and interpretation of the chemical results contained therein. These limitations relate to consistency and to the reporting requirements of the licence. They include:

1. The reports do not specify sample handling techniques.
2. Definitions of certain parameter names are not provided. Therefore, there can be variations in understanding of the definition of certain terms between laboratories and/or municipalities and/or over time (e.g. both NFR and TSS appear in the database, but they are likely the same measurement).
3. Analytical techniques are not specified and, therefore, accuracy and detection limits are subject to uncertainty.
4. Units of reporting, such as nitrite as nitrogen rather than nitrite, may not be recognized as important by an untrained person assigned the duty of collating laboratory results and preparing a monthly report for a municipality. Even if the report appears to be specific, it may be misleading simply because the preparers left off the "as nitrogen" because its importance was not understood. Another example is that phosphate is reported when it likely is total phosphorus (from digestion) measured as phosphate.

3.0 ILLUSTRATIVE EXAMPLE

The purpose of this section is to take the user through one source data file and its related effluent data file, in order to clarify any remaining issues. This example assumes that the user is familiar with dBase IV and understands how to perform specific procedures such as sorting, indexing, searching, etc. Manipulating the data or extracting particular information from the database are not covered by this guide. There are a variety of dBase IV manuals that cover such details. For the purpose of this example, however, the user is directed step by step as follows:

1. Assuming space is available, copy the file NRBS.exe from the disk contained in Appendix A of this guide to the computer hard drive.

2. At DOS PROMPT (at appropriate directory now containing NRBS.EXE) type 'NRBS.EXE'. The file will self-execute creating all file names used in this document (NRBS.CAT also included).

3. Open dBase IV and use NRBS.dbf (source data file).

4. The file has two options for on-screen viewing:
   a) Regular dBase 'data' view which identifies fields with the abbreviations used in this document; [Figure 3.1]
   b) 'Form' view - which provides an expanded definition of each field. [Figure 3.1(a)]

5. Press F2 to enter BROWSE mode.

4. Use 'GO TO' Menu, select 'FORWARD SEARCH', enter the example **Fort Smith.** Then, dBase will locate the Fort Smith record. In this example, there is only one Fort Smith record. If more records exist, dBase will select the first record matching the search criteria.

5. Press F2 to display the Fort Smith record.

You are now looking at the source file information for Fort Smith, NWT, located on the Slave River (Figure 3.1 or 3.1(A) depending on which of 4a) or 4b) you selected). It has a license number N1L4-0567. As Fort Smith is located in the NWT, there is no land survey system and, therefore, no entries for legal subdivision (of a section), section, township, range and meridian. However, it is located at 60° north and 111.88° west. The municipal sewage system has two primary and one secondary facultative cells which discharge continuously. Volume of discharge, pH, total suspended solids, total coliforms, fecal coliforms and 5-day BOD are reported. The name of the file containing this latter data is 'FTSMITH. DBF'.

6. Close 'NRBS.DBF' and open 'FTSMITH.DBF'.

7. The file has two options for on-screen viewing:
   a) Regular dBase 'data' view which identifies fields with the abbreviations used in this document; [Figure 3.2(a)&(b)]
   b) 'Form' view - which provides an expanded definition of each field. [Figure 3.2(c)&(d)]

Figures 3.2(a) and 3.2(c) show the structure of the first entry in this file in EDIT mode. The first entry in this file is for January 3, 1990 and shows that there was no measured (or measurable) discharge. BOD, total suspended solids, pH, total coliforms and fecal coliforms are shown in this record.

7. Move down to the next record dated February 7, 1990, and review the image as shown in Figure 3.2(b) or 3.2(d). The data in the rest of this file is similarly arranged.

For statistical analysis of the data, it is recommended that the file be exported to a spreadsheet, such as a Quattro or Excel spreadsheet, which provide a more efficient and more detailed set of procedures.

FIGURE 3.1
STRUCTURE OF FORT SMITH RECORD IN SOURCE DATABASE -- NRBS.DBF

NAME	Fort Smith
FACILITY	
LICENSE_NO	N1L4-0567
DRAIN_BAS	Slave
LSD	N/A
SEC	N/A
TWP	N/A
RGE	N/A
MER	N/A
LATD	60.00
LONGD	-111.88
TYPE_IND	municipal sewage
TREAT	two primary facultative cells, one secondary facultative cell
DISCHARGE	continuous
PARAMETER	volume of discharge, pH, TSS, total coliform, fecal coliform, BOD5
ALL_DISCH	
RECVNG_W	Slave
FILE_N	FTSMITH.DBF
WASTE_T	E

FIGURE 3.1(A)
STRUCTURE OF FORT SMITH - 'FORM' VIEW
RECORD IN SOURCE DATABASE -- NRBS.DBF

This database contains a list of all licensed municipal and non-pulp mill industrial dischargers in the NRBS study area. It is an index to show the user what dischargers exist and in which files to look for monitoring data.

Name of industry or municipality:	Fort Smith
Name of facility:	
License Number:	N1L4-0567
Drainage Basins of the Peace, Athabasca or Slave Rivers:	Slave
Locational Information:	
LSD: N/A Section: N/A	Township: N/A Range: N/A
Meridian: N/A Latitude (degrees):	60.00000
Longitude (degrees, negative denotes west of Prime Mer.:	-111.88
Municipal or Type of Industry:	municipal sewage
What type of treatment does the effluent receive before discharge?:	two primary facultative cells, one secondary facultative cell
What type of discharge (Continuous or Periodic?):	continuous
List of parameters for which data exists in the effluent database file:	volume of discharge, pH, TSS, total coliform, fecal coliform, BOD5
What is the allowable frequency of discharge (once or twice)?:	N/A
Seasonal discharge (spring, fall, or both)?:	N/A
Name of Waterbody which receives the effluent:	Slave River
Waste type? Liquid (L), gaseous (G), solid (S):	L

For detailed information on this discharger, please refer to the effluent database named: N/A

In dBase IV, use the above named database file and its accompanying form file for examination of effluent data. Select the form file name to view the data.

End Record

FIGURE 3.2(A)
STRUCTURE OF FIRST RECORD
IN DATA SOURCE FILE -- FTSMITH.DBF

DATE	01/03/90
FLOW_G	0
BOD_MGPL	72.0
TSS_MGPL	21.0
PH	6.90
T_COL-NPDL	1300000.00
FECAL_NPDL	290000.00

FIGURE 3.2(B)
STRUCTURE OF SECOND RECORD
IN DATA SOURCE FILE -- FTSMITH.DBF

DATE	02/07/90
FLOW_G	0
BOD_MGPL	98.0
TSS_MGPL	14.0
PH	6.98
T_COL-NPDL	0.00
FECAL_NPDL	600000.00

FIGURE 3.2(C)
STRUCTURE OF FIRST RECORD - 'FORM' VIEW
IN DATA SOURCE FILE -- FTSMITH.DBF

FTSMITH.dbf Continuous Municipal Discharger Database
There are 16 municipal sewage treatment facilities which discharge effluent on a continuous basis. This database file represents one of these faciities.

Date:	01/03/90	
Flow (discharge rate):	N/A	Imperial gallons
Biological Oxygen Demand:	72.0	milligrams per litre
Total Suspended Solids:	21.0	milligrams per litre
pH:	6.90	
Total Coliform:	1300000.00	number per 100 ml
Fecal Coliform:	290000.00	number per 100 ml

End Record

FIGURE 3.2(D)
STRUCTURE OF SECOND RECORD - 'FORM' VIEW
IN DATA SOURCE FILE -- FTSMITH.DBF

FTSMITH.dbf Continuous Municipal Discharger Database
There are 16 municipal sewage treatment facilities which discharge effluent on a continuous basis. This database file represents one of these faciities.

Date:	02/07/90	
Flow (discharge rate):	0	Imperial gallons
Biological Oxygen Demand:	98.0	milligrams per litre
Total Suspended Solids:	14.0	milligrams per litre
pH:	6.98	
Total Coliform:	0.00	number per 100 ml
Fecal Coliform:	600000.00	number per 100 ml

End Record

APPENDIX A

DISKETTE CONTAINING DATABASE FILES

APPENDIX B
GLOSSARY OF DATABASE ACRONYMS

APPENDIX B
GLOSSARY OF DATABASE ACRONYMS

ACRONYM	TERM
AG	silver
AL	aluminum
ALL_DISCH	allowable frequency of discharge denoted as either once or twice
AS	arsenic
ATHABASC	Athabasca continuous municipal discharge data
BARRHEAD	Barrhead continuous municipal discharge data
BIOASSAY	fish bioassay (LC_{50})
BOD	biological oxygen demand
C	celsius
CA	calcium
CAT	cation:anion ratio
CD	cadmium
CL	chloride
CL2	chlorine
CO	cobalt
CO3	carbonate
COD	chemical oxygen demand
COLOR	colour
COMMENTS	comments
COND	conductivity
CR	chromium
CU	copper
DATE	date
DBF	database file
DISCHARGE	type of discharge denoted as either continuous or periodic discharge
DISOX	dissolved oxygen
DRAIN_BAS	drainage basins of the Peace, Athabasca or Slave rivers
EDSON	Edson continuous municipal discharge data
F_RES	filterable residue
FACILITY	name of facility
FE	iron
FECAL	fecal coliform
FILE_N	name of file in which the data for the particular facility is located
FL	fluoride
FLOW	effluent discharge rate or volume discharged
FTCHIP	Fort Chipewyan continuous municipal discharge data
FTMCMUR	Fort McMurray continuous municipal discharge data
FTSMITH	Fort Smith continuous municipal discharge data
GRCACHE	Grande Cache continuous municipal discharge data
GRPRAIRI	Grande Prairie continuous municipal discharge data
HARD	total hardness
HC03	bicarbonate
HG	mercury
JASPER	Jasper continuous municipal discharge data
K	potassium
KGPD	kilogram per day
LACLABIC	Lac la Biche continuous municipal discharge data
LATD	latitude in degrees
LONGD	longitude in degrees (negative denoting west of prime meridian)
LICENSE_NO	licence number
LSD	legal subdivision
MANNING	Manning continuous municipal discharge data
MER	meridian (W4; W5; W6)
MG	magnesium
MGPL	milligram per litre
MISCIND	miscellaneous non-pulp mill industrial discharge data
MN	manganese
MO	molybdenum
MSPCM	microsiemens per centimetre
MUNPER	periodic municipal discharge data
NA	sodium

APPENDIX B
GLOSSARY OF DATABASE ACRONYMS

ACRONYM	TERM
NAME	name of industry or municipality
NFR	non-filterable residue
NH3	ammonia-nitrogen
NI	nickel
NINA	nitrite-nitrate nitrogen
NO	number
NO2	nitrite-nitrogen
NO3	nitrate-nitrogen
NPDL	number per decilitre (number of organisms per 100 millilitres)
NRBS	source database
NTU	nephelometric turbidity units
O_G	oil and grease
OD	odour number
OH	hydroxide
ORG_N	organic nitrogen
P_ALK	phenolphthalein alkalinity
PARAMETER	a list of all parameters for which there are data in the effluent database file
PB	lead
PEACER	Peace River continuous municipal discharge data
PH	pH
PHEN	phenol
PHNOL	phenol
PRCORRECT	Peace River correctional institution continuous municipal discharge data
RCVNG_W	name of waterbody which receives effluent
RGE	range
RSIO2	reactive silica dioxide
SE	selenium
SEAS_DISCH	seasonal discharge denoted as spring, fall or both
SEC	section
SI	silicon
SLAVELKE	Slave Lake continuous municipal discharge data
SLPHD	sulphide

ACRONYM	TERM
SO4	sulphate
SULP	sulphate
SUNCOR	non-pulp mill industrial discharge data for suncor
SURF	surfactants
T_ALK	total alkalinity
T_COL	total coliform
T_PO4	total phosphate
TC	total carbon
TCU	true colour units
TDS	total dissolved solids
TEMP	temperature
TIC	total inorganic carbon
TKN	total kjeldahl nitrogen
TOC	total organic carbon
TON	threshold odour number
TREAT	a brief description of the type of treatment the effluent receives before being discharged
TS	total solids
TSS	total suspended solids
TURB	turbidity
TWP	township
TYPE_IND	either municipal or type of industry
V	vanadium
VOLUME	volume
VSS	volatile suspended solids
WABASCA	wabasca continuous municipal discharge data
WASTE_T	waste type denoted as liquid (L), gaseous (G); or solid waste (S)
WHITCRT	Whitecourt continuous municipal discharge data
ZN	zinc