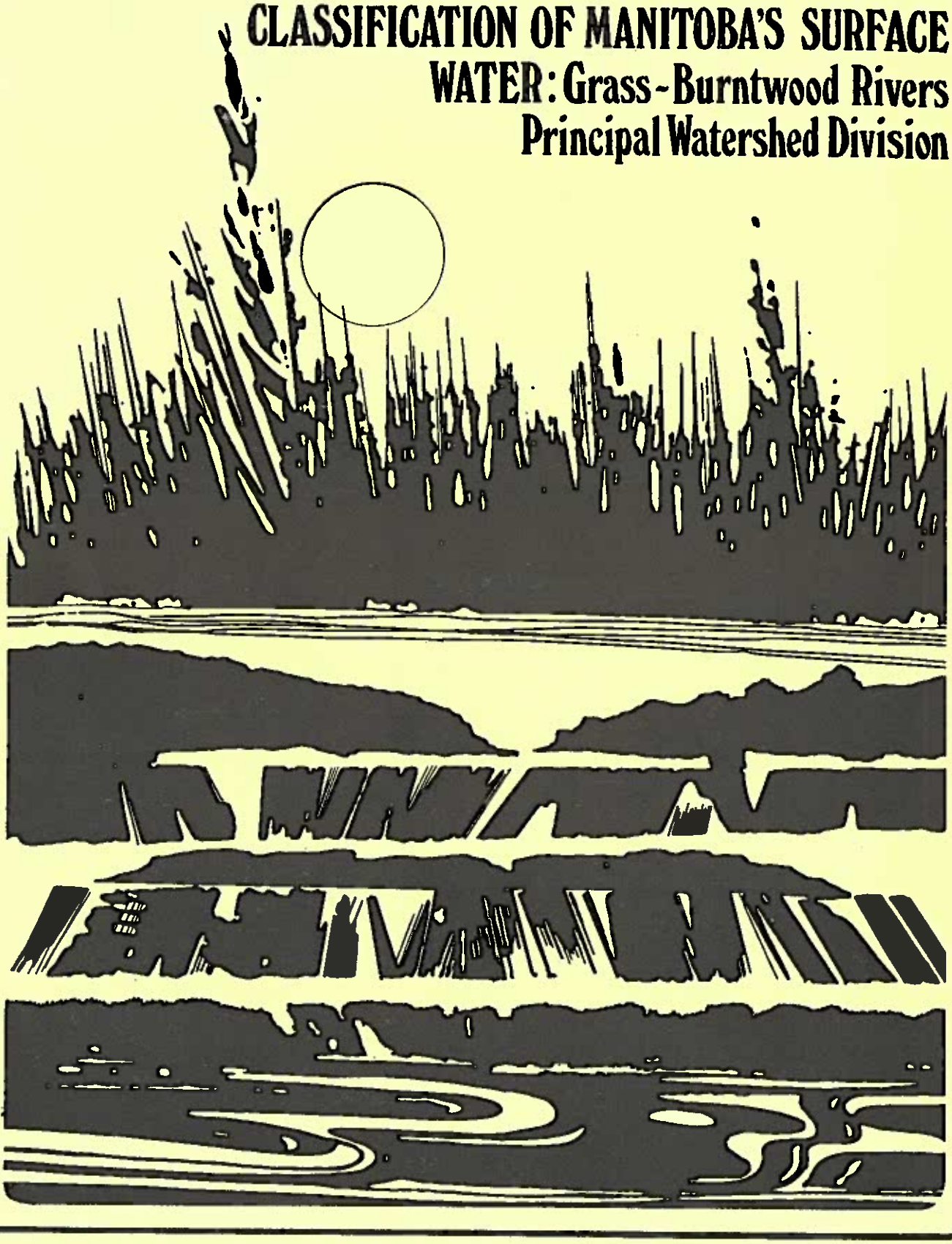
MANITOBA
THE CLEAN ENVIRONMENT COMMISSION

REPORT ON A PROPOSAL FOR THE CLASSIFICATION OF MANITOBA'S SURFACE WATER: Grass-Burntwood Rivers Principal Watershed Division



REPORT

ON A PROPOSAL FOR THE

CLASIFICATION OF

MANITOBA'S SURFACE WATER

GRASS-BURNTWOOD RIVERS

PRINCIPAL WATERSHED DIVISION

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THE CLEAN ENVIRONMENT COMMISSION

JUNE 1982

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ACKNOWLEDGEMENTS

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HISTORICAL CANOE ROUTES ON THE GRASS AND BURNTWOOD RIVERS
from a "Map Exhibiting the New Discoveries in the Interior Parts of North America" printed in London in 1795 by A. Arrowsmith
C. Churchill
Seal River
B
A
Cape Tatnam
Seal Island
Outer Beacon
Severn House
Mr. Falconer with Indians in a Canoe in 1767.
Severn Riv.
Sturgeon R.
Dead R.
Severn Lake
Black L.
NENA WEWHICK INDIANS
Frog L.
Favourable L.
Family L.
Moose L.
Cat L.
Cat Lake House
Cat Lake R.
Goose L.
Eagle L.
Canadian House
Split L.
Apussigamo L.
Burntwood L.
Pelican L.
Rood L.
Goose L.
Carrying Place
Play Green Lake
LAKE WINNIPEG
Cedar L.
Deer R.
Swan R.
Swan Riv. Ho.
Thunder Hill
Somerset Ho.
Marlboro Ho.
Osnaburgh House
Red Lake House
L. St. Joseph
Gov. Wegus Lake
Little Crow L.
Sturgeon L.
Skunkhoulhaw L.
Winnipeg R.
Island Portage
Rat Portage
Lake of the Woods
Back Road
Lake Winipeke
Asseneboyne River
House in 1780
Portage 9 Miles
Fine Fort McGrant 1784
STONE INDIANS
Red River
White Wood L. and Portage

CHAPTER 1

RECOMMENDATIONS

It is recommended that the system of stream classifications, contained in the proposal document attached as Appendix "D" to this report, be adopted with the exception of those waters affected by the Churchill River Diversion. As a result of the Churchill River Diversion, increased flow and inundation is causing a deterioration of certain water quality components. These water quality changes will continue throughout an equilibration period, which may be several decades duration. Manitoba Hydro also has a number of planned power development sites on the Burntwood River which will result in further inundation and flow alteration. These developments will also affect water quality. Every practical and realistic measure to mitigate these water quality concerns should be undertaken by Manitoba Hydro and incorporated into all stages of planning, construction, and postconstruction operational procedures.

CHAPTER 2

CONCLUSIONS

1. The Commission concludes,

   (a) that the water uses listed for protection in the Grass and Burntwood River systems are appropriate to the present and anticipated future uses of the waterways under consideration;

   (b) (i) that in those instances where ambient water quality is inferior to the recommended water quality objectives, further discharge of constituents that exceed the recommended objectives should be carefully considered;

   (ii) that the retention of the objectives under such conditions is necessary to maintain the integrity of the classification system and draw attention to existing points of stress;

   (c) that the nondegradation classification is suitable and appropriate for the upper Grass and Burntwood Rivers system in due consideration of the pristine and beautiful surroundings of the headwaters of these two rivers, the former of which is the natural base of the Grass River Provincial Park. This classification is intended to indicate the need in this ecologically sensitive area for a very high degree of pollution control and will require a high standard of planning and measures to control pollution on the part of any potential developers and regulatory agencies. The Commission believes that this designation is justified and necessary even though the extra attention to pollution control that will be required may well have some degree of impact on potential mining developments in some locations as a result of high initial development costs.

(d) that the stream classifications recommended for the Grass and Burntwood Rivers Principal Watershed Division are suitable for adoption, apart from those waters affected by the Churchill River Diversion where it is expected that during the equilibration period, resulting from increased flow and inundation, the water quality may be deteriorated for a number of decades. Every reasonable and practical measure should be taken in terms of the diversion and regulation of the Burntwood River to mitigate against deteriorating water quality conditions.

2. As a result of the diversion of the Churchill River, the waters of the Rat River system, the Burntwood River below Threepoint Lake, as well as Footprint Lake are in the process of dynamic modification that will take many years to complete and, while insufficient data are available to provide a definitive description of the water quality in the present state of this drainage system, symptoms are present which are typical of water quality alterations which accompany inundation of topsoils and vegetation in new reservoirs. Authoritative estimates indicate that these ongoing impacts on water quality may persist for several decades or more. Additional impoundments are projected for construction in the lower Burntwood River, extending the duration of these transitional changes for a further period from the date of construction.

The Commission is also mindful that any proposals for additional power developments will be subject to the provincial environmental impact assessment review. Consideration should also be given to a similar review of any future major mining developments.

CHAPTER 3

INTRODUCTION

Background

The current program for reviewing water quality began in 1977 when the Minister then responsible for Environmental Management requested The Clean Environment Commission to investigate a system of stream classification and surface water quality objectives as developed by the Environmental Management Division. He noted at the time that these objectives "would to the best practicable degree, reflect a commitment to and point the way towards restoration, maintenance and enhancement of the chemical, physical and biological quality of the Province's waters"[1]. After receiving this letter and circulating a surface water quality proposal prepared by the Division, the Commission held a hearing in June 1977 and continued to receive additional contributions of information throughout that year. In May of 1978, the Commission's "Report on a Proposal Concerning Surface Water Quality Objectives and Stream Classification for the Province of Manitoba" was issued. In the report, the Commission recommended that a program be undertaken aimed at classifying all streams in Manitoba in accordance with the schedule of water uses as provided for in the report. The Commission also recommended that the stream standards be used as targets to be aimed for by all government agencies involved in water quality and use and, in particular, by the Commission in setting appropriate effluent limits. In a letter to the Chairman December 19, 1978, the Environment Minister approved the report and requested the Commission to proceed to conduct public hearings to apply the stream classifications and water quality objectives to all of the nineteen major watershed divisions in Manitoba.

In November 1979, the Commission held hearings in the Souris River basin and issued its Souris River Report February 28, 1980. The next watershed dealt with by the Commission was the Red River system where hearings were held from December 1980 to February 1981 with the Commission's

"Report on a Proposal for the Classification of Manitoba's Surface Water Red River Principal Watershed Division" being released in November of 1981.

After consulting with the Environmental Management Division and communicating with the Minister, the Commission commenced its investigation of the development of stream classifications and water quality objectives for the Grass-Burntwood Rivers Principal Watershed Division in July 1981.

Preparatory Phase

Based on its previous experience, the Commission considered it essential, before launching into a series of public hearings, to provide sufficient background information at both the expert and nonexpert level to enable the public as well as interested government department, companies and organizations to make a meaningful contribution to the hearings. With this in mind, the proposal document "Proposed Classification of Manitoba's Surface Water Grass-Burntwood Rivers Principal Watershed Division", June 1981, as prepared by the Environmental Management Division in collaboration with the Water Resources, Parks, Fisheries, and Wildlife Branches of the Department of Natural Resources as well as the Departments of Agriculture, Health, and Municipal Affairs, was given the widest practicable distribution commencing August 11, 1981. Copies of this proposal were sent to all interested departments of the Federal and Provincial Governments as well as to municipal, community, and Indian band councils, companies, organizations and associations within the Grass-Burntwood Rivers basins as well as those with provincial or national scope. In addition, the Commission prepared a simplified version of the proposal document "Proposed Grass-Burntwood Rivers Classification of Water Quality" intended for use by laymen unacquainted with the technical details of the surface water classification procedure. Copies of this booklet were forwarded in sufficient quantities for distribution by municipal, Indian band and community council offices throughout the Grass-Burntwood Rivers watershed division. The proposal document was accompanied by an introductory letter from the Commission Chairman explaining the purpose of the investigation. The Chairman's letter is attached as Appendix A to this report. The proposal document is attached as Appendix D to this report.

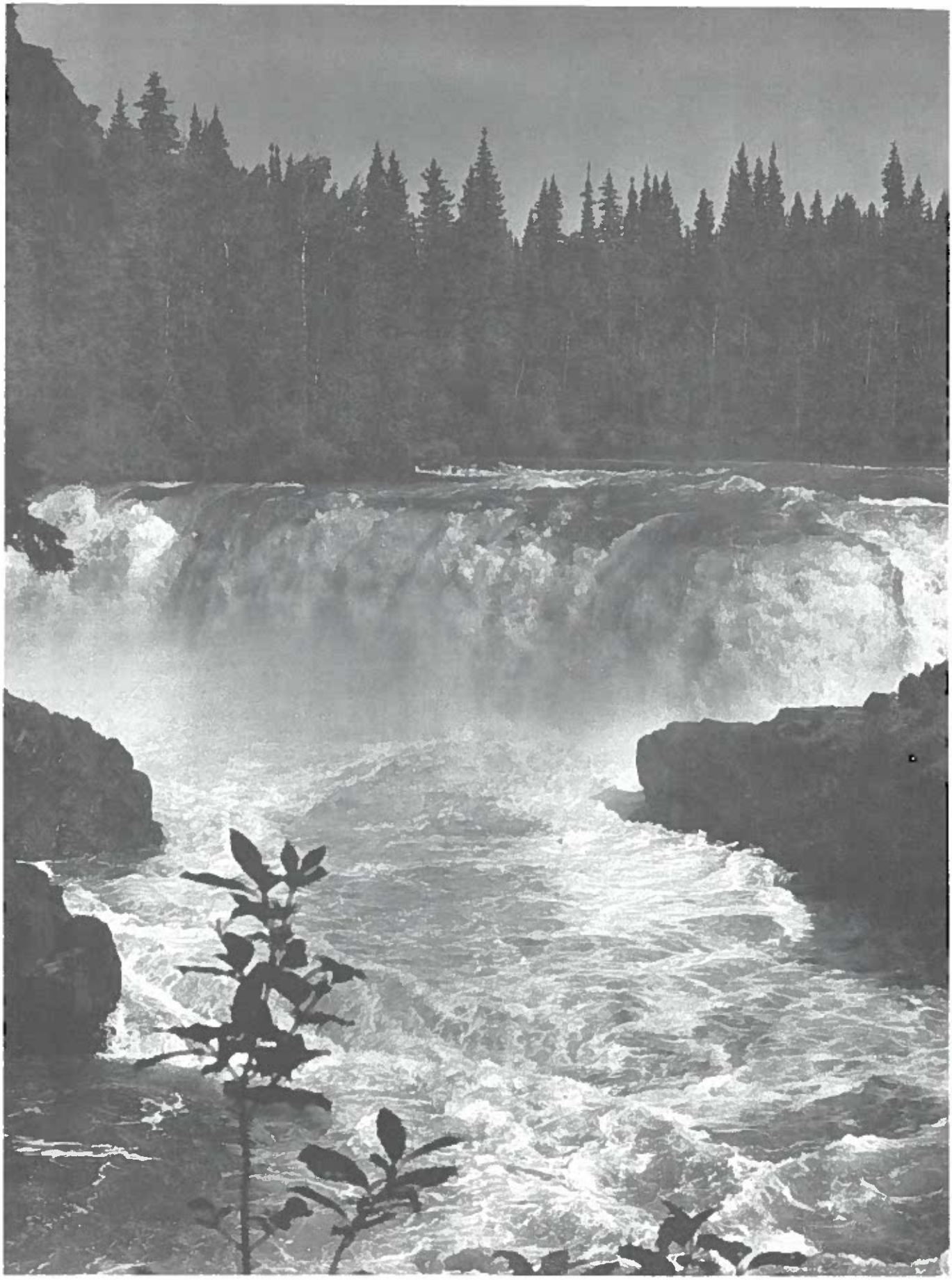
In addition to circulation of the proposal document and the explanatory pamphlet, the Commission published advertisements in the newspapers circulating within the subject watershed division. An offer was forwarded to councils and organizations on behalf of departmental officers who had offered to attend council and organization meetings to explain the classification procedures. Information was provided to the print and electronic media serving the north country and a number of items were broadcast explaining the Commission's purpose in carrying out the investigation. To announce the hearings in communities not served by a local newspaper, the Commission forwarded a supply of notices for posting on bulletin boards and at gathering places such as schools, stores, and community offices. A copy of the newspaper advertisement published by the Commission in connection with these hearings is attached as Appendix B.

CHAPTER 4

CONDUCT OF HEARINGS

The first of the public hearings was held October 26, 1981, in the Legion Hall at Snow Lake, the centre of mining activity in the Grass River drainage basin. The second hearing, on October 28, 1981, was held in the United Church Hall at Nelson House at the Indian Reserve at Footprint Lake in the Burntwood River drainage basin. The third hearing was held in the Provincial Building at Thompson on October 29, 1981.

The Commission was somewhat disappointed at the low attendance, by the general public, experienced at these hearings. Although a considerable number of expert witnesses representing industry and the provincial and federal governments attended the hearings, the number of individual citizens who wished to make representations was not large. Because of the specialized nature of stream classifications and water quality objectives, the Commission has noted, at its previous hearings, that members of the public are unlikely to attend unless they have a direct interest or specialized knowledge of the bodies of water under examination.



Pisew Falls on the Grass River at Pisew Falls Provincial Heritage Park, 74 km South of Thompson on provincial road 391.

CHAPTER 5

THE PROPOSAL

General

The water use classifications being reviewed by the Commission in the present series of hearings are contained in a report "Proposed Classification of Manitoba's Surface Water Grass-Burntwood Rivers Principal Watershed Division", June 1981. This proposal was prepared after a review of existing and anticipated water uses in the drainages of these two rivers and following study of the scientific literature to develop appropriate objectives for the many individual components of water quality. Development of the proposal was carried out by the Environmental Management Division in collaboration with the Water Resources, Parks, Fisheries, and Wildlife Branches of the Department of Natural Resources and the Departments of Agriculture, Health, and Municipal Affairs.

Following completion of the hearings, the proposal was reviewed by its authors and minor details were revised in light of the evidence received. This revised version is attached as Appendix O and serves as the basis for the comments, conclusions and recommendations contained in this report.

The proposal contains descriptions of the topography, people, hydrology, climate, and resources of the Grass and Burntwood Rivers basins. The economic conditions are described indicating the population of 26,000 is mainly supported by resource-based industries. The major population centre at Thompson and the Town of Snow Lake being largely supported by major mineral developments in those areas. Other industries include the extraction of some 252,000 cubic metres of timber annually, a trapping industry grossing in excess of $400,000.00 per year, and an extensive commercial fishery valued at $200,000.00 per year based on quotas totalling some 180 tonnes from a variety of lakes in both drainages. In addition, there is an extensive tourism and recreation industry including an unexcelled

sports fishery indicated by the 25 tonnes taken from Reed Lake in one year alone together with canoeing, camping, hunting, and cottaging opportunities including 320 cottages and the operation of commercial lodges, mainly in the Grass River drainage.

Water Quality Classifications

The water quality classifications contained in the proposal are based on the system of surface water quality objectives established for Manitoba in the Commission's 1977 "Report on a Proposal Concerning Surface Water Quality Objectives for the Province of Manitoba". This system sets up water classifications on the basis of six water use categories; domestic consumption, fisheries and recreation, industrial consumption, wildlife and agriculture, navigation and waste disposal, and "other uses". Each of the main categories has quality categories ranging from "A" to "O" depending on the suitability of the water for the intended use. In addition, the "nondegradation" classification is used in appropriate circumstances.

In the proposal, the "nondegradation" classification is recommended for the unspoiled wilderness and semi-wilderness areas of the upper portions of both river systems, above Wekusko Lake in the Grass River system and upstream of Threepoint Lake in the Burntwood drainage.

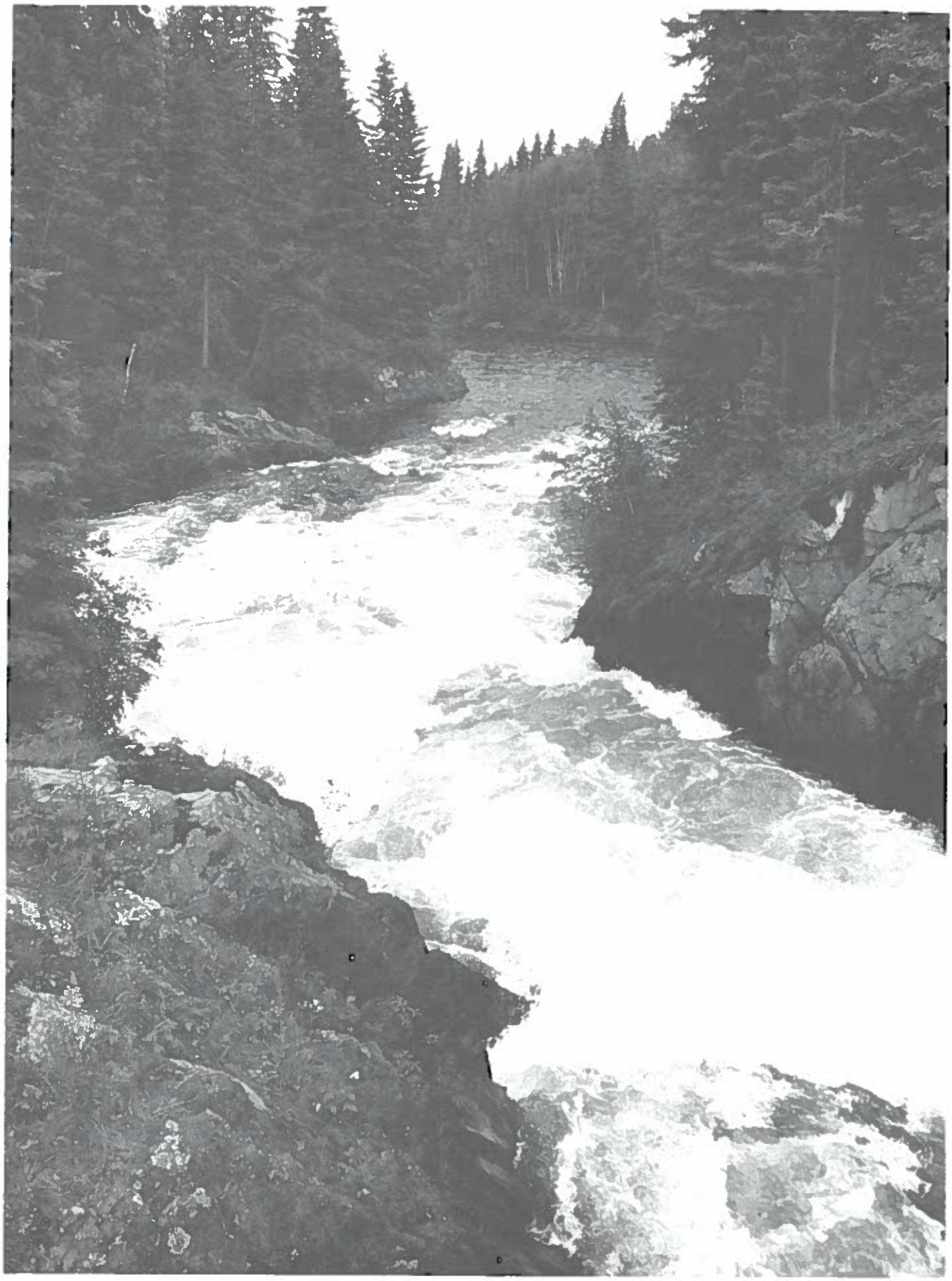
Moving further downstream in the Grass River basin, grade "B" is recommended for domestic consumption (indicating disinfection required); category "A" for fisheries and recreation; "A" for industrial consumption; "C" for wildlife and agriculture ("A" and "B" apply to agricultural irrigation qualities not required in the Grass and Burntwood where virtually no farming takes place): also the lower Grass River is recommended as suitable for the nonconsumptive uses of navigation and waste disposal.

The classifications proposed for the Burntwood drainage, including that portion where the Churchill River Diversion Project has increased water levels and flow rates, include category "C" for domestic consumption (disinfection, coagulation, clarification and filtration required prior to

use); "B" for fisheries and recreation (suitable for cool or warm water sport and commercial fisheries and for all aquatic recreation); "B" for industrial consumption (suitable with moderate treatment); "C" as suitable for wildlife and agriculture and also graded as suitable for navigation and waste disposal.

Public Discussion

The proposal document, Appendix O, was prepared as a necessary preliminary step to compile meaningful authoritative surface water quality objectives for consideration by the Commission. A further and perhaps more important reason for the preparation of the proposal was to provide a starting point for the preparation of discussion documents and public input to assist the Commission in its deliberations concerning the selection of water quality objectives and stream classification in these two important river basins.



Wekusko Falls on the Grass River.

CHAPTER 6

REVIEW OF EVIDENCE RECEIVED

Snow Lake Hearing

The Chairman, Mr. Stan Eagleton, introduced the matters to be considered at the hearing and he outlined briefly the background of the surface water quality program being carried out by the Commission throughout the Province. He indicated the Grass-Burntwood Rivers Principal Watershed Division was the third to be dealt with in a program which is intended to cover all nineteen watershed divisions in Manitoba.

Mr. Dwight Williamson of Environmental Management Services of the Environmental Management Division introduced the proposal **"Proposed Classification of Manitoba's Surface Waters Grass-Burntwood Rivers Principal Watershed Division"** which is attached as Appendix O to this report. He emphasized that this was a proposal to be used only as a basis for discussion at the public hearings. Based upon this proposal and evidence received at the hearing, the Commission will then be in a position to recommend suitable classifications for the Grass-Burntwood Rivers. He further pointed out the present program is in some sense similar to the zoning of land for various types of use.

A Manitoba Government interdepartmental committee was involved in the preparation of the report which includes a review of the present and future uses of the water. The classification system permits the establishment of water quality objectives based upon the uses designated. The water quality objectives would be used as a planning tool and a guide to assist in establishing appropriate effluent limits. It is not intended to curb industrial, municipal or private development, but to ensure resultant discharges are compatible with other uses being made of these waters. The public hearings allow a critical evaluation of this process.

The stream classification system is based on six use categories; domestic consumption, fisheries and recreation, industrial consumption, agriculture and wildlife, navigation and waste disposal, and other uses.

Under each use category, the relative quality is identified by letters A, B, C, or D. Category A refers to the highest quality with C or D identifying lower levels.

Mr. Williamson identified three areas within the Grass-Burntwood River basins for which three separate levels of water quality objectives were recommended in the proposal. The first area consisted of Wekusko Lake, Setting Lake, and the lower Grass River. Category B is recommended for domestic use with disinfection only; for fisheries and recreation, category A is recommended for both cool and cold water fish; industrial consumption is also category A, which requires only limited treatment; for wildlife, category C indicates the waters are suitable for this use.

The second area covered by the recommendations comprises the Nelson House region and the Burntwood River below Notigi Lake. In this area, category C is recommended for domestic consumption which requires coagulation, sedimentation, filtration and storage in addition to disinfection to make the water suitable for this use; category B for fisheries and recreation, indicating suitability for cool or warm water sport or commercial fish; category B for industrial consumption requiring a moderate degree of treatment; and category C for the wildlife classification.

The third area identified in the report is the upper Grass River above Wekusko Lake and the upper Burntwood River upstream of Threepoint Lake where a nondegradation classification is recommended. Mr. Williamson explained that this recommendation does not require that the area be managed as a wilderness or ecological reserve, but because the potential for recreational use, sport and commercial fisheries is great, and because of the sensitive nature of this largely wilderness headwaters area, stricter environmental controls are being proposed to maintain the present water quality without future degradation. He indicated this should not discourage industry, but should ensure that the best practical or best available technology is used to treat any effluents that may be discharged within the area. He testified this might require higher development costs on the part of those seeking to open new mines in the area. While there is likely to be development within the area, stricter environmental controls would be appropriate.

Under questioning, Mr. Williamson and Mr. Doug Peterson, a representative of Environmental Control Services, stated that it is a normal

requirement of their department that raw water be disinfected before use for human consumption. It was indicated that the use of the lower Burntwood River for navigational purposes may, to some extent, be limited by floating and submerged deadfall resulting from diversion of Churchill River waters to this portion of the Burntwood system. Mr. Williamson allowed that the present classification system may not be too well suited to accommodate the transitory nature of changes now taking place in this portion of the drainage system. Mining activities in the upper Grass River system appear to comply with the nondegradation classification being proposed.

Detailed questioning of Mr. Peterson and Mr. Williamson included a number of questions concerning Anderson Lake and the discharges via Anderson Creek to Wekusko Lake. As this matter arose a number of times during the hearing, some preliminary explanation may be justified. On May 18, 1978, the Honourable Len Marchand, Minister of State (Environment) on behalf of the Minister of Fisheries and the Environment for Canada, issued an order designating Anderson Lake as a tailings impoundment area pursuant to the Fisheries Act and the Metal Mining Liquid Effluent Regulations. This designation followed application by Hudson Bay Mining and Smelting Co., Limited to discharge tailings and liquid effluent from its Stall Lake ore concentrator and from mines in the Snow Lake area into Anderson Lake where the tailings are stored, with discharge of effluent via Anderson Creek into Anderson Bay of Wekusko Lake. The quality of the effluent is required to meet limits, terms and conditions as prescribed in the Canada Metal Mining Liquid Effluent Regulations and in Order No. 766 issued by the Manitoba Clean Environment Commission December 29, 1977. The level of Anderson Lake is maintained by a control structure installed by Hudson Bay Mining and Smelting Co., Limited and liquid effluent is released by means of a valve-controlled discharge pipe or, alternatively, during high water, through an overflow sluice which forms part of the control structure.

Continuing to answer questions from Commission members, Mr. Williamson and his supervisor from the Manitoba environment department, Mr. Dennis Brown, reiterated that the nondegradation classification, which was introduced to the water quality classification system on recommendation of The Clean Environment Commission, as recommended by the department for the upper Grass and Burntwood Rivers, was intended to require mining operations to have somewhat more stringent environmental

controls over their effluent than in other areas. It was indicated that the mixing zone would not be entirely eliminated under these considerations. Mr. Williamson indicated that the normal mixing zone has been defined as constituting 25 percent of the width of a flowing stream or a 300 foot (90 metre) radius area in a lake.

In answer to a question concerning increased flow and inundation caused by diversion of Churchill River waters through the Burntwood River, Mr. Williamson confirmed this causes additional erosion but noted the difficulty in accurately predicting degradation that is going to occur.

Mr. Russell Bartlett, of Wekusko Lake Fisherman's Association, noted there are some 29 cabins and other residences in Anderson Bay and Berry Bay of Wekusko Lake. He enquired whether this water is safe to use for domestic consumption.

Mr. Peterson indicated that monitoring in 1981 for a limited number of parameters showed that the water met the criteria specified in the recommended water quality objectives; however, he stated it is the position of his department that, for public health reasons, all raw water should be disinfected before being used for human consumption.

Mr. Bartlett indicated that people have been living on the bay for 35 or 40 years. He took exception to the decision to discharge effluent from Anderson Lake into Anderson Bay. He could not see why residents should be expected to alter their way of living because the mining company wants to pollute the bay.

Mr. Peterson reiterated that, provided the water of the bay meets the criteria recommended to the Commission, the water will be suitable for domestic consumption provided it is disinfected.

Drawing attention to the extensive commercial fishery in Wekusko Lake and the high quality of the fish being taken, Mr. Bartlett requested to know whether there is any possibility the discharge of effluent to the lake will cause any downgrading of the quality of these fish.

Mr. Peterson confirmed that, on the basis of the very limited amount of data, the effluent being discharged via Anderson Creek meets the limits prescribed in The Clean Environment Commission order. Noting that the weather had prevented attendance of fisheries experts, departmental officials present were unable to provide authoritative comments on any possible impact on fish quality except to note that the objectives recommended for Wekusko Lake provide for the propagation and maintenance of warm and cool water sport and commercial fish.

Mr. Joe Bauhs, a Vice-President of the Manitoba Wildlife Federation, made a representation on behalf of the 357 members of the Snow Lake Game and Fish Association. He stated there is a need for more industry in the north and to improve the industry that is there at the present. He drew attention to an incident in the spring of 1981 when effluent was discharged from Anderson Lake which stank terribly. He recounted that Mr. Bartlett caught some 8 or 10 mullets and put them into an enclosure in Anderson Creek downstream of the effluent discharge. Within two hours, all of the fish were dead. He noted the department had explained the odours and toxicity to the fish by saying the water was anaerobic (that is to say, there was not enough oxygen present to sustain life or reduce the odour problem); however, he noted the effluent discharge was bubbling out of the release valve and that this bubbling should have provided enough oxygen content to have kept the fish alive for more than two hours. He noted that the Hudson Bay Mining and Smelting Company has a large number of activities in the area including the Spruce Point Mine on Grass Lake in the Grass Lake Provincial Park and the Chisel and Ghost Lake Mines near Snow Lake. He worked for the company for many years and expressed the opinion that things were going to be neglected unless the people keep up their pressure on the mining industry and the government. He asserted, as a resident of Snow Lake, that there is a tremendous amount of chemicals going from the mill into Anderson Lake. He requested that it be explained to him what was eventually going to happen with the buildup of tailings lying on the bottom of Anderson Lake.

Mr. Peterson replied that, provided the pH of Anderson Lake remains alkaline, the impurities in the bottom of Anderson Lake will remain

there; however, if the water should become particularly acidic, some of these impurities could come into solution and be discharged with the effluent. He noted that there was no compliance problem with the condition of the water or the impurities contained in the effluent from Anderson Lake, as monitored by the department. He also noted that in a shallow lake, when water is drained off from under the ice, there may be a lack of oxygen or an anaerobic condition particularly if there is natural organic detritus in the bed of the lake. After discussion, Mr. Peterson indicated that a discharge had taken place from Anderson Lake on May 26, 1981, without prior notice having been filed with the department by the Hudson Bay Mining and Smelting Co., Limited. He gave it as his understanding that, rather than having been discharged in the normal manner, a sudden rise in the level of Anderson Lake had caused overflowing in the overflow sluiceway provided for this purpose. He told the Commission that effluent samples had been collected by the department in May and September of 1981 and that, as previously mentioned, the results of these analyses indicated the effluent was in compliance with the limits prescribed in the Commission order. As this was the first year of operation of the Andersosn Lake control structure, both the company and the department had been surprised by the sudden rise of water that took place in May. He noted further experience would be required to become familiar with the behaviour of the water levels and for the adoption of an appropriate regime for effluent discharge management. Modification of the control structure might have to be considered after further experience.

Mr. Wayne Fraser of Hudson Bay Mining and Smelting Co., Limited explained that Mr. Hank Bloy of the Mining Association of Manitoba Inc. was unable to appear at the hearing as his plane was prevented from landing at Flin Flon by adverse weather conditions. In the absence of Mr. Bloy, Mr. Fraser read a brief on behalf of the association.

The brief stated that exploitation of Precambrian ore deposits has been responsible for the development of existing population centres and transportation infrastructure throughout the north of Manitoba. Without mining, it is doubtful whether other developments such as fishing, wildlife, and forestry could have been developed to the present extent. While present day technology permits mineral exploitation without impacts as severe as those experienced in the past, the impact of these developments cannot be

totally eliminated. Waste must be removed, wastewater must be disposed of, transportation facilities must be put in place, equipment will generate noise, and all this activity cannot be carried out without impinging on the natural environment. Meanwhile, the precambrian shield has a vast potential for additional development as more ore bodies are discovered. It would be unfortunate for both the people and the companies in the north if large tracts of this shield were removed from exploration and extraction activities.

Important mineral potential exists in the Flin Flon and Snow Lake areas, designated in the proposal for nondegradation classifications. Mines within the Grass River area were operated in an earlier period. A new base metal mine is currently being developed on the south shore of Reed Lake. Other known mineral deposits on Reed Lake look promising for the future. The rigid application of the nondegradation classification may well restrict or prevent any human activity including camping, lodge operation, as well as resource extraction, within those portions of the drainage basins. Construction of access roads and continuation of forestry and mining could be prevented if the nondegradation classification is strictly applied. It is not reasonable to transport all wastes, garbage, and sewage to dump sites outside designated areas. Strict observance of nondegradation would stop all land clearing, road building, camp sites, cottage developments, and mining within the area. The brief asked the question whether the best interest of all citizens, both private and corporate, would be served by reserving large areas as untouched and untouchable.

The standards proposed for areas in the Grass and Burntwood Rivers establish objective numbers, in a number of cases, where the naturally occurring concentrations exceed the proposed objectives. In the lower division of the Burntwood River, for example, the proposed quality criteria is exceeded part of the time for copper, faecal coliform, manganese, nickel, and turbidity, while iron exceeded the limit 40 percent of the time and colour over 90 percent of the time. Also, the association would question the proposed value given for arsenic in Table 10 of the proposal document as being similarly inconsistent. There was a feeling that to implement standards which cannot be met due to natural events is impractical. Under such circumstances, the association suggested that any water user, whether industrial, domestic, or recreational, would often be in violation by

discharging water which has simply passed through a property without having its natural quality altered in any way. Similarly, enforcement of such standards would be entirely impractical as no corrective action could be taken to restore it to a quality envisaged by the objectives without treating the entire river flow. The association feels that any regulation should reflect a practical and attainable level.

The brief recommended that special provision be made for startup situations where it may not be entirely possible to control effluents to the degree achievable in established operating facilities. For example, during construction, excavation of earth and rock increases the suspended solids in surface water. Similarly, the lack of historical operating data for a new facility precludes definitive design of pollution control devices and exceptions should be made for these startup situations, as they exist for only a limited period of time and are not expected to have a significant impact upon the total water system. As no corrective action is practical, enforcement at this stage of an operation is considered inappropriate.

With regard to monitoring and control, the association noted that the monitoring locations and methods have not been made clear. Neither has it been made clear whether limits will apply to the control of individual effluents or to the rivers in general. They proposed that this latter application be adopted as the purpose of the objectives is to control whole divisions and monitoring should be on a broad scale. Effluent should be monitored as at present; however, the dilution effects should be recognized in this connection.

Mr. Fraser tabled, as part of his brief, a map of mineral showings and developments within the Grass River Provincial Park and vicinity. This map, which is attached as Figure 1 to this report shows a large number of developing and potentially exploitable mineral locations in and near the provincial park.

After completing the representation on behalf of the Mining Association, Mr. Fraser indicated he wished to make a few comments concerning the proposal document (Appendix O). He considered the remarks on Page 8 of the proposal concerning the high cost of living in the north and the vulnerability of employees in an single industry economy to be overstated He felt that wage levels are commensurate with the cost of living and noted

that the Hudson Bay Mining and Smelting work force has not fluctuated in response to the current price or demand for minerals in the marketplace. He emphasized the remarks in the Mining Association brief concerning instances in the proposal where specific water quality objectives are more restrictive than natural constituents of the ambient waters being considered.

Mr. Fraser continued by comparing the water quality objectives with the effluent limits contained in the Federal Mining Liquid Effluent Regulations and Guidelines, April 1977. He noted these limits were developed on the basis of consensus between government and industry as to the best available technology and the levels which could consistently be achieved during the operation of mining developments. He quoted as an example the limit for zinc under the federal regulation as 0.5 milligrams per litre whereas the objective in the proposal document is 0.05 milligrams per litre or one-tenth of the federal standard. He indicated that a mixing zone would be clearly and fundamentally required if the indicated water quality objectives are to be used. However, he noted the mixing zone concept is not recognized in the federal Fisheries Act under which the metal mining regulations were issued. The standards and regulations apply to the end of the pipe and not to the content of a mixing zone. Also, clearly a mixing zone in a lake is different from that in a flowing stream. He envisaged a possible mining operation under development on an island in Reed Lake where it would not be practical to run a causeway to shore or to divert the effluent over the great distances required to ensure it did not enter the Grass River drainage. Winter cold conditions in the north would not permit the use of a 10 or 15 mile pipeline for this purpose; therefore, the mine might not be practical if this requirement were enforced. A nondegradation category would leave a great deal of discretion in interpretation, while providing no detailed guidance as to effluent standards to developers or prospective operators on waterways proposed for the nondegradation classification. Mr. Fraser stated he could supply a considerable body of data which shows that many lakes in the north have natural levels of various constituents which are greater than the amounts of identified for various activities in the water quality objectives. Therefore, if the guideline levels are rigidly applied, it could mean that unnecessarily restrictive limits would be applied to an operator.

Mr. Whidden, a Commission member, noted the objective of the report was to identify the important uses of a body of water and then to specify, on the basis of the most up-to-date available scientific opinion, the most sensitive consistent objectives needed to support these uses. He quoted, for example, the fishery where various species may be stressed by a number of constituents normally contained from time to time in the ambient waters or where bathing, as another example, might not be advisable perhaps because of transient higher levels in bacterial contamination. He noted it is important that these essential activities be protected and it is worthwhile identifying those areas in which current uses may already be in danger or stress by the presence of higher concentrations of contaminants than are considered desirable by the best scientific opinion available. The system thus identifies water quality objectives with desired use patterns to provide guidance for those concerned with setting limits on point sources of contamination in the future. Mr. Whidden noted that there was a proposed mine development on an island in Reed Lake and wondered if there would be a conflict with mining in a provincial park.

Mr. Fraser stated the Mining Association feels that all these activities can go on concurrently within the park and questioned whether a rigid application of the nondegradation concept would allow this kind of development to go forward.

The Chairman noted further that the Environmental Management Division had stated that the proposed nondegradation classification did not rule out any possible mining development that might be proposed in the area, but that special technical measures might have to be taken to ensure that the effluent did not degrade the body of water on which the mining development was located.

Mr. Fraser stated that, contrary to the belief that mining companies only react when there is public pressure, his company has spent millions of dollars in research and in improvements, for example, to the tailings area at Flin Flon in spite of the fact that this was not required by an order or regulation. Concerning the control structure at Anderson Lake, he stated the reason for locating the discharge pipe low on the dam

was to permit controlled discharge at any time of the year, even under winter ice conditions. The dam spillway had been installed as a fail-safe measure to protect the earthen structure from overflowing. The discharge pipe also provides a monitoring point for measuring constituents in the effluent from the operation and, on abandonment, provides for sealing off without further modification of the dam structure. As to the discharge in the spring of 1981, Mr. Fraser explained that, after some three years of operation of the control structure with no previous requirement to discharge, a sudden snow melt brought the water level to a point where there was only three inches of freeboard on the dam on a Friday afternoon. At that point, some discharge was essential because of the snow melt and rain which occurred the same weekend. The emergency spillway came into operation automatically and, at that time, the valve was opened to draw off discharge from the bottom of the lake. The water in Anderson Lake, at the point of withdrawal was low in dissolved oxygen, perhaps as a result of limited snow cover on the ice surface and resulting higher biological activity. The result was a buildup of odorous gases of decomposition. In the circumstances, it was not possible to provide advance notice of the effluent discharge to responsible government officials. When the odour became apparent, the valve was closed; however, the overflow continued over the spillway. The discharge structure is several miles away from the point where tailings enter the lake. The company continuously monitors the movement of the solids and is committed under an agreement with the federal government that, if the tailings migrate halfway down the lake, a causeway would be installed at that point to keep the solids from moving further down the lake towards the discharge point. The remaining concern, that metals in solution would enter the effluent in unacceptable levels, had already been answered by government witnesses who stated that the quality of the effluent was in conformance with the limits prescribed by the order of The Clean Environment Commission.

During the remainder of the hearing, there was further discussion revolving primarly around water quality objectives being proposed and certain specific components which are lower than the concentrations occurring in the ambient waters. Reference was made by Environmental Management Oivision representatives to the limited data base being used to recommend quality objectives for large and complex watersheds. Mr. Fraser, Mr. Sleigh, and

Mr. Whidden made reference to the desirability of reviewing this matter. Mr. Sleigh suggested that creditability of those not familiar with the process might be strained unless another more acceptable approach can be found. It was agreed, however, that, in instances where lower objectives are proposed than occur naturally, an intention is to ensure that, should any pollutants be added from a point source, the concentrations of the critical elements are not further increased.

Nelson House Hearing

On October 28, 1981, the Commission proceeded to Nelson House for the second hearing of the present series. Nelson House, with a population of 2,000, is located on Footprint Lake. Most of the population live on an Indian Reserve; however, a small population of less than 200 lives off the reserve. While the lake is below the Notigi Dam structure, the water levels of the lake have risen as a result of the increased flows and the water quality has deteriorated.

After convening the hearing and noting that only two members of the local population including one representative of the Community Council were present, the Commission accepted a brief submitted by Councillor G. Spence on behalf of the Nelson House Band Council. It was reported that the Chief and several council members had been called away suddenly to attend to band business at a meeting in Winnipeg.

The Council's brief, after expressing satisfaction that a hearing was held in Nelson House, stated that for the last 30 years the community has been adversely impacted by industrial development and its attendant needs. The Hydro project, which diverted the waters of the Churchill River into the Rat and Burntwood Rivers, was of benefit to people in southern Manitoba and the United States. Council advised the Commission this diversion had drastically and directly affected both the homes at Nelson House and the traditional trapping, hunting, and fishing areas.

The brief went on to state that the Nelson House Band together with four other bands forms part of the Northern Flood Committee which negotiated an agreement known as the Northern Flood Agreement with Manitoba Hydro and

the Governments of Manitoba and Canada. This agreement was intended to compensate the residents for all adverse effects of the diversion project, both direct and indirect. The brief complained that postdiversion socio-economic and environmental studies have not yet been carried out by Manitoba Hydro as expected. Consequently, the brief indicated, despite the fact that the Churchill River diversion has caused extensive and intensive adverse impacts on the land and people, they are unable to qualify or quantify them at the present hearing. There is, for example, an effect of water levels on the water quality. Legal action has been brought against three parties to the agreement because of their alleged failure to act on increased mercury levels in fish and people since the diversion was completed. No one seems to know the source or cause of the increased mercury but the people believe that this problem did not exist before the Thompson mine and the Hydro project were developed. The brief requested that the Commission impress upon the Manitoba Government the vital importance of implementing the postdiversion studies of the effects of the diversion project on the Burntwood drainage basin and to include this area in the proposed stream classification of the Grass-Burntwood Rivers watershed.

Thompson Hearing

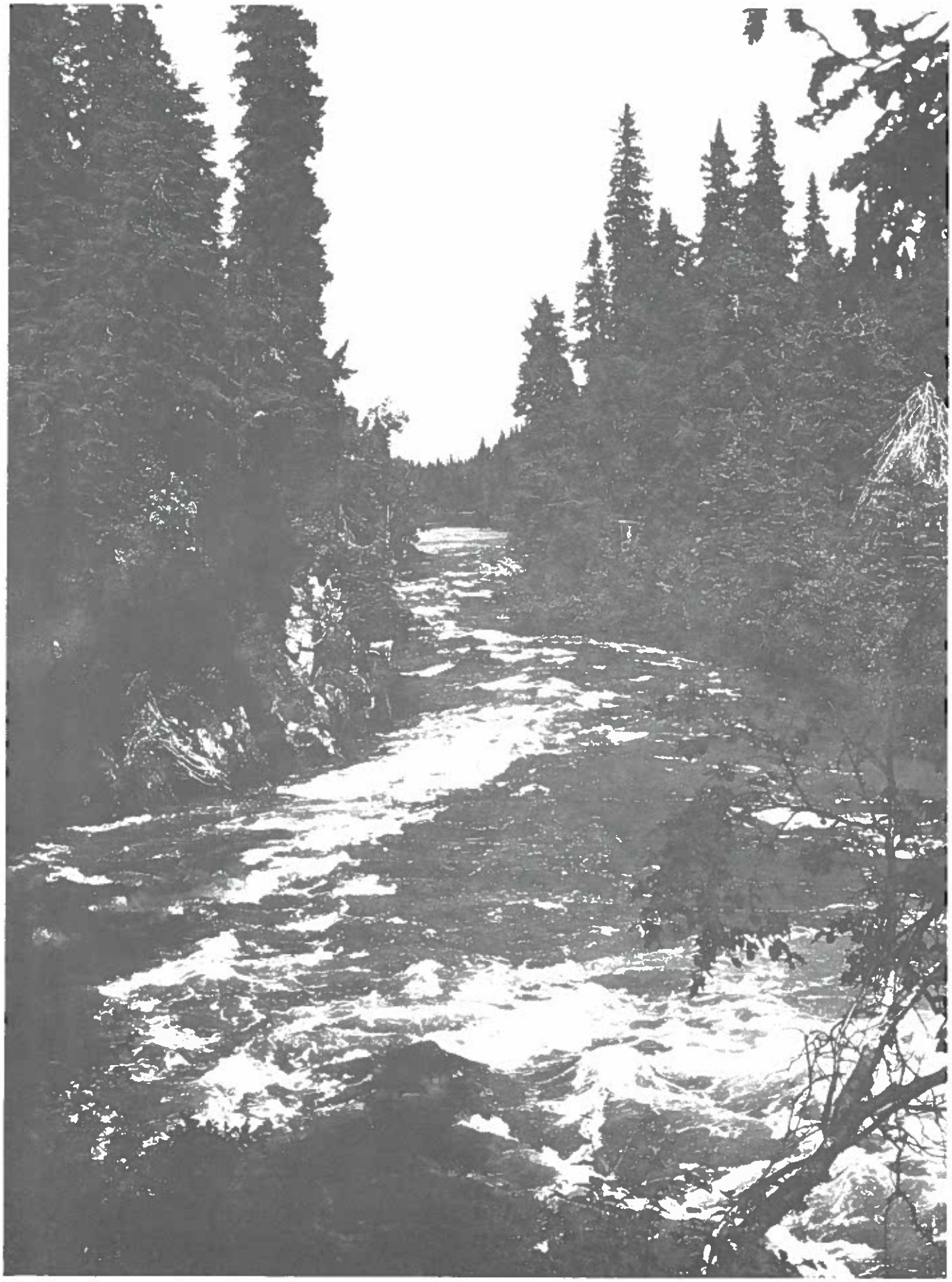
The Commission Chairman opened the hearing by describing the background of the surface water quality and stream classification program which has been carried out by the Commission since the inception of this program in 1977. He described the role being played by the Environmental Management Division in preparing specific technical proposal documents based on a compilation of the latest scientific opinion and available data. He noted the proposal was prepared in consultation with other departments of the Manitoba government. Reference was also made to the preparatory phase carried out by the Commission by its advertisements, broad circulation of the technical proposal document, and preparation and distribution of a simplified version of the proposal for public information.

Mr. Dwight Williamson and Mr. Dennis Brown again appeared as the principal witnesses for the Environmental Management Division.

Mr. Williamson's representation was similar to the presentation he gave at Snow Lake. In addition, he spoke briefly to the nondegradation classification being proposed for the upper portion of the Grass and Burntwood Rivers drainage. He noted that the industrial resources extraction potential is great within the area where this classification is proposed; however, the recreational, and sport and commercial fishery potential is also great. The Division hoped that the adoption of a nondegradation classification would not discourage industry but should ensure that, in all cases, the best practical or the best available technology is used in the treatment of effluent.

Mr. Brown elaborated briefly on the problem perceived by some of those present at Snow Lake concerning existing concentrations of individual constituents which exceed the proposed objectives. He quoted examples for these exceedences in the Wekusko Lake division where total hardness has a specific objective of 50 milligrams per litre and the average current water quality is given at 78 milligrams per litre. A further example being lead, where the objective is .003 milligrams per litre and the current value given from water quality monitoring data is .007 milligrams per litre. He stated that there is a limited amount of available data. These data is not intended to represent the entire watershed division. The proposed specific objectives for the few chemical constituents, which at some points exceed the objectives, may be met in other parts of the watershed division. He told the Commission it is not intended that the existing values should be used to preclude industrial development. However, where these exceedences exist, it should mean that, on a site specific basis, a developer may have to meet more restrictive limits in terms of the discharge of certain components in the effluent, so as not to increase the concentration of the critical constituents within the surface waters, outside of the mixing zone, beyond the existing background level.

Mr. Williamson noted that the Division recognizes that there is a certain statistical variation within all waters, and proponents wishing to undertake development work might require their own data base relative to the receiving waters to which it is intended to discharge effluent, to enable the environmental impact and probable treatment requirements to be accurately predicted prior to any discharges taking place. It would be expected that



Grass River below Pisew Falls, 32 km North of Wabowden.

any industry, in its planning, would then strive to meet the classification. It is difficult to speculate as to the impact of a nondegradation classification on industrial development. The application of a nondegradation specification is both site and industry specific and would take into account the particular discharge and its impact on the receiving water. Only after examining all these factors in detail would it be possible to predict the degree of treatment appropriate to meet the classification. Again, it was necessary to bear in mind the classification is only an objective established for the guidance of both the operator and the authority that will prescribe the enforceable limits on effluent quality.

There followed a considerable number of questions from members of the Commission and others present. In answer to one question, **Mr. Williamson** advised that some of the water quality objectives selected were below amounts that are detectable by available analytical techniques. The .005 milligrams per litre quoted for cyanide, for example, is apparently based on bioassay tests and is below the current detection limit of .02 milligrams per litre.

Mr. Grant McVittie, a fisheries technician questioned whether the present classification scheme is perhaps not relevant since the present Burntwood River might more properly be called the Churchill River as a result of the diversion.

Mr. Williamson admitted there was a problem in deciding where the watershed ended, but noted it might be of less importance to determine the origin of the waters than to consider their quality. For practical purposes, it was necessary to designate certain watershed divisions. In answer to a further question, he indicated the water quality objectives being recommended at present represent the existing situation and appear realistic to the authors of the proposal document. He also confirmed that the objectives being proposed would not be legal standards, but that the Environmental Management Oivision would take the objectives into account when making recommendations on site specific effluent problems to The Clean Environment Commission.

In answer to questions, Mr. McVittie stated that, as one impact of the diversion of Churchill River waters through the Burntwood River system, the fish contain higher levels of mercury than are acceptable for commercial sale and that this would adversely impact on the traditional uses of these waters in this system by northern residents. Also, while the river is perhaps more navigable now than it was before the diversion, initial problems were experienced with floating logs and debris.

Mr. Nick deGraff, a fisheries specialist, appeared as a concerned citizen and requested information concerning the monitoring which will be carried out to establish the base line data in the three water quality areas chosen within the Grass-Burntwood Rivers watershed division.

He was advised by Mr. Williamson that there are ten water quality stations within the area that are currently being monitored six times per year.

Mr. deGraff indicated that water quality characteristics change from time to time and, if you are not in the vicinity at the time, for example, when effluent is being discharged, you may get no indication that effluent was present in the stream.

Mr. Williamson advised that the effort, in this case, was to establish ambient quality parameters unrelated to effluent.

Mr. deGraff, however, stated that, in his opinion, certain of the testing carried out in relation to the fishery was done at inappropriate times and places with insufficient testing carried out while effluent was being discharged. He noted that it seemed useless to have all these guidelines without the proper statistical analysis of the situations that are actually occurring and the proper continuous monitoring that should be carried out especially in a one industry city like Thompson, to determine any impact of the contaminants in the receiving waters. He also expressed concern about the sublethal effects of constituents on the fishery. He suggested it might be advisable to use automated monitoring in circumstances where it is not possible to have environmental technicians continuously on the scene.

Mr. Brown noted that such equipment must be specially designed with very high sensitivity and is extremely expensive.

Mr. John Ashton, Environmental Services Director, Inco Metals Company, stated he thought it likely Mr. McVittie was referring to discharges to the Burntwood River from the tailings area at Thompson. He stated this discharge is continuous when the mill is in operation, but that there is virtually no variation in river water quality as a result of the discharges from the tailings area. The tailings have a very long settling time. The decant from the tailings area is of fairly constant composition. Virtually all parameters would meet the water quality objectives detailed in the proposal document following discharge to the river. He noted that there is no order of The Clean Environment Commission concerning this effluent.

A letter from Mr. W. Barbaza, Director of Tourist Oevelopment of the Manitoba Department of Economic Oevelopment and Tourism, stated that the watershed being considered is extremely important to the tourism/recreation industry. The high quality of the scenic water setting and fishing resources relating particularly to the upper Grass River division and Wekusko Lake area have attracted high levels of public and private investment for tourism and recreation purposes. A recent tourism planning study which assessed the tourist resources of the province identified this region for its present value to the tourist industry and its unique importance to the future development of tourism in northern Manitoba. The recommendations arising from this study, while not yet accepted as government policy, emphasized the strategic importance of maintaining the high quality of the tourism resource generally and of the fishing resources in particular in this region. The study described the area and the adjoining watershed areas as Manitoba's premier outdoor recreation resource area. The Oepartment of Tourism concurs with the recommendation on page 16 of the proposal document that objectives for water quality control for the Grass-Burntwood Rivers system "should reflect the requirements of the recreational uses. Specifically to maintain the quality at or above the level required for the most demanding form of water recreation - albeit not as restrictive on the Burntwood River as on the Grass River portion of the watershed".

Mr. Henry Bloy, General Manager, Mining Association of Manitoba, read into the record the same Association brief presented by Mr. Fraser at the Snow Lake hearing two days previously.

At the Chairman's request, Mr. Williamson and Mr. Brown repeated some of the points contained in their presentation since Mr. Bloy had been unavoidably absent from the hearing in Snow Lake.

On questioning, Mr. Bloy emphasized that water quality objective monitoring should be carried out at a number of places in the watershed and averaged and not taken near an effluent discharge pipe. He believed it was hardly possible to have a development without some sort of degradation of the water quality occurring locally. While the industry does not expect the public to accept a destructive impact, some minor degradation may possibly occur. He felt there was an area in which both the industry and public could live with a balanced economic and ecological basis. He quoted the Snow Lake mill and the City of Thompson as ongoing examples of this philosophy. However, he noted that the mining industry cannot live with a nondegradation classification as contamination is likely, in some instances, to extend beyond the designated mixing zones.

In a brief appearance before the Commission, Mr. Max Morelli, Chief of Water Standards and Studies in the Manitoba environment department, noted that Ontario does not have a system of surface water quality classification such as the one in use in Manitoba. In lieu of such a system, the goal in Ontario is to ensure that surface waters are of a quality satisfactory for aquatic life and recreation. Areas with quality better than the Ontario objectives are to be maintained at or above these objectives. This was, in essence, what the department is seeking to recommend in the case of the upper portions of the Grass and Burntwood Rivers systems by the use of a "nondegradation" objective.

Mr. D. Brett, Mr. J.Callum, Mr. J. Akins, Mr. G. Rempel, and Mr. O. Windsor appeared on behalf of Manitoba Hydro. In his introduction, Mr. Brett indicated that a brief prepared for presentation at the hearing would be read by Mr. Windsor and that the other officials would be available to provide any clarification required by the Commission.

The brief began by outlining Manitoba Hydro's understanding of the background of the Commission's surface water quality program up to the present date. It noted the objectives were goals and guidelines and not to be construed as standards for the receiving waters. Also, that existing water use is utilized as the stepping off point for the classification process and that the Commission will rely on participants and representations to establish existing and potential uses. In this context, Hydro wished to examine four points. These included the existing and potential uses and the basis for stream classifications proposed for the lower Burntwood River, concerns with regard to the basis of the objectives and concerns regarding parameters contained in the objectives, specifically turbidity and temperature. It was noted that the brief bore entirely on objectives recommended for the lower Burntwood system.

The brief stated "Manitoba Hydro is and will continue to be a major user of the waters of the Burntwood River". Churchill River flows diverted by way of the Burntwood River will provide additional power from generating stations on the lower Nelson River. Hydro expects future sites will be developed on the Burntwood River and work has been done on three components of the ultimate development. First is construction and operation of the diversion of the Churchill River at Southern Indian Lake into the upper Burntwood drainage under an "interim water power licence" issued by the Province of Manitoba; testing, monitoring and management of the diversion under government review; and thirdly, studies to evaluate potential sites on the Burntwood River for future hydroelectric generating plants. The diversion was accomplished by constructing a 5.6 kilometre channel from South Bay on Southern Indian Lake into the headwaters of the Rat River. This resulted in an increase of flows at Thompson by a factor of ten. Socio-economic effects of the diversion were assessed and reported on by a Canada-Manitoba study (Lake Winnipeg, Churchill and Nelson Rivers Study Board). In 1973, a control structure was built at the outlet of Notigi Lake and under the Interim Water Power Licence of 1975, Manitoba Hydro is authorized to release an average flow of 30,000 cubic feet per second (850 cubic metres per second) through this control structure. The licence requires this diversion be operated so that flows in Thompson do not exceed 34,000 cubic feet per second (960 cubic metres per second). The result has adjusted the mean annual flow at Thompson from 99-113 cubic metres per second

to 765-850 cubic metres per second. The maximum instantaneous flow from 578 to 1020 cubic metres per second and the minimum instantaneous flow from 7.8 cubic metres per second prediversion to 646 cubic metres per second after the completion of the diversion project. The brief stated this data confirms diversion of the Churchill River into the lower Burntwood has become the dominant factor in this portion of the river system.

Operating trials of the new diversion will include observations of specific deviations, system response time, formation of stable ice regimes and augmented flow test, all of which have been authorized as specific deviations from the interim licence conditions. The result of these programs will contribute to determining the conditions of the final diversion licence, when granted.

The Lake Winnipeg, Churchill and Nelson Rivers Study Board, in its 1975 report, recommended that consideration be given to acceleration of the construction schedule of any further power plants that are intended on the Burntwood River. As part of its overall planning process, Manitoba Hydro is carrying out the Burntwood River Environmental Overview Study, including a socio-economic evaluation to determine which of the various alternatives for reservoir and power generation site development in the Burntwood River should be pursued when the corporation, after appropriate approval procedures, decides new development would be appropriate.

The brief states that Manitoba Hydro recognizes the lower Burntwood River has undergone a dramatic change in the past five years and that a stable hydraulic regime has not yet been established. Any further hydroelectric development on the Burntwood will further modify the river flow and these existing and potential dominant uses must be considered in establishing the water quality objectives to avoid undue rigidity in river basin management. The classification proposal notes these uses but does not sufficiently recognize the diversions for hydroelectric purposes as the dominant use of this section of the Burntwood River.

The brief recommends the Commission clearly identify the Burntwood River from the Notigi control structure to the river mouth as a potential development reach and that this be recognized by any classification proposal. The brief further stressed that this will not obviate the need for Hydro to satisfy government regulations for environmental studies prior to future development. It would, however, identify a well recognized major potential use of this portion of the river.

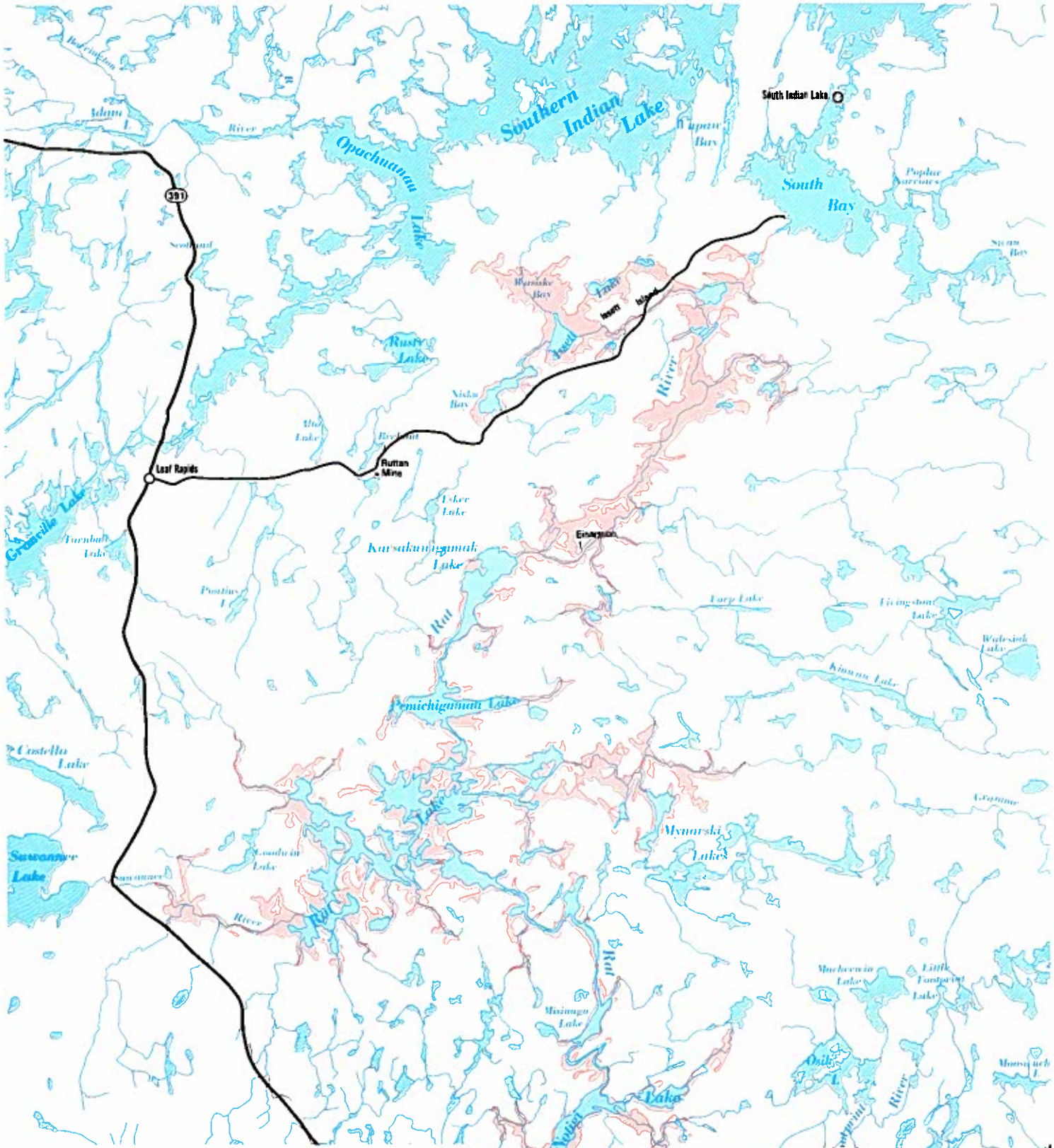


Figure 2

RAT RIVER SYSTEM

Churchill River Diversion - Upper Section
Showing Pre-Diversion and Post-Diversion Water Levels

Scale 1/500,000

LEGEND

Pre-Diversion

Post-Diversion

Cartography by: Surveys and Mapping Branch, Manitoba-1982

Manitoba Hydro expressed concern in the brief about certain specifics in the recommended objectives. For example, colour objectives recommended for the Burntwood River are exceeded 90 percent of the time. The data represents quite a short period and, in the Nelson House division, only a single sampling station on a tributary to the main Burntwood River has been used. Variation in water quality parameters such as turbidity and suspended sediments will occur, in relation to any single sampling location, and the timing of events such as flow management and runoff, following local heavy precipitation, will have a major effect on the readings.

The brief repeats that, since completion of the diversion in 1976 and the imposition of a tenfold flow increase, conditions along the Burntwood River are still dynamic and have not yet stabilized to a point where final determinations can be made. Many water quality parameters did not experience detrimental changes that could be attributed to the water diversion. Pre and postdiversion conditions indicate suspended solids are in a similar range, temperature shows no significant effects, transparency increases were experienced, conductivity slightly decreased, most major ions showed slight decreases, dissolved oxygen levels, after initial decreases, have now stabilized at or near saturation levels.

The brief, while indicating temperature variations are not a factor in the present classification, nevertheless included a discussion of the impact of such changes on larval development in fish and other aspects of the biota.

The brief discussed turbidity at some length indicating this quality varies widely in the Burntwood River and that definitive patterns are improbable, particularly along the Churchill River diversion which is dynamic as increased flows are a recent feature of the drainage. In view of the wide range of values for turbidity within the natural environment of the Burntwood River, Hydro questions the validity of using a special turbidity value for this reach especially as other uses of the waters are not affected by the existing range of turbidity values.

In this connection, Hydro filed the following recommendations:

1. That major existing surface water uses be clearly identified before the classifications are developed.

2. That the Churchill River diversion segment be recognized as the unique and dominant use of the Nelson House and lower Burntwood River divisions of the Grass-Burntwood Rivers watershed.

3. That the Burntwood River, downstream of the Notigi control, be identified as an area of potential hydro development.

4. That objectives for water quality be reevaluated in terms of existing stream uses and natural stream characteristics.

5. That the Commission avoid undue rigidity in recommending objectives for the lower Burntwood River system because of the fundamental changes still ongoing and because of potential hydro development.

6. That a maximum temperature objective be used rather than a temperature change criteria.

7. That the objective for turbidity be reviewed because of the extreme variability of existing and future conditions.

The next witness before the Commission was Dr. Robert E. Heckie of the Freshwater Institute of Fisheries and Oceans Canada. Dr. Heckie stated the lower Burntwood and the Rat Rivers are going to experience a number of transitions over a not yet defined time scale extending perhaps 10 to 30 years into the future, especially if future developments are likely to further alter the present regime. However much of a challenge, it is necessary for the Commission to try to set objectives in this state of dynamic and continuing change. He noted Hydro's concern that the results of a number of ongoing changes in the water regime are not predictable. In this context, it would be misleading to establish objectives for the lower Burntwood River in the same manner as might apply to the other portions of the drainage basin or as might be applicable for a large industrial point source or multiple point sources which can be controlled or eliminated. The processes which are occurring in the Burntwood River are in a real sense uncontrollable and this is the concern that Hydro is expressing. Dr. Heckie

concluded by stating that he is not an expert on fish biology and is unable to offer comments on the impact of water temperature on fish. However, he noted he shares Hydro's concern that the temperature regime as stated in the objectives is not clear as to the time span envisaged for the temperature range quoted.

Before the hearing concluded, the Chairman and several Commissioners commented on their disappointment that, while the subject of water quality management may be somewhat technical, more citizens of northern communities had not come forward to give the Commission the benefit of their advice and recommendations. They noted the Commission had made considerable efforts to ensure the public was aware the hearings were taking place and that the Commission was anxious to receive expressions of concern and aspirations of the residents of the Grass and Burntwood Rivers basins. The Chairman then declared the hearing terminated.

CHAPTER 7

CHURCHILL RIVER DIVERSION PROJECT

Diversion Route - General

The Governments of Canada and Manitoba signed an agreement August 24, 1971, which provided for the regulation of Lake Winnipeg, the diversion of water from the Churchill River and the development of hydroelectric potential of the Churchill River diversion route. This route, measured from South Bay on Southern Indian Lake, measures approximately 416 kilometres down the Rat River and lower Burntwood River to Split Lake on the Nelson River. The Rat River segment contains a number of lakes; Issett Lake, Karsakuwigamac Lake, Pemichigamau Lake, Rat Lake, Mynarski Lake, Misinagumisinagu Lake, Notigi Lake, and Wapisu Lake. The Rat River system then joins the lower Burntwood at Threepoint Lake and the following lakes are affected; Footprint Lake, Wuskwatim Lake, Opegano Lake, Birchtree Lake, Ospwagan Lake, Mystery Lake, Moak Lake, and Apussigamasi Lake. This portion of the watershed has a relatively low profile with few notable topographical features. It is composed of precambrian granite mostly overlain by glacio-lacustrine clays and tills with muskeg, peat and organic soil deposits especially in the upper reaches and with permafrost occurring in association with some of the organic soils and clays. The original diversion plan called for construction of a channel from South Bay of Southern Indian Lake to Issett Lake and a control structure or dam located downstream of Notigi Lake. Both of these structures have been completed. Also called for in the plan, but not yet constructed, were dams and powerhouses located at Wuskwatim Lake, Manasan Falls, and First Rapids located just above the junction of the Odei River.

Southern Indian Lake

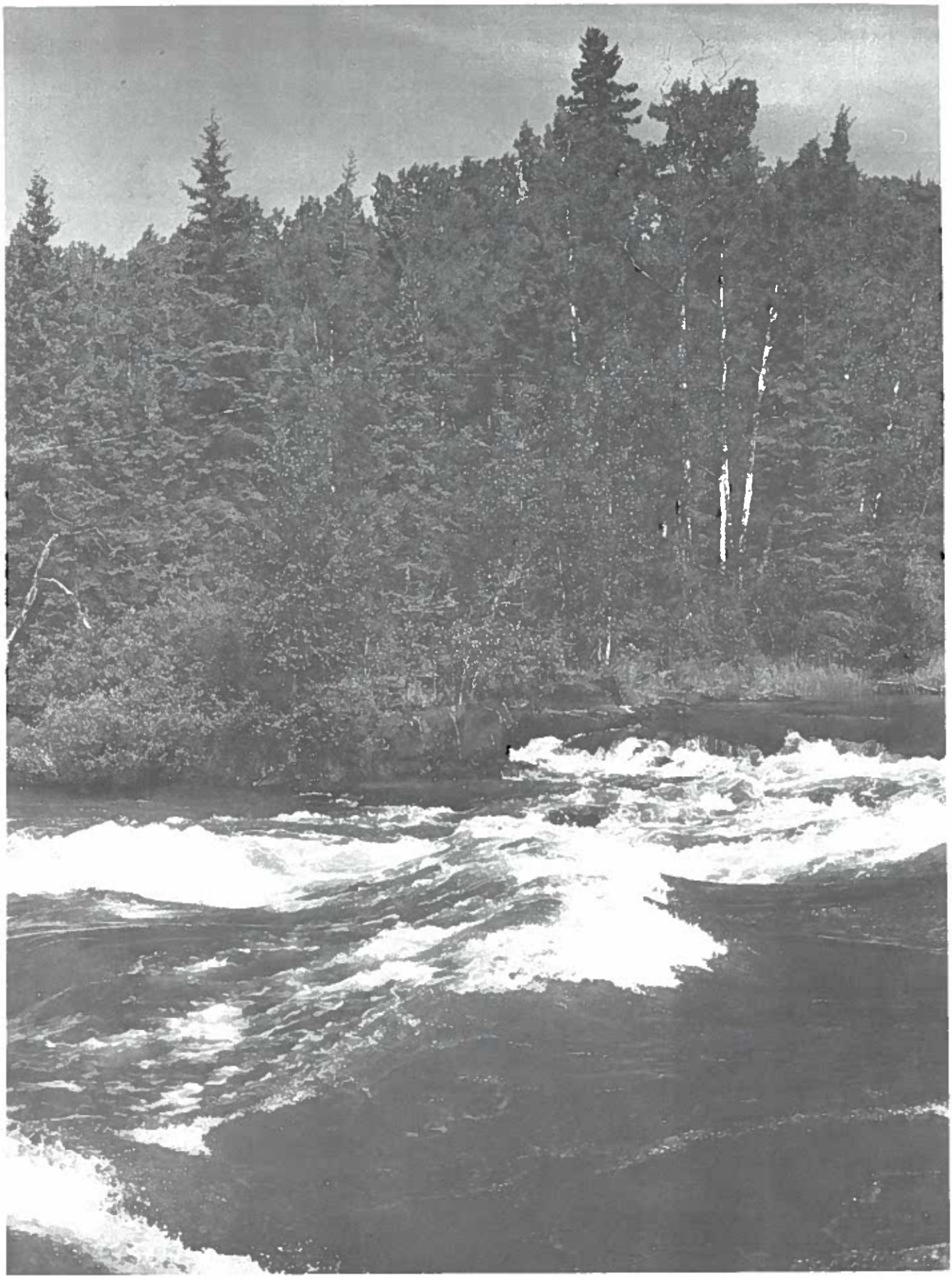
The diversion of Churchill River waters was made possible by the construction of the Missi Falls dam at the outlet of Southern Indian Lake

which came into service in the summer of 1976. The level of Southern Indian Lake was raised by 3 metres to a mean depth of 12 metres with the result that 85 percent of the Churchill River water was impounded and redirected into the Rat/Burntwood system. As a result, the area of Southern Indian Lake was increased from 1900 square kilometres to 2424 square kilometres and the volume of the lake was increased by some 40 percent. The shoreline of the lake was extended to 3595 kilometres with two-thirds of the shoreline composed of loose material of which it is estimated 225,000 tonnes was eroded in 1976 alone with 20 cubic metres of fine grained materials being observed eroding per metre of shoreline in each open water season[2].

Rat River System

To provide for the controlled release of water from the Rat River system forebay area to the Burntwood River, Manitoba Hydro constructed a control structure downstream of Notigi Lake. This structure was brought into operation in 1974 and, by 1976, the depth in the upper Rat River had been increased by 9.7 metres and, at the control structure below Notigi Lake, to 15 metres above precontrol levels. As a result of this rise, the shoreline of the Rat River system impoundment area increased from 800 kilometres to 2253 kilometres. This resulted in the flooding of 409 square kilometres (41,070 hectares) of land being flooded of which 48 percent was treed and 44 percent was a combination of muskeg and trees. Only a small percentage of the timber was removed from the area to be flooded. As in Southern Indian Lake, it was expected that the action of waves and currents would actively erode the clay banks causing increased turbidity of the water. Stabilization of these shorelines is not expected to take place for several decades following the date of diversion and, in protected shoreline areas such as flooded bays and stream valleys, the stabilization process was expected to be very slow because of congestion with standing and fallen trees[3].

By 1976, the diversion channel connecting South Bay of Southern Indian Lake with Issett Lake in the headwaters of the Rat River system had been completed and, by 1978, the Notigi control structure was being operated to ensure the quantity of water being diverted through Wapisu Lake and



Sasagiu Rapids on the Grass River, 24 km North of Wabowden on provincial road 391.

Threepoint Lake to the lower Burntwood River does not exceed the 849 cubic metres per second authorized in the Interim Water Power Licence issued to Manitoba Hydro in 1975 by the provincial government.

Nelson House Area Lakes and the lower Burntwood River

The result of this diversion was to increase the flows at the Notigi Rapids control point from a precontrol level of 35 cubic metres per second to a new average flow of 760 cubic metres per second. The levels in Wapisu Lake, Threepoint Lake and Footprint Lake, where the shores consist of silt and clays, were increased by 5.2 metres. The flow in the lower Burntwood River was increased tenfold. Erosion and channel cutting is expected to continue over the years until the river and lakes downstream reach bedrock[4] with many bays and protected shorelines remaining congested with standing and dead trees. Increased turbidity and decreased light penetration were expected as results of the increased erosion of shore materials.

The water quality in the Rat River system is impacted twice by the Churchill River diversion. First, the water diverted through the South Bay diversion channel comes from Southern Indian Lake; itself a new reservoir. These problems are related to the recent flooding of topsoil, muskeg, and forest, the rapid erosion of extensive new shoreline and the development of new flow patterns. On entering the Rat River reservoir, the quality of these waters is further affected by the inundation of over 40,000 hectares of soil, muskeg, and forest, the erosion of new shoreline, 300 kilometres longer than formerly, where rapid wave action is eroding the banks in many of which permafrost melted rapidly causing accelerated sloughing of surface material.

Water Quality Impacts of Diversion

The more obvious water quality impacts of these changes in the Rat River system include the presence of greater turbidity, decreased light penetration, an increased nutrient load and tendency to accelerated eutrophication and added siltation with effects also on dissolved oxygen levels, biological activity and temperature regimes.

Another water quality impact has been an increase in the amount of methylmercury found in the fish.

In 1977 and 1978, following opening of the Churchill River diversion, the commercial fishery in Notigi, Rat, Mynarski, Wapisu, and Issett Lakes was closed because of high mercury concentrations in the fish. While it was observed that the concentrations in lake whitefish rose significantly following completion of the diversion project and while levels of between 2.04 and 2.67 parts per million were found in pike and walleye in Rat Lake as reported by the Freshwater Institute, 1978, and while these levels are comparable to the levels found in the industrially polluted waters of the English/Wakegoon River system in Ontario, insufficient data are available on prediversion mercury levels in fish to establish a clear causal relationship between postdiversion concentrations and the possible impact of the Churchill River diversion project. It should be noted that high mercury content in fish is not, in itself, a conclusive determining factor, as other shield areas, for example, pristine Island Lake in northern Manitoba, have high piscine mercury content without any evidence of anthropogenic causation[5].

Fish caught in the Rat River reservoir and the lakes immediately downstream continue to be unacceptable for commercial sale in Canada due to their mercury content. However, the value of commercial sales of fish from these waters has not been so important as concern related to the domestic consumption by the local population and, in particular, the residents of Nelson House. In this connection, there arises a natural concern for the health aspects of these people. Negotiations are currently underway to put in place a joint Canada-Manitoba study relative to the determination and origin of mercury in northern Manitoba waters.

The Northern Flood Agreement was signed December 16, 1979, between the governments of Canada and Manitoba and Manitoba Hydro and the Northern Flood Committee, Inc., representing the Indian Bands of Nelson House, Norway House, Cross Lake, Split Lake, and York Factory. This agreement recognizes that resource users have been and may continue to be adversely affected and that "it is in the public interest to ensure that any damage to the

interests, opportunities, lifestyles, and assets of those adversely affected (should) be compensated appropriately and justly[6]". The agreement provided for the appointment of an arbitrator empowered to adjudicate claims and for the payment of equitable compensation.

Future Development

The Churchill River diversion now provides additional water to assist with the generation of electricty at Manitoba Hydro's Kettle and Long Spruce Generating Stations on the lower Nelson River. However, further power generation potential exists on the Burntwood. In the original plan, power generation facilities were envisaged at the Notigi control, at Early Morning Rapids, at the outfall from Threepoint Lake, below Wuskwatim Lake, and at Kepuche, Manasan, and First Rapids, downstream on the Burntwood. At present, the socio-economic and environmental impacts of various combinations of these options are being considered by Manitoba Hydro in conjunction with the Manitoba government Environmental Assessment and Review Agency. It can be expected that completion of all or any of these projects will exacerbate and prolong the impacts associated with the creation of new reservoirs. In reviewing these developments, the Lake Winnipeg, Churchill and Nelson Rivers Study Board, in its 1975 report, recommended acceleration of the scheduling of construction of the Burntwood River power plants[7]. This was apparently recommended in order to accelerate the restoration of established water regimes, to permit the eventual stabilization of the beds and shores of the streams, lakes and reservoirs and permit the quality of the water to return to more normal and acceptable levels.

CHAPTER 8

THE NON-DEGRADATION CONCEPT

General

As noted earlier in this report, the proposal under review recommends that the waters of the upper drainage of both the Grass and Burntwood River systems, rather than receiving a numerical water quality rating, be classified "nondegradation". This designation was included in the "Report on a Proposal Concerning Surface Water Quality Objectives and Stream Classification for the Province of Manitoba", for several reasons. "Many of Manitoba's waters have a high natural quality and yet there is at the present time little or no demand for their utilization. Protection of these waters may thus aim at preserving them for future undesignated uses. Other waters are being used for wildlife management or form an ecological reserve. Again others have value as wild rivers. In each case, protection would aim at preserving rivers as much as possible in their present state[8]". The Commission went on to recommend, "That, where this appears desirable, specific surface waters be classified as not to be degraded in quality[9]".

Other Jurisdictions

The nondegradation concept is used as a basis for water quality standards in many jurisdictions. For example, in Arizona in the "Water Quality Standards for Surface Waters", 1979 revisions:

> "Existing surface water uses occurring within natural watercourses shall be maintained and protected. No further water quality degradation, which would interfere with or become injurious to these existing instream uses, is allowable . . . . Waters whose existing quality is better than the established standards . . . . shall not be lowered in quality unless (the state water quality planning and participation processes) have been fully satisfied and

> it has been . . . . demonstrated to the State Water Control Council that such change is justifiable as a result of necessary economic or social development. In no event, however, may degradation of water quality interfere with or become injurious to existing instream, nonconsumptive water uses."

Also in the "Standards of Water Quality for State of North Dakota", Regulation 61-28-02, April 7, 1977:

> "Waters whose existing quality is higher than the established standards will be maintained at the higher quality unless it can be affirmatively demonstrated that a change in quality is justifiable to provide necessary economic or social development and will not adversely affect the stated beneficial uses of the water. All exceptions must be supported by data. Exceptions will be granted only on a case-by-case basis."

Note that in both of these regulations, having proposed nondegradation as the objective of water management, it is set aside by a system for permitting authorized exceptions.

Existing High Quality

As was suggested in 1977 by the Commission, many of the waters in Manitoba are of such high, natural quality and occur in surroundings of such aesthetic excellence that assigning a nondegradation classification appears entirely appropriate as a water quality objective to serve as a guidepost to future development. This is apparent from the representation submitted by the Department of Economic Development and Tourism to the Thompson hearing which stated, in part:

"The watershed, as noted in the proposal (Appendix O), is extremely important to the tourism/recreation industry in northern Manitoba. The high quality of the scenic water and fishing resources related to the river system, particulary in the upper Grass River division and Wekusko Lake area,

have attracted a high level of public and private investment for tourism and recreational purposes. The Region attracts the highest level of tourism in the North.

In a recent planning study for tourism in Manitoba, in which the tourism resources of the province were fully assessed, this region, among several others, was identified for its value to the present industry and its unique importance to the future development of the industry. The recommendations made by that study . . . . emphasized the strategic importance of maintaining the high quality of the resources generally, and of fishing resources in particular in this region. The study described the area, plus adjoining watershed areas, as Manitoba's premier outdoor recreation resource area."

In its survey publication **Grass River, Towards a Master Plan for Grass River Provincial Park**, the Parks Branch of the Oepartment of Natural Resources identified some of the unique advantages of this park as containing the best fishing, in over 150 lakes, of any park in the Manitoba parks system. In addition to a number of unparalleled wildlife, forest, and vegetation occurrences, it encompasses "excellent canoeing and wilderness camping opportunities along the scenic and historic Grass River Canoe Route". The publication goes on to mention that four commercial lodges and three campgrounds with 122 campsites are located in the park and, by contrast, a new copper and zinc mine is under development in the park with a considerable number of other potential mine locations being considered for development. Outlined in the publication are a number of precepts developed to help define the role of the Grass River Provincial Park within the parks system. These include the intention that, among other objectives, the park would manage to:

1. Provide opportunities for high quality sport fishing and moose hunting . . . .

2. Maintain its semi-wilderness character and outdoor recreational experiences . . . .

3. Accommodate commercial utilization of resources where it does not lessen future recreational use or unduly compromise the primary purpose of the park.

The Commission was advised that, while the lakes in the upper Burntwood drainage tend to be somewhat shallower and the terrain to be somewhat less dramatic, the many rivers and lakes in the headwaters of the Burntwood River system have similar intrinsic and aesthetic quality values as those described for the upper Grass River basin.

Effects of Non-Degradation Proposal

Witnesses at the Commission hearings disagreed as to the expected impact of approving a nondegradation classification for these waters. As has been noted, the Mining Association of Manitoba felt such a policy would effectively prevent development by substantially adding to the costs of a new mining project. This was considered a matter of special concern to those considering development of a number of mineral sites within the area designated as "nondegradation".

Representatives of the Environment department, on the other hand, stated this classification should not discourage industry. They pointed out this classification would apply only outside the limits of mixing zones, normally consisting of 25 percent of the width of flowing streams and zones with a 90 metre radius in lakes. The departmental representatives recognized the great potential for the industrial development of resources within the area. However, they stated the area is particularly sensitive to indiscriminate exploitation and uncontrolled development. For this reason, the nondegradation classification is being recommended to ensure that effluents are not discharged without adequate treatment consisting of the best practical or best available technology. This technology should limit the disruption of ecosystems within the nondegradation areas.

NOTES

1. Letter dated 77 01 21 from the Honourable Sidney Green, then Minister of Mines, Resources and Environmental Management, to the Chairman of The Clean Environment Commission.

2. R. A. Bodaly and R. E. Hecky, Postimpoundment increases in Fish Mercury Levels in the Southern Indian Lake, Manitoba, November, 1979, p. 1.

3. Lake Winnipeg, Churchill & Nelson Rivers Study Board, Technical Report, 1975, p. 7-12.

4. Ibid. p. 7-13.

5. Bodaly and Hecky, p. 3.

6. Northern Flood Agreement, December 16, 1977, p. 47.

7. Lake Winnipeg, Churchill & Nelson Rivers Study Board, Idem p. 1-21.

8. The Clean Environment Commission Report on a Proposal Concerning Surface Water Quality Objectives and Stream Classification for the Province of Manitoba, May 1978, p. 18.

9. Ibid. p. 13.

A P P E N D I X A

LETTER FROM THE CHAIRMAN

File: 1887.0

MANITOBA
CLEAN ENVIRONMENT COMMISSION
Office of the Chairman
Telephone: 895-5333
Box 4, 139 Tuxedo Avenue
Winnipeg, Manitoba
R3N 0H6

August 11, 1981

SUBJECT: Investigation and Classification of the Grass and Burntwood Rivers Drainage Basin - Surface Water

At the request of The Honourable Gary A. Filmon, Minister of Consumer and Corporate Affairs and Environment, The Clean Environment Commission will be holding public hearings in a number of centres in the Grass and Burntwood Rivers drainage basin in connection with the subject investigation. These hearings are expected to take place in October 1981.

We invite and encourage you to actively participate in the following important matter.

Our almost unlimited and wide-spread resource of fresh surface water is perhaps the most important heritage of Manitobans. Since the acceptance of its 1977 report on surface water quality, the Commission has undertaken a series of investigations and will be submitting reports and recommendations to the Manitoba Government on the water quality and stream classification of Manitoba's nineteen major watershed basins. These investigations commenced in 1979-1980 with the Souris River Basin and continued in 1980-1981 with the basin of the Red River.

All individual residents, together with companies, municipal, community, and band councils, associations, organizations, and departments of local, provincial, and national governments are requested to forward briefs or submissions to the Commission. These briefs and submissions should establish what surface water quality objectives, stream classifications and associated land uses will be required to protect, maintain and enhance the quality of our surface waters, now and in the future. Current uses requiring protection include recreation, consumption by humans, industrial operations, habitat for fish and wildlife, as well as the aesthetic and intrinsic values which attach to our streams, rivers and lakes. Support for these aesthetic values and water uses will require the maintenance of appropriate water quality standards while at the same time making provisions for necessary discharges of municipal and industrial wastes. Maintaining such standards will have attendant cost factors including, for example, quality requirements for waste discharges.

To stimulate discussion and provide a technical basis for the matters under investigation in these hearings, we are enclosing *Proposed Classification of Manitoba's Surface Water Grass-Burntwood Rivers Principal Watershed Division*. This proposal and report has been prepared by an

interdepartmental committee of the Manitoba government co-ordinated by the Environmental Management Division of the Department of Consumer and Corporate Affairs and Environment. Additional resource material, as it may become available, will be mailed to you.

The Commission will rely on participants to express their concerns and aspirations at our hearings and to provide evidence on those water quality uses which should be reported on and recommended for protection in the Commission's report to the Manitoba government. Your co-operation and participation in making your views known to the Commission will be very much appreciated.

If you require additional information or clarification, please contact the Commission office.

Yours truly,

Stan Eagleton,
Chairman.

A P P E N D I X B

ADVERTISEMENT OF PUBLIC HEARINGS

MANITOBA

THE CLEAN ENVIRONMENT COMMISSION

NOTICE OF PUBLIC HEARINGS

GRASS AND BURNTWOOD RIVER BASINS

The Clean Environment Commission will hold public hearings to investigate the application of water quality objectives and stream classifications to surface waters in the Grass-Burntwood Rivers Principal Watershed Division under Section 13(1) of The Clean Environment Act, at the following times and places:

Legion Hall **102 Elm Street** **SNOW LAKE, Manitoba** **October 26, 1981** **3:00 p.m.**	**United Church Hall,** **NELSON HOUSE,** **Manitoba,** **October 28, 1981,** **1:00 p.m.**	**Provincial Bldg.,** **59 Elizabeth Dr.,** **THOMPSON, Manitoba,** **October 29, 1981,** **9:00 a.m.**

The purpose of these open public hearings is to receive representations from members of the public and from associations, companies, municipal, band and community councils and government departments outlining their concerns and aspirations concerning these two river systems.

The main water uses are determined in large part by the water quality.
Which water used should be protected and at what cost?

Fishing?	**Human Consumption?**
Wildlife?	**Recreation?**
Navigation?	**Industry?**
Agriculture?	**Waste Disposal?**

You are invited to attend the hearings or to send in a brief or letter to the Commission at Building No. 2, 139 Tuxedo Avenue, Winnipeg, Manitoba, R3N 0H6. For further information phone 895-5333.

A P P E N D I X C

LIST OF EXHIBITS

LIST OF EXHIBITS

1. "Report on a proposal Concerning Surface Water Quality Objectives and Stream Classification for the Province of Manitoba", The Clean Environment Commission, Revised Edition May 1979.

2. "Proposed Classification of Manitoba's Surface Water Grass-Burntwood Rivers Principal Watershed Division", June 1981, as prepared by the Environmental Management Division, Department of Consumer and Corporate Affairs and Environment in collaboration with Water Resources, Parks, Fish & Wildlife Branches of the Department of Natural Resources and Oepartments of Agriculture, Health, Municipal Affairs.

3. Presentation to The Clean Environment Commission by the Mining Association of Manitoba Inc., "Investigation and Classification of the Grass and Burntwood Rivers Drainage Basin - Surface Water".

4. Map indicating mining and mineral occurrences in the Grass River Provincial Park area.

5. Presentation to The Clean Environment Commission on behalf of the Nelson House Indian Band.

6. Letter from Mr. W. Barbaza, Director of Tourist Development of September 11, 1981.

7. Brief from Manitoba Hydro.

8. Information Pamphlet - Grass River Provincial Park Master Plan Study.

A P P E N D I X D

PROPOSED CLASSIFICATION OF MANITOBA'S SURFACE WATER

GRASS-BURNTWOOD RIVERS PRINCIPAL WATERSHED DIVISION

Prepared by Environmental Management Division,
Department of Consumer and Corporate Affairs and Environment
in collaboration with
Water Resources, Parks, Fisheries, & Wildlife Branches of
the Department of Natural Resources and Departments of
Agriculture, Health, Municipal Affairs

June 1981
Revised February, 1982

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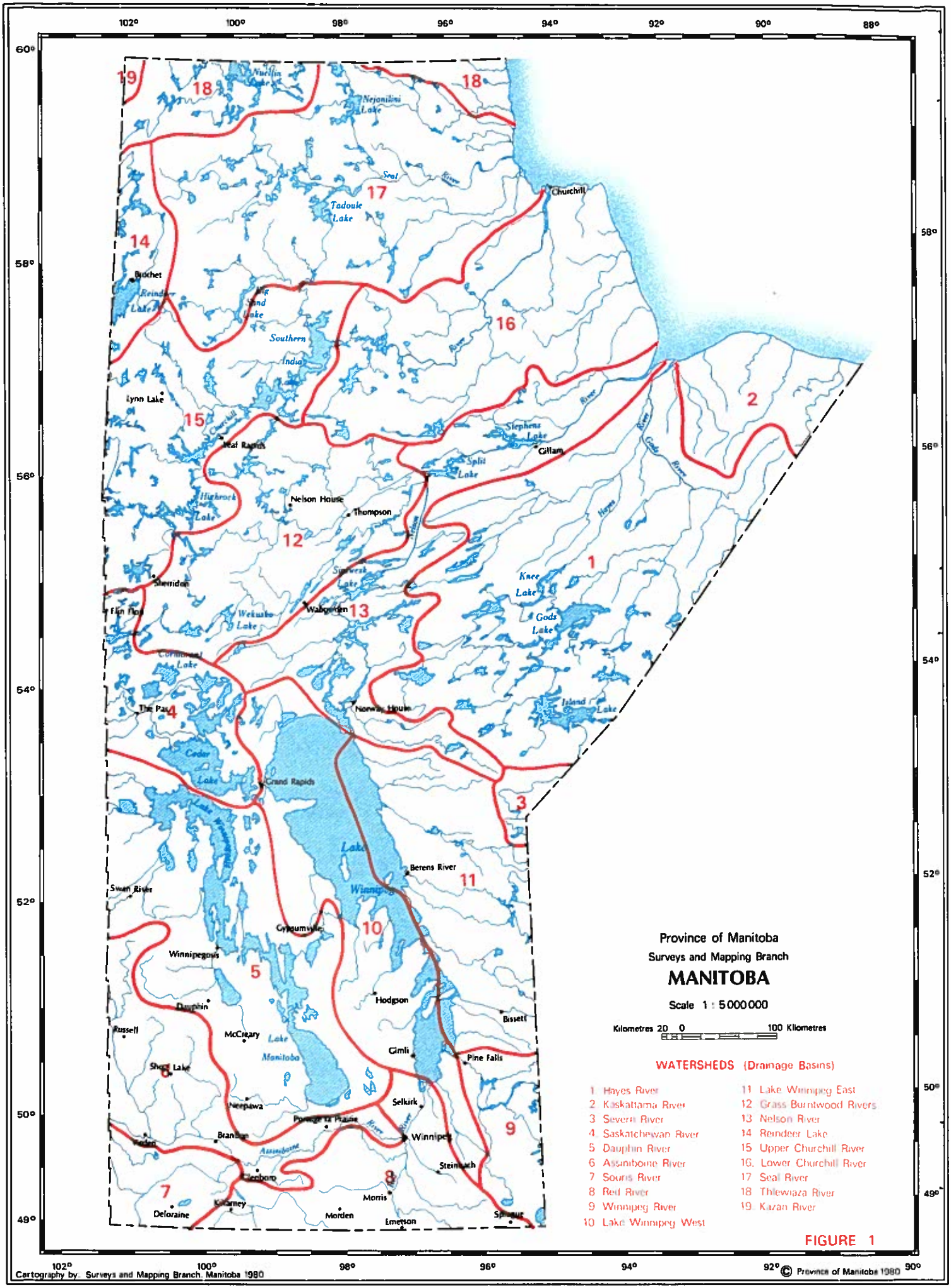
PROPOSED CLASSIFICATION OF MANITOBA'S SURFACE WATER

GRASS-BURNTWOOD RIVERS

1.0 INTRODUCTION

This report is prepared for presentation to the Clean Environment Commission as a follow-up of the Commission's "Report on a Proposal Concerning Surface Water Quality Objectives and Stream Classification for the Province of Manitoba, May 4, 1978."(1) The report, which was approved by the Minister of Mines, Natural Resources and Environment on December 19, 1978, subdivided the province into 19 watersheds, the Grass-Burntwood Rivers system being designated as drainage basin number twelve (Figure 1). The background information and recommendations for specific water quality objectives has been compiled by an interdepartmental committee. This report is prepared as a basis for discussion at public hearings and for consideration by the Clean Environment Commission.



1.1 GENERAL DESCRIPTION

The Grass-Burntwood Rivers grouping, contained totally within Manitoba, contributes drainage to the north-west portion of the Nelson River principal watershed division.

The area under study is shown in Figure 2. The divisions of the study area and their percentage contribution to the grouping are listed in Table 1.(2)

The region transects two major geological blocks, the northern Churchill Block and the southern Superior Block. Underlain with Precambrian rock, predominantly granite and granitic gneisses, the area also includes several pockets of sedimentary rocks mainly greywacke and quartzite.(3)

Surface deposits mainly lacustrine in origin, were derived from streams flowing into glacial Lake Agassiz. Clays and silts, with bog and rock outcrops, occupy the central region with the periphery composed mainly of glacial drift, predominantly granitic materials. Approximately twenty-five percent of the soils are well drained. Relief within the region varies between 213-274 meters above sea level.

The soils, mainly grey wooded podzol, are low in available nutrients and tend to be stony and poorly drained. A very small portion of the region is suitable for agriculture, its use further restricted by the limited availability of hardy crop varieties and the relatively short 70 to 90 day frost free period. Annual precipitation is approximately 44 cm with snowfall levels exceeding 110 cm during the November to April period. Temperatures vary considerably during the year and while extreme levels have been recorded they are usually of short duration. The average June temperature ranges between 9.4 to 11.7°C with the January range being -23 to -26.7°C.

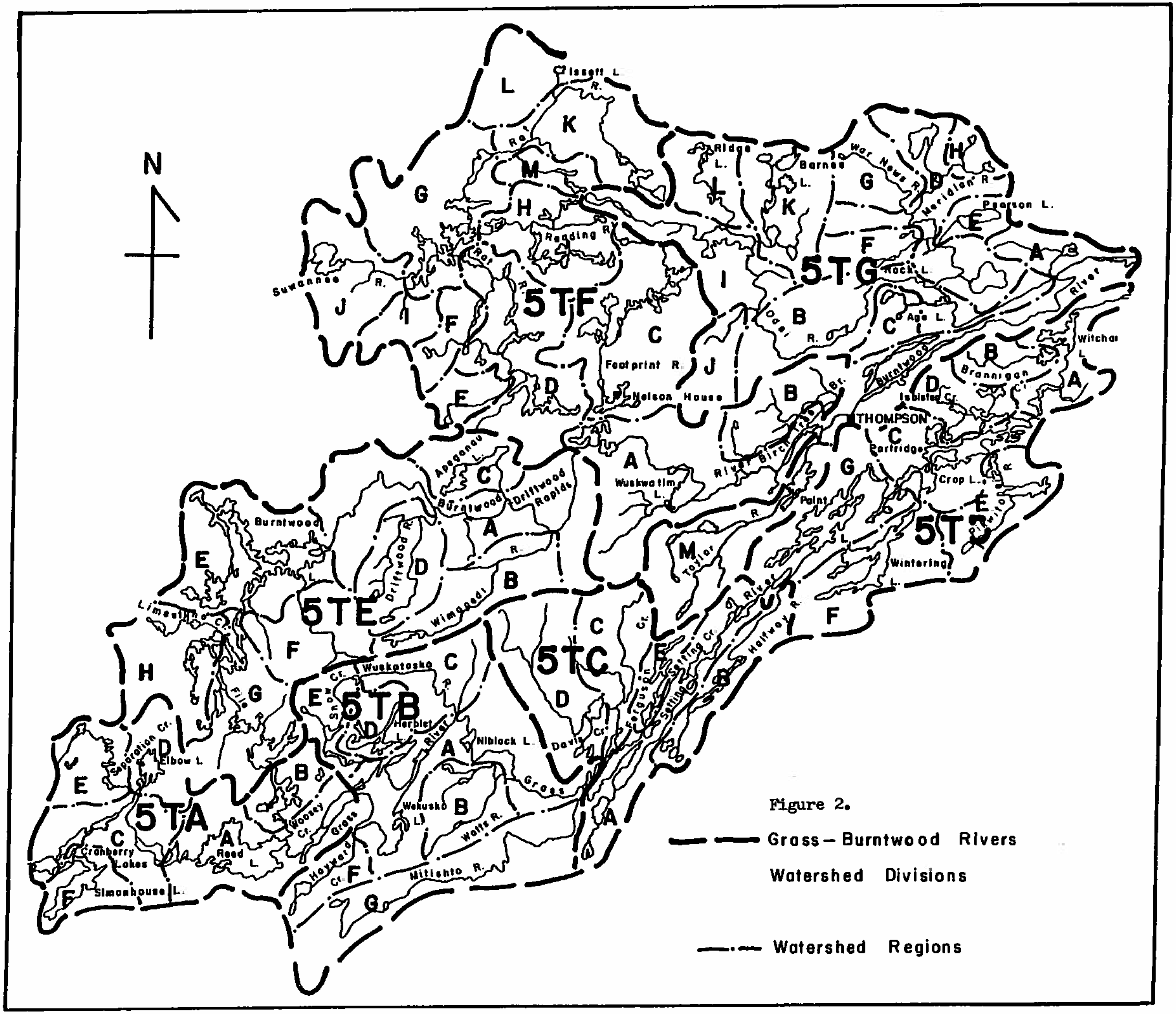

N
5TA
5TB
5TC
5TE
5TF
5TG
THOMPSON
Burntwood
Driftwood Rapids
Footprint R.
Nelson House
Wuskwatim L.
Niblock L.
Wekusko L.
Mitishto R.
Wintering L.
Witchai L.
Brannigan Cr.
Cranberry Lakes
Simonhouse L.
Elbow L.
Limestone Cr.
Suwannee R.
Issett L.
Reading R.
Pearson L.
Grass – Burntwood Rivers
Watershed Divisions
Watershed Regions

Figure 2.

The combination of poorly drained soils, cool temperatures and a short growing season are reflected in the vegetative cover. The northern coniferous forest, composed mainly of black spruce, white spruce and balsam fir is of commercial quality, however, limited utilization occurs (see Chapter 6.0).

The region originally valued for its fur production has in recent years experienced significant growth in tourism.

The major commercial resources are minerals such as gold, lead, copper, zinc, and nickel, and fishing, mainly whitefish and pickerel.

2.0 HYDROLOGY

The headwaters of the Burntwood River lie in the tributaries to Burntwood Lake over the height of land south of Flatrock Lake on the Churchill River. The Grass River starts with the Cranberry Lakes in the Grass River Provincial Park north of The Pas, Manitoba.

Prior to the operation of the Churchill River Diversion in 1977 the Burntwood River at its mouth had a mean annual runoff of about 3.629×10^9 m^3 (2,950,000 acre-feet). The diversion of water from the Churchill River into the Burntwood River system has increased the mean for 1977 and 1978 to 4.588×10^{10} m^3 (18,650,000 acre-feet). The annual volume of flow of the Grass River above Standing Stone Falls has ranged from 7.786×10^8 m^3 (633,000 acre-feet) in 1961 to 3.788×10^9 m^3 (3,080,000 acre-feet) in 1966 with a mean annual runoff approximately 2.263×10^9 m^3 (1,840,000 acre-feet) over the period of record.

Because the Burntwood River is part of the Churchill River Diversion the Burntwood River at Thompson had an unnaturally high daily maximum discharge of 980 m^3/s (34,600 cfs) in 1978. Prior to the Churchill River Diversion the highest daily discharge recorded was 580 m^3/s (20,400 cfs) in 1966. The highest recorded daily discharge at Grass River above Standing Stone Falls is 246 m^3/s (8,700 cfs) in 1966. The lowest recorded daily discharge for both rivers occurred in 1977. The Burntwood River at Thompson recorded low was 5 m^3/s (175 cfs) while at Grass River below Standing Stone Falls the recorded low was 7 m^3/s (249 cfs).

The Burntwood River is regulated by the Notigi Control Structure, which was constructed in 1975 at the south end of Notigi Lake on the Rat

River. The Notigi control is regulated to restrict maximum flows in the Burntwood River (at Thompson) to 960 m^3/s (34,000 cfs). In its Burntwood River System Environmental Overview Study Manitoba Hydro is presently examining 5 potential sites for hydro-electric generating stations, including Early Morning Rapids, Wuskwatim, Kepuche, Manasan and First Rapids. When this study concludes at the end of 1981 some of these sites may be discarded from further consideration or all may be retained for more detailed design work, depending on the study results. No man-made dams have been constructed on the Grass River.

Groundwater does not account for much of the water used in the Grass-Burntwood River systems. With the abundance of fresh water from the rivers, streams and lakes, groundwater will remain an untapped resource at least for major users in this region for the foreseeable future.

3.0 DEMOGRAPHIC ANALYSIS

Approximately 26,000 people reside within the Grass-Burntwood Rivers watershed basin. Of the major communities Thompson dominates the population accounting for over 81 percent of the total.

The communities may be divided into two main categories, traditional settlements such as Nelson House, characterized by a very young population, and resource settlements such as Thompson, characterized by a high percentage of working age males. The population of this area has been growing at an annual rate of 2.4 percent since 1971.

In general it may be said that the population of this area is younger, has a higher proportion of males, and is more rapidly increasing than the total Manitoba population.

4.0 ECONOMIC CONDITIONS

Discovery and development of natural resources has facilitated an increase in availability of wage employment to many northern residents. Educational levels of the native peoples, especially the younger generation, have been increasing and many are now taking an active role in community affairs.

Many factors affect the rate of employment or unemployment within this area, the two main factors being job location and season of employment. In some communities traditional activities such as hunting and fishing take priority over occasional wage employment. Declining renewable resources and the encroachment of industrialization and development has made it difficult to maintain an economy based solely on traditional activities. Many residents rely on a combination of traditional pursuits coupled with seasonal wage employment and transfer payments.

Agriculture plays no significant role in this area. The only crop production is carried out in the Wabowden area on the fields of a former Dominion Agricultural Experimental Substation.(4) These limited activities do not affect the watershed classification.

The mining industry and Manitoba Hydro are the major industrial employers of the area. This concentration of employment into two major fields exposes the work force to dramatic fluctuation in employment dependent upon the current price and demand for minerals and electrical power. The high salaries paid by the industrial employers only partially offset the high cost of northern living. Food, fuel and accommodations tend to be 10-41% higher in the north than in the south.

5.0 FISHERIES

The Grass-Burntwood River System is a major fish resource area for the Northwest Region of Manitoba. The Grass River portion of this system includes lakes shown in Table 2. The Burntwood River portion includes lakes shown in Table 3. These lakes do not comprise an all-inclusive list of waterbodies along the Grass and Burntwood Rivers. They do, however, show the lakes currently utilized to any large degree by commercial or recreational fishermen. Adequate amounts of information on all the lakes and tributaries of the Grass-Burntwood system is not available. Many of the unnamed, small lakes and creeks play a significant role in the life cycle of fish present in the system, acting as spawning/nursery areas during spring and fall fish migrations. It would be impossible to identify all the critical habitat areas individually. Because of the paucity of information available and the heterogenous nature of the fish resource present, the maintenance of the system as a whole at its present level of water quality is essential if the fishery resource is to be adequately protected.

The commercial quotas and main fish species for the headwater areas of the Grass-Burntwood river system are listed in Tables 2 and 3.

The angler harvest of fish from the system is unknown. A 1979 creel census survey on Reed Lake alone revealed approximately 25,000 kilograms (55,000 pounds) were harvested by anglers. The Grass-Burntwood river system provides a diverse, high quality fishing experience for anglers. The few areas such as Reed, 2nd Cranberry and File Lakes where lake trout occur have recorded depths between 35 and 55 meters.

The Grass-Burntwood system is a productive watershed in terms of a fisheries resource, from both a commercial and recreational point of view. Excellent water quality largely accounts for this productivity.

Present recreational, commercial or industrial use of the Grass-Burntwood System in the western part of the drainage basin is such that minimal, if any, fishery habitat deterioration is occurring. A Federal Fisheries research station is located on Heming Lake (Separation Creek region). Both Heming Lake and Wapun Lake have been set aside as "experimental waters" and no commercial or recreational fishery is permitted on these lakes. Research work has also been carried out by Federal Fisheries on Demarch and Quigley Lakes in the Separation Creek chain. Recent forestry developments along Limestone Creek have opened up new, formerly remote areas. Forest harvesting has resulted in some alteration of Limestone Creek shoreline from its natural state.

The diversity and abundance of cool and warm water species suggests a high level of water quality which should be maintained if recreational use is to continue as a high priority in the Grass-Burntwood river system.

5.1 GRASS RIVER SYSTEM

Several areas above Setting Lake in the Grass River and associated lakes have previously been identified as sensitive areas deserving of protection.(5) Lake trout are found in Reed and 2nd Cranberry Lakes in this area. Lakes range upward to 52 meters in depth.

From the Setting Lake Region and on, the lakes along the Grass River are typical shield lakes, an abundance of islands and rock outcrop shorelines being the main features. Fish production is high on these lakes and the abundance of spawning and nursery areas have allowed this. The lakes are no deeper than 18 meters, averaging between 3 and 6 meters deep. Game species present are: pike, walleye, sauger, and perch. Commercial species are in order of importance: whitefish, walleye, pike and tullibee. Other species present are: burbot, white suckers, long nose suckers, shorthead redhorse suckers. Natural trout are not present. Paint Lake, Setting Lake, the Grass River and tributaries in between these lakes are very important angling waters in this area. In addition, there are a dozen lakes that are commercially fished on a regular basis. The value of the fisheries resource in this drainage is extremely high.

5.2 BURNTWOOD RIVER SYSTEM

The Rat-Burntwood Lakes are not typical of other shield lakes for two reasons: (i) These lakes are located on a thick overburden of glacio-lacustrine clays left from glacial Lake Agassiz. As a result these lakes have high nutrient loads from weathering of these clays and the shorelines are more regular due to the fact that the bedrock is covered by overburden. (ii) The lakes along the Rat-Burntwood are flooded. A control structure at Notigi has led to the formation of the Rat-Notigi reservoir. However, even downstream of the Notigi control structure, water levels have been rising; e.g., Wapisu more than 4 meters, Threepoint close to 5 meters, Footprint more than 3 meters, and Wuskwatim 4 meters. The cause of this flooding is that the outflow of Southern Indian Lake has been re-routed from the Churchill River into the Rat-Burntwood system. The flow throughout the Rat-Burntwood diversion route has been increased approximately tenfold, to increase the flow in the Nelson River for purposes of Hydro generation.

The Rat-Burntwood Lakes support good populations of walleye, whitefish and pike as well as other "rough fish" species such as tullibee, suckers, burbot, and mooneye. Burntwood Lake near the headwaters is an excellent walleye lake and Hassett and File Lakes offer good angling for lake trout. At the lower end of the Burntwood, sheepshead, carp and sauger are also found. There have been some reports of sturgeon being taken years ago on the Burntwood River. Only the lower portion of the Odei supports any significant fish populations. The upper portion has mainly small pike along with large quantities of "rough fish."

There is a concern over growing evidence of increased mercury levels in fish from the Rat-Burntwood part of this system.

6.0 FORESTRY

Most of the land area of the Grass-Burntwood Watershed is covered by boreal forest. Forest stands are of primary importance to any watershed as they influence the water regime according to their water retention capacity, soil moisture conservation, and evapotranspiration rates.

The Grass Burntwood watershed encompasses all or most of forestry management units 83 to 88 and smaller parts of four additional units. The total merchantable volume of the units 83 to 88 was estimated at 2043 million cubic feet, with potential allowable cut of 25 million cubic feet annually. (6)

Intensive timber production activities have a potential of influencing water quality in various ways (increased sediment load, turbidity, nutrient transfer etc.) generally leading to acceleration of the eutrophication process. However, no studies were carried out under the Northern Manitoba conditions. The effects of cutting within this watershed would probably be less pronounced owing to the flat terrain which is less susceptible to erosion.

Commercial scale lumber cutting is carried out by Manfor (Manitoba Forestry Resources Ltd). The 1977-1982 development plan calls for cutting of approximately 9 million cubic feet.(7) Ongoing operations located in the Wekusko and Setting Lake Divisions have not caused any controversy regarding water quality effects to date.

7.0 TRAPPING INDUSTRY

Streams and lakes provide habitat for aquatic furbearers and serve the trappers as main access routes. The Grass-Burntwood watershed contains all or most of six Registered Trapline Sections, and parts of four additional sections. The total value of muskrat, beaver, otter, and mink furs taken during the 1978-1979 trapping season was over 417 thousand dollars.(8)

Effects of changes in water quality on these mammals are largely unknown. Otter shows some preference for cleaner waters, but all four species do occur in streams and lakes of various trophic levels and have adapted to a wide range of different habitats. They may be affected by toxic materials induced into the water. Unfortunately it is unknown what levels of which toxics constitute hazard to these furbearers. At present the well-being of wildlife does not appear to be a restrictive consideration with regard to classification of waters within this watershed.

8.0 RECREATION

The Grass-Burntwood Watershed presents diverse recreational opportunities. These water systems serve not only residents of Thompson, Wabowden and Snow Lake, but a great majority of tourists who visit Northern Manitoba.

There are four major Provincial Parks found along the Grass River system - Grass River Provincial Natural Park, Wekusko Falls Provincial Recreation Park, Pisew Falls Provincial Heritage Park and Paint Lake Provincial Recreation Park. These and other smaller park sites, provide seven campgrounds and more than ten wayside and water access sites. There are nine lodge and tourist outfitting operations and 320 cottages also located along the Grass River system. Over the past several years, facilities on the Grass River have attracted annually over 1,300 camper use days as well as many day users.

While the Grass River is a well noted and historic canoe route, users also enjoy fishing, power boating, sailing, swimming, camping, picnicing and hunting as it is one of the most easily accessible waterways in Manitoba still able to provide a wilderness experience.

The recreational benefits and opportunities associated with the Grass River are dependent upon the quality of the natural environment. Present and future recreational use and the economic benefits associated with tourism can only be sustained if the natural qualities and features which attract visitors are maintained. And as indicated by the Natural Park and Heritage Park designations along its route, much of the Grass River has

been dedicated to achieve this purpose.

The Burntwood River has much less recreational use. Over most of its course the river is not easily accessible and recreational use of the accessible portions is hampered at times by floating debris and water level fluctuations.

Objectives of water quality control for the Grass-Burntwood River system should reflect the requirements of the recreational uses: specifically to maintain the quality at or above the level required for the most demanding form of water recreation, albeit not as restrictive on the Burntwood River as on Grass River portion of the watershed.

9.0 WATER SUPPLY

Several communities and a number of mines depend on the lakes and streams of the area for their water supply. The treatment which this water receives differs from place to place (Table 4). Table 4 shows the bodies of water utilised by the municipal public water systems and shows the estimated consumption (actual measured 1977 consumption in case of the City of Thompson).

The sources of industrial water supply are shown in Table 5, the actual consumption by the industrial users is not known.

10.0 WASTEWATER SYSTEMS

Active industrial facilities discharging waste water into this watershed are listed in Table 5, which are operated by INCO and HBM&S companies, and operate mostly under existing Clean Environment Commission orders. Table 6 gives also the yearly volume of the discharges.

There are eleven domestic sewage facilities within the area, which are shown in Table 6. The facilities at the communities of Wabowden and Nelson House, the school at Thicket Portage, and the Provincial Park at Paint Lake presently produce an effluent which can be considered of a secondary treatment quality. Snow Lake is serviced by 2 plants; one is a primary treatment plant. This effluent prior to discharge to a nearby swamp is chlorinated. The effluent returns to Snow Lake above the water intake. Tests conducted at the water intake have shown no public health implications insofar as the water supply is concerned. Another portion of the townsite is serviced by means of a chlorinated secondary sewage treatment plant. Effluent is also returned to Snow Lake. The City of Thompson is serviced principally by a primary sewage treatment plant which discharges chlorinate effluent to the Burntwood River. A portion of the south end of the city is serviced by a secondary sewage treatment plant which discharges to the Burntwood River via Thompson Lake. This effluent is also chlorinated.

11.0 WATER USE CLASSIFICATION PROPOSALS

The Grass-Burntwood watershed classification has been based on existing and potential uses according to Water Quality Objectives, Province of Manitoba.[1] These objectives were defined for the following designated water uses.

1. Domestic Consumption
2. Fisheries and Recreation
3. Industrial Consumption
4. Agriculture and Wildlife
5. Navigation and Waste Disposal
6. Other uses

Proposed classification is based upon acceptable quality for the end use. Waters of existing quality superior to any specific uses may be subject to a non-degradation objective. The objective for such waters will be to maintain the existing high quality.

Because of the excellent water quality of the Grass River in the Upper Division and the Burntwood River in the Upper Division a non degradation objective is proposed. It is recognized that the remaining divisions of the Grass River Basin have a high quality water. It is proposed that they be classified Domestic Consumption B, Fisheries and Recreation A, Industrial Consumption A, Agriculture and Wildlife C, and Navigation and Waste Disposal. This combination is designated as Specific Objective D, for brevity.

Burntwood River Lower and Nelson House divisions of the Burntwood River Basin are proposed to be classified Domestic Consumption C, Fisheries and Recreation B, Industrial Consumption B, Agriculture C, and Navigation

and Waste Disposal (Specific Objective E for short). The proposed classification recognizes present conditions and uses of this basin.

Table 7 presents an overview of the proposed classification. The specific objectives by water quality parameter are listed in Table 8. Table 8 values conform to the Manitoba Water Quality Objectives referred to above. (1)

12.0 WATER QUALITY DATA

Table 9 presents a compilation of provincial water quality monitoring network data within the basin, and Table 10 presents a parameter comparison to the proposed objectives. The full record of available data was used in preparation of this proposal. The data are stored in the computer of Manitoba Data Services. In addition, data collected by the Federal Water Quality Branch at 6 stations were used (NAQUADAT file).[9]

The use and quality of water in the Grass-Burntwood drainage basin conform to the proposed objectives in almost all parameters.

REFERENCES

(1) Clean Environment Commission 1979. Report on a proposal concerning surface water quality objectives and stream classification for the Province of Manitoba. Revised edition May 1979. 50pp.

(2) Fedoruk, A.N. 1970. Proposed watershed divisions of Manitoba. Manitoba Dept. Mines and Natural Resources. Canada Land Inventory Rep. 10. 89pp.

(3) Weir, T.R. 1960. Economic Atlas of Manitoba. Manitoba Dept. Industry and Commerce, Winnipeg.

(4) Teillet, D.J. 1979. A resource information package for Mid North Manitoba. Canada Dept. Regional Econ. Expansion, Manitoba Department Mines and Natural Resources, Environment Info. Rep. 79-1.

(5) Personal communiqué from Fisheries Branch to Inter-Departmental Planning Board Task Force on Shoreline Reserves.

(6) Forestry Working Team 1975. The Forests of Manitoba (1974). Manitoba Dept. Mines Nat. Resour. Environ. Manage. Winnipeg, 352pp.

(7) Rannard, D.C., Manitoba Dept. Natural Resources, Personal communication.

(8) Manitoba Dept. Natural Resources, Wildlife Branch records.

(9) Environment Canada 1978. Water Quality Data Manitoba 1961-1976. Inland Waters Directorate, Ottawa.

TABLE 1: Divisions of the Grass River, Burntwood River Principal Watershed: Identification and Approximate Surface Area in km^2 (sq. mi.).

REGIONS	IDENTIFICATION	APPROXIMATE MANITOBA AREA	PER CENT OF BASIN	PER CENT OF WATERSHED
Reed Lake Region	5TA-A	966 (373)	6.3	2.4
Woosey Creek	5TA-B	394 (152)	2.6	1.0
Cranberry Lakes Region	5TA-C	723 (279)	4.7	1.8
Elbow Lake	5TA-D	394 (152)	2.6	1.0
Separation Creek	5TA-E	368 (142)	2.4	0.9
Simonhouse Lake	5TA-F	350 (135)	2.3	0.8
TOTAL: GRASS RIVER UPPER DIVISION	5TA/A-F	3193(1233)	20.7	7.9
Niblock Lake Region	5TB-A	1474 (569)	9.6	3.6
Watts River	5TB-B	477 (184)	3.1	1.2
Wuskatasko River	5TB-C	426 (203)	3.4	1.3
Herblet Lake	5TB-D	319 (123)	2.1	0.8
Snow Creek	5TB-E	324 (125)	2.1	0.8
Hayward Creek	5TB-F	269 (104)	1.7	0.7
Mitishto River	5TB-G	1380 (533)	9.0	3.4
TOTAL: WEKUSKO LAKE DIVISON	5TB/A-G	4768(1841)	30.9	11.8
Setting Lake Region	5TC-A	772 (298)	5.0	1.9
Halfway River	5TC-B	482 (186)	3.1	1.2
Ferguson Creek	5TC-C	723 (279)	4.7	1.8
Davis Creek	5TC-D	855 (330)	5.5	2.1
Setting Creek	5TC-E	238 (92)	1.5	0.6
TOTAL: SETTING LAKE DIVISION	5TC/A-E	3069(1185)	19.9	7.6
Witchai Lake Region	5TD-A	526 (203)	3.4	1.3
Brannigan Creek	5TD-B	256 (99)	1.7	0.7
Partridge Crop Lake Region	5TD-C	697 (269)	4.5	1.7
Isbister Creek	5TD-D	394 (152)	2.6	1.0
Pikwitonei Creek	5TD-E	515 (199)	3.3	1.3
Wintering Lake	5TD-F	1059 (409)	6.9	2.6
Paint Lake Region	5TD-G	935 (361)	6.1	2.3
TOTAL: GRASS RIVER LOWER DIVISION	5TD/A-G	4382(1692)	28.4	10.9
TOTAL: GRASS RIVER BASIN	5TA/5TD	15413(5951)	100.0	38.4

TABLE 1 (cont'd): Divisions of the Grass River, Burntwood River Principal Watershed: Identification and Approximate Surface Area in km^2 (sq. mi.).

REGIONS	IDENTIFICATION	APPROXIMATE MANITOBA AREA	PER CENT OF BASIN	PER CENT OF WATERSHE
Driftwood Rapids Region	5TE-A	1580 (610)	6.4	3.9
Wimapedi River	5TE-B	728 (281)	2.9	1.3
Apeganau Lake	5TE-C	412 (159)	1.7	1.0
Driftwood River	5TE-D	648 (250)	2.6	1.6
Burntwood Lake Region	5TE-E	992 (383)	4.0	2.5
Burntwood Lake Tributary 'A'	5TE-F	730 (282)	3.0	1.8
File River	5TE-G	1096 (423)	4.4	2.7
Limestone Creek	5TE-H	702 (271)	2.8	1.8
TOTAL BURNTWCOD RIVER UPPER DIVISION	5TE/A-H	6887(2659)	27.8	17.1
Wuskwatim Lake Region	5TF-A	1518 (586)	6.1	3.8
Birch Tree Brook	5TF-B	505 (195)	2.0	1.2
Footprint River	5TF-C	1326 (512)	5.4	3.3
Rat River Lower Region	5TF-D	1251 (483)	5.1	3.1
Rat River Tributary 'A'	5TF-E	264 (102)	1.1	0.7
Rat River Tributary 'B'	5TF-F	350 (135)	1.4	0.9
Rat River Middle Region	5TF-G	1225 (473)	4.9	3.0
Reading River	5TF-H	673 (260)	2.7	1.7
Rat River Tributary 'C'	5TF-I	241 (93)	1.0	0.6
Suwannee River	5TF-J	619 (239)	2.5	1.5
Rat River Upper Region	5TF-K	966 (373)	3.9	2.4
Issett Lake	5TF-L	466 (180)	1.9	1.2
Rat River Tributary 'D'	5TF-M	171 (66)	0.7	0.4
TOTAL: NELSON HOUSE DIVISION	5TF/A-M	9575(3697)	38.7	23.8
Burntwood River Lower Region	5TG-A	1124 (434)	4.5	2.8
Odei River Lower Region	5TG-B	1070 (413)	4.3	2.7
Age Lake	5TG-C	295 (114)	1.2	0.7
Meridian River	5TG-D	1085 (419)	4.4	2.7
Pearson Lake	5TG-E	137 (53)	0.5	0.3
Rock Lake	5TG-F	220 (85)	0.9	0.6
War News River	5TG-G	394 (152)	1.6	1.0
Meridian River Tributary 'A'	5TG-H	215 (83)	0.9	0.5
Odei River Upper Region	5TG-I	816 (315)	3.3	2.0
Odei River Tributary 'A'	5TG-J	622 (240)	2.5	1.6
Barnes Lake	5TG-K	624 (241)	2.5	1.6
Ridge Lake	5TG-L	487 (188)	2.0	1.2
Taylor River	5TG-M	1204 (465)	4.9	3.0
TOTAL BURNTWOOD RIVER LOWER DIVISION	5TG/A-M	8293(3202)	33.5	20.7
TOTAL: BURNTWOOD RIVER BASIN	5TE/5TG	24755(9558)	100.0	61.6
TOTAL: GRASS RIVER/BURNTWOOD RIVER WATERSHED	5T	40168(15509)	—	100.0

Table 2. Lakes important to fisheries - Grass River drainage basin.

Division Identification	Name	Commercial Quota (kg)	Main Fish Species[1]
5TA-A	Loucks		Pi,Wa,Wh,Ci,WS
	Reed		Pi,Wa,LT,P,Wh,Ci,B,WS,LNS
	Tramping		Pi,Wa,LT,P,Wh,Ci,B,WS,LNS
	Sewell		Pi,Wa,WS
	Krug		Pi,Wa,WS
5TA-B	Woosey	7300	Pi,Wa,P,Wh,Ci,WS
	Morgan		Pi,Wa,P,Wh,Ci,WS
	Halfway		Pi,Wa,WS
5TA-C	First Cranberry		Pi,Wa,P,Wh,Ci,WS
	Second Cranberry		Pi,Wa,LT,Wh,Ci,B,WS,LNS
	Third Cranberry		Pi,Wa,P,LT,Wh,Ci,B,WS
	Brunne	4600	Pi,Wa,P,Wh,Ci,WS
	Otaskawetawin		Pi,Wa,P,Wh,Ci,WS
	Wedge	2300	Pi,Wa,P,Wh,Ci,WS
	Anvil		Pi,Wa,Wh,Ci,WS
	BC	2300	Pi,Wa,Wh,Ci,WS
	Barb		Pi,WS
	Iskwasum		Pi,Wa,Wh,Ci,WS
	Amphipod		Small trout
5TA-D	Elbow		Pi,Wa,Wh,Ci,WS
	Claw		Pi,Wa,Wh,Ci,WS
	Webb		Pi,Wa,WS
5TA-F	Simonhouse		Pi,Wa,Wh,Ci,WS
	Election	2300	Pi,Wh,Ci,WS
	Webster		Stock trout
5TB-A	Wekusko	65800	Pi,Wa,Sa,P,B,Wh,Ci,WS,LNS
	Kormans		Stock trout
5TB-D	Herblet	11400	Pi,P,Wh,Ci,WS
	Wolverton		Pi,WS
5TB-E	MacLeod		Pi,Wa,Wh,Ci,WS
	Squall		Pi,Wa,Wh,Ci,WS
	Snow		Pi,Wa,Wh,Ci,WS
5TC-A	Setting	22680	Wh,Wa,Pi,WS,LNS
	Pakwa	13608	Wh,Wa,Pi
	Phillips		Wa
	Kiski		Wa,Pi,P,WS,LNS
	Fish		
5TC-B	Halfway	13608	Wh,Pi

Table 2 (continued)

Division Identification	Name	Commercial Quota (kg)	Main Fish Species[1]
5TD-A	Witchai	9072	Wh,Wa,Pi
5TD-B	Brannigan	4536	P,Wh,Wa
5TD-C	Partridge Crop Natawahunan	13608	Wh,Wa,Pi
5TD-D	Buckingham Isbister	2268 2268	Wa
5TD-E	Pikwitonei	6804	Wh,Wa,Pi
5TD-F	Wintering	22680	Wh,Wa,Pi
5TD-G	Paint	6804	Wh,Wa,Pi
5TD-H	Mid		Stocked trout

[1] SPECIES KEY:

Pi	- Pike	Ci	- Cisco
Wa	- Walleye	WS	- White sucker
P	- Perch	LT	- Lake trout
Wh	- Whitefish	B	- Burbot
Sa	- Sauger	LNS	- Longnose sucker

Table 3. Lakes important to fisheries - Burntwood River drainage basin.

Division Identification	Name	Commercial Quota (kg)	Main Fish Species(1)
5TE-B	Wimapedi		
5TE-C	Apeganau	6804	Wa,Pi
5TE-E	Burntwood	29500	Pi,Wa,Wh,Ci,WS
	Takipy	4600	Pi,Wa,Wh,Ci,WS
	Hassett		Pi,LT,Wh,Ci,WS
	Guthrie	13700	Pi,Wa,Wh,Ci,WS
5TE-G	Limestone Point	11400	Pi,Wa,P,Wh,Ci,WS
	Batty	6900	Pi,Wa,P,Wh,Ci,WS
	Moody	2800	Pi,Wa,Wh,Ci,WS
	Loonhead	4600	Pi,Wa,Wh,Ci,WS
	File		Pi,Wa,LT,P,Wh,Ci,WS,LNS
	Morton		Pi,Wa,P,Wh,Ci,WS
	Dow (Muddy)	2800	Pi,Wa,Wh,Ci,WS
	Corley		Pi,Wa,WS
	Norris		Pi,Wa,WS
5TE-H	Walton	2300	Pi,Wa,WS
	Star		Pi,Wa,WS
	Nokomis		Pi,Wa,WS
	South Nokomis		Pi,Wa,WS
	Hutchinson		Pi,Wa,WS
5TF-A	Wuskwatim	18144	Wh,Wa,Pi
5TF-C	Footprint		
	Leftrook		
5TF-D	Wapisu	13608	
	Notigi	4536	Wh,Wa,Pi
5TF-G	Rat	20412	Wh,Wa,Pi
	Karsakuwigamak		
	Pemichigamau		
5TF-H	Mynarski East & West	11340	Wh,Wa,Pi
5TF-I	Suwannee	4536	Wh,Wa
	Costello		
	Issett		
5TG-C	Age		Pi,WS,LNS

Table 3 (continued)

Division Identification	Name	Commercial Quota (kg)	Main Fish Species[1]
5TG-D	Orr		Wh,Pi,WS,LNS
	Troy		Pi
5TG-J	Odei River		Stocked trout
5TG-M	Ospawagan Upper		LT,Splake(stocked)
	Ospawagan Lower		Wa,Pi
	Tullibee)	experimental	
	Goldeye	(1977) 2268	Wa,Pi

[1] For Species Key see Table 2.

TABLE 4. Municipal Public Water Systems in the Grass/Burntwood Principal Watershed.

Location	Raw Water Source	Treatment	1979 Water* Consumption ($m^3 \times 10^3$)
Nelson House	Footprint Lake	Filtration, Iron Removal, Taste/Odour Control, Chlorination	0.3
Pikwitonei	Pikwitonei River	Filtration, Chlorination	0.2
Snow Lake	Snow Lake	Chlorination	636.4
Thompson	Burntwood River	Coagulation, Sedimentation, Filtration, Chlorination	3280.9
Wabowden	Bowden Lake	Filtration, Chlorination	71.6

* Estimates, except Thompson which is a 1977 figure.

Table 5. Active Industrial Facilities

Operation	Water Use: Purpose	Water Use: Source	Water Use: Treatment	Discharged Liquid Waste Water: Category	Volume/Year m^3	Receiving Water Body	Type of Discharge & Comments
INCO							
Thompson Complex	-Domestic	Burntwood R.	-Coagulation -Sedimentation -Filtration -Chlorination	-Sewage Effluent	63,500,000	Burntwood R.	- Continuous Discharge (Thompson and Tailing Basin effluent)
	-Process H_2O -Cooling H_2O	Burntwood R.	None	-Tailings Slurry Decant -Minewater -Slag H_2O -Cooling H_2O			
Pipe Mine #2	-Domestic -Minewater -Cooling H_2O	Taylor R.	-Filtration -Chlorination	-Sewage Effluent -Minewater -Cooling H_2O	678,000	Kipper L.	- Continuous Discharge
H.B.M. & S.							
Chisel L. Mine Ghost L. Mine	-Domestic -Cooling H_2O -Minewater	Ghost Lake	-Chlorination	-Sewage Effluent -Cooling H_2O	?		
				-Minewater	226,000	Morgan L.	- Continuous Discharge
Stall L. Mine Stall L. Concentrator Anderson Mine	-Domestic -Minewater -Process H_2O -Cooling H_2O	Snow Lake	-Chlorination	-Sewage Effluent -Tailings Slurry Decant -Minewater -Cooling H_2O	-	Wekusko L.	- Designed for intermittent disch from Anderson Lake Reservoir by periodic drawdown.
Osborne L. Mine	-Domestic -Cooling H_2O -Minewater	Snow Lake Adjacent Natural Reservoir	-Chlorination -Chlorination	-Sewage Effluent -Cooling H_2O	?		
				-Minewater	73,000	Osborne L.	- Continuous Discharge
Spruce Point Mine	-Domestic -Cooling H_2O -Development H_2O	Reed Lake	-Chlorination	-Sewage Effluent -Cooling H_2O -Development H_2O	?	Undetermined as yet	- Continuous Discharge - Mine is presently under develop

Table 6. Domestic Waste Effluent Inventory of the Grass–Burntwood Rivers Drainage Basin.

Discharger	Type of Facility	Receiving Water Body	Hydraulic Loading (m^3/yr x 10^3)	Bacti Quality Total Coliforms	Organic Load Kg. BOD/yr	Comments
Snow Lake	Imhoff Tank	Snow Lake	558	150,000+	29,016	Continuous Discharge
Snow Lake	Extended Aeration	Snow Lake	222	150,000+	14,635	Continuous Discharge
Wabowden	Lagoon	Rock Island Lake	63	<240	567	Fall discharge – Plus overflow
Sasagiu Rapid Lodge	R.B.C.*	Grass River	4.5	82,000	248	Continuous Discharge
Thicket Portage	Lagoon	Wintering Lake	3.8	<240	19	Discharge once/year
Thompson	Primary Plant	Burntwood River	1,046	150,000+	75,331	Continuous Discharge
Thompson	Aerated Lagoon	Burntwood River	965	150,000+	12,555	Continuous Discharge
Nelson House	Extended aeration –Chlorination	Foot print Lake	41.4	<400	—	Continuous Discharge
Birchtree Mine	Lagoon	Thompson Lake	–	–	–	Not in use
South Soab Mine	Lagoon	Soab Creek	–	–	–	Not in use
Paint Lake	Extended Aeration with holding pond	Liz Lake	6.77	less than 240	–	

*Rotating Biological Contactor

Table 7. Proposed classification of the Grass-Burntwood Rivers Drainage Basin (by division).

Division	Identification	Proposed Classification	Specific Objective[1]
Grass River Upper	5TA/A-F	Non-degradation	ND
Wekusko Lake	5TB/A-G	1B,2A,3A,4C,5	D
Setting Lake	5TC/A-E	1B,2A,3A,4C,5	D
Grass River Lower	5TD/A-G	1B,2A,3A,4C,5	D
Burntwood River Upper	5TE/A-H	Non-degradation	ND
Nelson House	5TF/A-M	1C,2B,3B,4C,5	E
Burntwood River Lower	5TG/A-M	1C,2B,3B,4C,5	E

(1) As in Table 8.

Table 8. Interim Water Quality Objectives [1]

Parameter	Units	Specific Objective D	Specific Objective E
Aluminum (Al)	mg/L	5.0	5.0
Ammonia (N)	mg/L	0.02	0.02
Arsenic (As) Total	mg/L	0.01	0.01
Barium (Ba)	mg/L	1.0	1.0
Beryllium (Be)	mg/L	-	-
Boron (B)	mg/L	5.0	5.0
Cadmium (Cd)	mg/L	(K)	(K)
Chloride (Cl)	mg/L	50	100
Chlorine (Cl_2)	mg/L	0.01	0.01
Chromium (Cr + 6)	mg/L	0.05	0.05
Chromium, Total (Cr)	mg/L	1.0	1.0
Cobalt (Co)	mg/L	1.0	1.0
Colour True Units	mg/L	15	15
Copper (Cu)	mg/L	0.02(L)	0.02(L)
Cyanide (CN)	mg/L	0.005	0.005
Detergents & Saponates	mg/L	-	-
Dissolved oxygen	% sat'n mg/L	60 or over(M)	47 or over(M)
Faecal Coliform Organisms	counts per 100 ml	10(A)	100(C)
Fluoride (F)	mg/L	1.2	1.2
Hardness, Total ($CaCO_3$)	mg/L	50	250
Iron, Total (Fe)	mg/L	0.3	0.3
Lead (Pb)	mg/L	0.03	0.03
Lithium (Li)	mg/L	-	-

Table 8. Interim Water Quality Objectives (continued)[1]

Parameter	Units	Specific Objective D	Specific Objective E
Manganese (Mn)	mg/L	0.05	0.05
Mercury (Hg)	µg/L	0.2	0.2
Methylene Blue Active Substances (Foaming Agents) (MBAS)	mg/L	0.5	0.5
Molybdenum (Mo)	mg/L	-	-
Nickel (Ni)	mg/L	0.025	0.025
Nitrate-Nitrite (N)	mg/L	10	10
Nitrite (N)	mg/L	10	10
Pesticides (1)		As specified in Tables in Reference (1).	
Pesticides (2)			
pH		6.5-8.5	6.5-9.0
Phenol (ic compounds)	mg/L	0.001	0.001
Polychlorinated Biphenyls (PCB)	mg/L	0.000002	0.000002
Radioactive Materials		(X)	(X)
Selenium (Se)	mg/L	0.01 or (DD)	0.01 or (DD)
Silver (Ag)	mg/L	0.05 or (DD)	0.05 or (DD)
Sodium (Na)		-	-
Specific Conductance	µmhos	-	-
Sulfate (SO_4)	mg/L	250	250
Sulfide (H_2S)	mg/L	0.002	0.002
Temperature	C^o	0.5(0)	(0)1.0
Thallium (Tl)	mg/L	0.05	0.05

Table 8. Interim Water Quality Objectives (continued)[1]

Parameter	Units	Specific Objective D	Specific Objective E
Threshold Odour Number		4	4
Total Coliform Organisms	counts per 100 ml	100(Z)	500(R)
Total Dissolved Solids	mg/L	500	1000
Toxic Algae		(BB)	(BB)
Turbidity Value	JTU	5	25
Unspecified Toxic Substances		(CC)	(CC)
Uranium (U)	mg/L	(DD)	(DD)
Vanadium (V)	mg/L	0.1	0.1
Zinc (Zn)	mg/L	5 or (DD)	5 or (DD)

(1) For Footnotes explanation see Table 10.

Table 9. Provincial Water Quality Monitoring Sites Within Grass-Burntwood Rivers Watershed Division

Watershed Reference	Station	Source	Location	Period of Record	Sampling Frequency	Parameters[1] Sampled
5TA	Grass River Upper Division					
	WQ090	Reed Lake	east of Fourmile Island	1976-78	6 to 8 times per year	1 & 2
	WQ421	Reed Lake	northwest area	1979-81	6 to 8 times per year	3 in 1979, 3 & 5 in 1980, 3 & 5 & 6 in 1981
5TB	Wekusko Lake Division					
	WQ091	Wekusko Lake	near Wedge Point	1976-78	6 to 8 times per year	1 & 2
	WQ381	Wekusko Lake	near Grass River	1978-81	6 to 8 times per year	3 in 1978-79, 3 & 5 in 1980, 3 & 5 & 6 in 1981
	WQ382	Wekusko Lake	Anderson Bay	1978-81	6 to 8 times per year	3 in 1978-79, 3 & 5 in 1980, 3 & 5 & 6 in 1981
	WQ413	Herblet Lake	west end	1978-81	6 to 8 times per year	3 in 1978-79, 3 & 5 in 1980, 3 & 5 & 6 in 1981
	WQ420	Wekusko Lake	Herb Bay	1979-81	6 to 8 times per year	3 in 1979, 3 & 5 in 1980, 3 & 5 & 6 in 1981
5TC	Setting Lake Division					
	WQ092	Setting Lake	northwest area	1976-78	6 to 8 times per year	1 & 2
5TF	Nelson House Division					
	WQ050	Footprint Lake	near Nelson House	1975-81	6 to 8 times per year	1 in 1975-77, 4 in 1978-79, 4 & 5 in 1980-81
5TG	Burntwood River Lower Division					
	WQ093	Burntwood River	Thompson	1975-81	6 to 8 times per year	1 & 2 in 1975-77, 3 in 1978-79, 3 & 5 in 1980, 3 & 5 & 6 in 1981
	WQ094	Apussigamasi Lake	center	1976-81	3 to 8 times per year	1 & 2 in 1976-77, 3 in 1978-79, 3 & 5 in 1980, 3 & 5 & 6 in 1981

Table 9. Provincial Water Quality Monitoring Sites Within Grass-Burntwood Rivers Watershed Division (continued)

Watershed Reference	Station	Source	Location	Period of Record	Sampling Frequency	Parameters[1] Sampled
5TG	Burntwood River Lower Division (continued)					
	WQ362	Upper Ospwagan Lake	center	1977-81	6 to 8 times per year	1 & 2 in 1977, 3 in 1978-79, 3 & 5 in 1980, 3 & 5 & 6 in 1981
	WQ422	Apussigamasi Lake	inlet area	1979-81	3 to 8 times per year	3 in 1979-80, 3 & 5 & 6 in 1981

[1]Parameters

1 - temperature, specific conductance, total residue, filterable residue, nonfilterable residue, pH, alkalinity, cadmium, copper, lead, zinc, calcium, magnesium, hardness, manganese, iron, potassium, sodium, dissolved oxygen, total organic carbon, total inorganic carbon, colour, turbidity, fluoride, total Kjeldahl nitrogen, ammonia, nitrate-nitrite, total phosphorus, ortho phosphorus, chloride, sulphate, mercury, total coliform, fecal coliform.

2 - arsenic, nickel

3 - temperature, specific conductance, nonfilterable residue, pH, arsenic, cadmium, copper, lead, nickel, zinc, dissolved oxygen, total Kjeldahl nitrogen, nitrate-nitrite, total phosphorus, mercury, total coliform, fecal coliform.

4 - temperature, specific conductance, nonfilterable residue, pH, dissolved oxygen, total organic carbon, total inorganic carbon, total Kjeldahl nitrogen, nitrate-nitrite, total phosphorus, mercury, total coliform, fecal coliform.

5 - alkalinity, calcium, magnesium

6 - total organic carbon, total inorganic carbon.

Table 10. Water Quality Data - Grass River Upper Division (5TA)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Objective Non-Degradation	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Arsenic (As)	<0.040	0.006	ND			
Cadmium (Cd)	0.005	0.003	ND			
Chloride (Cl)	3	1	ND			
Colour True Units	60	10	ND			
Copper (Cu)	0.017	0.004	ND			
Dissolved Oxygen (% sat'n mg/L)	75	92	ND			
Faecal Coliform Organisms Counts/100 ml	14	1	ND			
Fluoride (F)	0.12	0.09	ND			
Hardness ($CaCO_3$) Total	87	78	ND			
Iron (Fe)	0.08	0.03	ND			
Lead (Pb)	0.020	0.006	ND			
Manganese (Mn)	0.02	0.01	ND			
Mercury (Hg) (µ/L)	0.02	0.01	ND			
Nickel (Ni)	0.038	0.012	ND			
Nitrate & Nitrite (N)	0.86	0.09	ND			
pH	7.0;8.6	7.8	ND			
Sulfate (SO_4)	10	5	ND			
Temperature ^oC	23.0	11.5	ND			
Total Coliform Organisms (counts/100 ml.)	23	2	ND			
Total Dissolved Solids	170	104	ND			
Turbidity (JTU)	2.30	1.20	ND			
Zinc (Zn)	<0.050	0.012	ND			

Table 10 (cont'd). Water Quality Data - Wekusko Lake Division (5TB)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective D	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Arsenic (As)	0.260	0.009	0.01	90	3A	
Cadmium (Cd)	0.006	0.003	(K)	100	2A	
Chloride (Cl)	4	2	50	100	3A	
Colour True Units	10	6	15	100	3A	
Copper (Cu)	0.020	0.004	0.02(L)	100	2A	
Cyanide (Cn)	0.06	0.01	0.005		2A	detection limit is 0.02 mg/l
Dissolved Oxygen (% sat'n mg/L)	79	95	60 or over(M)	100	2A	
Faecal Coliform Organisms Counts/100 ml	4	1	10(A)	100	1B	
Fluoride (F)	0.10	0.08	1.2	100	3A	
Hardness ($CaCO_3$) Total	121	78	50	<10	3A	
Iron (Fe)	0.15	0.06	0.3	100	1B	
Lead (Pb)	0.020	0.007	0.03	100	2A	
Manganese (Mn)	0.07	0.02	0.05	>90	3A	
Mercury (Hg) (µ/L)	0.07	0.01	0.2	100	2A	
Nickel (Ni)	0.030	0.012	0.025	>90	2A	
Nitrate & Nitrite (N)	0.76	0.09	10	100	3A	
pH	6.9,8.7	7.8	6.5-8.5	>90	2A	

Table 10. Water Quality Data - Wekusko Lake Division (5TB) (continued)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective D	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Sulfate (SO_4)	10	5	250	100	1B	
Temperature °C	24.0	12.0	(0) 0.5		2A	
Total Coliform Organisms	1450	3	100(%)	>90	1B	
Total Dissolved Solids	170	100	500	100	3A	
Turbidity (JTU)	4.0	1.67	5	100	1B	
Zinc (Zn)	0.10	0.014	5 or (DD)	100	1B	

Table 10 (cont'd). Water Quality Data - Setting Lake Division (5TC)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective D	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Arsenic (As)	<0.040	0.009	0.01	100	3A	
Cadmium (Cd)	<0.010	0.003	(K)	100	2A	
Chloride (Cl)	3	2	50	100	3A	
Colour True Units	25	17	15	62	3A	
Copper (Cu)	0.006	0.003	0.02(L)	100	2A	
Dissolved Oxygen (% sat'n mg/l)	80	92	60 or over(M)	100	2A	
Faecal Coliform Organisms Counts/100 ml	0	0	10(A)	100	1B	
Fluoride (F)	0.11	0.08	1.2	100	3A	
Hardness ($CaCO_3$) Total	92	76	50	<10	3A	
Iron (Fe)	0.22	0.07	0.3	100	3A	
Lead (Pb)	0.010	0.005	0.03	100	2A	
Manganese (Mn)	0.03	0.02	0.05	100	3A	
Mercury (Hg) (µ/L)	<0.05	0.01	0.2	100	2A	
Nickel (Ni)	0.020	0.011	0.025	100	2A	
Nitrate & Nitrite (N)	0.43	0.08	10	100	1B	
pH	7.5;8.4	7.9	6.5-8.5	100	2A	

Table 10. Water Quality Data - Setting Lake Division (5TC) (continued)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective D	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Sulfate (SO_4)	10	6	250	100	1B	
Temperature °C	20.0	10.1	0.5 (0)		2A	
Total Coliform Organisms	9	1	100(Z)	100	1B	
Total Dissolved Solids	150	110	500	100	3A	
Turbidity (JTU)	3.30	2.06	5	100	3A	
Zinc (Zn)	0.100	0.025	5 or (DD)	100	3A	

Table 10 (cont'd). Water Quality Data - Grass River Lower Division (5TD)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective D	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Chloride (Cl)	2.5	1.5	50.0	100	3A	
Copper (Cu)	0.004	0.003	0.02(L)	100	2A	
Fluoride (F)	0.07	0.06	1.2	100	3A,1B	
Hardness ($CaCO_3$) Total	96.0	80.1	50.0	<10	3A	
Iron (Fe)	0.31	0.12	0.3	>75	3A	
Lead (Pb)	<0.01		0.03		3A	one sample
Manganese (Mn)	<0.01	<0.01	0.05	100	3A,1B	
Nitrate & Nitrite (N)	1.60 *	0.38	1.0	100	3A	
pH	7.4;8.0		6.5-8.5	100	3A	
Sulfate (SO_4)	5.2	3.5	250	100	3A	
Total Dissolved Solids	99	82	500	100	3A	
Turbidity (JTU)	7.2	4.9	5	>50	3A	
Zinc (Zn)	0.02	0.01	5(DD)	100	3A	

*Suspected contamination.

Table 10 (cont'd). Water Quality Data - Burntwood River Upper Division (5TE)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Objective Non-Degradation	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Chloride (Cl)	2	1	ND			
Colour True Units	60	46	ND			
Copper (Cu)	1.100 *	0.076	ND			10-percentile=0.001
Faecal Coliform Organisms Counts/100 ml	4	2	ND			
Fluoride (F)	0.08	0.06	ND			
Hardness ($CaCO_3$) Total	68	56	ND			
Iron (Fe)	0.18	0.09	ND			
Lead (Pb)	0.012	0.003	ND			
Manganese (Mn)	0.03	0.01	ND			
Nitrate & Nitrite (N)	1.40	0.26	ND			
pH	7.2;8.0	7.6	ND			
Sodium (Na)	4	3	ND			
Specific Conductance (µmhos)	146	111	ND			
Sulfate (SO_4)	5	3	ND			
Total Coliform Organisms	1100	14	ND			10-percentile=0
Turbidity (JTU)	23.0	12.60	ND			
Zinc (Zn)	0.007	0.003	ND			

*Suspected contamination.

Table 10 (cont'd). Water Quality Data – Nelson House Division (5TF)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective E	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Cadmium (Cd)	<0.010	0.003	(K)	100	2B	
Chloride (Cl)	2	1	100	100	3B	
Colour True Units	50	27	15	<10	1C	
Copper (Cu)	0.010	0.002	0.02(L)	100	2B	
Dissolved Oxygen (% sat'n mg/L)	79	93	47 or over(M)	100	2B	
Faecal Coliform Organisms Counts/100 ml	4	1	100(C)	100	1C	
Fluoride (F)	0.14	0.06	1.2	100	1C	
Hardness ($CaCO_3$) Total	117	74	250	100	3B	
Iron (Fe)	0.36	0.09	0.3	>90	1C	
Lead (Pb)	0.020	0.004	0.03	100	2B	
Manganese (Mn)	0.05	0.01	0.05	100	1C	
Mercury (Hg)(µ/L)	<0.05	0.01	0.2	100	2B	
Nitrate & Nitrite (N)	3.60	0.19	10	100	1C	Poorest is unusually high (possible sample contamination)
pH	7.1; 8.7	7.6	6.5–9.0	100	2B	
Sulfate (SO_4)	27	5	250	100	1C	
Temperature °C	22.0	10.6	(O)1.0		2B	
Total Coliform Organisms	150	5	500(R)	100	2B	
Total Dissolved Solids	162	111	1000	100	1C	
Turbidity (JTU)	18.0	4.76	25	100	1C	
Zinc (Zn)	0.100	0.015	5 or(DD)	100	2B	

Table 10 (cont'd). Water Quality Data - Burntwood River Lower Division (5TG)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective E	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
Aluminum (Al)	1.6	0.8	5.0	100	4C	
Arsenic (As)	<0.040	0.005	0.01	100	1C	
Barium (Ba)	<1.0	0.1	1.0	100	3B	
Cadmium (Cd)	0.010	0.003	(K)	100	2B	
Chloride (Cl)	35	3	100	100	3B	
Chromium (Cr)	0.024	0.015	0.05	100	3B	
Colour True Units	120	44	15	< 10	1C	
Copper (Cu)	0.055	0.005	0.02L	> 90	2B	
Dissolved Oxygen (% sat'n mg/L)	81	103	47 or over(M)	100	2B	
Faecal Coliform Organisms Counts/100 ml	>1500	4	100(C)	> 90	1C	
Fluoride (F)	0.28	0.07	1.2	100	1C	
Hardness ($CaCO_3$) Total	176	75	250	100	3B	
Iron (Fe)	1.1	0.32	0.3	60	1C	
Lead (Pb)	0.025	0.005	0.03	100	2B	
Manganese (Mn)	0.11	0.02	0.05	> 90	1C	
Mercury (Hg)(μ/L)	0.05	0.01	0.2	100	2B	
Nickel (Ni)	<0.100	0.015	0.025	90	2B	
Nitrate & Nitrite (N)	0.84	0.13	10	100	1C	

Table 10. Water Quality Data - Burntwood River Lower Division (5TG) (continued)

Parameters (in mg/L unless specified)	Current Water Quality		Proposed Specific Objective E	% of Time Data Values Acceptable	Limiting Classification	Comments
	Poorest	Average				
pH	7.1;8.5	7.8	6.5-9.0	100	2B	
Sulfate (SO_4)	27	6	250	100	1C	
Temperature ^{o}C	24.0	9.8	(0)1.0	100	2B	
Total Coliform Organisms	12000	21	500(R)	< 90	2B	
Total Dissolved Solids	200	117	1000	100	1C	
Turbidity (JTU)	74.00	16.14	25	< 90	1C	
Zinc (Zn)	0.070	0.011	5 or(DD)	100	2B	

EXPLANATION OF FOOTNOTES

(A) At least 95% of the samples in any consecutive 30-day period should have a faecal coliform density of less than 10 MPN per 100 ml.

(C) At least 90% of the samples in any consecutive 30-day period should have a faecal coliform density of less than 100 MPN per 100 ml.

(K) 0.01 milligrams per liter for waters with hardness greater than 100 mg/L ($CaCO_3$).

0.004 milligrams per liter for waters with hardness lower than 100 mg/L ($CaCO_3$).

(L) or not greater than 1/10 the 96-hour LC50 value.

(M) % saturation is at the ambient temperature.

ND Non-degradation objective.

(O) No change greater than stated degrees Celsius beyond the natural minimum and maximum temperatures.

(R) The median (50 percentile) based on not less than 5 samples per month should be not greater than 500 MPN per 100 ml.

(X) Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use.

(Z) At least 95% of the samples in any consecutive 30-day period should have a total coliform density of less than 100 MPN per 100 ml.

(BB) Avoid use of water bearing heavy growth of blue green algae.

(CC) None at levels harmful either directly or indirectly.

(DD) .01 of the 96-hour LC50 value.