

DOMINIQUE-JANINE EXTENSION, McCLEAN LAKE PROJECT, AND MIDWEST JOINT VENTURE

Report of the Joint Federal-Provincial Panel
on Uranium Mining Developments in Northern Saskatchewan

OCTOBER 1993



Saskatchewan

Canada

**Uranium Mining
Developments in
Northern Saskatchewan:
Dominique-Janine
Extension,
McClean Lake Project, and
Midwest Joint Venture**

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**Panel Report on the Dominique-Janine Extension, the McClean Lake Project
and the Midwest Joint Venture Project**

In accordance with the mandate announced in April, 1991, the Joint Federal/Provincial Panel on Uranium Mining Developments in Northern Saskatchewan is pleased to submit the attached report.

Our review has been completed under the terms of reference provided at the time of our appointment in August, 1991. The documents supplied by the proponents have been subjected to a thorough technical review and public meetings have been held in **La Loche, Ile-à-la-Crosse**, Buffalo Narrows, Prince Albert, La Ronge, Wollaston Lake, Black Lake, Saskatoon and Regina.

On the basis of this review, we recommend that the Dominique-Janine Extension should be allowed to proceed, subject to certain conditions stated in the report. This recommendation is based on the conclusion that the project will provide substantial benefits in the form of employment, business opportunities and royalties, while causing only a small incremental increase to existing environmental and health risks.

We further recommend that the Midwest Joint Venture project not be allowed to proceed. The expected benefits from this project are meagre, while the chances for negative health and environmental impacts are great.

For the McClean Lake Project, we have concluded that the socio-economic benefits to northern Saskatchewan could be increased and the health and environmental risks reduced to an acceptable level by a modest delay, primarily to provide time for education, training and research. We recommend, therefore, that this project be delayed for at least five years, and that its approval at that time be subject to the conditions outlined in the report.

The panel also recommends that the findings and conclusions described throughout the report be given careful consideration by governments, the proponents and other interested parties.

Respectfully,

A handwritten signature in black ink, appearing to read 'Donald G. Lee', with a stylized, flowing script.

Donald G. Lee
(Chairperson)

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EXECUTIVE SUMMARY

The major recommendations arising from our review of the Dominique-Janine Extension, the **McClean** Lake Project, and the Midwest Joint Venture are summarized in this section. These recommendations have been formulated by assessing the balance between the potential benefits and risks to the region and to the province.

Because the people who live in northern Saskatchewan would experience the greatest impacts of these projects, particular importance has been placed on their concerns and aspirations. An improvement in educational levels would permit northerners to take greatest advantage of the employment opportunities presented by development of these mines. A spacing of the start-up dates of approved projects over a number of years would allow education programs to keep pace with the labour demands. A delay in some of the projects would also leave time for the implementation of monitoring regimes, the completion of baseline health studies, and the improvement in tailings management systems.

This report is presented with the understanding that its existence will not limit our ability to review the two additional projects contained in our mandate—the Cigar Lake and **McArthur** River developments. Readers should not assume that these recommendations prejudice, in any way, those that might be made on the basis of these forthcoming reviews.

The information in chapter 1 of the following report defines the scope of the report; the discussion in chapter 2 provides a summary of the important issues associated with uranium mining in general; and chapters 3, 4 and 5 deal with the specific projects.

The Dominique-Janine Extension

The socio-economic benefits associated with the proposed extension of the Dominique-Janine mine at Cluff Lake would be significant. The health and environmental risks, incremental to those already in existence, could be reduced to acceptable limits provided certain conditions are met. The proponent has, in the past, demonstrated respect for the local environment, concern for worker health, and interest in the socio-economic well-being of the residents of the impacted communities. We recommend approval of this project subject to implementation of the following conditions:

1. establishment of a new Human Resource Development Agreement in which Cogema be required to select a minimum of 50% of its new employees from residents of the primarily-impacted communities and a minimum of 30% from residents of the secondarily-impacted communities. These conditions should also apply to contractors and sub-contractors;
2. agreement on a form of revenue sharing that is acceptable to the majority of the impacted communities;
3. establishment of a monitoring committee (as described in section 2.2.6) for the Cluff Lake Mine;
4. provision of a financial guarantee to cover decommissioning and post-decommissioning costs;
5. adoption of the exposure standards recommended in Publication 60 of the International Commission on Radiation Protection (ICRP-60) without allowing the collective dose to increase;
6. completion of a review of worker health training programs;
7. establishment of mechanisms for conducting an **epidemiological** study of the health of current and former workers at the Cluff Lake mine;
8. establishment of an air quality monitoring program using moss pillows and development of a system for monitoring the quality of the groundwater in the vicinity of the Claude pit;
9. evaluation and selection of a different option for deposition of waste rock. Only innocuous waste should be disposed of in Cluff Lake. Options for disposing of other waste rock in the Claude and Dominique-Janine pits should be evaluated. The Claude pit should be decommissioned by filling it with rock capped by clean overburden;
10. establishment of a research fund to support the search for innovative ways of reducing the volume of effluent released and the quantity of chemicals required to treat contaminated water;
11. development of site-specific water quality objectives, establishment of a program to reduce contaminated mine water inflows, and assessment of the possible impacts to the Island Lake watershed;
12. specification of total environmental loading for the mine, and development of a material-balance for contaminants in all liquid effluent;
13. evaluation of alternative oxidants that could replace sodium chlorate in the leaching process and thereby permit recycling of mill effluent;
14. use of the Environmental Transfer Pathway model (**ETP/AECB**) as the focus for an integrated monitoring program, and the assessment of cumulative effects;
15. agreement that the decommissioned Dominique-Janine pit not be connected to Cluff Lake, and that Claude Creek not be rerouted to flow through the decommissioned pit; and
16. evaluation of alternative methods of tailings disposal, with the goal of closing down the present tailings management facility as soon as possible.

The Midwest Joint Venture

The Midwest Joint Venture project, as described in the EIS and its Amendment, is not acceptable; the benefits that could be obtained are insufficient to balance the potential risks. It is,

therefore, recommended that permission to proceed should not be granted for reasons that are presented in chapter 4.

The McClean Lake Project

It is recommended that the **McClean** Lake project be delayed for at least five years.

This would allow time to obtain more experience with previous surround tailings management facilities, to acquire comprehensive community health information, to **maximize** employment opportunities to northerners through education and training, to discuss further the larger issues, and to assess cumulative biophysical and socio-economic impacts.

Its approval at that time should be contingent on fulfillment of the following conditions:

1. evaluation, by the regulatory agencies, of the previous surround tailings pit at Rabbit Lake after several more years of operation;
2. collection and evaluation of baseline data on groundwater flow patterns and water quality. In particular, the panel recommends that accurate flow rates be determined for the streams in the Collins Creek watershed and that the modelling of predicted impacts on the receiving waters be revised accordingly;
3. development of plans to reduce contaminated mine-water inflows;
4. evaluation of alternative oxidants that could replace sodium chlorate in the proposed milling process;
5. participation in the establishment of a research fund to support the search for innovative ways to reduce the volume of effluent and quantity of chemicals required to treat contaminated water. The panel also recommends that site-specific water quality objectives be developed for the **McClean** Lake project. In addition, the total environmental loading should be specified and a material-balance developed for all contaminants in the liquid effluent;
6. use of the Environmental Transfer Pathway model (**ETP/AECB**) as the focus for integrating the monitoring program at McClean Lake. The general design of the monitoring program should be the same as that at other uranium mines. This would guarantee a consistent replication of treatments for biological effects monitoring and eventually produce the database required for the study of cumulative effects. The results of biophysical monitoring at **McClean** Lake should be reviewed by the independent monitoring committee recommended in section 54.3;
7. assessment of cumulative effects using the **ETP/AECB** model and validation of the results by use of a whole ecosystem approach to monitoring, as specified in section 2.3.1 and section 5.3.7;
- a. decommissioning plans that include filling of mined-out pits with waste rock capped by clean overburden;
9. adoption of sediment quality guidelines for Saskatchewan and institution of a program to monitor sediment quality in the Wollaston Lake drainage system;
10. adoption of a Human Resource Development Agreement that includes employment objectives of 30% (75 workers) of the initial workforce from the Athabasca Basin and 40% (100 workers) from the rest of northern Saskatchewan, with the balance (**30%**, 75 workers) coming from southern Saskatchewan or elsewhere. After the mine has been in operation for three years, these objectives should be changed to require the selection of a minimum of 50% of all new employees from residents of the primarily-impacted communities and a minimum of 30% from the residents of secondarily-impacted communities. These conditions should also apply to contractors and sub-contractors;
11. agreement on a form of revenue sharing that is acceptable to the majority of impacted communities;
12. establishment of a monitoring committee (as described in section 2.2.6) for the McClean Lake Project;
13. provision of a financial guarantee to cover decommissioning and post-decommissioning costs;
14. adoption of the exposure standards recommended in Publication 60 of the International Commission on Radiation Protection (**ICRP-60**), without allowing the collective dose to increase;
15. implementation of a program to collect and **analyze** changes in indicators of community health for the impacted communities, and formulation and implementation of remedial health strategies; and
16. further public discussion of the larger issues identified in section 2.5 of this report.

1.0 INTRODUCTION

1.1 Review Process

In April, 1991, the governments of Canada and Saskatchewan announced a joint federal-provincial environmental assessment review to study uranium mine developments in northern Saskatchewan (see figure 1). To be included in the review were proposals for the Dominique-Janine Extension, **McClean** Lake, and Midwest Joint Venture. The review was also to include proposals for operating mines at **McArthur** River and at Cigar Lake. Each project proposal was at a different stage of development, and would progress through the sequences of the review process when appropriate. A panel was appointed in August, 1991.

Three proposals are being considered in this part of the review: the Dominique-Janine Extension at Cluff Lake; a proposed new mine at **McClean** Lake; and a proposed new mine, the Midwest Joint Venture (MJV), at South **McMahon** Lake.¹

For the three proposals being considered, Environmental Impact Statement (EIS) Guidelines were drafted by Saskatchewan Environment and Public **Safety**² in November, 1989, December, 1989 and March, 1990, respectively, in accordance with the provincial *Environmental Assessment Act*.

Subsequently, the Atomic Energy Control Board (AECB) referred the new uranium mine proposals (the MJV and **McClean** Lake projects) to the federal Minister of the Environment for public review under Section 12(b) of the *Environmental Assessment and Review Process (EARP) Guidelines Order*.

The proposed expansion of an existing uranium mine (the Dominique-Janine Extension) was also referred for review. Because the AECB had concluded that the adverse environmental effects of the proposal might be significant, it cited Section 12(e) of the *EARP Guidelines Order* as the basis for the referral.

The proposals for the Dominique-Janine extension, the **McClean** Lake new mine, and the Midwest Joint Venture new mine were at similar stages of development. The panel decided, on behalf of all stakeholders, that it would be most expeditious to combine the public hearing phase of the review for these three proposals.

The panel reviewed the Environmental Impact Statements (**EISs**) from the three proponents and their subsequent responses to the panel's requests for additional information,

The panel also reviewed comments provided by government agencies and public presenters.

Participant funding of \$200,000 was made available to help the public take part effectively in the review. The funds were intended to assist recipients in reviewing **EISs** and in preparing for and participating in the public hearings.

As required by its terms of reference, the panel then conducted public hearings in March, April and May of 1993. The sessions were held in Regina, Saskatoon, Black Lake, **Wollaston** Lake, La Ronge, Prince Albert, Buffalo Narrows, **Ile-à-la-Crosse** and La **Loche**.

After the public hearings, the panel prepared the following report, which assesses the acceptability of the proposed Dominique-Janine Extension, the **McClean** Lake new mine, and the Midwest Joint Venture new mine. In accordance with our terms of reference, recommendations are made on whether or not each project should be allowed to proceed, and in each case reasons are provided.

This report is submitted to the federal Minister of Environment, and the designated Minister of Natural **Resources**;³ the Saskatchewan Minister of Environment and Resource Management; and to the Atomic Energy Control Board.

1.2 Panel

1.2.1 Membership

The Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan was appointed on August 22, 1991. Donald Lee, Head of the Department of Chemistry at the University of Regina, is Chairperson of the panel. Other panel members are:

- James Archibald, Associate Professor of Mining Engineering, Queen's University;
- John Dantouze, Vice-chief, Prince Albert Tribal Council;
- Richard Neal, Associate Dean (Academic), and Professor of Biology, College of Arts and Sciences, University of Saskatchewan; and
- **Annalee** Yassi, Associate Professor and Director of Occupational and Environmental Health, Faculty of Medicine, University of Manitoba.

¹ The proponent of the extension at Cluff Lake is the Cluff Mining Partnership, comprised of Cogema Resources Ltd. (80%) and Corona Grande Exploration Corporation (20%).

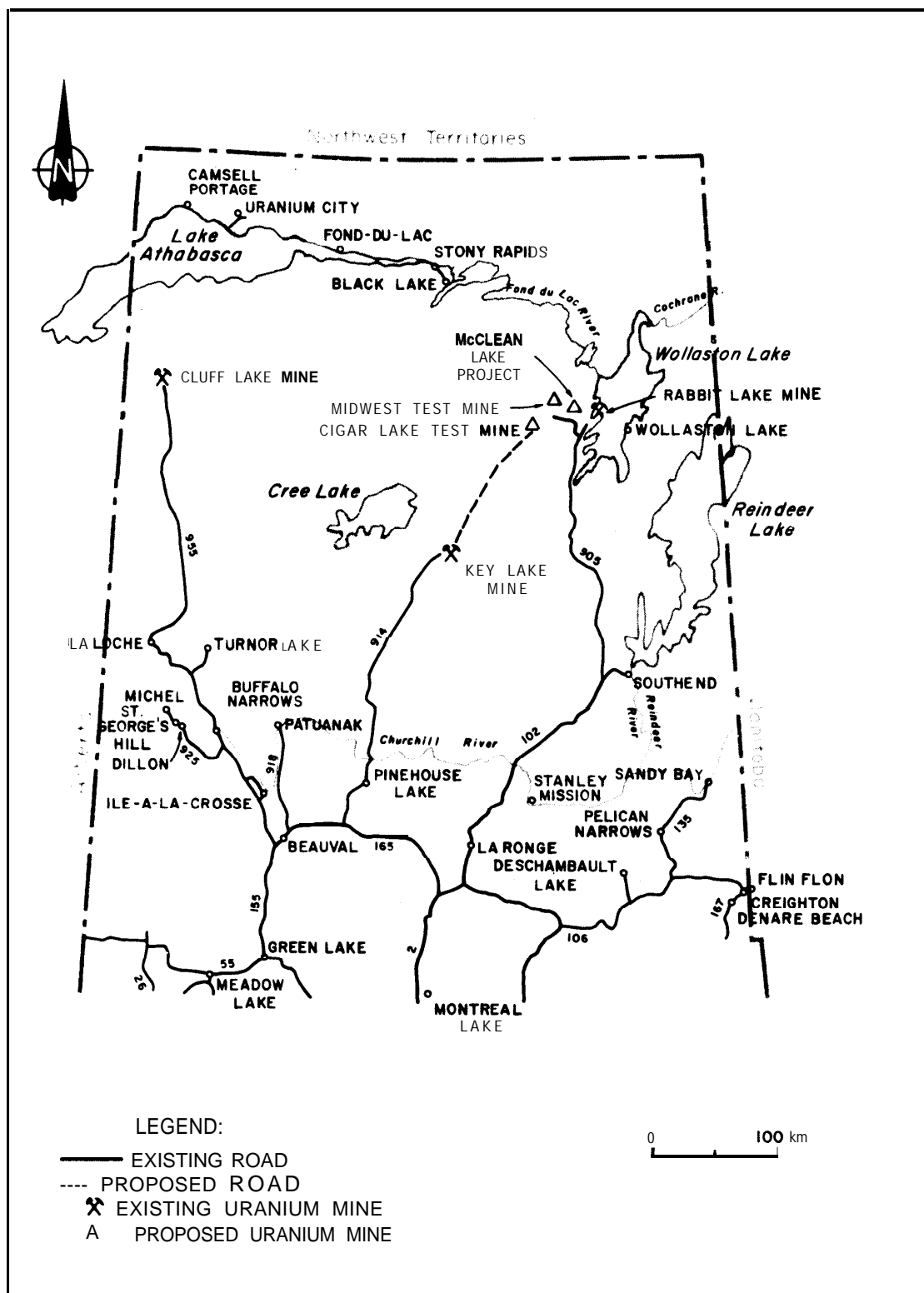
The proponent of the **McClean** Lake project, at the time of the public hearings, was Total Minatco. Other participants in the joint venture were Denison Mines Limited (22.5%) and OURD (7.5%). At the start of the public hearings, the proponent for the Midwest Joint Venture was Denison Mines Limited. During the public hearings, Total Minatco became project operator and major shareholder (56%), with Denison Mines Limited (19.5%) OURD (4.5%)

and **Uranerz** Exploration and Mining Limited (20%) as other shareholders.

² Saskatchewan Environment and Public Safety became Saskatchewan Environment and Resource Management in March, 1993.

³ Natural Resources is a new department and includes the previous department of Energy, Mines and Resources. The Minister of Natural Resources is the Minister responsible for the Atomic Energy Control Board (AECB). It was the AECB which requested the Minister of the Environment to conduct a public review.

Figure 1
Location of Existing and Proposed Projects



Biographies of the panel members are in Appendix A.

1.2.2 Mandate

The panel was given a three-fold mandate: to review the environmental, health, safety and socio-economic impacts of the proposed uranium mine developments; to determine from its review whether each project was acceptable or unacceptable; and to provide full opportunities for public consultation and review.

Complete terms of reference for the panel are in Appendix B.

This report on our review of the Dominique-Janine Extension, the **McClean** Lake project, and the Midwest Joint Venture is presented with the understanding that its existence will not limit our ability to review the Cigar Lake and **McArthur** River projects. Readers are cautioned not to assume that these recommendations will in any way prejudice those which will be made in the future reports. We reserve the right to complete a full and fair review of the Cigar Lake and **McArthur** River projects in a fashion that is independent from, and unbiased by, the reviews described in this report.

2.0 GENERAL ISSUES AND RECOMMENDATIONS

During the public hearings many participants raised issues that are relevant to all of the proposed projects. While some of these issues are very general (e.g. the educational levels of people living in northern Saskatchewan) and others more specific (adoption of ICRP-60, for example), they are the same or similar for all of the projects and are, therefore, most efficiently addressed in a collective fashion. These common issues are described in this chapter along with the presentation of a number of recommendations that flow from their consideration. Descriptions of the individual projects and recommendations pertaining to each are presented in subsequent chapters.

2.1 Nature of the Recommendations

Assessing the acceptability of a project under environmental review involves a balancing of potential benefits against potential risks. While establishing such a balance is never easy, it is more straightforward when a majority of the benefits are expected to accrue to the same people who are required to accept the greatest risks. In the case of uranium mining, however, a proper balance is more **difficult** to reach because northern people are expected to accept the greatest environmental and health risks while the economic benefits are shared more universally. Many of the recommendations in this report are made in an attempt to rectify this situation. To do so, it is necessary to minimize the potential for environmental damage and to maximize the likelihood that a substantial portion of the socio-economic benefits derived from uranium mining will remain in not-them Saskatchewan. Regional risks, associated with the possible contamination of air, land and water, must be exceeded by socio-economic benefits to justify a continuation or expansion of the uranium industry.

Concerns were raised regarding end uses and other larger issues impacting on whether uranium mining should be allowed to proceed in northern Saskatchewan. However, the terms of reference provided to us prohibit such considerations from influencing our recommendations, and we have proceeded accordingly.

We have made a positive recommendation for the acceptance of one project (chapter 3) because substantial benefits in the form of employment, business opportunities and royalties may be obtained with only a small incremental increase to existing environmental and health risks. For another (chapter 4), we have made a negative recommendation because the potential benefits are meagre and the chances for negative health and environmental impacts great. For the third project (chapter 5), we have determined that the socio-economic benefits to northern Saskatchewan could be increased and the health and environmental risks reduced to an acceptable level by a modest delay, primarily to provide some time for education, training and research.

⁴ R. M. Bone, *The Geography of the Canadian North* (Toronto: Oxford University Press, 1992), p. 38-70.

2.2 Participation of Northern People

*But we did not give up either our right to govern our lives, or the right to make our living from the resources that dene **nené** (our land) can provide. This means that, regardless of issues about jurisdiction, we insist on being directly included in all aspects of determining how the resources are used.*

Black Lake and Fond du Lac First Nations
Represented by Chief J. Martin, D. Deranger,
E. Boneleye, P. Robillard and A. Adam, *Transcript of
Public Hearings, Saskatoon, Saskatchewan, May 19,
1993, p. 208.*

Few people have had to adapt to new economic and social situations more quickly and completely than the people of northern Saskatchewan. Circumstances have forced them to change from a nomadic hunting economy (in effect prior to contact with Europeans) through a fur trapping/trading economy, and into the present resource-based wage economy, in about 300 years.⁵ It is not surprising that they have found the transition difficult and that many are now forced to rely on transfer payments (welfare) from central governments.

When one reviews the conditions that many northern people must endure, it is natural to ask the question, "What could have been done to avoid this situation?" However, it is much more important to consider questions such as, "What can now be done to improve conditions?", and "What is a fair and reasonable response to the current aspirations of northern aboriginals to regain a measure of ownership over their traditional lands and take control of their own destiny?" A wise and generous answer to the latter two questions on the part of the people of Canada, as represented by their governments, could go a long way toward righting past injustices and allowing the people of northern Saskatchewan to create a brighter future for themselves and their descendants. We recognize that a Royal Commission⁵ is currently assessing aboriginal issues, and look forward, along with the people of northern Saskatchewan, to their recommendations. Our report focuses only on the impacts of uranium mining; the Commission's mandate with respect to aboriginal issues is larger.

We must realize that measures taken with respect to the mining industry in general, and uranium mining in particular, can provide, at best, only a small portion of the solution to the problems associated with northern development. However, they could be part of the total solution and, since the mining companies appear to be genuinely committed to working for

⁵ *The Royal Commission on Aboriginal Peoples*, co-chaired by René Dussault and Georges Erasmus.

an improvement of conditions in northern Saskatchewan, an opportunity to explore creative alternatives exists.

Throughout the public hearings, people in northern Saskatchewan continuously lamented their lack of control in an area that had traditionally been "their land". It is apparent that the wish by aboriginal peoples to be in charge of their own region is partly an economic issue and partly a spiritual longing to be reunited with their cultural history.

We support the people of northern Saskatchewan in their wish to be accepted as equals (if not masters) when developments are being planned for their region of the province. Although as a consequence of the 1930 Resources Transfer Agreement legal ownership rests with the Crown (i.e. the people of Saskatchewan), we do not believe that it is in Canada's best interests to continue to deny the people of northern Saskatchewan a measure of ownership over their traditional lands and/or the resources contained therein. Because the economic and social problems faced by the people of northern Saskatchewan are so severe and encompassing, there is little doubt that, if allowed to remain unresolved, they will eventually have a highly adverse effect on the entire provincial economy. It is, therefore, incumbent upon us from both a compassionate and a materialistic point of view to take whatever measures are available to provide the people of northern Saskatchewan with an opportunity to secure their own future. Existing treaties, that were likely executed between two very unequal partners, should not be allowed to prevent governments from taking actions that would empower the northern people to be responsible stewards of their traditional lands. Outright or joint ownership could provide northerners with an economic base and, at the same time, foster a sense of dignity and responsibility that would be hard to achieve in any other way.

*... You know, the treaties promised us that as long as the sun shines, the **rivers** flow, even rocks are not moved, that we would continue to use the land and **utilize the land forever...and** if we were given free roam and access to the land, that also gives us certain rights to do whatever we wanted to with the land. We didn't give up those rights....*

Senator Chicken (translated by A. Adam), *Transcript of Public Hearings*, Black Lake, Saskatchewan, April 13, 1993, p. 107.

In the following paragraphs, we have restated a number of suggestions that were brought to our attention and which we believe would assist northern people to govern their lives and to make a living from the resources that their land can provide, as expressed in the quotation that opened this section.

2.2.1 Revenue Sharing

There's all different kinds (of) ideas about revenue sharing. Our region is so different between Black Lake, Fond du Lac, Wollaston, Uranium City...If there's any revenue sharing. ...it should be brought down to a community, each community.

P. Bougie, *Transcript of Public Hearings*, Black Lake, Saskatchewan, April 13, 1993, p. 89.

To establish a formula for revenue sharing and ensure that it is directed in an orderly manner is difficult but it is possible. We would like to have the opportunity to participate; it would be a good problem for northern people to have.

T. Tornquist, *Transcript of Public Hearings*, La Ronge, Saskatchewan, April 16, 1993, p. 6.

An increase in economic activity usually leads to an increase in jobs and business opportunities, and the benefits extend far beyond those directly employed in an industry. However, it is important to **recognize** that these benefits are much more limited in northern Saskatchewan. Only a small proportion of the northern labour pool can be hired by the uranium mines, and the business opportunities for northerners, while important, are much more limited than for southern Saskatchewan. Furthermore, much of the money that is paid to northern workers and businesses by the uranium mines will flow south because goods in the south are cheaper and more available. Thus, most northerners receive little, if any, benefit from the uranium mining industry because the economic system of the region fails to redistribute the wealth. A new method of sharing the wealth created by the uranium mines is required, to allow more people of the region to benefit.

It is essential that an equitable form of revenue sharing be worked out with northern people before additional projects are approved. This need has been consistently advocated by panels such as ours for the past fifteen years. Both the Cluff Lake⁶ and the Key Lake Boards of Inquiry⁷ made strong recommendations in this regard, and, in our report on the McArthur River Underground Exploration Program, we have noted that, "it is northern people who must tolerate the intrusion of

⁶ *Final Report, Cluff Lake Board of Inquiry*, E. D. Bayda, Chairman, 1978, p. 206.

⁷ *Key Lake Board of Inquiry Report*, R. W. Mitchell, Chairman, 1981, p. 50.

mines, and it is they who bear the greatest **risk** of environmental damage or social disruption by these developments.”⁸ They should, therefore, share more generously in any benefits (royalties, crown mineral disposition fees, corporation capital taxes and surcharges, corporate income taxes, municipal property taxes and crown surface lease fees) that are derived from the mines. Disbursement of the net revenues, estimated conservatively at **\$488.3-million** for the years 1980-1992,⁹ into the general provincial coffers does not seem equitable and leaves the residents of northern Saskatchewan with the impression that resources are being taken from “their land” with no direct compensation. The mechanism by which this compensation should take place will likely pose a difficult problem for the provincial government and we will not attempt to offer advice on how revenue sharing should be achieved. However, we **recommend that no new uranium mining developments be undertaken until a form of revenue sharing, acceptable to the majority of impacted communities, has been agreed upon.**

2.2.2 Human Resource Development Agreements

Human Resource Development Agreements are the instruments through which northerners are guaranteed an equitable share of the jobs that will be made available in these projects. Despite a high rate of unemployment among northerners, the mining companies have only succeeded in obtaining, at best, about 50% of their workforce from northern Saskatchewan. Cogema stated that 52% of the current workforce at its Cluff Lake mine are **northerners**,¹⁰ while the **Cameco Corporation** has established a goal of having 50% northern employment by 1995.”

Increasing northern participation in the workforce appears to be a fairly complex problem. On one hand, we heard that workers, some of them with experience, were available and anxious to work in the mines, while on the other hand, we were told that, because educational levels are low, companies have difficulty recruiting qualified personnel. If this information is correct, there is an abundant supply of unskilled labour available, but a scarcity of people in northern communities who have **sufficient** training to fill many of the positions that exist at the mine sites and in the company offices. This problem can only be solved, as discussed below, by provision of appropriate training for northern people. An orderly, planned increase in mining activity (as opposed to a rapid expansion) would most likely be of the greatest benefit to northerners as far as employment is concerned. **We are, therefore, recommending that the start-up of any approved projects be**

spread over a number of years and that the companies work together with the appropriate agencies to ensure that training keeps pace with development. Using this approach, the Human Resources Development Agreements could be renegotiated to guarantee that a much larger percentage of the **new** employees hired for these projects come from northern communities—a goal of 80% would seem obtainable. These goals should apply to all levels of employment, including administrative and executive positions. The employment objectives should also apply to on-site contractor or sub-contractor employees.

2.2.3 Definition of a Northerner

A question closely related to the human resources agreements is the way in which a “northerner” is defined for purposes of calculating employment percentages. The present definition—a person who has spent one-half of his/her life, or at least ten years, as a resident of northern Saskatchewan—was **criticized** on several occasions because it includes many people who are now residents of southern Saskatchewan, and because it does not give any preference to people of aboriginal descent.

Formulation of a new definition will be a difficult task because it must not be a racist statement, and because it should not restrict, in any way, a person's freedom of movement within the province. Some of these difficulties may be resolved through the natural flow of human activities. For example, since most residents of the northern communities expressed a wish to remain there, the current tendency to move south once they become regular wage-earners will be reduced when northern communities have better schools and services available. Similarly, there appears to be little need to distinguish between aboriginals and non-aboriginals because an increasing majority of residents of most northern communities can claim at least partial aboriginal **ancestry**.^{12,13} The question ultimately becomes, “Which communities should be considered when defining a northerner, and how should persons be counted who were formerly residents of the north and now live in the south?” This could also prove to be a difficult question to resolve by consultation with northern people because each community wishes to have the most-favoured status. For example, the people of La Loche, since theirs is the closest community to Cluff Lake, believed that they should be given priority for jobs at that mine,¹⁴ while the Athabasca communities expressed the opinion that they should have first chance

⁸ *McArthur River Underground Exploration Program*, report by the Joint Federal/Provincial Panel on Uranium Mining in Northern Saskatchewan, January, 1993, p. 4.

⁹ *Interim Report: Information from the Government of Saskatchewan requested by the Joint Federal/Provincial Panel on Uranium Mining in Northern Saskatchewan for the Cigar Lake and McArthur River Projects*, SERM, May, 1993, p. 83.

¹⁰ L. Bear, *Transcript of Public Hearings*, Regina, Saskatchewan, March 22, 1993, p. 71.

¹¹ J. McIntyre, *Transcript of Public Hearings on the McArthur River Underground Exploration Program*, Saskatoon, Saskatchewan, December 4, 1992. p. 8.

¹² Ft. M. Bone, *The Geography of the Canadian North*, (Toronto: Oxford University Press, 1992), p. 190, reports that 75.1% of the population of northern Census Divisions in 1986 were of aboriginal origins.

¹³ E. Weick, *Health in the Context of Uranium Mining in Northern Saskatchewan*. (Ottawa: ESAS Inc., 1992), p.6, notes that only the four larger urban centres (Air Ronge, La Ronge, Creighton and Flin Fion) have substantial non-aboriginal populations.

¹⁴ Despite being the closest community to the Cluff Lake Mine, only one person from La Loche is currently employed by Cluff Mining according to L. Bear, *Transcript of Public Hearings*, La Loche, Saskatchewan, April 20, 1993, p. 26.

at the available jobs because all of the mines are located somewhere in the Athabasca Basin?

We believe that it would be preferable to reduce the emphasis placed on the definition of a northerner and replace it with a regulation requiring the companies and their contractors to select a substantial percentage of their new employees from the impacted communities. Each mine should be required to define, in consultation with the province, a number of primary and secondary impact communities (located north of the old Department of Northern Saskatchewan boundary) from which they would hire primarily and in which they could offer incentives for the people to obtain appropriate training. Most of the new employees would then be expected to come from the communities of greatest impact; for example, 50% would come from the primary impact communities and 30% from the secondary impact communities. Workers from other parts of northern Saskatchewan and those who move south could still be counted as northerners for statistical purposes, but would not be considered as residents of the impacted communities when new hiring took place. This arrangement would encourage the mining companies to focus their educational and training programs more directly toward those communities that are expected to experience the greatest environmental and social impact of each particular mine.

2.2.4 Education and Training

Improved education and training opportunities are required if northern people are to become equal partners in the development of that part of Saskatchewan. The ability to obtain a sound kindergarten to grade 12 (K-12) education without having to leave home has long been taken for granted by people living in southern Saskatchewan. Similar opportunities should be made available to the citizens of northern Saskatchewan. It is unfair, for example, to expect students to come south to complete their high school grades. Teenagers and their parents experience enough stress without also having to adjust to a different culture. The inevitable consequence of such a system is an unusually large number of drop-outs. The situation with respect to drop-outs is improving where schools are **available**,¹⁶ but all communities do not have access to a high school. We also heard that the teaching of science and mathematics in northern schools is considered by some parents to be below the standards maintained in southern Saskatchewan? If this is true, every effort should be made to correct the situation; a resource-based economy requires graduates who have a good understanding of science and technology.

It is clear that every effort is being made to improve both the quality and accessibility of K-12 education. This work should be supported and encouraged to the maximum extent possible. A good basic education, in addition to equipping northern people to become leaders in their own territory, allows for the possibility of employment beyond the boundaries of northern

Saskatchewan and provides entrance requirements for institutions of higher education. With a very large population of children and young adults,¹⁸ it seems likely that not all of the young people in northern Saskatchewan will be able to find employment without venturing out into the larger world. A K-12 education will enable northerners to do that more easily and more successfully.

It is also important to provide post-secondary training for specific jobs and occupations. At the present time, training for mine-related employment is facilitated by the *Mineral Sector Task Team* which includes representatives from the northern mineral industry, Northlands College, Employment Canada, the Prince Albert Tribal Council, the **Métis** Society and the provincial Departments of Economic Development, and Education, Training and Employment. Through close cooperation with the mining companies and careful planning, an attempt is being made to **"maximize the hiring, training and advancement of northern people in the region's mineral sector"**.¹⁹ We applaud this initiative and encourage its continuation. When coupled with a planned expansion of the industry, it should be possible to obtain a majority of new employees from the impacted communities.

Programs that enable and encourage northerners to enter apprenticeship programs should also be promoted. In addition to employment in the mining industry, an individual with appropriate qualifications in one of the trades has opportunities for employment beyond the boundaries of northern Saskatchewan. Competent electricians, plumbers, etc. are in widespread demand. The presence of tradespeople in local communities could also lead to an improvement of the standard of living in the North.

2.2.5 Northern Business Opportunities

*The continuing development of the uranium industry in Northern Saskatchewan is integral to the improvement of economic conditions to the north. It's a development that not only provides direct benefits, but it a/so creates the wealth, **workforce**, and attitude necessary to start improving the economy.*

J. Roberts, *Transcript of Public Hearings*, La Ronge, Saskatchewan, April 15, 1993, p. 72.

A number of northern residents indicated that increased participation in the mining industry by local businesses could be beneficial to the development of northern communities. The ability to call on local people for services could also be an asset for the mining companies in certain instances.

¹⁶ J. J. Mercredi, *Transcript of Public Hearings*, Black Lake, Saskatchewan, April 13, 1993, p. 30; G. Fern, *ibid*, p. 36.

¹⁸ R. McKay, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 3, 1993, p. 169.

¹⁹ D. Dewar, *Transcript of Hearings*, Buffalo Narrows, Saskatchewan, April 19, 1993, p. 67.

¹⁸ E. Welck, *A Socio-Economic Overview of Uranium Mining in Northern Saskatchewan*, (Ottawa: ESAS Inc., 1992), p. 3.

¹⁹ R. McKay, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 3, 1993, p. 165.

Participation by local contractors would be encouraged by the establishment of company information offices staffed by people who, in addition to informing northerners of employment and business opportunities, were capable of providing assistance in the preparation of bids and/or proposals. In some cases, it might also be advantageous to all concerned if preferential treatment were given to bids received from northern contractors. The availability of start-up capital for business ventures (provided either by governments or proponents) would also assist northerners in their attempts to participate in mining activities, or in other business ventures of their choice.

These mining developments are in a region traditionally used and controlled by northern people and it seems only fair that they should be provided with an opportunity to benefit, not only through employment and revenue sharing, but also by the development of business expertise within their communities. **We therefore urge proponents and governments to create conditions under which the ability of northerners to participate in available business' opportunities is maximized.**

2.2.6 Monitoring Committees

How can we have our elders better understand what is going on here? How can they be more involved?

E. Benoanie, *Transcript of Public Hearings, Wollaston Lake, Saskatchewan, April 14, 1993, p. 106.*

There is a need for the people of Saskatchewan to be reassured that the mines are operating in compliance with all regulations and that northern economic benefits are being maximized through appropriate hiring practices and policies related to business opportunities. However, it is clear from the hearings that neither the word of company executives nor of officials from the regulatory agencies will be accepted without a certain amount of scepticism. To be completely believed, information must come from knowledgeable and trusted members of the local communities. It would therefore appear that the objective of providing the citizens of Saskatchewan with accurate and believable information concerning the mines could be achieved most effectively by formation of a monitoring committee for each mine. Such a committee, composed of members elected by each of the primary impact communities, along with one or two knowledgeable persons appointed by the provincial government, could meet at the mine site with mine officials and representatives of the regulatory agencies two or three times a year to receive and **scrutinize** reports on the operation of the mine, and to observe site conditions. In turn, the **committees**,²⁰ which could derive their legal standing from regulations introduced by the appropriate government

departments, would be required to issue annual public reports on their findings.

The regulations governing the committees should be stated in such a way that it is clear the committees can neither interfere with the operation of the mine nor attempt to formulate or influence policy. Their function would be one of receiving, evaluating and transmitting information in an understandable and unbiased fashion.

In addition, as the levels of education improve in northern Saskatchewan, the regulatory agencies would be wise to recruit members for their boards and technical staffs from the regions in which the mines are located. Having people from the northern communities actually involved in the regulation of the mines would help to demystify the work of the agencies and increase public confidence.

2.3 Biophysical and Related Concerns

The primary biophysical concern expressed by the public was contamination of the environment by radionuclides and heavy metals. Other contaminants, such as sulphates and chlorides, were of less concern. Contaminants can be released into the environment during the operational phase of the mines and long into the future. Consequently, proper decommissioning of the mines and long-term containment of contaminants were also major issues. Residents of the Athabasca region should be able to hunt, fish, harvest plants, drink the water, and use the land throughout the region without fear of being poisoned by past, present or future mining activity.

The following is a sample of the questions asked by the public.

- What are the background, i.e., pre-mining development, levels of the various contaminants in the region?
- What changes have occurred at the existing mine sites?
- Are the air, soil, water, sediments and biota being monitored adequately?
- Who checks to see that monitoring is done properly?
- How can the air and liquid effluent emissions be reduced?
- Are the air and water quality objectives appropriate for the region?
- Are there guarantees to ensure that the mine sites will be properly decommissioned?
- How will contaminants, especially the radionuclides and heavy metals in the tailings, be contained in the long term?
- What plans are there for the long-term monitoring of decommissioned mine sites?

transportation and accommodation. Alternatively, a more **arms-length** arrangement of costs could be made by providing grants that would be administered by a third party such as one of the Tribal Councils.

²⁰ We suggest that these committees could consist of six people appointed for six-year terms (on a staggered basis to ensure continuity). Costs could be shared by government and the mines with government providing per *dies* and the mines providing

- **Do the effects of different mines overlap and accumulate to produce regional effects? What are the cumulative effects?**

In summary, the biophysical **issues of most concern to the public were monitoring of the environment; the effects of liquid effluent and aerial emissions on the biota; the long-term containment of contaminants in the tailings; decommissioning; and cumulative effects. Each of these concerns is expanded upon in the following sections.**

2.3.1 Monitoring

The reasons for monitoring the environment at each mine site have been discussed by Swanson²¹ and Dirschl et al.²² It is important to know what is there before mining begins; what changes will or have occurred during the operation of the mine; and how the environment will recover or be restored after decommissioning. This should include data on changes in the biota, and on the concentration of various radionuclides and heavy metals in specific ecosystem components.

Monitoring at the existing mines has concentrated on water, and then, with decreasing emphasis, on air, aquatic sediments, soil, and biota. Researchers have developed a voluminous database on chemical contaminants, but with little understanding of the impact of the various chemicals on the surrounding biota²³ and local inhabitants (section 2.4.2.1). There is a lack of integration in the monitoring of the various aspects of the environment and a possible lack of understanding of the rationale for monitoring some ecosystem components.

The panel recommends that a common model such as the **Environmental Transfer Pathways model (ETP/AECB)²⁴ be used as the focus for integrating the monitoring program.** This model is powerful, flexible and easy to use. It integrates airborne and water-borne emissions from multiple sources and predicts contaminant concentrations through time in specific components (air, water, sediment/soil, plant and animal species) at specific locations. The model may be used to predict the concentrations of a specific contaminant, such as arsenic, to which biota or humans may be exposed. This allows an assessment of environmental impacts or probable health risks, providing the biological effects of the contaminant are known. Alternatively, the cumulative radiation dose from all radionuclides may be estimated for humans obtaining their food and water from the immediate area of a mine-site. Thus, the main "purpose of the proposed modelling is to **determine if the food chains within local ecosystems could transfer significant quantities of radionuclides or other contaminants to any possible future inhabitants, so that their natural ecosystems can be fully protected from any potential...damage...The objective of the modelling is to protect future generations, their**

native food sources and the entire sustaining ecosystem from any deleterious effects"²⁵

The **ETP/AECB** model is of limited value by itself. It is vital that it be validated by a carefully designed monitoring program which can determine whether the predictions of the model have any resemblance to reality. The model can help design the monitoring program in three main ways. First, it can identify key components that should be measured (monitored). Second, it can identify key processes, such as the transfer rates of contaminants between components, which may require quantification or further study. Third, it may suggest where permanent monitoring sites should be located relative to the expected concentration gradients of contaminants, as well as identify potential control (unimpacted) monitoring sites.

The **ETP/AECB** model and similar models used by the proponents in their Environmental Impact Statements suggest that the following components should be monitored: air, soil, terrestrial plants, a terrestrial vertebrate such as the snowshoe hare, groundwater, surface water, aquatic sediments, benthic invertebrates, and fish. Air and water should be monitored throughout the year. The remaining ecosystem components should be monitored on a two-year cycle, until the various sampling problems have been overcome, and then on a longer cycle as the changes slow down. In the post-decommissioning phase, the cycle may be five to ten years or even longer.

A carefully designed monitoring program will help to determine the impacts of the various emissions on the biota. However, it is difficult to isolate the impacts of mining on the biota from impacts on the biota caused by other factors. Therefore, an adequate monitoring program must include simultaneous monitoring of control areas, replication of treatments at independent sites, careful selection of sample sites and components, and use of standard methodologies to provide data that can be compared between sites and through time. **The panel recommends that the general design of the monitoring programs should be the same for all uranium mines. This will guarantee the consistent replication of treatments required to determine biological impacts and eventually produce the database necessary for the study of cumulative biophysical impacts (see section 2.3.6).**

The design of the monitoring program is the responsibility of the regulatory agencies in consultation with the mine operators. At present, data collection is the responsibility of the mine operators, with periodic independent samples collected by the regulatory agencies acting as an audit. This operates effectively for chemical monitoring, but monitoring of the biota will require a different audit. For the latter, the panel suggests

²¹ S.M. Swanson, *Cluff Lake: Status of the Environment Report*, (Saskatchewan Research Council Publication No. E-2200-2-E-91, 1991).

²² H.J. Dirschl, N.S. Novakowski, and L.C.N. Burgess, *An Overview of the Biophysical Environmental Impact of Existing Uranium Mining Operations in Northern Saskatchewan* (Ottawa: ESAS Inc., 1992).

²³ Swanson, *Cluff Lake: Status of the Environment Report*.

²⁴ Atomic Energy Control Board, *Cumulative Impact of Uranium Mining in Northern Saskatchewan*, Submission to Public Hearings, Saskatoon, Saskatchewan, May 4, 1993. B. Zgola, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 4, 1993, p. 1-22. D. Lawson, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 4, 1993, p. 22-45.

²⁵ Environment Canada, Western and Northern Region, Submission to the Public Hearings, Saskatoon, Saskatchewan, May 4, 1993.

that species' samples be retained permanently so that identifications and counts can be confirmed independently.

Finally, there is the issue of trust as discussed in section 2.2.6. Can one trust a company to monitor its own activities, and are the regulatory agencies too involved with the companies to provide independent, objective assessment of the data? The natural tendency of the proponents is to interpret the data in the most favourable and optimistic way. For this reason, the panel recommends **that biophysical monitoring be among the subjects reviewed by the independent monitoring committees, proposed in section 2.2.6.**

2.3.2 Liquid Effluent

Mines deal with large volumes of contaminated water. The contaminated water comes from mine water inflow; from precipitation collected after it has percolated through ore stockpiles and special wastes; from the milling process; and from pore water expressed from the tailings. Treatment with chemicals precipitates most of the radionuclides and heavy metals which are then deposited in the tailings management facility. The resulting effluent has a high concentration of total dissolved solids (TDS) and a low concentration of radionuclides and heavy metals.

The method of water treatment involves an environmental trade-off, whereby the mitigation of one problem (containment of metals and radionuclides) creates or exacerbates another problem (increased salinity). The effluent is saline because the high TDS content consists largely of chloride and sulphate salts. This is fatal for some organisms and adversely affects others, particularly in a region such as northern Saskatchewan where the water normally has an extremely low TDS content. The environmental impact of increased salinity is acceptable for two reasons. It is less harmful than elevated concentrations of radionuclides and metals, and the salinity change in the receiving waters is not permanent. After decommissioning, when water treatment stops and the concentration of TDS drops to background levels, those organisms that have been eliminated because of the change in salinity can reinvade and become reestablished.

The dispersal of radionuclides and metals is not entirely prevented by the method of water treatment because the total environmental loading²⁶ of various contaminants can still be considerable if sufficiently large volumes of effluent are released. Even though the concentrations of radionuclides and metals are very low, the large volume of effluent means that surprisingly large amounts of these elements are released. For example, at Cluff Lake a total of 12,816 kg of uranium was released in **8,181,769 m³** of water during the seven-year period, 1982-1988.²⁷ Similarly, the Department of Fisheries and Oceans has calculated that **"...over the anticipated life of the project, this will result in the discharge of approximately**

103,230 kg of uranium"²⁸ in treated effluent discharged from the McClean Lake project.

The spread of radionuclides and metals is limited because they are adsorbed by the sediments and suspended particulate matter, to a degree determined by factors such as the nature of the sediments and the speed of water flow. Contaminants will spread less if the effluent is released into a bog or lake where the water is in contact with rich organic sediments for a long period, than if released into a river or lake with a large turnover rate.

The two problems posed by liquid effluent are antagonistic; a decrease in one (salinity) leads to an increase in the other (total environmental loading of radionuclides and metals). Moreover, they are resolved in incompatible ways. In the first case, the effluent should be diluted as rapidly as possible to flush the salts from the system; in the second, the aim is to confine the effluent for as long as possible to allow time for contaminants to be adsorbed from solution.

One procedure that is compatible for both problems is to reduce the volume of effluent by decreasing mine-water inflow and by recycling water in the milling process as much as possible. A second compatible resolution is to remove radionuclides and metals from the contaminated water by other processes, such as adsorption onto organic particles or ion exchange columns.²⁹ Both solutions require further research.

The panel has three recommendations regarding the release of liquid effluent. **First, a research fund should be established to support the search for innovative ways to reduce the volume of effluent and the quantity of chemicals required to treat contaminated water.** The objectives should be a "zero effluent" mill, and liquid effluent from the other mining operations with low concentrations of all contaminants, not just radionuclides and metals. The research fund could be established at either the federal or provincial level and be administered by the appropriate regulatory agency. Funds could be obtained by placing a modest environmental tax on the total environmental loading of key contaminants in the liquid effluent.

Second, site-specific surface water quality objectives, appropriate for the Athabasca region rather than for Saskatchewan as a whole, should be developed. The present Saskatchewan Surface Water Quality Objectives (SSWQO), applicable for southern Saskatchewan where there is often a high concentration of TDS in the water, are not always appropriate for the Athabasca region. Where the SSWQO and the Canadian Water Quality Guidelines differ, the more stringent should apply. In addition, the new objectives should include a uranium water quality guideline for aquatic biota, and guidelines for any other significant ions or elements which are presently excluded.

²⁶ Total environmental loading = concentration of contaminant in effluent x volume of effluent released.

²⁷ T. P. Hynes, *The Impacts of the Cluff Lake Uranium Mine and Mill Effluents on the Aquatic Environment of Northern Saskatchewan*, M.Sc. Thesis, University of Saskatchewan, p. 40.

²⁸ *Position and Technical Review Of the Response to the Uranium Mines Review Panel Request for Additional Information concerning the Complementary McClean Lake and Midwest Projects, McClean Lake Project*, Department of Fisheries and Oceans, Central and Arctic Region, Submission to Panel, March, 1993.

²⁹ *Technical Position on Dominique-Janine Extension*, Environment Canada. Submission to Panel, May, 1993.

Third, the total environmental loading should be specified for all contaminants. Each mine should be required to develop a material-balance for all contaminants released in its effluent. The mines should be able to account for the spread of contaminants in the watershed. The estimates could be checked by the monitoring program.

2.3.3 Air Emissions

The primary concern expressed by the public with respect to aerial emissions was the release of radon (and the subsequent deposition of radon progeny) from mine ore bodies, ore stockpiles, waste rock, the mill, water treatment facilities and tailings. Radioactive dust was also a concern.

For many people, the central question, however, is to what extent do radon and radon progeny from mining activity represent a regional or even global health hazard? On the one hand, *... radon mixes very rapidly with the atmosphere, and the presence of even large radon sources cannot readily be detected a short distance away. Furthermore radon has a short radiological half life (less than four days) and the /eve/s therefore cannot build up over a long period of time.*³⁰ *"On the other hand, the tailings continue to release radon for over 100,000 years. And if the tailings are not isolated from the atmosphere, the sum of exposures for all those years could be large in absolute terms. . . Basically, . . . radionuclides are pumped out of the tailings area and over very large areas of land. And what we have is radioactive fallout onto vegetation, consisting mainly of those polonium iso topes. . ."*³¹

Regional radon concentration data³² indicate that the values for northern communities are as low as, or lower than, those for southern communities in Saskatchewan. However, elevated concentrations of radon progeny, particularly polonium-210, near the uranium mines could present a health risk if incorporated into food chains.³³ If the levels of radon progeny are elevated within a 5-10 km radius of a mine, and mines are developed so that tailings pits are in close proximity to one another, measurable cumulative effects could result. This could have a significant impact for inhabitants of the region choosing to obtain a substantial part of their food from the area, as noted in section 2.4.2.1.

This risk is difficult to assess because of inadequate monitoring of the aerial deposition of contaminants around the mine sites.³⁴ An improved monitoring program (see section 2.3.1) would address this problem. Secondly, the flux of radon from tailings management areas in the long term will depend on how they are decommissioned (see section 2.3.4). Finally, the future spatial pattern of development of uranium mines is not known, although several mines may be developed in the area to the west of Wollaston Lake. Future-risks from the combined

effects could be investigated by cumulative effects modelling (see section 2.3.6).

Because of its potential negative impact on the environment, all reasonable measures should be taken to minimize the release of radon and to thereby mitigate health risks by reducing the deposition of radon progeny. Measures should also be taken to reduce the creation and release of radioactive dust to a practical minimum.

2.3.4 Tailings

Most of the radionuclides and metals contained in the ore body are deposited in the tailings management facility. The long-term containment of these dangerous contaminants is vital.

There are two tailings management design concepts used in Saskatchewan. The first stores the tailings above ground. Contaminants are contained in the long term by covering the tailings and encapsulating them above the water table. However, some seepage of precipitation through the cover will always occur, resulting in continuous seepage through the tailings and the lowest seal of the downstream impermeable barrier. *"... there is no known way to achieve near absolute contaminant immobility and thus a maintenance-free condition"*³⁵

The second type stores the tailings in a pit below the water table using a pervious surround method. This involves lining the pit with a very permeable layer and placing the tailings in the centre. The enclosed tailings are expected to consolidate and become more dense than the surrounding layer. The contaminated water expressed from the tailings as they consolidate is pumped from the bottom of the pit to the water treatment plant. After the site is decommissioned, water ideally will move around the tailings through the more permeable surroundings so that, theoretically, contaminants will only be released by diffusion, a very slow process. *"...through this method, the radionuclides and other chemical contaminants can be virtually immobilized within the tailings deposit. In theory, the method appears to be flawless but only time will tell and, as yet, not enough time has passed to enable a final assessment?"*

Both methods of tailings management must contain contaminants for tens of thousands of years before they will cease to be a radiological hazard. Moreover, the non-radioactive toxic metals, such as arsenic, will persist forever. Perhaps wisely, the public fears that whatever can go wrong, will go wrong. For example, the cover or dikes encapsulating the above-ground tailings may erode and fail, allowing rapid dispersal of contaminants into the air and surface waters. Thus, the long

³⁰ L. D. Brown, *Risk Assessments for Exposure of the Public to Ionizing Radiation*, Submission to Public Hearings, Saskatoon, Saskatchewan, May 7, 1993, p. 3.

³¹ G. Edwards, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 19, 1993, p. 80.

³² *A Cross-Canada Outdoor Radon Survey*, B. Grasty (1991), together with the results from a follow-up survey completed in 1992. Submitted to the panel by Mineral Industry Environmental Protection Branch, SERM, April 26, 1993.

³³ M. Shiell, *Biophysical Aspects of High-Grade Uranium Mines*, Submission to Public Hearings, Saskatoon, Saskatchewan, May 5, 1993.

³⁴ H.J. Dirschl et al, *Biophysical Environmental Impact*, p. 81.

³⁵ H.J. Dirschl et al, *Biophysical Environmental Impact*, p. 77.

term storage of these harmful substances needs to be studied very carefully.

One suggestion made to improve the safety of the tailings storage would be to remove thorium-230 and radium-226 from the **tailings**.³⁶ These two elements have half-lives of 60,000 and 1,622 years, respectively, whereas the other elements in the uranium decay series have half-lives ranging from a fraction of a second (polonium-214) to a few decades (lead-210). Thus, the removal of thorium-230 and radium-226 would reduce the radiological hazard of the long-term storage of the tailings. The concentrated thorium and radium would comprise a small volume, permitting more expensive methods of containment to be considered for these elements.

A second suggestion concerns the cover for the in-pit, pervious surround **method**.³⁷ If the tailings were covered with successive layers of glacial till, waste rock and overburden rather than with water, the tailings should consolidate still further as a result of the increased pressure. This should make it even more difficult for water to flow through the tailings and **disperse** contaminants, and should minimize the flux of radon to the atmosphere (see section 2.3.3).

Such suggestions require careful study and research. **The panel concludes that research funds are required to examine innovative techniques for the management of the tailings.** Funds could be created and administered in a similar way to that proposed for funding research on liquid effluent (see section 2.3.2).

And now here the uranium companies are asking us to increase the level of experimentation in a major way when the verdict isn't nearly in on the first round of experiments in waste management.

V. Drummond, Transcript of *Public Hearings*, Prince Albert, Saskatchewan, April 21, 1993, p. 146.

2.3.5 Decommissioning and Post-Decommissioning

Following uranium extraction, the mine site and surrounding environment should be restored to approximately their original state. The inhabitants of the Athabasca region should be able to use the territory in traditional ways: hunting, fishing, trapping, and gathering berries and herbal medicines. The way in which the site is decommissioned should be in part under the control of the inhabitants of the region. For example, they should be involved in decisions about whether open pits should be allowed to fill with water (contaminated at least in

the short term), or whether they should be filled with waste rock topped by glacial till.

The public was adamant that decommissioning costs are the financial responsibility of the mining companies and not of the government (i.e., the taxpayer). Much of this concern stems from the unsatisfactory way in which mines near Uranium City were abandoned when they were no longer profitable. For example, it **appears** that it is going to be costly to complete corrective work at the Gunnar Mine **site**.³⁸ Furthermore, because of poor initial planning, it seems likely that it will not be possible to restore the site as completely as is desirable and in as acceptable a fashion as the public expects for modern mining operations. This situation must not be allowed to re-occur.

The projects under consideration have been described in such **a way** that preliminary plans for decommissioning and site restoration have been established and agreed upon in advance; however, it is also necessary to have a guarantee that corporate funds will be available to execute these plans regardless of the financial health of the owners. Without such guarantees the public would not be protected from future costs if the mine owners were unable to provide the required funds. The guarantee should cover the possibility of an unexpected cessation of operations prior to completion of the project as well as the costs associated with decommissioning and site-restoration after the ore has been completely extracted as envisaged in the Environmental Impact Statements.

The public was also insistent that, because of the long-term hazard of contaminants, the mine-site should be monitored long after the mines have closed. Clearly, funds are also required for post-decommissioning monitoring.

During the public hearings, we were told that there are several ways in which a company could provide such guarantees. Insurance, performance bonds, trust funds, an irrevocable letter of credit and a pledge of assets were mentioned as **possibilities**.³⁹ Other jurisdictions, such as British Columbia, have introduced programs that require deposition of "reclamation securities" at the commencement of a project and a periodic re-evaluation to ensure that potential decommissioning and post-decommissioning costs have not expanded to exceed the value of the securities on **deposit**.⁴⁰ While not wishing to suggest the exact form it should take, we **recommend that a financial guarantee to cover the decommissioning and post-decommissioning costs of a project be secured from the proponent before that project is approved.**

2.3.6 Cumulative Effects

Cumulative biophysical effects are complex because the effects may be cumulative in several **ways**.⁴¹ Effects may:

³⁶ G. Edwards, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 19, 1993, p. 62.

³⁷ Environment Canada, Western and Northern Region. Submission to the Public Hearings, Saskatoon, Saskatchewan, May 4, 1993, p. 26-28.

³⁸ R. Barsi, *Transcript of Public Hearings*, Regina, Saskatchewan, March 23, 1993, p. 111.

³⁹ K. Haapanen, *Transcript of Public Hearings*, Regina, Saskatchewan, March 23, 1993, p. 388.

⁴⁰ *Guidelines for Mineral Explorations: Environmental, Reclamation and Approval Requirements*, Ministry of Energy, Mines and Petroleum Resources, Province of British Columbia, 1992.

⁴¹ H. Sadar et al, *Assessing Cumulative Effects of Saskatchewan Uranium Mines Development*, December, 1992.

- be cumulative through time;
- be cumulative in space (multi-sources of contaminants from a single mine, several mines, or mines plus other activities in an area);
- be a combination of several different contaminants on a single species; and/or
- impact one or more species through ecosystem alterations.

A good example of cumulative effects through time is shown with the issue of total environmental loading, discussed in section 2.3.2. The concentration of a contaminant may be extremely low in the liquid effluent but the total amount of the contaminant released may be large because of the enormous volume of effluent. If the contaminant is adsorbed by aquatic sediments, its concentration may increase in the sediment to levels above that observed in the water column. This process of concentration of contaminants by aquatic sediments has been observed for molybdenum and uranium at the Cluff Lake mine,⁴² although the biological effects are unknown at this time. Thus, compliance with regulations, such as Saskatchewan Surface Water Quality Objectives, does not necessarily prevent the accumulation of some contaminants, over time, to potentially harmful concentrations. There is a need for limits on total environmental loading of contaminants and for an accounting of the fate of all contaminants released, as recommended in section 2.3.2. **The panel recommends that the Saskatchewan government adopt sediment quality guidelines similar to those of the Ontario government.**

A contaminant may also be released from several sources at a single mine, or from different mines, resulting in spatial cumulative effects. One example is the release of radon from mine workings, waste rock, ore stockpiles, the mill, the tailings management area, and the water treatment plant at a single mine. The various emissions must be considered together to determine how they overlap and potentially augment one another. Another example is the release of liquid effluent from different mines into the same watershed or convergent watersheds. In considering the cumulative impacts of different mines it has been argued that, *"In provincial monitoring procedures, existing sources are monitored to the point where measures do not exceed background. This provides the point at which the potential for cumulative impacts is generally considered to be zero. Provided there is no overlap in areas, there is no cumulative or 'combined' impact?"* This is true for most species in ecosystems because the individual members of those species live entirely within the sphere of influence of a single mine. However, it is not necessarily true for the few species, such as barren ground caribou or humans, which range over an area that may include several mines. In the latter case it can be argued that the exposure to contaminants is additive if there is more than one mine in an individual's home range. For example, exposure would be approximately

doubled if there were two mines rather than a single mine in an individual's home range, and so on. Thus, spatial cumulative effects need to be assessed carefully on a case-by-case basis.

Organisms are not affected on a contaminant-by-contaminant basis but by the combined effects of all contaminants, and other forms of disturbance. For example, an organism may be very sensitive to changes in **salinity**,⁴⁴ although the precise mix of ions may also be important. The interactive effects of the various contaminants are extremely varied. They may be greater than the sum of the individual effects taken independently (i.e., synergistic), such as the health risk of radiation and arsenic discussed in section 2.4.1.2. In contrast, the effects of different contaminants may also be antagonistic. For example, the toxic effects of ammonia and many other contaminants are reduced as the **hardness**⁴⁵ of the water increases.

The cumulative effects through time and space, and between different contaminants, can be modelled and assessed in a preliminary way by the Environmental Pathway model (ETP/AECB) discussed in section 2.3.1. However, the cumulative biological effects are impossible to predict in detail because the effects on organisms are species-specific, and ecosystem processes are extremely complex. Moreover, ecosystems can compensate for some environmental changes. For example, if an increase in the salinity causes the elimination of a species, the effect on the structure and function of the ecosystem may be minimal if that species is replaced by a similar, more salinity-tolerant species. From a practical point of view, the main assessment of cumulative biological effects will require a well-designed monitoring program. The latter requires that whole ecosystems be studied by monitoring key components and processes, as discussed in section 2.3.1. Such a program should identify major changes in ecosystem structure and function, and measure contaminant concentrations in important species that may be harvested by humans.

We recommend that a program designed to monitor cumulative biological effects be implemented for the Cluff Lake site and the west side of Wollaston Lake before further development is allowed.

2.4 Health Issues

Health is widely accepted as being more than the absence of disease; it is a state of physical, mental and emotional well-being. The terms of reference of the panel reflect this broad understanding by encompassing socio-economic effects along with environmental and health considerations. All three potential impacts on health (i.e. direct physical effects, socio-economic effects, and psychological effects) have, therefore, been included in our analysis of the possible effect of the proposed uranium mines on worker and community health.

⁴² T. P. Hynes, *Impacts on Aquatic Environment*. S. Swanson, *Cluff Lake: Status of the Environment Report*.

⁴³ R. Zukowsky, *Perspectives on Cumulative Impact Assessment in Saskatchewan*. Submission to Public Hearings, Saskatoon, Saskatchewan, May 4, 1993, p. 4.

⁴⁴ Salinity is defined as a measure of the total amount of soluble salts (ions) in water or soil.

⁴⁵ Hardness is defined as the concentration of calcium and magnesium in soil and water.

2.4.1 Occupational Health and Safety

The occupational health and safety hazards facing uranium miners include those associated with all mining operations as well as those specific to uranium mining. Thus, in addition to musculoskeletal injuries; respiratory diseases, including **silicosis**; heavy metal toxicity; and vibration and noise-induced injuries, uranium miners encounter radiation-related diseases.

2.4.1.1 Radiation Health Risks

It is now internationally accepted that ionizing radiation carries a greater risk per dose of exposure than had been thought previously. This acceptance is based on new scientific evidence, which recognizes that each **milliSievert (mSv)** of exposure is actually associated with 2-4 times greater risk than had been appreciated when the former standard was applied. The International Commission on Radiation Protection (ICRP), therefore, has recommended decreasing the allowable occupational exposure from **50 mSv** annually, to **20 mSv** per year averaged over 5 years. The new standard also includes contributions from all sources of radiation exposure. The level of acceptable risk was chosen because it corresponds to a one in 10,000 mortality risk per year (0.4% lifetime risk of occupationally-induced death). This is comparable to occupational risk in other industries and is therefore thought to be **acceptable**.⁴⁶ However, some labour organizations and environmental groups believe it is still unacceptably high, and continue to question the science on which it is **based**.⁴⁷

... relatively low doses spread among a relatively high population of workers do not produce fewer detriments than a high dose spread among a small group of workers.

D. Anderson, *Transcripts of Public Hearings*, Saskatoon, Saskatchewan, May 17, 1993, p. 24-25.

In 1991, the AECB published Consultative Document C-122 to invite public comment on the adoption of the ICRP-60 exposure standards. A presenter pointed out that some of the proposed workplace designs would exceed the proposed **20 mSv/year** limit, and another urged caution in adopting the ICRP-60 standards because, *"In the case of uranium mining*

*where the ability to modify exposure of workers is limited, imposition of lower dose limits is unlikely to reduce the collective dose. In fact, it may be that by forcing uranium mining companies to adopt job rotation schemes, the collective dose, and the consequent risk, may be increased."*⁴⁸ Another presenter cited the *Ham Commission's*⁴⁹ warning that using miners for shorter time periods without reducing the total exposure would probably increase the number of cancer victims.*

We agree with these cautionary comments, but also **recognize** that there is a consensus of scientific opinion indicating that a tightening of standards is warranted. It is, therefore, recommended **that** measures be taken to implement the standards recommended by **ICRP-60** before approval of **any** additional uranium mines; measures must also be taken to ensure **that collective doses are not permitted to rise**.

In addition to complying with established radiation standards, uranium mining companies are required to implement the concept of **ALARA** (As Low As Reasonably Achievable) **risks**.⁵¹ It is not permissible to use a certain method if a comparable, but safer, method is available. This principle recognizes that unnecessary exposure is unacceptable, even if regulations are not exceeded. In our opinion, **ALARA** is an important concept, one that the proponents and regulators should vigorously promote. During the hearings, it appeared that some proponents had not used their past experience to develop a good understanding of the significance of health effects attributable to radiation exposures. This is worrisome given the importance of this understanding as a motivator in applying the **ALARA** principle.

Of equal importance to the application of good regulations and the observation of the **ALARA** principle is the insistence upon maintaining actual (not approximate, estimated or average) exposure records. Instrumentation for this purpose is now available and we **recommend that the use of personal dosimetry which measures both alpha and gamma radiation become standard practice in uranium mines**.

2.4.1.2 Combined Effects of Radiation and Heavy Metals

Some Saskatchewan mines contain high concentrations of arsenic and nickel, both known to be carcinogenic, as well as uranium. A study of Ontario miners has suggested that there is a synergistic effect between radiation and arsenic exposure? This finding implies that the risk of lung cancer to

⁴⁶ M. Measures; D. Brown. *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 7, 1993.

⁴⁷ M. Schmidt, "The New Recommendations of the International Commission on radiological Protection-No Progress for Radiological Protection", *International Perspectives in Public Health*, Vol. 7, (1991), p. 20-28; 'Permitting Unacceptable Risks: The New international Commission on Radiological Protection Radiation Safety Standards', *Friends of the Earth*, London, England, (February, 1991).

⁴⁸ T. Meadley, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 19, 1993, p. 230.

⁴⁹ Report of the Royal Commission on the Health and Safety of Workers in Mines, James Ham, Chairperson, 1976.

⁵⁰ S. Helliar, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 17, 1993, p. 199.

⁵¹ D. Brown, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 7, 1993, p. 200-201.

⁵² R.A. Kusiak, A.C. Ritchie, J. Muller, J. Springer, 'Carcinoma of the Lung in Ontario Gold Miners: Possible Aetiological Factors.' *British Journal of Industrial Medicine*, April, 1991.
R.A. Kusiak, A.C. Ritchie, J. Muller, J. Springer, 'Lung Cancer Mortality in Ontario Uranium Miners', draft paper issued for comment, October 15, 1991; subsequently accepted for publication in the *British Journal of Industrial Medicine*, 1993.

miners employed in mines with both a high grade of uranium and a high concentration of arsenic may be considerably greater than predicted from the sum of the individual exposures. A similar situation may also exist for nickel and other mining exposures, although this has not been well studied (see section 2.4.1.3).

Whether the risks of arsenic, and possibly **nickel**,⁵³ in the presence of radiation **are** synergistic or additive, it is clear that miners **working** in such mines are likely at greater risk than their counterparts in mines **which contain little or none of** these heavy metals. It would, therefore, seem reasonable that the regulated exposure limits should be adjustable to account for variations in mining conditions. **It is recommended that the proponents voluntarily reduce exposure limits for underground mines containing high concentrations of arsenic, and that regulators establish site-specific combined exposure limits that would approximate an acceptable risk?**

The hazards posed by the high-grade uranium ore are exceedingly multiplied by the intimately associated very large amounts of high-grade arsenic..

J. Stmad, Speaking Notes for Public Hearings, Saskatoon, Saskatchewan, May 5, 1993.

... the Saskatchewan limits will probably be amended to reflect the evidence of increased cancer risk from inorganic arsenic..

J. Alderman, Speaking Notes for Public Hearings, Saskatoon, Saskatchewan, May 4, 1993, p. 3.

2.4.1.3 Epidemiological Studies

Much of the information regarding the health effects of mining has come from epidemiological studies. These studies of the distribution and determinants of disease have served as the basis for identifying hazards, quantifying risk and setting standards to control these risks. During the late 1940's and into the 1950's, as uranium mining expanded, excess lung cancer was documented in US uranium miners as a result of an epidemiological study conducted by the US Public Health Service? Since then, many other groups of underground miners

have been documented to have increased risk of lung cancer. This has generally been thought to be related to the radon contamination in underground mines. Recently, however, the role of other cancer-causing exposures in mines has also been actively explored.

To date, four epidemiological studies of Canadian uranium miners have been conducted and all have shown increased risk of lung cancer.⁵⁶ The Ontario Miners' study followed the mortality experience of over 50,000 miners who worked in Ontario uranium mines by linking the list of miners to the Canadian National Mortality Database, internationally renowned for its comprehensiveness. The exposure to radon progeny for the period before 1968 had to be estimated by linking work histories with area measurements, as personal dosimetry information was not available during the early years. The uranium miners **showed a significant increase** in overall deaths and specifically deaths from lung cancer. Excess mortality from lung cancer in Ontario gold miners (exposed to large concentrations of arsenic) was also **found**.⁵⁷ This is when the authors **realized** that exposure to arsenic and radon decay products **was** particularly problematic. A **follow-up** of these miners confirmed that the risk of death due to lung cancer was greatest among uranium miners, who had also worked in gold mines?

Workers employed in the Port Radium mine were also found to have a significant excess in lung cancer deaths. A study of over 8000 workers employed between 1948 and 1980 at Beaverlodge Uranium Mines was also conducted. A much greater excess of lung cancer was found in Beaverlodge miners compared to the Ontario and Northwest Territories miners, which has raised many questions. Smoking appeared unlikely to have accounted for much greater risks. Apparently, a follow-up study of these miners has been conducted, but it is not known to the **panel**⁵⁸ whether the much greater risk (per working level) experienced by these miners was related to faulty exposure estimates or other explanations.

There have been major improvements in mining techniques and ventilation standards in mines during the past few decades. Exposure standards have also been reduced and it would appear that mining conditions are now better than ever before. Without appropriate study, however, it is impossible to provide quantitative verification of this assumption. As discussed in the previous section, some of the changes may, in fact, be detrimental to the overall health of miners. The only way that one can properly ascertain the consequence of any changes is through a thorough epidemiological study. Such a

⁵³ Internationally respected committees on cancer have consistently concluded that there is strong evidence that some types of nickel are carcinogenic. While the Ontario-based studies have confirmed increased cancer with some types of nickel exposure, and have also found increased lung cancer in nickel miners, the carcinogenic agent in nickel mines is still the subject of investigation.

⁵⁴ Acceptable risk is considered to be one in 10,000 occupational-induced mortalities per year as recommended in ICRP60.

⁵⁵ National Research Council, Biological Effects of Ionizing Radiation Committee (BEIR IV), *Health Risks of Radon and Other Internally Deposited Alpha Emitters*, (Washington, DC: National Academy Press, 1966).

⁵⁶ M. Measures, 'Exposure and Dose Limits for Workers and Members of the Public in Canada,' *Submission to Public Hearings*, Saskatoon, Saskatchewan, May 7, 1993, p.9.

⁵⁷ R.A.Kusiak, A.C. Ritchie, J. Muller, J. Springer, "Carcinoma of the Lung in Ontario Gold Miners: Possible Aetiological Factors", *British Journal of Industrial Medicine*, April 6, 1991, p. 808-817.

⁵⁸ R.A.Kusiak, A.C. Ritchie, J. Muller, J. Springer, "Lung Cancer Mortality in Ontario Uranium Miners". Draft paper issued for comment, October, 15, 1991; later accepted for publication in the *British Journal of Industrial Medicine*, 1993.

⁵⁹ At the time of the hearings, this report was unavailable.

study would compare the health impacts on miners from the Uranium City era with those from the more modern mines at Rabbit Lake, Key Lake and Cluff Lake. It would compare open-pit and underground mines and provide data on whether the effects of various miner rotation/shift patterns could be evaluated from a health perspective. It could also be used to predict future risks and perhaps suggest ways in which they could be mitigated. While an adequate latency period is required before any results could be truly reassuring, beginning a study now (15 years after commencement of the modern mines) would still be useful.

With the introduction of personal dosimetry monitoring, as recommended in section 2.4.1.1, the continuation of this epidemiological study into the future would permit comparisons to be made using actual, not average or estimated, exposures. Proper monitoring would also provide the data required to gain insight on questions surrounding the possible additive or synergistic effects of arsenic, nickel, or other mining exposures. **For these reasons, it is recommended that arrangements be made to conduct an on-going epidemiological study of all Saskatchewan uranium miners (past, present, and future). It is recommended that the study begin as soon as possible, and that the results be promptly communicated to the public.**

The reality for workers has been that when experts disagree, the worst case scenario has generally proven to be the one that is closest to the truth.

Communications, Energy and Paperworkers Union of Canada, *Submission to the Public Hearings*, Saskatoon, Saskatchewan, May 18, 1993, p. 4.

2.4.1.4 Noise Reduction

The control of noise in mines is an occupational health and safety issue that merits particular comment. Excessive noise is a safety factor because it can cause fatigue, and interfere with communication, thereby increasing the chance of an accident or an injury. It is also a direct health concern because it can cause hearing loss or damage.

Saskatchewan Labour's brief indicated that *"...amendments to the Occupational Health and Safety Regulations will probably place more emphasis on noise reduction".⁶⁰ We agree with this objective and urge that regulations which place emphasis on noise reduction be introduced.*

⁶⁰ J. Alderman, *Speaking Notes for Public Hearings*, Saskatoon, Saskatchewan, May 4, 1993, p. 3.

⁶¹ G. Telfer, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 4, 1993, p. 201-204.

2.4.1.5 Importance of Worker Involvement

... If education, monitoring and dose reduction programs are to be effective, ... they must be developed and implemented with full participation of the worker who knows better than anyone else what is going on in the workplace, and how conditions can be improved.

G. Telfer, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 4, 1993, p. 203.

As workers have to accept a risk, they should do so on the basis of full participation and a complete understanding of the issues involved.

J. Alderman, *Speaking Notes for Public Hearings*, Saskatoon, Saskatchewan, May 4, 1993, p. 2.

Worker education and formal worker involvement in health and safety are crucial to worker protection. Saskatchewan's proposed new *Act Respecting Occupational Safety and Health* (Bill 56) will **recognize** this reality and require the establishment of joint workplace safety and health committees with defined responsibilities. **The proposed legislation (Bill 56) would promote a higher level of assurance in the health and safety of the proposed new mines and its timely adoption is recommended.**

A union representative who appeared before the panel indicated that union members wanted mining jobs, but believed that much could be done to further reduce risks to workers? He also contended that occupational health and safety committees function best in unionized workplaces, and expressed particular concern for health and safety of workers of non-unionized mine contractors.

The brief from the union also referred to a computer-based training course on radiation **safety**,⁶² which has been used at Cluff Lake. We suggest that this type of learning tool should continue to be developed, adapted as needed, and made available to all workers in this industry.

2.4.1.6 The Need for Occupational Health Professionals

With the advent of the Workplace Hazardous Materials Information System (WHMIS) and other worker right-to-know initiatives, workers are asking more questions about health hazards and the potential work-relatedness of their health problems. Occupational health matters, important in any workplace, are particularly fundamental with respect to uranium

⁶² *All About Radiation*, a self-teaching interactive video produced by the Canadian Institute for Radiation Safety, **Saskatoon**.

mines, because of radiation-related health issues. While **physicians** working in northern Saskatchewan have taken initiatives to assist workers/patients with such concerns, the resources and training needed for these often complex assessments seem to be insufficient? Limited availability of occupational physicians' time may severely restrict the number of visits and the extent to which occupational health concerns can be addressed. **The proponents should ensure adequate availability of knowledgeable occupational health professionals.**

2.4.1.7 Socio-Economic Related Health impacts

Proposed **workcamp** amenities and site facilities have been described in the EIS, along with a discussion of issues related to worker lifestyle. The latter included existing or proposed **measures regarding** alcohol, tobacco and drugs, recreation and entertainment needs, and food and accommodation. We note that the impact of the mines in these areas is likely to be positive. In **workcamp** situations, however, attention should be paid to both primary prevention measures, and to early identification of problems followed by counselling and rehabilitation as needed.

The way in which workers are hired, fired or promoted can either increase or reduce stress depending on the perceived fairness of the process followed. This is particularly important when minorities are involved. **The need for culturally-sensitive orientation and counselling to ease the adjustment of aboriginal people into full-time industrial employment is evident.**

Most workers who addressed the issue of worker lifestyle strongly supported the **7 day-in/7 day-out** shift concept. Although there are hardships associated with the commuting lifestyle, there are also problems related to boom-and-bust mining towns. **On balance, the panel finds the 7 day-in/7 day-out concept acceptable. There is, however, a need for the proponents to provide on-site counsellors who can help workers resolve family/work conflicts and related issues.**

The proceedings of a conference held in **Saskatoon**⁶⁴ reported a number of cautionary observations about the 7 day-in/7 day out rotation. For example, it noted that health and safety implications of rotational schedules and the extended workday are still not well understood and need further study. The conference also noted that diet is an important issue associated with the employment of a native labour force; to avoid digestive problems, it was advised that country foods (fish and game) be included in the diet. With respect to family stress, the conference summary cited a survey in which three-quarters of the respondents had an overall negative view of the commuting system and about 66% of the remainder had some negative comments, with spouses more negative than miners. It was noted that 67% of long-distance commuting miners were married, and 92% were male. The conference urged the hiring

of more women, the hiring of couples, subsidized and private telephone lines and social events for families.

The panel also noted that very few of the women presenters supported uranium mining development, and that few women have been hired in this industry. More obvious opportunities for women in this industry might offset some of their concerns.

The panel concludes that flexibility to accommodate family needs should be encouraged and that special attempts should be made to provide employment opportunities for a growing pool of well-qualified northern women.

2.4.1.8 The Psychological Health of Workers

The importance of traditional harvesting and gathering activities to the spiritual well-being of aboriginal people was stressed throughout the public hearings. Many people stated that working at the mines does not negate these activities; in fact, some presenters noted that uranium mining development can actually enhance the potential for continued traditional activities. In any event, work arrangements that permit employees to engage in traditional activities will promote their health and well-being.

Risk, or the perception of risk, can also have a strong effect on the psychological health of workers. Everyone accepts certain risks daily; driving a car, walking across a street and almost everything else we do involves risk. Usually such risk does not impact on health from either a physical or a psychological perspective. However, if, in order to find employment, one is forced to accept risk or engage in an activity which he or she may feel is potentially detrimental, it may have a psychological effect on his/her health and sense of well-being. It is, therefore, important to understand those factors that contribute to the acceptability of the risks associated with uranium mining. These are discussed further in section 2.4.2.5.

2.4.2 Community Health Impacts

*... the data from Saskatchewan Environment and Resource Management, as well as Saskatchewan Labour, indicates that within a few kilometres of existing uranium mining sites that radiation levels are back to background. Therefore, unless there is an emergency spill, there should be no direct negative impact on the **physical** health of people who live in the areas surrounding the mines... Even though it is much easier to study a biomedical impact like cancer than a **socio-health** impact like employment, both issues are relevant and important to the health of northern residents.*

J. Lyster, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 7, 1993, p. 207.

⁶³ D. Dewar, *Transcript of Public Hearings*, Buffalo Narrows, Saskatchewan, April 19, 1993, p.104-105.

⁶⁴ *Long Distance Commuting in the Mining Industry: Conference Summary*, edited by M. Shrimpton, K. Storey, Centre for Resource Studies/Energy Mines and Resources Conference, November 1990, Saskatoon, Saskatchewan.

2.4.2.1 Contamination of Air, Water and the Food Chain

There is a fundamental concern that chemicals from uranium mines may enter surface or groundwater, thereby contaminating drinking water, and fish. The potential terrestrial contamination of edible local foods (including terrestrial wildlife), and the consequent effect on human health must also be considered. In this regard, the need for proper environmental monitoring (section 2.3) is evident.

Some presenters raised concern about a potential link between uranium mining and adverse health effects such as cancer, 'birth defects, spontaneous abortion and a myriad of other problems. A calculation of health risk to someone eating caribou daily was conducted by experts from the Bureau of Radiation and Medical Devices, Health and Welfare Canada.⁸⁵ Various tissues from the caribou in Baker Lake were found to contain elevated concentrations on polonium-210 and lead-210, which were associated with a calculated total dose to the consumer of 1.41 mSv/year. Using the ICRP-60 risk coefficient, a lifetime cancer risk of 0.5% is calculated, compared to the background cancer risk of about 20%. This level of increased risk is small, roughly equivalent to the risk associated with natural background radiation. Whether or not this incremental level of risk is acceptable is the subject of debate. The lack of environmental health risk assessment data makes any conclusions regarding the health concerns of the impacted communities problematic. **Appropriate studies are needed to more fully assess environmental health risk to human populations caused by the possible contamination of air, water and the food chain.** Such studies should be conducted as part of the comprehensive community health studies recommended in section 2.4.2.6.

2.4.2.2 Transportation of Dangerous Goods

Residents of some of the villages along northern highways raised concerns related to the transportation of dangerous goods over roads that pass near or through their communities. We also heard from individuals familiar with the trucking industry who described precautions taken during the transportation of dangerous goods. Although we do not wish to recommend new legislated requirements in this area, we urge that care be taken to ensure the safe handling of materials, and that emergency training and response capabilities be available to all impacted communities. It is the proponents' responsibility to share information concerning the materials being transported, and their safe handling and emergency response measures, with the communities.

... whatever you get out of the uranium mine is transported within the town of La Loche...if there was a spill here... What kind of precautions are we going to take within the community?

I. LeMaigre, Transcript of Public Hearings, La Loche, Saskatchewan, April 20, 1993, p. 107.

2.4.2.3 Socio-Economic Impacts on Health

Some concern was expressed that mine employment could cause community health problems through the influx of money, drugs and alcohol into the communities. For example, the presence of a few large wage-earners may increase the despair of those unable to obtain employment and thereby contribute to community disharmony. On the other hand, the panel heard from many young people who want the jobs and business opportunities provided by the mines, and who look to those who have been employed in the mines as positive role models.

In some of the communities, living conditions are poor, often lacking basic sanitation and infectious disease control measures. Depressed social, psychological and economic conditions have produced a situation that is inadequate from a health perspective.

Rapid population growth in some communities has resulted in the presence of a number of young people who need to establish their self-worth either through traditional land-use activities or employment. **Recognizing this reality, the panel concludes that economic development is imperative to the health and well-being of northern peoples.**

The role uranium mining could play in this needed development was the subject of many presentations. In addition to jobs and business opportunities, positive benefits reported include the establishment of an air transport system and the creation of roads which presently link many northern communities. Such transportation networks have found strong acceptance by most communities.

On the other hand, public concern was expressed that some of the community health problems may be partially attributable to the increasing development of public roads, and the consequent availability of alcohol, etc. No studies are available, however, to assess concerns that increasing community health risk has developed as a direct result of mining activity. This **emphasizes** the need for the comprehensive health studies recommended in section 2.4.2.6.

2.4.2.4 Environmental Protection, Development and Health

The importance of preservation of the environment to the health and well-being of individuals, their communities and future generations was a common theme at the public hearings.

Several presenters discussed various socio-economic philosophical perspectives; one stated that **developmentalists** see their goal as creating a comfortable and efficient lifestyle

⁸⁵ Health Assessment of Po-210 in Caribou from the NWT, memo submitted to the Public Hearings by D. Lawson, Saskatoon, Saskatchewan, May 4, 1993.

through an understanding of how things work (science), producing the most efficient tools (technology), and advancing as quickly as possible (progress). She contrasted this with environmental and native traditionalist values which stress responsibility as stewards of the earth-locally, regionally and globally in this and future generations. She and other presenters challenged the developmentalist values as seeing □ ... *the environment as existing to serve humanity's need to prosper*.⁶⁶ The dichotomy between the wish for a pristine environment and the need for economic development may cause internal conflict and consequent health problems. Decision makers should **recognize** that the ideology of development is not embraced by all.

2.4.2.5 The Acceptability of Risk

The presence of health risk can have a profound effect on the physical and psychological health of a community. The acceptance of such a risk is usually linked to a variety of factors, some that may have little to do with scientifically quantifiable exposures, doses or documented effects. The perception of a risk can often be just as damaging as its actual presence. Every effort should therefore be made to provide impacted communities with a sound basis for judging the extent of a risk or the lack thereof. The following principles should be carefully considered when proponents and governments expect communities to accept the risks associated with the intrusion of uranium mines onto their lands.

- The most important determinant of acceptability of risk is whether or not that risk is voluntary. The right to say no makes saying yes much more acceptable. Letting people of the north decide was a major theme in numerous presentations.
- The distribution of risks and benefits must be perceived to be fair; those who must endure the greatest risks should reap the greatest benefits.
- Trustworthiness is an essential element in the acceptability of uranium mining. Monitoring committees, composed largely of people from the impacted communities, may be able to provide information that northerners will trust.
- Health risks associated with memorable catastrophic events are more feared. The fact that the world first learned of nuclear technology from Hiroshima and Nagasaki cannot be ignored.
- Health risks from "natural" versus "man-made" sources cannot be compared. The fact that radon levels in basements may be greater than radon levels in some mines is irrelevant to many people.
- A risk is deemed more acceptable if there is a good moral reason for accepting it; conversely, if a risk offends an individual's moral standards, it is unacceptable. The possibility

that uranium mining may contribute to global problems has caused many people to view it as an immoral activity. Few communities would wish to accept a risk that could contribute to the proliferation of nuclear weapons or similar problems.

- Some of the uncertainties regarding the potential long-term health impacts of uranium mining relate to the inherent complexity of the issues and the absence of sufficient study. Education could lead to a better understanding of this industry and a consequent decrease in the uncertainty of its impacts by the public. It is not clear to the panel how this information could best be conveyed nor whether a more sophisticated understanding would lead to better acceptance or more widespread rejection of uranium mining.

Proponents and regulators should take these factors into consideration when they are dealing with impacted communities.

Many people feel an uneasiness when uranium mining is mentioned. They don't have anything definite that they can put their finger on.

C. Bradek, *Transcript of Public Hearings*, Prince Albert, Saskatchewan, April 21, 1993, p. 139.

2.4.2.6 Disease Causation and Community Health Data

Some northerners raised questions about possible links between a wide variety of health problems in their communities and the existence of uranium mines. While some of the health concerns in question are not likely attributable to the mines on toxicological or radiological grounds, a more indirect link may exist. The unexplained increase in congenital **anomalies**,⁶⁷ for example, while based on very small numbers, demands study and consequent prevention. However, the lack of baseline health data on northerners has made the evaluation of the health impacts of uranium mining difficult.

The social health impact of uranium mining, positive or negative, defies assessment without a comprehensive community health study. The panel, therefore, recommends **that a comprehensive health study of northern people be conducted as a "baseline" against which any future impact of uranium mining can be assessed.** This will require a combined effort of federal and provincial authorities, together with extensive participation by the communities. We also urge federal and provincial community health educators to seek better understanding of community perceptions of disease causation and to work with the community leaders to formulate remedial strategies.

⁶⁶ C. Stang, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 17, 1993, p. 4.

⁶⁷ J. Irvine, D.C. Gillis, L. Tan, S. Chiu, L. Liu, D. Robson, 'Lung, Breast and Cervical Cancer Incidence and Survival in Saskatchewan Northerners and Registered Indians (1967-86)', (Whitehorse, Yukon: 6th. International Congress on Circumpolar Health, 1990).

Surely, from a common sense point of view, the evaluation of health of people who must frequent either the mines or their environs is more important than any other aspect of mine operation.

B. Forgay, *Transcript of Public Hearings*, Regina, Saskatchewan, March 22, 1993, p. 314.

The Bayda Inquiry, many years ago, came out with the suggestion that there should have been a baseline health study done of northerners before further uranium development proceeded.

D. Dewar, *Transcript of Public Hearings*, Buffalo Narrows, Saskatchewan, April 19, 1993, p. 86.

2.5 Larger Issues

Here we are asked to break down the nuclear industry, frame by frame, to examine only three uranium mining proposals and their artificially discrete impacts. We are asked to view uranium mining as though it occurs in isolation from nuclear power, nuclear weapons, and the scramble to find a high level waste repository in Canada.

S. Fortugno, *Speaking Notes for Public Hearings*, Saskatoon, Saskatchewan, May 17, 1993, p. 5.

2.5.1 Sustainable Development

Saskatchewan's Round Table on Environment and Economy recently published a report outlining eight principles of sustainable development for the province.⁶⁸ Of the principles enunciated (environmental/ economic reality, environmental/economic integration, adaptability, renewability, efficiency, stewardship, sufficiency and accountability), the one most difficult to apply to mining is "renewability". It is, of course, impossible to mine ore in a fashion that is completely renewable. Once the ore has been removed, refined and used elsewhere, it will never again be renewed in the sense, for example, that a forest which has been harvested can be replanted. The report of the Round Table puts it this way:

The concept of sustainable development applies to non-renewable resources in a different way than it does to renewable resources. The mining of any given ore body is not sustainable, but the mining industry as a whole can continue over time. As mineral deposits are mined, new deposits are discovered while new technologies and products reduce the need for these minerals.⁶⁹

⁶⁸ *Conservation Strategy for Sustainable Development in Saskatchewan*, Province of Saskatchewan, 1992, p. 5.

⁶⁹ *Ibid*, p. 29.

In addition, it is possible to apply the principle of renewability in the sense of site decommissioning and reclamation. Restoration of the land, water and air to predevelopment quality will allow nature to again flourish and renew the mine site.

The *Mining Advisory Committee* of the Round Table has expanded on the concept of sustainability as it applies to mining and published a list of seven characteristics of sustainable mining developments, the central one being:

Sustainable mining balances economic growth and protection of the environment by sensible trade-offs that consider all costs and benefits in the decision-making process.⁷⁰

During the public hearings, there was considerable discussion of whether or not uranium mining could be considered a sustainable development. Although the arguments were substantial on both sides of the question, we are of the opinion that uranium mining can, if properly done, meet the criteria of the province as expressed in the report of the Round Table. However, it is clear that whether or not uranium mining will be significant in the future of northern Saskatchewan, it is not indefinitely sustainable and it will not be the entire answer to northern development. Governments would, therefore, be wise to simultaneously promote other forms of economic activity.

If it is indeed the case that northerners are being given a choice only between uranium mines and continued desperate poverty, then I'd say they're being given no choice at all.

J. McPherson, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 8, 1993, p. 2.

Several opponents of these projects suggested a variety of possible alternatives to uranium mining (for example, *ecotourism*, fisheries, native crafts, expanded wild rice farms and other forms of agriculture such as berry picking) that are more in keeping with the objectives of sustainable development. However, many of these possibilities are not mutually exclusive with uranium mining and should be actively promoted and encouraged regardless. **The best future for sustainable development in northern Saskatchewan lies in a planned and diversified economy. Uranium mining may be one of its components.**

Many presenters noted that the World Commission on Environment and Development, which popularized the concept of sustainable development, called for a broadening of environmental assessment to include strategic policy issues and their implications. As was noted in section 2.4.2.5, some

⁷⁰ *Sustainable Development in Mining*, Province of Saskatchewan, 1991) p. 3.

presenters have taken issue with the limits of the panel's mandate.

Sustainability	<i>Board of Inquiry to choose sustainability for our children and grandchildren.</i>
Regina, Saskatchewan, Sask.	Taylor, <i>Transcript of Public Hearings</i> , Regina, Saskatchewan, March 22, 1993, p. 294.

2.5.2 Alternative Energy Sources

Several members of the public pointed out that selection of alternative energy sources could reduce the need for nuclear power and the consequent environmental damage associated with uranium mining. Coal, hydro, natural gas, wind, solar, biomass and geothermal are alternatives that could be considered as possible replacements for nuclear power. However, as detailed in the report of another review panel,⁷¹ each of these possibilities also comes with certain environmental or economic disadvantages—burning coal or natural gas contributes to the greenhouse effect, hydro electric dams cause flooding, wind is site-specific, solar is currently uneconomical, and so on. It is apparent that there are certain risks and trade-offs associated with the generation of power from any source of energy.

There is, however, one approach that is completely benign as far as the environment is concerned; conservation is an effective way of reducing the need for additional energy. It is apparent that this is a favoured option of large segments of the population and it is one that should receive serious consideration from government.

*We do not need nuclear power,
And we do not need uranium mines.
We need to learn to use the
power of the wind and the sun,
And leave consuming ways behind.*

O. Dancer and J. Dancer, *Transcript of Public Hearings*, La Loche, Saskatchewan, April 20, 1993, p. 50.

2.5.3 Local and Global Economics of Uranium Mining

Representatives from the provincial and federal governments reported that the demand for new uranium ore (in excess of present inventories, fuel stocks from Western countries available for re-processing, and material originating from the former Soviet Union) will exceed supply for at least the next decade.^{72,73} At present, however, nuclear power utilities worldwide maintain an inventory of uranium sufficient to meet power generating demands for a minimum period of two years. Similarly, large proven uranium reserves exist in Australia and countries of the former Soviet Union which could affect the demand for Saskatchewan uranium if they were brought into production. In addition, large uranium ore bodies other than those under current review have been delineated in northern Saskatchewan.

Offsetting potential impediments to the sale of Saskatchewan uranium are factors which will contribute to a slow, but steady, rise in world demand for uranium. According to information provided to the panel, several countries, such as Japan, South Korea and France, are expanding their nuclear power industries and will continue to require additional guaranteed sources of uranium supply. Elsewhere, older nuclear reactors are being dismantled and replaced by fewer but larger units with significantly greater power generating capacities than those which they are replacing.⁷⁴

Australia has a legislated policy restricting production of uranium to only three mines to **minimize** environmental loading and to maintain a high price for the **product**.⁷⁵ Australia also had a floor price policy until about 1988 whereby uranium could only be sold at prices above a certain level, thus assuring minimum guaranteed royalty returns to the government. By restricting the inventory of uranium available for international sale, and maintaining a minimum sale price, Australia limited its capability to produce and sell uranium. This may have favoured Saskatchewan producers.

Existing inventory will ensure a surplus of uranium until at least the middle of the present decade. However, some predictions suggest that supplies of newly-mined uranium will be unable to meet demand in the following ten- to fifteen-year period. Some projections show a steady, though moderate, increase for nuclear power demand, of approximately 1.8% per year until 2010.⁷⁶ Based upon this and varied production scenarios, the average annual growth rate of Western world uranium requirements until 2005 is also estimated to approximate 1%. It is therefore feasible that, after approximately 1995, increased uranium production may be necessary to keep pace with world uranium demand.

⁷¹ Saskatchewan Electrical Energy Options, Saskatchewan Electrical Energy Options Review Panel Final Report to SaskPower, November, 1991.

⁷² R. Williams, *Transcript of Public Hearings*, Regina, Saskatchewan, March 22, 1993, p. 207-208.

⁷³ R. Clayton, *Transcript of Public Hearings*, Regina, Saskatchewan, March 23, 1993, p. 222-223.

⁷⁴ R. Williams, *Submission to Public Hearings*, Saskatoon, Saskatchewan, March 22, 1993, Figure 12 and p.(iii) - Summary.

⁷⁵ R. Williams, *Submission to Public Hearings*, Saskatoon, Saskatchewan, May, 1993, p.33.

⁷⁶ R. Williams, *Submission to Public Hearings*, Regina, Saskatchewan, March 22, 1993, Figures 7 and 8.

*... existing operational facilities in the traditional supplier countries cannot meet **projected** Western world reactor requirements. The shortfall in production may be met by the expansion of certain existing operations, by the development of a small number of new projects....*

R. Williams, Submission to Public Hearings, Saskatoon, May 18, 1993, p.34.

The forecast of increased demand implies that uranium prices should remain at, or increase above, present commodity levels. Historically, however, prices have tended to be lower than predicted; no proven method for accurately predicting price levels has been developed.

The panel recommends that control of industry production be considered. As well, the establishment of a minimum pricing policy should be examined. The Australian model permitted that country to retain its share of the world uranium market and to maintain a reasonably high commodity price. If similar pricing controls were to be established in Saskatchewan, the province would **realize** higher royalty returns on the product sold, even if unregulated production throughout the world were to result in a lowering of the international commodity price. With a planned development of Saskatchewan's reserves, sufficient to meet anticipated world demands, the province might retain its share of world production while maintaining a firm product price.

2.5.4 Regulatory Agencies

2.5.4.1 Northern Involvement

There is a perception that regulatory groups, at both federal and provincial levels, deal too intimately with proponents of uranium mining ventures to maintain objectivity. Without participation, northerners feel excluded from the regulatory process.

Regulatory agencies such as Saskatchewan Labour, the Mineral Industry Environmental Protection Branch and the Atomic Energy Control Board appear to have few northern employees. Coincidentally, northern communities lack information concerning mine occupational mishaps, regulation implementation, regulation enforcement and penalty assessment. **Regulatory agencies should endeavour to recruit aboriginals into their operations to mitigate perceptions of bias and to facilitate public confidence.**

2.5.4.2 Harmonization of Government Activities

Many federal and provincial government agencies are involved in the regulation of the uranium mining industry. Although each has a specific mandate, they attempt to work together for the common good of the uranium mining industry and the public. In some cases, regulators may be duplicating effort, at unnecessary cost. Currently, guidelines and regulations governing radiation safety, surface water quality and

other factors exist at both federal and provincial levels. Such regulations may have differing standards, and may not incorporate the most recent internationally-recognized limits. **The panel perceives a need for the harmonization of federal and provincial activities relating to mine regulation and enforcement.**

2.5.4.3 Foreign Ownership

A 50% Canadian ownership rule applies to all companies operating in Canada. This regulation states that companies which are more than 50% owned by foreign nationals (Cogema and Total Minatco, for example) require either special dispensation (called *grand-fathering* for previously-operating companies) or federal ministerial waivers. **All proponents, venture participants and operating uranium mining companies which are being reviewed in this report have been exempted from the ownership regulations, with the result that approval of these projects would place a substantial portion of the uranium industry under the control of foreign ownership.** Some presenters stated that this is an unhealthy situation and that federal ministerial waivers should be used more restrictively.

2.5.5 The Nuclear Fuel Cycle

We regard the nuclear industry as the major health hazard to the people of the world. . .

M. Repo, Transcript of Public Hearings, Saskatoon, Saskatchewan, May 19, 1993, p. 249.

2.5.5.1 Nuclear Power

The concept of nuclear energy as a source of power is one with a relatively short history of application; it is also the least understood and least trusted of all available energy options. Despite the observation that nuclear power does not contribute to atmospheric pollution by the production of carbon dioxide and other flue gases, significant public concern about nuclear power issues was communicated. For example, the report of another panel, referred to us, notes:

It should be clearly appreciated that there are widely held and deeply felt concerns about nuclear safety, waste disposal and other issues which must be recognized and addressed. . . There are. . . some fundamental philosophical objections to nuclear power generation which are held by a significant proportion of the general public. These concerns are much broader than the generation of electrical energy within Saskatchewan. They initiate with the mining of

uranium in Saskatchewan and its utilization in various forms throughout the world.⁷⁷

2.5.5.2 Non-Proliferation Treaty

Although nuclear weapons proliferation is outside the mandate of the panel review, many participants expressed concern regarding this topic. Many perceive the end uses of Saskatchewan uranium to be detrimental to the general public good. Rather than being used solely to benefit society through power/energy production, uranium is and has been seen to be **utilized** for weapons production.

...perhaps the greatest shortcoming of Saskatchewan's involvement in uranium mining is that any benefits gained from uranium mining are experienced by the current generation of Saskatchewan residents while the problems created are left behind for future generations of Saskatchewan residents and citizens of the globe to grapple with.

P. Prebble, Transcript of *Public Hearings*, Regina, Saskatchewan, March 23, 1993, p. 291.

Participants noted that specific proponents, such as Cogema, are wholly-owned subsidiaries of foreign governments heavily involved in military weapons research, fabrication and testing. Accordingly, mining proponents are viewed as a direct part of the chain leading to weapons production. Should such companies be given approval for mining, they will continue, in the perception of some members of the public, to enhance the development of weapons and promote proliferation. The **Nuclear Non-Proliferation Treaty**, of which Canada is a signatory, prohibits the use of uranium in the production of enriched uranium for military applications. However, there is no process whereby exported Canadian uranium can be separated from uranium derived from other sources. Therefore, no proven method exists for preventing incorporation of Canadian uranium into military applications.

Current Canadian limitations on end uses of uranium provide no reassurance to the public that Canadian uranium is used solely for non-military applications by purchasers. **The panel wishes to bring concerns related to the possible use of Saskatchewan uranium for weapons to the attention of the government.**

2.5.5.3 High Level Waste Disposal

Many members of the public perceive that there is no safe method of long-term storage or disposal of nuclear fuel wastes. Under existing regulations, used nuclear fuel from Canadian reactors is stored at the reactor site either by submerging it in water pools, or by placing it in above-ground

caskets. Such storage requires continuous monitoring and care by site staff in perpetuity.

A generic **waste storage** concept is the subject of review for a separate FEARO panel.⁷⁸ Intended for permanent disposal, the concept is based on a non-retrievability scenario with nuclear fuel waste being placed in deep underground repositories.

Neither nuclear waste storage nor an examination of the Canadian nuclear fuel storage concept is part of our panel's mandate.

2.5.6 Joint Review Process

Members of the public raised the following specific concerns about the efficacy of the Environmental Assessment Review process for judging the proposals submitted.

- The degree of participation by provincial and federal government departments was uneven. The panel received considerable technical information from some government agencies, but was unable to obtain sufficient information from others. Of the information received, some was extensive, technically suitable and well prepared, whereas other information was of limited benefit to either the public or the panel.
- Some participants found the length of time provided during technical sessions insufficient for asking questions and obtaining information from available experts. Similarly, technical presenters did not always have sufficient time to present all relevant information or to respond to public and panel questions.
- Some participants were concerned that undue emphasis would be placed on technical rather than non-technical considerations such as values, theological and spiritual beliefs, morality, and fairness. The panel has endeavoured to ensure that this was not the case.
- In the northern communities visited, only the proponents were allotted time to make presentations at each and every location. Since the proponents presented primarily the beneficial impacts of the proposals, an unrealistic image may have been created for members of the public. The suggestion was made that, if opponents of proposals were given similar time to present the negative factors of the proposals, fairer public consideration of issues could be achieved.
- The panel maintains its position that procedures which permitted only local residents to make presentations at community public hearings were fair and just. This participation format avoided public appearances by out-of-community residents that would have been repetitive for the panel. At many sites, due to the large number of local participants eager to make presentations, the addition of extra-community speakers would have taken up considerable time, and might have inhibited local participation.

⁷⁷ *Saskatchewan Electrical Energy Options*, Saskatchewan Electrical Energy Options Review Panel Final Report to **SaskPower**, November, 1991, Section 3.3.2.4, p. 21-22.

⁷⁸ Environmental Assessment Panel on the Nuclear Fuel Waste Management and Disposal Concept.

- A concern was raised that only three of the uranium mining proposals were being reviewed at this time, with other mining proposals being reviewed separately. Particular concern was expressed that it might not be possible to **properly** assess cumulative effects.
- The lack of legal process by which the public hearings were conducted was considered a positive feature. In particular, members of northern communities participated with less perceived restraint. The panel believes that legal procedures during public hearings require considerable expense to develop and maintain, and inhibit public input.
- The EIS review process should be streamlined to prevent unnecessary and lengthy delays in the approval or rejection process. Present review intervals may take in excess of **3-5** years. In the Midwest Joint Venture proposal, for example, initial project review began in 1989, and has only now reached the public hearing review phase. Proponents are concerned that lengthy review processes may detrimentally affect the economic viability of ventures. Fixed contract intervals and development start-up schedules often determine the financial success of ventures, as well as the long term cost to establish, maintain and conduct the EIS review itself.
- Many of the recommendations of the earlier Key and Cluff Lake inquiries, following public consultation and reviews similar to those conducted by this panel, have not been acted upon. The public perception is that recommendations made by the present panel may also not be acted upon by government. This would defeat the intent of the review process and negate the considerable efforts made by the panel, members of the public, proponents, and government departments to conclude a full and fair review.

Future environmental review panels and both federal and provincial branches of government should evaluate these public concerns. Government response should be prompt to all issues brought forward in this report. Reasons for accepting or rejecting recommendations should be clearly stated for public dissemination.

... the frustrations you may hear today...is because there's been so many promises, so many panels, but basically nothing has been done.

His Worship **B. Belanger**, *Transcript of Public Hearings, Ile-à-la-Crosse, Saskatchewan, April 16, 1993, p. 36.*

2.5.7 Public Acceptance of Uranium Mining

A public opinion survey ascertained that approximately **three-quarters** of the provincial population were in favour of the continuation of uranium mining.⁷⁹ It was noted that **women were less supportive than men. General opposition to this industry by 25% of the population suggests that opponents can not be dismissed as a small group of environmental or anti-nuclear activists. Moreover, as noted by one presenter, a *Star Phoenix* poll found that more than two-thirds (67.4%) of the respondents did not want uranium sold for use in nuclear weapons.**⁸⁰

The "deep ecologist" view would suggest that a moratorium on all such activity be instituted; persons should strive to live in harmony with the pristine environment, avoiding any potential for disruption. On the other hand, the "pragmatic" view suggests that poverty is currently a greater threat to the health of northerners than is radiation.

Ideally there should be no necessity to choose between jobs and the environment; sustainable development principles suggest that the two can coexist. Some environmentalists argue that uranium mining could be rejected, with the needed economic development provided through alternative **non-mega-project** options. Uranium mining proponents, on the other hand, insist that the environment can be maintained and restored to an almost pristine state, posing no direct or indirect threats to human health or well-being.

Thus, the philosophy brought to the specific recommendations in the following chapters is one of proceeding with cautious development. This should be done to ensure the maximum benefit to the people of Saskatchewan, and particularly to the impacted communities.

Saskatchewan is a leader in the uranium industry. It has developed competitive mines, a highly skilled workforce, and the technical expertise second to none.

E. J. Hinz, *Transcript of Public Hearings, Saskatoon, Saskatchewan, May 14, 1993, p. 271.*

⁷⁹ D. Fast, *Transcript of Public Hearings, Saskatoon, Saskatchewan, May 4, 1993, p. 233-246.*

⁸⁰ *Star Phoenix*, October 22, 1988, p. 1.

3.0 THE DOMINIQUE-JANINE EXTENSION

3.1 Project Description and Site Map

The Cluff Mining Partnership is seeking authorization for an extension to its open pit mining operation at Cluff Lake. The Cluff Mining Partnership is comprised of Cogema Resources Ltd. (80%), which is the operator of the partnership, and Corona Grande Exploration Corporation (20%). In the balance of the report, Cogema Resources Ltd. will be referred to as the responsible party for the proposal under review.

The proposed Dominique-Janine Extension is approximately 75 km south of Lake Athabasca and 15 km east of the provincial border with Alberta, in the southern portion of the **Carswell Structure**. The water systems in the area of the site drain through interconnected lakes and small rivers into the Douglas River, which flows northwest, eventually emptying into Lake Athabasca.

Since early 1980, the Cluff Mining Partnership had been mining and milling ore from several deposits adjacent to the proposed Dominique-Janine Extension. Open-pit extraction of ore from the northern part of the Dominique-Janine ore body began in early 1989, and was completed by the end of December, 1991.

Data from a drilling exploration program indicated that the zone of mineralization for the Dominique-Janine ore body extended continuously southward from the open pit to the edge of Cluff Lake. Mining this additional mineralization, a **10-million cubic metre open pit project**, is the purpose of the **Dominique-Janine Extension** proposed for review by Cogema (see figure 2).

The Dominique-Janine Extension, approximately 650 m long by 350 m wide, would extend **100-150 m** into Cluff Lake. The southern rim of the pit would be approximately 25 m below the current lake level, and the final pit floor might be as much as 125 m below. Construction of a perimeter dam around the southern rim of the Dominique-Janine Extension open pit, to control the inflow of lake water into the pit, has been proposed. Dewatering wells would be installed between the dam and the pit rim to control seepage which might pass under or through the barrier wall; water collected in these wells during the mining period would be pumped back to Cluff Lake. Additional rock mined from the proposed extension would be placed under water in Cluff Lake. Although the original EIS envisaged also putting special waste in the dike, the revised project description proposes to dispose of the special waste in the mined-out Claude Pit. The rationale for underwater waste disposal is to minimize oxidation of the waste rock and subsequent generation of acid.

During decommissioning, Cogema proposes the reclamation and revegetation of ground surface areas after the removal of all constructed surface structures and buildings. Accumulated waste rock in Cluff Lake would create a new dry land area which would also be reclaimed and vegetated. The dam structure would be left intact, with water flooding the pit progressively until the level reached that of Cluff Lake. Cogema would

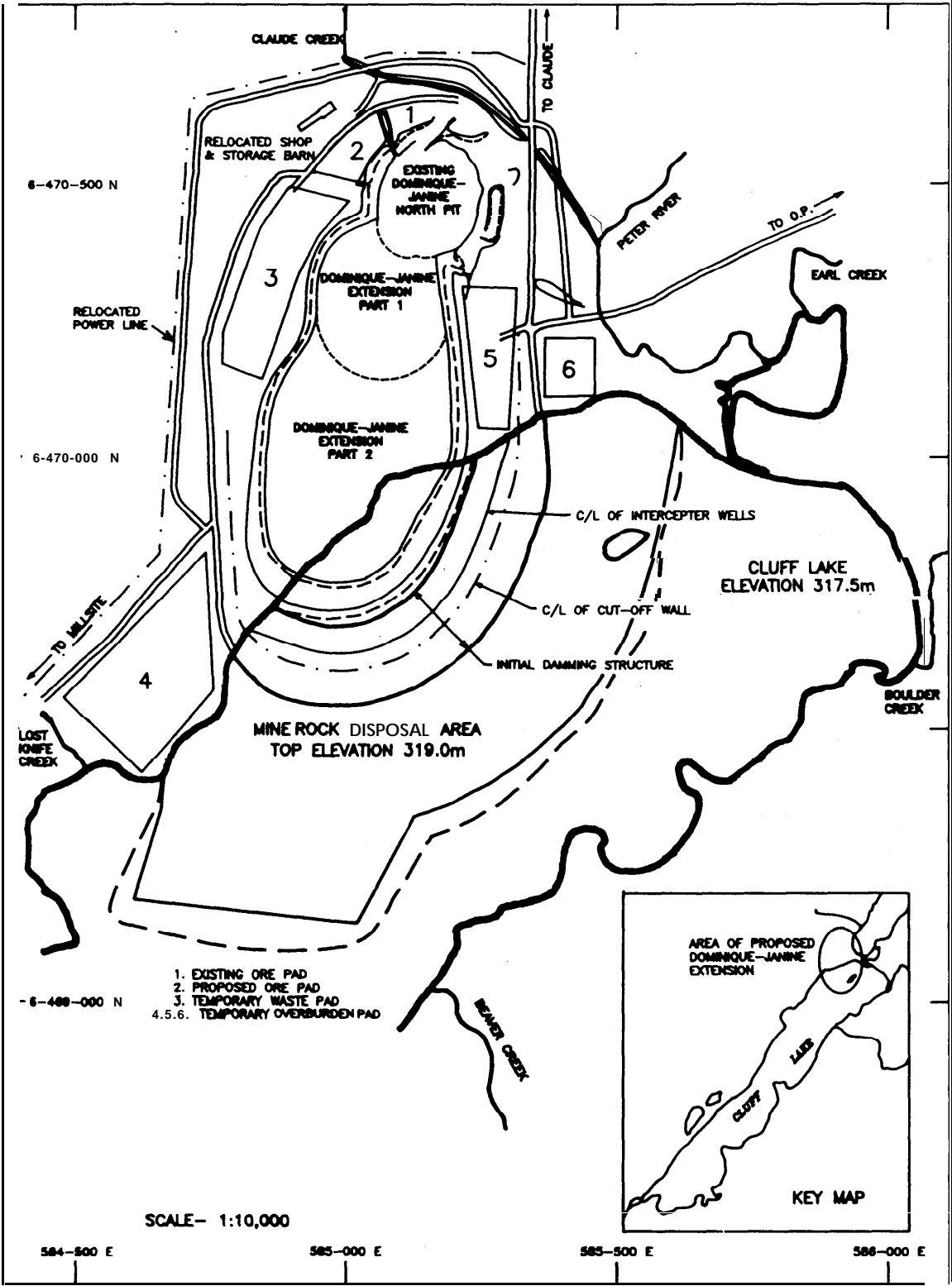
monitor the quality of the pit water until provincial regulatory limits were met. At that time, it is proposed that a channel be constructed to connect the pit with Cluff Lake.

3.2 Recommendations

The socio-economic benefits associated with this proposed extension to the Dominique-Janine mine at Cluff Lake will be significant. The health and environmental risks, incremental to those already in existence, could be reduced to acceptable limits provided certain conditions are met. The proponent has, in the past, demonstrated respect for the local environment, concern for worker health, and interest in the socio-economic well-being of the residents of the impacted communities. With the expectation that these positive attitudes will continue, we recommend approval of this project subject to implementation of the following conditions:

1. establishment of a new Human Resource Development Agreement in which Cogema be required to select a minimum of 50% of its new employees from residents of the primarily-impacted communities and a minimum of 30% from residents of the secondarily-impacted communities. These conditions should also apply to contractors and sub-contractors;
2. agreement on a form of revenue sharing that is acceptable to the majority of the impacted communities;
3. establishment of a monitoring committee (as described in section 2.2.6) for the Cluff Lake Mine;
4. provision of a financial guarantee to cover decommissioning and post-decommissioning costs;
5. adoption of the exposure standards recommended in Publication 60 of the International Commission on Radiation Protection (ICRP-60) without allowing the collective dose to increase;
6. completion of a review of worker health training programs;
7. establishment of mechanisms for conducting an **epidemiological** study of the health of current and former workers at the Cluff Lake mine;
8. establishment of an air quality monitoring program using moss pillows and development of a system for monitoring the quality of the groundwater in the vicinity of the Claude pit;
9. evaluation and selection of a different option for deposition of waste rock. Only innocuous waste should be disposed of in Cluff Lake. Options for disposing of other waste rock in the Claude and Dominique-Janine pits should be evaluated. The Claude pit should be decommissioned by filling it with rock capped by clean overburden;

Figure 2
Dominique-Janine Extension



10. establishment of a research fund to support the search for innovative ways of reducing the volume of effluent released and the quantity of chemicals required to treat contaminated water;
11. development of site-specific water quality objectives, establishment of a program to reduce contaminated mine water inflows, and assessment of the possible impacts to the Island Lake watershed;
12. specification of total environmental loading for the mine, and development of a material-balance for contaminants in all liquid effluent;
13. evaluation of alternative oxidants that could replace sodium chlorate in the leaching process and thereby permit recycling of mill effluent;
14. use of the Environmental Transfer Pathway model (ETP/AECB) as the focus for an integrated monitoring program, and the assessment of cumulative effects;
15. agreement that the decommissioned Dominique-Janine pit not be connected to Cluff Lake, and that Claude Creek not be rerouted to flow through the decommissioned pit; and
16. evaluation of alternative methods of tailings disposal, with the goal of closing down the present tailings management facility as soon as possible.

3.3 Biophysical Concerns

3.3.1 Air Quality

Public concern over the release of radioactive dust and radon (along with the subsequent deposition of radon progeny) has been discussed in section 2.3.3. This concern could be assessed more critically if a better designed monitoring program were prepared.

The results of monitoring air quality at Cluff Lake have been reviewed by Swanson⁸¹ who concluded that high-volume sampling should be continued, but that the use of dustfall jars for monitoring aerial deposition should be replaced by a system using "lichen/moss pillows". Preliminary use of the latter in 1985-86 yielded interesting results. Some data suggest that most aerial deposition of contaminants occurs within 3 km of the mill but other data indicate a much larger radius of deposition. A better designed monitoring program would settle this issue.

The panel recommends that air quality monitoring be augmented by the use of "moss pillows" to map the aerial deposition of contaminants. Such a procedure need not be conducted yearly, but could be part of a comprehensive system of ecosystem monitoring conducted two or three times each decade.

⁸¹ Swanson, *Cluff Lake: Status of the Environment Report*.

⁸² *Review of the Cogema Environmental Impact Statement, Dominique-Janine Extension, Addendum A and B*, Atomic Energy Control Board, submission to the panel, March 18, 1993, p. 2.

3.3.2 Hydrogeology

Cogema proposes to dewater the extended Dominique-Janine (D-J) pit using interceptor wells in the dam and pumping from sumps in the bottom and walls of the pit. Uncontaminated water would be discharged into Cluff Lake, and contaminated water diverted for water treatment before discharge into Island Lake. The volume of contaminated mine-water that would require treatment prior to discharge to the environment is not known at this time. There is a possibility of exceeding the capacity of the water treatment facility; it would need to be more than doubled if all of the intercepted water required treatment. Cogema has stated that it would expand the water treatment plant, if necessary, but has not evaluated the overall impacts to the aquatic environment should this scenario become a reality. The panel notes that this concern is shared by the AECB⁸² and will, therefore, be addressed during the normal licensing procedure. A recommendation to reduce the volume of contaminated mine-water inflow is made in section 3.3.4.

There is also a concern that water from Claude pit, which will have special wastes placed in it, may flow and pollute nearby water bodies.⁸³ **The panel recommends that groundwater around Claude pit be monitored to determine if contaminants would move from the pit.**

3.3.3 Waste Rock Management

For management purposes the waste rock is classified into one of three categories: special waste (containing 0.05%-0.1% U_3O_8 , and readily soluble material); other waste rock, with a potential acid-generating capacity; and clean waste rock. The clean waste rock would be used to construct a dam to separate the D-J pit from Cluff Lake; the special waste would be placed in the mined-out Claude pit and covered with till or other waste rock; and the bulk of the other waste rock would be placed in Cluff Lake to form a large flat area reaching to 1-2 m above lake level. The objective of the subaqueous disposal for the majority of the waste rock is to prevent its oxidation and subsequent generation of acid.

There are three main concerns. First, the classification of waste rock is an issue. The Mineral Industry Environmental Protection Branch of Saskatchewan considers special waste to be 0.03%-0.1% U_3O_8 rather than the criterium used by Cogema. In addition, it may be difficult to separate clean waste rock from waste rock with acid-generating potential under field conditions. Second, the placement of the bulk of the waste rock in Cluff Lake may cause problems of turbidity that would adversely affect the water quality of the lake. Third, if the disposal of rock in Cluff Lake fails to prevent acid generation, it would be an extremely difficult problem to mitigate.

These concerns, together with others relative to the decommissioning plans for the D-J and Claude pits (see section 3.3.8), would be addressed if all of the waste rock, with the

⁸³ *Technical Review of the Dominique-Janine Extension*, Department of Fisheries and Oceans, submission to panel, January, 1993.

exception of that required for the dam, were disposed of in the Claude and mined-out D-J pits. Special waste could be disposed of in both pits allowing Claude to be decommissioned prior to the complete excavation of the D-J extension. With a suitable cover of clean overburden, it might not be necessary to separate innocuous and potentially acid-generating waste rock. Waste rock disposed of in this fashion would not be exposed to atmospheric oxygen, nor subject to wind and wave erosion, as would be the case if it were placed in Cluff Lake.

The panel recommends that only innocuous waste be disposed of in Cluff Lake and that options for disposing of other waste rock in the Claude and Dominique-Janine pits be fully evaluated. The Claude pit should be decommissioned by filling it with rock, capped with clean overburden, as opposed to allowing it to flood.

3.3.4 Surface Waters and Fisheries

The panel has requested additional information on the Island Lake watershed (specifically on cumulative environmental impacts, aquatic community structure, aquatic bioaccumulation, and predicted impacts to the aquatic environment).⁸⁴ The proponent is currently conducting a field study, but the final report will not be available until the end of 1993 or early 1994.⁸⁵ The panel notes, however, that sufficient background information to assess impacts to the Island Lake watershed will have been collected prior to any expansion of mining at Cluff Lake and recommends that the regulatory agencies evaluate the impacts before a licence is granted.

Issues relating to the release of liquid mine effluent (in this instance into the Island Lake watershed) are discussed in section 2.3.2. That section provides the rationale for the following three recommendations. First, the panel recommends that the Cluff Lake mine participate in the establishment of a research fund to support the search for innovative ways of reducing the volume of effluent released and the quantity of chemicals required to treat contaminated water. Second, the panel recommends that site-specific water quality objectives be developed for the Cluff Lake mine. Third, the panel recommends that the total environmental loading be specified for the Cluff Lake mine and that a material-balance be developed for all contaminants in the liquid effluent.

There are two further specific recommendations related to reducing the volume of effluent. First, it may be possible to reduce the volume of contaminated mine-water inflow by placing a network of dewatering wells around the entire pit, not just in the dam structure. If the intercepted water were sufficiently clean to be released directly into Cluff Lake, effluent loading to the Island Lake watershed would be reduced. The panel recommends that attempts be made to reduce contaminated mine-water inflows. Second, because the Cluff Lake mill uses sodium chlorate as an oxidant in the leaching circuit, the mill effluent contains a high chloride content and,

therefore, cannot be recycled. There may be alternative oxidants that could be used in the leaching circuit which would allow the mill effluent to be recycled, thereby reducing effluent loading to the receiving environment. **The panel recommends evaluation of alternative oxidants that could replace sodium chlorate in the Cluff Lake mill.**

3.3.5 Wildlife and Terrestrial Habitat

It is unlikely that the D-J extension by itself would have major impacts on the terrestrial environment. Rather the concern is with possible cumulative effects (see section 3.3.7) and whether certain rare plants, that are known to occur in the Cluff Lake area, might be affected by mining activity. The panel notes that Cogema Resources Ltd. has undertaken an inventory of rare plants around Cluff Lake, the results of which should be available to the regulatory agencies before licences to proceed are granted.

3.3.6 Monitoring

The panel's general recommendations on monitoring are dealt with in section 2.2.6. Some of the particulars of air quality monitoring have been recommended in section 3.3.1. Monitoring of the aquatic environment should focus on the Cluff Lake drainage system and the Island Lake watershed. In keeping with the arguments advanced in section 2.3.1, the panel recommends that the Environmental Transfer Pathway model (ETP/AECB) be used as the focus for integrating the monitoring program at Cluff Lake. The general design of the monitoring program should be common to all uranium mines. This will guarantee the consistent replication of treatments required to determine biological effects monitoring and eventually produce the database necessary for the study of cumulative biophysical impacts.

3.3.7 Cumulative Effects

The location of the Cluff Lake mine is such that cumulative biophysical effects involving other uranium mines are likely to be so small as to be undetectable. Thus, the cumulative effects of concern will be those involving a single mine; these have been discussed in section 2.3.6.

Probably the most significant cumulative effect at Cluff Lake would be that generated by the liquid effluent over time. Metals and radionuclides are being concentrated in the sediments and it is not known how this would impact aquatic ecosystems in the Island Lake watershed (see sections 2.3.6 and 3.3.4). **The panel recommends cumulative effects be assessed using the ETP/AECB model and that a whole ecosystem approach to monitoring be adopted, as specified in section 2.3.1.**

Sediment quality guidelines should be established, as discussed in section 2.3.6.

⁸⁴ Request for Additional Information on the Dominique-Janine Extension, Joint Federal/Provincial Panel on Uranium Mining Developments in Northern Saskatchewan, October, 1992.

⁸⁵ Dominique-Janine Expansion Project Request for Additional Information by the Joint Federal/Provincial Panel, Terrestrial Aquatic Environmental Managers Ltd., May, 1993.

3.3.8 Decommissioning and Site Reclamation

Cogema proposes to decommission the mined-out **Dominique-Janine** pit by allowing it to fill with water. Once the quality of the pit water meets the Saskatchewan Surface Water Quality Objectives, the proponent plans to breach the dam wall, connect the flooded pit to Cluff Lake, and to reroute Claude Creek so that it drains through the flooded pit.

As indicated in section 3.3.3, the panel recommends that the Claude pit be filled with waste rock and capped with till. The balance of the waste rock would then be deposited in the D-J pit. However, since there would not be enough rock to completely fill the D-J pit, it would be partially flooded. In such an event, it is recommended **that the Dominique-Janine pit not be connected to Cluff Lake and that Claude Creek not be rerouted to flow through the decommissioned pit.** Containment of contamination is more desirable than dilution.

There is also concern about the long-term containment of tailings and associated contaminants in above ground structures (see section 2.3.4). **The panel recommends that Cogema evaluate alternative methods of tailings disposal that are less subject to surface erosion and infiltration by precipitation than the present tailings management facility.** The objective is to close down the use of the present tailings management facility as soon as possible.

The need for a decommissioning fund, guaranteed to be available regardless of the financial capabilities of the mine owners, has been discussed in section 2.3.5. In keeping with the arguments advanced therein, it **is recommended that a financial guarantee to cover decommissioning and post-decommissioning costs be secured before the D-J Extension is approved.**

3.4 Socio-Economic Concerns

With the economic times so uncertain, mining and exploration in northern Saskatchewan is one of the very few bright spots the province has.

L. Wolkowsky, *Transcript of Public Hearings, La Ronge, Saskatchewan, April 16, 1993, p. 24.*

3.4.1 Human Resource Development Agreement

During the public hearings, Cogema indicated that it anticipated a large percentage of the new employees for the expansion of the D-J pit would be **northerners.**⁸⁶ **It is, therefore, recommended that a new Human Resource Development Agreement be established in which Cogema be required to select a minimum of 50% of its new employees from residents of the primarily-impacted communities and a**

minimum of 30% from the secondarily-impacted communities. (A further rationale for this recommendation can be found in section 2.2.2.)

3.4.2 Revenue Sharing

The need for governments to establish a mechanism for sharing revenues with the impacted communities has previously been discussed in section 2.2.1 and it is **strongly recommended that the Dominique-Janine Extension not be allowed to proceed until a form of revenue sharing, acceptable to the majority of impacted communities, has been agreed upon.**

3.4.3 Monitoring Committee

The establishment of a monitoring committee for the mine site would provide a mechanism through which the public could receive information from an independent source about the operation of the mine with respect to biophysical impacts, results of health studies, compliance with regulations, employment practices and other economic opportunities for northerners. **It is, therefore, recommended that the provincial government establish a monitoring committee (as described in section 2.2.6) for the Cluff Lake mine.**

3.5 Health Concerns

3.5.1 Occupational Health

The panel was favourably impressed with the safety record of Cogema, and with its efforts to train workers regarding health hazards. However, it is important to continue to promote the highest possible level of worker health, safety and well-being. The proponent's commitment to this area, along with the involvement of its union, the vigilant efforts of the regulators, and the watchful eye of a community monitoring committee should permit this project to proceed with an acceptable degree of risk.

The general comments in section 2.4.1. apply to this project as well. Specifically, **the exposure standards recommended in ICRP-60 should be adopted, without allowing an increase in the collective dose, and mechanisms for conducting an epidemiological study of worker health should be promptly put into place.**

The workers from Cogema who appeared before the panel spoke highly of the worker monitoring and notification program at Cluff Lake. **Nonetheless, the panel believes that improvements can be made in worker notification; i.e. by providing more easily understandable explanations of the significance of the reported numbers.** Consultation with adult educators in the impacted communities may assist the authorities at Cluff Lake in identifying methods to best accomplish this goal. The proponent should also ensure sufficient availability of occupational health practitioners to address worker health concerns.

⁸⁶ M. Poissonnet, *Transcript of Public Hearings, La Loche, Saskatchewan, April 20, 1993, p. 132.*

3.5.2 Community Health

The proponent has made efforts to inform the impacted communities concerning mine issues. With the assistance of the

proposed monitoring committee, similar attention should be directed to the other health concerns discussed in chapter 2.

4.0 MIDWEST JOINT VENTURE

4.1 Project Description and Site Map

At the time public hearings began, Denison Mines Limited, as project operator for the Midwest Joint Venture (MJV), was seeking approval to develop an underground uranium mine at South **McMahon** Lake. The MJV was comprised of Total Minatco Ltd. (56%), Denison Mines Limited (19.5%), OURD [Canada] (4.5%), and Uranerz Exploration and Mining Limited (20%). During the hearings, the panel learned that Cogema Resources Ltd. would be purchasing the project. At the close of the public hearings on May 20, 1993, the panel was unclear with respect to the ultimate ownership of the Midwest Joint Venture.

The uranium deposit which MJV proposes to develop is located close to Points North and about 20 km west of the **McClellan** Lake site. It is connected to Highway 905 by a 2 km local access road.

Mineralization was discovered in 1977 and by 1980, 442 holes had been drilled in an attempt to delineate the deposit. An Environmental Impact Statement was submitted in 1981 for a proposal including open pit mining and on-site milling of the ore. A formal review was not initiated in 1981, due to a corporate decision to defer development of the project. Ownership of the project changed in 1987 with Midwest Joint Venture acquiring the property and becoming the operator.

Midwest Joint Venture obtained approvals in 1988 to proceed with an exploration program to assess underground conditions including the geotechnical and hydrogeological environment, and to gather data to evaluate potential mining methods. MJV's 1991 proposal and its subsequent amendment are based on information collected from the test mining project.

In 1991, Midwest Joint Venture applied for approval to construct and develop an underground mine, a mill and a tailings disposal area. This proposal was amended in September, 1992, to reflect the decision by the MJV and Total Minatco to develop their respective ore bodies on a complementary basis. The Midwest Joint Venture now proposes to mill its ore at the proposed **McClellan** Lake mill or at Cameco's Rabbit Lake mill. Its tailings would be disposed of in either the JEB open pit, (enlarged to provide the required capacity), or the Rabbit Lake pit. The MJV proposal now also includes the building of a plant at the mine site for treatment of contaminated surface and underground water (see figure 3).

The Midwest ore body lies under the Mink Arm of South **McMahon** Lake. Because most of the exploration holes drilled into the ore body were not cemented off, it is proposed that Mink Arm be dewatered to minimize flow of surface water into the underground workings.

The shaft sunk for the test mine would be deepened a further 60 metres, and used for initial underground development from

the west side of Mink Arm. This shaft would later become the primary ventilation exhaust shaft, in conjunction with a smaller shaft specifically constructed for additional ventilation capacity. A production/air intake shaft would also be sunk to a depth of 220 metres on the east side of Mink Arm.

It is proposed that the mine would be developed on three levels: the drill level, the haulage level, and the drainage level.

Ore mining would occur during a six-month "summer" period. The main Midwest ore body, with an average grade of 6.2% uranium, would be mined from above, with drillers protected from radiation by a layer of barren rock. High grade ore would be removed on a lower level by shielded or remotely operated machinery. Lower grade ore would be mined manually by benching, a modified conventional method.

Ore would be either transferred directly to trucks for haulage to a mill, or stockpiled temporarily on the surface near the headframe.

4.2 Recommendation

The Midwest Joint Venture project, as described in the EIS and its Amendment, is not acceptable; the benefits that could be obtained are insufficient to balance the perceived risks. It is, therefore, recommended that permission to proceed should not be granted for reasons summarized in the following sections.

4.3 Potential Risks

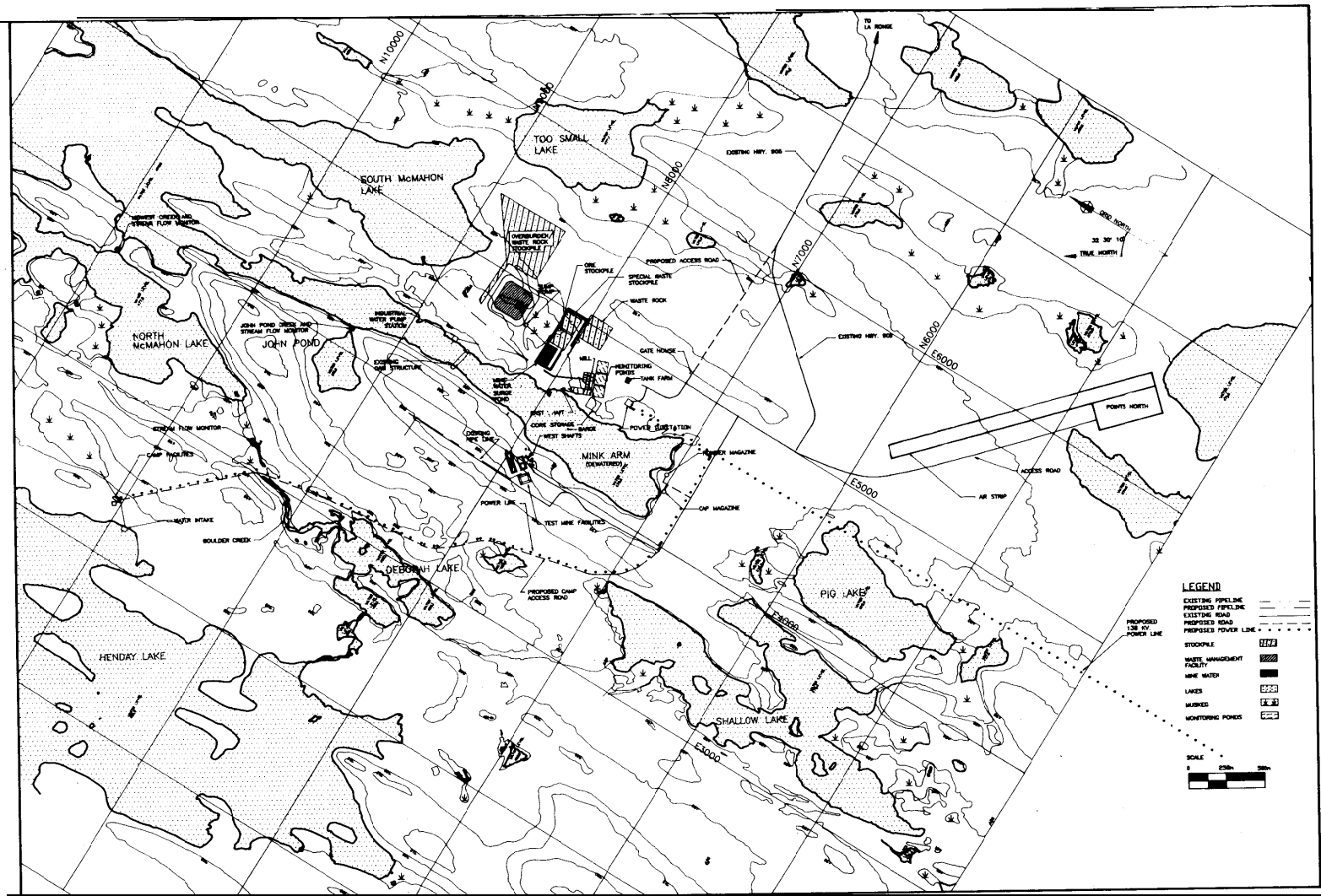
Presenters at the public hearings raised several concerns about the acceptability of this project. Those project-specific concerns determined to be most significant include:

- the use of unacceptable mining methods;
- mining, in confined underground spaces, of an ore that contains high concentrations of uranium, arsenic and nickel;
- the existence of over 600 exploration bore holes, most of them uncapped, in the vicinity of the ore body;⁸⁷
- the need to transport high grade ore on a public highway;
- the potential for environmental damage through the release of contaminated effluent into the Smith Creek watershed and the need to dewater an area of several square kilometres around the mine site;
- uncertainties in the disposal of mill tailings containing high concentrations of toxic heavy metals; and
- the contribution of this proposed mine to the combined effects of all of the mines (existing and proposed) in a relatively small area on the west side of Wollaston Lake.

between 1978 and 1980; and on page 5-I 1, the number has increased to "more than 600", due to additional exploration.

⁸⁷ *Midwest Uranium Project Environmental Impact Statement*, August, 1991, Volumes 1 and 2. On page I-I, it states that three holes were drilled in 1977; on page 1-2, it mentions 439 more

Figure 3
Midwest Joint Venture Site Plan



Each of these concerns and their attendant risks is briefly discussed below.

4.3.1 Unacceptability of Mining Methods

Midwest Joint Venture proposes the use of two underground mining methods for ore extraction. The first technique, a standard manual benching method that requires direct worker access, is proposed for use in low grade ore zones. The second, the Nqn-Entry Vertical Panel (NEVP) method in which workers are not in direct contact with the ore, is proposed for mining in higher grade ore zones. For manual benching, some mining analogs exist at the Cluff Lake Mine where it has been shown that implementation of appropriate ventilation and dust control strategies can restrict worker radiation exposure to acceptable limits. However, MJV has indicated that the average geological grade of low-grade ore approximates 1.8% U_3O_8 with some spot grades being higher? The indicated low-grade ore composition is approximately double that of Cluff Lake ore and eighteen times that of the average ore grade mined in Elliot Lake, Ontario. The EIS does not justify the use of the manual benching method nor satisfactorily indicate ore grade limits to differentiate site selection between the two principal mining techniques. Thus, the proposed benching method would expose workers to elevated risks due to gamma radiation and radon progeny.

During test mining of the Midwest deposit, high grade ore was removed using the blind raise boring technique. However, this method was eventually rejected for full-scale mining in favour of the NEVP method proposed in the EIS. Using this technique, underground workers are restricted from direct access to the **orebody** by a considerable thickness of inert waste through which remote drilling of blast holes and ore extraction operations are conducted. Broken ore is removed on an underlying haulage level utilizing either remotely controlled or shielded equipment. Any mechanical breakdowns of equipment, excavation failures or ore blockages at extraction sites would, however, require worker access to the equipment and sites to permit removal and repair. Under such conditions, workers who are not adequately shielded, either by design or by accident, would be likely to incur excessive gamma exposure.

Substantial risk to worker health is, therefore, associated with the proposed mining methods.

4.3.2 Radiological and Chemical Toxicity of the Ore

The MJV ore reserves, currently estimated at 361,000 tonnes, contain high concentrations of both arsenic (As) and nickel (Ni) as well as uranium (U).⁹⁰ Typical core samples contained

1.08 - 9.62% As, 0.94 - 4.80% Ni and 0.25 - 11.8% U.⁹⁰ Since arsenic and nickel are toxic and uranium is both toxic and radioactive, inhalation or ingestion of ore dust could cause chemical and radiological health impacts on the workers. All three exposures (arsenic, nickel and alpha radiation) have been linked to elevated risks of lung cancer, as discussed in section 2.4.1.

Of particular concern is the possible synergistic effect resulting from occupational exposure to high concentrations of both uranium and arsenic as discussed in section 2.4.1.2. The potential health risk when all three exposures are present has not been adequately studied. In confined underground spaces, workers might undergo continuous exposure to toxic, radioactive dusts causing an unacceptable level of occupational health risk.

4.3.3 Uncapped Bore Holes

During the exploration phase of this project, over 600 bore holes were drilled in an attempt to define the location and quality of the ore body. These holes, the majority of them remaining uncapped and open, now present a **sizeable** risk to the health of miners attempting to remove ore from below, as they create a potential for unrestricted flow of surface and subsurface radioactive water into the mine **workings**.⁹¹

Ground water at the Midwest Joint Venture site characteristically exhibits the presence of high concentrations of radon which can pose serious worker exposure and health problems if adequate interception and drainage is not provided. Despite the proposed dewatering of Mink Arm, significant groundwater inflows would continue to occur through the overlying, altered Athabasca sandstones, especially during the development stage of the proposed mine.⁹² The installation of dewatering wells to systematically drain the overlying rock strata would reduce, but not eliminate, inflow through these drill holes. Any undrained portions of subsurface waters and additional quantities of surface waters due to local rainfall would remain unaffected by dewatering. Such radon-bearing water would, therefore, pose a hazard to underground workers.

Should failure of all or part of the dewatering system occur, rapid build-up of mine water inflows might result? During test mining, three water-bearing drill holes were intercepted by the single access drift that was being advanced. Such holes were successfully capped, at depth, and it was possible to transport water flows away from worker-occupied sites. However, should drill hole interceptions occur within unoccupied sites, where remotely controlled equipment must be used, the ability to cap them becomes problematic. Consequent excess water and radon/radon progeny inflow to the mine would create an additional exposure risk to workers.

⁹⁰ Midwest Uranium Project *Environmental Impact Statement*, August, 1991, Volume 2, "Project Description", Section 5.3.7, p. 5-74.

⁹⁰ Midwest Uranium Project *Environmental Impact Statement*, August, 1991, Volume 2, "Project Description", Section 5.2.1.3, p. 5-9.

⁹⁰ Midwest Uranium Project *Environmental Impact Statement*, August, 1991, Volume 2, "Project Description", Section 5.2.2.1, Table 5.2.1.3, "Analyses of Typical Ore Samples."

⁹¹ Midwest Uranium Project *Environmental Impact Statement*, August, 1991, Volume 2, *Project Description*, Section 5.3.2.2, p. 5-47

⁹² Midwest Uranium Project *Environmental Impact Statement*, August, 1991, Volume 2, *Project Description*, Section 5.2.3.3, p. 5-32

⁹³ Midwest Uranium Project *Environmental Impact Statement*, August, 1991, Volume 2, *Project Description*, Section 5.2.3.4, p. 5-33

4.3.4 Transportation Hazards

Midwest Joint Venture proposes to transport mined ore over a considerable distance (30-50 km) for milling. This might put worker health at risk due to possible radiation exposure created by release of radioactive dust and the proximity of truck drivers to large volumes of high grade, gamma-emitting ore. While the concept of complementary utilization of existing or proposed mills is commendable, the potential exposure of transport workers to radiation and dust must be considered.

The need to transport large volumes of ore using Highway 905 could also present a significant health risk to the public. Increased traffic, along with the inevitable accidents and spills, could cause both physical and psychological effects on community health. In addition, mine-related traffic accidents could inconvenience travellers and could have a serious impact on various local businesses that depend on Highway 905.

The proponent has indicated that a plan to directly link the Midwest and McClean Lake sites, thereby reducing road length and consequent driver exposure, was considered and rejected. Adoption of such a closed, direct haul route to the McClean Lake mill would also have reduced potential public exposure to possible radioactive contaminants, and decreased traffic disruption on Highway 905. No reason has been presented by the proponent for rejecting this transport option.

4.3.5 Surface Water Impacts

In order to reduce mine water inflows, MJV proposes to pump the water in Mink Arm over an already constructed dam into South McMahon Lake and to remove subsurface water by the installation of a number of dewatering wells in the vicinity of the mine. In the short-term, this would have a drastic effect on the environment; all aquatic life in Mink Arm would be destroyed, bogs and fens would dry up, and terrestrial vegetation would suffer from the lack of moisture in the soil. The long-term effects, although difficult to predict, would depend to a large extent on the decommissioning and restoration programs employed.

During mining, all treated mine water would be released into North McMahon Lake. Such releases, projected to range between 61,000 - 400,000 m³/month during the entire project lifetime, would contain substantial amounts of various dissolved solids. The achievable effluent concentrations of the sixteen principal contaminants to be released into North McMahon Lake have been modelled and several metals, such as cadmium, copper, and nickel (as well as ammonia) are expected to exist at levels higher than provincially-legislated standards.

Furthermore, as discussed in section 2.3.2, surface water impacts reflect only the transient state of water quality. In many respects, total loading to the watershed, and particularly to the sediments therein, is more important. These have not been adequately addressed by the proponent.

4.3.6 Hydrogeological Impacts

Midwest Joint Venture proposes to dewater the Mink Arm of South McMahon Lake, as well as subsurface zones about the Midwest orebody. The consequences of dewatering would be a depression of the existing groundwater table and reduction of hydrogeologic flows over at least the eleven-year period of mining.

As with the other mine proposals, the panel and regulators consider the assessment of baseline hydrogeologic data to be very important in determining the impacts of a mining operation on the environment. Midwest's assessment of existing hydrogeologic conditions is based on data collected over one decade ago, and limited to data from areas lying largely within the MJV lease boundaries. The proponent has not evaluated recent hydrogeologic conditions of its lease or of regional areas adjacent to it. Nor has MJV done an assessment of the predicted hydrogeologic flow disruptions expected to result from dewatering. Accordingly, the baseline data and flow modelling presented are inadequate for the purpose of environmental assessment.

4.3.7 Disposal of Mill Tailings

Because the MJV ore is laden with toxic heavy metals, particularly arsenic and nickel, the mill tailings and effluent would necessarily contain the same elements. The problems associated with the disposal of such dangerous tailings have not been adequately addressed by the proponent. Their suggestion that disposal would take place at either the JEB or the Rabbit Lake sites overlooks the fact that neither of these disposal facilities has been approved to accept MJV tailings.

Safe disposal of mill tailings, a major environmental concern of several presentations at the public hearings, has not been adequately addressed by the proponent.

4.3.8 Cumulative Impacts

Cumulative impacts on that portion of the Athabasca Basin west of Wollaston Lake and south of Hatchet Lake (approximating the Smith Creek and Collins Creek watersheds) might be considerable. Several existing or potential mining operations are close to the MJV site. While the area actually used by the mining operations would be small, the overall effect of the operations, with the possibilities for interconnecting roads and power lines, would be widespread. Some of the lakes and streams would become unsuitable for fish and it is likely that most of the game animals would leave the area. As a result, the entire area might become unproductive for traditional hunting, fishing and gathering activities. Even if opportunities for such activities were not eliminated, local people might choose not to use land adjacent to the mines as a source of food. Approval of the MJV project would further increase this problem.

When this portion of the Athabasca Basin is viewed in a regional context, it is evident that several existing and potential mining operations are close to the Midwest Joint Venture/McClean Lake sites. The risk of air pollution, particularly by the release of radon and its progeny, increases when several mining sites are located in the same area.

Similarly, cumulative impacts to the Smith Creek and Collins Creek **watersheds have not been examined in sufficient detail**. Total **downstream** deposition quantities, sites of deposition and the capabilities of sediments, biota, etc. to absorb such discharges have not been adequately addressed. In particular, little attention has been paid to the possibility that milling of the MJV ore, with its high nickel and arsenic content, could cause an increase of contaminants in the mill effluent. As discussed in section 5.3.4, this could result in enhanced risk to the Collins Creek watershed.

*When we look around in our communities here in the **Athabasca region**, we have a lot of **water** which we still **enjoy...our water** is still fresh. When you look at the **water and rivers** in south Saskatchewan, and North and South Saskatchewan River, how many **people** are going to go down to the shore and make tea with that water? That's why **when we see** those **types** of things, we see that you can't enjoy a cup of tea from that water, that we want to **protect** our future water resources as well.*

B. Sandypoint, *Transcript of Public Hearings, Black Lake, Saskatchewan, April 13, 1993, p. 62.*

4.4 Potential Benefits

Benefits associated with this project include the following:

- employment, particularly for northerners;
- business opportunities; and
- royalties and taxes.

The potential for each of these benefits to contribute to improved socio-economic conditions is briefly discussed in this section.

4.4.1 Employment

The complementary Midwest Joint **Venture/McClean** Lake mining proposal forecasts the creation of approximately 95 new jobs at the MJV site. It is not clear how many of these jobs would be seasonal since mining is proposed only for summer months. Some positions at the JEB mill would also be extended. Based on present hiring practices by mining companies within the Athabasca Basin, about 50% of these positions would be filled by northerners. An obvious benefit would **result**.

4.4.2 Business Opportunities

Approval of this project would provide mining contractors, engineering firms, and related businesses with an opportunity for more work. Presenters at the public hearings indicated that

such possibilities would be welcomed by the Saskatchewan business community, particularly in the present economic climate. This project could, therefore, provide needed economic benefits.

It appears, however, that the work associated with the MJV mine would be of most benefit to firms operating from the southern part of the province; the proposal does not offer substantial business opportunities to the north, nor does the EIS propose contracting practices or surface lease agreement clauses significantly favouring northern development. Direct benefits to the northern economy through increased business opportunities for northerners would, therefore, appear to be minimal.

*...**objectivity** is difficult to maintain **after** seeing years and years of so-called **northern** development result in continual poverty, social problems, unemployment, substandard health services, etc.*

His Worship B. Belanger, *Transcript of Public Hearings, Ile-à-la-Crosse, Saskatchewan, April 16, 1993, p. 31.*

4.4.3 Royalties and Taxes

Low uranium prices during the last decade have provided little assurance that present and future uranium mining ventures can remain economically viable. Oversupply of uranium, with consequent low prices, has caused the provincial royalties during the period of 1978-1992 to be much less than expected. Several public hearing participants expressed concern that, if prices remain low (or drop even further), negligible benefits from this non-renewable resource would accrue.

Although the MJV mine was initially proposed in 1991 as a stand-alone project, the Amendment issued in October, 1992, suggested the situation had significantly changed in a period of only a few months. It appeared that an independent mine was now no longer viable as indicated by the statement, *"...given the conditions of today's markets, it is doubtful that the Midwest project would be economical on a stand-alone basis".*⁹⁴ The impression is thereby left that the financial viability of the project is tenuous. It is difficult to justify the environmental damage this project would cause when its profitability may be doubtful. Low profitability would also reduce possible revenue sharing with northern communities.

4.5 Risks Versus Benefits

An objective assessment of the risks and benefits described in the preceding sections requires the conclusion that the project not be allowed to proceed. The substantial risks to worker and community health, along with significant potential for environmental damage, are not balanced by the projected economic benefits.

⁹⁴ *Complementary McClean Lake and Midwest Projects, Midwest Project Environmental Impact Statement Amendment, 1992, p. 1-3.*

5.0 McCLEAN LAKE PROJECT

5.1 Project Description and Site Map

At the time public hearings began, Total Minatco Ltd. was proposing development of uranium ore reserves at **McClean Lake**. Total Minatco Ltd. is a wholly owned subsidiary of TOTAL, an integrated oil and gas company based in Europe, and, with 70% interest, was to be the project operator of the McClean Lake Joint Venture. The other participants in the joint venture were Denison Mines Limited, with a 22.5% interest, and OURD (Canada), with 7.5%. During the hearings we were informed that the project would be purchased by Cogema Resources Ltd. At the close of the public hearings on May 20, 1993, the panel was unclear with respect to the ultimate ownership of the McClean Lake project.

The McClean Lake site is in northern Saskatchewan about 12 km northwest of the existing Rabbit Lake mine, and about 350 km north of the town of La Ronge. Access to the project site is by a private road from Provincial Highway 905, or by use of the airstrip at Points North.

Mineralization was discovered at McClean Lake (the McClean Lake North deposit) in January, 1979. Further exploration resulted in the discovery of the McClean Lake South deposit; the Sue A, B and C deposits, about 2.5 km to the east; and the JEB deposit, about 9 km north. Total Minatco proposes the development of the McClean Lake deposits as an underground mine and the JEB and Sue A, B and C deposits as open pit operations.

The McClean Lake deposits, at a depth of about 160 m, would be accessed by a ramp. Vertical shafts would be used for ventilation, minewater pumping and backfill transport. An ore transfer pad would be built to store ore from the underground mine temporarily before it is transported to the main stockpile. Contaminated water would be pumped approximately 2 km to the water treatment plant at the Sue site.

The open pit mining operations for the JEB and Sue A, B and C deposits would involve overburden stripping and waste rock mining, followed by mining of the ore zones. A lined ore storage pad for the stockpiling of ore would be located close to the JEB pit. The pad would be used by mining operations at all six ore bodies. Waste rock and overburden would be placed in prepared areas close to the open pits, and might be used subsequently for construction activities if tests showed the material to be suitable.

The Sue A, B and C pits would have a waste rock disposal site, a water treatment plant, contaminated-water holding ponds, and treated-water monitoring ponds.

The McClean Lake proposal includes the building of a mill complex where ore would be processed to produce **yellowcake**. A water treatment facility would be built at the mill complex, located near the JEB pit. Water collected by the drainage systems for the ore storage pad would be processed here, as would JEB minewater, collected runoff, and tailings seepage water. It would also treat mill process waste streams and tailings decant water from the mill. Treated water would be

pumped to Sink Lake for regulated discharge through Vulture Lake to McClean Lake (see figure 4).

Tailings from the milling process would be deposited in the mined-out JEB pit for disposal using the pervious surround concept. This would require that the ore from JEB be removed and stored while the pit is being prepared to receive the tailings.

Ancillary facilities would include a shop and change rooms at the Sue site: offices, warehouses, shops, change rooms, a power generator plant, contaminated water storage ponds and treated water monitoring ponds at the mill site; fans and air heaters, electric power generators, minewater sedimentation ponds, a waste rock disposal area and an ore transfer pad at the McClean Lake underground mine site; and a camp designed to accommodate construction and production crews for all sites, to be built 800 m from the mill.

All active areas would be linked by roads and power lines. Pipelines would be used to transport minewater from the **McClean Lake** underground mine to the Sue Water treatment plant, and from the Sue and JEB treatment plants to Sink Lake.

It is proposed that the McClean Lake project and the Midwest Joint Venture be developed in a complementary way, with the McClean Lake site developed first, and the Midwest Joint Venture brought into production by 1999. Ore from the Midwest site would be milled at the JEB mill; tailings from the Midwest operation would also be disposed of in the mined-out JEB pit.

5.2 Recommendations

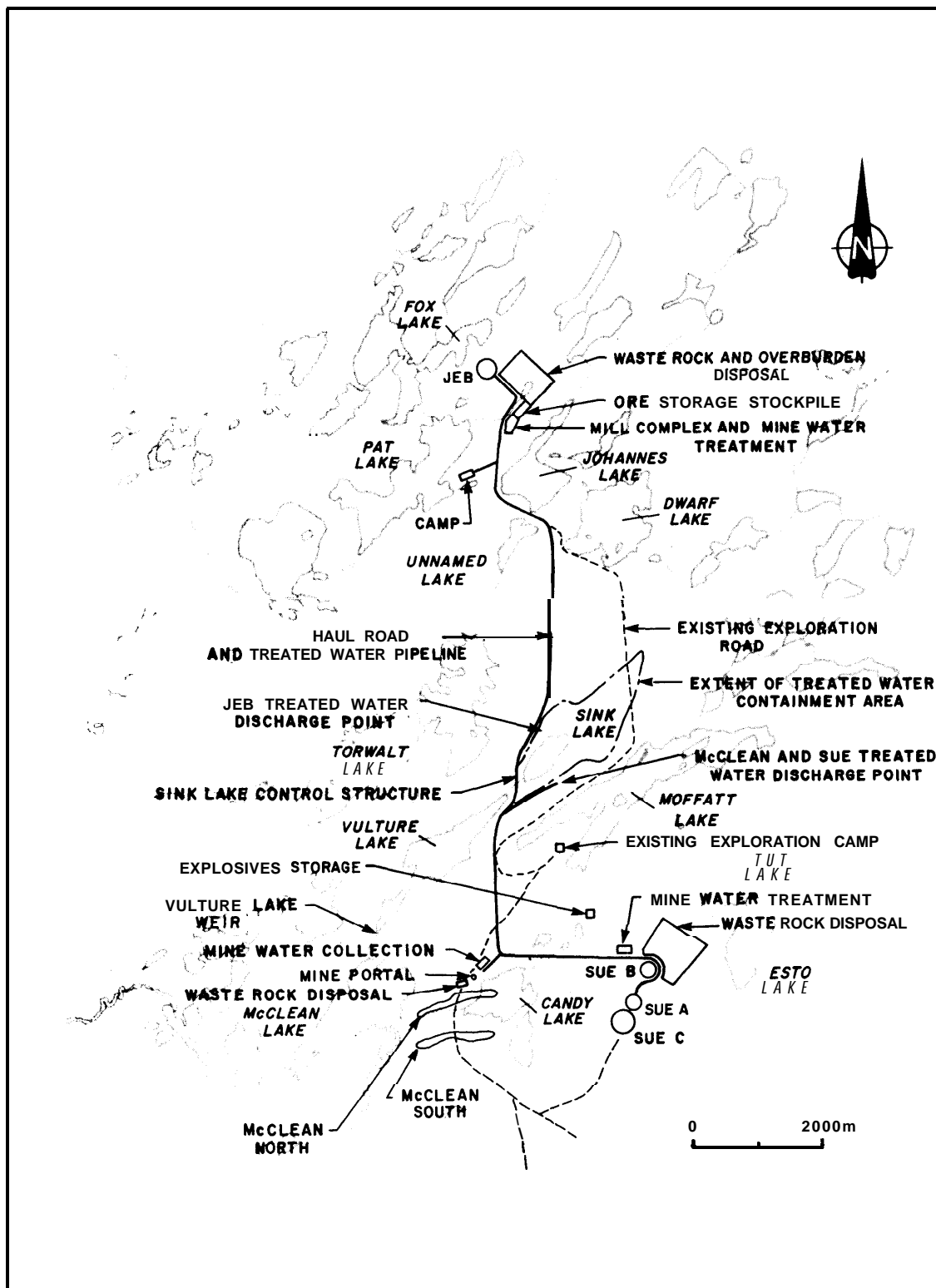
It is recommended that the McClean Lake project be delayed for at least five years.

This would allow time to obtain more experience with pervious surround tailings management facilities, to acquire comprehensive community health information, to maximize employment opportunities to northerners through education and training, to discuss further the larger issues, and to assess cumulative biophysical and socio-economic impacts.

Its approval at that time should be contingent on fulfillment of the following conditions:

1. evaluation, by the regulatory agencies, of the pervious surround tailings pit at Rabbit Lake after several more years of operation;
2. collection and evaluation of baseline data on groundwater flow patterns and water quality. In particular, the panel recommends that accurate flow rates be determined for the streams in the Collins Creek watershed and that modelling of predicted impacts on the receiving waters be revised accordingly;
3. development of plans to reduce contaminated mine-water inflows;

Figure 4
McClean Lake Project



4. evaluation of alternative oxidants that could replace sodium chlorate in the proposed milling process to permit recycling of mill effluent;
5. participation in the establishment of a research fund to support the search for innovative ways to reduce both the volume of effluent and quantity of chemicals required to treat contaminated water. The panel also recommends that site-specific water quality objectives be developed for the **McClean Lake** project. In addition, the total environmental loading should be specified and a material-balance developed for all contaminants in the liquid effluent;
6. use of the Environmental Transfer Pathway model (**ETP/AECB**) as the focus for integrating the monitoring program at **McClean Lake**. The general design of the monitoring program should be the same as that at other uranium mines. This will guarantee a consistent **replication** of treatments for biological effects monitoring and eventually produce the database required for the study of cumulative effects. The results of biophysical monitoring at **McClean Lake** should be reviewed by the independent monitoring committee recommended in section 54.3;
7. assessment of cumulative effects using the **ETP/AECB** model and validation of the results by use of a whole ecosystem approach to monitoring, as specified in section 2.3.1 and section 5.3.7;
6. decommissioning plans that include the filling of **mined-out** pits to surface with waste rock capped by clean overburden;
9. adoption of sediment quality guidelines for Saskatchewan and institution of a program to monitor sediment quality in the Wollaston Lake drainage system;
10. adoption of a Human Resource Development Agreement that includes employment objectives of 30% (75 workers) of the initial workforce from the Athabasca Basin and 40% (100 workers) from the rest of northern Saskatchewan, with the balance (**30%**, 75 workers) coming from southern Saskatchewan or elsewhere. After the mine has been in operation for three years, these objectives should be changed to require the selection of a minimum of 50% of all new employees from residents of the primarily-impacted communities and a minimum of 30% from the residents of secondarily-impacted communities. These conditions should also apply to contractors and sub-contractors;
11. agreement on a form of revenue sharing that is acceptable to the majority of the impacted communities;
12. establishment of a monitoring committee (as described in section 2.1.5) for the **McClean Lake** Project;
13. provision of a financial guarantee to cover decommissioning and post-decommissioning costs;
14. adoption of the exposure standards recommended in Publication 60 of the International Commission on Radiation Protection (ICRP-60) and measures to prevent the collective dose from increasing;
15. implementation of a program to collect and **analyze** changes in indicators of community health for the impacted communities, and formulation and implementation of remedial health strategies; and
16. further public discussion of the larger issues identified in section 2.5 of this report.

5.3 Biophysical Concerns

5.3.1 Air Quality

There is general concern over the release of radioactive dust and radon, with the subsequent deposition of radon progeny, as discussed in section 2.3.3. This concern could be assessed more critically if a well designed program, such as the one proposed by the proponent, were used to monitor radon and dust, together with radionuclide and metal uptake in soil, lichen, vascular plants and the snowshoe hare. The monitoring of vegetation and wildlife should occur on a three-year cycle and start before mine excavation to provide required baseline information.⁹⁵ **The panel notes the commitment given by Total Minatco to establish a comprehensive air quality and aerial contaminant deposition monitoring program.** A delay in the start-up date of this project will provide the proponent with an opportunity to accumulate comprehensive air quality baseline data before mining begins.

The issue of cumulative effects associated with aerial emissions from a complex of mines or proposed mines to the west of Wollaston Lake is dealt with in section 5.3.8.

5.3.2 Hydrogeology

Review participants expressed concern about the lack of information on groundwater patterns, retardation factors, etc. While such information appears to be of little more than academic interest to the **proponent**,⁹⁶ the Saskatchewan Mineral Industry Environmental Protection Branch considers background and baseline data to be very important in determining the effects of an operation on the **environment**.⁹⁷ **The panel shares this latter assessment and recommends that baseline data be collected on groundwater flow patterns and water quality.** Further rationale is provided for this recommendation in section 5.3.4.

⁹⁵ Complementary **McClean Lake and Midwest Projects, McClean Lake Project, Environmental Impact Statement, Additional Information Requested by Uranium Mines Review Panel**, Total Minatco Ltd., November, 1992, Deficiency Number 3.35.

⁹⁶ Complementary **McClean Lake and Midwest Projects, McClean Lake Project, Environmental Impact Statement, Additional Information Requested by Uranium Mines Review Panel**, Total Minatco Ltd., November, 1992, Deficiency Number 3.28, p. 2.

⁹⁷ Technical Review of **McClean Lake Project - Additional Information Requested by Uranium Mines Review Panel**, Saskatchewan Mineral Industry Environmental Protection Branch, January 28, 1993.

5.3.3 Waste Rock Management

The proponent proposes to dispose of most of the waste rock, mined from the JEB and Sue sites, in surface rock **piles adjacent to the mined-out open pits**. About 2% of **the waste rock** would be classified as special waste (**0.03%-0.1% U_3O_8**) and would be disposed of mainly in the Sue C open pit. Most of the waste rock from the **McClean Lake underground mine** would be used as backfill as the ore body is mined out.

The main consideration for the management of waste rock seems to be cost; it is least expensive to dispose of it on the surface. However, concerns about contaminated **leachate** from the rock piles affecting the water quality of the adjacent flooded pits have not been addressed. There has been no consideration of using the waste rock from one open pit as fill for another, even where there are closely situated open pit mines to be developed in sequence (as in the Sue A, Sue B, and Sue C mines).

The management of waste rock needs to be considered as part of an integrated decommissioning of the mines. As discussed in section 5.3.9, we favour filling all mined-out pits with waste rock, capped by clean overburden.

5.3.4 Surface Water and Fisheries

Surface waters are affected in three main ways by the proposed mining activity. First, liquid effluent (derived from the mill, the tailings treatment facility, the stockpiles and contaminated mine water) would be released into Collins Creek by way of Sink Lake, Vulture Lake and **McClean Lake**. Second, Candy Lake would be drained while the **McClean** underground mine is being constructed and in operation. The lake would be refilled and restocked with fish after the mining operation is completed. Third, surface water bodies would be created in the flooded Sue open pits and above the tailings in the JEB pit.

The impact of the release of liquid effluent would be major and will be considered at length below. The draining of Candy Lake would be of a temporary nature and is subject to the *Fish Habitat Compensation Agreement* which is the mandate of the Department of Fisheries and Oceans. The creation of lakes by the flooding of open pits should be avoided, as discussed in section 5.3.9.

In assessing the impact of liquid effluent on the receiving waters, it is important to know the flow rates for streams in the Collins Creek watershed. Unfortunately, the historic data are of questionable value. Thus, the proponent **has** developed a synthetic set of data, based on flow rates for Thyme Hill River, that seems to correlate well with the limited available data. However, **the** uncertainties associated with this approach are considerable. For example, is the storage capacity of Sink Lake sufficient to delay the release of effluent during periods of low water flow? **in an attempt to avoid unacceptable impacts on the quality of the surface water, the proponent should determine accurate flow rates for the streams in the Collins Creek watershed and model the predicted impacts on the receiving waters accordingly.**

Some of the general issues relating to liquid effluent are discussed in section 2.3.2. The discussion therein is particularly relevant to McClean Lake because of the large volume of effluent that would be created by that proposed project. The volume is estimated to average approximately **3,760,000 m³** a year over the 18 years of the project, but in some years it would be almost double this **amount**.⁹⁸ Using the proponent's **data it is possible** to calculate the average total environmental loading (total mass released in effluent) for various contaminants. For example, almost 400 kg each of arsenic and nickel, more than 2,000 kg of uranium, and more than 13,000 tonnes of total dissolved solids would be released on average each year. Thus, the release of contaminants in the liquid effluent would be substantial. It is not surprising to learn that the Saskatchewan Surface Water Quality Objectives would be exceeded for many contaminants in Sink Lake, Vulture Lake and even part of McClean Lake.

The proposed impacts to Sink Lake, Vulture Lake, McClean Lake and Collins Creek are not acceptable because there is good evidence to suggest that the volume of effluent could be lowered substantially in at least two ways. First, the volume of contaminated mine-water requiring treatment could be decreased by intercepting groundwater with a network of **de-watering** wells around each open pit. Uncontaminated groundwater could be released directly into the watershed. **The panel, therefore, recommends that contaminated mine-water inflows be reduced.** Second, the proponent plans to use sodium chlorate as an oxidant in the milling process for ores with a low arsenic content. If this is done, it will not be possible for the mill effluent to be recycled because of its high chloride content. The use of alternative oxidants, which allow the mill effluent to be recycled, would reduce chloride loading in the effluent. **The panel, therefore, recommends the evaluation of alternative oxidants that could replace sodium chlorate in the proposed mill, to permit recycling of mill effluent.**

The rationale for the following three recommendations may be found in section 2.3.2. First, the panel recommends **that the McClean Lake mine participate in the establishment of a research fund to support a search for innovative ways to reduce both the volume of effluent and quantity of chemicals required to treat contaminated water.** Second, the panel recommends that site-specific water quality objectives be developed for the McClean Lake mine. Third, the panel recommends that total environmental loading be specified for the McClean Lake mine and that a **material-balance** be developed for all contaminants in the liquid effluent.

I must stress that you have to watch the water because water is how we sustain our life.

T. Dzeyllion, Transcript of Public Hearings, Wollaston Lake, Saskatchewan, April 14, 1993, p. 128.

⁹⁸ *McClean Lake Project, Environmental Impact Statement Amendment*, Total Minatco Ltd., September 1992, Section 2.

53.5 Tailings Management

Tailings management can also have a substantial deleterious effect on the quality of surface water downstream from the mine site. For this project, it has been proposed that the mined-out JEB pit be used as a pervious surround disposal facility to contain mill tailings from both the McClellan Lake project and the Midwest Joint Venture mine. The use of one tailings facility for two projects should be environmentally beneficial because it would reduce the proliferation of such sites. Placement of the tailings in a pit would also decrease the likelihood of surface water contamination (but raises the spectre of possible ground water contamination).

Despite these theoretical advantages, we were reminded by the public that the pervious surround method for tailings containment has not yet been adequately tested. The only such pit in the Athabasca Basin, the nearby Rabbit Lake facility, has not been in operation long enough to demonstrate its viability. It is the panel's opinion that it would be prudent to observe the operation of that facility for a few more years before deciding on whether or not to license another. **This is one of the primary reasons why we are recommending a delay in the start-up of this project for at least five years. The time interval will provide the regulatory agencies with an opportunity to observe and evaluate the facility at Rabbit Lake; it will also undoubtedly provide the proponents with information that can be used to improve the design of the JEB facility.**

...no new pervious surround tailings until the pilot project at Rabbit Lake is proven. That's my position.

M. Shiell, Transcript of Public Hearings, Regina, Saskatchewan, March 22, 1993, p. 269.

5.3.6 Wildlife and Terrestrial Habitat

The area of the proposed McClellan Lake project is not highly productive and wildlife populations are low. The main concerns of the public related to possible widespread contamination of the area, including the vegetation and wildlife, by radionuclides and metals. This concern is discussed in sections 5.3.7 and 5.3.8.

One rare plant has been found in wetland habitats in the project area and could be impacted by mining development. The panel concludes that this risk is acceptable, given that these habitats are commonly found throughout the region. However, the proponent should undertake to implement all reasonable measures to protect such habitats from disruption.

⁹⁹ Complementary McClellan Lake and Midwest Project, McClellan Lake Project, Environmental Impact Statement, Additional Information Requested by Uranium Mines Review Panel, Total Minatco Ltd., November, 1992, Deficiency Number 3.33 and Deficiency Number 3.36.

5.3.7 Monitoring

The proponent has developed a comprehensive monitoring program that would start before mine excavation in order to provide adequate baseline information.⁹⁹ While the proposed monitoring program for the terrestrial environment is satisfactory, the corresponding program for the aquatic environment requires modification. In particular, the division of monitoring activities into core and second-level components, whereby the latter would only be monitored if certain, unspecified action levels in core components were exceeded, is not acceptable. It is suggested, instead, that all of the second-level components be monitored on the same basis as core components, with the possible exception of radionuclide and heavy metal content of benthic invertebrates. Otherwise, the overall design and rationale of the proposed monitoring program is consistent with the general philosophy discussed in section 2.3.1. In keeping with the arguments therein, **the panel recommends that the Environmental Transfer Pathway model (ETP/AECB) be used as the focus for integrating the monitoring program at McClellan Lake.** The general design of the monitoring program should be the same as that at other uranium mines. This will guarantee a consistent replication of treatments for biological effects monitoring and eventually produce the database required for the study of cumulative effects. The results of biophysical monitoring at McClellan Lake should be reviewed by the independent monitoring committee recommended in section 5.4.3.

A delay in the start-up date for this project would allow the proponent to establish a monitoring program and obtain considerable baseline data before mining starts.

5.3.8 Cumulative Biophysical Effects

There is considerable potential for cumulative effects arising from the McClellan Lake project. It involves five mines (JEB, Sue A, Sue B, Sue C, and McClellan underground) which are located within a 10-20 km radius of several other ore bodies that have been or could be mined in the future (Dawn Lake, Midwest, Eagle Point, Collins Bay A, Collins Bay B, Rabbit Lake, Horseshoe, and Raven). Indeed, it is not a question of whether or not there will be cumulative environmental impacts, but of their magnitude.

Three cumulative biophysical impacts are of potential concern: impact on surface waters; concentration of contaminants by aquatic sediments; and airborne dispersal of contaminants.

Liquid effluent from the McClellan Lake project would drain via Collins Creek into the west side of Wollaston Lake, approximately 40 km north of where effluent from the existing Rabbit Lake mine is discharged via Effluent Creek into Hidden Bay on Wollaston Lake. Preliminary assessments¹⁰⁰ suggest that cumulative effects from the two mines (and also from the two more distant mines at Cigar Lake and Key Lake) on the water

¹⁰⁰ "Cumulative Impact of Uranium Mining in Northern Saskatchewan", Atomic Energy Control Board, Submission to Public Hearings, Saskatoon, Saskatchewan, May 4, 1993. McClellan Lake Project, Environmental Impact Statement, Amendment, Total Minatco Ltd., September, 1992, Section 3.

quality of Wollaston Lake would be impossible to detect. Nevertheless, the McClean Lake project would add one more polluted watershed to the west side of Wollaston Lake. Consequently, there would be a worsening in water quality in this region which might affect the traditional use of the land by local communities (see section 5.4.4).

The enormous volume of effluent expected to be discharged by the project and high total environmental loading of many contaminants (see section 5.3.4) would result in large quantities of metals and radionuclides being accumulated in the sediments of Sink, Vulture, **McClean** and Keweenaw Lakes. Furthermore, contamination would mainly occur in the top 10 cm of the sediments. This is where aquatic macrophytes are rooted and is also the environment for bottom-living animals. The proponent's EIS indicates that by the end of the project the sediment quality in Sink and Vulture Lakes would exceed the "severe effects level" of the Ontario Sediment Quality Guidelines for arsenic, cadmium, copper, and nickel. This level indicates concentrations at which prolonged disturbance of the sediment dwelling community can be expected, with resultant harmful effects on the majority of bottom-living species. This impact on the sediment-dwelling community is expected to persist for a long time. The proponent's modelling analysis of sediment quality indicates that sediment quality in Sink and Vulture Lakes would exceed the Ontario Sediment Quality Guidelines for arsenic and cadmium for at least 100 years following the proposed decommissioning of the project. Clearly, plans should be developed to minimize or mitigate these effects before mining begins. We also note that Saskatchewan has no guidelines for sediment quality.

The remaining cumulative impact of concern is that radon, radon progeny, and radioactive dust emissions would overlap with those of nearby mines to produce a wider, regional effect. Preliminary modelling by the proponent indicates that radon from McClean Lake, at concentrations elevated above background levels, would overlap with radon from the proposed Midwest mine and the existing Rabbit Lake mine. Similarly, there would also be overlap of elevated dust concentrations from the McClean Lake and Rabbit Lake mines. However, the zone of overlap is predicted to be at very low concentrations, at about one-thirtieth of background levels for radon, for example.

Residents of the Athabasca region, particularly those in the Wollaston Lake area, will continue to be concerned about the possible deterioration of water and air quality, and whether the plants, fish and wildlife that they harvest are contaminated. **The panel shares these concerns and recommends that cumulative effects be assessed using the ETP/AECB model and that the results be validated by using a whole ecosystem monitoring approach, as specified in sections 2.3.1 and 5.3.6. We also recommend that the Saskatchewan government adopt sediment quality guidelines similar to those of the Ontario government.**

53.9 Decommissioning and Site Reclamation

The flooding of the Sue pits and the tailings-filled JEB pit is objectionable. For example, the proponent's model for the flooded Sue pits suggests that the Saskatchewan Surface Water Quality Objectives for arsenic, copper and nickel would be exceeded for at least 500 years. Moreover, in assessing the water quality of the flooded pits, the effect of **leachate** from the surface waste rock piles has not been included. There would be sufficient waste rock to completely fill all of the pits and thereby reduce the problem of **leachate** from this source to a minimum, as well as eliminate the concern over water quality in the flooded pits. **The panel recommends that all open pits be filled to surface with waste rock and capped with clean overburden.**

Plans for the reclamation of Candy, Sink, Vulture, McClean and Keweenaw Lakes would require the approval of the Department of Fisheries and Oceans.

It is recommended that a financial guarantee to cover decommissioning and post-decommissioning costs be secured before the McClean Lake Project is started. The need for such a guarantee for all mines has previously been discussed in section 2.3.5.

5.4 Socio-Economic Concerns

5.4.1 Education and Training

During the public hearings, the Executive Director of Northern Education described a Consortia Training Plan¹⁰¹ that has been developed to address emerging labour market and training issues. This plan requires cooperation between employers and educators to ensure that there will be an approximate balance between the number of jobs available and the number of trained personnel. Such a plan will work best if sufficient time is made available to design the project and train the workers. In order for this Consortia Training Plan to work most effectively, several new projects should not begin at the same time. It will be easier to prepare for a gradual increase in employment opportunities. **Many of the workers required for the McClean Lake project will require more extensive training than, for example, the new workers at the Dominique-Janine extension at Cluff Lake.** This is one of the reasons why we are recommending that the Dominique-Janine Extension be allowed to proceed as soon as the specified conditions are met, but that the start-up of the McClean Lake Project be delayed for at least five years. Given sufficient lead time for training, it should not be difficult for the operating company to meet the employment objectives outlined in the proposed Human Resource Development Agreement described below.

5.4.2 Human Resource Development Agreement

In section 2.2.2 we have recommended that the Human Resource Development Agreements include provisions requiring

¹⁰¹ R. McKay, *Transcript of Public Hearings*, Saskatoon, Saskatchewan, May 3, 1993, p. 163.

80% of all new employees for existing mines to be drawn from the primary and secondary impact communities. However, for a new mine this goal may be too ambitious. In their submission to the panel, officials of the McClellan Lake Project suggested that hiring would include 40-75 workers from the Athabasca Basin, 50-100 workers from other northern Saskatchewan communities and **75-160** workers from southern Saskatchewan, for a total of 250 **employees**.¹⁰² Delaying this project for approximately five years would provide a greater opportunity for education and training prior to start-up and thereby give the company a better chance of meeting its upper estimates for hiring from the Athabasca Basin and northern Saskatchewan. **It is, therefore, recommended that the Human Resource Development Agreement for the McClellan Lake Project include employment objectives of 30% (75 workers) of the initial workforce to be recruited from the Athabasca Basin and 40% (100 workers) from the rest of northern Saskatchewan with the balance (30%, 75 workers) coming from southern Saskatchewan or elsewhere. After the mine has been in operation for three years, these objectives would be replaced by those pertaining to existing mines, i.e. 50% of all new employees must be from the primarily-impacted communities and 30% from the secondarily-impacted communities, as described in section 2.2.2.**

5.4.3 Revenue Sharing and Monitoring Committee

Delaying the start-up of this project by at least five years would also provide sufficient time for the province to work out a revenue-sharing program that is acceptable to the impacted communities, and to establish the regulations required to govern the selection and activities of a monitoring committee. **It is recommended that the project not be allowed to proceed until a form of revenue sharing acceptable to the impacted communities has been implemented and a monitoring committee for this project has been appropriately established.** It should be noted that McClellan Lake officials have already indicated their concurrence with the suggestion that a monitoring committee be established for the project with representation from the impacted **communities**,¹⁰³ similar to the recommendation we have made in section 2.2.8.

5.4.4 Inherent Rights

Before a new mine site is established, there must be a clear understanding of any residual inherent rights that may exist and how compensation would be provided for the loss of those **rights** if mining interferes with the use of the land for traditional hunting, fishing, trapping and gathering activities. The province of Saskatchewan has acknowledged that the *Natural Resources Transfer Agreement* which is part of the

Constitution Act, 1930 "... guarantees Indian people the right to hunt, fish and trap for food on unoccupied Crown land or other lands to which they have a right of **access**".¹⁰⁴ The way in which aboriginal people are to be compensated for the loss of these rights when land, which had traditionally been unoccupied, is used for other purposes should be clearly established before developments are allowed to begin. In the specific case of the McClellan Lake Project, a substantial area of dry land, as well as several lakes, streams and bogs, would be affected and it is our opinion that, although the area may not be in current use by any specific person, it is still a parcel that would be subtracted from the total amount of land available for traditional uses. **The panel recommends that the loss of inherent rights on that particular parcel of land be recognized and the families or communities involved be compensated by the province.**

It is **recognized** that arriving at an acceptable form of compensation for the loss of these inherent rights may take considerable time, and a delay in the project would provide an opportunity for this concern to be settled before start-up. We are aware that these and similar issues may be considered by the *Royal Commission on Aboriginal Peoples*, and a delay would permit governments to also have the benefit of its recommendations before approval of this project is considered.

5.4.5 Cumulative Effects

Mining of any non-renewable resource cannot be sustained indefinitely. To be sustainable development, within the definition of the Brundtland Report, the mining of uranium must **"...meet the needs of the present without compromising the ability of future generations to meet their own needs"**.¹⁰⁵ Sustainability of the industry as a whole can, however, be achieved over a long period of time by sequential development of various **deposits**.¹⁰⁶

Mineral reserves are depleted **as** deposits are mined out, and are subsequently replenished by new discoveries, or by technological advances that make lower grade deposits economic to develop. Innovations in developing alternate energy sources may even eventually eliminate the demand for uranium. However, it is important not to mine out current reserves unless the market demand coincides with the amount of ore being produced. **Otherwise**, the natural environment will have been disrupted for no sound cause.

Coinciding with the cycle of development of mineral resources is the accompanying employment and spin-off economic development which result from mining activity. The side benefit of direct and indirect employment is the positive impact most often cited by those supporting the continuation of expansion of uranium mining. Negative impacts can thus be accepted,

¹⁰² W. Keyes, *Submission to Public Hearings*, Saskatoon, Saskatchewan, March 19, 1993.

¹⁰³ K. Haapanen, *Transcript of Public Hearings*, Regina, Saskatchewan, March 23, 1993, p. 155.

¹⁰⁴ *Interim Report: Information from the Government of Saskatchewan requested by the Federal/Provincial Panel on Uranium Mining in Northern Saskatchewan for the Cigar Lake and McArthur River Projects*, SERM, 1993, p. 4.

¹⁰⁵ G. Brundtland, *Our Common Future*, World Commission on Environment and Development, Oxford University Press, 1987.

¹⁰⁶ *Conservation Strategy for Sustainable Development in Saskatchewan*, Saskatchewan Round Table on Environment and Economy, 1992.

within regulatory standards, provided there are offsetting positive impacts, such as employment.

The potential positive effect, i.e., more employment for northern aboriginals, would be greatly diminished if the projects were allowed to proceed before there were enough trained and educated northern aboriginals available to fill the jobs created. **Therefore, the McClean Lake project should be delayed until a sufficient supply of skilled and educated workers from the impacted communities exists to satisfy the employment demands of this project and existing mines.**

A delay in development would have a second advantage; the overall amount of job dollars being injected into the northern economy from uranium mining could be sustained at a more constant level by a postponed development at McClean Lake. **If the latter project were phased into production as others, i.e. Ciuff Lake and Rabbit Lake, were mined out, a continuity of employment would occur, thereby avoiding a boom-bust cycle.**

5.5 Health Concerns

5.5.1 Occupational Health

The comments and recommendations discussed in section 2.4 apply to this project. While several of the components of the project do not pose health risks that are greater than those posed by existing uranium mines, some components of the project are troublesome. From an occupational health viewpoint, Sue C and the underground mine constitute situations of high grade uranium ore and high arsenic concentration. The underground mine poses particular concerns in

this regard, as underground mines tend to be associated with higher levels of worker exposure. Section 2.4.1.2 addressed the issue of the synergism of arsenic and radiation. The complexities of dose, dose rate, age at exposure, and concomitant risk factors such as cigarette smoking, as well as arsenic and radiation, all affect the health risks associated with this project. Before approval is granted, the proponent and the regulators must be able to address these complexities and assure the public that the level of health risk associated with the combined exposures in these mines is within acceptable limits.


55.2 Community Health

Several community health concerns were identified in section 2.4.2. The extent to which uranium mining has had a positive, negative or no impact on health in the impact communities cannot be evaluated due to the unavailability of sufficient environmental health risk information and the lack of community health data. The panel therefore recommends that **a community health assessment be undertaken before the McClean Lake project is approved.** The community health concerns may be surmountable, with the use of appropriate technology and monitoring. However, the uncertainty factor (as discussed in section 2.4.2.6), the public uneasiness concerning larger issues (section 2.5), and the likelihood of watershed contamination (section 5.3.4) make the assessment of the potential community health risks impossible at the present time. Provision of sufficient time for further public discussion could also promote consensus among the people of Saskatchewan concerning the issues surrounding uranium mining.

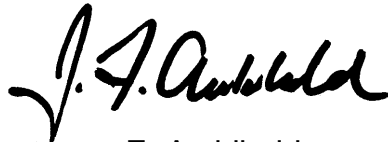
JOINT FEDERAL-PROVINCIAL PANEL

ON

URANIUM MINING DEVELOPMENTS IN NORTHERN SASKATCHEWAN



Donald Lee
(Chairperson)



James F. Archibald



John Dantouze



Richard Neal



Annalee Yassi

APPENDIX A

PANEL MEMBER BIOGRAPHIES

DONALD LEE (Chairperson)

Dr. Lee is Head of the Chemistry Department at the University of Regina and Past President of Luther College. A native of Saskatchewan, he has a Master of Arts degree from the University of Saskatchewan, a Ph.D. in Chemistry from the University of British Columbia and has completed post doctoral studies at Harvard University. Dr. Lee has been a member of the faculty at the University of Regina since 1967 and has served as a visiting professor at Stanford University and as a visiting scientist at the University of Oslo. He has published over ninety scientific papers and numerous non-scientific articles.

Active in community affairs for many years, Dr. Lee has been Chairman of the Saskatchewan section of the Chemical Institute of Canada, Executive Member of the Saskatchewan Association of Independent Schools, a national official of the Canadian Amateur Swimming Association, and President of the Regina Optimist Dolphin Swim Club.

JAMES F. ARCHIBALD

Dr. Archibald received his Ph.D. in Mining Engineering at Queen's University and is now an Associate Professor in the Department of Mining Engineering at Queen's. His work experience is primarily in the academic field with some associated private consultation. Dr. Archibald is a member of the Canadian Institute of Mining and Metallurgy (CIM), the CIM Backfill Sub-Committee (Rock Mechanics Group) and the American Institute of Mining Engineers.

Dr. Archibald's research interests include measurement and control of radiation hazards in underground mines, mine ventilation systems, in-situ stress analysis, rock burst prediction and structural mine design evaluation. Dr. Archibald is a member of the High Level Waste Disposal Scientific Review Group examining the concept of deep geologic disposal of nuclear fuel waste.

JOHN DANTOUZE

Mr. Dantouze is a Vice-chief of the Prince Albert Tribal Council, with responsibilities encompassing treaty issues, First Nations self-government, and a variety of program, service, and policy areas. Previously, Mr. Dantouze was Prince Albert Tribal Council Community Planning Advisor for the Athabasca Indian Bands of Fond du Lac, Black Lake and Hatchet Lake in northern Saskatchewan.

Mr. Dantouze also sits as an advisor on the Caribou Management Board and the Athabasca Task Force Committee on

northern Health Services. He recently participated in the Saskatchewan Environmental Assessment Review Commission formed to review the province's environmental assessment review process, and acted as a Dene interpreter when the Commission visited the Athabasca region of northern Saskatchewan.

RICHARD NEAL

Dr. Neal is Associate Dean (Academic) and Professor of Biology in the College of Arts and Science, University of Saskatchewan. He received both his Bachelor of Science and Ph.D. in Zoology from the University of Southampton, U.K. Dr. Neal has been a member of the Department of Biology at the University of Saskatchewan since 1968, and has taught extensively in the field of Biology.

Dr. Neal's research interests include population ecology and a broad range of environmental issues, including impacts of uranium mine and mill effluent on the aquatic environment in northern Saskatchewan, effects of pesticides on prairie ponds and duck populations, and revegetation of lands **salinized** by potash mine tailings. Dr Neal is actively involved in a number of professional organizations and has been the Chairman of **the** Environmental Advisory Committee for the City of Saskatoon.

ANNALEE YASSI

Dr. Yassi is an Associate Professor and Director of the Occupational and Environmental Health Unit, in the Department of Community Health Science, University of Manitoba. She is also the Director of the Department of Occupational and Environmental Medicine at the Health Sciences Centre in Winnipeg. Dr. Yassi received her Bachelor of Science **degree** in 1974 from McGill University and her M.D. in 1977 from **McMaster** University. She obtained a Master of Science degree in Community Health, (Epidemiology/Occupational and Environmental Health) in 1985 from the University of Toronto, and is a Royal College Fellow in both Community Medicine and Occupational Medicine.

Dr. Yassi has served as an occupational physician for the Manitoba Federation of Labour Occupational Health Centre; **she** has also served as **the** principal medical consultant **for** the Manitoba Hazardous Waste Management Corporation. She has conducted numerous health hazard evaluations and has been involved in several environmental impact assessments affecting **Native** communities. **She** was also a member of the Canadian Public Health Association's Task Force on Human and Ecosystem Health.

APPENDIX B

TERMS OF REFERENCE FOR THE ENVIRONMENTAL ASSESSMENT REVIEW OF URANIUM MINING DEVELOPMENT

MANDATE

1. The panel shall review the environmental, health, safety and **socio-economic** impacts (hereinafter referred to as "impacts") of the proposed uranium mine developments (listed in Schedule A) in northern Saskatchewan and assess their acceptability.

In assessing the acceptability of the proposed developments, the panel will include in its review and consider:

- a) the historical experience with past and existing uranium mining operations in Saskatchewan;
 - b) the cumulative impacts of existing operations and the proposed developments;
 - c) the short and long term impacts of the proposed projects, spanning their construction phase, operating period, decommissioning phase and post-decommissioning phase;
 - d) the impact of employment and socio-economic opportunities afforded northern residents by the proponents and the measures necessary for implementation of those opportunities;
 - e) the adequacy of measures proposed by the project proponents to protect environmental quality and to safeguard worker health and safety, and whether the measures can be expected to meet the requirements of Canadian and Saskatchewan law, regulations and policies applicable to uranium mine developments;
 - f) the adequacy of monitoring, enforcement and compliance systems to ensure that measures necessary for mitigating adverse impacts can be implemented; and
 - g) the benefits afforded by the proposals.
2. The panel shall determine from its review whether a project is acceptable or unacceptable.

In concluding that a project is acceptable, the panel may recommend that specified minimum terms and conditions, including any mitigative measures or any other measures relating to the impacts under the panel's review, be implemented where it considers these necessary for the protection of health, safety and the environment or for dealing responsibly with **socio-economic** concerns. The panel may also suggest measures that it considers would enhance the acceptability of the proposals.

If the panel concludes a project is unacceptable, it shall provide its reasons for this conclusion.

3. In fulfilling its mandate, the panel shall provide full opportunities for public consultation and review.

REVIEW PROCEDURES

Detailed written procedures for conducting the review shall be established by the panel and made available to the public.

TECHNICAL EXPERTS

The panel may secure the services of independent technical experts to assist and advise on complex technical and/or socio-economic issues related to its mandate. Such experts will also be available to respond to inquiries from review participants.

STAGES OF THE REVIEW

Schedule A lists the five proposals to be reviewed by the panel. The five proposals have been referred due to potentially significant or unknown adverse environmental effects and public concern.

While all of the proposals are in the planning stage, some are further advanced than others. Environmental Impact Statements (EIS) have been prepared for the first three proposals listed in Schedule A, one of which (Dominique-Janine extension) is associated with the existing operating uranium mining facility and two of which are for new uranium mining facilities. EIS documents have yet to be prepared for the last two proposals listed in Schedule A. The panel will take the differing stages of these projects into consideration in scheduling its review.

The panel will seek public comment on the three available **EIS's** and determine their adequacy before proceeding to public hearings. When the panel is satisfied with the information provided, including that with respect to the cumulative impacts, it may report on one or more of these projects to the Ministers as described in the following stages of the review. The panel shall submit its final report(s) on these proposals within 18 months of its appointment.

In reviewing the remaining two proposals, the panel will conduct scoping sessions in appropriate communities to solicit public comment and, based on these comments and its own consideration, prepare and issue Guidelines to the respective proponents for the preparation of **EIS's**. The cumulative impacts of these two proposals will be considered when the EIS

documents have been submitted. The stages of the review following submission of these documents to the panel are outlined below. The panel shall submit its final report(s) on these two proposals within 18 months of receipt of the **proponents' EIS's**.

1. Review of Information

- a) Review of the available information on the environmental, health, safety and socio-economic impacts of the uranium mining industry in Saskatchewan to date. The information and any related reports prepared will be made available to the public.
 - b) Review of the past performance of the uranium mining industry in providing employment and socio-economic opportunities to northern residents. The information and any related reports prepared will be made available to the public.
 - c) Review by the panel of Environmental Impact Statements (**EISs**) submitted by the proponents. The **EISs** will also be made available to the public for review and written comment.
 - d) The panel may draw on proponents, technical agencies from within federal or provincial governments, independent experts and the public for available information.
2. Should the panel, after reviewing the above information and considering public comments, deem an EIS deficient it may request additional information from the project proponent.
3. Once the panel is satisfied with the information provided, it will announce public hearings for the project in question. If appropriate, the hearings may be structured to address more than one project.
- For the purposes of promoting public awareness and facilitating public comment, the panel will hold meetings and/or hearings in the appropriate northern communities, Regina, Saskatoon and in such other Saskatchewan communities as the panel may think necessary.
4. When the panel is in a position, following the completion of **public** hearings, to **provide a report** on its findings.

conclusions and recommendations relevant to a specific project, it will submit the report to the federal Ministers of Environment and of Energy, Mines and Resources and to the Saskatchewan Minister of Environment and Public Safety.

The panel should, to the extent possible, ensure that the timely review of a specific project is not jeopardized by delays in the review of another project included **in its mandate**.

LINKAGE TO OTHER POLICY PROCESSES

The panel is not expected to interpret its mandate so as to duplicate the work of other public inquiries and policy processes or to focus on national or international issues which are not directly related to the impacts of the proposals.

However, concerns may be raised by the public which extend beyond the impacts of direct concern to the panel, and in such cases the panel will ensure that the public is provided a reasonable opportunity to express these concerns.

SCHEDULE A

EIS Submitted

1. Dominique-Janine Extension
Amok Ltd.¹⁰⁷
2. South **McMahon** Lake Project
Midwest Joint Venture (Denison Mines Ltd.¹⁰⁸)
3. **McClean** Lake Project
Minatco Ltd.

EIS to be Prepared

4. **McArthur** River Project
McArthur River Joint Venture (Cameco Corporation)
5. Cigar Lake Project
Cigar Lake Mining Corporation

¹⁰⁷ Responsible party for Dominique-Janine Extension is now **Cogema** Resources Ltd.

¹⁰⁸ Responsible party for Midwest Joint Venture is now Total Minatco.

APPENDIX C

PANEL ACTIVITIES

-
- Joint public review announced and Terms of Reference issued by Robert de **Cotret**, Minister of the Environment, and Grant **Hodgins**, Minister of Saskatchewan Environment and Public Safety, April 18, 1991
 - Joint Review Panel members appointed by **Beattie** Martin, Minister of Saskatchewan Environment and Public Safety and Jean Charest, Minister of the Environment, August 22, 1991
 - Panel toured all proposed mine development sites, October 1-6, 1991
 - Panel's Operational Procedures released December 19, 1991
 - **EISs** received and released for a **90-day** public review as follows:
 - Midwest Joint Venture, December 19, 1991
(deadline date for submissions-March 20, 1992)
 - McClean Lake Project, January 13, 1992
(deadline date for submissions-April 13, 1992)
 - Dominique-Janine Extension at Cluff Lake, March 31, 1992
(deadline date for submissions-June 30, 1992)
 - Deadline date for public submissions for MJV and McClean Lake extended to May 29, 1992
 - Scoping Meetings for Cigar Lake and McArthur River announced January 7, 1992, to begin February 7, 1992
 - Dates and locations of Scoping Meetings announced January 22, **1991**, as follows:

February 7, 1992	Ben McIntyre School, Uranium City
February 8, 1992	Fond du Lac Band Hall, Fond du Lac
February 10, 1992	Community Hall, Stony Rapids
February 10, 1992	Community Hall, Black Lake
February 11, 1992	Hatchet Lake Band Hall, Wollaston Lake
February 12, 1992	Arena Hall, La Loche
February 13, 1992	Complex Hall, Buffalo Narrows
February 14, 1992	Community Hall, Ile-à-la-Crosse
March 2, 1992	Ramada Renaissance, Regina
March 3, 1992	Holiday Inn, Saskatoon
March 4, 1992	Marlboro Inn, Prince Albert
March 5, 1992	Kikinahk Centre, La Ronge
 - Modifications to the Midwest Joint Venture and McClean Lake projects issued May 6, 1992
 - Technical Reviews of Midwest Joint Venture and McClean Lake projects, as prepared by Ecologistics Limited, issued May 29, 1992
 - Draft Guidelines and Government Information Requests for Cigar Lake and McArthur River issued June 1, 1992, for public review until July 3, 1992
 - Summary Report on Scoping Meetings for Cigar Lake and McArthur River, prepared by Quadra Planning Consultants Ltd., issued August 19, 1992
 - Guidelines for the Preparation of Environmental Impact Statements and Government Request for the Cigar Lake and McArthur River projects issued September 11, 1992
 - Request for Additional Information issued to Amok Ltd. on October 7, 1992
 - EIS Amendments for Midwest Joint Venture and McClean Lake issued October 30, 1992, for a public review period ending November 30, 1992
 - EIS on McArthur River Project Underground Exploration Program, July 1992, and Addendum, October, 1992, referred to Joint Panel for public review on October 29, 1992, with review period ending December 2, 1992
 - Dates and locations for Public Hearings on McArthur River Underground Exploration Project announced November 1, 1992, as follows:

December 3, 1992	Hotel Saskatchewan, Regina
December 4-5, 1992	Holiday Inn, Saskatoon
December 6, 1992	Community Hall, Fond du Lac
December 7, 1992	Community Hall, Black Lake
December 8, 1992	Hatchet Lake Band Hall, Wollaston Lake
December 9, 1992	Community Hall, Pinehouse
December 10, 1992	Kikinahk Centre, La Fionge
 - Response to Panel's Request for Additional Information from Total Minatco on the **McClean** Lake project issued on December 15, 1992, for a public review period ending January 15, 1993
 - Panel issued commissioned reports December 15, **1992**, as follows:
 - *Health in the Context of Uranium Mining in Northern Saskatchewan*, Ed **Weick**, ESAS

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- *An Overview of the **Biophysical** Environmental Impact of Existing Uranium Mining Operations in Northern Saskatchewan*, Dr. Herman Dirschl, ESAS
 - *A **Brief** Historical Review of the **Beaverlodge** Mining Area of Northern Saskatchewan*, R. Barsi and Dr. A.W. Ashbrook
 - *A Socio-Economic Overview of Uranium Mining in Northern Saskatchewan*, Ed Weick, ESAS
 - *Review of the **Cluff** Lake and Key Lake Reports*, L. Vigrass
- Response to Panel's Request for Additional Information from Midwest Joint Venture issued on December 23, 1992, for a public review period ending January 22, 1993
 - Panel issued specialists' report, *Assessing Cumulative Effects of Saskatchewan Uranium Mines Development*, on January 8, 1993
 - Panel submitted **McArthur** River Underground Exploration Program report to federal and provincial governments, on January 15, 1993
 - Cogema's (formerly AMOK) Response to the Panel's Request for Additional Information issued February 8, 1993, for a public review period ending March 5, 1993
 - Public Hearings dates and locations announced on February 19, 1993, and extended dates announced March 26, 1993. An additional change in the dates of the Hearings was announced on April 26, 1993. Hearings were held as follows:
- | | |
|-------------------|---|
| March 22-24, 1993 | Hotel Saskatchewan, Regina |
| April 13, 1993 | Community Hall, Black Lake |
| April 14, 1993 | Hatchet Lake Band Hall, Wollaston Lake |
| April 15-16, 1993 | Kikinahk Centre, La Ronge |
| April 16, 1993 | Friendship Centre, Ile-à-la-Crosse |
| April 19, 1993 | Complex Hall, Buffalo Narrows |
| April 20, 1993 | Arena Hall, La Loche |
| April 21, 1993 | John M. Cuelenaere Library, Prince Albert |
| May 3-5, 1993 | Holiday Inn, Saskatoon |
| May 7-8, 1993 | Holiday Inn, Saskatoon |
| May 17-20, 1993 | Holiday Inn, Saskatoon |
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APPENDIX D

SUBMISSIONS TO PANEL

APPENDIX D-I

REFERENCED BY ALL THREE REVIEWS

D-I.1 Oral Presentations Made At Public Hearings

Alam, Rabbi

Algoma Manitoulin Nuclear Awareness (Ed Burt)

Alto Construction (Ron Kunkel)*

Anderson/Fast Marketing Solutions (Doug Fast)*

Association of Consulting Engineers of Saskatchewan (E.J. Hinz)*

Athabasca Airways (Jim Glass)

Atomic Energy Control Board (George Jack, Mary Measures, Dalsu **Baris**, Bernie Zgola, Tom Viglasky, Larry Chamney, Kevin **Scissons**, Rick McCabe, Ron Moore, Fred **Ashly**)*

Augier, Danny

Ayotta, Ivan

Battlefords Awareness Movement (Laird **Brittin**)*

Batty, Linda

BCP Engineering Ltd. (Gary **Cabalt**)*

Beauvin, Marie

Beaver Eye, Joe

Bell, Jack*

Benoanie, Ed

Bethel United Church, Council of (Judy **Howsam**, Helen Smith-McIntyre, Mary Jean Roy)*

Big Eye, J.B.

Big Eye, Maurice

Black Lake and Fond du Lac Bands (Chief Joe Martin, Pierre Robillard, Donald Deranger, Edwin **Boneleye**)*

Boan, Derek*

Bougie, Paul

Bouvier, **Vye***

Brade k, Carla

Brady Development Corporation, Pathway to Success Program (Michelle Harding)

Brent Construction (Russ Clunie)

Brucy, Martin
Bryce, Elizabeth*
Bryson, Mike*

Canadian Coalition for Nuclear Awareness (Gordon Edwards)
 Canadian Labour Congress and the Saskatchewan Federation of Labour (Don Anderson)
 Canadian Nuclear Association (The Honourable John Reid, Ian Wilson)*
 Canadian Union of Public Employees, Saskatchewan Division (Glen **Makahonuk**)*
 Carle, Gordon
 Case, **Leila**
 Chambers, Doug
 Chary, Srinii'
 Cheecham, Roy
 Chevalier, Malann
 Chicken, Senator Louis
 Christie, Larry
 Churchill **Métis** Labour Management Board (Max Morin)
 Cisyk, Dave
 Citizens Concerned about Free Trade (Marjaleena Repo, David Orchard)*
 Clark, Peter
 Clay, Colin **P.***
 Cominco Engineering Services Ltd. (Will **Brandsema**)*
 Communications, Energy and Paperworkers' Union of Canada (R.E. **Neilsen**)*
 Communications, Energy and Paperworkers' Union, Local 46 (Geoff Case and **Del** Josephson on behalf of John Case, Sid Schmidt, John Case)*
 Community Services Health Clinic (Michael Wilson, Michael **Murphy**)*
 Conlon, Art (on behalf of Sharon Aubin)*
Conwest Construction (Oliver (Bob) Cromwell)*
 Crush, Terry
 Cummings, Rick
 Curry, Bill
 Cusitar, Murray
 CUSO (Don Kossick, Marlene Larocque, Jacqui Barclay)*

 Daigneault, Tony
 Dancer, Joys
 Dancer, Oriole
 Deranger, Donald*
Denechezhe, Sophie*
 Denison Mines Ltd. (Andy **Rickaby**)*
 Dewar, Dale
Dillen, Ken*
 Dobbin, Murray (presented by David Geary)
 Drummond, Val
 Dumais, William
 Dzeyllion, Martin
 Dzeyllion, Tony

 Energy, Mines and Resources Canada (Richard Williams, Greg **McGuire**, Grant Feasby, Ron Edwards)*
 Environment Canada (Dennis Lawson, Bill Howard)*
 Environmental Engineering Research Unit, University of Saskatchewan (Lee **Barbour**, John **Gillis**)*
 Epp, William*
 Favel, Brian

Favel, Jim
 Favel, William
 Federation of Saskatchewan Indian Nations (Vikas Khaladkar on behalf of Chief Roland Crowe)
 Fern, George
 Fisher, Linda*
 Fisheries and Oceans Canada (Bruce **Fallis**)*
 Fitzsimmons, Michael
 Flood, Peter'
Forgay, Beryl*
 Fortugno, **Maria***
Fortugno, Stefania*
Francis, Mai
 Froese, Dan'
 Froese, Joe

Gagne, Louise*
 Garrett, Jim*
 Geary, David*
 George, **Isabelle***
 George, Chief Louis
 GML Integrated Environmental Management Ltd (Raymond Van de **Woestyne**)*
 Gramiak, Connie*
 Greenfield, Dave
 Greenpeace (Stan **Gray**)*
 Guillet, Raymond

Harding, Jim*
 Hardy, Naomi
 Harrison, Phil
 Hauta, Shirley*
 Hawkins, Valerie*
 Health and Welfare Canada (Jerry **Shaw**)*
 Helliard, Stephen*
 Hellmuth, Ralph*
 Herman, **Cecile**
 Herman, Emil
 Herman, Lester
Holden, Joe'
 Howe, Eric*

Ile-à-la-Crosse, Town of (His Worship Buckley **Belanger**)*
 IndEx'93 (**Barb Klassen**)*
 Indian and Northern Affairs Canada (George Cornwell)*
 Inter-Church Uranium Committee (**Phillip Penna**, Michael **Poellet**)*
 Interprovincial Association on Native Employment (Roberta Burns)*
 Inuit Tapirisat of Canada (Jamie **Kneen**, Joan **Scotti**)*
 Iron, Joe Sr.
Irvine, J.*

J.P. Enterprises (J.P. Proulx)
Jacek, Sister Regina
 Jack, Bob
 Janvier, Diane
 Janvier, Jacob
 Jensen, Debbie
 Johnson, Harold
 Josie, Martin
 Josie, Sarazine

Kennedy, Ray
 Kilborn Western Inc. (Ted Bassett)*
 Kirshner, David
 Kitsaki Development (J.P. Roberts)
 Klassen, Cameron
 Kramer Ltd. (**Garry** Ewen on behalf of Tim Kramer)
 Kyle, Croft

Laban, Jimmy
 La **Loche** Airways (Craig Schnell)
 Lamont, Tom'
LaRiviere, Tom*
 La **Ronge** and District Chamber of Commerce (Peter Kelly)'
 La Ronge Economic Development Committee, Town of (Scott Robertson)*
 La Ronge, Town of (His Worship Morris Gabrush)'
 Lau, Victor
 Le Maigre, Ida
 Le Maigre, Mark
 Lindner, Degen*
 Loewer, Roland
 Logue, Maureen

McDonald, **Bart**
 McIntyre, Lawrence
 McKay, Norma
 Paul McKay
 McPherson, Jean*
 Malboeuf, Norma
 Meadow Lake Heritage and Future Development Association,
 and Meadow Lake District Chamber of Commerce
 (Eric Roberts)
 Mercredi, Germaine
 Mercredi, John James
 Mercredi, Robert
Métis Society of Saskatchewan (Norman Hansen)
Métis Society of Saskatchewan, Local 126 (**Robert** Doucette,
 Deb Hopkins)*
Metke, Bill*
 Montgrande, Sharon
 Montour, L.
 Morin, Jeff
 Morin, Gordon
 Morin, Sharon
 Morin, Vital
 Mumm, Maggie*
 Murphy, Linda
 Myers, David*

Naldzil, Alfred
 Norsask Native Outreach Inc. (Vicky Marinuk, Antoinette Le
 Maigre, Doreen **Morin**)*
 North Saskatoon Business Association (Ed Stevens)'
 Northeast Economic Development Association (Torance
 Tomquist)*
 Northern Explosives Ltd. (Larry Wolkowsky)
 Northern Mining Coordinators (Les **Erikson**)*
 Northern Resource Trucking Ltd. (Roger Olyowsky, Chief
 Harry Cook, Dwayne **Hounsel**)*
 Northwatch (Lloyd Greenspoon)
 Northwest Credit Union (Bill Jeffrey)

O'Conway, Marcie

Onyskevitch, Morris*

Parrott, Dan
 Partnership, The (Betty Anne Latrace-Henderson)*
 Pedersen, **Gil***
 Pedersen, John'
 Pedersen, Yens (on behalf of Jean Sloan)*
 Peerenboom, Laurie*
 Pelican Narrows, Northern Village of (Torance Tornquist for
 Ron **Canada**)*
Penna, James'
Pinehouse, Village of (His Worship Peter Smith, Greg Ross)
 Pokebusters (Karen Weingeist)
 Porcupine Plain Opportunities Programs (Carl Kwiatkowski)
 Powder, Danny
 Powder, Dennis
 Powder, Steve
 Prince Albert Citizens for Energy Alternatives (Steve
 Lawrence)*
 Prince Albert Development Corporation, Security Services
 (Raymond Sanderson)*
 Project Plow Shares (Ellen Gould)
 Pronteau, Gilbert

Quigley, Tim*

Rachar, Paul
 Ratt, Brian
 Regan, Gerald
 Regnier, Bob
 Robillard, **Archie**
 Robillard, Chief Dan
 Robillard, Dennis
 Robillard, Henry
 Robillard, Mervin
 Robillard, Simon
 Robillard, Ted
 Rogalla, Dieter'
Rushton, Michael*

Sachacherl, Ugo*
 Salt, **Reg***
 Sanderson, Lillian
 Sandypoint, Billy
 Saskatchewan Association of Rural Municipalities (Val **Kono-**
 noff, Jim Angus)*
 Saskatchewan Conference of the United Church of Canada,
 The Church in Society Committee (Sylvia Thompson)*
 Saskatchewan Construction Association Inc. (Jim Chase)*
 Saskatchewan Education, Training and Employment (Ray
MackKay)*
 Saskatchewan Energy and Mines (Ray Clayton, Jane
 Forester)*
 Saskatchewan Environment and Resource Management (Ron
 Zukowsky, Ron **Barsi**, Bruce Smith, Greg Vogelsang,
 George Lucas)*
 Saskatchewan Environmental Society (Peter **Prebble**)*
 Saskatchewan Executive Council (Frank **Bogdasavich**)*
 Saskatchewan Government Employees' Union (Fiona Bishop,
 Dale **Holmberg**)*
 Saskatchewan Health (Danni Boyd, Jane Lyster, Kathy
 Chisholm, Gloria Sills, Leonard Hamm)'
 Saskatchewan Indian and **Métis** Affairs (Victor Taylor)*

Saskatchewan Labour (John Alderman, Denis Brown)*
 Saskatchewan Mining Association (Bob Cunningham)*
 Saskatchewan Municipal Government (Ron Styles, Brian Goff in)*
 Saskatchewan Natural History Society (Jim Elliott)*
 Saskatchewan Social Services (Brenda Righetti)*
 Saskatchewan Urban Municipalities Association (Alderman Ted Cholod, His Worship Buckley Belanger)*
 Saskatchewan Young New Democrats (Keith Jorgenson)*
 Saskatoon Chamber of Commerce (Albert Johnson)*
 Saskatoon, City of (Peter McCann)*
 Saskatoon Economic Development Authority (Dick Pinder)*
 Saskwatch (Paul Hanley, Larry Morris)*
 Sayezi, Donald
 Sayezi, Jimmy
 Sayezi, Max
 Scarfe, Albert
 Schlichemeyer, Cheryl
 Senior Environmental Organization of Regina (Verena Catikkas)*
 Sentar Consultants Ltd. (Donald Somers on behalf of Stella Swanson)*
 Septre Controls Ltd. (Stan Powell, Larry Bohn)*
 Shiell, Maisie*
 Shumard, Shirley
 Siemens Transport (Brian Smith)*
 Simpson, Graham
 Six Seasons Catering (William Smith)*
 Smillie, Adelle*
 Sproule, Cathy
 Stang, Carol
 Strnad, J. G.
 Swider, Rick
 Sydiaha, Stephanie
 Sylvester, Donnie
 Sylvester, Linda
 Symis, Marie
 Synergy Today (His Worship Bill Childerhose)
 Tavini-Huiraatira-Polynesian Liberation Front (Remuna Tufariua)*
 Taylor, Allan S.
 Telesis³ (John Scharf, Bud Burrell)*
 Thyssen Mining Construction of Canada Limited (Andrew Fearn)*
 Tron Power Ltd. (Ron Hemeon)*
 Tsannie, Chief Joe
 Twin Rivers Educational Environmental Society (read by Yens Pedersen for Val Shockey)*
 United Steelworkers of America, Local 8914 (Gordon Telfer)*

University of Saskatchewan (Bill Stolte)*
 Uranium Coalition (Marvin Resnikoff)*
 Uranium Saskatchewan Association Inc. (Tim Meadley)*

Vector Enterprises (Bob Heath)*

Wartman, Mark
 Watson, Ron
 Wells, Stewart
 West Wind Aviation (Dennis Goll)*
 Whitehawk, Joe
 Weingeist, Karen
 Wiercinski, Criss*
 Winnipeg Coordinating Committee for Disarmament (Philip Kienholz)
 Woods, Bob
 World Uranium Hearings (Gunter Wippel)*

N. Yanke Transfer Ltd. (Russell Marcoux)*
 Yole, Sharon

'A written submission was supplied to accompany the oral presentation, and is available for public review.

D-1.2 Written Submissions

Beverly and Kaminuriak Caribou Management Board (Jerome Denecheze)
 BIG MOUNTAIN Aktionsgruppe, Team Frankfurt (Wolfgang Sandkühler)
 Breti, Sybil
 Concerned Citizens of Manitoba (Anne Lindsey, Dave Taylor)
 Fort Qu'Appelle Peace and Justice Committee (N.L. Rowell)
 Fortugno, Frances
 Government of the Northwest Territories (Titus Allooooloo)
 Huculak, Jim
 Indigenous Women's Network (Lea Fouchée)
 McConnell, Madage
 NO-Candu Coalition (Diana Chown)
 NUEXCO Information Services (Thomas C. Pool)
 Orchard, R. Lyle
 PA Foundry Ltd. (Merriett Hewitt)
 Penna, Marion
 Peoples' Organization Against Nuclear Power and Nuclear Weapon, Gävle, Sweden (Thorild Dahlgren)
 Pike, C.
 Pomroy, Brent
 Thomas, Patricia
 Trendocher, Loretta
 UNECO (Ken Smith)

APPENDIX D-2

DOMINIQUE-JANINE EXTENSION

D-2.1 Oral Presentations Made at Public Hearings

Buffalo Narrows Airways (Dennis O'Brien)
 Cogema Resources Inc. (**Michel** Poissonnet, Liz Quarshie,
 Lyle Bear, Stan Penner)*
 Communications, Energy and Paperworkers' Union, Local 48
 (Geoff Case and **Del** Josephson on behalf of John Case,
 Sid Schmidt, John Case)*
 Forester, John
 Gardiner, Abraham
 Gardiner, Rodney (read by Joe Whitehawk)
LaFleur, Jim
Meneley, W. A.
 Piercy and Associates (read by **A.R.** Garden of McPherson,
 Leslie and Tyerman, for Harold Piercy)
 Petit, Frank
 Quarshie, Ellis*

D-2.2 Written Submissions

Atomic Energy Control Board (George Jack)
 Beaver Foods Ltd. Limited (**R.** J. Henderson)
 Environment Canada, Western and Northern Region (B. M.
 Burns)
 Fisheries and Oceans, Central and Arctic Region (P.H.
 Sutherland)
Flett, Alex, Edward, and **Timmy**
 Health and Welfare Canada (Jerry Shaw)
 Inuit Tapirisat of Canada (Jamie Kneen)
 Saskatchewan Environment and Public Safety (Technical
 comments from provincial departments and agencies)
 Saskatchewan Environmental Society (Peter **Prebble**)
 Saskatchewan Natural History Society (Jim Elliott, Donald
 Harron)
Shiell, Maisie
 The Uranium Coalition (prepared by Radioactive Waste Man-
 agement Associates)

APPENDIX D-3

McCLEAN LAKE

D-3.1 Oral Presentations Made at Public Hearings

Brown, Adrian
Corman, Jim
Halbert, Bruce
 Hamlet of Wollaston Lake/Hatchet Lake Band Joint Commit-
 tee (Chief Joe Tsannie, Jack Bell)*
 La **Ronge/Air** Ronge Economic Development Committee
 (Scott Robertson)*
 Points North Freight, (George Eikel)
 Total Minatco Ltd. (Ken Haapanen, Al Morrish, Dennis
DeWinter, Walter Keyes)*
 Visions North Community Futures Committee (Angus Pratt)*

D-3.2 Written Submissions

Atomic Energy Control Board (George Jack)
 Environment Canada, Western and Northern Region (B. M.
 Burns)
 Fisheries and Oceans (P.H. Sutherland)
 Fond du Lac Indian Band, Black Lake Indian Band, and Prince
 Albert Tribal Council Health and Welfare Canada (Tim
 Bonish)
 Indian and Northern Affairs Canada (Clifford S. Starr)
 Inuit Tapirisat of Canada (Jamie Kneen)
 Joint Review Committee, Hamlet of Wollaston Lake and
 Hatchet Lake Indian Band (Her Worship Flora **Nato-**
magen, Chief Joe Tsannie)
 Saskatchewan Environment and Public Safety (Technical
 comments from provincial departments and agencies)

Saskatchewan Environmental Society (Peter Prebble)
Saskatchewan Natural History Society (Jim Elliott, in cooperation with Donald E. Harron))

Shiell, Maisie
The Uranium Coalition (Prepared by Radioactive Waste Management Associates)

APPENDIX D-4

MIDWEST JOINT VENTURE

D-4.1 Oral Presentations Made at Public Hearings

Hamlet of Wollaston Lake/Hatchet Lake Band Joint Committee (Chief Joe Tsannie, Jack Bell)
La Ronge/Air Ronge Economic Development Committee (Scott Robertson)*
Midwest Joint Venture (Joe Anderson, Herb Fredericksen)
Montell, Jacques
Points North Freight (George Eikel)*
Rickaby, Andy
Visions North Community Futures Committee (Angus Pratt)*

Environment Canada (B.M. Burns)
Fisheries and Oceans (P.H. Sutherland)
Fond du Lac Indian Band, Black Lake Indian Band, and Prince Albert Tribal Council
Health and Welfare Canada (Jerry Shaw)
Joint Review Committee, Hamlet of Wollaston Lake and Hatchet Lake Band (Chief Joe Tsannie)
Saskatchewan Environment and Public Safety (Technical comments from provincial departments and agencies)
Saskatchewan Natural History Society (Jim Elliott, in cooperation with Donald E. Harron)
Shiell, Maisie

D-4.2 Written Submissions

Atomic Energy Control Board (George Jack)

APPENDIX E

BIBLIOGRAPHY OF REVIEW DOCUMENTS

APPENDIX E-I

REFERENCED BY ALL THREE REVIEWS

- *A Brief Historical Review of the Be8weridodge Mining Area of Northern Saskatchewan*, by R.G. Barsi and Dr. A.W. Ashbrook, October, 1992
- *An Overview of the Biophysical Environmental Impact of Existing Uranium Mining Operations in Northern Saskatchewan*, prepared by Environmental-Social Advisory Services Inc. (Herman J. Dirschl, Principal), October, 1992

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- ***A Socio-Economic Overview of Uranium Mining in Northern Saskatchewan***, prepared by Environmental-Social Advisory Services Inc. (Ed Weick, Principal), October, 1992
 - ***Assessing Cumulative Effects Of Saskatchewan Uranium Mines Development***, prepared by an independent team of specialists (Principal authors: M. Husain Sadar, David R. Cressman, and Dianne C. Damman)
 - ***Health in the Context of Uranium Mining in Northern Saskatchewan***, prepared by Environmental-Social Advisory Services Inc. (Ed Weick and Dr. John O'Neil, Principals)
 - Review ***of the Cluff Lake and Key Lake Reports***, by L. W. Vigrass, September, 1992
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APPENDIX E-2

DOMINIQUE-JANINE EXTENSION

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 - ***Environmental Impact Statement: Dominique-Janine Extension, Addendum***, Cogema Canada Ltd/Ltée, January 1993.
 - ***Cluff Lake Status of the Environment Report***, Stella Swanson, Editor, October 29, 1990
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APPENDIX E-3

McCLean Lake

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- ***McCLean Lake Project, Environmental impact Statement***, Total Minatco Ltd., August 1991.
 - ***Complementary McCLean Lake and Midwest Projects, McCLean Lake Project Environmental Impact Statement***, Total Minatco Ltd., September 1992.
 - ***Complementary McCLean Lake and Midwest Projects, McCLean Lake Project Environmental impact Statement, Additional information Requested By Uranium Mines Review Panel***, Total Minatco Ltd., November 1992.
 - ***McCLean Lake Project, Environmental Impact Statement, Additional information Transmission Line Tap***, Total Minatco Ltd., March 1993.
 - ***Technical Review of the Minatco Limited Environmental Impact Statement for the Proposed McCLean Lake Uranium Development***, prepared by Ecologistics Limited, May 21, 1992.

APPENDIX E-4

MIDWEST JOINT VENTURE

- ***Midwest Uranium Project, Environmental Impact Statement***, Midwest Joint Venture, Denison Mines Limited (Operator), August, 1991.
- ***Complementary McClean Lake and Midwest Projects, Midwest Project Environmental Impact Statement Amendment***, Midwest Joint Venture, September, 1992.
- ***Complementary McClean Lake and Midwest Projects, Midwest Project, 1991 Environmental Impact Statement***,
Additional Information Requested By Uranium Mines Review Panel, Midwest Joint Venture, November, 1992.
- ***Technical Review of the Midwest Uranium Project Environmental Impact Statement***, prepared by Ecologistics Limited, May 25, 1992.