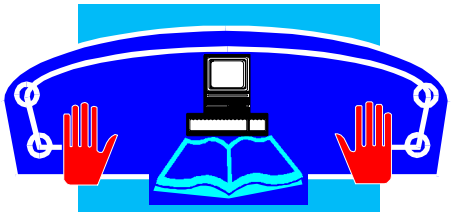

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ECOLOGICAL IMPACT ASSESSMENT, MITIGATION AND MONITORING

Submission to the Environmental Management Plans Technical Session

BHP Diamond Mine Environmental Assessment Panel

Yellowknife, NT

Prepared by

Government of the Northwest Territories

Department of Renewable Resources

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EXECUTIVE SUMMARY

Successful management of the environmental impacts associated with the NWT Diamonds Project requires a comprehensive approach to ecological impact assessment, environmental mitigation and monitoring. These three components of environmental management are interconnected. Because uncertainties exist in the assessment of potential environmental impacts, effective mitigation and monitoring are extremely important. Adjustments to mitigation and monitoring plans need to be made as new information becomes available. Effects monitoring studies need to be ecosystem-based and long-term to account for natural variability in the low Arctic ecosystem. A management structure is also needed to oversee a cooperative, multi-stakeholder effects monitoring program. Participants in the monitoring program should include representatives from BHP, resource management agencies, Aboriginal groups and other stakeholders.

An Environmental Protection Plan (EPP) should be developed before construction of the mine begins. The Plan needs to be comprehensive and detailed, and should be developed with input from northern experts including government personnel and traditional knowledge holders.

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1.0 INTRODUCTION

The NWT Diamonds Project will be the first diamond mine in Canada. The scale and type of this mining development are unprecedented in the Northwest Territories. The project is also unique given that it will occur in the low Arctic, a wilderness environment which is generally poorly understood. This is the project to which all other diamond mining developments will be compared. Given the diamond and other mineral potential of the region, it is important to set high environmental standards for this and future mining developments.

The purpose of this submission is to evaluate three essential components of environmental management for the NWT Diamonds Project - ecological impact assessment, mitigation and monitoring. It also provides recommendations to ensure that environmental impacts resulting from the project are minimized.

The Strategic Plan for the Wildlife Management Division, Department of Renewable Resources, provides the framework for the Division to participate in environmental impact assessment and review. Our mandate is to "ensure that viable populations of all wildlife species exist in their natural habitats" and to "ensure that the natural capabilities of ecosystems to support wildlife are not impaired by development" (GNWT Wildlife Management Division 1995).

Having reviewed the Proponent's Additional Information and 1995 data reports, outstanding deficiencies in the Environmental Impact Statement (EIS) pertaining to ecological impact assessment, mitigation and monitoring are presented in Appendix 2.

2.0 ECOLOGICAL IMPACT ASSESSMENT

2.1 Issue

The Proponent's impact assessment has resulted in conclusions about VECS which incorporate significant uncertainty. Throughout the life of the project, the Proponent will need to collect information about VECS (monitoring) to test impact predictions.

2.2 Background

Rationale and Importance of Impact Assessment

The primary rationale for conducting an environmental impact assessment is the opportunity to identify undesirable effects, and to modify projects in the design stage so that these effects are minimized or eliminated.

Predicting the significance of likely impacts which will result from project activities is a prerequisite to developing mitigative measures and subsequent predictions of residual effects and their significance. Predictions of the significance of residual effects without adequate baseline may not be accurate. The Proponent has collected baseline data over only 2 field seasons because of its development schedule.

Action Taken by the Proponent

The EIS contains an Impact Assessment Matrix which rates the effects of project activities on Valued Ecosystem Components (VECs) for the exploration, construction, operation, and decommissioning periods (Appendix IV-A). A summary of the physical and biological residual effects (Table 2-1) is also presented for these activity periods (Table 2-1, Vol. IV, p. 2.2). Conclusions concerning the significance of residual impacts on vegetation (Vol. IV, Sec. 3.2) and on wildlife and habitat (Vol. IV, Sec. 3.3) result from this assessment.

For most VECS regarding wildlife (eskers, vegetation, habitat, caribou, grizzly bears, wilderness, biodiversity), the future capacity for sustainable development given specific potential impacts is rated as high, and the significance of residual effects is rated as negligible or minor (Appendix IV-A). This results in the Proponent's conclusion that "The biological impacts associated with the NWT Diamonds Project will be negligible to minor." (vol. Iv, p. 3.1).

Ecological mapping has been conducted to provide "a framework for developing industrial activities that minimize or avoid negative impacts to wildlife" (Ecological Mapping 1995 Baseline Study Update, p. 5-l). Mapping of ecosystem units was conducted for the study area based on interpretation of aerial photographs and field investigations over 2 years. Wildlife habitat capability maps for selected species for a portion of the study area are provided in the 1995 study update report on ecological mapping.

2.3 Specific Concerns

(i) It is not clear what methodology or criteria were used to conduct the assessment of potential ecological impacts. Although information is provided in the EIS on methodology and modelling for assessing impacts on the physical environment (Appendix IV-B), comparable information is not provided for impacts on the biological environment.

Predictions of the significance of likely effects of the project on the ecosystem were made before measurement of the baseline conditions was completed. It is unclear on what basis predictions of impacts were made. Therefore, conclusions regarding the significance of project impacts on the ecosystem may not be valid. Several examples are provided below to illustrate this point. (refer to Vol. IV, Section 3 and Appendix IV-A)

Caribou -The prediction that theeffects oncaribou will benegligible or minor is based on the conclusion that few caribou will use the project area and an examination of theliterature from other areas. This conclusion is based on survey data from 1 year and an examination of literature. Caribou may travel through the project area in large numbers and therefore, the prediction may be inaccurate. (Refer also to the GNWT's submission on caribou for specific details and additional examples.)

Grizzly bears - The Proponent predicts the effects of noise and other human activities on bears will be minor. The basis for this prediction is the assumption that the area provides poor habitat for bears, and therefore, avoidance of the area will not result in significant loss of feeding or denning habitat. However, baseline studies of bears and their use of habitats in the area have not been completed, so this assumption may be unfounded. (Refer also to the GNWT's submission on grizzly bears for more details and additional examples.)

Habitat - The prediction that habitat loss resulting from roads and processing facilities will have negligible to minor effects is not supported by an analysis of habitat loss in relation to its use by wildlife species. Contemporary methods of ecological modelling should be used to predict the impacts of habitat loss on wildlife over the short and long-term.

Limited assessment of vegetation loss resulting from pits, tailings impoundments and waste rock dumps has been conducted (Vol. IV, Table 3.2-l). This type of assessment should be extended to other direct losses of aquatic, wetland and terrestrial wildlife habitat which will result from project activities, including other facilities, roads and airstrips. For example, based on the information provided in the EIS, we have estimated that about 14 km^2 of terrestrial habitat will be lost directly, during the exploration and construction phases alone.

The Proponent should analyse the potential effects of habitat loss on wildlife given several scenarios, including: (i) total, permanent loss of disturbed habitat, which will occur if revegetation efforts are unsuccessful; (ii) minimal long-term habitat loss, which may result with 100% success of revegetation; and (iii) various other rates of revegetation success.

Birds - Concerns related to the assessment of effects on birds are provided in Appendix 3.

(ii) Indirect loss of habitat will occur because of project activities, for instance when animals stop using an area because they avoid areas of human activity. This habitat alienation resulting from decreased availability of habitats has not been addressed by the Proponent. The limited discussion of habitat loss in the EIS

considers losses only through direct means, such as by removal or disturbance of vegetation and terrain. Impact assessment should include an analysis of total habitat loss, which includes both direct and indirect losses.

(iii) Ecosystem units have been mapped and some wildlife habitat capability maps have been produced. While these efforts are commendable, it is unclear how these maps will be used to minimize impacts of the project on wildlife and habitat.

The ecosystem unit maps should be used to quantify potential impacts of the project on wildlife by: (i) estimating abundance of wildlife by habitat type and for the area of impact; (ii) determining potential habitat loss by habitat and by species and (iii) predicting impacts of habitat loss on wildlife populations.

One remaining concern is that the capability mapping is contingent on an understanding of how wildlife use habitats. The Proponent's wildlife capability maps will not assist in minimizing impacts to wildlife unless they are based on sufficient data on habitat use by wildlife in the area.

(Iv) Impacts on the interactions of ecosystem components have not been addressed. The Proponent has only considered the impacts on individual components (e.g., caribou, bears). Interactions which need to be addressed include the effect of direct and indirect loss of aquatic and wetland habitat on waterfowl and furbearers, and the effect of reduced numbers of small mammals and other prey species (e.g., ptarmigan) on furbearers and birds of prey. The VEC methodology for environmental impact assessment requires an examination of the relationship and linkages between the VECS (Beanlands and Duinker 1983).

(v) Statements in the EIS regarding the significance of potential impacts were often associated with statements that the impacts would be temporary, when the duration of impacts is not known. For instance, for vegetation loss resulting from construction of facilities and roads, for which the probability of loss of habitat is rated as high, the significance of residual effects is rated as negligible/minor. This optimism may be attributed to the Proponent's reclamation success at their Island Copper Mine on Vancouver Island. However, because a reclamation program of this size is unprecedented in the low Arctic, the likelihood of success of revegetation efforts and the time it will take to reestablish vegetation are unknown. It is possible that most areas effected by the project may never be restcred to their natural condition, and will, therefore, remain disturbed habitats over the short and long-term.

(vi) The effects of many relevant project activities on several VECS are not addressed. For instance, the effect of roads on wilderness is not included in the impact assessment matrix or summary table. This contrasts with definitions of wilderness,

which commonly use a lack of roads as a criterion (e.g., Conservation of Arctic Flora and Fauna - CAFF 1993). Wilderness is commonly seen as a prerequisite for sustainable grizzly bear and wolverine populations.

2.4 Summary and Conclusions

An impact assessment based on adequate baseline data has not been completed. Therefore, conclusions may not be valid. Information on local and regional populations of wildlife and their use of habitats should be derived from inventories conducted over several years to allow for consideration of variation among years. New information should be incorporated as it becomes available, and adjustments should be made to predictions as necessary. The Environmental Management Plan must be flexible to allow for adaptive management and contain a mechanism to allow for mine operational changes in response to unforeseen ecological impacts. Given the uncertainties related to impact predictions, mitigation and long-term monitoring programs are essential.

The Proponent should work with biologists from the Department of Renewable Resources and the federal Department of the Environment to analyse likely impacts of the project, to predict changes to baseline conditions which are likely to result from project activities, and to develop mitigative measures which will minimize these impacts. The Proponent should work with stakeholders (including Aboriginal groups, outfitters, government and non-government agencies) to evaluate the significance of the potential impacts and the residual impacts that will remain following implementation of mitigative measures.

2.5 Recommendations to the Panel

The Proponent should continue to refine impact predictions based on new information (including 1995 data) as it becomes available. This analysis should examine the linkages between the VECS and where possible, a quantification of impacts on all biological VECS (caribou, bears, furbearers, birds, small mammals).

The significance of project impacts should be evaluated taking into account the perspectives of all stakeholders. Mitigative measures must continue to be refined based on this assessment.

3.0 MITIGATION AND ENVIRONMENTAL PROTECTION PLANS

3.1 Issue

An Environmental Protection Plan (EPP) is essential for successful management of environmental impacts of the NWT Diamonds Project. Although the proponent has included an Environmental Management Plan as part of their Environmental Impact

Statement, detailed protection procedures have not yet been provided and should be developed priorto construction and operation ofthe mine.

For purposes of this submission and the review of the Proponent's EIS, the term **"EnvironmentalM anagement Plan'' and ''Environmental Protection Plan'' are considered to be synonymous.**

3.2 Background

Role of Environmental Protection Plans

Environmental Protection Plans are widely used in industrial development projects to mitigate negative environmental impacts throughout the life of a project. EPP's have been developed as generic plans or as project-specific, day to day operational procedures, for projects such as seismic work, oil and gas pipelines, hydro-electric developments and surface mines (AGRA Earth and Environmental, pers. comm.). Project specific plans are prepared following environmental assessment and review to ensure the recommendations of the review process, the policy and legislative requirements, and the operating terms and conditions of the project are translated into a comprehensive, yet practical set of operating procedures. This tool serves as:

- A reference document for all project activities and components of the environment requiring special protection and mitigative measures;
- The basis for a concise operational field manual used by company and government personnel for environmental inspection purposes;
- Information allowing contractors to understand the environmental operating procedures under which they are required to complete a specific job; and
- A document whereby the developer can demonstrate to project regulators, Aboriginal groups, stakeholders and the public, their formal commitment to environmental protection.

Need for an Environmental Protection Plan

An Environmental Protection Plan for the NWT Diamonds Project is important given the uncertainties in the EIS's assumptions, predictions and conclusions. The scale and type of this mining development are unprecedented in the Northwest Territories. An EPP for this project, along with a comprehensive effects monitoring program, will ensure that environmental impacts are minimized. It will also provide the opportunity for the Proponent to set high environmental standards for this and future mining developments.

Assessment of Proposed Mitigative Measures

A review of Volume Ill, Environmental Management Plans and Volume IV, Impacts and Mitigation, was completed to determine whether adequate mitigative measures were proposed. The Government of the Northwest Territories' Conformity Report identified concerns with the lack of detail in the mitigation measures proposed at that time, No refinement of the these measures has occurred prior to these hearings. Several examples are provided to illustrate this point:

> "If **quarry sites are required, they will be selected with the aim of minimizing disturbance to** denning **areas." " Wildlife** use of the esker adjacent to quarries will be monitored." (Vol. Ill, page 7.2)

Although the Proponent's intent is to minimize disturbance, this statement lacks detailed information on proposed quarrying activities and how den sites will be protected. The Proponent needs to work with government biologists to develop practical, yet effective protection measures early in the planning phase. These measures are particularly important since the Proponent has identified the Misery Lake quarry site as an area of potential conflict between denning carnivores and development activities.

> Several general statements are made regarding minimizing disturbance to migrating caribou; "During mine operation, vehicle movements and speed will be managed to accommodate caribou movements yet maintain mine prod uction." (Vol. Ill, p. 7.3)

This type of policy statement falls short of the specific protection measures necessary to ensure that interactions between project activities and caribou will be minimized.

> "The Proponent, however, will periodically make recommendations to project aircraft operators and pilots to develop flight guidelines that minimize noise disturbance to sensitive wildlife/outfitter areas . .." (Vol.III, p. 6.7)

The identification of sensitive wildlife areas needs to be completed before specific mitigative measures are prescribed. The Proponent should develop appropriate protection measures for sensitive wildlife areas, including raptor nesting areas, found within their claim block. These measures should include restrictions on minimum altitude and approach distances during sensitive times of the year. Specific flight corridors should also be established.

> "A GIS system is now available for the study area that provides for an ecological inventory and a tool for assessing potential impacts and assists in developing mitigating measures to control impacts." (Ecological Mapping -1995 Baseline Study Update)

The Proponent is planning to use ecological mapping in the assessment, mitigation and monitoring of vegetation impacts from project activities. This is a good approach given the potential for habitat loss from surface development such as waste rock piles. It is a useful planning tool which needs to be implemented as soon as possible. Further work is needed to complete the ecological mapping work and the assessment of important habitats. This is a pre-requisite for the development of mitigative measures.

Reclamation

The EIS states, "Reclamation will be the major means of mitigating impacts associated with the development and operation of the NWT Diamonds Project." (Vol. III, p. 9.1) The initial revegetation research being conducted by the Proponent is based on good experimental design. The Proponent's proposal to reclaim disturbed areas progressively over the life of the mine is also a good approach. The Proponent should be commended for its efforts in this regard.

Reclamation success depend on research efforts in this area and the company's commitment to a long-term revegetation monitoring program of disturbed sites. The highly variable, low Arctic environment combined with large areas of disturbed land, will present reclamation challenges never attempted before in this environment. Although a goal of the reclamation program is to create productive wildlife habitat, the success of such a program is unknown and the impacts may be long-term.

3.3 Approach Required

We are willing to work cooperatively with the Proponent to develop environmental protection procedures and monitoring programs necessary to ensure that environmental impacts are minimized and to determine the residual impacts of this project. This partnership will be beneficial to both parties.

3.4 Summary and Conclusions

Successful management of the potential environmental impacts of the NWT Diamonds Project requires a comprehensive approach to environmental management. The Environmental Management Plan contained in the Proponent's Environmental Impact Statement provides a framework for a more detailed approach to environmental management. The Plan has identified strategies to minimize impacts. A detailed Environmental Protection Plan and long-term monitoring program are key elements still required of the Proponent. Minimizing environmental impacts requires an accurate prediction of potential impacts and information feedback on the effectiveness of mitigation which is provided by monitoring.

3.5 Recommendations

The Proponent should prepare a comprehensive Environmental Protection Plan, including an operational field manual of environmental protection procedures. This plan should address all phases of the project: construction, operation and abandonment.

The Environmental Protection Plan should be developed in consultation with appropriate regulatory and management agencies and Aboriginal groups.

The Environmental Protection Plan should include a comprehensive effects monitoring program. Scientific and traditional knowledge should be incorporated into the plan.

Development of an Environmental Protection Plan for the NWT Diamonds Project should be a recommendation of the Panel, for the approval of this project.

We have contacted several mining companies and regulatory agencies in Canada and the United States to obtain copies of Environmental Protection Plans. These documents will be filed with the Panel Office when they are available. A copy of Interprovincial Pipeline (NW) Limited's Environmental Protection Plan for the Norman Wells to Zama pipeline will be filed with the Panel as an example of an Environmental Protection Plan developed for a resource development project in the Northwest Territories.

4.0 MONITORING - WILDLIFE AND WILDLIFE HABITAT

4.1 Issue

Wildlife and wildlife habitat have been identified as Valued Ecosystem Components for the NWT Diamonds Project (Vol. II, Table 1.1-1). The Proponent's Environmental Monitoring Program does not provide sufficient detail to allow for the assessment of the effectiveness of impact mitigation and the project's residual impacts.

4.2 Background

The EIS states that "Monitoring will be conducted throughout all phases of project development and will be integrated into all project activities." (Vol. III, p. 10.1) Monitoring will also continue during post-closure activities. Furthermore, the Proponent states that this monitoring program will bean integral component of their Environmental Management Plan (EMP). The goal of the EMP is "to preserve ecosystem integrity as well as to prevent and mitigate any potential environmental impacts" (Vol. III, p. 1.9). The monitoring program is intended to ensure compliance with government guidelines and permit requirements, to provide a feedback mechanism for determining the accuracy of predicted environmental impacts, and to evaluate the effectiveness of mitigative actions.

A successful effects monitoring program should be designed with scientific rigour. Reference topre-construction baseline information is essential. Theprogram needs to produce results which will distinguish natural variation in the ecosystem from anthropogenic effects. In some cases, pre-construction baseline data collected by the Proponent has not been analysed. Completion of this work is still required.

The Proponent outlined their monitoring activities for wildlife and wildlife habitat in Vol. III (p. 10.14- 10.20) of their EIS and in more detail in the Additional Information Response to the Panel (Chapter 15). The Monitoring Plan requires further development. The approach is good and follows the adaptive management concept which sets criteria or thresholds to compare the parameters to be monitored. The key, however, is to select the appropriate parameters for study and employ methods that will be sensitive enough to detect changes so that appropriate management actions can be taken. Documenting the presence/absence of wildlife by employees is not appropriate for monitoring wildlife effects.

Chapter 15 of the Additional Information Response (p. 15.14) states that the specifics of the environmental monitoring program will be reviewed by the proposed Environmental Advisory Group (EAG) and other parties or specialists. It also states that the mandate of the EAG is surveillance.

A distinction must be made between surveillance and effects monitoring activities. Surveillance activities need to be coordinated by the Proponent and the appropriate regulatory agencies. Effects monitoring needs to be a cooperative program involving the Proponent and resource management agencies. A separate management structure to coordinate effects monitoring studies is required.

4.3 Specific Concerns

Information Gaps - The Proponent has failed to identify significant gaps in knowledge and understanding of the tundra ecosystem upon which key decisions will be made. Information gaps should be identified and used to develop research and monitoring programs designed to gather the required information. The type of information collected should be specific to the impact assessment process.

Birds and Small Mammals - The Proponent has conducted surveys of birds and small mammals in their claim block. However, it is not clear if annual monitoring will continue for these species during operation of the mine, Some monitoring for impacts should include these wildlife groups because they are often used as indicators of the health of an environment.

Eskers - Eskers have been identified as a VEC because wildlife use them as travel routes and insect relief areas, as well as feeding and denning habitat. Eskers are also an important source of granular material for construction of airstrips,

camps, roads and other development infrastructure. Eskers are diverse structures and some appear more important than others for wildlife. The Proponent has surveyed the eskers within their claim block and currently plans to limit their use of eskers to the Airstrip Esker and a small part of the Lac du Sauvage Esker. The Lac du Sauvage Esker is known to be important to wildlife and the area identified as a quarry should avoid most denning areas. Both mitigation and monitoring programs are needed to understand the effects of quarrying activities and the removal of esker material on carnivores and other wildlife species. The EIS acknowledges that continued monitoring is required, but detailed information is lacking.

Barren-ground Caribou and Grizzly Bears - The importance of these VECS is well understood. These species have received special attention throughout the review of this project. Monitoring requirements for caribou and grizzly bears are discussed in detail in separate submissions by the GNWT.

Program Management - The EIS and Additional Information indicate that the Environmental Advisory Group will oversee the Proponent's Environmental Monitoring Program, Although proposed monitoring activities are limited to within their claim block, the Proponent is involved in grizzly bear research and monitoring as part of the West Kitikmeot/Slave Study. The role of the EAG, specifically regarding surveillance, effects monitoring on their claim block, and the Study need to be clarified.

4.4 Approach Needed

An effective Environmental Management Plan requires a comprehensive surveillance and effects monitoring program. Effects monitoring studies should include a design which incorporates control vs. impacted areas together with a before-and-after approach (Osenberg et al. 1994). Long-term monitoring is required to take into account natural variability in the ecosystem.

A management structure including company personnel, resource management agencies, Aboriginal groups and other stakeholders is needed to oversee the effects monitoring program.

Two examples of models used for cooperative effects monitoring programs are the Norman Wells Research and Monitoring Program for the Norman Wells Pipeline Project and the program for monitoring military flying activities in Labrador and Quebec. Copies of these documents will be filed with the Panel when they are available.

4.5 **Recommendations**

The Proponent should undertake a collaborative effects monitoring program to address potential impacts which may occur within their claim block and beyond.

The comprehensive environmental monitoring program should be ecosystem based and use both contemporary scientific methods and traditional knowledge.

A management structure should be established to coordinate the monitoring program. The Panel should examine the models provided and recommend a suitable approach for the NWT Diamonds Project.

Participants in the management and implementation of the monitoring program should include representatives from BHP, resource management agencies, Aboriginal groups and other stakeholders.

5.0 REFERENCES

Beanlands and Duinker. 1983. An ecological framework for environmental impact assessment in Canada. Institute for Resource and Environmental Studies. Dalhousie University, Halifax, Nova Scotia. 132pp.

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APPENDICES

LIST OF APPENDICES

APPENDIX 1

Summary of Recommendations to the Panel

Ecological Impact Assessment

1. The Proponent should continue to refine impact predictions based on new information (including 1995 data) as it becomes available. This analysis should examine the linkages between the VECS and where possible, a quantification of impacts on all biological VECS (caribou, bears, furbearers, birds, small mammals).

2. The significance of project impacts should be evaluated taking into account the perspectives of all stakeholders. Mitigative measures must continue to be refined based on this assessment.

Mitigation and Environmental Protection Plans

1. The Proponent should prepare a comprehensive Environmental Protection Plan, including an operational field manual of environmental protection procedures. This plan should address all phases of the project - construction, operation and abandonment.

2. The Environmental Protection Plan should be developed in consultation with appropriate regulatory and management agencies and Aboriginal groups.

3. The Environmental Protection Plan should include a comprehensive effects monitoring program. Scientific and traditional knowledge should be incorporated into the plan.

4. Development of an Environmental Protection Plan for the NWT Diamonds Project should be a recommendation of the Panel, for the approval of this project.

Monitoring - Wildlife and Wildlife Habitat

1. The Proponent should undertake a collaborative effects monitoring program to address potential impacts which may occur within their claim block and beyond.

2. The comprehensive environmental monitoring program should be ecosystem based and use both contemporary scientific methods and traditional knowledge.

3. A management structure should be established to coordinate the monitoring program. The Panel should examine the models provided and recommend a suitable approach for the NWT Diamonds Project.

4. Participants in the management and implementation of the monitoring program should include representatives from BHP, resource management agencies, Aboriginal groups and other stakeholders.

APPENDIX 2

Outstanding Deficiencies Pertaining to Ecological Impact Assessment, Mitigation and Monitoring

The following deficiencies were also identified in the GNWT's Conformity Report (1 995).

Guideline No.	Deficiency
405	Identification of significant gaps in knowledge and understanding upon which key conclusions are based has not been conducted. This information should be used to design better monitoring programs.
603(e)&(f)	More information is required on how traffic will be managed to reduce potential effects on wildlife and wildlife habitat, particularly for the Misery Access Road. Many of the mitigative measures in the wildlife management plan are too vague to assess whether they will be effective in minimizing environmental effects. More detailed information on mitigative measures and criteria for implementing mitigative measures is required.
701	The spatial boundaries utilized by the Proponent for environmental assessment seem to focus within the boundaries of their claim block. A larger study area should be used to determine the effects of the project on wide-ranging wildlife species such as caribou, wolves, wolverine and grizzly bears.
808(C)	New information on distribution and abundance of vegetation and habitat types resulting from the ecological mapping program has not been used to reassess predictions of ecological impacts, mitigative measures and the proposed monitoring programs.
901, 908, 909	The short and long-term effects of the project on the biological environment have not been evaluated adequately. Information gaps should be clearly identified, particularly when the information is needed to support predictions of project" effects o-n wildlife and wildlife habitat, or to develop effective mitigative measures.
902	The effectiveness of the traffic and wildlife management plans in mitigating project effects has not been assessed. The probability of residual project effects should be considered in relation to the proposed environmental management plans, commitments and company policies.

903 The effects of the exploration activities have not been described adequately. Conclusions are subjective in nature and without scientific rigour.

The assessment of the long-term cumulative effects of the project when combined with potential future development in the claim block is inadequate. Many relevant factors were omitted, such as the effects of more access roads.

904, 905 The prediction of effects is not based on scientific data, and appears to be based on opinions. The degree of uncertainty in predicting the effects should be considered as part of the assessments. The analysis of the significance of the effects predicted is qualitative and subjective in nature, and could be improved using a quantitative approach.

1001, 1002, 7003 More information is required on specific mitigative measures and criteria for implementing mitigative measures for wildlife and wildlife habitat.

7707,7702 It is not clear how the results of the land monitoring program will be used to make adjustments to the traffic or wildlife management plans and company commitments and policies. More detailed information is required on the land monitoring program.

1204 The assessment of cumulative effects of future development is not adequate. The cumulative effects assessment should include consideration of more access roads within the claim block, more or larger tailings dumps and waste rock piles, and the timing and success of the reclamation program.

APPENDIX 3

Ecological Impact Assessment of Birds

Concerns

The Proponent states that the effects of project activities on wildlife and on biodiversity, including birds, will be negligible or minor during the exploration, construction, and operation phases of the project. This prediction was made despite the lack of data on birds in the area. The 1995 baseline study update report on birds assists in providing the necessary baseline data on which to assess impacts on birds. However, only the raw data have been compiled with little quantitative analyses. Furthermore, a single year of data collection will not indicate the annual variation in use of the area by migratory birds. Although meaningful assessment of impacts can now begin, analyses of these, and of additional data collected over several years, are required before the full significance of project impacts on migratory birds can be evaluated.

Action Needed

A thorough analysis is required before predictions of the significance of habitat loss can be made. This analysis should include merging information on habitats and birds and calculating densities by habitat type. For example, our biologists have estimated losses of birds resulting directly from habitat losses, using data provided by the Proponent in their 1995 update report on birds, as follows: 3600 songbirds, 900 shorebirds, 500 ducks, 500 ptarmigan, 2000 individuals of other bird species, plus the annual production of young. The significance of these losses is unknown.

Questions which need to be addressed as part of an assessment of project impacts on birds are provided here. Similar questions should be used to assess impacts on other wildlife species.

1. What are the estimated populations of birds in the area of impact?

2. What are the estimated populations of birds in the area by habitat type?

3. Beyond absolute reductions in populations due to habitat loss, what are the other impacts that will affect the bird resource?

4. How will impacts on birds be minimized and mitigated?

5. What are the expected impacts of activities beyond the study area? For example, loss of grouse and ptarmigan to the winter truck traffic related directly and indirectly to the proposed project should be assessed.

6. In 1995, during the critical period of spring migration, poor weather prevented waterfowl inventory for much of the time. Will inventory of waterfowl be conducted in subsequent years?

7. In 1995, because of different timing of inventories of plots on developed and undeveloped land, comparisons were not possible. Is this work planned for 1996?

APPENDIX 4

Definition of Terms

Ecological Impact Assessment (Westman 1985)

Ecological

Referring to ecosystem components (structures) and their interaction (functions).

Impact

The effect of **a** human-induced activity on an ecosystem.

Assessment

Analysing and evaluating impacts, where:

Analysis is an objective task which includes:

(1) identifying activities
(ii) taking measurement of baseline conditions
(iii) predicting changes to baseline conditions which are likely to result from project activities.

Evaluation is a subjective task which involves determining the significance of likely effects, and depends on the application of human values.

Monitoring (Beanlands and Duinker, 1983)

Monitoring

Repetitive measurement of environmental variables.

Effects Monitoring

Monitoring of specific ecological phenomena to document change for the purposes of testing impact hypotheses and predictions by determining project effects, and determining the effectiveness of mitigative measures.

Compliance Monitoring

Monitoring to comply with environmental stipulations and regulatory terms and conditions (i.e., surveillance).

APPENDIX 5

Curriculum Vitae - Steven B. Matthews

EDUCATION

1978 Bachelor of Science (Honours) degree in Biology, York University, Toronto, Ontario. Thesis title: Seasonal patterns of translocation in arctic plants.

1972 Secondary School Honour Graduation Diploma, George S. Henry Secondary School, Don Mills, Ontario.

EMPLOYMENT HISTORY

1986 to Present — **Environmental** Assessment Biologist
Wildlife Management Division, Department of Renewable Resources, Government of the Northwest Territories, Yellowknife, NT.

Responsible for the Division's Environmental Assessment Program. Conducts technical reviews of environmental reports, including EIS's, federal land use and lease applications. Recommends to regulatory agencies and industry operating terms and conditions, mitigative measures and environmental monitoring programs related to wildlife and wildlife habitat. Provides advice to two federal environmental reviews committees - Lands Advisory Committee and Regional Environmental Review Committee. Designs and conducts environmental monitoring programs for wildlife (e.g., raptors) and habitat (i.e., habitat inventory and assessment).

1982 to 1986 — Pipeline Monitoring Biologist
Environmental Planning and Assessment Division, Department of Renewable Resources, GNWT, Yellowknife.

Designed and implemented environmental monitoring programs for the Norman Wells Pipeline Project. Reviewed environmental studies, reports and project permits. Represented the Department as a member of the Norman Wells Research and Monitoring Program. Provided technical advice to project advisory committees. Prepared project reports. Supervised Renewable Resource Officers assisting with field studies.

1981 to 1982 — Project Biologist, Marine Programs
Environmental Protection Service, Environment Canada, Yellowknife, NT. Designed and implemented a monitoring program for the near shore marine environment of the Beaufort Sea. Reviewed reports and provided technical advice to federal government advisory committees. Prepared scientific reports.

PUBLICATIONS AND REPORTS

MATTHEWS, S.B. 1991. An assessment of bison habitat in the Mills/Mink lakes area, Northwest Territories, using Landsat Thematic Mapper data. Arctic 44(1 st Suppl.): 75-80.

MATTHEWS, S.B. 1989. Norman Wells Pipeline Project raptor monitoring program, 1980 to 1988. NWT Department of Renewable Resources, Yellowknife. File Rep, No. 82. 46 pp.

BROMLEY, R.G. AND S.B. MATTHEWS. 1988. Status of the Peregrine Falcon in the Mackenzie River Valley, Northwest Territories, 1969-1985. Pages 59-63 In: T.J. Cade, J.H. Enderson, C.G. Thelander, and C.M. White (Eds.). Peregrine Falcon populations - their management and recovery. The Peregrine Fund, Boise, Idaho. 949 pp.

MATTHEWS, S.B. AND R.M. LARSON 1987. An evaluation of the Norman Wells Project by the Department of Renewable Resources, Government of the Northwest Territories. NWT Department of Renewable Resources, Yellowknife. Unpubl. rep. 100 pp.

APPENDIX 6

Curriculum Vitae - Leslie A. Wakelyn

EDUCATION

1984 Master of Science degree in Wildlife Biology, Colorado State **University, Fort Collins. Thesis title: Analysis and comparison of existing and historic bighorn sheep ranges in Colorado.**

1979 **Bachelor of Science** (Honours) **degree in Zoology, University of Alberta, Edmonton.**

EMPLOYMENT EXPERIENCE

1993-present **Habitat Biologist** for Wildlife Management Division, NWT Department of Renewable Resources (NWT-DRR), Yellowknife. Responsible for NWT Habitat Conservation Project. Initiated project by obtaining outside funding (from Wildlife Habitat Canada). Current focus is on facilitating establishment of a network of wildlife conservation areas for the NWT in cooperation with Aboriginal land claim organizations, wildlife co-management boards, and other government agencies.

1989-1993 **Wildlife Technician** for Raptor and Environmental Assessment Programs, Wildlife Management Division, NWT-DRR, Yellowknife. Participated in a variety of wildlife research and management programs which involved project planning, field studies, data analysis, and report preparation.

Major projects included raptor surveys (by helicopter and boat), a study of terrestrial toxicological contamination (by collecting ptarmigan eggs and tissues), assessing trends in microtine abundance (by trapping), and wildlife habitat mapping (in boreal, subarctic, and arctic regions) using remote sensing techniques. Also responsible for departmental input into land application screening process (assessing potential impacts, submitting recommendations to land management agencies, maintaining a database) and for habitat-related input into planning documents.

1988-1989 **Contract Biologist** for Wildlife Management Division, NWT-DRR, and visiting researcher with the Boreal Institute for Northern Studies, University of Alberta. Evaluated the application of Landsat data for mapping NWT wetlands and attended several natural resource management courses for professional development.

1986-1988 **Raptor Habitat (86/87) and Wetlands (87/88) Biologist** for Wildlife Management Division, NWT Department of Renewable Resources, Yellowknife. Assessed the feasibility of using remote sensing techniques to identify potential falcon breeding habitat and to map northern wetland areas.

1985 **Biologist** for Mutrie-Wishart Environmental Consultants, Calgary. Prepared applications to provincial regulatory agencies for pipeline projects and vegetation management plans for transmission lines in Alberta.

1985 **Field Biologist for** IEC Beak Consultants Ltd., Calgary. Assisted with ungulate pellet group counts near Rocky Mountain House, Alberta.

1984- **Biologist** for Habitat Branch, Alberta Fish and Wildlife Division, Calgary. Developed

1985 wildlife habitat management guidelines for use in forest management on the Bow Crow Forest Reserve. Also revised several reports on the impact of development on wildlife habitat in Alberta's eastern slopes.

1982-1984 **Graduate Research Assistant in Department** of Fishery and Wildlife Biology, Colorado State University, Fort Collins. Investigated habitat characteristics of existing and historic bighorn sheep ranges in Colorado.

Produced habitat maps for 40 sheep ranges by interpretation of aerial photographs and forestry maps, ground truthing, and interviews with government biologists and wildlife officers. Compared habitat of existing and historic ranges using univariate and multivariate statistical analyses. Also prepared and graded exams for an undergraduate wildlife management course.

1981 **Research Biologist** for Alberta Recreation and Parks, Kananaskis Country. Conducted literature reviews and prepared reports for provincial park resource management programs.

1981 **Field Biologist** for International Environmental Consultants Ltd., Calgary. Assisted with moose browse survey in Kananaskis Country.

1980-1981 **Biologist for Ecoplans Limited, Calgary and Edmonton. Researcher and co-author for environmental assessment projects in Alberta and British Columbia, including oil and gas pipelines, reservoir recreation and rehabilitation, forest and fire management, and urban/industrial land development.**

1979 **Field Biologist** for Syncrude Canada Limited, Fort McMurray and Edmonton. Contractor to bird deterrent program. Observed waterbird activity, directed searches for dead and moribund wildlife, analyzed data, and prepared summary reports.

1978 & **1979 (summers)** **Environmental Technician for Syncrude Canada Limited. Assisted with water and invertebrate sampling, fish seining, breeding bird surveys, small mammal trapping, atmospheric studies, and the bird deterrent program.**

PROFESSIONAL AFFILIATIONS

Member: Canadian Nature Federation

The Wildlife Society

CAREER AND PERSONAL DEVELOPMENT/VOLUNTEER WORK

1991/92 Participated in cross-cultural exchange program of Canadian Crossroads International. Worked for the Department of Wildlife and Natural Areas, Ministry of Agriculture, Ecuador.

Conducted an analysis of wildlife management problems based on discussions with government personnel and others, and through direct observation of zoos (public and private), retail outlets for wildlife and wildlife products, and current environmental conditions. Provided numerous management recommendations in report form (English and Spanish versions).

1988 Special student, Faculty of Science, University of Alberta. Coursework in remote sensing (1 undergraduate, 1 graduate-level course), natural resource **economics, and forest management.**

1980 Unclassified student, Faculty of Science, University of Calgary. Coursework in biology (zoogeography, population genetics) and environmental studies (global issues).

PUBLICATIONS AND REPORTS

POOLE, K.G., L.A. WAKELYN, AND P.N. NICKLEN. 1996. Habitat selection by a lynx population in the Northwest Territories. Can. J. Zool. in press.

WAKELYN, L.A. 1992. Conservation and management of wildife in Ecuador -an analysis. Prep. for Division de las Areas Naturales y Viola Silvestre, Ministerio de Agricultural y Ganaderia, Quito, Ecuador.

WAKELYN, L.A. 1992. Diagnostic de la problematic national para la conservation y manejo de la viola silvestre en Ecuador. Prep. for Division de las Areas Naturales y Vida Silvestre, Ministerio de Agricultural y Ganaderia, Quito, Ecuador,

WAKELYN, L.A. 1990. Wetland inventory and mapping in the Northwest Territories using digital Landsat data. NWT Dept. Renewable Resources File Rep. No. 96.

RISENHOOVER, K. L., J.A. BAILEY, AND L.A. WAKELYN. 1988. Assessing the Rocky Mountain bighorn sheep management problem. Wildl. Sot. Bull. 16:346-352.

WAKELYN, L.A. 1988. Feasibility of using remote sensing to identify potential breeding habitat of falcons in the NWT - I Problem Analysis II Final report. Submitted to Northern Oil and Gas Action Prog. by NWT Dept. Renewable Resources, Yellowknife. Unpubl. rep.

WAKELYN, L.A. 1988. Landsat imagery for wetland inventory in the Northwest Territories - pilot study. Submitted to Wildlife Habitat Canada and Ducks Unlimited Canada by NWT Dept. Renewable Resources, Yellowknife. Unpubl. rep.

WAKELYN, L.A. 1987. Changing habitat conditions on bighorn sheep ranges in Colorado. J. Wildl. Manage. 51: 904-912.

WAKELYN, L.A. 1987. Wetland classification and inventory pilot project (stage II) - Work plan. NWT Dept. Renewable Resources, Yellowknife. Unpubl. rep.

WAKELYN, L. A., J. SCARTH, R. ZAMMUTO, F. GEDDES, AND R. USHER. 1986. Review of "The status of the fish and wildlife resource in Alberta (1984)". Submitted to Alberta Fish and Wildlife Div. by Alberta Chap., Wildl. Sot. Canada.

WAKELYN, L. A., AND P.I. ROSS. 1985. Wildlife habitat management guidelines for timber harvesting in the Bow-Crow Forest, Alberta. Alberta Fish and Wildlife Div., Calgary. Unpubl. rep.

McCALLUM, M., C. LEWIS, AND L.A. WAKELYN. 1985. Potential impacts of the Mount Allan ski facility on bighorn sheep and elk and proposed mitigation measures. Alberta Fish and Wildlife Div., Calgary. Unpubl. rep,

WAKELYN, L.A. 1984, Analysis and comparison of existing and historic bighorn sheep ranges in Colorado. M.S. Thesis, Colo. State Univ., Fort Collins.

WAKELYN, L. A., AND J.A. BAILEY. 1983. Analysis and comparison of existing and historic bighorn sheep ranges in Colorado. Proc. 28th Ann. Mtg. Central Mtns. Plains Sec., The Wildlife Society, Gunnison, Colo. Abstract.

WAKELYN, L. A., AND J.A. BAILEY. 1983. A review of habitat requirements and habitat management programs for mountain sheep. Wildlife/Silviculture workshop rep. USDA For. Serv., Rocky Mtn. Reg., Denver,

ANDERSON, E., C. ECKERT, AND L. WAKELYN. 1981. Owl Mountain State Wildlife Area habitat management plan. Submitted to Colo. Div. Wildl., Fort Collins. Unpubl. rep.

WAKELYN, L. A., AND G. MORE. 1981. Fire hazard reduction in forested facility areas - principles and guidelines. Alberta Prov. Parks, Kananaskis Reg., Canmore. Res. "Manage. Rep. Ser. KR-2.

WAKELYN, L. A., AND G. MORE. 1981. Transmission powerline right-of-way maintenance procedures in Kananaskis region - principles and maintenance. Alberta Prov. Parks, Kananaskis Reg., Canmore. Res. Manage. Rep. Ser. KR-1.

CONSULTANT REPORTS (Contributing author)

MUTRIE-WISHART ENVIRONMENTAL CONSULTANTS, Calgary and Edmonton. (1985)

Summary report on routing and environmental protection for the proposed Shell Canada Resources Limited Innisfail-Amerada pipeline. Prep, for Shell Canada Resources Ltd., Calgary.

Development and reclamation report for the proposed Paramount Resources Ltd. West Liege gas gathering system. Prep. for Paramount Resources Ltd., Calgary.

Development and reclamation report for the proposed Gulf Canada Resources Garrigton-Lanaway project. Prep. for Gulf Canada Resources, Calgary.

Vegetation management plan - Whitefish Lake substation (825S) to Mildred Lake substation (719S) 240kV transmission project. Prep. for Alberta Power Limited, Edmonton.

Vegetation management plan - 7L41 to Marguerite Lake substation (826S) 241/144 kV transmission project. Prep. for Albert Power Limited, Edmonton.

Development and reclamation plan for the proposed Esso Resources Canada Limited Obed-Kaybob South pipeline project. Prep. for Esso Resources Canada Ltd., Calgary.

ECOPLANS LIMITED, Calgary and Edmonton (1981).

Environmental evaluation for routing and construction of the West Pembina Recycling Plan gas gathering system. Part 1: route selection, Prep. for Hudson's Bay Oil and Gas Co. Ltd., Calgary.

Environmental evaluation of alternative routes for the Edson-Muskeg-Nordegg pipeline. Prep. for Hudson's Bay Oil and Gas Co. Ltd., Calgary,

Environmental appraisal for Radium industrial subdivision. Prep. for Kirk Ltd., Puyallup, Washington