Northwest Territories Water Board
Public Hearing
On An Application By
Royal Oak Mines Inc. - Giant Mine
for Water Use and Waste Disposal in a
Mining and Milling Undertaking
Water Licence N1L2-0043
Yellowknife, NT

January 28/29, 1998

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Mr. Gordon Wray, Chairman of the Northwest Territories Water Board called the Public Hearing to order at 10:00 am on Wednesday, January 28, 1998 in the Katimavik Rooms of the Explorer Hotel, Yellowknife, Northwest Territories.

MR. WRAY: Some twenty years ago, Canadians began to take a new and real interest in the environment in which we all live and work. In response to this heightened awareness, parliament enacted several new environmental laws. One of these was the *Northern Inland Waters Act* designed to help protect the environment North of 60.

Effective June 8, 1993, the *Northern Inland Waters Act* and regulations were revoked and replaced by the *Northwest Territories Waters Act* and Regulations.

The Northwest Territories Water Board provides for the conservation, development and utilization of the water resources of the Northwest Territories in a manner that will provide the optimum benefits of the waters for all Canadians and for the residents of the N.W.T. in particular. Under the *Act*, an application must be made to the Board prior to the use of any waters or disposal of any water borne waste. The requirement for an application applies equally to departments and agencies of the federal and territorial governments. The only exclusions are the use of water for domestic purposes, for extinguishing a fire or on an emergency basis, controlling or preventing a flood.

Over the past twenty years, the Board has evolved from a group of public servants towards a balanced reflection of the population of the Northwest Territories. The current Board is composed of seven members drawn from: native and non-native peoples; technical and non-technical backgrounds; development and conservation interests; government, industry, and public sectors; and federal and territorial nominations. All members sit as private citizens and, as such, neither represent nor are accountable to any particular interests or

organizations. All decisions of the Board are reached by consensus.

The powers of the Board are quasi-judicial and cover a range of discretionary and non-discretionary authorities. These include the powers:

- of a Commissioner under Part 1 of the *Inquiries Act*;
- to issue a licence for water use and waste disposal;
- to hold Licence Application Hearings;
- to hold general hearings;
- to regulate water use;
- to review and amend a licence;
- to assign a licence;
- to cancel a licence; and
- to require security.

To assist it in meeting its objectives and responsibilities, the Board has a small technical and administrative staff. In addition, the Board depends upon a Technical Advisory Committee for advice on a variety of technical issues. This committee is comprised of representatives of government agencies, industry, native organizations, and the general public, and while it may provide technical advice to both Applicants and the Board, it has no decision-making authority.

When an application for water use and waste disposal is received by the Board, it is reviewed for completeness and referred to the Technical Advisory Committee for an assessment of further information requirements. Members of the Board often visit the development site and a Public Hearing is scheduled. At the Public Hearing, the Applicant is first given an opportunity to present and explain its application. Formal intervenors are then invited to present their submissions. Government agencies are encouraged to submit formal interventions so that the public service can be seen to be acting in the public interest. Members of the general public who depend on the waters of the Northwest Territories for their livelihood are particularly encouraged to make informal interventions since it is their knowledge and judgement that are especially important to the Board in its decisions. Questioning of all parties is encouraged, although care is taken to ensure that the Hearing does not become a legal debate. A verbatim record is kept of all Board Hearings.

After a hearing, the Board refers particular technical issues to the Technical Advisory Committee for its review and advice. A draft licence is prepared and, along with the verbatim transcript, is forwarded to the Applicant and all Intervenors for comment. The Board then prepares a final licence for the Minister's signature. The Minister can accept or reject the Licence, but cannot change the conditions in it. No major water use proposal can lawfully be put into operation until the Minister's approval is given.

Water Licenses include terms and conditions governing operating procedures, water use and waste disposal criteria, contingency plans, environmental and engineering studies, surveillance programs, abandonment and restoration. While the responsibility for inspection and enforcement lies with the Northern Affairs Program of the Department of Indian Affairs and Northern Development, the Board receives full and timely feedback on compliance information.

I would now like to introduce the Members of the Board here today.

Melody McLeod was born and raised in Fort Resolution. She graduated from J.B. Tyrell High School in Fort Smith and completed a B.A. at the University of Alberta. She has spent the past 27 years working for public service in various capacities, and is now seeking challenges in the private sector.

Dr. Ian Gilchrist is the Territorial Chief Medical Health Officer for the Department of Health and Social Services. He holds degrees in Public Health and the Socio-Medical Sciences. He has worked in several Canadian and overseas jurisdictions.

Robert Hardisty was born and raised in the Deh Cho village of Fort Simpson. Educated in Fort Smith and Yellowknife, he has been actively involved in local activities and organizations. At present Mr. Hardisty works for the Liidli Koe First Nation as Business Manager responsible for the economic arm of the First Nation.

Laura Johnston has a Doctorate in Geology from Queen's University. She joined Environment Canada in 1977 as a scientist specializing in groundwater chemistry. Since 1989 she's been the Manager of the

Yellowknife Office of the Environmental Protection Branch of Environment Canada.

Eddie Dillon is the newest member of the Board. Mr. Dillon is a past Chairman of the Inuvialuit Development Corporation having served as Vice-Chairman and Member of the Board since 1978. He is currently Chairman of Aklavik Air Inc. Mr. Dillon sits on several Boards of Directors and currently holds the position of Executive Chairman of Norterra Inc., a group of marine transportation and manufacturing companies jointly owned by the Inuit of Nunavut and the Inuvialuit. Mr. Dillon is a Past President of the Committee of Original Peoples Entitlement (COPE) that successfully negotiated the Inuvialuit's final claim with Canada in 1984. Mr. Dillon is currently serving his third term as Mayor of Tuktoyaktuk.

Also with us today is the Board's Technical Advisor - David Milburn; the Board's Acting Executive Assistant - Vicki Losier; Legal Advisor - Alan Denroche; and Eli Chu who is looking after the reception desk.

My name is Gordon Wray and I am Chairman of the Board. I have spent 28 years in the North, 18 in the Eastern Arctic and 10 in the Western Arctic. I am a former Member of the Legislative Assembly in which I held several cabinet portfolios. I have been a member of the business community in the East and now in the West. I am also the current Deputy Chairman of the Workers' Compensation Board.

The procedure we will follow at this Public Hearing is as follows: first of all, I will ask the Applicant, Royal Oak Mines Inc. to make their presentation. Then, I will open the meeting for questions to be directed to the Applicant, firstly by the Board and secondly, by other participants.

All questions must be addressed to the Chair. I may not recognize a question that is not clear or not on topic and within this Board's terms of reference. I must stress that we do not foresee that there will necessarily be a consensus among the participants on their positions in relation to the application under consideration. However, and I stress this, we do expect that all parties to these Public Hearings will conduct themselves in an orderly and respectful manner. The purpose of questioning in the course of this Public Hearing, is to seek clarification of the points made

in the presentation, not to engage in debate or adversarial cross-examination.

To keep the discussions orderly, people in attendance who wish to ask questions are asked to raise their hands, go to the microphone in the middle of the room and obtain permission from the Chairman before speaking. In order that we can ensure we have the questions on tape for the transcript of the proceedings which will be prepared after the Hearing, each speaker is required to come up and speak into the microphone and to identify themselves and indicate the organization they represent, if applicable.

Next, individuals who have submitted a formal brief will be given an opportunity to present that brief. We have knowledge of formal briefs from, and these are in order of presentation:

1) Department of Indian Affairs and Northern Development;
2) Environment Canada;
3) Government of the Northwest Territories - Department of Renewable, Wildlife and Economic Development;
4) Yellowknife Health & Social Services - Joint Submission;
5) Department of Fisheries and Oceans;
6) Mr. Dave Talbot; and
7) NWT Enviro Watch.

While one of the objectives is to provide a full and fair opportunity for the expression, by any interested party, of any views or information relevant to the Application before us, please be advised that I will intervene from time to time if presenters appear to be dwelling on matters that are not, in my judgement or this Board's judgement, relevant to the matter before us today.

Following each presentation, there will be time allotted for the Board and other participants to ask questions. Again, the Board will have the opportunity to ask their questions, followed by the Applicant, and then other participants and interested parties in attendance.

Finally, time will be allocated at the end of the Hearing for the Applicant to offer their final remarks. These remarks, referred to as "closing summations", are an opportunity for the Applicant to clarify, correct, and

if necessary, change their submission prior to the close of the Hearing.

The application before us today is from Royal Oak Mines Inc. for Mining and Milling at the Giant Mine site. With that, I would like to invite Royal Oak Mines Inc. to make their presentation.

MR. STARD: My name is John Stard. I am the Mine Manager for Royal Oak Mines Inc. - Giant Mine, and I would like to introduce you to the panel here today.

Mr. Stephen Schultz is the Environmental Superintendent of both the Giant and Colomac Mines. Steve will be presenting to you the Use of Water, Effluent Treatment and Water Quality, Tailing Management and Studies Relating to Abandonment and Restoration.

Mr. Rick Allan is Corporate Manager of Projects. Rick will deal with Arsenic Trioxide Management at the Giant Mine.

Finally, Mr. Larry Connell who is our Corporate Environmental Manager. Many of you know Larry through past dealings with the Water Board. Larry will act as an advisor.

Mr. Chairman, Members of the Water Board, Members of the Public. We are before you today in support of our application for the renewal of Water Licence N1L2-0043 which was issued to Royal Oak Mines Inc. on May 1st, 1993. This Licence was amended May 1st, 1994 and expires April 30th, 1998.

Before I turn the floor over to Steve and Rick, I will give you an overview of operations at the Giant Mine. *(Slide Presentation)* The Giant Mine has had a long history and close association with the growth of the City of Yellowknife. In 1935 the first mineral claims were staked on what is now the Giant Property. A gold mine was developed and production began in 1948. In May of this year (1998) the Giant Mine will celebrate 50 years of production. In this time, the mill has processed 17,215,765 tons of ore and has recovered 6,847,973 troy ounces of gold. Over the course of this licence term, the mill has processed an average of 402,233 tons of ore per year and an average of 92,176 ounces of gold.

The Mine is a significant employer in the community. In 1997, the average number of employees was 321. The direct economic impact to Yellowknife in 1997 was approximately $35 million dollars.

The Mine has made significant improvements toward safety of the workers over recent years. The Frequency of Lost-Time Accidents has been reduced dramatically since 1989. As you can see, we have had a Lost-Time Frequency of almost 25 to a low of 2.4 in 1996. That is 2.4 accidents per 200,000 man-hours of work.

In the same vein, Giant has made some significant environmental improvements over the past twenty years. Since 1977 when the CPHA Task Force issued its Task Force Report on Airborne Arsenic Emissions, Giant has reduced its airborne arsenic emissions by 80% and waterborne emissions by 98%.

Royal Oak Mines Inc. is investing a large amount of capital into exploration activity at the Giant Mine. In 1997, $3.6 million was spent on exploration. Exploration drilling is continuing underground in order to find more mineable ore and extend the life of the Mine. Reserves to the end of 1996 are 553,269 ounces at a gold price of $390/oz. in US dollars. As you know, the price of gold is not $390, I wish it was. We are redoing the ore reserves right now and incorporating that into the Mine Plan. We have some cost incentives going on at the Mine and those numbers are being worked.

I would now like to turn the floor over to Steve Schultz. Thank you.

MR. SCHULTZ: My name is Stephen Schultz and I am the Environmental Superintendent at the Giant Mine.

(Slide Presentation) I will start my presentation today by describing the layout of the Mine and the location of various facilities that we are going to be talking about later on. This is a plan of the site. This is Yellowknife Bay. North is to the right on this map and over at this end is the townsite where Mine employees are housed. There are a number of open pits in the Baker Creek Valley and these were mined out in the 1980's. We no longer mine ore out of open pits, it all comes from underground.

As I am sure you all know, the Ingraham Trail runs right through the property. The main shaft is located here and this is where the ore is brought to the surface. The mill processing buildings are quite close to the shaft and waste from the mill is stored in four tailings ponds - South Pond, Central Pond, North Pond and the Northwest Pond. We have an Effluent Treatment Plant and the Settling Pond and Polishing Pond you see here are part of the Effluent Treatment System. We discharge treated effluent from the system into Baker Creek at this location. Baker Creek flows down the valley out into Yellowknife Bay.

This is a photograph of the site that was taken this summer. This is Yellowknife Bay down here and the Townsite to the south. These dark shadows are the open pits going though the valley. This is the Ingraham Trail and the Yellowknife River is up at this end. The main shaft and mill building are here, and this is the South, Central, North and Northwest Ponds. We are currently just using the Northwest and North Ponds for storage. We don't use the other two ponds any more. This is our Effluent Treatment Plant here and the orange colour, that is the Settling Pond. I will be describing that in more detail later on.
This lake here is Trapper Lake. The creek runs past the Northwest Pond and joins Baker Creek down here. I will be talking about Trapper Creek later on.

I am going to go into the milling process in some detail, because this is where we use most of our water and this is where most of the potential contaminants are released from the ore. Ore from underground is crushed and ground with water in the mill. The gold is associated with sulphide minerals so we use a process called flotation to separate the sulphide minerals. We produce a sulphide concentrate which is rich in gold. There is also a non-sulphide residue produced from this process which is pumped as a slurry to the tailings ponds.

So, we take the concentrate and we send it on to a roaster where we roast the ore at a high temperature. This exposes the gold and the suphides. We produce two streams from the roaster. Most of the solids are what we call a roaster calcine and we also produce a gas stream that goes on to a gas screening plant that I will describe in a moment.

The roaster calcine goes on to a cyanide leaching process where we add a cyanide solution and this dissolves the gold. We produce a gold rich solution from the cyanide leaching and gold is recovered from the solution by precipitation and refining and we pour gold bouillon. There is a residue from the leaching process and this is also pumped as a slurry to the tailings ponds.

The gas from the roaster is a dusty gas. The first stage in cleaning the gas is an electrostatic precipitator and this recovers the dust. the dust is rich in gold so we have another leaching circuit here that is similar to this one using cyanide. The product of this circuit goes on to refining and making bouillon. Again, that is a tailings residue here which is pumped out to the ponds.

Arsenio pyrite in the ore and the roaster is converted to arsenic trioxide which is a gas. This passes through the precipitator and it is condensed and filtered out in a baghouse which is basically just a large filter. The baghouse removes over 99% of the arsenic trioxide and the clean gas then goes to the stack. So, we recover an arsenic trioxide dust which is quite dry with a low moisture content and we pump this, using air, down into the mine and it is stored in chambers excavated out of the rock. Rick Allan is going to talk about that in detail later on.

I am now going to talk about the use of water. Water has an intricate role in mining and milling activities. I am going to describe how we currently use water and how we plan to make better use of water in the future.

This diagram shows how we use water on the property. Most of our water comes from Great Slave Lake and it is used in both the milling process and in the mining process. We also use a small amount of potable water from the City of Yellowknife for the Townsite. The other source of water on the property is groundwater seepage which seeps into the mine from the surrounding rock. Also in the mine we have a certain amount of seepage from one of our tailings ponds. This pond was constructed on top of the mine where there are a lot of old diamond drill holes and since the pond was built we have a certain amount of seepage coming into the mine. This seepage has reduced over the years as we have deposited tailings into the pond, but we still detect low

levels of cyanide in the minewater.

So, in the mine these various streams are combined - the seepage from the mine, the groundwater inflow and the wastewater from the mining process - and these are all pumped to the surface and it is joined with the mill tailings and wastewater from the Townsite and pumped to the tailings ponds. In the tailings ponds, the solid particles settle out and every summer and fall we decant the clear solution from the top of the pond and we send it to the Effluent Treatment Plant. In the Plant, we remove the dissolved contaminants and convert them into solid compounds. We send the effluent out to our settling and polishing ponds and here the solid compounds settle out and we decant clear, treated solutions to Baker Creek.

The minewater coming out of the mine contains fine suspended solids and also the low levels of cyanide that I talked about. Traditionally, when they have tried to use minewater in the mill, there have been extensive problems with the process. So, currently almost all of the minewater goes out into the tailings ponds. We have just finished constructing a plant in the mill that is going to treat minewater and remove these contaminants and allow us to use this minewater in the process. So, we are hoping that we can use significant amounts of minewater in the process and therefore reduce the consumption of fresh water.

The current Water Licence defines Total Water Consumption as the sum of the volume of water drawn from Great Slave Lake and the volume of groundwater pumped from the mine. The Water Licence stipulates a maximum annual consumption of 1.95 million cubic metres.

This is the pattern of water consumption over the past five years. We have been within the limit and the graph seems to show that the volume of groundwater has increased over the last three years. This is not a true trend. We discovered a serious problem in 1996 with one of our minewater meters and the readings which we had before then are unreliable. The readings we have had since then are considerably high and 1997 represents a more typical consumption of groundwater. The consumption of fresh water over the years has gone down and this is due to a number of conservation measures we have taken in both the

mine and the mill.

So, this is our current typical water consumption. We use about 1.3 million cubic metres of lake water and about .5 million cubic meters of groundwater for a total of about 1.8 million cubic meters in a year. We anticipate that when our Minewater Treatment System is up and running - and it will take some time to get it working, and we will have to try and use the water in the milling process, it may not be useable in all parts of the process - but we anticipate that we can achieve a 35% reduction in terms of water use.

So, we are hoping that in the future the water balance will look something like this, about .7 million cubic meters of lake water and, of course, we have no control of groundwater inflow into the mine, but the total will be about 1.2 million cubic meters. We would like to get there within a year, but we will have to see how well the new plant works out.

In summary, we have not requested any change to the limit but reductions to the limit would certainly be possible during this licence term. This is dependent on the success of our new plant.

I am now going to talk about effluent treatment and what we do to remove the contaminants from the water and I am going to review the quality of the water that we have discharged to Baker Creek over the past five years.

In the 1970's, Giant, in cooperation with Environment Canada, tested a new process to destroy cyanide called the Alkaline Chlorination Process. This test work was successful and in 1981 the Mine constructed a full scale plant. It was the first of its kind to destroy and remove cyanide at a gold mine. There were some problems with this process in that chlorine was added and that created a new environmental concern. So, in 1989 the Plant was converted to the Hydrogen Peroxide Process and it has operated with this process ever since. In 1990, the capacity of the Plant was doubled and the increase residence time in the Plant gave us improved efficiency of removal and better water quality. Finally, in 1994 during this licence term, we made specific modifications to improve the arsenic removal efficiency and this was to achieve a new limit that was set in the Water Licence as you will see later on.

This is what happens in the Effluent Treatment Plant. The blue arrows represent the flow of water through the Plant. We add a number of chemicals in various parts of the process. We start by decanting clear solution from our ponds during summer. We first of all add copper sulphate to act as a catalyst in the process. We add hydrogen peroxide which breaks down and destroys the cyanide and we add ferric sulphate which combines with the dissolved arsenic to form an insoluble compound called ferric arsenate. We also add lime in the process to raise the pH and precipitate the heavy metals as insoluble hydroxides. So, the flow leaving the Plant is treated water, but it contains these solid compounds we have made in the Plant. So we pass these on to our settling and polishing ponds, and here the solid compounds settle out. We then decant this clear, treated effluent to Baker Creek.

This is just to confirm the location of these facilities. This is the North Pond and the Northwest Pond and you can see a pool of water in the pond here. This is pumped to our Effluent Treatment Plant which is located here and this orange colour is the colour of the solid compounds we make in the Plant. The settling pond just beyond that is where additional settling takes place and we decant the treated solution through a pipeline to Baker Creek in this location here. There is a better photograph over in the corner that perhaps you can look at later.

Our Licence requires that we collect a 24-hour composite sample of the effluent, four days per week, Monday through Thursday. Recently, we have increased that to five days per week to give us better control over the process. The Licence also gives us two types of limits. The maximum grab concentration which is the maximum allowable concentration in any one sample; and, the maximum average concentration which is the maximum of the average of four consecutive samples. So, we can be above the maximum average on perhaps one or two days, but any more than that and we are likely to be out of compliance.

These are the limits in our current licence. You can see that the maximum grab sample concentration is double the maximum average concentration. The units are in mg/L which is the same as ppm (parts per million) and I have marked some of these parameters with an asterisk which indicates that the limit changed during the current licence

term and I will reviewing that as we go along.

I will be working my way through the various parameters of the Licence. I will not be showing you lead and zinc as these have been extremely low during the licence term. This is the picture for cyanide over the five years of the licence term from 1993 to 1997. The line is not very distinct. It is a red line here showing the maximum average concentration. You can see that the levels of cyanide have been well within the limit, absolutely no problems there.

This is the picture for arsenic. Again, the line is indistinct. The limits for arsenic changed during this licence term. They started out at 0.8 mg/L and they went down to 0.5 mg/L after 1993. We made modifications to the Plant to achieve this improved quality of water and you can see we were quite successful. There are a couple of single samples above this maximum average line and that is fine because they are single samples and they are within the limits for a maximum grab concentration. There was one incident in 1997 when the maximum average concentration was 0.51 mg/L for just one day, so we were just out of compliance on that one day.

This is the picture for copper. This is the maximum average concentration for 0.3mg/L. Generally, we have done pretty well and the level of copper has come down in the effluent. We had one unfortunate incident in October, 1996 when we exceeded the total maximum average concentration for a total of five days. This was caused by an upset in our Water Treatment Plant.

This is nickel over the five years. The maximum average concentration is 0.5mg/L. The levels of nickel are higher than other heavy metals. Nickel is harder to remove but we have done quite well here. Levels have come down and there is one single sample here that is above the maximum average concentration, but well within the limit for a single sample.

This is ammonia in the effluent discharge. Unfortunately, you almost cannot see the lines at all here. This limit also changed during the licence term. When the Licence was issued in May, 1993, the limit was set at 2.0 ppm. This was set and agreed upon without a thorough knowledge of the typical levels of ammonia in the effluent. When Giant first started to release effluent in the beginning of the 1993 season, we realized that the levels were much higher and there was no way of removing the ammonia. So, an emergency amendment was granted for the 1993 discharge season, setting the limit of 15.0 ppm. You can see that we had trouble achieving that limit. A permanent amendment to the Licence was granted in 1994 and this set the limit at 19.5 ppm and Giant started a program to reduce ammonia in the effluent. You can see that we have been well within the limits since then and the levels have come down steadily, so it has been quite successful.

The ammonia comes from the explosives used underground and the Effluent Treatment Plant will not remove ammonia. So, the way to control this is to reduce wastage of ammonia from explosives underground and that is what we have been doing. One factor also, is the mining method in use. For certain types of mining methods you use less explosives to break the ore. We have come down to about 12 ppm in 1997, but we may need to use slightly more explosives to mine the ore in future years. So, this level may in fact come up a little bit, but we are still quite confident it will be a small increase and the level will be below 15 ppm.

This is the pH of the effluent discharge. This limit also changed during the term of the Licence. It was initially set at 7.5 ppm and it rose to 9.5 ppm with a permanent amendment in 1994. In 1993, we had trouble keeping the pH below that limit. The pH of the water is closely tied with the levels of heavy metals. The lower the pH, generally, the higher the levels of heavy metals will be. The lower pH we had in 1993 was probably a factor in the higher levels of heavy metals and so on that year.

Finally, this is suspended solids in the effluent discharge. The maximum average concentration is right up here at the top at 15 mg/L so you can see we are well within the limits. There seems to have been some problems in 1993 and again, this may have been a factor in some of the

higher discharge concentrations in 1993.

These are the annual releases of contaminants to Baker Creek. So, this is the actual waste in kilograms of these various contaminants released each year. As you can see, there is a big drop in arsenic and this is due to the modifications we made in the Plant. As well, ammonia releases have been coming down steadily over the years. For all of the parameters, we are lower now that in the first couple of years of the Water Licence.

So, in summary on water quality, we have requested no change to the discharge limits, but these limits are now consistent with the Federal Metal Mining Liquid Effluent Regulations. We do recognize that some reduction to the ammonia limit may be possible in the new licence term.

Unauthorized discharges is the term used to describe incidents where harmful materials are released from a safe container such as a pipeline or a barrel. These are the incidents we have had at Giant over the Water Licence term. We report all incidents to the Water Resources Division of DIAND. The number of incidents in 1997 is nine. It is quite low, lower than most of the other years. The main reason for this is a greatly reduced number of tailings spills, down from eleven to three. This has been achieved by replacing the tailings pipeline. We replaced the entire pipeline from the mill all the way to the Northwest Pond and we have had fewer incidents of breaks in the line due to pipe fatigue and spills.

One black mark on our record in 1997 is the number of fuel and oil spills. Most of these were caused by carelessness and they were really quite preventable. So, we are going to be working this year on improving training and perhaps improving our handling techniques on fuels and oils to try and get that down.

I am going to talk about future tailings disposal now, what we intend to do with our tailings in future years. As the tailings solids settle out in the ponds, they trap a certain amount of water amongst the solids. This water is not recoverable in the summer months so the capacity of the tailings pond is permanently consumed by the volume to the tailings solids, as well as this pore water which amounts to about 300,000 cubic

meters per year. In addition to that, because we can't treat water in winter time, we have to store water during winter. For each winter season, we have to accumulate about 800,000 cubic meters in the pond. So, at these rates of consumption and our present capacity, we only have enough capacity to make it through to next winter. Obviously, we have to do something. We have to increase the capacity of the ponds or we have to perhaps change these figures.

Our Tailings Management Plan for the coming several years has two elements. First of all, reduce water consumption and secondly, increase the capacity of existing tailings ponds by raising dams.

Reduction of water consumption would reduce the requirement for over winter storage of water. So, we would be able to reduce that 8000,000 cubic meter figure. The minewater treatment systems that I have talked about and the potential 35% reduction will allow for two extra years of storage without raising dams or increasing capacity. We are hoping that, that will bring us into the year 2000. Sometime though, in this renewed licence term, we will have to increase the capacity of the tailings ponds. We have final designs completed for the raising of the existing Dam 2 on the North Pond and also for making repairs to Dam 3 on the North Pond. This construction could take place in the year 2000, but this is very much dependent on the success of our water recycling measures. The new dam and the repairs to the other dam will add 2,000,000 cubic meters to the North Pond for storage. This is easily sufficient capacity for three years. That is, three years that with our current water balance, if we make the reductions we hope to, it could be four or even more years.

There are a number of conditions in our current licence that required Royal Oak Mines Inc. to undertake special studies and projects relating to the closure of the Mine and restoration of the site. There are five of these conditions and I am going to work through four of them and Rick Allan will deal with the last one of arsenic storage underground.

The first of these studies was "Controlling Natural Till Erosion on Trapper Creek". Trapper Creek was diverted in 1987 to make way for the construction of the Northwest Tailings Pond. The creek diversion suffered serious erosion problems in subsequent years, allowing soil to

be washed down into Baker Creek. Royal Oak Mines Inc. was required to develop and implement a plan to control this erosion.

So, this is what we did in 1994 and 1995. We did this work in consultation with DFO and DIAND and we refined these methods over the course of the two years. The banks of the creek were graded to reduce the slope and increase stability. The creek bed was widened in places to reduce the water velocity. We put cobbles and broken rock on the bends of the creek to protect the banks from erosion. There was a lot of exposed till in the area which we seeded with grass to improve the stability and the appearance of the area.

The measures taken have been quite successful. The amount of erosion has been greatly reduced from former years so we consider this project to be complete and are requesting removal of this special condition from the Water Licence. The revegetated areas are being monitored for erosion and re-seeding will be required in the coming years.

The next project was an "Assessment of Acid Generation Potential of Minesite Materials". This is a problem at many mine sites across Canada. It occurs when sulphide minerals are oxidized and combined with water and sulphuric acid is produced that can leach metals from the materials and also acidify lakes and streams. It is a very serious problem at many mines.

We had a limited amount of data before this Water Licence term that suggested that both the mill tailings and the waste rock at Giant would not generate acid. But, Royal Oak Mines Inc. was required to undertake a thorough study to confirm these indications. So, in 1994 we took a 116 samples of various materials and sent them out to an independent laboratory and they were analyzed for their acid generation potential and also their acid neutralization potential. These are the results of the study. We are presenting the results here in the ratio of the neutralizing potential to the acid potential and generally, if this number is greater than 2 or 3, the potential for acid generation is very low. The materials we studied were tailings materials from all the tailings storage facilities, the old tailings and the new tailings, exposed rock that was in the open pit and waste rock from the mine that has been used for constructing dams and road on the property. You can see that all these numbers are

well above the accepted criteria for a risk of acid generation so there is a very low potential for acid generation and therefore the potential for metals to be leached by acid and released to the environment is very low.

So, we consider this study to be complete now and we are requesting that it be removed as a special condition of the Water Licence. We are going to be implementing an ongoing monitoring program which will take samples of tailings and waste rock as they are produced and they will be sent out for analysis. That will give us the confidence that no problem with acid generation is developing.

The next study was a "Surface Contamination Study". It was known before this licence term, that soils on the Mine property had been contaminated by the previous 45 years or so of industrial activity. We did not know the extent of the contamination or how much work would be required to clean it up, so Royal Oak Mines Inc. was required to undertake a thorough study of this contamination. Over the course of 1994 and 1995, soils at 141 sites on the property were sampled and sent out to an independent laboratory to be analyzed for a number of contaminants. We compared these results to national generic remediation criteria produced by the CCME, the Canadian Council of Ministers of the Environment. In comparing the results to these criteria, it was obvious that arsenic and hydrocarbons were the contaminants of most concern at the site.

Hydrocarbon contamination was generally limited to small areas where fuel and oil has been handled or stored at the Mine over the years and there obviously had been leaks or spills. Hydrocarbon contamination will be relatively easy to deal with just by excavating the soil and applying techniques such as Land Farming, which uses bacteria to break down the hydrocarbons. Remediation work is in progress at the site. In 1996, we cleaned up an area of hydrocarbon contamination near the Townsite and this past summer we have been working on cleaning an old waste oil storage yard near the mill building.

The picture with arsenic contamination is more complex. The arsenic levels exceeded the generic remediation criterion across the Mine property. We also found something interesting. We found that the

sample locations neatly fell into two categories, sites of low arsenic solubility and sites of moderate solubility of arsenic. This was determined using the BC SWEP leachate test which uses water at a pH of 5.2 to determine if metals could be leached from materials in for example, acidic rain.

So, this suggests that arsenic seems to be occurring in different forms and it also tells us that these sites should be a target for our remediation efforts. Over the course of the study, we tried to establish control or reference sites to give us an idea of the background levels of arsenic in the soils of this area. Of the sites that we sampled, we found elevated levels of arsenic, but the Water Board is concerned that these sites are not representative of natural soils. We accept this conclusion and this year we are going to be trying to establish new sites that are representative of natural soils that are acceptable to the Water Board.

We came to the basic conclusion that we would have to develop a site-specific remediation criteria based on the real risk to the environment. This is a procedure widely applied in other industrial sites and the CCME has standard guidelines for the development of this remediation criteria. So, in order to achieve this, we have handed all the data to expert consultants in this area and they are going to be advising us on how we can develop our remediation criteria for arsenic and also help us in the development of our plans for remediation.

Royal Oak Mines Inc. recognizes that there are standing issues with this study and consider the study to be ongoing. We are going to be submitting a detailed report in March, 1998, and from the work the consultants are doing, we are hoping to reach substantial conclusions which can be included in our new Abandonment and Restoration Plan which is due before November of this year.

The last study I am going to deal with, is the "Study of Covering Mill Tailings to Enhance Chemical Stability". As Giant attempted to mine the old tailings deposit in the late 1980s to recover gold, they found that in the process of mining, that the tailings deposit were extensively frozen from quite near the surface down 40 to 50 feet near the bottom of the deposit. It became obvious, that this frozen state was quite beneficial because the mobility of contaminants would be reduced in the frozen

tailings. Basically, water would not move in the frozen tailings, either run-off above or pore water in the tailings. So, Royal Oak Mines Inc. proposed that perhaps an insulating cover on the top of the tailings would prevent the frost from thawing the surface layers and it would further enhance the frozen state. We were required to undertake a study to evaluate that concept.

So, what we did in the winter of 1995, was to establish five test plots on the old South Pond. We put covers of waste rock in various thickness on them. It seemed to be a very practical minesite material that might provide the right type of cover. We installed electronic thermometers called thermistors underneath these covers and they were to measure the temperature of the tailings. These thermometers went down three and a half feet into the tailings. We used these thermometers to measure temperatures throughout the year for the following three years.

None of the covers we investigated prevented thawing of the tailings surface at the depth at which we measured the temperature. We did find that the covers provided some insulation value in that they delayed the thawing of the surface layers in summer times, but we concluded that the benefit of these waste rock covers was unlikely to justify the high cost. The thickest layers of waste rock we used was six feet thick, and you can imagine that, that is a hell of a lot of rock to cover the pond with. It is very expensive.

The study identified a number of very important data gaps. Because we only installed the thermometers so far down in the tailings, we don't know how much tailings thaw each summer, so, we don't know the active layer. Also, we don't know quite a lot about the chemical nature of the tailings and how much contamination could be released during thawing. Also, that is true historically. We have information on our current tailings, but we know less about the nature of the tailings that were produced many years ago. So, we deduced that further studies were required to fill these data gaps and this is what we are planning to do.

This winter we will be drilling two deep holes into the old tailing deposits. We are going to install electronic thermometers all the way to the bottom if we can do that. We are going to be recovering core samples from the

holes. The thermometers will help us evaluate the extent and the stability of the frozen conditions, and we can do laboratory test work on the samples to evaluate the chemical nature of both the tailing samples and the pore water. The samples will be very good representative samples throughout the deposit. From these two pieces of information, eventually we will be able to determine the risk of contaminant release from these tailings ponds.

As far as the original study on waste rock covers is concerned, we consider that study to be complete and we are requesting removal of that special condition from the Water Licence. We are going to be continuing to study the long-term stability of the tailings deposits. There will be a final report on this study submitted in March of this year and we are hoping to have some conclusions from the deep holes by the time we submit our updated Abandonment and Restoration Plan in November.

That concludes my part of the presentation. I am going to hand over to Rick Allan who is going to talk about "Arsenic Trioxide Management at the Giant Mine".

MR. WRAY: For those of you who have arrangements to make, I forgot to mention at the opening, that we are going to run today until 12:30. We will take a lunch break until 1:30 with coffee at 3:15 and close at 5:00 for the day.

MR. ALLAN: Thank you Mr. Chairman. Today I will be speaking on behalf of Royal Oak Mines Inc., on the subject of Arsenic Trioxide Management at the Giant Mine.

As some of you may know, I was Chief Engineer here at the Mine from November 1991 through December of 1994 and I am well aware of the issue. In 1993, I was also involved with Larry Connell in the development of the Terms of Reference for this study and some of the other studies and directed the work in 1994 that began to address this subject.

Since 1994, I have been working with a variety of projects for Royal Oak Mines Inc. throughout the country including Red Mountain in British Columbia, Matachewan and the Nighthawk Lake operation in Ontario.

In September of 1997, I was asked to step in and take over the direction of this study to see it through to closure. My expertise is primarily in underground mine engineering and that spans about twenty years, mostly in Northern Canada. This presentation that I am going to make will present to you the work that we have completed to date and the focus of the work that remains.

The study was originally intended to meet several key issues, one of which was the collection of relevant scientific data related to the arsenic trioxide and the conditions under which it is handled and stored. Secondly, to use that data to develop an acceptable closure plan, and thirdly, to assess the risk involved with the closure options.

The Terms of Reference were developed around five main areas of study. They are:

- the physical stability of the existing storage chambers including the bulkheads;
- a review of options for permanent abandonment;
- an analysis of permafrost conditions in the existing chambers;
- an analysis of hydrology in the area of those chambers; and
- a risk assessment of the permanent abandonment options.

For step one, we inspected the physical stability of the storage chambers and we did that to the maximum extent possible. When I came in, in the fall of last year, we did this again for my benefit. This has proven difficult due to the lack of access to some areas as a result of mining, including open pit and underground mining. There are a total of 69 individual bulkheads surrounding the arsenic chambers. Most are concrete bulkheads on the top and bottom accesses of each of the chambers. There are some indications that there are some timber bulkheads on upper accesses that date back to the 50s and 60s. These bulkheads exist in drift accesses, raise accesses or combinations.

In many cases, the original bulkheads were inaccessible because the access had been blocked, in some cases by mining activities, but also in a lot of cases concrete plugs were installed in some of the drifts. As mining advanced to these areas, the concrete plug would act as a barrier to prevent any damage due to the approaching mining. In turn, this made it impossible to get back to inspect the original bulkhead.

These plugs vary from twenty to thirty feet thick.

In the study of physical stability, we converted all the old mine plans into 3-D AutoCAD format so that we could accurately represent the data, both geology and mine layout, for further analysis.

This slide shows the arsenic chambers in relation to various key points, mainly the mill, the highway and Baker Creek. The mill is here and you can see Baker Creek in the background, with the highway running through the property. Some of the chambers sit below Ingraham Trail, some are very close to the mill and a couple are in fairly close proximity to Baker Creek. Another thing to note on this slide, is that originally some of the storage chambers were actually production stopes that were converted for the purpose of storage. There were five of them in total and four of them are out near the B1 Pit and then there is one out near the C-Shaft which is sitting underneath Baker Creek. So, there are five old production stopes converted for storage and another ten that have been purposely constructed for storage that are in areas of waste rock.

There are 15 chambers in existence, plus one which is partially developed. Five of them are old production stopes. The active chamber, which we call #14, is sitting idle right now because we found that there was room in #12, which was active during the early 90s. So, we are filling a small depression in that stope that has been made available due to compaction of the dust. Then, we will go back to #14. As I said, #15 is partially developed and it will be prepared in time for when #14 is filled. Currently though, we have put all the work on #15 on hold due to cash constraints resulting from the low price of gold. We would resume that as soon as our timeline got fairly tight on the construction or, we had to go back to #14. We have limited space in #14.

The total inventory of the material in the storage chambers includes 260,000 tons of dust at an average grade of 76% As_2O_3. Grades vary anywhere from 40% to 90%. The older chambers tended to contain higher gold and antimony values and much less arsenic trioxide. The current operation recovers a much higher percentage of the arsenic trioxide and it goes underground.

Daily production of arsenic trioxide at the Mine would normally run 10 to

13 tons of baghouse dust per day, but currently we are looking at 8 tons per day which reflects less arsenic in the ore and lower throughput right now.

This is another graphic showing the location of the chambers via the access points. There are three stopes that are accessed through the main C-Shaft on the main access level and the rest are accessible through our UBC portal. The access then would be down the B-Ramp, down to second level; or, in the blue outline, you see the upper access goes straight to the top of an arsenic distribution drift that was cut in the 50s for distribution to a number of stopes around B-Shaft. We have very limited access to these stopes right now because in many cases, the drift may have led to a raise down to a stope and that raise is inaccessible for a variety of reasons including just being filled with debris over a number of years. In our plans to get back to many of these stopes, we found that the costs and the safety issues were very steep. We are going to have to make a concerted effort to get back to these stopes and it will take some time to get back to them all.

There are several options for permanent abandonment that we looked into. The descriptions for these options begins with the simple premise that the arsenic either comes out of the mine or it stays in. There is also a great likelihood that recovery methods won't achieve full and complete removal, therefore, we may find that in the end, some arsenic trioxide dust will stay in the mine in the current form.

The options for safely leaving the dust underground would include techniques for re-establishing permafrost, keeping the mine pumped out forever, somehow isolating the stope with ice plugs, grout curtains or artificial pathways.

We looked at the options of re-establishing permafrost, but that assumes that permafrost was in place prior to mining and that the early chambers were constructed in areas of permafrost. Very little data can be found to prove this was the case in the first place. Recent studies have shown that the permafrost has retreated and is no longer in evidence in the area of the storage chambers.

This retreat of permafrost could be the result of mining activities which have removed an insulation layer of overburden through open pit mining, plus the addition of heated air for mine ventilation for a long period of time. It is still possible that permafrost could be returned to the area. The techniques to do that would likely require some accelerated techniques such as thermosyphons or fans to blow cold air into the mine upon closure to speed up the return of permafrost. We may also have to replace the insulation cover that has been removed through years of mining.

The chambers are in a dry condition and there is no evidence that the dust is being released into the environment. It is possible to consider that we pump the mine out for perpetuity, then there is little risk. It appears that it is technically feasible to do this, but it does require a long-term commitment of both funds and facilities and I believe we could assume that, that might be interrupted at some point. It is just a fact of life, it is a large commitment. Royal Oak Mines Inc. doesn't feel that the option to pump forever is a good permanent solution.

It may be possible to create pathways around the chambers by driving drifts in strategic locations. It might also be possible that these pathways already exist with current mining. Once the mine floods, groundwater would move around the openings through these drifts in preference to moving towards the chambers. This option would be possible for some of the chambers, but due to the effects of some of the previous mining, it may not be possible to see this kind of preferential pathway effect in all cases. It would also require a commitment to long-term monitoring and a thorough examination of groundwater conditions to validate this idea.

The option to remove all the material from underground is presented here. We have looked in some detail into mining methods that have been proposed to remove the material from underground and they are all technically difficult. It would require a combination of methods because the stopes have different shapes and different access points. The material properties have been found to be quite variable as well. In 1981, an engineering firm called Geocon, sampled the chambers during an exercise similar to this for the removal of the arsenic trioxide. That material was found to be varying from dry and dusty as it would appear

going in, to damp and compacted. Moisture content ranged up to 6%, but generally they were 1 to 2%.

It is very important to have a plan for the material once it has been recovered from the underground and removed to the surface and still remember that although we would try to remove it all, full recovery is very difficult and it may not be possible to get it all out.

There are several options available for handling the material once it is removed from the underground and arrives on the surface. This would include storage in tanks, bulk bags or a purpose-built building. We could also convert the material to a stable product like ferrous arsenate and then dispose of it in the tailings ponds. We could remove it and then reprocess it to a marketable form and transport it out of the Northwest Territories.

This slide is a representation of some of the recovery methods we have proposed. Although it may be difficult to see, there are a variety of methods. There are mechanical methods that work in some cases such as remote scoop trams, specially designed rotator head type equipment to withdraw the material from the bottom of the stope. We could use vacuums and withdraw the materials through bore holes from the surface or underground and then pneumatically convey the material to the surface. We would also want to look at slurry techniques because in the end the stope walls would be coated with some remnant dust or there may be some areas where the dust could not be recovered, say it is around construction or something. so, we would have to look at slurry methods to wash the material out. In that case the material would be washed back to a sump that would be an enclosed circuit with a plant that strips the arsenic from the solution and the solution goes back to the mine for further washing. Those kinds of methods in combination have been looked at.

This particular stope, the B-234, is one of the oldest and it is one we have proposed as a test mining area. It contains fairly low levels of arsenic trioxide, higher values of gold and antimony. It is also fairly accessible and in an area where we could mitigate environmental problems fairly easy.

This component of the original Terms of Reference was meant to study permafrost in the original mine workings. In 1994, six thermistor strings were installed to measure temperatures within the rock mass from surface down to 400 feet below surface. Most of the arsenic stopes sit between 75 and 300 feet below surface.

The data that we have recovered suggests that the permafrost has retreated from the area. The temperatures range anywhere from 0.3 to 3.7° Celsius throughout. There is no evidence of permafrost in the mine. We have noted that there is some evidence of permafrost at the 208 chamber. It is typically frosty in the access drift. It is very close to the B-1 pit and could just be frost penetration from the pit, but we are going to look a little closer at that and see if it has any data for future use. We have also recently found that at the A-shaft area where we have ceased mining for two years, that we left the portal open and the air has been allowed to rush down into the mine and over the two seasons, there has been a tremendous ice plug generated down in the A-shaft and that is something that we are going to monitor over the next little while to see if that shows some evidence that we could use techniques such as blowing cold air into the mine to create some isolation.

Currently, mine pumping in the area of the storage chambers maintains the area in a dry condition. However, little data exists on hydrogeology and hydrochemistry for the Mine area.

Royal Oak Mines Inc. is committed to updating geologic plans for further analysis and has been working with consultants and government agencies to determine the best approach to the completion of this element of the original Terms of Reference. It is important, in all cases, to complete this study as this information is required for both safe recovery methods and abandonment.

This slide shows the regional geology. You can see the Mine property. The arsenic stopes are between the C and the B Shafts and you can also see in dotted line, the Westbay Fault at the top of the screen. What we are using regional geology for, is to possibly determine groundwater flows and potential pathways that could be transportation ways for this material down to receivers such as Great Slave Lake and Back Bay.

I have an overhead here which is a geologic interpretation of the first layer of the arsenic stopes. The idea of developing a geologic plan of this detail, is that we could then determine where the pathways would be for this material after mine flooding, where it would tend to mobilize out of the stopes, if it did and then it would, from there, mobilize to other pathways into receptors. This is the kind of detail we are developing now to assist ourselves and our consultants in completing this part of the study.

A full risk assessment has not been conducted because basically, the studies are not complete. Although in part, this has begun as part of the workshop sessions held during the Technical Meeting on Arsenic Trioxide Management held in October, 1997. This meeting of about 40 persons was jointly sponsored by DIAND - Water Resources Division and Royal Oak Mines Inc. It included a number of government agencies and industry experts. That meeting was a very important step in better understanding the issues related to Arsenic Trioxide Management so that the evaluation process and technical development could proceed and also, at a faster pace.

Royal Oak Mines Inc.'s current focus is on the removal of the material from underground for processing to a marketable grade of arsenic trioxide and also, the recovery of gold from the residue. This is not a simple exercise. There is extensive test work going on at the Giant Laboratory to develop a process to obtain a high quality arsenic trioxide product. A product of 97% purity is likely required to compete in the market. Other impurities, such as iron and antimony which are prevalent in the dust, would have to be removed before we could market the product.

Another question that we are working on is the recovery of gold from the final residues. It is important that we find an economic method of recovering the gold. The other issue that we are having to deal with, is the final residues after the reprocessing of the material will contain high values of arsenic and will still require treatment and disposal.

Before any firm commitment can be made for removal of the materials from underground, it is going to require safe and effective mining methods, procedures to move the material to the surface, and facilities

to store and process the material on the surface.

Current market conditions for arsenic are fairly stable. Most of the arsenic is used in the wood preservatives industry. The US would be the prime market and they consume about 30,000 tons of arsenic trioxide per year. Most of that is obtained from China and Mexico. The market right now is about $0.33 (US) per pound. The market would be extremely sensitive to Royal Oak Mines Inc. coming onto the market with a quantity of product.

This is a summary of the activities that are currently underway in regards to the study. It includes laboratory work to develop suitable processes to refine the material to a marketable grade. We have a hydrogeologic study underway and we are working in cooperation with DIAND-Water Resources Division to develop Terms of Reference for this study and to work together in a cooperative way to seek reasonable and quick closure on the issue. Studies and designs for surface and underground work continue and we expect that we will have an interim report ready for March 31st in partial compliance of the original Terms of Reference. However, the study as we originally conceived and developed it, will not be finished. We anticipate that a full report, including risk assessment ready for environmental screening, will be ready by May, 2000.

Thank you Mr. Chairman, I will now turn it back to Mr. Stard to summarize and conclude.

MR. STARD: In conclusion Mr. Chairman, I would like to summarize the following points:

Length of Licence - Royal Oak Mines Inc. requests a 10-year term of renewal. This demonstrates a long-term commitment to good water quality management beyond the known and projected ore reserves and mine life.

Security Bond - Royal Oak Mines Inc. requests that the bonding remain at $400,000 for 1998 and to be reviewed and negotiated after the submission of the new Abandonment and Restoration Plan which is due in November of 1998.

Use of Water - Royal Oak Mines Inc. requests that water use be maintained at 1.95 million cubic metres per year. It may be possible to reduce water use to 1.5 million cubic metres during the term due to our water conservation presently in place. The problems identified with the faulty meters will be resolved and a report submitted by March 31, 1998.

Effluent Criteria -The current licence limits for effluent are consistent with the Metal Mining Liquid Effluent Regulations. Royal Oak Mines Inc. requests that no further change be made to the criteria on the Licence renewal. Royal Oak Mines Inc. agrees that there is room to move Total Ammonia levels to 15 mg/L over the coming licence term in a step-wise fashion.

Abandonment and Restoration Plan - To be completed by November 1, 1998.

SPECIAL CONDITIONS:

Erosion of Trapper Creek - Restoration of the Trapper Creek Diversion has been completed over the past five years and we request that this condition be removed from the Licence renewal. Royal Oak Mines Inc. commits to the ongoing maintenance of the re-vegetation in this area and to include the reporting of this activity in the annual Water Licence Report.

Acid Generation Potential - Studies completed over the past five years have demonstrated that all waste rock and tailings at Giant are net acid consumers. Royal Oak Mines Inc. requests that this condition be removed from the Licence renewal.

Surface Contamination Study - A further report will be submitted to the Board by March 31, 1998. We recognize that further discussions on this issue will be required. It is our intention to incorporate the findings and recommendations of this study in the Abandonment and Restoration Plan to be completed by November, 1998.

Study of Covering Mill Tailings - The original study has been completed over the past five years. Royal Oak Mines Inc. requests that this condition be removed from the Licence. Royal Oak Mines Inc. recognizes that the issue of long-term stability of the tailings

impoundment is still outstanding and has committed to collecting additional data from deep drilling to fill these data gaps. The findings of this work will be incorporated into the Abandonment and Restoration Plan in November, 1998.

Arsenic Trioxide Management - Royal Oak Mines Inc. will submit an Interim Report on March 31, 1998 and will complete a Hydrogeologic Study in cooperation with DIAND and the Water Resources Division. Based on the data collected to date and the new focus on removal and recovery, Royal Oak Mines Inc. proposed to refine the Terms of Reference in cooperation with the Northwest Territories Water Board. A final report will be submitted by May, 2000.

Mr. Chairman, this concludes our presentation and thank you for the interest shown toward the Giant Mine. Thank you.

MR. WRAY: Thank you. We will take a short ten to fifteen minute break.

---SHORT RECESS

MR. WRAY: Thank you ladies and gentleman. We will now reconvene the Hearing. This phase will run until 12:30. First order is, are there any questions of the Applicant from Board Members?

MR. HARDISTY: In your presentation, I noted that there was no mention of the dust that is blown off the tailings ponds?

MR. CONNELL: No, we did not specifically mention dust, but we recognize that as a specific issue, that needs to be resolved. In our communication with the Board, you are aware that we are looking at the application of sealants for the top of the pond for this year in the form of lignant sulphonate, or something of that nature that we would spray onto the pond to hold the tailings in position. This would be as an interim measure until we develop a more permanent solution which is the closeout of abandoned tailings so that they do not generate dust.

Some of the areas we can look at potentially flooding on an interim basis, as a means of controlling dust, but part of the process on the Northwest Pond, requires us to draw the pond down. We start at the

beginning of summer with a pond over all the solids and then we have to treat the water to release it to the environment over the summer months. So, as we draw the pond down, it does result in drying beaches of tailings which is where the dust comes from. In those areas, we think that the only thing we can do on the short term is to use some sort of chemical agent to try and crust the surface so that the dusts will not be picked up by the wind. So, we will be addressing that beginning this summer.

MR. WRAY: Thank you. I have a couple of questions on the removal and recovery part of your presentation.

Part of your presentation was to take a look at converting the substance that you could use in other processes. Are you aware of the fact that there is movement in the United States - which is probably one of the largest markets - by the Federal EPA Authorities to ban this substance? Are you aware of that?

MR. ALLAN: Yes, we are aware of that and we are following it very closely. As far as we know, there is still no resolution to that. It has not been proven to be a complete and entirely safe replacement. There are various substances. At the time, this Copper Chrome Arsenate (CCA) which is used as a wood preservative is still the favoured product. But it is a problem in the future. For a long-term operation of a plant to recover and treat the arsenic - and in this case we might be looking at a plant that would run from ten to twenty years - at some time the market for the trioxide could destabilize and that could create a problem for an economic operation to recover and treat the material.

MR. WRAY: I would assume that the United States would be your largest potential market, am I correct?

MR. ALLAN: Yes, the US market in the largest. The European market is not anywhere near that size and of course there are the additional transportation problems and costs.

MR. WRAY: As part of the study and I know it is at the preliminary stage, have you got any idea on the amount of the net cost? Obviously, there is gold in the dust that can be recovered, but do you have any preliminary figures

on the net cost of what removal and recovery would ultimately cost?

MR. ALLAN: I think the numbers are at a very preliminary stage. We have done some analysis and it shows a very marginal operation. It is very sensitive to gold recovery because that is the largest cash contributor and there are some problems recovering gold from residue. That has been evidenced by other people that have tried these processes, Con Mine for one. We would need fairly high recoveries of gold, 75% plus, and it is quite possible that we will be unable to achieve more than 50 or 60%.

MR. WRAY: My final questions would be, are you aware of any other mines in the world, but particularly in North America, where a similar problem exists like you are facing at Giant?

MR. ALLAN: Yes, Placer Dome operates the Campbell Mine in Bulmertown, Ontario. They originally stored arsenic trioxide-bearing dust from their roaster underground until they replaced the roaster with an autoclave. They have probably one-fifth of the amount underground and I am not sure of the grade of the dust, probably in the neighborhood of 80%. They store it at deeper levels. They maintain that it is contained in stopes that are dry. Their option for abandonment is to pump forever. They are aware of what we're doing and we're in touch, but they are more interested in the solutions we find as we are leading this because they understand full well that pumping forever to a depth of - say in their case 1000 feet - would be a problem. So, there is that one for sure in North America, and that is probably the only one.

MR. WRAY: Thank you. I have no further questions at this stage. Do any members of the audience have a question for the Applicant? If so, I would invite you to come forward to this table here and identify yourself and any organization you represent if applicable. If there are no questions, then we will move on to DIAND's formal presentation.

MR. TALBOT: My name is Dave Talbot and I am here representing myself. I would like to ask how much arsenic trioxide is stored above ground in drums?

MR. WRAY: Thank you, Mr. Schultz.

MR. SCHULTZ: There are several hundred barrels of arsenic trioxide stored above ground near the Northwest Tailings Pond and this comes from clean-outs and maintenance of the baghouse. What we plan to do with that material is when the #15 Stope is ready to be commissioned, we are going to take those drums down into the mine.

MR. WRAY: Do you have an idea on the amount Mr. Schultz?

MR. SCHULTZ: I believe it is several hundred. I do not have a precise number.

MR. WRAY: Thank you, Mr. Talbot?

MR. TALBOT: I have one more question Mr. Chairman. Mention was made of antimony being used with gold. I would like to ask if antimony in itself is being decanted into the creek and if so, in what volume.

MR. CONNELL: The ore at Giant does contain antimony levels and consequently, there is some antimony that passes through the system. When the licence limits were established for Giant, antimony was one of the elements that was looked at and it was found to be below any level of concern and consequently, I don't believe we have done any ongoing monitoring for antimony in the last five year period. It may be appropriate to periodically check that level, but antimony has never presented itself as any problem in the initial start-up of past water licenses because it is low.

MR. WRAY: Thank you. Mr. Talbot?

MR. TALBOT: Thank you.

MS. STEPHENSON: Good morning Mr. Chairman. I am Tasha Stephenson with the Department of Fisheries and Oceans. I would like Royal Oak Mines Inc., if they would, to give some clarification on their expected increase in ammonia levels. You mentioned that your mining techniques may change, and if you could.....

MR. CONNELL: What we meant by that, is basically that in the past year we have used a mining method called long-hole mining which tends to use less explosive per ton of rock broken. We know that given the ore reserve we have left, that we will not be able to do all of that mining using that

technique. We will have to use some selective techniques because the blocks of rock we are taking are smaller and consequently, the amount of explosive per ton of rock broken increases again. We know that in 1997, some of the reduction we say was due to this mining method and will not likely continue on into the subsequent years. That does not mean that we won't continue to try and resolve our handling problems, but we don't want to leave anybody with the false expectation that 1997 has all come from the result of handling improvements. Some of it has.

MR. WRAY: Thank you, and for the record that was Mr. Connell of Royal Oak Mines Inc.

MS. STEPHENSON: That's all, thank you.

MR. WRAY: Thank you. Kevin O'Reilly.

MR. O'REILLY: My name is Kevin O'Reilly and I am here before you today as a private citizen. I noted in Royal Oak's application that they intend to mill ore from Nicholas Lake at the Giant Property. I am curious to know a little bit more about the geology or chemistry of the ore and whether that might affect the effluent that might be released.

MR. CONNELL: At the current time, with Nicholas Lake and the price of gold, there is no active consideration for Nicholas Lake ore coming to Yellowknife. That will continue to change if the price of gold continues to improve. We see Nicholas Lake as another potential way of keeping the Giant operation extended but we fully understand that at that point in time it would need an environmental review of its own, either through an amendment to the Giant Licence to allow that milling to occur here or through its own process. We do know some things about the Nicholas Lake ore and perhaps Rick Allan can speak about the known mineralogy.

MR. ALLAN: I know some because I was involved in the purchase and some of those efforts, but the ore is not refractory, although it does contain arsenical pyrites to some extent. What our plans were for milling it, would be trucking it on a winter road, stockpiling it at Giant, and treating it in a batch, either through the existing mill or through an expansion to the mill to handle several hundred tons a day of this material in a fairly simple cyanide leach circuit. The tailings would then be deposited in special

areas like the North Pond where there is capacity and there is room for it to be covered seasonally so that it doesn't pose an acid generation problem in the future. Does that answer the question?

MR. O'REILLY: Partially. I take it from the answer that the ore from Nicholas Lake contains sulphur if it has to be covered to prevent acid rock drainage. I am just wondering what kind of effects that, and the other mineralogy, might have on the effluent if significant quantities of that ore are milled?

MR. CONNELL: The first thing we need to point out is that the ore from Nicholas Lake would not require roasting, so it would not present the same degree of release of materials that treatment of the current Giant ore does. We do not know specifically, at this point in time without a lot more testing to be done, what the make-up would be of an expected effluent from treating Nicholas Lake ore and that would have to be determined in any application for an amendment of a licence to allow us to treat that material. There is no active consideration being given to that work right now with the price the way it is, it is just not economic.

MR. O'REILLY: Thank you. I have one other line of questioning I would like to pursue. I did read the report that was submitted by Royal Oak Mines Inc. and EBA Engineering to the Water Board in December, 1997 where it is being proposed that the old tailings reprocessing plant be used for surface storage of the underground arsenic. I am wonder how Royal Oak sees proceeding with the Water Board in terms of - would approval be sought some time very soon now to begin storing that material on the surface or are we going to wait until a marketing plan and a reprocessing plant are designed and so on? I am just wondering about the phasing and staging of that.

MR. ALLAN: The intent of submitting the scoping document regarding the surface handling techniques, which include potential storage at the Tailings Re-Treatment Plant, was to generate discussion so that we could work towards design opportunities and environmental mitigation. Should we have material stored on surface? It is very important that we get the feeling of the Water Board and government agencies and the public on that issue so that we can determine the feasibility of doing that. If we store the material on the surface and stop storing it underground, we have limited opportunities. You put it in bags or tanks or say, large silos.

It is a fairly large quantity of material we are talking about, so the tanks would be of the size that are available at the Tailings Re-Treatment Plant. We looked at the feasibility of using those tanks versus new tanks in the case of that type of storage. It is virtually equivalent in costs to using those existing tanks with modifications and building new tanks.

We also looked at other options like bulk bags, and there are places in the world where they take their arsenic and store it in bulk bags and ship it to customers. We have dropped that idea because there are so many problems with the bags themselves. They have a very short shelf life and a limited re-use opportunity. From talking to people that accept the product in the US, especially from China, there is a lot of spills and broken bags and they struggle to handle the material when they get it. So, bulk bags are virtually out of the question. There is also the question of quantity. We would be looking at over 1,900 bags per year for our use or production of the product. So, if we stored a year's worth, we would have 1,900 bulk bags to dispose of eventually. That is just unheard of. You could also store it in a building. Just construct a big shed type building, like a concentrate building, and deposit the material inside as a dust or a compacted material, as a pellet or flake, but then the material would break down in the pile and you would have more trouble with safety and hygiene when it came time to recover it out of the building. Again, this document that we are circulating is to get some feedback on the opportunity to use that storage as opposed to underground.

MR. WRAY: Mr. O'Reilly, I am going to restrict questions on that document simply because, as a Board, we have not yet had a chance to review the document. We received it late in December, but we have not had a meeting since then. Our technical people have had it, but we have not had a chance, as a Board, to discuss it and I don't even know if all Board Members have had a chance to review it themselves. Some of them have just come into town for the first time. So, keep it fairly general if you can.

MR. O'REILLY: I do have some concerns if Royal Oak does intend to proceed to begin storage or removal of this stuff from underground and storing it above the ground and I am just trying to determine what the staging or phasing of this is and how they feel about what point they will be approaching the

Water Board and indeed, if they wish to proceed with storage above ground regardless of whether there is a marketing plan and a reprocessing plant that has been designed. So, I am just wondering, through you Mr. Chairman, if it is Royal Oak's intention to proceed with above ground storage in the absence of a market and a reprocessing plant?

MR. ALLAN: We don't intend to change the current practice of underground storage until such times as we have those elements in place and permits through the Water Board or other government agencies.

MR. WRAY: The answer is, there is no plan at the moment.

MR. O'REILLY: Okay. Thank you.

MR. WRAY: Dr. Gilchrist, I believe you had a question and Dr. Chouinard you had a question after that.

DR. GILCHRIST: Did I understand from you that there were 69 identified storage areas?

MR. ALLAN: That is 69 bulkheads and 15 storage chambers or stopes.

DR. GILCHRIST: Did I also understand that most of these are concrete, but some may be timber?

MR. ALLAN: That's correct. There is indication from documentation dating back to 1950, that some of the upper bulkheads were made of timber. All the bulkheads were designed for a hydrostatic head. Some of the bulkheads are nearer the surface so the requirements are less stringent. All the bulkheads on the lower levels in particular, as far as we know, are concrete. Plus, then the plugs that were placed in the drifts to isolate them, are either concrete or cemented tails.

DR. GILCHRIST: Did I understand that some of them are difficult to access?

MR. ALLAN: Yes, there are a number of them and I can't say exactly the percentage. It is a percentage of 15-20% that we cannot examine today. They are inaccessible.

DR. GILCHRIST: Does this mean that they will not be examinable or is there some way in which ultimately, they could be?

MR. ALLAN: Ultimately, they could be examined. It would require some mine development to intersect an area between a concrete plug and a bulkhead or just to get down to that plug or bulkhead by driving a new access. It is all possible, it just takes a fair amount of money and time and to get there safely because we are dealing with mining areas that were abandoned in the 1960s and we are trying to get in to see the condition of a bulkhead that may or may not be safe. So, as we develop plans to get into these areas, we have to backup mining plans with safety and hygiene issues, as well as environmental management should we find something that is unusual or unexpected.

DR. GILCHRIST: Are you satisfied that the inventory is accurate or are there potentially some storage areas that have not been identified?

MR. ALLAN: That inventory is accurate. There have been excellent records from the first day of the operation on the amount of baghouse dust delivered and where it was delivered to. The Mine has been responsible for regular inspections of the active chambers and chambers they could get to over all that period of time. In particular, I have been involved in doing that since the day I got here. So, I have a good feeling for them. The inventories were also compared to drill results in 1981 by GeoCon. They were successful in drilling to seven of the stopes and recovering material. The grades of the material for arsenic, gold and other impurities were very close in matching what was supposed to be there.

DR. GILCHRIST: Thank you.

MR. WRAY: Dr. Chouinard.

DR. CHOUINARD: Thank you Mr. Chairman. I am Dr. Sylvain Chouinard. I am a physician representing the Environmental Committee of the NWT Medical Association. There are a few questions that have been asked already by Mr. O'Reilly, so I am left only with one so it should be fairly quick.

I guess this could be addressed to Stephen Schultz as it is about surface contamination. When you were mentioning about the hydrocarbons and

land farming, you mentioned something about, "Well obviously land farming involves the use of bacteria to decompose or break down hydrocarbons", and so on. Do we have any data on how feasible this avenue would be for a cold area like this one.

MR. SCHULTZ: I am not personally very experienced in using land farming up here, but I understand that it is widely applied up here and it perhaps might take more seasons for the hydrocarbons to break down, but it still works up here and it is quite viable.

DR. CHOUINARD: That is essentially it, Mr. Chairman. Thanks.

MR. WRAY: Thank you, is there any further questions?

MR. PAQUIN: Thank you Mr. Chairman. I am Emery Paquin with the Territorial Department of Resources, Wildlife and Economic Development. A point of clarification from Royal Oak if I could, and it is with respect to the detailed proposal that the Company proposes to submit by the year 2000 on the arsenic trioxide stored underground.

In your application you referred to a detailed proposal and yet in your presentation this morning, the Company referred to it as a plan. In my mind, there is a considerable difference between these two terms. Could I seek clarification from the Company as to what they plan on submitting?

MR. ALLAN: The submission in May, 2000 would encompass closure options for the underground storage which may involve recovery and processing of the material. It would also include plans for the processing plant, the marketability of the product, the potential market, plans for final closure including treatment of residues, recovery of gold and final disposal of those items so that at that point, we would be able to proceed with the project, if you will. In between times, there will be some smaller issues concluded that we could report on, on a regular basis such as hydrology in the mine. Certainly, certain options will be discarded as we move forward so at that point in 2000, we feel comfortable we will be able to move forward with a final abandonment or recovery of the material.

MR. WRAY: Does that answer your question Mr. Paquin? I assume that it is a

proposal until you receive permission and then it becomes a plan after you have received permission with all the amendments.

MR. ALLAN: Then, I can come back here.

MR. WRAY: Any further questions?

MR. MUYRES: My name is Rick Muyres. I am an observer from the Sahtu with the Sahtu Land and Water Board. I have one question regarding the ASP or the solubility of the arsenic trioxide that you have in storage. Is it water soluble?

MR. CONNELL: Arsenic has a degree of water solubility that varies with water temperature. I will give you ranges. I am not that precise in numbers but I believe it has fairly low solubility in cold water, rising to about 100 g/L when you get to the boiling point of water. It is a fairly steep curve and that is one of the key tenants on how much the recovery process is based on extraction of that material is using hot water to leach away the arsenic from the arsenic trioxide, but it has this very steep solubility curve.

MR. MUYRES: It is water soluble?

MR. CONNELL: Yes, there is some water solubility.

MR. ALLAN: If I could just add to Larry Connell's comments. With the hydrogeological study that we are doing, we have recently done some lab test work, and the results aren't presentable, but we are looking at the extreme low temperature solubility of the material we are storing underground as opposed to say, a lab quality arsenic trioxide to add some relevance to the potential mobilization of this material because it remains water soluble. but it varies with temperature. Most of the curves we see on the solubility of arsenic are dealing with processed plant type temperatures, so the curves tend to start about 5 to 10° going up to the 95° Celsius range. We think our material is stored underground at temperatures between 0 to 3°, so we are dealing with tests for low temperature solubility to address the hydrogeology issue. Thank you.

MR. WRAY: Thank you. Are there any further questions? If not, it is now close to 12:20 and I did intend to shut down for lunch at 12:30, so rather than proceed with DIAND's intervention at this time, as I understand that the opening is around 20-25 minutes, we will break for lunch now and we will reconvene around 1:30 with DIAND and their intervention. Thank you.

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MR. WRAY: This morning we concluded the Applicant's presentation and the questioning of the Applicant. We begin this afternoon with the formal interventions. First, is the Department of Indian Affairs and Northern Development.

MR. LIVINGSTONE: Thank you Mr. Chairman. I am David Livingstone, Director of Renewable Resources and Environment here in Yellowknife. We have a fairly lengthy presentation ahead of us, so I thought we should get right into it. First, I would like to introduce the staff from DIAND that are here. Shannon Pagotto on my left, Regional Coordinator from Water Resources; Neill Thompson, Pollution Control Specialist from Water Resources; Ron Breadmore, Inspector from the District Office; and Francis Jackson, Pollution Control Specialist. We are expecting Alan Regel to join us shortly. He is our Legal Counsel from Justice Canada and is working with us on this file. For your information, Alan is over at the Court House now at a sentencing hearing for the Con Mine Water Licence infraction. So, it will be interesting to see what he comes back with.

We have also assembled a team of consultants whom we will be calling on towards the end of the DIAND presentation to give their views on arsenic reclamation and hydrogeological studies at the site.

We have filed the intervention with the Board, so we are not going to read it. We will highlight key points and the recommendations. At that outset though, we need to note that DIAND has a bit of a dual mandate as folks are aware. The Department promotes and encourages sustainable development and at the same time, has a fairly strong environmental mandate and we have tried to keep both roles in mind in developing these recommendations. I think we have been fairly successful in developing a balance.

Jim McCaul is Head of our Regulatory Section at Water Resources and he will be helping with the overheads. The introductions are done. We would ask Ron Breadmore to overview the compliance history of the last five years of Giant's operations. Then, I will take the microphone back and overview our recommendations before turning it over to the experts that we have available to us.

MR. BREADMORE: Mr. Chairman, as mentioned, my name is Ron Breadmore. I am a Water Resources Officer from DIAND and I am the Inspector responsible for the Giant Water Licence.

I am here today, to give the Board an overview of Royal Oak's compliance with their Water Licence over the past five years and I would also like to briefly describe the Department's inspection history at the site over the licence term and also some of the issues involved with enforcing the Water Licence.

I would like to start with a summary of Royal Oak's compliance. I have structured the presentation to reflect the actual Water Licence for ease of reference. Starting at the top here, we note that there is no Part A which is basically the "Definitions and Scope of the Operation" and therefore, there are no real compliance issues to address.

Under Part B - General Conditions of the Licence. There were some minor problems with late payment of water fees and posting of the security deposit. However, they were in place over the term of the Licence. The Annual Reports required by the Licence have been submitted, generally complete and on time.

Part C - Conditions Applying to Water Use. The annual limit of 1.95 million cubic metres of water has not been exceeded at any time by the Licensee, although we have been encouraging the Licensee to adopt water conservation measures. As previously noted, that may occur with some reworking in the plant and the treatment of minewater so we are anticipating some reductions there.

Part D - Conditions Applying to Waste Disposal. You should note that all mill waste, minewater and sewage were deposited to the tailings pond containment area. The main deposition pond was the Northwest

Tailings Pond. There were some very brief depositions to the North and Central Ponds but that was only for maintenance of the tailings line. All wastes were treated in the Effluent Treatment Plant prior to discharge to Baker Creek. It is worth noting that although an option in the Licence to discharge directly to Baker Creek, all minewater was discharged to the Tailings Containment Area for treatment.

With regard to effluent quality, overall compliance was good, although there were some serious excursions with the ammonia in 1993 and 1994 which resulted in amendments of the Licence to 15 and 19.5 mg/L.

There was a brief copper excursion in 1996. As previously mentioned, that was attributed to some problems with loading in the Effluent Treatment Plant and imbalances in the chemical treatment.

Some brief pH excursions also occurred in 1993. They were partially linked to the ammonia elevations and also, some chemical treatment processes in the plant.

Suspended solids were briefly elevated in 1993 and 1997 during the spring months. Those were attributed to the spring freshet and heavy loading from surface runoff as the numbers above in the upper part of Baker Creek were not elevated. They were only elevated at SNP 45 which would indicate loading from surface runoff.

There were some marginal arsenic excursions in 1994, 1996 and 1997. These were during the fall months, later in the season for the decant. It is possible that cold weather and cold water temperatures had something to do with those elevations. In each case, they were quickly remedied and brought back down.

Similarly, there were some marginal nickel excursion in 1993 and 1994 for the same reasons.

With respect to the tailings line, there was some work done by Royal Oak to reroute them closer to the tailings area away from the Ingraham Trail and Vee Lake Road. In 1996, a large portion of the tailings lines were replaced with thick wall pipe which seemed to have some significant impact in the reduction of tailings spills.

As required in the Licence, the geotechnical inspections of all dam structures were carried out on an annual basis with no significant concerns being identified.

Part E - Conditions Applying to Modifications. The only significant modification that occurred over the term was that in the Effluent Treatment Plant and it was reworked to achieve compliance with the lower arsenic maximum average concentration which was lowered from .8 to .5 mg/L.

Part F - Conditions Applying to Contingency Planning. The Department documented a total of 58 unauthorized discharges or spills over the licence term. The majority of the spills were minor and in that I mean that they were cleaned up on site and deposited to the tailings area. Two spills were designated as major and those were the ammonia and copper effluent excursions.

Spill reporting by the Licensee has been very good. Cleanup has been identified as a problem in some cases, but not for lack of effort. I believe it is possibly linked to resources and some other issues.

Recently there has been some concern discovered or identified with the hazardous material management on site. Specifically, some chemical reagents and waste oil and hydrocarbons. This is an issue that is going to be addressed in the upcoming season.

Part G - Conditions Applying to Abandonment and Restoration. There were five environmental studies required under their A & R Plan and all the studies have been completed. The emphasis here has been on progressive reclamation. For example, remediating areas as we go along with operations. The second point I would just like to clarify, is that the studies have been completed, have been implemented, however, as previously noted, only some of the progressive reclamation has been undertaken. Specifically, some of the work on the hydrocarbon stained areas and the townsite hydrocarbons.

The outstanding issue there is the Arsenic Trioxide Storage Study which is due March 31, 1998. As indicated, Royal Oak is working on that as we speak.

The last component of the Water Licence is the Surveillance Network Program. Basically, the requirements for the Licensee to monitor their effluent quality and water issues on site. Compliance has been generally very good. All reports have been submitted on time and have been complete. The Licensee undertook some methods to improve their analytical practises for their in-house lab, particularly the arsenic methodology. Some sampling techniques have also been improved. There was concern expressed at Site 43-1 for possible contamination of their auto sampler and that has since been covered.

The Licensee has also been involved with inter-lab studies for the period 1993 to 1995. The purpose of the study was basically to assess the performance of their lab against other environmentally accredited labs elsewhere, including DIAND's own lab. There have been no inter-lab studies performed since 1995 by the Department.

Recently there have been some minor departures from the Licensee QA/QC Plan. They are very minor issues relating to field sampling methodology which will be addressed in the upcoming season.

I mentioned before the spills under the contingency part of the Licence. I would now like to give a more detailed breakdown of the spills over the licence term. It is quite evident that the majority of the spills have been tailings, approximately 57% of the reported spills have involved tailings line breaks or leaks. Processed water was also involved, including minewater in around the mill. Fuel oil has been recently identified as an area of concern. Damp seepage was documented on two occasions. The treated effluent was a problem with the copper and ammonia excursions and others related to a minor release of some gas in the mill building which is not really Water Licence related, but was documented.

It is worth noting that the 58 spills does not include a spill that was reported by Royal Oak in their baghouse relating to arsenic trioxide dust. Given the fact that it did not escape out of the building, there was no environmental impact and it was not considered a spill, per se, by our Department.

Again, there were only two spills that were designated as major and those were the effluent spills. The other spills were designated minor

and were cleaned up on site.

Before I present the inspection history on the site, I think it might be useful to review some of the aspects of the Department's Risk Assessment System for their Water Licence inspections, as well as some of the types of inspections that we conduct on the minesite on a regular basis.

The Northern Affairs Program, Operations Directorate, under their statement of priorities, has developed a Risk Assessment System for Water Licence inspections. Basically, what that does is classify each mining operation based on the scale and nature of the undertaking. For mines that are active and have high volumes of fuel or chemical storage, industrial and domestic waste, high volumes of toxic tailings waste and where non-compliance issues are normally related to spills and spill reporting, these operations are classified as a Class "A" Mining and Milling Operation and is given the code C4L4 which relates to the severity and probability of the operation. C4 is the potential for serious impact to occur to the environment. L4 is the probability of a hazardous event occurring on site at least yearly, but less than monthly. With that in mind, the Giant Mine falls under that classification.

Under the Risk Assessment System for the C4L4 operations, we have a minimum number of inspections set for the minesite which was previously set at two inspections per year. Due to some concerns expressed by Departmental staff and Inspectors, that was increased to three inspections per year as of February, 1997. The inspection frequency may be increased above that minimum at the discretion of the Inspector depending on such activities on site as major construction or modifications that may require our presence and also the Licensee response or cooperativeness to directions or orders.

The other type of investigation we conduct is the spill investigation. The typical spill requires two to three site visits or follow-up investigations and inspections. Rarely can one be closed off on a single visit. The spill will remain open until it is cleaned up to the satisfaction of the Inspector.

While not classified as inspections, we also conduct miscellaneous site

visits which may be undertaking or participating in geotechnical inspections, A & R assessments or TAC tours. So, we get onsite quite often.

With that information up front, I have the inspection summary at Giant Mine from 1993 to 1997 by the type of inspection and over the five year term. In the scheduled inspections, the numbers ranged anywhere from a low of 1 in 1996 to 3 in 1994. For spill investigations, those numbers are actually the numbers of spills reported and do not include the follow-up inspections that were involved which may be two to three times that. In 1997, I have indicated the miscellaneous inspections that were conducted on site. My discussions with the previous Inspectors indicate that these miscellaneous types of visits occurred quite often over the course of the Licence as well.

Just to point out, you will probably see quite a few names attached to the Inspection Reports. There have been quite a few Inspectors involved with the Water Licence over the five year term beginning with David Jessiman, Water Resource Officer from 1993-95. He was involved with the Licence. Craig Broome and Darren Unrau, Resource Management Officers were involved with the Licence from 1996 to July, 1997 and myself, I have been involved with the Giant Mine from July, 1997 to present.

Just to wrap up the inspection component, I would like to briefly describe the Department's Enforcement Policy, if I may. The Policy is based on several components and considerations. The enforcement component consists of scheduled inspections, spill investigations, site visits or even something as simple as a meeting onsite with mine personnel. Of course when all else fails, there is prosecution.

When faced with non-compliance issues, there are several options available to the Department and the Inspectors. The first and most common, is the warning or a negotiated compliance. What that means is, say for example, an issue was identified during an inspection or investigation. It is brought to the attention of the operator, the Licensee, and the issue is typically resolved thereafter. For more serious issues that may involve other government departments, for example we may issue an order or direction. An example of that might be that this past

fall (1997), there was a waste oil spill on site and we revealed a lack of an appropriate area on site to deal with the spill and contaminated soil, so Royal Oak has since been directed to develop a land farm for the spring of 1998. For more serious infractions, there is a suspension of operations and the only example I can give over the term was the shutdown of the Effluent Treatment Plant when the ammonia problem arose in 1993. All other options that are deemed inappropriate, a form of prosecution is considered, however, that has not been the case over the licence term.

Some of the considerations we have to look at when choosing an enforcement option are:

- the urgency of the situation;
- the seriousness of the events and/or the difficulty in correcting the situation;
- the flagrancy of the events;
- compliance history of the Licensee; and
- also their cooperativeness.

We also have to select the option that best reduces the potential deterrent effect.

Before I conclude my compliance summary, I would just like to review an issue that generated some local attention back in the early Spring, February, 1997. It involved our Department as well as some other government agencies. Specifically, in early February our Department received a report of some large volumes of brown water flowing down Baker Creek near the Giant Minesite. Of course, the matter was immediately investigated and the investigation was carried out over a matter of a few visits. I will just breakdown some of the sites that were inspected and also what was tested for in the spills. The parameters in italics are not required or set out in the Water Licence, the ones in bold are. The sites across the top - if I may just show a map - indicate where the samples were collected. Sample #1 was the initial response to the report and that was sampled at the mouth of Baker Creek where it widens to the flats near the Ingraham Trail. On a follow-up inspection on February 6th, #2 the Martin Lake outflow which is several kilometres upstream of Baker Creek was sampled. On a subsequent investigation on March 14th, the area just downstream of SNP Station 43-1, where it enters the Baker Creek system, was sampled. As well, a site just

upstream of Site #1, within Baker Creek where there was an area of surface flow, and Site #5 which is not visible here on the map, but it is where Baker Creek enters Back Bay at the SNP Station #43-5.

The results indicated no significant elevations in any of the parameters tested. The only elevations that were detected which were just slightly above either detection or background levels, were at Site #3, the area just downstream of SNP Station 43-1. Again, no excursions above effluent limits were noted and all those results are in mg/L. I should note that on a follow-up inspection on March 17th, the Northwest Tailings Pond was sampled, just for reference.

To briefly summarize what the investigation conclusions were, again the licence limits for effluent quality were not exceeded, Environment Canada were also involved and did some microtoxicity tests within Baker Creek which proved to be negative. Water Survey provided records from Martin Lake which indicated that the flows into Baker Creek can occur between January and April and have occurred for seven of the past fifteen years. So, it is not an unusual occurrence. All the Departments involved came to the conclusion that the glaciation or the overflow, was determined to be outflow from Martin Lake.

Just to add to that investigation and to some concerns that there may be some dam seepage from Dams 22 and 21 and possible impacts on Trapper Creek, there was some follow-up inspections done in the Fall, 1997. Four sites were selected: Baker Creek Upper (just downstream of SNP #43-1); Baker Creek Lower (SNP #43-5 location); Trapper Creek Upper was the control site above Vee Lake Road toward Trapper Creek and above the dams; and Trapper Creek Lower was a site selected just below the propane tank farm near Vee Lake Road. The findings indicated that there was no significant elevations of any of the Licence parameters with the exception of a blip here on the ammonia which was marginally elevated. Further investigation revealed that, that was a single source or an isolated incident and there was no other data to indicate that the limits stayed elevated for any length of time. The results would suggest that given the findings in Trapper Creek that there does not seem to be any seepage impacts on Trapper Creek at this time.

Mr. Chairman, that concludes my presentation on Giant's compliance

and I would like to close off by stating that although the Licensee has experienced some difficulty in complying with the terms and conditions of its licence, overall compliance is deemed satisfactory and they have continued their cooperation with this and other departments. Thank you.

MR. WRAY: Thank you, Mr. Breadmore. Mr. Livingstone.

MR. LIVINGSTONE: Thank you, Mr. Chairman. The Department, as I have noted before, has filed an intervention so we are not going to go over all the recommendations. We will just go over the key ones this afternoon. We will start with overhead #4 - Water Use.

As we heard this morning, the current licence allows Royal Oak to use 1.95 million cubic metres of water annually. The Department feels that with conservation measures in place, that the licence volume of freshwater use could be reduced to 1.5 million cubic metres per year and that Royal Oak Mines Inc. provide the Water Board, within one year of issuance of the Licence, a Water Conservation Plan to further reduce water usage. So we are recommending a fairly quick reduction of the water use from 1.95 million to 1.5 million cubic metres a year and then a management plan to further reduce water use. With proper conservation, that would reduce the loading in Baker Creek and Back Bay.

Ammonia Limits - Over the Licence period ammonia limits have been revised. They are now at 19.5 ppm. We have done a fair amount of research into explosives handling practises and our research indicates that with better management practises, the ammonia level could be reduced to 10 mg/L fairly quickly. We can refer the Board to studies elsewhere from similar mines that lead us to believe that to be the case.

The Department has made five recommendations in our intervention on Tailings Containment Area and containment dams. I will not go over them in detail now, they are fairly standard, fairly typical recommendations for an operation of this nature.

Contingency Planning - Ron identified areas where good contingency planning is necessary. The last time that Royal Oak Mines' Contingency Plan was approved by the Board was in 1985. We believe that the Plan

should be updated immediately to reflect changes in technology, operations, and personnel, and submitted to the Board for approval and, that the Plan should be updated annually from here on in to address similar changes.

Abandonment and Restoration - We have identified three main issues in our intervention related to A & R at the minesite: Surface Reclamation; Underground Reclamation; and the A & R Plan itself. We have made four recommendations on surface reclamation to reduce or prevent the discharge of contaminants to the surrounding waters. These recommendations are consistent with legislation, the Board's guidelines, our Department's draft Mine Reclamation Policy, and the principle of progressive reclamation. On that latter point, we think that it is important that Royal Oak begin progressive reclamation immediately. For example, there are inactive tailings ponds that reclamation could be initiated at. That would also help with the dust problem.

Back in October, 1997, the Department, with Royal Oak Mines Inc. coordinated an expert's meeting on the issue of arsenic trioxide dust. Several of our experts will go over the arsenic issue. Dave Clark, from Dillon Consulting will review the results of that meeting. Bill Cullen, an expert on arsenic, will discuss arsenic generally and Francis Jackson will overview the Back Bay studies that the Department has been involved in with regard to water quality in Back Bay and the fish.

Based on the studies that we have done and the meeting back in October, we believe that it is quite feasible for Royal Oak Mines Inc. to submit an Arsenic Management Plan within a year of licence issuance. A lot of work has been done and we think that a years time would be adequate. We believe that the final plan, when approved, should be incorporated into the A & R Plan for the final closure of the Mine and that the final Arsenic Management Plan, when submitted, would trigger either a licence amendment or an entirely new licence and a corresponding environmental assessment.

Royal Oak Mines Inc. has committed to updating their existing A & R Plan and we support them in that, but recommend that the updated plan be submitted to the Board for its approval within three months of licence issuance. The Plan should incorporate all findings and conclusions from

the studies required in the current licence and should be updated annually to reflect changes in operation and technology, including the arsenic dust management plan.

On the A & R Plan, we retained John Brodie, one of the experts who will be speaking later, to conduct an assessment on the abandonment and restoration of the minesite. His studies indicate that the current cost of surface clean-up alone, would be in the neighborhood of $9 million dollars. Broken down, water related costs are estimated to be about $7 million and the current security deposit is $400,000. There is obviously a discrepancy. We recognize that Giant's financial situation with the current market for gold is poor and that gold mines in the North are closing. But, we also have an environmental mandate to address.

We have reviewed the issues carefully, and would propose the following security deposit schedule:

- We would recommend that the security deposit be increased to $1 million dollars within thirty days. That would be an increment of $600,000. On the first and second anniversaries each, an additional $1 million dollars be added to the security deposit; and an additional $2 million dollars each be added on the third and fourth anniversaries for a total security deposit of $7 million dollars at the end of five years.

In that context, the Department recommends a five-year Water Licence. This will allow a full review of licensed water use and waste disposal practises including plans for abandonment and restoration, notably the Arsenic Management Plan.

Finally, with regard to our recommendations, we have a number of recommendations in our intervention dealing with the Surveillance Network Program, recommendations for new stations that will help in planning for abandonment and restoration.

That, in a nutshell, is an overview of our key recommendations. What I would like to do now, is call on the experts that we have brought in to assist the Board in developing the Water Licence. We thought we would do it in three stages, have Bill Cullen, Dave Clark and Francis Jackson discuss arsenic issues from various perspectives, John Gale would then

discuss the hydrogeological studies that are currently underway and finally, John Brodie would overview his reclamation work.

I will just introduce the folks in a little more detail. Dr. Bill Cullen is from the University of British Columbia. He is a world class expert in the field of arsenic, arsenic compounds, and their effects on the environment. He has had well over twenty years of experience in that area. He is on the expert panel advising the US EPA reviewing acceptable arsenic concentrations in drinking water and he will provide an overview of arsenic and its properties. He will be the first one up.

Dave Clark is a Managing Partner with Dillon Consulting here in Yellowknife. Dillon is familiar and experienced in northern mine-related issues and Dave was intimately involved in the workshop we did here in October. He will provide an overview of the workshop results.

Francis Jackson works with Water Resources as a Pollution Control Specialist. He was heavily involved in the Back Bay studies on water quality and fish, particularly related to arsenic loading.

So, that will be the arsenic panel - if you like. Then we will have Dr. John Gale of Fracflow Consultants overview the research that he is currently involved with at Giant. John Gale is an international expert in the area of fractured rock hydrogeology and hydrochemistry.

Finally, John Brodie with Brodie Consulting will provide a summary of the work he has done earlier this fall in estimating abandonment and restoration costs for the Giant Property. John is an Engineer and he has had lots of experience in northern mines and abandonment and restoration issues.

With that, I will turn it over to Dr. Cullen.

MR. WRAY: Thank you Mr. Livingstone.

DR. CULLEN: Thank you very much. Mr. Chairman, Board Members, Members of the audience. My role here is simply to give you an overview of what I see some of the uses and abuses of arsenic have been over the years and to just generally put this whole thing into some sort of international

perspective.

So, if we can begin with this first slide which shows you the old alchemical symbol for arsenic which was in the form of a snake. This came originally from the smelting operations. As you can see, the date of this little poem is 1694, and the smoke there refers to the arsenic trioxide fumes that come when you heat certain metals. So, I will just read it to you, because it has a lot of relevant points to it.

"I am an evil, poisonous smoke...
But when from poison I am freed,
Through art and sleight of hand,
Then can I cure both man and beast,
From dire disease ofttimes direct them;
But prepare me correctly, and take great care,
That you faithfully keep watchful guard over me;
For else I am poison, and poison remain,
That pierces the heart of many a one."
(Valentini, 1694)

This refers to the fact that in those days, arsenic was used as poison. Large numbers of people were sent to an early grave through the result of poison, but also arsenic was used in medicine to supposedly cure various diseases. They were not very effective in curing in those days, but certainly it was very effective as a poison.

The next slide just shows you where arsenic sits in the Periodic Table of the Elements. Some of you will remember this from your High School or University years, but arsenic as we can see, is in Group 5 of the Periodic Table. This is the line over here, right under the very essential elements, nitrogen and phosphorous for life. So, arsenic sometimes gets confused with phosphorous in its chemistry, but there are actually very major differences which account for its toxicity. Antimony and bisthmus belong to the same group. So, we have arsenic, a fairly toxic element, sitting right below nitrogen and phosphorous, and the one thing that you have to remember, is that the toxicity and various properties of these various properties of all these elements depend on specific compounds. You just can't talk about arsenic as being a poison, you really have to talk about specific compounds of arsenic.

The sorts of compounds that we are dealing with here in these issues, are what I refer to as Agatha Christie arsenic. That is, toxic stuff and this is mainly going to be concerned with arsenic trioxide, unfortunately. The next slide will put some of these environmental situations - where is arsenic as we see it. In seawater we are down to the parts per billion - that is one part in a billion. For marine sediments, we are dealing with

parts per million - that is one part in one million. For freshwater, you notice these background concentrations are in the parts per billion. For human hair we go up to parts per million. The meat that we can eat is just less than one part per million, and for shrimp and certain seafood, you can go up to fairly high concentrations, up to a hundred parts per million arsenic.

So, arsenic is everywhere. But if you want to put that in human terms, the thing of relevance here is that statement within the earth's crust. Inevitably, we live in a world which contains about 5 ppm of arsenic in one form or another. In terms of measurements, we are dealing with 13 grams per cubic metre in the top metre of all land. Some land has more, some land has less. I would suspect that around here, you have more. But that is the average sort of situation that you are going to find and you just can't get away from it.

So, the sorts of minerals that you have, and generally speaking they are sulphides if they are down deep in the earth. So, we have realgar and orpiment. These are yellow and red arsenic. Then we have the arsenical pyrites, FeAsS, and this is the main ore that is around this particular region. If you come closer to the surface where oxidation can take place, the sulphur gets replaced by oxygen so we get these oxide forms of arsenic. These are the common ones. Now below that table there, you can see our human input of arsenic into the environment is approximately equal to the amount that nature puts in. You can see that weathering accounts for about 25 million, volcanoes, surprisingly large amounts, and also volatiles coming off fields in the terms of volatile compounds. So, we as humans, in the sort of operations that are going on in Yellowknife and other ways, put in about 160 million kg/yr in arsenic.

So, what forms are these arsenic and this is where we are very relevant. You can see here that there are a number of compounds with methyl groups, that's CH_3. These are organic arsenic compounds that are found in the environment.

Mostly, the compounds that we encounter in water around this area and indeed elsewhere, are these two forms of arsenic. This is in two so-called oxidation states or valent states as you used to know them. There is Arsenic 3 and Arsenic 5, otherwise known as arsenate or arsenite, and these are the ones that are commonly formed. The methyl compounds here are naturally occurring, they come as a result of biological activity, bacterial action on these so-called inorganic forms of arsenic there. So, you can find these, but at much lower concentrations, maybe one-tenth to one-hundredth of the concentration of the inorganic arsenic compounds that are up there.

You will notice that there are a few more exotic species here that you can find, and also these compounds are gaseous forms that you can

also find, but not common in this area. Just for curiosity and for education, I guess because that is my job as an educator, is to show you that things can get much more complicated in the marine environment. These are quite complicated arsenic compounds with sugar derivatives. These are ...(inaudible)... derivatives here, and these, if you go out and eat seaweed, these are the sorts of compounds. If you like Japanese foods like sushi, these are the sorts of arsenic compounds you are eating. Fortunately, they are not particularly toxic, at least we don't believe they are.

So, we are talking about toxicity. Now when arsenic compounds were used as poisons, we really had to talk about instant death and just to put these compounds - Agatha Christie Arsenic is this compound - this is the white arsenic - there are various names given to it. But you will notice in terms of mice, this is the most toxic compound. What this means, is that 35 mg per kilogram of mouse ingested, 50% of the mice will die with that particular dose. Human beings are much more sensitive than mice, but just bear in mind that it does not require much to kill you directly through ingestion. It is a nasty death.

Once you start putting methyl or organic groups onto it, you can see that the toxicity goes way down. For example, these are in the tons of thousands versus 35 mg there. So, here is the human sensitivity in terms of toxicity and the oxide that we are dealing with here, lies mainly there. It is probably the most toxic form other then the gaseous forms of arsenic that we are dealing with. Once you start going from - it is worth noticing here that this Arsenic 3 here is less toxic than Arsenic 5. So, arsenite is more toxic than arsenate. So, there are two inorganic forms - arsenite and arsenate and it is the arsenite, the oxide, that is more toxic to humans than the arsenate form. As you go on and put more organic groups on it becomes less toxic.

Now, that is acute toxicity we are talking about. But unfortunately, arsenic is also a carcinogen. It has been well recognized for a number of years that it is a Group 1 Carcinogen. Nobody knows what the mechanism of the carcinogenity is. In other words, nobody knows how it causes cancer, but there is absolutely no doubt that it does cause cancer if ingested.

The next slide will show you some of the arsenic hot spots in Asia. Arsenic is all over the world. You are not unique here. If it is any comfort in misery then you have it elsewhere and here are some situations in Asia. There are two areas in particular that I want to talk about and the first one is in Taiwan. The population of southern Taiwan was exposed to arsenic in drinking water for a number of years. In Bangladesh about a million people have also been exposed to high arsenic in drinking water and they are suffering from it. There are about 34 million potentially exposed to arsenic in that area as well.

So, just to show you what effects the Taiwan water can do to you, I am not putting this up to scare you, it is just simply that this is a reality of drinking water which has high arsenic content in it. The top slide is an example of keratosis, sort of skin lesions, and the bottom part of it is a disease called black foot disease. Ultimately, those toes at the bottom will spontaneously amputate themselves.

We are talking about very high concentrations of arsenic in drinking water, but there is no doubt that the initial work on cancer and arsenic was related to skin cancer. Arsenic became declared a sort of skin cancer about ten years ago. There is no doubt about that, but in recent years, and particularly in the last couple of years, people have begun to worry whether or not there are any other cancers caused by arsenic.

This slide here, which is actually the last one, asks the question, "Are there any other effects?" Well, it has definitely been shown in Taiwan that you can get liver cancer and rather surprisingly, lung cancer, through ingestion of high levels of arsenic. Some recent results from Taiwan suggest that high concentrations of arsenic can result in a lower IQ of children exposed to it.

I just want to close with some recent results from Chile along the same line. A study in District 2 of Chile which is a high arsenic bearing area, this is natural arsenic, not the result of mining or anything else like that, where cancers of the skin, lung and kidney can be said to account for about 7% of the deaths of individuals over the age of 30 and that is rather a staggering statistic.

So, where do we stand in terms of Canada's regulations? In 1978, there were research recommendations that research was needed on the mobilization of large quantities of arsenic, the byproduct of all sorts of things. Then, this situation was revisited again recently by the Canadian Government in terms of - 1993 regulations I think - and this resulted in arsenic being declared a substance that had to be regulated and regulations are in place. But one of the disturbing things about this as far as I am concerned, is that the recommendations that are associated with this particular act and other things are effectively the same as were made twenty years or ten years ago. So, really, progress in this area, I think, has been distressingly slow and I urge that everybody sort of get together with what I think is a very important act of trying to do something about this. This is a pretty major problem. Thank you.

MR. WRAY: Thank you, Sir.

MR. CLARK: This is a trendy little thing, I've got to give it a whirl. My name is Dave Clark and I am happy to provide you with an overview of some of the work that has been done related to the study of Arsenic Trioxide Management. I preface my comments by saying that my good friend Rick Allan stole most of my thunder this morning on reporting about the

workshop. However, hopefully I can add to the proceedings.

In the summer of 1997, DIAND retained Dillon Consulting Ltd. as an independent consultant to assess what is really happening with respect to the issue of Arsenic Trioxide Management. Are we in a situation where we are behind everyone else when it comes to the situation here at Royal Oak - Giant Mine? Where does it fit it? What are the alternatives to the long-term storage of the dust at depth? What prognosis, if you will, are there positive things happening, or are there negative things happening?

Consequently, they issued a scope of research for us that you see here on this slide. Effectively, we started off by looking at the current market for arsenic trioxide, both world-wide and as was mentioned earlier, the US. The US represents two-thirds of the world market for this commodity. You correctly raised this morning, Mr. Chairman, the fact that in the United States there is a growing concern, again because of the toxicity and possibly the knowledge that our friend Dr. Cullen has brought forward, asking the question with respect to the wisdom in using this type of material as a wood preservative. Of course of the 28 - 30,000 tons per year that get used within the United States, 90% is for wood preservatives. There have been minor fluctuations over the last few years, and because it is wood, one also looks at trends in housing starts, et cetera as influencing that market somewhat. But at this stage of the game, as Mr. Allan pointed out this morning, there are no good substitutes at this stage that can be used so consequently the predominant use for this material, from the standpoint of available markets for Royal Oak Mines Inc., does seem to be the United States and wood preservative.

Now the issue of "as is" is questionable because we took a look at what grade of arsenic trioxide. As was suggested this morning, what we have in storage here within the dust is somewhere likely less on average than 80%. The market is tightening up and while 95% this morning was mentioned as a target, it does seem as if the push is going to go very quickly towards 99+% pure in order to be able to tap into the market in an economic way. So, there is a need to look at the opportunities for upgrading in order to access a larger chunk of the market to satisfy the existing store of dust as well as ongoing generation.

The available and emerging technologies were reviewed and I would just draw your attention to the fact - and it was unclear to me yesterday - but there was a two-volume report that was issued in October, 1997 from Dillon to DIAND, and I am not sure whether or not the Board has received copies of those documents, but I am told by DIAND that they will readily make them available to you. They are the results of all this work.

Indeed, the research that we did confirmed that there are available and emerging technologies to upgrade. So the fact that they are sitting at less than 80% right now in itself is not a major concern provided that we can see our way clear to introduce technologies. One of the technologies that we believe is worthy of continued consideration is the WAROX process, an acronym for "White Arsenic Oxide", which again was started by Giant Mine in the late '80's and has been held in abeyance for awhile. But, it truly is one which merits further consideration along with others such as hot water leach which was mentioned earlier.

We took a look again at available and emerging technologies to retrieve dust from the underground storage. Again, it was one where the industry itself, the mining industry - where materials management is something that they do and they do a lot of. The issue of course with respect to the toxicity of this material is that you want to be very careful with respect to workers' safety, isolation, if at all possible. Therefore, the whole concept of available and emerging technologies to actually retrieve the dust from depth at Giant Mine were reviewed and looked at in categories such as mechanical retrieval, pneumatic retrieval and slurry retrieval. Royal Oak has indicated that they will continue all of that research and the potential for adapting it to Giant.

The other issue, of course, that can help spur on this effort is the presence of other valued commodities, and in particular, gold. As Rick pointed out this morning, the fact that there is approximately half an ounce per ton of gold within the dust, and again, available technologies we believe there are some that are adaptable.

In the event that the dust must be removed from the underground but there is no economically viable market, DIAND wished us to take a look at the whole issue of available and emerging technologies to treat the dust for disposal. Again, we are into either chemical treatment or physical treatment, possibly chemical in order to generate ferrous arsenate or the use of cement and zeolite and other add mixtures that could actually stabilize and reduce the ability of the arsenic to leach away from the dust itself. So, again, we came away with the feeling that there were opportunities there to consider if the economic market wasn't there and one deemed there to be a significant risk of leaving the material underground, then there are opportunities to actually treat this material.

Finally, with respect to the treatment, once you treat you have to put it somewhere. Again, the whole issue of, are there facilities that would receive treated material for disposal purposes, and the economics of that and really, it becomes somewhat uneconomical. The possible reality then if it needs to be an onsite, near surface disposal of a more stabilized material. Is that possible and what opportunities are there? Those are explored in the reports.

But of most interest I think, and it became the springboard for the workshop that took place in October, were the efforts to compile information on relevant projects, case studies, experts, and contractors. Through that exercise, there did seem to be a realization that we are not far behind everyone else. That, while there is optimism and a light at the end of the tunnel, we trust that it is not a train. But there is hope and there is work being done across North America and internationally because it is an issue of some importance to the mining industry and I think particularly of the interest of the individuals at the Barek El Indio [sic] mine in Chile, and actually attending the workshop here in October because they too have an arsenic trioxide problem and they are working very hard at trying to solve their problem. So, it was clear that people hadn't developed the wheel and we weren't just finding it. It was something that was in an evolutionary stage itself, but indeed wheels were turning.

So, in October, Dillon, under contract to DIAND, facilitated the workshop here. It was a collaborative effort of other federal agencies, the Government of the Northwest Territories, the City of Yellowknife and Royal Oak Mines Inc. The purpose really was to bring together those that were identified through research as being the best mines who were currently working on this problem to explore both technical and regulatory aspects related to potential management options for the arsenic trioxide dust, which is currently stored underground. The forum provided an opportunity for both the regulatory and the industry to identify issues that must be resolved prior to assessing the accessibility of any specific management practice. By issues, I would define those as uncertainties, data gaps or scaling up what we know is available at a laboratory scale or a small scale can it actually be applicable at the scale that Royal Oak need to consider.

The three-day session was held October 28th through 30th right here in Yellowknife. Forty were in attendance from industry, regulatory agencies, we had a good report from the Ontario Ministry of Environment with respect to some of the issues that they are wrestling with, the research community and scientific bodies. Represented there were not only the technical focus on the dust itself, but also public health and representatives of Occupational Health and Safety.

The range of management scenarios included technologies available or emerging. Basically, they fall into the category that was discussed this morning, the idea of leaving it underground and trying to do something with it or bringing it to the surface and doing something with it. Again, as something that was somewhat worrisome to the group that were assembled, there was some indication as to the need, there were gaps with respect to our knowledge of the hydrogeological regime and what would happen if you turned the pumps off. Equally, the issue of what happens with residue that might remain after removal and Royal Oak had acknowledged that as being a problem. As a result, the whole issue

of understanding better the hydrogeology in the area of the stores is extremely important.

The issue of potential of treatment containment, the group discussed and highlighted issues related to either stabilization at depth or the introduction at what I would refer to as hydrogeologic control or thermal control such as the permafrost as was discussed earlier.

With respect to transportation to the surface, there were considerations of a variety of opportunities, as I say, both pneumatic and mechanical to raise the material and a feeling that it is doable, but with essential caution for workers' safety and contingency in order to maintain control in the event of an upset condition, both to the workplace as well as the environment at large.

Finally, there was confirmation that the stabilization of the dust was solid waste, which would have attributes that would be far less risky than what would appear if it was untreated or were available. Going back to what the overall objective both of Royal Oak and of mines that were together, the issue of is there already a practice that can be virtually adaptable in the short term at Royal Oak. Despite the optimism of the various components, virtually all of the experts that were gathered there, there was no identifiable, this is the fix, this is what we have to do.

So, it will take time to allow certain of the research to again occur and opportunities for trying at an increasing scale, particularly the treatment. As I say, I think at the end of the session, the group broke up with a feeling of optimism not only for the Royal Oak problem, but the arsenic trioxide as it affects mining in general.

So, to summarize a range of what I would describe as viable management scenarios for the arsenic trioxide dust are believed to exist. The key technical components of these scenarios are proven or are evolving and have a high probability of success. There are risks with every one of them. There is no easy answer and the issue will come down to how to mitigate the risk. However, to optimize a management plan for Royal Oak it will require that several uncertainties are identified or that were identified at the workshop, both environmental and economic, market stability being one and obviously, environmental pathways and receptors are yet to be resolved.

So, that document, the proceedings, I believe has been conveyed to the panel or it would definitely be made available. So, there are the two sets of documents. One, the independent review by Dillon. The second, the proceedings of the workshop that occurred in October. Thank you.

MR. WRAY: Thank you, Sir.

MR. JACKSON: Thank you, Mr. Chairman, Members of the Board. My name is Francis Jackson and I am with Water Resources. I have been asked to come here this afternoon and present some results from a study that was conducted from 1992 to 1994 in the Yellowknife Back Bay area.

The concerns first came across my desk in the Spring of 1992 from a letter that was addressed to an MLA regarding concerns of water quality and fish quality in the YK Back Bay area. These were community concerns from Dettah and Ndilo regarding the water and fish. We initially held a meeting at the band office in Dettah to see if we would require a study. After an initial meeting with several non-government organizations and government organizations, we came upon a consensus that there was a need for a study. A working group was formed with representatives from Dettah, Ndilo, a number from the Metis Nation office, the Dene Nation office, the Department of Fisheries and Oceans, Mackenzie Regional Health Services and the Water Resources division. What we wanted to do was discuss or study design and many other issues that I will show you in a second.

It was a long process. We didn't rush through it. We met seven times over a four-month period. Those discussions included areas where we should sample in the area of Back Bay. We came upon a consensus and agreed upon 13 water and sediment sites and five fish sites. Let me stress that these sites were chosen by the community and not by any government people. All we did was provide our expert advice by saying yes or no.

It was obvious there were concerns with the water and the fish, but we also included sediment as part of the aquatic environment and it does hold heavy metals.

The 13 sites we chose started at the Yellowknife River, which we used as the control site for the water quality part of it. We went as far south as the Peg Outlet of Miramar Con Mine discharge. There were 13 sites, but for the purposes of this presentation, I will only be discussing five sites of interest. The first one will be the Yellowknife River. The second will be Baker Creek Outlet. The 13th is the tip of Latham Island, which is a swimming hole that Ndilo children use. At Dettah as well, site 11, is a swimming hole and there is the discharge outlet of Miramar Con Mine. There is information on all these sites. There is a full report, if you are interested.

So, we looked at what parameters we should analyze for in the water. We came to an agreement that we should look at all of them such as nutrients, metals, physical and bacteriological. What we would look at in the sediments is a full metal scan. We would look at eight heavy metals in fish tissue. We looked at muscle tissue in general. We looked at the eggs, when possible. We looked at gills and some of the stomach parts as well. Once we agreed on the whole study design, we agreed

that this wouldn't be a one-time shot, we would go for two years. I will show you where we sampled. These are the five sites, in the solid orange.

So, the main objectives to the study was to attempt to provide definitive answers to the following questions: Is the water safe to drink out in YK Back Bay; is the water safe to swim in; and, were the fish safe to eat?

So, we formed our working group, we coordinated with the band office who we were going to work with locally. We hired local people to help us out and collect the samples. We went out sampling. We started in August 1992. The whole study was completed in March of 1994. After the study was completed, the report was written and after looking at the water quality data, it was recommended that more sampling continue on in the summer of 1994. The extra samples were collected from June to September 1994 to obtain summer trends during the decant season. The extra samples were collected at the five sites of the original 13. We required no more sediment or fish samples, the data base was sufficient. The main objective of the summer study was to enhance the water quality data base and obtain trends at the five sites originally sampled.

Water quality results for the first two years of the study, looked like that. So, we have a couple of samples at the end of the year of 1992, and a winter sample of 1993, two samples in the summer of 1993 and a low sample in the winter of 1994, which shows you a basic trend. When you continued the study for the summer of 1994, we came up with a little bit better of an idea of what was going on. These are plotted against the CCME limits for drinking water guidelines and the freshwater quality guidelines. Arsenic at Baker Creek Outlet is significantly higher, but if you recall the licence limit, it is way below the licence limit for the maximum average concentration. The freshwater aquatic life is set at 50 parts per billion, which is micrographs per litre and drinking water was set at 25. This is the national guideline set by CCME.

Dettah Dock site and the YK River site and the tip of Latham Island site are all well below both of those guidelines. Peg Outlet is a little lower because the sample site is further from the source where the Peg River hits Great Slave Lake. At Baker Creek, we were sampling right at the outlet.

If you look at arsenic and sediment, these are based on three samples per site. There was a max average and min plotted here for all sites and, again, the Yellowknife River is our control. Baker Creek is significantly highest and Peg Outlet, as well. You will notice there is an old Giant site. This site was picked based on traditional knowledge from one of our local people from Dettah. They had remembered a time when they had discharged from I believe was the North Pond, but I am not sure, directly over the terrain into Great Slave Lake, into the YK Back Bay area. So, this is probably one of the reasons you have a high level

there. I don't know when it happened or when it was completed, but it is relatively high and it looks like it was just yesterday, but it isn't because you know the Company is discharging out of Baker Creek.

When we look at arsenic values and fish tissue, basically is consistent across the Board for all species. If you look at the site descriptions, on GSL number one, is on the opposite shore of Giant Mine; GSL number two is on the tip of Latham Island; GSL number three is at the Peg outlet of the Miramar Con Mine discharge system; number four is control site which is out on Horseshoe Island just past Dettah; and, site number five is the outlet of Baker Creek. Some species weren't obtained from GSL five, but we do have some that were. They are pretty much standard right across the Board compared to the other sites. There might be one, a high flyer, at GSL two for burbot; mean arsenic values in burbot tissue. Otherwise, it is pretty much the same.

In conclusion, all the water quality data was sent to Mackenzie Regional Health Services, who assessed it for a risk assessment. We wanted to know if the water was safe to drink. It is, with prior treatment, and this is common sense as you treat your water anywhere you are drinking natural occurring water. Is it safe to swim in? Yes, it was. It meant the recreational guidelines set by CCME. All the fish data was sent to Health Canada in Ottawa. They provided a health assessment on the fish and they concluded that the fish were deemed safe to eat. No consumption limits were set. You don't have to worry about eating so many grams of fish like you do in Ontario.

So, in conclusion, we were out there to answer three questions for the community and we did. I can't stress enough that it was a community-driven project, not a government one.

Just as a side note, as it is a concern out there in the Back Bay area all the time, as we become more environmentally aware of our surroundings, we have always known, and talked about them the most, the mine outlets. At the end of the study, the summer of 1994, I collected a sample at one of our least known areas, and not talked about very much, outlets, at a storm-drain outlet that I call SD1. SD1 is a storm-drain outlet right here. That is on School Draw. If you go to Dettah on the ice road, it is on the right side and after a heavy rainfall you can see it very well. As well, I collected sample the following year, the summer of 1995, at storm-drain outlet two, which is in the Peace River Flats of Back Bay. I will show you six overheads comparing mine outlets to storm-drain outlets. Keep in mind, there are eight data points for the mine outlets and only one sample collected for each year of the storm-drain outlet collections.

So, for total copper, significantly higher at storm-drain outlet number one, which is the one on School Draw. There is some influence coming from storm-drain outlet number two. Zinc is significantly higher at the

two storm-drain outlets. There is more data presented here, but all I am presenting is data collected at the same time I collected the storm-drain data. So, there is other data for the mines, but I am only trying to relate to the same time frame. Total iron, again higher at the storm-drain outlets. Arsenic, significantly higher at Baker Creek Outlet but, again, way below their licence limit. Finally, the recreational limit for swimming in water is less than 200 coliform units per decilitre. At this one sample site at SD2, which is in Back Bay, there was 80,000.

In conclusion, there is a report available, if you would like it. I have copies of it. Just give me your business card or name and address and I will provide you with a copy. Presently, I am writing a draft report on the summer sampling aspect of this study. The first two years was completed, the report is done. I have a summer sampling one, just for the summer sampling from June to September 1994. Thank you.

MR. WRAY: Thank you, Mr. Jackson.

MR. GALE: My name is John Gale. I am with Fracflow Consultants. I am back in the corner trying to get close to the screen, so we can see things. Our job was basically to set up a study and look at the hydrogeology of the mine site and mine area. Since we just started this past week, I will just take you through the various components of the work, not necessarily in the order they should be done, but in the order that we will do them, based on the available data.

The first thing we are going to look at is the water chemistry. We are looking at surface water and groundwater. These are two key things that we need to address. There is very little data on the chemistry of the groundwater to date and John Gibson and Glen Percy are both out sampling different parts of the mine to get a hand on exactly what the chemistry looks like as a function of depth and spatially over the mine itself.

Someone raised a question about what will happen when the pumps are turned off. We certainly know that the mine will flood, it will fill with water. There is no such thing as a dry mine. Mines filled with water are shut down, it is just a matter of when. What is important to us, for example, is what will be the chemistry of the water in the mine once it fills with water. Water that has contributing components. So, on closure, we will look at exactly where the water will come from; how much will be groundwater; how much will be surface water; and, will there be any input from the tailings pond area as well.

The other thing that is important to us is the geological framework. The Mine is putting together all the old mine maps and looking at the rock types, the regional structure and the drainage basin. The one thing we will be doing some work on is looking at the fracture patterns, that is the geometry of the fracture system because as the joints themselves and

the large scale structure that contributes the groundwater flow into the mine, the matrix of this rock, the so-called porous matrix, is going to be very low compared to that of the joint plains.

Since we just started working on the project, I will take you through several examples of why we are doing this, what this work will do for us and using some examples from other sites, this one is from central Sweden...What we show in the middle is a cross-section looking down at a typical mining horizon right here. This is a sink tunnel structure. We actually have bore holes going down to 1.2 kilometres or 1200 metres at depth. In fact, I think they went down to 1.5 kilometres of depth. This would be a typical section that we would draw through the mine like Giant Mine. In this particular case, we were sampling water from a series of bore holes in the mine and from the surface. We are looking at the groundwater chemistry. We are looking at the groundwater stable isotopes and their so-called radioactive isotopes in the water, which are naturally occurring. We use those to try to determine the source of the water because if we have water coming up from below it will certainly add one chemistry. If we have water coming down from above, we will have a different chemistry. Those will determine how we can develop the options of whether we can leave the arsenic or the contaminants in the mine, for example, at the upper levels or put them deeper down and whether these are viable options because it will determine whether we have water coming from below which will have strongly reducing conditions versus the oxidizing conditions from above.

You can see right here in terms of using isotopes, this is a tritium unit right here, which is the one that is introduced by the bomb testing several years ago. You can see the shallow waters we are looking at, you will see there were some very high tritium values indicating that we were dealing with shallow waters with water coming in from above. In the deeper levels, we found that nearly all the samples had very low tritium units. So, we can use those to characterize and determine the source of the water at the different points in the mine itself; the upper levels and the lower levels. It is a very preliminary or simple way of looking at it. There are a number of isotopes to look at which is...The 018 numbers right here, for example, the option values and a range of other things that John Gibson and Glen Percy will look at over the next week or so.

Next slide, please. When you start to look at how a mine will fill, the first thing you have to know, and something which the Mine is hoping for, is exactly what will be the volume of the open space, that is the volume of the drifts, the volume of the stopes, for example, the back fill -- What will the volume of the porous space required to fill the mine? In this case, it is open pit mine that we are looking at right here. Looking at it as a function of the depth from ground surface. In this case, we will go down in the Giant Mine to about 2,000 feet of depth. We will look at the volume of space at the different levels. There is the deepest level right

here showing approximately about 750,000 cubic metres of space. As you come up through the system, you probably have more openings at the top, for example, and you finally get to the open pits at the surface, you are looking at the volume of space that has to be filled with water, once the Mine closes.

Again, the first step, which is being done right now, Richard is looking at in some detail, trying to develop the volume space versus the depth. We have to know this in order to look at what will be the chemistry of the water as it fills.

This is what we are going to be looking for over the long term. Again, we are assuming quite correctly that once we shut down the pumps the mine will flood. All I want to show you right here is that there is going to be a number of components. The groundwater will be one component of what comes into the mine as the mine fills. This will change with time because as the mine floods, the pressure of the water in the mine will certainly increase and this will reduce the gradients coming into the mine itself and reduce the amount of groundwater flowing into the mine. There was some direct rainfall on the open pit area, for example, right here. We saw rainfall running off the catchment area into the mine. There will be a fair bit of snow melt, depending on what we have in terms of precipitation. There will be runoff from snow melting in the catchment area and running into the mine itself.

So, you can see from this site in Eastern Canada, the snow melt part was the largest single contribution to the filling of the mine. The groundwater became less important with time as we began to fill the mine. This flattens out right here and means that we have very little water coming in from groundwater flow. The other components, in terms of the direct rainfall, will continue.

Let me show you a few examples. This shows, for example, looking at the very first year once the pumps are shut off, over the first 12 months, when the curve flattens out it means there is no contribution during that period of time. If there is a slope on it, it means there will be a steady contribution from that component. At the beginning, this is the groundwater part right here. There is a steady contribution of groundwater in to fill the open pit or the mine right here. Obviously, the snow melt only occurs over a short period of time, this one during the May/June period, but it is a significant contribution to the filling of the mine itself. So, all these components had to be addressed and we had to use the chemistry and the isotopes to separate the various parts coming in from the current; 400 to 500 gallons per minute or 2,000 litres of water coming into the mine right now, what we call ground water, and it certainly contains components of these other parts right here. Our job is to separate those out because they determine the final chemistry of the water in the mine itself.

Look at the final one right here. This is the final year picture of an open pit right here. Again, you can see this is the snow melt period, May and June. There is never a snow melt in the July/August period. You can see the groundwater here is a much lower quantity and it hasn't flattened out but will be a small component in the long term.

Next one, please. This shows exactly what we would be looking at in the long term because again these are the snow-melt period. Two year cycle, snow melt right here. You can see that the groundwater is only a small component right here overall. Then we have the other parts coming in and flushing the system through. It will take a long time to flush the open pit or the mine itself, but we can look at the chemistry right here which is the snow melt. We can look at the runoff and picture them in the long term, exactly what it will look like and what will be flowing out of the mine in the long term.

Next slide. The other two things we are going to look at...I will go through these fairly quickly because we are just trying to show you the framework in which we are working. The big thing in most of these hard-rock mines is looking at the major and minor features. These are the large-scale fault systems, it is called the major ones; and the small-scale fracturing or the fracture system in the regularly fractured rocks. We need to know exactly how much water will move through it and equally important, how fast it will move because we are looking at the impacts downstream in the receptors. All of these things have to be pulled together using a three-dimensional groundwater flow model or a groundwater flow and transport model. We need to determine the full system configuration, the amount of time it will take to fill the mine and the minewater chemistry at the end of the day and when it finally stabilizes in the long term, what will be the rate of seepage out of the mine through the fractured rock system through and the overflow from the mine workings. Again, we are looking at where the seepage locations and then we can look at the receptors in those areas.

What we are talking about right here is the major fracture zones. This is an example again of a mine in Sweden. This shows the mine workings. These would be the large-scale features going through, which will be the main conduits carrying the largest amount of water into the mine workings, but in between those, in these white areas, will be the regularly fractured rock, and we characterize that by the amount of detailed fracture mapping, the geometry, the spacing and so on, and how they contribute the flow. This is just an example of how one would look at the continuity of these large-scale features. Here, they run for kilometres, some very long fault traces which control the flow in the system both on a regional basis and on a local basis.

Next slide. The final point I want to make is in terms of transport. We had to do a series of bore hole measurements underground in terms of what we normally call ...(inaudible)... testing, to get a feel for what

exactly is the size of the opening through which the flow is occurring. On this one, I am showing a typical bore hole being drilled down. What I am trying to show, is we looked out here in terms of radial distance as a log scale - this is 10 metres up to 1000 metres - and exactly how fast would the water move from the rock mass into the bore hole right there, if we have different size openings or different fracture apertures. Over here, this is typically about 500 micrometres, a fairly large aperture. 100 is typical of many of the rock masses we work with, but there is a range of apertures in any rock mass. Once we know what the range is like, we can look at the time for the contaminants can move once they are dissolved in the groundwater itself. We see right here that we something like 1,000 second right here. The water would only move less than a metre in 1,000 seconds whereas in this larger fracture, it would move 30 to 40 metres in the same period of time. So, the flow rates are tied to the square of the aperture. So, we have to know from the bore hole testing exactly what we are dealing with. So, the argument we have been making is working with the Mine we have developed a good program of bore hole testing to characterize the flow rates and get a good handle on the velocity. We cannot do a risk assessment until we actually know the flow and the transport characteristics of these rocks.

So, this is what we are trying to do and where we are going in the next number of weeks and months. Thanks very much.

MR. WRAY: Thank you, Sir. Mr. Livingstone, just for my own time management purposes, how much longer?

MR. LIVINGSTONE: David Livingstone. I think 20 minutes or so for John Brodie's presentation and then it is your call.

MR. WRAY: I think we will take a short break right now. Thank you.

--SHORT RECESS

MR. WRAY: If you could take your seats, please, Ladies and Gentlemen. We will reconvene the meeting now and we will continue with the DIAND intervention. We have Mr. John Brodie, to make the final presentation on behalf of DIAND. Mr. Brodie.

MR. BRODIE: Good afternoon, Mr. Chairman. My name is John Brodie. I am pleased to have this opportunity to present a summary of my work regarding reclamation of Royal Oak's Giant Mine. I have prepared a reclamation liability assessment of Giant Mine. The objective of my work was to prepare a first order estimate of the cost to reclaim the site to an acceptable condition considering public health and safety and environmental protection. This estimate is based on a two-day site inspection and a review of the available data. The site inspection was conducted in October of 1997.

Royal Oak last prepared an abandonment and reclamation plan for the Giant Mine in 1994. Royal Oak's plan is mostly conceptual and does not provide the detail necessary to prepare a first order cost estimate of reclamation liability. Consequently, in order to prepare the cost estimate, it was necessary to carry out the following steps for each mine component. First, characterize the A&R concerns; secondly, suggest potential measures to mitigate those concerns; and finally, develop quantities of work and unit costs for the reclamation work.

These steps were conducted for each mine component and are presented in detail in my report. It is possible that further work by the Company may show that additional measures are required or that the extent, effectiveness or cost of the suggested measures need to be modified or the Company may find less costly methods to achieve an acceptable reclamation condition.

The cost estimate was developed using the reclaim model for estimating the cost of mine reclamation. This model serves as a check list to ensure that all necessary reclamation activities are addressed. It is based, in part, on industry experience on the cost of reclamation work in other mines in the Yukon and Northwest Territories.

Following is a summary of the reclamation activities and the cost for the mine components. There are minor reclamation concerns for the pits, underground workings, dumps and quarries. The main reclamation measures here are the capping or ceiling of the 24 openings to the underground mine and controlling the flushing of arsenic-bearing water from the underground mine into the pits as the mine floods. Berms of waste cloth should be constructed around the section of the pits on Highway 4 to restrict inadvertent access to the pits. The estimated reclamation liability for these mine components totals to $584,000.

Reclamation concerns for the tailings are control of dust erosion by wind and arsenic release in runoff and seepage. Reclamation tests on the tailings indicate the covering to induce or maintain permafrost will not be effective or economically achievement in meeting these concerns. Based on observations of some grasses naturally being established in the North tailings pond, it is believed that revegetation may be a viable method to control dust erosion. Revegetation of the tailings will be difficult due to toxicity and absence of nutrients. Consequently, a high cost for revegetation has been assumed.

Seeding may need to be delayed until some of the soluble arsenic is flushed out of the surface layer of the tailings. In order to protect vegetation, all roads leading onto the tailing area should be removed or blocked.

Short-term measures for control of wind erosion until vegetation is established may be necessary. These measures could include the use

of chemical additives as was discussed by Royal Oak earlier. The cost of these short-term measures has not been included in the reclamation cost estimate. Progressive reclamation and revegetation testing and sampling in the inactive South and Central Ponds should be conducted to verify this approach.

Some measures to improve stability of the tailings dams slopes by flattening is also required for abandonment of the tailing areas. Royal Oak should conduct a geotechnical assessment of the long-term stability of these dams, including an evaluation of the effects of foundation thawing. Seepage ponds for collection of seepage are included in the reclamation cost.

Riprap covers are recommended to control erosion of the tailings in Baker Creek and in Yellowknife Bay. The estimated reclamation liability for all the tailings areas, excluding water treatment which I will address separately, is $524,000.

The reclamation cost for the tailings could be higher if tailings deposition during the final years of operation is not conducted so as to develop large beaches in front of each dam, as recommended by Royal Oak's geotechnical consultant.

Water management activities at closure will include construction of spillways and plugging decant towers in the tailings areas and measures to prevent the erosion or release of the water treatment sludges. The estimated reclamation liability for water management is $365,000.

Upon completion of mining activities, the mill and surface buildings, including the town site should be demolished and the waste disposed of in one of the pits. The demolition costs includes the allowance for the removal of asbestos siding and friable asbestos insulation from the mill buildings and equipment. Demolition costs are estimated to be $1,040,000. An audit is recommended to verify the cost for asbestos removal.

In conjunction with the demolition works, it will be necessary to remove or dispose and manage the hazardous materials and contaminated soils on site. It is assumed that arsenic-contaminated soil will be relocated to the tailings areas and hydrocarbon-contaminated soil will be bioremediated on site. The estimated reclamation liability for hazardous materials and contaminated soils is $631,000. An audit of the quantity of hazardous materials is recommended to verify this figure. Progressive reclamation could include the relocation of much of the contaminated soil and bioremediation of the hydrocarbon-contaminated soil.

Additional costs for reclamation, including contractor mobilization and demobilization, project management, engineering, contingency allowance of 20 per cent and reclamation research, are estimated to

total to $2,962,000.

Water ...(inaudible)... and treatment is expected to be necessary after closure. Inspections and monitoring of post-mine closure facilities such as tailings dams will also be required. The annual water treatment and monitoring costs is estimated to be $300,000. Flushing of contaminants is expected to diminish with time and treatment will not be required in perpetuity. However, thawing of tailings and pond water could take many decades. The deeper tailings will thaw more slowly, thus reducing the rate at which contaminants are released. At some point in time, contaminants will be sufficiently diluted that no further treatment is required. It is my recommendation that the allowance for 20 years of collection and treatment be provided. The net present value of the $300,000 annual cost for treatment and monitoring over 20 years is $4,789,000.

My estimated total cost for reclamation of the Mine, excluding the arsenic trioxide storage, is approximately $9,000,000. This amount for the Giant Mine is not large, considering the size and age of the Mine. In fact, this is just slightly more than $1 per ounce of gold produced over the life of the Mine.

There are two activities which could reduce the reclamation liability. These are the preparation of a detailed A&R plan and conducting progressive reclamation. A detailed A&R plan, based on site-specific studies, would assist on identifying the lowest cost reclamation measures and what additional testing or research is necessary to optimize those measures.

Progressive reclamation is a reclamation conducted during the mine life on those areas where no further mining activity is planned. The benefit of this practice is to reduce the outstanding liability at closure and allow verification of the intended reclamation measures.

Royal Oak should be encouraged to prepare a detailed abandonment reclamation plan and conduct progressive reclamation on areas such as the South and central tailings ponds and contaminated soils.

In my assessment of reclamation liability, I also conducted a brief evaluation of the arsenic trioxide vaults. Determination of the final solution for the arsenic trioxide will involve assessment of scientific data, detailed engineering design, risk assessment, cost and concerns of land owners and the general public. Addressing all these issues is beyond the scope of my work. Clearly a risk assessment will be required to identify an acceptable solution.

Considering that my assessment of the arsenic trioxide vaults is relatively superficial and that more detailed work has been conducted by others and was presented earlier today and that there are significant

studies yet to be conducted, this hearing may not benefit of a summary of my work regarding the arsenic trioxide storage. However, if I am questioned by the Board, I will continue my presentation or answer questions, as appropriate, during the question period. Mr. Chairman, would you like me to continue?

MR. WRAY: Yes, go ahead, Mr. Brodie.

MR. BRODIE: In evaluating the options for managing the arsenic trioxide, my approach was to evaluate the technical or engineering aspects of each options. The objective was to identify the least costly of the technically viable options. Those options which are not expected to provide sufficient environmental protection were not considered further in the cost estimation. Some of the cost estimate work was taken from the work of Dillon Consulting conducted late last year.

I looked at 12 options and I will go through them relatively quickly and very briefly.

Option 1 was do nothing and was clearly unacceptable as it was expected to result in excessive release of arsenic.

Option 2 was construction of additional bulkheads, construction of grout curtains and construction of iceplugs to immobilize the arsenic trioxide were considered unlikely to be effective.

Thermosyphons to induce permafrost in the rock above and around the vaults was considered technically possible and represented a passable long-term solution.

Perpetual mine dewatering was unlikely to be an effective control and would be a perpetuity responsibility.

Hydraulic isolation, by preventing groundwater flow into or out of the chambers, is a proven concept that has been used at other sites such as the Rabbit Lake tailings disposal in Saskatchewan. It could be achieved, but it might be very difficult to demonstrate its effectiveness.

Options nine, ten and eleven, all involve removal for either on-land storage or on-land upgrading or conversion in storage. These options are all very costly but technically viable.

Finally, the provision of long-term water treatment of contaminated water coming out of the mine is conceptually viable, but this is really just a delayed program of removal and treatment or containment on land.

Of the options that I reviewed, the least costly option was to enhance the development of frozen conditions with the installation of a thermosyphon network in and around the vaults. This option was estimated to cost $7

million.

A more detailed assessment may find that one of the options, which I ranked as viable or as not viable, may be effective and it may also be that the less costly option is not technically viable. Furthermore, as this assessment has considered only the technical and financial aspects to the problem, it should not be reviewed as a recommendation for the least costly option. Consideration of other factors may result in a different option or preferred option. That concludes my presentation.

MR. WRAY: Thank you, Mr. Brodie. I take it, Mr. Livingstone, that, that concludes your presentation. Am I correct?

MR. LIVINGSTONE: It does.

MR. WRAY: Thank you. I will now open to questions and we will start with Board Members, the Applicant and then members of the audience. First of all, do any Board Members have questions? I have a few. The first one deals with the compliance issues. I think what isn't well understood is that the Board is not responsible for enforcement of its licenses. Enforcement officers do not work for the Board and do not take direction from the Board. They work for DIAND and I assume, correct me, that ultimately in the case where a prosecution is brought forward, that, that is a discussion that takes place between DIAND and the Department of Justice. Ultimately, Justice would decide if a prosecution would go ahead. Am I correct?

MR. LIVINGSTONE: I will take a shot at it and turn it over to Ron if there is anything more to add, but I suspect that in the end it is the Justice advice that carries considerable weight, but it is the Department that determines whether to go ahead or not.

MR. WRAY: Thank you. In the compliance section of your intervention, you say: "The Licensee is encouraged to adopt a more proactive approach to its operations to prevent reoccurrences of some of the problems experienced over this licence term." Could you perhaps give us a couple of examples of what you are thinking of when you make that statement?

MR. LIVINGSTONE: I will turn that over to Ron.

MR. BREADMORE: Some of the approaches the Licensee could take would be stepping up some routine inspections of some areas such as tailings lines. That is done daily already, but that would be one example of a proactive approach. This could also be applied to other areas on the Mine site, just tying in other areas of inspection during their daily routine checks of the Mine site.

MR. WRAY: Have you discussed any of these issues with the Mine management?

MR. BREADMORE: Yes, I have, in the fall of 1997.

MR. WRAY: What type of response did you get?

MR. BREADMORE: The one example I can give is with the tailings lines. They do check them periodically or daily and also in the spring and fall to determine any damage over the seasons. We were going to look further to see if there is any more technology that they can pressure test the lines or do anything more than visual inspections to anticipate any problems with the pipe.

MR. WRAY: Have you made any recommendations with regard to things like fuel spills which seems to account for a lot or at least some of the problems?

MR. BREADMORE: Just speaking again from the follow up from the 1997 inspections, they had been directed to develop a land farm site on the mining site to deal with the contaminated soil issue.

MR. WRAY: Thank you. Mr. Livingstone. On page 20 of your intervention with regard to costs of the security deposit and clean up, you state: "It is assumed that financial assistance for a mine site is divided between the Water Board for water related aspects and the Department Land Administrators through land leases for the land portion. In this instance, the territorial Department of Municipal and Community Affairs has responsibility as the Lands Administrator. It has not required any financial assurance from the Company." I note that in the next paragraph you have got a $9 million cost estimate for water and land-related surface reclamation. I, therefore, assume that because you have pegged the water-related cost at $7 million, that $2 million difference is what you peg as the land-related cost.

MR. LIVINGSTONE: That is correct. That would be those aspects of the property that don't influence or don't have an effect on water quality. For example, buildings that could be demolished.

MR. WRAY: Thank you. I will ask the territorial government representatives, when they are in front of us, the same question. I wonder if you ever had any discussions with the Government of the Northwest Territories with regard to security deposits that they may or may not hold? There are, as I understand it, at least three mines, Treminco, Con and Yellowknife, which sit on Commissioner's land, which are different from other mines in the territories which are on federal Crown land.

MR. LIVINGSTONE: Yes, we have had some discussions with MACA. For the Giant property, at least, they don't have a security deposit requirement, according to what we have been told. Instead, their lease requires that the land holder return the property in a state satisfactory to the Government of the Northwest Territories. I think it is important to distinguish between security deposit and the ultimate liability. A security

deposit enables the government to quickly access funds to clean up a property, if need be, but the leaseholder remains liable.

MR. WRAY: Did you tell the Government of the Northwest Territories that?

MR. LIVINGSTONE: I think they understand that.

MR. WRAY: Have they accepted it?

MR. LIVINGSTONE: Perhaps you could ask.

MR. WRAY: I will. I assume that the dollar figures you have given us are in 1997-98 dollars?

MR. LIVINGSTONE: That is correct.

MR. WRAY: Thank you. One question I have and it isn't so much the way to a detail, but it has been reported to us by several people, including some of your employees, that you have noticed a change in attitude by the Mine in terms of dealing with this issue. In the last few meetings over the last few months, the Mine has demonstrated an increased level of cooperation and seems to now want to do the right thing. Would that be a correct statement to make? Is that opinion of some of your departmental employees shared by yourself?

MR. LIVINGSTONE: I can only relate to my own personal experience with the operator. It dates back not very far. I haven't worked with Giant Mine much before the last few months, but my involvement since September or October on the arsenic dust issue has demonstrated to me at least that the folks that we are dealing with are committed to solving the problem. I can't speak for Royal Oak employees beyond the folks that I have talked to, but I have certainly been impressed with the ones I have dealt with directly. They do seem to want to do the right thing.

MR. WRAY: Thank you, Mr. Livingstone. I will ask the Applicant if they have any questions of DIAND on their intervention. There is a marked difference between the fact, for example, that you have requested your security deposit stay at $400,000 and the Department is asking for $7 million. I wonder if you have any comment on that.

MR. CONNELL: Yes, Mr. Chairman, one question to start off with. In the submission, DIAND has recommended that the Board require Royal Oak to file within one year of the licence renewal, a definitive management plan for dealing with the removal or stabilization of the arsenic trioxide stored underground. Royal Oak has indicated that it is our belief that this is going to take two years. In light of what we have heard this afternoon, we all have a better understanding of the work that is still in front of us in the hydrogeology study, the development of a process, the piloting of that process and then going into the actual design of a plant and

bringing back to whoever the regulatory bodies are, a definitive proposal that takes one option and has it defined enough that it can then go into a permitting or regulatory process. There seems to be that discrepancy. It is our feeling that we can't do that within one year. Are we not understanding what DIAND is requesting in the way of a proposal? Are you suggesting that within one year we can actually have a definitive proposal that can withstand environmental screening and review?

MR. WRAY: Thank you, Mr. Connell. Mr. Livingstone.

MR. LIVINGSTONE: We will stand by our recommendation that Royal Oak Mines put together, in a year's time, a solid proposal. We understand that there is a lot of work ahead and that it will take a fair bit of effort on Royal Oak's behalf, but let's not forget that Royal Oak has had five years in which to initiate a lot of work that would have put them in that position by now, had it been done. I understand Royal Oak's position, but I think we really do have to get on with this exercise and get on with it quickly, to the best of our ability. I think it is a major task, but it is doable in a year.

MR. WRAY: Thank you, Mr. Livingstone. I guess that was pretty definitive, Mr. Connell.

MR. CONNELL: Yes, Mr. Chairman. On the point of the security bond, the value of $9 million is not a surprise and it shouldn't be a surprise to anyone. The last Abandonment and Restoration Plan that Giant filed, or Royal Oak filed, actually quoted a figure of something like $8.8 million as our estimate back in 1994. So, the numbers that come back are tying in with our own estimates of where reclamation stands. Obviously, the whole issue of security bonding is just a matter of resources, loading that extra cost upon us at this point in time will have a significant impact of the viability of the Mine to actually find that money and put it forward. Up to now, our bonding is in the form of surety bonds. As this number climbs, I don't believe surety bonds will become the viable way to put that money forward. It is going to become real cash. We recognize your need to ultimately reach a point where we have to be bonded for the liability, but we would ask in your deliberations to consider the economic impact that, that has upon the Company as well.

MR. WRAY: Thank you, Sir. Are there any questions for DIAND from the floor? Mr. O'Reilly. You can either use the microphone there or you can come to the table, if you wish.

MR. O'REILLY: Thank you. I just wanted to comment briefly at the beginning that I am impressed with DIAND's presentation; the breadth of work they have underway. I did read through the submission they made and generally agree with most parts of it. I have been to the Water Board many times following up on this. I haven't seen a copy of the Dillon report filed at the Water Board, nor have I seen one from Mr. Brodie on reclamation costs. I am just wondering if DIAND has had a chance to file those with the

Board and, if not, would they agree to do so?

MR. WRAY: Thank you. I was going to ask that same question. I don't believe the Dillon report is at the Board and I know that Mr. Brodie's isn't. At least it wasn't in the last few days.

MR. MILBURN: The first feasibility study that Dillon provided to DIAND is not at the Board, but the summary report of the workshop, a two-volume summary, which incorporates a lot of the feasibility study, has been filed with the Board. The Brodie report has not been filed with the Board yet.

MR. O'REILLY: Is it possible that we could get a copy of Mr. Brodie's report before the end of the Water Board hearing?

MR. LIVINGSTONE: We sent the Brodie report to Royal Oak Mines for them to have a look at and we haven't received any comment back. I see no difficulty in providing the Board with both the Brodie report and the initial Dillon report. We can do that.

MR. WRAY: Thank you, Sir.

MR. O'REILLY: Thanks. I don't see any representative from Justice there and I have a few questions about security, but I am not sure if I will be able to get the right sort of answers. I will try anyway.

I am concerned with the length of time that it has taken Royal Oak to do a number of the studies that were terms and conditions of the last licence. Is it possible to, in the future, if there is requirement for further research or studies, to tap the security bond to ensure that, that work is done, if necessary?

MR. WRAY: Mr. Livingstone. In other words, if work is not done that is required by the Water Licence, does DIAND have the legal right to tap into the security deposit to have that work done?

MR. LIVINGSTONE: I am not sure. We could get back to the Board on that. I suspect the answer is yes, but I don't know for sure.

MR. WRAY: Okay. We will take it under advisement and perhaps tomorrow you could give us an idea.

MR. O'REILLY: Thanks. My preliminary reading of the *NWT Waters Act* would indicate that, that is a possibility, but it might be best to get an opinion from Mr. Regel on that.

My other question is with regard to security and if for some reason the Mine were to shut down and there was a requirement to clean up and there isn't enough money in the security, does the Crown have the ability to go back after the Company to recover the full reclamation costs even

if these are above and beyond what is set out in security?

MR. LIVINGSTONE: The answer to that is yes. In fact, we have done that in some cases.

MR. O'REILLY: If that is the case, I would be very interested to hear under what circumstances that may have occurred in the past.

MR. WRAY: Perhaps that is something you could deal with Mr. Livingstone separately. It doesn't pertain to Royal Oak.

MR. O'REILLY: You never know, it may. I think that is the extent of the questions I had. Thank you.

MR. WRAY: Thank you, Sir. Are there any further questions from the floor? Thank you very much. I am sorry. Mr. O'Brien.

MR. O'BRIEN: My name is Chris O'Brien. I don't know if this is on or not, but is Dr. Cullen still here? Dr. Cullen seems to be familiar with bad arsenic situations in other parts of the world. I was wondering if he could characterize the situation we find ourselves in here in Yellowknife, given that we are now contemplating ensuring that what Giant has produced is properly dealt with. Is he aware of the situation we have in Yellowknife? We have the dust from tailings; runoff from the land; deposition over the years, so there is runoff from that; there is what is in the tailings ponds, possible excursions; arsenic trioxide in the emissions from the stack, et cetera. Can he just characterize the situation as he sees it, given that there is still a lot of work that has to be done on the effects of arsenic. Also, I think has only become well known to the public in the last few years, that arsenic is a serious carcinogen.

MR. WRAY: Thank you, Mr. O'Brien. Dr. Cullen.

DR. CULLEN: The situation around the world, where the worst arsenic exposure have occurred, are not really related to mining. The problems in Bangladesh where I mentioned that 30 million people may be at risk are due to natural arsenic present in the groundwater. This is also true in Taiwan, where people have dug deep wells and they become arsenic-rich water. It is even true in Chile. Even though this is a mining district, the water the people are drinking that is largely responsible for their problems is river water and it isn't associated with mining. Around the world then, one can say that the worst arsenic disasters that are in existence are non-mining related.

Regarding the current situation, the levels of arsenic that we have been described today in Back Bay are below of currently acceptable drinking water in the United States and Canada. So, as far as regulators are concerned, there isn't a problem. The big thing I see for the future is to simply make sure that the drinking water supply of this community does not get contaminated with arsenic or any other supply of water does not

get contaminated with arsenic. The potential is here. The work that is going to be done, or the work that has been done in the past, is people with good will makes sure that this does not happen. Thank you.

MR. WRAY: Thank you, Sir. Mr. O'Brien.

MR. O'BRIEN: Dr. Cullen, we also have an airborne arsenic problem here in Yellowknife. Are you familiar with that?

DR. CULLEN: Yes, I am.

MR. O'BRIEN: Can you characterize the seriousness of that?

DR. CULLEN: Again, it is the same sort of problem. Arsenic is a carcinogen. It is ingested through lung cancer, as you are probably aware. This has been a problem with the smelters in the United States and various other places. I understand the emissions from this mine have been reduced considerably in the past years. I don't know what the current status of it is. If it settles onto the land, it can be immobilized by binding up the soil. I just don't know what the current situation is of that. But, yes, it can presumably get into the food supply. There is no evidence or very little suggests that in terms of vegetables, et cetera, that arsenic in soil gets taken up to any great extent.

MR. WRAY: Thank you, Sir. Mr. O'Brien.

MR. O'BRIEN: My other question is about ferric arsenate. We heard earlier that arsenite is more toxic than arsenate. I can't remember who the expert was who was talking about that. The question really relates to the chemical stability of ferric arsenate. I think one of the possible solutions to the problem was to somehow chemically bind up the arsenic and the arsenic trioxide, change it chemically into ferric arsenate. I am not sure how it was going to be left, a tailings pond situation. What I would like to know is how stable that is over a very long period of time and can it possibly biodegrade, or whatever the term would be, into some form which could become biologically available, especially if we have erosion of these deposits.

MR. LIVINGSTONE: I will ask Dr. Cullen to address that.

DR. CULLEN: Actually, I am not sure that the process that is being used does actually produce ferric arsenate or whether it is precipitating arsenate attached to ferric hydroxide gel. This is a well known means of purifying water for arsenic. So, I would have to defer to that in terms of the Mine because I don't know whether that is actually happening.

To answer your question directly about ferric arsenate, studies do indicate that ferric arsenate can be immobilized by microbial action. There is some recent work in the United States. So, there are bacteria

that will work on most arsenic-containing materials and mobilize it, given the chance.

MR. WRAY: Thank you, Sir. Mr. O'Brien.

MR. O'BRIEN: Thanks. That is good to know.

MR. WRAY: Thank you. Any further questions for DIAND on their intervention?

MR. O'REILLY: My apologies. I neglected to get at a couple of issues when I was up here. I was wondering if DIAND could indicate if any of the studies they have undertaken with Mr. Clark, Dr. Cullen or Mr. Brodie are cost-shared with Royal Oak.

MR. LIVINGSTONE: The Dillon work was funded by DIAND. The workshop was cost-shared among a number of different agencies: Environment Canada, City of Yellowknife, Royal Oak Mines. They all contributed in addition to DIAND. The Brodie work has also been funded solely by DIAND.

MR. O'REILLY: When I went through the DIAND report, I didn't see any mention of the second portion of Mr. Brodie's presentation where he began to get at some very preliminary estimates of reclamation or clean-up costs for the underground arsenic trioxide. I am wondering why that wasn't included in DIAND's written submission.

MR. LIVINGSTONE: As John mentioned, his findings are preliminary. There are a range of options available and it is premature to start costing out any one of them. We want to look at all the options, do a thorough risk assessment of each one, before anyone settles on any one preferred option.

MR. WRAY: I think Mr. Brodie made it clear that the first part of his presentation was attached to DIAND and he did, in fact, seek the Chair's permission...If you want to editorialize the second part as a preliminary number, which I am always open to. Thank you.

MR. O'REILLY: To further follow on that, would it not be prudent and, in fact, consistent with DIAND's draft mine site reclamation policy, for the Northwest Territories to include something in the security for that work. Right now there is nothing in DIAND's estimate right now. I understand that they say that, that can be reopened, once we have some further data and figures. That is fine. But I am wondering if it wouldn't be prudent and consistent with their evolving policy to include a figure or some amount to begin to cover off those costs.

MR. LIVINGSTONE: What we did was identify the cost that we felt could be included in a Water Licence security deposit in this stage of Giant's operation. I think where Kevin is coming from strikes me as being more similar to the environmental agreement security deposit that we struck with BHP. There are two aspects of it: one is the regulatory water management

issues dealt with through a Water Licence security deposit; and, the other is the broader environmental management issue Giant Mine.

The licence application before us is for the continued operation of the Mine and that is what we reviewed. We recognize that there is a large and important issue related to the arsenic dust management, but we aren't at the stage yet where we have a plan in front of us. My answer to that is, I am not sure. It would be the Water Board's call in the end if the Water Board wanted to consider tying a security deposit of some sort to the Arsenic Management Plan.

MR. WRAY: Thank you for that, Mr. Livingstone. I really appreciate it. I will, however, note that this licence or any new licence can be amended at any time by the Board. I don't know what regulatory authority is going to be in charge a few years from now or a year from now, but I hope whoever it is would seek to, if an amendment to the Licence was made to incorporate this plan, make the amendment and the plan itself subject to a Public Hearing. That would be something that would be proper. If we are still around, I think that is something we would think of. We can amend at any time.

MR. O'REILLY: One further question. Is it DIAND's opinion then, that the arsenic that is stored underground is part of the current Water Licence and part of the current potential public liability for this mine when it is closed? I wasn't quite sure where Mr. Livingstone was coming down on that issue.

MR. LIVINGSTONE: It certainly is part of the overall liability of Royal Oak Mines, but as long as the Mine is operating in the form and fashion that it has been operating in for the last licence period, we feel that the arsenic management, as an interim measure, is adequate to protect the environment. The vaults are well inspected. Any arsenic water that enters the system is pumped through the minewater and out into the treatment plant and into the tailings pond from the treatment plant and into Baker Creek. So, the current operations of the Mine with regard to the arsenic dust are, in our view, acceptable. Ultimately, we are going to have to come to agreement on the final fate of the arsenic dust stored underground. That is going to be an important decision point, but it isn't the decision point we are at now, in our view.

MR. WRAY: Thank you. Mr. O'Reilly.

MR. O'REILLY: I am not quite sure I agree with the line of reasoning that was presented. That is the same reasoning that was used as part of the screening where DIAND passed this issue onto the Water Board. I will just leave it at that for now. I don't agree with the line of reasoning. Thanks.

MR. WRAY: Thank you, Kevin. Additional questions for DIAND? If not, we will move on to the next presentation, then, which is...I am sorry, Mr. Livingstone.

MR. LIVINGSTONE: Just one more thing. The experts that we have retained are available tomorrow as well. So, should the Water Board feel the need to consult them, they will be here.

MR. WRAY: Thank you, Sir. I see a hand being raised now. Do you have a question for DIAND?

MR. MUYRES: My name is Rick Muyres. DIAND has just stated that the bulkheads were well inspected in their containment process. It was just previously stated that many of them cannot be accessed. How do you inspect something that is not accessible?

MR. LIVINGSTONE: What I think I said was that the vaults themselves were well inspected, what I meant was well managed. That access points available are certainly inspected. More to the point, the water management process of Giant Mine vastly reduces the risk of any arsenic discharges outside the mine via the vaults because of the draw-down effect and the treatment of any minewater through the water treatment process.

MR. WRAY: Thank you. The next presentation is Environment Canada. I believe that Mr. Harbicht is going to be making the presentation. Perhaps you could introduce your colleague, Sir.

MR. HARBICHT: Thank you, Mr. Chairman. Steve Harbicht representing Environment Canada. On my right is Ann Wilson, our Water Pollution Specialist and she will address any questions as a specialist regarding water quality issues.

Board Members, Members of Royal Oak Mines Inc., other regulators, government departments and public. Environment Canada's intervention to the NWT Water Board presents concerns and recommendations with respect to Royal Oak Mines Inc. NWT Water Licence Renewal Application for the Giant Mine operation submitted to the Board May 19, 1997.

Mr. Chairman, I will take the liberty to shorten the presentation a little bit in areas that is a repeat of what Giant Mine has already said with regard to the make up of the mine and processing and so forth. I will skip over that and concentrate more on our recommendations and concerns. Is that acceptable?

MR. WRAY: Yes, Sir, go ahead.

MR. HARBICHT: Thank you. I will move right into our technical comments and recommendations.

Technical Comments And Recommendations

The first area deals with the Tailings Containment Area (TCA); and the Tailings Management Plan. The first tailings disposal sites used at the

start of mining had no containment structures and effluent was discharged directly to the environment. As an example south of Dam 7 and down to Great Slave Lake. This occurred approximately until the mid-1950s. At that time, the Central Pond was constructed to receive the tailings, followed by the adjacent North and South Ponds. In the late 1980s, the North, Central and South Ponds were altered as part of the tailings reprocessing project that was implemented, and the northwest pond was constructed to receive both production and reprocessed tailings in 1987. No restoration work has been conducted any at of the sites to date.

Royal Oak's submission indicates that the Northwest pond will continue to be the main active tailings storage area until the winter of 2000, with reuse of minewater being key to the storage life. Recovery of water from flotation tailings would increase the life of the Northwest pond by an additional one to two years. Subsequently, the reconstruction of Dam 2 in the North Pond could be used for another three years.

The Tailings Management Plan is conceptual in nature and doesn't provide for the contingency of more storage capability being required. There is a need to develop a detailed Tailings Management Plan which would include the following: estimated remaining tailings storage capacity; estimated volumes of tailings or contaminated soil input; evaluation of options such as backfilling tailings within the mine; required water recycling targets; estimated volume of effluent that would be treated and released; and, the final configuration of each site when abandoned.

Environment Canada recommends that Royal Oak Mines Inc. provide a Tailings Management Plan that would define the present status of its tailings area, describe how it intends to operate these sites until closure and include an additional Surveillance Network Program station to monitor volumes of tailings being placed in the containment areas.

Dams And Dykes

Permafrost has been indicated as being a component of some of the perimeter dams, specific dams were not identified, which were constructed on frozen layers of sand and gravel where bedrock was too deep. The permafrost study initiated in 1994 indicates that there is likely no permafrost left in the area. If these dams were originally designed with permafrost as an integral part of the design, it is necessary that geotechnical surveys adequately validate this component of the dams. If the permafrost has disappeared, it could result in either foundation failure or subsurface drainage from the upstream side. Those areas which have downstream toe seepage may be the result of permafrost degradation within the foundation.

Environment Canada recommends that Royal Oak Mines Inc. identify the areas of the TCA, which is Tailings Containment Area, parameter

dams which had no bedrock exposure and were assumed to have permafrost conditions, conduct a geotechnical inspection to evaluate these areas for seepages, either immediate or downstream, establish a monitoring program to check for loss of effluent from the TCA, and repair dams to eliminate and prevent seepage and loss of effluent.

Effluent Treatment System Analytical Results

The hydrogen peroxide treatment process, used to treat the effluent pumped from the Northwest Treatment Facility, has been shown to be effective in achieving the water quality parameters stipulated within the current Water Licence, with the exception of ammonia prior to licence amendment. Following treatment, the effluent is directed to the settling and polishing ponds. During discharge from the polishing pond to Baker Creek, the Water Licence requires that a 24-hour composite sample be taken from the outfall four times weekly and analyzed for parameters of concern. An incident, which has been alluded to a couple of times already, occurred during October of 1996 in which copper values exceeded the licence limits during decant for a period of five days. The capability exists to detect such excursions from licence limits in a timely fashion. The analytical results for samples should be made a available and reviewed the same day, and if there are any problems, discharges from the polishing pond could be stopped and corrective measures applied to bring the effluent quality into compliance.

Environment Canada recommends that monitoring of the licence parameters for effluent quality be timely and eliminate lag times during which effluent is discharged to the environment at levels above those specified by the Licence.

Ammonia

The Water Licence has gone through two amendments which provided for increases to the ammonia levels within the effluent, raising limits to the present level of 19.5 p.m. Ammonia levels have consistently decreased over the period 1993 to 1996, from an annual average in 1993 of 15.3 mg/L to 12.2 mg/L in 1996. Improvements in blasting agent handling and use have largely been responsible for the drop in ammonia levels.

However, with the amount of effluent released during the decant period, ammonia is being released to the environment in substantial amounts. This raises concerns on two levels. Firstly, the un-ionized form of ammonia, NH_3, can be highly toxic to aquatic life. Secondly, the loading of nutrients to Back Bay contributes to eutrophication and possible loss of water quality. The extent of degradation of the environment is not known, however by minimizing such loading, the impacts to the lake environment are reduced.

Environment Canada recommends that ammonia limits be reduced to 10 ppm to provide better protection to the aquatic environment. If

necessary, this lower limit could be implemented in two stages over the first two years of the renewal. As an example, renewal at 15 ppm and then dropping to 10 ppm by year 2000.

Bioassay Testing

Past Water Licenses issued to Royal Oak Mines Inc. have controlled effluent quality with set limits for certain parameters. This provides a means of regulating tailings effluent for certain contaminants, but does not assure compliance with section 36(3) of the *Fisheries Act*. Bioassay testing has been adopted by other jurisdictions, as an example, Ontario Ministry of Environment and Energy, as a means to improve water quality. Given that aquatic ecosystems in the North are among the most vulnerable to contaminants, bioassay testing should be required for effluent being released to the environment.

Environment Canada recommends that Royal Oak Mines Inc. be required, as a licence condition, to carry out bioassay testing of effluent on a monthly basis during periods of discharge.

Water Recycling

Royal Oak Mines Inc. has indicated that plant modifications are being considered in order to recycle minewater within the mill. These considerations were mentioned previously during the last licence amendment, however the graphic presentation in Royal Oak's submission indicates only a small reduction in freshwater use since 1993. Also proposed is the recovery of water from the mill flotation tailings. Both measures would decrease the volume of effluent requiring treatment and release to the environment. Environment Canada encourages Royal Oak Mines Inc. to incorporate recycling into its process stream. Given the experience gained with its Colomac project, it should be feasible to implement this action within the next year.

Environment Canada recommends that Royal Oak Mines Inc. provide a water recycling management plan to the Board which would have an initial 30 per cent reduction in freshwater usage following the issuance of the Water Licence and a further 20 per cent reduction in the second year.

Spills

With the rebuilding of the tailings pipeline, unauthorized discharges have been reduced substantially in numbers and volume, but are continuing to occur. Environment Canada encourages Royal Oak Mines Inc. to seek continued improvements in preventing and minimizing spills. This should include improvements in the implement of the spill contingency plan, as DIAND Inspectors have noted some problems with spill response and clean-up.

Environment Canada recommends that Royal Oak Mines Inc. seeks continued improvements in preventing and minimizing spills and in

ongoing response training and contingency planning.

Abandonment And Restoration
Trapper Creek
Controlling till erosion along Trapper Creek was identified in the last Water Licence and the action that Royal Oak Mines Inc. implemented during the last licence term has been effective in reducing erosion. The present design has been in place over the last two open water seasons, and has effected a marked reduction in sediment transfer from Trapper Creek. The revegetation program and channel stabilization that was implemented should be evaluated on a continual basis; ongoing maintenance is required to ensure that this area of the Mine site remains stable.

Environment Canada recommends that Royal Oak Mines Inc. continue maintenance of Trapper Creek channel to ensure that sediment transfer is limited by maintaining the stability of the creek and its surrounding slopes.

Acid Rock Drainage
The work conducted by Royal Oak Mines Inc. to evaluate acid rock drainage, ARD, indicates a low ARD potential for the ore/waste rock tested. This testing should be continued periodically to evaluate the ore presently being mined, and if satellite properties or custom milling are planned for the future an adequate testing program should be implemented for each type of ore.

Environment Canada recommends that Royal Oak Mines Inc. provide to the Board for approval, within one year of issuance of the Licence, a plan that will identify the monitoring program that will be implemented for evaluation of ARD associated with future ore and waste rock that will be mined/milled at Giant Mine.

Surface Contamination
Substantial surface contamination has accumulated over the fifty-year period of mine operations, with arsenic being the main concern identified, although hydrocarbon contamination also requires remediation. The Water Licence renewal submission suggests that the high levels of arsenic in samples on the Mine site may be from naturally occurring sources; however, given that these samples were high in arsenic values in the surface sample but not at depth, the source is likely from a recent activity rather than a natural source.

Environment Canada agrees with the approach Royal Oak Mines Inc. is taking in prioritizing the sites that have elevated contaminant levels. Royal Oak Mines Inc. proposes to prepare remediation plans for the next update of the A&R plan, targeted for November 1, 1998, however implementation of the clean-up for some of these sites should begin before that date. For each site to be remediated, the Board should be

provided with the proposed plans which would outline the following: a detailed map showing the area; the volume of material expected to be removed; the actual volume of material removed; the treatment and disposal to be used; and, the final condition of the area following clean-up.

For the rest of the rest of the contaminated areas, it is recommended that before any decision is made on the abandonment of these sites, a risk assessment should be conducted to help in the determination of the appropriate abandonment process.

Environment Canada recommends that Royal Oak Mines Inc. undertakes the progressive clean-up and reclamation of those sites identified as priority sites, and a risk assessment to evaluate actions required prior to abandonment of the rest of the Mine lease identified as containing contamination.

Subsurface A&R

Royal Oak Mines Inc. is still in the process of determining its closure plans for the arsenic trioxide that is stored in a series of subsurface vaults. Approximately 270,000 tons are presently stored in these vaults with 15 tons of arsenic trioxide being added daily. Based on the studies and evaluations completed to date, it appears that Royal Oak Mines Inc. has concluded that relying on permafrost poses too high a risk for long-term storage. In addition, no information was provided for the groundwater regime within the area and there are unknown risks associated with the options of maintaining the vaults dry by pumping or by isolating them from groundwater pathways. Royal Oak Mines Inc. appears to now be focusing on permanent removal or securing of the arsenic trioxide stored underground at the site as the method of closure for the arsenic storage vaults. However, the detailed description is proposed to be submitted for review by May 1, 2000.

This issue of the disposal of the arsenic trioxide or closure of the values was to have been under active investigation by Royal Oak Mines Inc. during the five-year period of the last Water Licence; to date little progress has been achieved. As this mine has identified a mineable reserve of 553,269 ounces of gold which translates into 5.7 years of known mine life, the method of dealing with the arsenic trioxide needs to be determined and submitted to the Board as soon as possible. Whatever ultimate disposal method is approved, it will in all likelihood require several years to complete.

Environment Canada recommends that Royal Oak Mines Inc. submits its plan for the permanent removal or securing of the arsenic stored underground to the Board for approval within one year of the issuance of the Licence.

Tailings Abandonment and Restoration (A&R)

Royal Oak Mines Inc. conducted a series of studies over the last three years to evaluate different methods of permanently covering the tailings. Various covers were tested for their ability to maintain permafrost in the tailings, in order to create a thermal barrier which could be factored into plans for final abandonment of the tailings. However, preliminary results indicate there would be problems in maintaining a permafrost condition. Delay of spring thawing may be the most likely effect of covering the tailings, but materials are unlikely to remain frozen year-round.

Given the predicted climatic change and associated increases in mean temperatures, Environment Canada has concerns with reliance on permafrost as a means of stabilizing the tailings mass. Therefore, it believes that other means of permanently isolating the tailings mass from surface water and groundwater must be identified and evaluated. As the Northwest pond is nearing its life expectancy, the means of accomplishing this isolation should be determined within the next year.

The A&R plan must also deal with the sludges that are contained within the sedimentation and polishing ponds of the tailings treatment facilities. As with the tailings mass, these sludges must be permanently isolated from the environment.

Environment Canada recommends that Royal Oak Mines Inc. complete its evaluation of means of permanently isolating the tailings mass and sedimentation and polishing ponds sludges, from the environment and develop a plan by August 1998 for approval by the Board.

Baker Creek

Over the course of mining operations, the channel of Baker Creek has been altered repeatedly and subjected to spills and siltation. Abandonment and Restoration Planning should include a survey of the creek to identify any contaminated areas and remedial measures which may be required. Such measures should focus on restoring the creek as fish habitat and stabilization of the final configuration.

Environment Canada recommends that Royal Oak Mines Inc. be required to conduct a survey of Baker Creek to identify restoration measures which would reinstate fish access to and usage of the length of the creek from the decant pipe to Back Bay and to develop a restoration plan for implementation as part of the A&R plan.

Environmental Monitoring Following Closure

The A&R plan should identify proposed post-closure monitoring for the Mine site, including locations, frequency and duration of monitoring.

Environment Canada recommends that Royal Oak Mines Inc. be required to include proposed post-closure monitoring for the Mine site in the revised A&R plan, with identification of monitoring locations, frequency and duration.

Duration of Licence

We are getting close to the end. Production life of the Mine is forecast to be as short as 5.7 years based on current economic gold reserves, or no longer than 8 years should stricter roaster stack emission regulations be enforced in 2006, which may be uneconomical for Royal Oak Mines Inc. to comply with, making closure probable. The licence term should reflect the probable life of the Mine, as during that period the effects of operations are expected to be known and mitigable. The commitment that Royal Oak Mines Inc. has made regarding the conclusions and recommendations reached in the surface contamination study, the ARD study and the tailings cover study is acceptable and can be assessed adequately by the TAC. However, what cannot be assessed at this point in time is the permanent removal of securing of the arsenic trioxide. This will form a future proposal which would require an environmental assessment, whether as a licence amendment or as a licence renewal.

Environment Canada recommends that a five-year licence term is appropriate given the potential for a significant change in operations following that time period.

Security Deposit

The existing security deposit of $400,000 is inadequate in light of the actual costs which would be incurred to restore the Mine site. The level of financial assurance should be sufficient to meet all liabilities, including removal or stabilization of the underground arsenic trioxide.

Environment Canada recommends that the size of the security deposit required by the Water Board reflects the actual costs of the reclamation of the Mine site.

That concludes our intervention, Mr. Chairman. I would like to bring more of an information note to the Board and as well to the representatives of Royal Oak. This relates to the AQUAMIN process that was conducted over the last few years dealing with the revamp of the Metal Mining Liquid Effluent Regulations.

The AQUAMIN set up or provided a summary report, or a final report of its findings which was a complete review of the Metal Mining Liquid Effluent Regulations. As it stands now, the direction that is being taken is the regulations will be reconstructed using recommendations from the AQUAMIN report. The target date — and I emphasize target — is March of 1999. So it isn't that far in the future. If the recommendations come forth that are provided in this summary document, it will mean that a gold mine with cyanidation would likely be captured under the MMLER's and presently, they are not. It may incorporate other parameters that will be identified as regulated parameters and it may identify contaminants that may be a monitored contaminant. An example would be cyanide. I think their recommendation is that it become a regulated parameter. Ammonia is one that is recommended as a monitored parameter.

So, there are several things recommended in here. As I say, we don't know what the final product will be. It is in the future and I just wanted to make that point available now so you are aware that you are aware that there may be changes coming. Thank you, Mr. Chairman.

MR. WRAY: Thank you, Mr. Harbicht. Any questions? I have one. I must admit, I meant to ask DIAND a similar question and I forgot. You are recommending on the ammonia concentrations moving from 15 to 10. When I look at the Giant presentation, they have been moving down to coming close to that area. I take it that it is your position, and I may ask DIAND to comment after Steve, that the Mine can, with existing technology and better management practices, bring the levels down to at least 10. Is that what you think can happen here?

MR. HARBICHT: When we look at the results that we have seen with their monitoring program, we saw a trend that was indicating a downward movement, and as you indicated, close to the 10 ppm. We felt that 10 parts per million as a level that could be targeted. It is something we felt the mining company should be able to achieve. It is a situation that other mining companies are able to achieve and is one that in the southern parts of Canada is a level that is being accepted by other regulatory bodies.

MR. WRAY: Thank you. Perhaps I will ask the Applicant, in both the interventions to date from DIAND and DOE, they are both firm on the 10 parts ammonia. The suggestion is that, that is quite achievable with good management practices and I do note that you have been moving downwards in the ammonia levels since 1993. I ask for your comment on the level of 10, are there better and more effective management practices that you can still put in place? You did mention in your presentation that you had cleaned it up to a certain degree, but there were probably things you could still do.

MR. CONNELL: Thank you, Mr. Chairman. We have taken the steps we need to take in order to clean up the housecleaning issues which have got us down to this 12.5, on average. We do not have technology or know any process that will get us with a cost-effective means to 10 immediately. I think that what is being shown here both by DIAND and Environment Canada is a carrot out in front of us saying get us to 10. I want to follow that up with the AQUAMIN report. As you have heard, ammonia is not a regulated substance or proposed to be regulated under the Metal Mine Liquid Effluent Regulations. That came about because of problems the mining industry is having in achieving 10 across this country. I think you have to be very careful when you compare mining operations to look at the specific type of mining and you have to look at the same tonnage gold mines that Giant is in. You can't compare the larger tonnage gold mines, which are bulk-method mining, which use a different ratio of explosives per ton of rock. They get more efficient as the bulk tonnage increases. In open pit mining, you get even higher ratios of lower

explosive rate per ton of rock. In small tonnage gold mining, we are dealing with higher rates of explosive per ton of rock broken, which consequently ends up putting more ammonium nitrate into the groundwater coming out of the mines.

The experience in Ontario, is that a number of the gold mines are having extreme difficulty in achieving 10 ppm and there are a number of cases where even the requirement is you monitor for it, where mines are not achieving the 10 ppm. I see it as a realistic target out there, but I can't tell you today, and I don't think anyone from DIAND or Environment Canada could tell you today, how we could implement that or what the cost would be of implementing that. It is something out there in the future. Thank you.

MR. WRAY: Thank you, Sir. I will now ask the Applicant if you have questions for Environment Canada on their intervention.

MR. CONNELL: I held most of the things until proper summation time. One point that should be brought forward now to help clarify things is the information regarding the foundation conditions of the Northwest tailings pond are already on file with the Water Board as part of the design documents that were submitted for approval for that construction. I forget the specific dates for that, but it does identify what foundations were relied upon and where there was reliance placed upon the ground conditions.

We should also not draw the conclusion that because we have seen a retreat of permafrost in the mining areas where we have definitely stripped off the tomb covering above the rock and where we have introduced warm air over a number of years and algae applies to the tailings impoundment at the Northwest pond where we really have maintained this layer of insulating property on top of the permafrost and have then added to it by building the dam on top. So, we don't have any evidence that the permafrost has been lost under those dams. This is also an area that the Geotechnical Engineer, the Inspector that does his annual inspection, is constantly aware of. He makes those findings part of his inspection every year. It isn't something that has just been neglected. It is definitely something that they consider as part of their inspections on those dams on an annual basis and report in their annual report.

When we first applied for the right to discharge seepage, it was on the basis that most of the seepage that was being observed at the toe of these dams wasn't the same chemical concentration as was inside the dam. It was already well underneath there. So, obviously it isn't direct seepage coming out of the dam that is collecting at the toe. There is some contributing factor because the levels are higher than they would be in the background, but we should not interpret that the total volume of water that is being collected in these seepage ponds is coming from the dams themselves. The chemistry of that surface water definitely

indicates that there is other sources of water where that is coming from . A lot of it can be snowmelt that comes down from the dam on the outside of the clay course. Thank you.

MR. WRAY: Thank you. That was more of a summation than a question. Are there any questions from the floor for Environment Canada on their presentation? Thank you very much, Mr. Harbicht. As usual, concise and to the point.

MR. HARBICHT: Mr. Chairman, I am not sure if you have a copy of the AQUAMIN Summary Report, but if you would like one for your office, we would be happy to pass one on.

MR. WRAY: Now that you have referenced it, we will require a copy. All documents that are referenced in the presentation are documents that we will seek.

MR. HARBICHT: We will get one for you.

MR. WRAY: We will adjourn for today and reconvene tomorrow morning at 10:00 with the presentation by the Government of the Northwest Territories.

---ADJOURNMENT

January 29, 1998

MR. WRAY: Good morning, Ladies and Gentlemen. We concluded yesterday's session with the Department of the Environment. I said the first up today would be the GNWT's Department of Resources, Wildlife and Economic Development. However, Yellowknife Health and Social Services asked if they could switch with RWED because Dr. Chouinard has some commitments and RWED has agreed to allow the switch. So, we will begin this morning with the Yellowknife Health and Social Services joint submission. Dr. Chouinard.

DR. CHOUINARD: Thank you, Mr. Chairman. For the first part of the presentation I will be using the overhead and then I will come back and sit down over here. I just have a few words of introduction.

This is a joint submission involving the Yellowknife Health and Social Services, Northwest Territories Medical Association Environmental Committee, Department of Health and Social Services and the NWT Branch of the Canadian Public Health Association. Essentially, we have all met and discussed and everyone wanted to have the name of their group mentioned in this presentation.

I will move to the overhead. A the various groups that I mentioned realize that the Giant Mine site has been a major contributor to the growth of Yellowknife in the past and present. We all share concerns that this should be allowed to continue. Also, we feel that some

improvements to the mine operation would be necessary. That is especially in areas where there is potential for significant impacts on the health of people and the environment in the region. So, we asked the Board to incorporate the recommendations that I will be going through later on in this presentation into the conditions of a renewed Water Licence for Royal Oak Mines to operate the site.

Before I go any further, I would like to talk a little bit about arsenic, more specifically about arsenic trioxide. Some of this material has already been mentioned by Dr. Cullen yesterday, but I feel that it is always nice to hear things more than once and I must admit it isn't exactly the same thing. I have extra details and it won't be too long.

Toxicity Source

As everyone already knows at this point in time, arsenic is widespread in the earth's crust and is a trace contaminant of many metal ores. It is a by-product of the smelting industries and is incorporated in various biocides or pesticides and fungicides, which is what wood preservatives are. So, the industrial use of arsenic, most of it, is directed toward the biocide industry.

Various insecticides in the past also were made using arsenic. It isn't what we see used as much any more, but there are certainly a lot of countries that are still using it. Arsenic is also found, as one might imagine, in laboratories and is used in the metal industries and use to be used in the chemical weapon industry. These are relics from World War I and World War II. There are still a lot of this stuff hanging around and it needs to be disposed of.

Arsenic, as Dr. Cullen mentioned yesterday, has a very complex chemistry. I don't know if you remember the transparency that was put down where they were showing complex molecules; it was a very long one. I won't be talking about those ones, in particular, but it is quite complex. People try to simplify things a bit, to say there are organic compounds which means that there is carbon associated with the molecules and organic compound such as arsenic trioxide.

Arsenic trioxide is known as one of the most toxic and also the most carcinogenic in terms of arsenic compounds. The roots of exposure involved for humans, can be through inhalation of dust, smoke or fumes, or through the ingestion of food and water that is already contaminated by either the metal industries, use of biocides and, in many parts of the world, from natural sources. There is also some traditional Asian medicines that contain arsenic trioxide in minute amounts, but those amounts can vary. One of the reasons we know how much arsenic trioxide is necessary to cause someone to die is from the ingestion of some of those arsenic tablets, where the person actually passed away and it had been figured out how much had been taken. Obviously, this would be a difficult study to push from an ethical point of view to try to

determine the lethal dose of arsenic in humans.

For most people, the main source of arsenic is from food and water. The average exposure, just to give a number, to arsenic that we get in a day is 47 micrograms per day. We have to mention that arsenic occurs and is present in grains, grapes, meats -- I am talking about meat from animals from farms, not animals that are freely roaming and eating normal stuff — and also seafood. Seafood is definitely a big contributor. The levels that we can find in seafood, again just to give a number, the average is between 5 and 150 ppm. The background level in food in general, excluding those groups that I just mentioned, is below 150 parts per billion. Most of those levels that we found in seafood are related to organic arsenic. Actually, it is arsenic butane, which is an organic compound and is considered to have relatively low toxicity and is more easily and readily excreted than other arsenic compounds.

Disposition

Depending on the compound of the arsenic that we are talking about, absorption is generally very good and it certainly is very good for arsenic trioxide. It is well absorbed from lungs and the gastrointestinal tract. Arsenic trioxide is one of the most soluble of the arsenic compounds and is certainly readily absorbed through the organs that I just mentioned. It also accumulates and I will come back to that. There is evidence that it accumulates in the brain, the heart, kidneys, skin and other organs.

Organic compounds, in terms of what happens after it is being absorbed, it is considered that generally speaking that organic compounds are more easy to excrete, but it really depends on which kind of organic compounds we are talking about because there is quite a variety. I will not prolong this part of the talk.

Inorganic compounds are definitely not as easily excreted as other organic compounds. If we compare, for instance, what we find in seafood. Inorganic arsenic, such as arsenic trioxide, it is believed that it has to be transformed, to some extent, in order to be excreted more readily. The fact of the matter is we know there is accumulation and excretion is never complete. Accumulation is present to a small degree. I could rephrase this and say it is present to a quite important degree. After three days, about 75 per cent of what you have ingested, let's say arsenic trioxide, will come out. After that, you will lose a little bit of arsenic through your nails, hair and skin flakes, but the bulk of what is left is going to stay in your body and it isn't known what actually happens to this. Obviously, this has an impact on long-term health implications such as cancer and other problems that can develop with long-term exposure.

Toxicity

To talk specifically about toxicity, as I mentioned earlier inorganic compounds are considered to be more toxic. One of the reasons is the

problem with excretion. Arsenic trioxide is certainly in that group. The kind of effects that we know once arsenic is in a human still hold a lot of unknowns. There is a lot to be learned about arsenic still, but there are a few things that we know fairly well and think we understand fairly well. It has been known for many years to be a metabolic poison. What I meant by that is we use oxygen. Arsenic interferes with the ability of cells to use oxygen as a production of energy. It also has an impact on chromosomes causing chromosomal breaks and aberration which, in the long run, will lead to cells multiplying in an abnormal way. This is cancer.

Yesterday, when Dr. Cullen was talking about lethal doses in mice, we had something like 35 milligrams per kilo. We know the sensitivity in humans is much higher than in mice. The dose of 70 to 180 milligrams of arsenic trioxide will generally cause someone to die within 24 hours. For dose size comparison, a baby aspirin is 80 milligrams of aspirin. A normal Tylenol — not that I want to do publicity here — are 300 milligrams. So, half a Tylenol would be 180. That is a lethal dose. That isn't much when you think of it. It has to be ingested orally.

This is what we call a high dose intoxication. In this setting, arsenic will cause death by liver failure, cardiac rhythm problems and bleeding from the gastrointestinal tract. Small amounts, so not enough to cause you to die within 24 hours, can certainly make you sick over a period of a few days. Usually we find that people can have irritation and erosion of the intestinal tract and the gastrointestinal tract. The bone marrow is also effected. Bone marrow is the site of production of all kinds of blood cells; red cells, white cells and cells involved with clotting.

Following exposure to even a single dose, after a few days of latency, there will be a problem with the function of certain nerves, such as sensory nerves and also, to some degree, nerves involved with muscle activation. Liver dysfunction can also become part of the picture. Depending on the dose, this can actually lead to severe damage that can ultimately cause death or cirrhosis.

In those circumstances, if the exposure is stopped or halted, those problems can be reversed, to some degree. We have to keep in mind that there will still be arsenic that will remain and can potentially cause problems later on.

Chronic exposure to lower doses, over many years, is well known to be toxic to the skin. We saw yesterday some pictures from Dr. Cullen. We do get a thickening of the superficial layers of the skin, which give quite a characteristic appearance. Those lesions are precancerous in the sense that they are already related to some chromosomal dysfunction and can later on become a skin cancer. There is also dermatitis or inflammation of the skin that can appear with ongoing chronic exposure. Arsenic can also affect the liver, as I mentioned, even chronic exposure

at low levels. This can take a few years to develop, but liver disease can appear. You can also have problems with the central nervous system. This can involve the brain and the spinal cord. It can definitely have some impact, in that perspective, in behavioral problems. There are many unanswered questions and how it affects the central nervous system still has to be clarified, but it is well known to be one of the substances that can cause brain dysfunction and behaviour problems.

As I mentioned earlier of the break up of chromosomes, arsenic is well known to be a carcinogen. This has been generally accepted for a few years. It causes cancer with skin, liver and lungs. This is after years of low-level exposure. In addition, recent studies have shown that exposure to arsenic is related to an increased risk for bladder, kidney, prostate and nasal cavity cancer.

Biological Indicators

Indicators from a biological point of view, urine measurement is the preferred method of assessing the current or recent exposure. Blood levels can be useful in the really acute type of exposure. Obviously, if you want to monitor someone, poking someone to get blood versus getting urine samples isn't as practical. Blood levels aren't used that often for monitoring purposes. Hair sampling can also be used. One of the problems with that is it is a reflection of past exposure and it becomes difficult to determine what is actually internal in the hair and external contamination on hair.

Abandonment And Restoration

Unless there are questions, I will go back to the table. I only have about four minutes to go. I would like to focus on the restoration and abandonment plan at this point in time.

We feel that current and past Abandonment and Restoration Plans have not provided reasonable certainty to Yellowknife area residents as to how the Giant Mine property will be restored to an acceptable condition in terms of potential human health and environmental concerns. We feel there must be real and measured progress in establishing an acceptable Abandonment and Restoration Plan which addresses health, safety and environmental issues and takes into account the future use of the site.

It is recommended that the Water Board require Royal Oak Mines to submit a revised Abandonment and Restoration Plan within one year of the issuance of the Licence which satisfactorily addresses the following key issues.

Arsenic Trioxide Management

The current and past practice of storing arsenic trioxide underground, as we have heard many speakers yesterday mention...It seems we are all thinking the same way about it. Obviously, underground storage poses potentially catastrophic impacts on human and environmental health.

There is no reasonable evidence to demonstrate that there is an acceptable method of ensuring that this hazardous material can be maintained in a stable state in the storage vaults on a permanent basis. Recent evidence indicates a significant amount of water in the mine that was not previously documented which further discourages the notion of stable, long-term storage of arsenic in these vaults. I know Steve Schultz did mention something to that concern yesterday. I guess there was a problem with measurements before. An interesting analogy is that Atomic Energy Canada Ltd. has failed to secure approval for the storage of radioactive waste underground in other areas of the Canadian Shield after decades of research to find a site that would keep everything enclosed.

It is recommended that the Abandonment and Restoration Plan provide for removing as much arsenic trioxide as technically possible to the surface and that it be treated or processed into a form adequate for commercial reuse or that it be processed into a relatively safe material with an above-ground method of storage that allows for stability and also for easier monitoring and observation. The Abandonment and Restoration Plan should also provide for a method of ensuring encapsulation from the inside the vaults to stabilize residual arsenic trioxide and also provide a plan for long-term monitoring. This should include a health environmental risk assessment which takes into account the methods proposed to achieve this and the future use of the site.

Physical Security And Safety

The Giant Mine site straddles a transportation corridor and adjoins an area which is popular for recreational use. The tailings ponds, mine adits and several open pits are serious potential safety hazards to humans who may enter upon the site.

It is recommended that the Water Board require reasonable security measures to be provided on the site during operations to prevent unauthorized access to those areas. That should be part of the condition of the Water Licence and be addressed in the Abandonment and Restoration Plan.

Stability Of The Tailings Ponds

To date, the Abandonment and Restoration Plan has not provided for a method that assures the physical and chemical stability of the tailings ponds. In fact, abandoned and disused ponds are in a state that allows dry tailing material to be blown around the area by wind action.

It is recommended that it be made a condition of the Water Licence that all tailings ponds be stabilized, in some manner, to prevent the escape of material. This is by providing adequate cover within the duration of the Licence.

It is also recommended that the revised Abandonment and Restoration

Plan provide for a means of establishing physical and/or chemical stability in all containment areas.

Surface Contamination
We have talked about this yesterday also. We know there is some contamination to the surface by hazardous materials. We mentioned hydrocarbons, but to a vest extent it is primarily arsenic trioxide. The Abandonment and Restoration Plan should address the method and level of site remediation of surface contamination. There is some debate as to the levels of naturally occurring arsenic relative to the levels created by the operation of the Mine in the area.

It is therefore recommended that the Water Board require that the Abandonment and Restoration Plan to: a) remediate the surface contamination of the site to the level prescribed by the Canadian Council of Ministers of the Environment of 12 mg/kg of inorganic arsenic or; b) that an alternative standard be established based upon a health risk assessment conducted for Royal Oak Mines by an independent authority which is based upon an identified use of the site.

Updates Of The Abandonment and Restoration Plan
It is recommended that the Water Board requires of Royal Oak Mines annual updates to the Abandonment and Restoration Plan.

Baghouse Maintenance And Air Emissions
The proper operation and maintenance of the baghouse is key to achieving the lowest emissions, utilizing the existing equipment.

It is recommended that Royal Oak Mines be required through the Water Licence to operate the baghouse in accordance with manufacturer's instructions, keep daily records of maintenance and key performance indicators, provide quarterly reports to the Board on emissions of arsenic trioxide and provide for periodic inspections of the facility by qualified, independent personnel to ensure the accuracy of reports and that proper maintenance is being conducted. We don't particularly have concerns here. We feel confident that we would have the cooperation of Royal Oak Mines. We mention for the sake of completeness.

Security Deposit
One last word about the security deposit. In order for the Abandonment and Restoration Plan to have any real assurance of being effective beyond technical feasibility, there must be necessary resources secured to ensure that this is implemented. From that perspective, we recommend that the Water Board require of Royal Oak Mines a security deposit in the manner and amount that reflects the true cost of abandonment and restoration.

Term of Licence
It is recommended that the term of a renewed Water Licence for Royal Oak Mines to operate at the present site be for five years.

That concludes my presentation, Mr. Chairman.

MR. WRAY: Thank you, Dr. Chouinard. We will now move to questions, first by the Board, then by the Applicant and then by members of the audience, if there are any.

I have a few questions. On page 2 of your submission, under 2.5, Biological Indicators, within the context of the statements: "There is no specific biochemical test that reflects arsenic toxicity." To your knowledge and to date, when I phrase it within the context of that statement, have the health authorities in Yellowknife determined any illness of anyone in this city with regard to arsenic exposure?

DR. CHOUINARD: Let's use an example. If you believe someone has had a heart attack, there is actually one blood test whether or not this has happened. In terms of arsenic, there is nothing specific. It is all indirect tests that will tell you that there is some liver damage, there is a problem with bone marrow, but these aren't specifically related. It doesn't tell you that it is definitely related to arsenic. You have to still look at other possibilities as causes.

MR. WRAY: Could you say then that you haven't identified health problems in the city that relate specifically to arsenic exposure?

DR. CHOUINARD: That is right.

MR. WRAY: Thank you, Sir. On page 4, under 3.4, Surface Contamination, you have an a) recommendation and then: "b) that an alternative standard be established based upon a health risk assessment conducted for Royal Oak Mines by an independent authority which is based upon an identified use of the site." Could you perhaps elaborate on that recommendation?

DR. CHOUINARD: One of the problems that might have been with the level of arsenic that is mentioned there, is the fact that we aren't sure what the natural levels are around the region. If it appears that they are actually higher than the recommendation, obviously we cannot hold this level to Royal Oak. So, it is from that perspective.

MR. WRAY: Thank you. Do any Board Members have any questions for Dr. Chouinard? Do any members of the Royal Oak contingent have any questions?

MR. ALLAN: You have already covered it.

MR. WRAY: Are there questions from the audience for Dr. Chouinard? Mr. O'Brien.

MR. O'BRIEN: The Chairman raised a point. He asked you, Dr. Chouinard, if there have been any proven links between arsenic and health problems in Yellowknife. The old cause and effect problem. You said no, there hadn't been any links proven. I asked Dr. Cullen, one of DIAND's experts yesterday, if he could characterize the seriousness or not of the situation of arsenic on our environmental health in Yellowknife. As I remember, all he said was mining is not one of the serious problems of arsenic around the world. The two cases he gave was people drilling down into water tables where there is natural arsenic and ingesting it through their drinking water, which obviously is a real problem. The only other thing he said, if I can just shorten it, is he said things are better than they used to be. That is obvious to everybody. It isn't going into the water in the same amounts, nor into the air.

I have lived in Yellowknife for over a period of 20 years or more and there have been studies and reports. I don't think anyone has ever given the public an understanding of how serious it is to live here. Obviously things are better and I know it is very difficult for any expert to say on a scale of one to ten, it is a nine or a five. Is there any way that anyone can give members of the public some idea of how dangerous or what the threat of living with arsenic is in Yellowknife? You talked about the chronic exposure and long-term effects. No one is going to die right away, but there are things like behavioral problems. These are things that creep up on a society.

I know these guys are going to clean up the mess as best they can with the help of the Water Board, a little bit of the stick and carrot. Is there any way we can ever tell how dangerous or not it is to live in Yellowknife? Can anyone characterize for me the situation for a person like me living in Yellowknife, maybe for the rest of my life?

MR. WRAY: Thank you, Mr. O'Brien. Dr. Chouinard. I would just remind people to identify themselves before they speak in the microphones. It makes it easier.

DR. CHOUINARD: It is difficult to answer this question in a definite, precise way. What we know what is in the air right now is acceptable and does not appear, at this point in time...Of course, I haven't been living here for 20 years; I have been here for 10 years. I can certainly say if we start from the late 1970s to this point, people don't appear to have been sick because of arsenic in the air or in the water. We know that the content of arsenic, even in Back Bay, is quite acceptable for human consumption. So, this would not be a source. The usual sources are air, which doesn't appear to be a problem, and in terms of drinking water, it is the same thing. With fish, the content is also very acceptable. It is much lower than what we would get in seafood from the ocean. I can say that it is safe because things appear to be contained at this point in time. There is no

doubt that there is a big pile of arsenic and that it is a real potential threat. If we put this aside, I can't say it is dangerous because of arsenic to live in Yellowknife.

MR. WRAY: Thank you, Dr. Chouinard.

DR. CHOUINARD: The other thing we have to remember is although all the levels we have seen in fish, water and air have been acceptable, if there were higher levels in the past — and we know there were — in the air and water, the consequences of those levels are also something that take 20 to 30 years to express themselves. This also make the call about who is getting sick and who isn't difficult because often we simply don't have enough time behind us. Since the 1980s and throughout the 1990s, levels have been very acceptable.

MR. WRAY: Thank you, Sir. Dr. Cullen, do you have a question for Dr. Chouinard.

DR. CULLEN: This is actually a very important point in terms of people who have lived here a long time. My question is related to the fact that epidemiological studies are about the only way one can try to sort that out. Has anyone ever looked at this from a long-term point of view?

DR. CHOUINARD: There have been studies on cancer rates. We can compare this region with other regions. There is no obvious difference in terms of numbers from that perspective. We also have to keep in mind that some people who have worked here in the past, when conditions were sub-optimal, left Yellowknife after a number of years, which means some of them will be getting cancer somewhere else in Canada.

MR. WRAY: Thank you, Sir. Any other questions for Dr. Chouinard? Dr. Chouinard, thank you very much for your presentation. We will now move to the Government of the Northwest Territories; Resources, Wildlife and Economic Development.

MR. PAQUIN: My name is Emery Paquin. I am the Director of the Environmental Protection Service with the Department of Resources, Wildlife and Economic Development. On my right is Lisa Dyer. She is an Environmental Impact Analyst with the Service and a member of the Water Board's Technical Advisory Committee.

Introduction
The Department of RWED would like to thank the Northwest Territories Water Board for providing an opportunity to present some of our concerns associated with the renewal of Giant's Water Licence.

Departmental Mandate
The mandate of the Department, like Indian and Northern Affairs, is twofold. It is to promote the wise use and conscientious protection of natural resources while encouraging economic development in the

Northwest Territories. In relation to our participation in these hearings, RWED's intention is to ensure that the environmental impacts associated with industrial activities on Commissioner's lands are assessed and that impacts such as the release of contaminants are minimized.

Statement Of Issues

This presentation will focus upon issues associated with the eventual closure of Giant Mine. Specifically, we are concerned with the permanent abandonment and interim management of the property including the Tailings Containment Areas, restoring of surface contamination found at the Mine site and the permanent abandonment and management of the arsenic trioxide waste.

Considering our outstanding concerns with the abandonment and restoration of the property upon closure, we will also address in our presentation the current security required of the Mine, as well as the term of the licence being requested.

Abandonment And Restoration

The Abandonment and Restoration Plan for the Mine was originally drafted in 1992 and updated in 1994. Numerous studies have been conducted as a requirement of the Water Licence since the plan was first developed. The A&R plan should be updated to reflect information gained from these studies. As you will hear from our presentation, it is the view of RWED that there is additional work required of Royal Oak to make the current A&R plan comprehensive. For this reason, we feel Royal Oak should be required to update their Abandonment and Restoration Plan for Giant Mine on a yearly basis throughout the term of the Licence. These yearly updates will ensure that the plan incorporates study results and any proposed changes to mine closure. Regular updates will also allow changes to the plan to be reviewed and approved by the Water Board in a timely fashion.

In the Mine's licence application, Royal Oak states that "all hazardous materials would either be disposed of at the site, or removed from the site for disposal by a third party." It is our position that only those materials or wastes approved by the Water Board or other regulatory agencies should be disposed of at the Giant property. Hazardous wastes are normally generated when products that contain contaminants such as used oil or batteries are no longer required for their intended purpose. In an attempt to minimize the quantity of this waste that will eventually have to be disposed of and to ensure proper practices are developed by Royal Oak Mines, it is further recommended that the Company be required to develop and submit a Hazardous Waste Management Plan as a condition of the Water Licence. This plan should consider hazardous waste disposal for abandonment and restoration in addition to the management practices during the operation of the Mine.

Stability Of Tailings
One issue we would like to discuss here is the tailings located at the Mine site must be abandoned in a physically and chemically stable state.

Background
Royal Oak recently submitted in the 1997 Annual Report, results from a study that evaluated containing the tailings in a permanently frozen state using insulating covers. Several different covers were evaluated, consisting of varying thicknesses of waste rock, as well as a synthetic liner/sand/waste rock mixture. As stated in the Water Licence application: "The results attained during the first two years of monitoring indicated that none of the covers have been effective in ensuring the maintenance of the permafrost in the underlying tailings solids throughout the summer months." Royal Oak will submit their final report for the insulating cover study to the Board in the Spring of this year.

Royal Oak concludes in their application that insulating covers delay thawing of tailings during the normal period of spring melt. By extending the time interval over which tailings are frozen, Royal Oak believes that an insulating cover will reduce the potential for runoff to contact the tailings and in turn minimize the potential for contaminant movement for the Tailings Containment Areas.

This conclusion does not account for variable climatic conditions or potential warming trends that may be encountered upon permanent closure of the Giant Mine. It remains unclear to us how effective insulating covers will be in preventing long-term contaminant migration under these conditions.

In their application, Royal Oak argues that cover designs found to be effective in delaying tailings from thawing may be cost-prohibitive. For this reason, Royal Oak proposes to use floatation tailings as an insulating cover. In the Water Licence application, Royal Oak has proposed to conduct additional research to determine potential economical insulating covers that maintain the surface layers of tailings in a permanently frozen state. To date, the insulating value of floatation tailings has not been evaluated.

Recommendation
A strategy to maintain tailings at Giant Mine is essential to ensure that migration of contaminants from the Tailings Containment Areas does not occur upon closure. The initial results from the insulating cover study suggests that this cannot be accomplished with the covers that are currently being evaluated. Royal Oak should be required to develop a long-term strategy for the permanent closure of their Tailings Containment Areas that focuses on ensuring permanent stability. If permanent stability does not appear to be technically feasible, then Royal Oak should be required to evaluate effluent treatment from the tailings area after closure until such time that the release of

contaminants from the tailings are within acceptable levels to the Water Board.

RWED recommends that Royal Oak be required to submit a revised Abandonment and Restoration Plan for Giant Mine, a year after the Licence is issued. The plan should include an evaluation of options for permanent abandonment of the tailings in a physically and chemically stable state as well as post-closure tailings treatment and monitoring. Royal Oak's preferred options should be identified and rationalized with study results and economic analyzes.

Another issue that we would like addressed is the present dust generation from the tailings pond during the continued operation of the Mine property.

Background
Over the last couple of years, the Department has received several complaints from several residents within Yellowknife from dust generated from the tailings ponds. As a requirement of the current Licence Part D: Conditions Applying to Waste Disposal 5.1) states, "the solids fraction of the mill tailings shall be permanently contained within the Tailings Containment Area." That is an existing requirement under the Water Licence.

Recommendation
Royal Oak Mines must be required to meet the intent of this section and stabilize the surface of the tailings pond so that dust is no longer generated. For this reason, it is recommended that a section similar to that already included in the Licence be strengthened and, once again, be included in the renewed Water Licence.

Surface Contamination
A surface contamination study conducted at the Mine property in 1995 has confirmed that elevated levels of arsenic and petroleum products are present in soils on the property. There is a debate as to whether these elevated levels of arsenic are from activities that have taken place during mining operations or whether elevated levels are naturally occurring.

Background
The levels of arsenic present in samples obtained from the soils on the Mine site exceed the remediation criterion for contamination on industrial lands currently developed by the Canadian Council of Ministers of the Environment.

In 1991, the Environment Ministers issued a report entitled, "Interim Environmental Criteria for Contaminated Sites." In this report, the remediation criteria for arsenic in soil is 50 parts per million. This was the accepted remediation standard for arsenic by regulators when the

surface contamination study by Royal Oak was conducted and is referenced as a recognized standard in that report. Many of the remediation parameters in the CCME's interim guidelines were not scientifically defensible and recently have been updated based on current scientific information. The CCME has recently evaluated the criteria for a number of parameters including arsenic. The revised criterion for arsenic is now 12 parts per million on industrial lands. With respect to petroleum-contaminated soils, Royal Oak Mines has indicated that the standards outlined in the GNWT's Environmental Guidelines for Site Remediation will be adopted for clean up of petroleum-contaminated soils on their site.

Recommendations
Since no remediation of arsenic-contaminated soils has taken place on the Giant property to date, the Department recommends that Royal Oak Mines be required to remediate the surface contamination to 12 parts per million. This value is based on scientifically defensible information and takes into account toxicological impacts of arsenic on the environment and potential health risks associated with human exposure to arsenic.

The Department realizes that the CCME criteria are generic and not specific to the Yellowknife area, where it is believed that arsenic occurs naturally in soils at a higher level than the national average. If the Water Board feels the current CCME criterion do not reflect soil conditions in the region, the Royal Oak Mines should be required to conduct a risk assessment to determine an alternative soil remediation criterion for arsenic on the property that protects both the environment and the public. The risk assessment should consider the species of arsenic present and whether these forms of arsenic are available for ecological uptake or have the potential to impact human health.

If Royal Oak Mines is required to undertake such a risk assessment, the final report should be submitted one year after issuance of the Licence. The establishment of a remediation criterion will allow Royal Oak to implement progressive remediation of contaminated sites on the property. In regards to the clean up of petroleum-contaminated soils, RWED recognizes Royal Oak's agreement to use the GNWT standards and encourages the Water Board to recognize these standards while developing terms and conditions in the current Water Licence.

Arsenic Trioxide Management
The interim and long-term management of arsenic trioxide produced by Giant Mine has not been specified by Royal Oak and remains uncertain.

Background
For the sake of everyone, I will skip over a little bit. Royal Oak has proposed to submit an arsenic trioxide management proposal in the year 2000, either for securing this material underground or for the permanent

removal of arsenic from underground storage for either refining or stabilization. The proposal would include a schedule for implementation and be suitable for environmental assessment. That is what the Mine recommends.

Recommendations
In our opinion, Royal Oak Mines has had sufficient time to develop a proposal for the management of arsenic trioxide and that waiting two years after a new licence is issued is not acceptable. I think it is important to note here the wording. Royal Oak Mines has used the word "proposal." The Department recommends that Royal Oak be required to submit a management proposal for arsenic trioxide six months after the Licence has been issued. This proposal should include a schedule of when studies and activities will be conducted as well as a commitment to submitting detailed design plans for review by the Water Board within two years after the proposal has been accepted by the Board.

Two management options have been proposed by the Mine, either leave the arsenic underground or remove it for treatment above ground. In either instance, a risk assessment is required and should be a condition of the Water Licence before either option can be implemented. A risk assessment for underground storage of arsenic trioxide was a requirement of the current licence. To date, no risk assessment has been completed by Royal Oak. Royal Oak has stated in their application that they do not intend to complete the current studies and various reasons have been given in support of this decision. Regardless of the reasoning, the Water Board must set terms and conditions in the current Water Licence to guarantee the work required to develop and implement a management plan for arsenic trioxide is completed. Licence conditions must also be flexible enough so changes in the original scope of studies or plans do not lead to the abandonment of the original goal, which is to evaluate the risk associated with managing arsenic trioxide waste.

Licence Term
With respect to the term of the Licence, in the Water Licence Renewal Application, Royal Oak has requested a 10-year Water licence term. Royal Oak estimates ore reserves to be a little over 500,000 ounces and projects the mine life of Giant Mine to be 5.7 years. The total mineral inventory for Giant Mine is slightly over 2 million ounces, which would provide a mine life of 21.8 years if it were economical to retrieve this gold.

Recommendations
The Department recommends that the term of the Water Licence be five years if changes to the arsenic management plan trigger an environmental assessment. The Department would otherwise recommend that the term of the Licence be three years, if the significant changes to the management plan would not trigger an environmental assessment.

Mr. Chairman, there was some uncertainty when we were preparing this as to whether or not the management plan for arsenic would indeed trigger a public environmental assessment process. So, that is the basis for the two recommendations.

It is unclear at this point, whether changes to the management plan would require a Water Licence amendment and, in turn, trigger an environmental assessment. It is our understanding from the renewal application, that a substantial changes in the arsenic trioxide waste management plan may be proposed. This would result in aboveground treatment of arsenic trioxide instead of the permanent storage underground. It is our view that any major changes to the management plan requires an environmental assessment, so the government agencies, aboriginal groups, non-profit organizations, as well as concerned individuals have an opportunity to participate in the review of the proposed management option.

Security Deposit
The amount held in security by the Water Board does not currently reflect the true cost of abandoning or restoring the Giant Mine property.

Background
In the current licence, Royal Oak has been required to maintain a security deposit of $400,000. Royal Oak has estimated the cost to abandon and restore this site to be approximately $8.7 million, while the Department of Indian and Northern Affairs has estimated this cost to be approximately $9 million. These estimates do not include the cost to permanently store, treat or stabilize the arsenic trioxide waste.

The current security requirement of Royal Oak Mines is well below the estimated cost to abandon and restore the Mine site. Security is required to ensure that mining companies implement their closure plans. It also provides a level of assurance that funds are available to close the site should a company not meet their closure obligations.

Recommendation
With these points in mind, the Department recommends that the Water Board increase the security required of Royal Oak to $1 million immediately upon the renewal of the Water Licence. According to the Northwest Territories Waters Regulations, security can be obtained from a company in several forms, some involving the direct deposit of cash, while others a financial commitment which can be drawn upon at some later date. RWED recommends that the security take the form of the latter, either as a promissory note or an irrevocable letter of credit.

Summary
To summarize very briefly, there are six main issues the Department is requesting the Water Board consider during the development of the Water Licence:

- abandonment and restoration;
- interim and permanent stability of tailings;
- surface contamination;
- arsenic trioxide management;
- licence term; and,
- security.

With that, Mr. Chairman, I will conclude my remarks but I would request that you allow me to invite two further representatives of the government to the table; that would be Mr. Buddy Williams representing Municipal and Community Affairs, as well as Mr. Sylvester Wong, representing the Mine Safety Division.

MR. WRAY: Yes, Mr. Paquin, go ahead. Thank you. I have a couple of questions and then I will turn it over to other Board Members. On page 5 of 8 — and I note that you did specifically point out the wording here — you say: "It is our opinion, Royal Oak Mines Inc. has had sufficient time to develop a proposal for the management of arsenic trioxide and that waiting two years after a new licence is issued is not acceptable." You recommend that a management proposal for arsenic be submitted six months after the Licence has been issued, which would include: "... a schedule of when studies and activities will be conducted as well as a commitment to submitting detailed design plans for review, two years after the proposal has been accepted by the Water Board." When I first read that I thought in the first part of your statement, you seem to be taking a hard line, but at the end of the day it looks like you are recommending two and a half years for a proposal. When you say a management proposal after six months, what do you mean by proposal? What would you see in that proposal as separate from a detailed design two years after that? Could you clarify that for us?

MR. PAQUIN: I will try to clarify that. What we mean by a proposal is just more or less a general commitment on the part of Royal Oak as to how they are going to manage their arsenic waste; whether they are going to try to identify a means of leaving it underground or whether they are going to identify a means of removing it from underground and treating it at surface. We would also be looking, at that point, a schedule by which Royal Oak plans on implementing the further studies that would be required to develop the detailed engineering plans that would allow them to put that proposal into practice. The detailed engineering plans would then be the detailed plan that we refer to that would be required after two years. We felt that it was important for the Water Board to have an understanding of the general intent of Royal Oak Mines with respect to the underground arsenic, rather than detailed plans be developed by the Company simply to find out that it isn't acceptable by the regulatory agencies. It is a stepwise process.

MR. WRAY: In other words, within six months, you would expect to see a proposal from Royal Oak that says this is where we are going and this is how we

intend to get there. You would have that reviewed by the regulatory authorities first, prior to Royal Oak doing any detailed planning work on their options. Is that correct?

MR. PAQUIN: That is correct. It is appropriate for the Company to know whether their intended means of dealing with this issue is acceptable to the Water Board and regulatory agencies before they go ahead and undertake more detailed, expensive engineering design.

MR. WRAY: Okay. On 3.3, you recommend the term be: "...five years if changes to the arsenic management plan trigger an environmental assessment," but only: "...three years if significant changes to the management plan do not trigger an environmental assessment." I take it by that statement then that you are looking for or expecting this management plan that they ultimately develop would be subjected to some environmental assessment process.

MR. PAQUIN: That is correct.

MR. WRAY: And if no such process exists or is contemplated, then your recommendation would be that the Licence would be for five years?

MR. PAQUIN: If no such process existed, we would recommend that the licence term be three years, so the subsequent renewal of the Licence would allow the assessment to take place of the management plan at the same time as the Licence is being renewed.

MR. WRAY: Thank you. On 4.3, I will refer back to yesterday to the intervention by DIAND and statements made by them, that DIAND and, therefore, the federal government are saying at the end of the day, if everything else fails, the landowner is liable for the costs of clean up of his mine site. The landowner in question is the Government of the Northwest Territories, which leases the land to Royal Oak Mines. Given that, I am curious to know why the Government of the Northwest Territories would ask for a security deposit much lower than any other government agency and certainly far lower than any cost of clean up would be.

The second part of that question would be is there any intention of the Government of the Northwest Territories to impose their own security deposit or some method through the lease from recovering money for the clean up?

MR. PAQUIN: I will answer the first part of that question and then refer the second part to Mr. Williams. A considerable amount of thought was given to the security deposit. In our opinion, there are two ways that the issue of the security deposit can be approached: one is the manner that Indian and Northern Affairs has proposed and that is to require a relatively high security deposit, one which would largely cover the anticipated costs of restoration; and, the other way to look at it would be to require a lower,

yet significant, deposit with the expectation or the demand that an aggressive progressive reclamation program be undertaken by Royal Oak or by the Company during the term of their licence. Our preference would be the latter. I think $1 million is a significant amount. I think it brings the level of security in line with other gold mines that are of a similar size in nature that exist in the Northwest Territories. Instead of having the companies cash tied up in the form of a security deposit, we would like to see some of the financial resources of the Company put towards aggressive reclamation of the environmental liabilities that exist at the Mine site now. I don't know if that answers your question, Mr. Chairman. That was the reason behind the lower security deposit level. As far as the second part of the question, I will refer that to Mr. Williams.

MR. WILLIAMS: Yes, Mr. Chairman. In answer to your question, I can do it in a few parts. When the lease was initially issued in 1983, there wasn't a legislative requirement for a security deposit. To date, none has been implemented, but it is something we are currently looking into with our Department of Justice and other GNWT departments to see what we can do on that. It is something we are actively seeking at this time.

With regard to the second part, as far as ultimate liability for the site, we recognize that we, as landowner, do share in that more so as the proponent, than the actual land user. So, we would first want to see that avenue completely exhausted through the courts.

As well through the Abandonment and Restoration Plan, we would look to see that a lot of our requirements and issues are addressed through one encompassing document that deals with all issues with the site, they would identify what requirements we would have as well on Royal Oak. Any overlaps between water and lands would have to be worked out between the federal and GNWT agencies. So, we are counting on a number of those areas to address the security deposit at this time. Thank you.

MR. WRAY: Thank you. When does that lease expire, Mr. Williams?

MR. WILLIAMS: The lease was issued effective June 1, 1983 for a 30-year term. It does contain a replacement guarantee that at the end of the 30-year term, another lease of a 30-year term can be issued.

MR. WRAY: Does the Government of the Northwest Territories have the flexibility to amend terms and conditions of that lease?

MR. WILLIAMS: There is a flexibility to amend the terms, however, any amendments are normally required to be signed off by both the lessee and the lessor. So, it would require Royal Oak being a party to any amendments to the lease.

MR. WRAY: You mentioned the Abandonment and Restoration Plan. When and if an A&R plan is accepted by the Water Board, could you see the possibility of incorporating that plan into the terms and conditions of your land lease?

MR. WILLIAMS: I would think if everyone was in support of that, it could be done, yes.

MR. PAQUIN: Excuse me, Mr. Chairman. I neglected to turn the microphone over to Mr. Wong. He has some additional information that may help with respect to closure of property.

MR. WONG: Under the *Mine Health and Safety Act*, there are sections dictating the requirements upon closure of the Mine, as what is deemed satisfactory to the mine safety unit. There are several options. If the Mine is failing to do so, the cost may be recovered, we have the mandate of getting a consulting firm or someone to do the job and bill it back to the Mine. Also, there are fines and penalties and causes that would have to be settled through the court and the Justice department.

MR. WRAY: Thank you, Sir. It appears to perhaps consolidate. There appears to be sufficient legislation and regulations from different sources which would ensure that a proper A&R plan could be put in place. My concern is that because there are so many agencies involved, I think the preference, at least of the Applicant, would be to see one plan that was accepted by everybody, as opposed to different plans of Occupational Health and Safety, Mine Safety, MACA, Water Board, DIAND, et cetera. Perhaps that is a goal that we should be striving towards, to make sure there is one plan that is acceptable to all parties. Mr. Williams, could you provide the Board with a copy of the lease, please? Dr. Gilchrist.

DR. GILCHRIST: Mr. Paquin, you made reference to the idea that your recommendation with regard to the security deposit is based on a notation of progressive reclamation. Have there been discussions with GNWT and Royal Oak with regard to this option?

MR. PAQUIN: My understanding is that there have not been specific discussions with the GNWT, but there have been discussions between the Mine and the Technical Advisory Committee to the Water Board to which we are a member of. Thank you.

MS. JOHNSTON: At the bottom of page 3, in recommendation 2.2.3, you recommend that: "...requirements of Part D 5a) be strengthened and included in the renewed Water Licence." Could you expand on what sorts of things you would see? Thank you.

MR. PAQUIN: Yes, the current condition states that: "The solids fraction of the mill tailings shall be permanently contained within the Tailings Containment Area." There has been some discussion with respect to what the intent of that clause is. Some people interpret the clause to mean that water

borne tailings would be contained within the Tailings Containment Area and not the dry solid tailings. So, the intent of this particular term should be clarified to make it perfectly clear that it is both the water borne tailings as well as the dry tailings dust.

MR. WRAY: Thank you, Mr. Paquin. Any other questions? Before proceeding with the questions from the Applicant or the general audience, the Chairman has been drinking too much water, so we will take a 10-minute break.

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MR. WRAY: The next phase would be questions of the GNWT by the Applicant. Do you have any questions, Mr. Connell?

MR. CONNELL: No, Mr. Chairman. I think most of the issues we were going to discuss have been covered off with the questions that have gone back and forth. Thank you.

MR. WRAY: Thank you. Any questions from the audience? Mr. O'Reilly.

MR. O'REILLY: I would like you to thank you for your pursuit of questions on the land lease, surface lease issue. I just want to ask one more question on that. Is there anything in the terms and conditions of the current lease that would require or could be used to require Royal Oak to clean up the surface?

MR. WRAY: Mr. Williams.

MR. WILLIAMS: Currently in the lease, there is a restoration requirement that upon expiry of the lease, the lessee shall restore the land to a condition satisfactory to the Deputy Minister of MACA. So, there is a requirement to do a clean up at the end.

MR. WRAY: Thank you. Mr. O'Reilly.

MR. O'REILLY: Thank you. I have just one further comment on the issue. The Auditor General of Canada has commented several times on the public accounts of the Northwest Territories encouraging GNWT to enter environmental liabilities properly into the public accounts. I think there is an opportunity here for development of a policy or perhaps new regulations dealing with surface leases to encourage that GNWT is left with no public liability within block line transfers and so on.

My second line of questioning is about the security level that has been suggested by GNWT. Is it the position of the Government of the Northwest Territories that reclamation costs should be covered by companies?

MR. PAQUIN: Yes, Kevin, it is the position of the Department of RWED that

remediation costs are covered and are the responsibility, the sole responsibility, of the party that discharged the contaminant in the first place.

MR. WRAY: Thank you. I appreciate the answer, however, I think the question was is it the position of the GNWT. I don't know if you are able to speak for the position of the entire government. I noticed though, that it was the position of the Department. Is that also the government position or just the Departmental position?

MR. PAQUIN: I can't speak on behalf of the entire government, but the one thing I would say is that polluter pays principle is one of the main principles behind the Environmental Protection Act of the Northwest Territories and that act has been passed by the Government of the Northwest Territories.

MR. WRAY: Thank you. Mr. O'Reilly.

MR. O'REILLY: Great. I am not sure who to ask this question to. What sort of carrying costs are associated with security deposits. I don't know if this is something that Emery may be able to answer. Is it one per cent or a half per cent? What sort of carrying costs are associated with security bonds?

MR. WRAY: Can you answer that, Mr. Paquin?

MR. PAQUIN: No, quite honestly I can't.

MR. WRAY: That is probably more of a question for DIAND, Mr. O'Reilly. I will attempt to find an answer for you.

MR. O'REILLY: I also understand that Royal Oak has begun to set aside money for reclamation in a trust fund. There are some tax advantages for that, so I am trying to get at what sort of costs are really associated with putting up security that might be significantly more than the $1 million that has been requested by GNWT. I am just wondering if it is the view of the Government of the Northwest Territories that the carrying costs that might be associated with $7 million versus $1 million are so significant that it would be an insurmountable obstacle for the Company?

MR. PAQUIN: I wouldn't term it to be insurmountable. We haven't done an in depth analysis of what the costs would be to Royal Oak in carrying the $7 million security. A lot of it would depend on the risks that the various financial institutions would consider that are presented by Royal Oak as a company. I go back to my earlier comments that there would be an additional cost, albeit I don't know what that cost would be, for the Company to carry a $7 million security deposit versus a $1 million security deposit. We would prefer that additional cost be placed directly into progressive reclamation of the property rather than having the cost

incurred upon the Company for no other reason other than to maintain the security.

MR. WRAY: Thank you. Mr. O'Reilly.

MR. O'REILLY: I wonder if the GNWT did receive the Brodie and Dillon reports from DIAND or if they have just become aware of them like the rest of us yesterday?

MR. PAQUIN: We were aware that the Brodie study was underway, but we were not provided with copies of the report.

MR. WRAY: Thank you. There are copies of those reports at the back of the room.

MR. O'REILLY: I appreciate that. I think they are very significant documents because it is the very first time we have seen cost figures dealing with the arsenic trioxide that is currently stored underground. I am just surprised that they weren't brought forward to the Board much earlier because they date from September and November of last year. Is the Government of the Northwest Territories then given to any thought about security for the arsenic trioxide that is stored underground?

MR. PAQUIN: Obviously, when the measure of liability is finally determined for the underground arsenic, the level of security should reflect those liabilities as well as the known surface-related liabilities as identified in the Brodie report.
I also go back at this point to a commitment that the Company made yesterday morning and that was that they would agree to review an amount of security at the time that the Abandonment and Restoration Plan was submitted to the Board, November of this year. The Department would certainly support such a review of the security deposit at that time.

MR. O'REILLY: I have no further questions. Thanks.

MR. WRAY: Thank you, Sir. Are there any other questions for the GNWT?

MR. TURNER: Thank you, Mr. Chairman. My name is Bob Turner. I am with the North Slave Metis Alliance. This is a question regarding a statement that was brought up by DIAND with regard to the definition of satisfactory restoration. It was mentioned that their restoration definition is: "return land to a state satisfactory to GNWT." I would like some clarification on that. There seems to be a bit of discrepancy on security deposits between departments. Are there different views on restoration between departments? Since the responsibility as the landowner will be MACA, I am just wondering if they can provide a definition of "satisfactory."

MR. WILLIAMS: The restoration requirements are somewhat flexible until a determination is made on the expiration of the land use, to determine what condition

would meet the long-term needs of that particular parcel of land and those interested parties in that area. Specifically in the case of Royal Oak Mines, a determination would be made between the city, the GNWT and other federal regulatory agencies to determine what minimum requirements that are to address any liabilities and any long-range plans that the City of Yellowknife may have for that area or any other interested groups in that area. Thank you.

MR. TURNER: Since they are going to be negotiating with the city and other departments, I believe you mentioned that responsibility doesn't kick in until the end of the lease, which is approximately 2013, are they going to be waiting until then to start that process?

MR. WILLIAMS: We will be participating in a review of the current A&R plans and the revisions to them to ensure that any ongoing and long-range plan restoration and abandonment of the site will take into account our long-term requirements of the Commissioner.

MR. TURNER: That's it for now.

MR. WRAY: Thank you, Sir. Any other questions? Mr. Paquin.

MR. PAQUIN: Thank you, Mr. Chairman. It is the preference of the Department that a single Abandonment and Restoration Plan be developed. There has been some question with respect to how the review would take place, various standards, et cetera. I think it is important to make it very clear that we feel that one A&R plan should be developed by the Company that would address both the water-related abandonment issues as well as the land-related abandonment issues. This is the only way that I can see it occurring effectively and efficiently because it is virtually impossible to separate those two when it comes to designing an abandonment plan.

MR. WRAY: Mr. O'Brien.

MR. O'BRIEN: On page 5 of your submission, you say: "It is our opinion, Royal Oak Mines has had sufficient time to develop a proposal for the management of arsenic trioxide and that waiting two years after a new licence is issued is not acceptable." You recommend that the Company submit a management proposal six months after. I remember attending a meeting about this underground arsenic issue about four years ago. At that time, the engineer for the City of Yellowknife accused the Company of dragging its feet. He really got worked up about it; understandably, I think. Now, although I believe in March of this year Royal Oak was supposed to submit a proposal, it now put that off. Now I think they are going to do a plan, not a proposal, by the year 2000. I am not sure if I can hear the sound of foot dragging again, but is the GNWT willing to recommend to the Water Board that there be penalties if the Company does not produce the stuff on time. Whether the Water Board accepts

that six months from now, they give a management proposal and two years, a detailed plan and implementation, would the GNWT be willing to recommend that there be penalties to the Company if these things are not produced on time?

MR. PAQUIN: Would the Department recommend penalties? Quite honestly, we have not discussed this as a department. We have discussed, however, the merits, in a number of different forms in relationship to a number of different issues. The merits of actually financially penalizing a company for not carrying through on their obligations; on the one hand, there has to be some very strong incentives for the Company to comply with the requirements of their licence, on the other hand, a financial penalty is viewed by some as making it even more difficult for a company to subsequently comply with the requirements if they don't meet the first deadline. You are actually taking financial resources away from the Company that could be used to go towards complying with the requirement. I am not sure if I am making myself clear. The short answer to your question, Chris, is no the Department has not considered whether financial penalties should be applied for non-compliance of interim requirements within the Licence. On the other hand, we strongly believe that the regulatory agencies have a responsibility to ensure that the terms and conditions of the Licence are complied with.

MR. WRAY: Thank you, Mr. O 'Brien. Any other questions? If not, we will move on to a presentation by the Department of Fisheries and Oceans. I thank the GNWT witnesses. I am sorry, Dr. Gilchrist had a question.

DR. GILCHRIST: I am just following up from one of the earlier questions of Mr. Paquin. Given that there was a recommendation for a $1 million security deposit, based on the notion of progress reclamation, did you envisage when this recommendation was developed that the arsenic trioxide would remain onsite or would be removed?

MR. PAQUIN: We didn't make any assumptions with respect to the ultimate management of the arsenic trioxide. We believe it is too early to prejudge that outcome. We would be looking forward to what the Company proposes to do with their arsenic trioxide before we make a decision on that. I don't think we have all the information that is required in order to make that decision.

DR. GILCHRIST: I guess I ask the question because it seems to me to make a difference in terms of the amount you are proposing as a security deposit, whether you are going to be having to deal with an onsite arsenic trioxide issue or not.

MR. PAQUIN: I go back to a comment that I made during the question period; that is with respect to a term and condition of the Licence being incorporated that would allow a re-evaluation of a level of security deposit upon submission of the updated Abandonment and Restoration Plan. I do

believe that it would be appropriate for this review to take place because the proposal from Royal Oak with respect to what they proposed to do with their arsenic trioxide could then be incorporated, or some indication of it could be incorporated, within the A&R plan.

MR. WRAY: Thank you, Sir. We will now move on to the Department of Fisheries and Oceans.

MS. STEPHENSON: Good afternoon. I am Tasha Stephenson, Habitat Management Biologist, representing the Department of Fisheries and Oceans. Our submission is included on the back table in written form. I will just be going through it with a certain amount of ad-libbing. Because there has been a bit of new information come out during the hearing and also several things have been covered quite thoroughly by other intervenors.

Technical Comments And Recommendations
Mine Operation
Effluent Limits For Ammonia
Fisheries and Oceans technical comments start out with a discussion of the issue of the effluent limit for ammonia.

DFO has noted that during the term of the current Water Licence, the regulatory response to non-compliance with ammonia limits has been to increase the effluent limits to something that the Mine can achieve. Improvements in the explosives handling and use over the last years, as the Company explained, have resulted in decreased discharge levels. This is a step in the right direction. We would like to see this trend continuing because even as it is, the levels of ammonia that are being loaded into the aquatic environment are still quite high. This is a concern to fish and fish habitat.

As you all probably know, the Canadian Council of Ministers of the Environment recommendation for protection of freshwater aquatic life for ammonia is in the range of 2 milligrams per litre depending on temperature and pH. DFO recognizes that this limit is likely below what can realistically be achieved with the available technology and methods of this mining operation. However, we believe it is realistic to achieve levels that are at least half of what are currently present in the Licence.

Recommendation
Therefore, we recommend that the total ammonia limit be reduced to 10 milligrams per litre and that Royal Oak Mines continues to improve their efforts to implement practices to reduce the amount of ammonia in their waste water. They mentioned yesterday that they predict their levels to actually increase in the next years, but I suggest that their concurrent proposal to include minewater recycling may help to alleviate that problem. Perhaps a lower ammonia limit in their licence could inspire them in their water recycling efforts.

Water Management - Recycling
The proposal has been put forward previously to implement recycling process water to reduce their water use and the waste water disposal. We haven't seen this being implemented yet. DFO supports the idea that these measures be undertaken as soon as possible to reduce the amount of effluent requiring treatment and subsequent release into the environment and, therefore, significantly reduce the loading of ammonia, cyanide, other metals and contaminants.

Recommendation
Therefore, DFO recommends that Royal Oak Mines develop their water recycling proposals and implement them within, as approved by the Board, the first year of their renewed licence.

Spills Management
There was some discussion yesterday about spills management. DFO notes that there have been frequent tailings spills, but these have been reduced in recent years because of the upgrading of the tailings line. DIAND Inspectors have also noted that there are problems associated with spill response and clean up. Fisheries and Oceans is already concerned with the existing spill prevention and contingency.

Recommendation
We, therefore, recommend that Royal Oak Mines actively promote the implementation of approved measures to prevent spills and that this include regular maintenance and upgrading of facilities and equipment if necessary, regardless of whether or not it is predicted that the mine life is going to be short-term.

I am also wondering if the enforcement agency, DIAND, shouldn't consider dust to be included as an unauthorized discharge, since this seems to be something that the Mine has had some past problems with controlling.

Tailings Management
Royal Oak Mines has proposed, and this quote is from one of their submissions: "...limited increases to dam elevations on the existing tailings ponds" to increase tailings containment capability. Fisheries and Oceans has some concerns, as have other departments expressed, about the stability of the existing dam structures that were based on assumptions of permafrost. There was some discussion of that yesterday as well. It is my understanding that the dam stability or the extent of permafrost in the foundation of those dams hasn't been completely characterized.

Recommendation
DFO recommends that it should be done. Similarly there was a lot of discussion yesterday regarding the assumption of permafrost to stabilize the tailings in the containment area. It seems to me the general

conclusion is, this will not work. Royal Oak Mines proposes further testing to characterize the chemical constituents of the tailings and the pour water, but they haven't put forward proposals yet for alternatives to the permafrost containment technique.

Recommendation
The proposed modifications to the dams seem to be a component of an as-yet poorly defined Tailings Management Plan. Fisheries and Oceans recommends that Royal Oak Mines develop a detailed Tailings Management Plan to be submitted within a year of the licence renewal. This plan should be supported with quantitative data for forecasting tailings production in the future for the remaining lifespan of the Mine. The stability and impermeability of the existing dam structures should be assessed and proposals for redressing any deficiencies, if they are noted, should be included in the Tailings Management Plan, along with more detailed proposals on the dam extensions if that goes ahead. Alternatives to the use of permafrost as a stable method of containment should be included in this Tailings Management Plan.

This plan should take into consideration the transition from the current active management of Tailings Containment Area to the final abandonment and restoration requirements.

Abandonment & Restoration
Surface Contamination
Under abandonment and restoration, as others have noted, there is a problem with surface contamination.

Recommendation
DFO recommends that the clean up and reclamation of the priority contaminated areas be implemented on a progressive basis, concurrent with the ongoing operations, and not necessarily waiting until the next update of the Abandonment and Restoration Plan.

The control of dust could be part of the surface contamination remediation and DFO recommends that proposals for dust control be submitted before this summer.

DFO also requests a risk assessment for the reclamation of the surface contamination be submitted as part of their Abandonment and Restoration Plan update.

Underground Arsenic Trioxide Management
To date, the studies, as everyone has commented, have not been completed or submitted as required in the current licence. Fisheries and Oceans is concerned that the management plan will not be completed in time for implementation if it is left any longer.

Recommendation

Therefore, DFO recommends that Royal Oak Mines submit its plan for permanent abandonment and restoration or removal and permanent containment of the arsenic stored underground within the one-year limit of the licence renewal, and that the plan include a risk assessment of each option.
We submit to the Board that they not be lenient in allowing further extensions to this proposed deadline for an arsenic trioxide management plan.

Fish and Fish Habitat
Back Bay, Great Slave Lake
As has been noted previously in other presentations, Baker Creek and Back Bay are the receiving aquatic water bodies for the mine effluent. This is where DFO's primary concerns with long-term impact are located. Specifically with regard to ammonia and the toxic effects it has on aquatic life, as well as the nutrient loading and subsequent potential for water quality degradation regarding the nutrient loading to Back Bay.

The concerns about Baker Creek go beyond contaminant loading. There has been significant physical alteration to Baker Creek, as well as subjected to mine effluent discharge and erosion and siltation. The DFO is concerned with potential long-term effects and impacts that these factors have had and may continue to have on the aquatic life and fish habitat of Baker Creek.

Recommendation
DFO recommends that an effluent monitoring program similar to the Surveillance Network Program be continued throughout the abandonment and restoration phase of the post-mine closure for Baker Creek and Back Bay. Specifically, DFO recommends that the Royal Oak Mines Abandonment and Restoration Plan incorporate a detailed proposal for the rehabilitation of Baker Creek to productive fish habitat. This would require an assessment of historical data and information on the original use by fish and the original condition of Baker Creek, an assessment of the current conditions and a review of potential methods to restore or establish fish habitat throughout the creek.

To compliment the Baker Creek restoration, the Company will need to look at controlling erosion within the mine site, which may also contribute to the deposition of sediment and further degradation of Baker Creek.

Trapper Creek
The Trapper Creek site, as was discussed earlier, has had some of this sort of work done on it in the past and the stabilization program seems to be working well. DFO supports the ongoing maintenance of this project.

Recommendation
DFO recommends that monitoring and maintenance of the Trapper Creek revegetation program and channel stabilization be continued.

Recommended Term Of Licence
Finally, regarding the term of the Licence, Royal Oak Mines indicated yesterday that they would like a 10-year term and they suggest this is a demonstration of their long-term commitment. Fisheries and Oceans recommends that a maximum term of five years be allowed as this is within the expected predicted lifespan of the Mine with the current reserves. This would allow for a proper review of not just the arsenic trioxide management plan, but all of the required reports and plans and the Company's compliance with them to that time. A licence renewal prior to closure of the Mine would allow for another public scrutiny and review of the Mine's implementation of these plans and allow for alterations, modifications and further suggestions for closure. Thank you.

MR. WRAY: Thank you, Ms. Stephenson. I have a couple of questions. With regard to the reduction of the ammonia to 10, would you see that happen immediately, phased in, gradually? What kind of time period would you see the movement down to 10 by the Mine?

MS. STEPHENSON: Fisheries is recommending the new licence start with a limit of 10.

MR. WRAY: So, no phasing in, just boom.

MS. STEPHENSON: Yes. We would have recommended that the limits not be increased to the levels they are in the current licence.

MR. WRAY: Thank you. My second question has to do with an intervention we will get to this afternoon. However, the actual written submission has already been filed with the Board. It contains a statement that is somewhat puzzling to me. As you are the representative of DFO, I would like you to try to clarify it. In a submission to the Board by Mr. Talbot, on page 1, the statement is: "Fish and wildlife are dying from the effluent from the tailings ponds. I have met with the Department of Fisheries and they report that they are unable to enforce their laws because of the Water Licence." I wonder if you care to comment on that statement?

MS. STEPHENSON: The first part or the second part?

MR. WRAY: On all of it.

MS. STEPHENSON: Okay. With regard to the first part, fish are dying in Baker Creek. I have recently come to this job and I am not very familiar with the background of the whole history of this area, but it is my understanding that fish habitat has been destroyed and, therefore, are probably fewer fish, if

any, left in that creek relative to the original condition. The first part of that statement I would find pretty easy to accept.

With regard to the second part that Fisheries and Oceans is not able to enforce our legislation because of the Water Licence, I believe that is an erroneous statement. I am quite sure that the Water Licence contains a clause which specifies that compliance with conditions of the Licence does not absolve the Licensee from complying with other legislation. The Fisheries Act still holds that the deposit of deleterious substances is prohibited unless authorized and the destruction or alteration of fish habitat is prohibited unless authorized.

MR. WRAY: That was also my understanding and that is why I was asking. The statement that "I have met with Department of Fisheries..." and you say you are new, so I will pursue with Mr. Talbot who he met with. It was my understanding that the Fisheries Act was paramount over everything else. In 27 years, I haven't seen anything that would stop DFO from laying charges before, so I have no reason to think you would stop now. Any additional questions from the Board? Mr. Dillon.

MR. DILLON: Yesterday we had a presentation from Francis Jackson of Water Resources with regard to a study that has been done on fish in that area. Has your department reports or studies that have taken place in the same area?

MS. STEPHENSON: Again, I have to apologize for my recent history. I believe our department was a participant of those studies. Perhaps someone from Environment Canada could better answer because I think that they, together with or in cooperation with our department, have participated in studies. I am putting them on the spot by passing the question on to them.

MR. WRAY: Steve Harbicht, Department of Environment.

MR. HARBICHT: Thank you. Thanks for putting me on the spot. Regarding the study that Francis Jackson presented yesterday, I think he included that DFO was a participant in the study. Their activities at the time — and I was with DFO when that study as initiated and subsequently left — was dealing with the fish in the Yellowknife Back Bay area. They concentrated on sampling as well as the analytical work associated with each of the samples collected. The sediment and the water were handled through the DIAND part of the study.

MR. WRAY: Thank you, Steve. Any other questions by the Board? Does the Applicant have any questions for Ms. Stephenson? Mr. Connell.

MR. CONNELL: Yes, Mr. Chairman. DFO in making their recommendation that ammonia levels be reduced to 10 ppm immediately, can you provide us with what information you base that on with regard to technology that you believe

Giant Mine could apply to achieve those reductions?

MS. STEPHENSON: With respect to specific technology, no. It is my understanding however that other mines have been able to achieve those levels in other areas. I understand from your comments yesterday, that the mining techniques in those other mines may be different from Royal Oak's operations. However, our position is that as long as limits are set to be easily achievable, there is no incentive for methods or operations to be changed in order to protect the environment better. I also suggested that the minewater recycling may significantly reduce those levels.

MR. CONNELL: Yes, one more question on the same issue. In my interpretation or my understanding of what may take place with water conservation is exactly the opposite. I will give you this analogy of how I see it. We have two sources of water coming to surface: one from the minewater which contains "x" pounds of ammonia; and, we have fresh water coming from the lake which essentially contains zero. The purpose of our plan is to treat the minewater, so that we use less of that fresh water. In actual fact, the freshwater component, the one that is diluting the ammonia, is going to drop by 20 or whatever per cent it achieves. So, I would expect that since we aren't removing ammonia in any of these processes, we should actually see an increase in the ammonia concentration reporting to the pond as a result of our water conservation initiatives. So, while I appreciate that everyone wants to see some incentive for us to move towards lower ammonia levels, I think we are just hearing that those are objectives and nobody can provide us with a clear statement of how we can actually get there. We may have to fight to hold the current reductions we have achieved, as we get through these water reductions.

MR. WRAY: I didn't hear a question there, Mr. Connell. Do you have a comment, Ms. Stephenson?

MS. STEPHENSON: I don't think so. I understand their explanation.

MR. WRAY: Are there any questions for DFO from the audience? Mr. O'Reilly.

MR. O'REILLY: Thank you, Tasha. I hope you won't take the line of questioning I want to pursue, personally. I was really interested in the Baker Creek rehabilitation. I guess in the second last paragraph on page 9, talking about doing a historical assessment of the original state and fish use of the Baker Creek area, does DFO have any idea of what the extent and severity of degradation has been on Baker Creek and Back Bay?

MS. STEPHENSON: Thank you. I believe that we do have several files on the background of Baker Creek. Unfortunately, I think the Mine operations began before it was assessed. So, pulling together all of this information will be a project that may take some digging. I don't think we should ignore the fact that there is a lot of local knowledge here, which may be able to fill in the gaps that Fisheries files may have.

MR. O'REILLY: Thank you. I am pleased to hear that. Perhaps it is hearsay and I can't speak on their behalf, but I have heard Yellowknives Dene First Nation and Elders speak about a remarkable pickerel run on Baker Creek in the past. I did hear Ms. Stephenson admit that there has been habitat destruction, does the Company actually have any current authorization for habitat destruction?

MS. STEPHENSON: No, again a lot of the changes to Baker Creek have happened historically and the Mine doesn't currently hold any authorizations for habitat alteration or destruction.

MR. O'REILLY: On page 4 of the DFO submission, it mentions that the CCME guidelines for protection of freshwater aquatic life is 2 milligrams per litre for total ammonia. DFO's only recommending a maximum limit of 10 milligrams per litre in the new licence. What effect would 10 milligrams per litre have on the fish?

MS. STEPHENSON: That's a difficult question to answer because it depends on the form of ammonia, whether it is ionized or un-ionized, the temperature and the species of animal you are referring to as fish. So, there is no definitive answer that says this particular level will have this effect on this environment. The CCME guidelines are generalized.

MR. WRAY: Thank you. I would also, Mr. O'Reilly, point out, while I can't provide you with specific levels, I can guarantee you that there probably isn't a major municipality either in this territory or anywhere else in the country that could even achieve 2 milligrams. So, 2 milligrams may be something at some point in time we would all like to achieve, but I don't think it is achievable right now with available technology.

MR. O'REILLY: I guess I am trying to establish whether the enforcement of the *Fisheries Act* is driven by the best available technology or the protection of fish and their habitat.

MR. WRAY: Ms. Stephenson. That's a good question.

MR. O'REILLY: I am sorry, but I have to ask it.

MS. STEPHENSON: The question was whether enforcement of the *Fisheries Act* is based on available technology or protection of fish. Is that right?

MR. O'REILLY: Yes.

MS. STEPHENSON: To a certain extent, this is a weasel answer, but the particular section of the Fisheries Act which deals with deleterious substances is actually enforced by the Department of Environment, rather than Fisheries and Oceans. So, perhaps they have to answer that question. With regard to the Fisheries Act specifically, if the Department of Fisheries and Oceans' legislation — and it goes back to the issue of whether the Water

Licence conditions absolve the Licensee of meeting other legislation – is transgressed and fish are killed or fish habitat is destroyed, then the Department can and should prosecute. Does that answer your question?

MR. WRAY: That's a very political answer. Mr. O'Reilly.

MR. O'REILLY: That is the sort of response I expected and I admit that I am a weasel asking the question in the first place. I guess I am playing devil's advocate trying to determine whether the Mine and its current level of effluents are destroying fish and their habitat and whether the 10 milligrams per litre will perpetuate that and allow that to continue. I was wondering what the position of the Department of Fisheries and Oceans is with regard to enforcement of their *Act*. I am probably not going to get much further than the response I have gotten so far. Thanks.

MR. WRAY: Do you wish to attempt a response, Ms. Stephenson?

MS. STEPHENSON: I will just add a further comment that with regard to actually enforcing something like Section 36 of the Fisheries Act, which prohibits the deposit of deleterious substance, which is what the case would be for the ammonia question, evidence would have to stand up in court that this was a deleterious substance and it did impact on the fish in this habitat. So, those considerations have to be included in any decision to proceed with prosecution or in any assessment of whether or not there was a problem in terms of the Mine's activities impacting on fish.

MR. WRAY: Thank you. Any additional questions for Ms. Stephenson? If not, thank you very much for attempting to answer some fairly difficult questions. It is now 12:30, so we will adjourn for lunch and we will reconvene at 1:30. Thank you.

---LUNCH RECESS

MR. WRAY: If we could come to order, please. Good afternoon, ladies and gentlemen. The next intervener scheduled is Mr. Dave Talbot. Dave, please take a seat. I also have been given three notifications of verbal presentations. We do these in the order which they were filed with us. So, after Mr. Talbot, we have Mr. Sangris and Mr. Erasmus. Mr. Erasmus, representing the Dene Nation and Mr. Sangris representing the Yellowknives Dene Band. Because both filed at exactly the same time, I will leave it up to those two gentlemen which one goes first and second. After Mr. Erasmus and Mr. Sangris, Mr. Bob Turner representing the North Slave Metis Alliance. Mr. Talbot.

MR. TALBOT: Thank you, Mr. Chairman. Before I get into this, I would like to say that I listened to your comments yesterday about the Water Board not being responsible for the actual enforcement of the laws that DIAND look after. So, if those people reading into my submission would take that into

consideration, the last page asks the Water Board to take certain actions and it would naturally be Indian and Northern Affairs who would take those actions.

Thank you, Mr. Chairman, for having me here. I won't read through the whole thing in the interest of saving time. I would like to, if I could at this point, respond to a question you asked this morning on the first page of my submission. I did actually go to Fisheries here in Yellowknife. I went to their office and met with the Office Manager, Mr. Winston Fillatre, who is the Enforcement Officer with Fisheries. I went there specifically because I wanted to get an answer from Fisheries as to why they would protect Mosquito Creek and they wouldn't protect Baker Creek. That was the response I got from Fisheries at that time.

MR. WRAY: Thank you, Sir. It is important that we have that on the record. My question was primarily to find out who, within the Department of Fisheries, made that statement. Thank you.

MR. TALBOT: Mr. Chairman, in my submission, I mentioned photographs. I don't know if it is appropriate at this time to hand them to the Board.

MR. WRAY: If you wish to enter them as part of your intervention, you could give them to Ms. Losier and she could distribute them.

MR. TALBOT: I have taken the liberty of showing them to Royal Oak before I brought them to you. The only other item I would like to add to my submission is based on what I have heard in the last few days. I believe that security...There have been figures of $7 million, $9 million, $1 million offered to the Board. I believe that Royal Oak has said in their own estimation, they calculated it in the vicinity of $8 million, so I would suggest that, that would be a reasonable amount for a security.

As to whether or not security should be at that amount or whether it should be in place at all, I would like to refer to the Inland Water Regulations. Under Article 12.2(b): "The past performance by the Applicant licence or protective assignee in respect to any other licence, is to be used in fixing that amount..." -- as to what that security amount is going to be. I believe that given the history and the fact that the present Water Licence has not been completed; that the information required from Royal Oak has not been forthcoming, I believe in this case, that gives the Board the full authority to use the cost of cleaning up as a security.

I would also suggest that the Licence be limited to, at the very most, five years. I would think, however, it would be more reasonable to have it for just one year and then re-evaluate the situation then.

That is all I have to say, Mr. Chairman.

MR. WRAY: Thank you, Mr. Talbot, and we do have your written intervention. For the record, I am looking at, and Board Members have looked at, pictures presented by Mr. Talbot of various scenes of 45 gallon drums, some sealed, some lying on their sides, with some material spilling out onto the ground. Mr. Talbot, could you please indicate, for the record, where and when these pictures were taken?

MR. TALBOT: Those pictures were taken, Mr. Chairman, late last summer. You will recall that I asked Royal Oak yesterday as to what the quantity was of this arsenic stored above ground. I believe they said 700 barrels. During our discussions here in the late summer, some employees of Giant mentioned that they had observed this and that is when the pictures were taken.

MR. WRAY: Thank you, Sir. Do any Board Members have questions for Mr. Talbot. Does the Applicant have any questions for Mr. Talbot? I now open it up to members of the audience? Thank you very much, Mr. Talbot. I take it we can keep the pictures. Thank you.

We had scheduled Enviro Watch, but they have advised us that they are unable to make a personal presentation. However, we do have Enviro Watch's application on file and it will be entered into the record. I will now ask for either Mr. Erasmus or Mr. Sangris, whichever you prefer. You could do it jointly, it is up to you.

MR. ERASMUS: Thank you, Mr. Chairman. My name is Bill Erasmus, National Chief of the Dene Nation. With me is the Chief of the Yellowknives Band, Fred Sangris. Maybe we could do a joint submission. I will have Fred Sangris speak first and then I can speak after him. Then we would be open for questioning.

MR. WRAY: Go ahead, Sir.

MR. SANGRIS: Good afternoon, Board Members. My name is Fred Sangris, for the record. I am the Chief of the Yellowknives Dene First Nation in Ndilo. I have a copy of this. It was handed over already.

As the original people of this area, my tribe, we are very familiar with the Giant Mine and its history. Long before the Mine was built in 1938, our traditional camp was located where the present Giant Mine is now. Our people knew about the gold way before it was discovered. In fact, it was the Dene women from Dettah who showed the prospectors where to locate it. It was of no value to us. It didn't mean anything to us.

What was important was the water, fish, game, moose, beaver, muskrat. Those were important to us. We fished at the mouth of Baker Creek. In my language, we call it "ihdaa deh" which means Jackfish River. That is the traditional name of this area. Jackfish River was a favourite berry-picking area and firewood gathering site. There may be a lot of

important sites in that area.

Now we can't hunt there any more. We can't eat the fish from the lake and we can't drink the water. At times, we cannot even breath. All because of the arsenic.

There was an arsenic discharge in 1949 that resulted in the death of four children from one family in Ndilo. This is from my tribe. A 1967 Health and Welfare report stated that a herd of cattle and other livestock had died and that children had become sick as a result of drinking contaminated meltwater during the spring of 1949 and that "Indians" living on Latham Island became sick and died in April 1951. Public Health warnings were issued by Dr. Stanton for the two springs following the arsenic discharged. Free drinking water was provided to the people Ndilo because of the contamination of their water supply from arsenic from Giant Mine. In the mid-1970s, concerns were raised again about water quality. In 1974, officials posted warning signs around Back Bay and Yellowknife Bay, so residents would not drink the arsenic-contaminated water. This concern was extensively noted by the southern media.

Giant Mine's application to the Water Board states that they have a lease for Commissioner's land, which expires May 31, 2013. This is not correct. This is Yellowknives Dene land. It is only leased. This is part of our traditional and current land use area that we have selected for negotiations with the federal government. We are filing a claim against the Government of Canada for the loss of use of our land around this mine site.

Our Elders remember when the Mine was built. We were never consulted and we did not give our consent to have this mine built on our land. Because this is our home and we will always be here, we want to change the relationship of the past.

Although we cannot, at this time, support the renewal of Royal Oak's licence, we are recommending that their current licence be extended six months beyond its expiration date of April 30th until October 31st. We support the call of the Department of Resources, Wildlife and Economic Development for Royal Oak to develop an arsenic management plan within six months.

We are, therefore, proposing that by July 31st Royal Oak must have developed:

- a reclamation plan.
- a management plan working with the Yellowknives Dene First Nation and Elders using the traditional knowledge of this area. This management plan would require an environmental assessment and would address the following: storage and disposal of arsenic (both surface and subsurface); stability and clean up of tailings;

monitoring the quality of the water entering Great Slave Lake and Baker Creek.

Royal Oak would be required to pay a security deposit that would cover the cost of clean up, a minimum of $10 million.

Between August and November 1998, the Water Board would review the reclamation and management plan submitted by Royal Oak. A portion of that security deposit would also have to be deposited. By the end of October, the Water Board will review Royal Oak's application for renewal of its licence at Public Hearings. The renewal is conditional on its meeting the three above-noted conditions.

The Yellowknives Dene do not want a repeat of their past experience. They do not want the Mine to close and leave the arsenic where it can contaminate our water supply again. We are asking that the Water Board exercise its authority to safeguard our people, my people, and the people of Yellowknife and the Northwest Territories.

I would also like to remind you that even to this day, my people can't use the water. The fish are contaminated. My people are dying of cancer. In the last five years, cancer has risen very high. We live right across from Giant Mine and we can see the Giant stack. People still fish, still hunt the traditional food, still pick berries and still gather wood for firewood and cooking. Developers and explorations don't have any respect for my people's way of life or what is important to them. I want them both to understand that. Thank you.

MR. WRAY: Thank you, Mr. Sangris. Mr. Sangris has provided us with a written statement of his remarks and we will enter that onto the public record. Thank you. Mr. Erasmus.

MR. ERASMUS: Thank you, Mr. Chairman. My presentation will be oral, but I would like to put on paper my thoughts afterwards and I can have them to you for when you are rendering your decision.

As you know the Dene Nation is a territorial organization that represents people beyond the boundaries of Yellowknife. So, my report reflects concerns of other communities and wishes that have been brought to our concern over the years. We have spoken about Royal Oak, Giant Mines and other surrounding mines and developments at our meetings and in our deliberations over the years. I can provide you with some of that information to show that the interest is there and the concern that this is a real issue. As you are aware, it isn't only an issue to the Dene. I believe this is a people's issue. It affects all citizens in the North and other people in Canada.

We realize that this mine has quite a reputation across the country because they are using methods unlike other mines in extracting and getting the end result. We understand that there are approximately 25 kilograms of arsenic going into the environment daily; 50 to 60 tons of sulphur dioxide, which affects all of us. We are especially concerned that underground there is something like 280,000 tons of arsenic being stored. We are very concerned that the storage facilities may not be able to hold the arsenic and that it may get into our drinking water which will affect not only the animals and the environment, but the people in and around the lake throughout the whole Mackenzie Valley. I think 280,000 tons is probably enough to effect the whole planet. We are very concerned about that.

We fully support the Yellowknives Band not to issue a new licence. We feel that the Board has the authority to look at the existing licence, see if the Mine has met the requirements from the last licence. Upon our study, it is clear that the Mine did not come up with an action plan on reclamation and a management plan that they were supposed to have under the last licence. Initially, we were going to suggest that they have a short-term licence of two to three years on condition, but because we find that they have been negligent in our view, we feel that you ought to extend their present licence to a maximum of six months, which means being in operation for another nine months. Within six months, have the management plan put before us, which then gets public scrutiny. Because of the special situation that they are in the Yellowknives traditional territory, that they work with the Yellowknives so that they can include their traditional knowledge and practical outlook towards future management. When Public Hearings begin, the public should be supported financially to look at the findings and then comment, and decide on what action to take from there.

Along with that, we feel that the $400,000 security bond is very inadequate and that, at the very least, $10 million should be set aside, which reflects more of a cost estimate that people are coming up with. As you know, no one knows what the cost is going to be. From the last few days, we hear that for underground pumping cold water to freeze the permafrost at the very least would cost $7 million. That isn't talking about the surface. So, we feel $10 million would be accurate and provide some stability and security to people in and around Yellowknife.

We also want to remind you of the most recent Supreme Court decision in British Columbia which has affect in the North and across Canada. It is the Delgamuukw case between the Crown and the Nisga'a Indians of Northern British Columbia. The decision is very far reaching. It establishes that people do indeed have aboriginal title in that area; that the provincial laws are limiting and cannot extinguish the rights of those peoples; that even though licenses and applications may have come before the government and have been issued to developers, the initial people from that area still have an interest in the development and have

to be brought into the equation. I think that is what the Yellowknives are asking here.

Also the question of compensation is brought up in that court case which is a question that the Dene also have. The point I am trying to make about the court case is I believe you ought to get your legal people look at the case to see how it might apply in this instance. I do believe the territorial government and federal government are reviewing the decision and seeing how their policies, approaches and attitudes towards First Nations is going to be impacted by that major case. Our office can also make available to you analyzes and opinions that we are able to get in the next little while.

Very quickly, Mr. Chairman, those are the comments I wanted to add. I was born in Yellowknife. I live in Ndilo right across from Giant Mines. I have lived here most of my life. Arsenic is a fact of life. We would like to see improvements. We would like to congratulate the Water Board in being open and making available the opportunity for people like us to come forward and bring our views so that you can hear all of the interest that you have before you. With that, thank you very much, Mr. Chairman.

MR. WRAY: Thank you, Mr. Erasmus. Do any of the Board Members have questions for Mr. Erasmus and Mr. Sangris? Dr. Gilchrist.

DR. GILCHRIST: Chief Sangris, could you tell us whether there have been any discussions with Giant Mine about their relationship with their band?

MR. SANGRIS: We don't have a relationship. There is no communication. The only time they wanted to talk to us was when there was the Giant Mine strike and they wanted emergency workers. They decided to hire our people. Before that and even now, a lot of our people don't work in the Mine there. None of my people are employed there, not one. If there is another emergency like that, they will come to us and start hiring our people. There is no relationship now. That is something we have to work on.

MR. WRAY: Does the Applicant have any questions for either Chief Sangris or Chief Erasmus?

MR. CONNELL: I don't have any questions, but I would ask if I could take a copy of the written submission from Chief Sangris with me today to get to our management personnel. I think that is important that, that, be communicated promptly to them.

MR. WRAY: Yes, we will try to arrange for you to get a copy. Unfortunately, we don't have a photocopier here, but perhaps the hotel will let us make a copy. Any questions from the audience for either gentlemen? No? If not, thank you very much for your presentation.

MR. SANGRIS: I would just like to make a comment.

MR. WRAY: Go ahead.

MR. SANGRIS: There was a discussion on the Back Bay fish study last year. I would like to remind the Board that initially when the Back Bay study was underway, it was a joint effort between the Yellowknives Dene First Nation, Department of Health and DIAND. I wanted the Board to know that. When the study was underway, we were left out of that process. In the beginning, we were together but we were eventually left behind. There was no communication from Health or DIAND. That study was done solely on their own, was taken away from us and the reports were done by themselves. We were not part of that report. I want to remind you of that.

MR. WRAY: I take it with that comment that you do not support the conclusions of the study?

MR. SANGRIS: No.

MR. WRAY: Thank you, Sir. Dr. Gilchrist, you had a question?

DR. GILCHRIST: To follow upon my question to Chief Sangris, I would direct a similar question to Giant Mine. Have you, at some point, looked at the relationship with the Dene people? Has this been a subject of discussion?

MR. CONNELL: Mr. Chairman, I am not in a position to be able to answer that. Unfortunately, I don't have a specific response so anything I would say would be incorrect. I know of no relationship or no work that has gone on.

MR. WRAY: Thank you, Mr. Connell. Chief Sangris.

MR. SANGRIS: In the history of the Yellowknives that was done this past summer, our traditional knowledge study, is in the back. Maybe you want to grab one. That will give you an idea of traditional knowledge studies. We would also like to keep the doors open for Giant Mine to start talking with us. That might be the start of our working relationship.

MR. ERASMUS: Thank you, Mr. Chairman. I have a final comment. I want to make it clear that we aren't here advocating that the Mine shut down. I don't want anyone to interpret our comments today to be unfair to the Mine. I think we are trying to follow a practical approach that asks the Mine to assume the environmental responsibility that goes with this kind of major development. You as the regulating Board are the proper authorities to bring the question to. If people understand that, that is the light within our argument, then we would be pleased to present it in that way. Thank you.

MR. WRAY: Thank you. I do have one question. It may not be that you are able to answer it. In Chief Sangris' presentation, you lay out certain time lines. For example, extend the Licence for six months and then the Water Board would look again at the reclamation plan, et cetera. As you are very well aware, one of the difficulties that we face is we are quite unsure at this point in time what authority is going to be around in six months to look at this. As you know, the *Mackenzie Valley Regional Management Act* is presently in second reading and is expected to go for third reading fairly soon. If that is proclaimed at some point in time within the next three to four months, it effectively will bring to an end this Board and replace it with something else. The problem is none of us are quite sure yet what will replace or what the transition would be between the two boards or how any reports that we may commission will be treated by another board. Do you have any comment on that process? How do you see that process suiting your purposes?

MR. ERASMUS: Thank you. Very good point. My suggestion is that there is no guarantee that the legislation, as is, is going to get passed. Secondly, if the legislation is passed, however the Board is slow in getting moving, which is likely because of the past history, I would suggest that you look at ways Canada can use its discretionary authority. The Minister of Indian Affairs, for example, using the discretionary authority to put into effect the recommendations or the decision that this Board makes. Canada has to take the lead, if not the DIAND department, the Fisheries and Oceans or whoever is responsible. One of the departments has to take the lead. So, I would suggest that you include those thoughts in your final decision-making. Thank you.

MR. WRAY: Thank you, Sir. I take it that is it. Thank you very much gentleman. We now have Mr. Bob Turner, representing the North Slave Metis Alliance. Mr. Turner.

MR. TURNER: Thank you, Mr. Chairman. My name is Bob Turner. I am with the North Slave Metis Alliance. We are the other aboriginal group who have traditionally used and occupied land in this region, as the Yellowknives. We just haven't been treated on the same equitable basis.

I think we all know that the Mine is polluting our environment. We have experts saying discharged water is below allowable limits. What our people need is assurance that we can understand. At these points of discharge, where they say the allowable limits are drinkable, I think we would agree with it if we were to see these experts drinking that water. If not, the recommendation we would like to make is for the safety of the public because we hear, unofficially, you sure wouldn't want to drink that water. The recommendation would be to put signs up in those areas warning people that the water that they drink, if they are unaware of the mine site and they are a tourist who came in and paddled around the corner, if they become thirsty and drink the water, it may have harmful effects.

The other recommendation would be with regard to the security deposit. We don't want to see the governments, neither the federal nor territorial, becoming responsible for reclaiming the area. There are many examples of that process happening now where mines have abandoned the sites and left the country. A good example is Discovery Mine. The federal government is bearing the burden of the costs.

So, we recommend that the security deposit reflect the actual costs of reclamation. According to technical information from other government departments that we have to trust, we think it should be $9 million plus.

Our definition of "restoration" would be when we see these experts out on that site drinking the water from the creeks or eating the fish from the rivers. Thank you.

MR. WRAY: Thank you, Sir. Questions from Board Members for Mr. Turner? Mr. Connell, do you have questions for Mr. Turner? Any questions from the general audience? If not, thank you very much, Mr. Turner. I have just now been given another slip of paper. I would invite Mr. Kevin O'Reilly to make his presentation.

MR. O'REILLY: Thank you. I was out in the hall. First of all, I am here as a private citizen and I really hadn't intended to even make a presentation but I did want to offer a few observations. I have sat here over the course of the hearings and I wanted to offer a few observations/recommendations.

I am really concerned about the underground arsenic and the lack of progress on this issue. I know that it is a historic problem. Royal Oak may be relieved to hear me say that. I am not even sure if they should bear the full responsibility for that. It is an ongoing issue because every day that we wait, another 10 to 13 tons of arsenic trioxide dust is blown underground. We can't wait any longer. We have to find a way to deal with this issue.

I can sense some goodwill here, but I am really concerned about this and I want to see something done about it as soon as possible. I appreciate the work that DIAND has done on the issue. I think it was very helpful that they had a number of their experts here today. I appreciate the work that they have commissioned on this. I do disagree, however, with the approach that they took on the screening of the application. I don't think it was appropriate that it be handed over to the Water Board without a firm proposal coming forward from the Company. Without a firm proposal, how do you know what you are actually screening. I could hear Mr. Livingstone admit that the underground arsenic is part of the application and, therefore, part of this project. I am concerned that they handed it over to the Water Board probably too early.

I also disagree with DIAND's approach on security. I think that we

should be looking at setting aside some security now for the underground arsenic if we are talking about a five-year term for the Licence. I don't think the position that they put forward is completely consistent with their own evolving policy on mine site reclamation.

I am also a bit surprised and actually astounded that DIAND didn't submit the Dillon report and Mr. Brodie's report on reclamation to the Water Board much earlier than yesterday or perhaps even today when we found it at the back of the hall. I note that they are dated September and November. I think they are very significant documents because for the very first time, at least that I am aware of, we actually have some very rough cost figures for what it is going to cost to deal with the arsenic trioxide underground. I just wish in the future that this sort of documentation can be brought forward earlier and aid us in discussions of licenses and so on. If you are here in a few months, I would still like to make that recommendation that DIAND do this much more quickly.

I am concerned about GNWT's position on the security; only $1 million. It doesn't really give me much comfort knowing in the surface lease the clean up is at the complete discretion of the Deputy Minister of MACA. If we know that the full reclamation costs for this at the surface may be $7 million or $9 million and they are only recommending $1 million now, where is that going to leave us further down the road when we start to deal with the issue of the underground arsenic trioxide. It clearly points to the need that the GNWT has to have a policy in place to limit public liability for its lands. We don't have that yet.

Another observation on the Department of Fisheries and Oceans, I pushed the point of what really drives that organization, whether it is protection of fish and their habitat or best available technology. In my own mind, it is fairly clear what is driving it. I am concerned that we have to find ways to lower than ammonia levels in the discharge. If the workers are given better training and there is some monitoring of how the explosive is handled underground, there is probably some ways to reduce the ammonia. I don't think anyone has really touched on the issue of the sewage going into the tailings. There is probably ways to significantly reduce the amount of ammonia by diverting the sewage and properly treating it.

On the term of the Licence, I think this clearly has to be tied to the issue of the arsenic trioxide management plan. I think five years is far too long. We can't wait that long. I think the term of this licence has to be tied to that issue and I am suggesting a licence of no more than two years. I would suggest that the security be set, at least initially in this two-year licence, for $7 million as DIAND suggested. I think what should be immediately increased to $4 million and on the first anniversary another $3 million added.

The term of the Licence should also be tied in to the submission of a

proposal from Royal Oak that receive the thumbs-up from some of the regulatory bodies. Once that proposal has been submitted, that should trigger a new Water Board hearing. So, the term of the Licence may be less than two years, but it rests really on Royal Oak's shoulders. If they don't get it within a two-year period, then we have to find a bigger hammer.

I think there needs to be specific provisions in the Licence so that DIAND has the ability to tap a security if the necessary research and studies are not conducted. I think there are provisions in the Water Act to do that now.

In closing, I am calling for a licence of a much shorter duration than five years and that it really be tied to the production of an adequate arsenic trioxide management plan. Thanks.

MR. WRAY: Just one question, Kevin. The arsenic trioxide underground plan, would you see that as part and parcel of a much larger Abandonment and Restoration Plan or as a separate component?

MR. O'REILLY: I know that, if memory serves me correctly, the Abandonment and Restoration Plan dates from 1993-94. It is in dire need of being revised as well. We have to deal with this issue of the arsenic trioxide now. Every day we wait another 10 to 13 tons is going underground. We can't wait any longer. I do think that is a component of the abandonment and restoration issue, but I don't want to have to wait any longer. I want something done about this now. I have been harping on this issue, as you can appreciate, almost as long as I have been in Yellowknife; 12 years. We have to find a way to deal with this.

So, I don't think they should be tied together. They are related but I don't want them tied together for the purpose of determining an appropriate term of the Licence. We have to get on with it.

MR. WRAY: Thank you. Any questions for Mr. O'Reilly from the Board? Mr. Connell, any questions from the Applicant? Questions from the audience? Thank you very much, Kevin.

Normally at this point in time, we would now ask the proponent for their summation remarks. However, prior to doing that, there are some issues that the Board must deal with. I have a question of the Applicant and then I propose to adjourn the hearing for one hour, at which point in time we will reconvene and the proponent can make their summation remarks and then I will make mine.

Prior to that, Mr. Connell, we have heard a lot during the last two days regarding "progressive reclamation." Have Royal Oak done any thinking or planning on a progressive reclamation plan for the mine site?

MR. CONNELL: We have put together our own internal progressive reclamation plans, but as you can well imagine the funding for those varies depending on our current fiscal ability to put those into place. So, we are actually doing progressive reclamation, it just isn't to the degree that most people would like to see. We have also been tardy or delayed in doing reclamation on some of the tailings impoundment areas because they still play an active role in our future plans for those tailings areas. For example, we do have plans, as we have stated, to go back and utilize the north pond. So, it would be inadvisable for us to try to reclaim that pond while it is still in our plans to neutralize it.

MR. WRAY: Thank you, Sir. We will reconvene at 3:30.

--SHORT RECESS

MR. WRAY: Thank you. We will now call the Hearing back to order. I apologize for being slightly longer than we had said. These are complicated matters. The next phase of the hearing is to hear a summation from the Applicant, Royal Oak Mines. Mr. Connell, you will be making that, I understand.

MR. CONNELL: Yes, Sir. Thank you, Mr. Chairman, Members of the Board, Ladies and Gentlemen. Thank you for your interest in the future of the Giant Mine as demonstrated by your attendance over the past two days at this licence renewal hearing.

Having heard all the interventions and the participation from the audience, I would like to take this opportunity to sum up on behalf of the Applicant, Royal Oak Mines Inc.

I know you are all well aware of the tough situation that the gold ming industry is currently facing. We do not know how long this cycle will last, but Royal Oak is intent on surviving through this period. I think 1998 will be a tough year economically and we would ask the Board and the other regulatory agencies to give this due consideration during their deliberations on the renewal of the Water Licence for the Giant Mine.

Specifically, I would like to review the key issues of concern to our company as you go away to deliberate on the renewal of the water use licence for the Giant Mine.

Length Of Licence Term

The first item is the length of the licence term. Royal Oak entered the Licence renewal process requesting a 10-year licence term. We requested this long period to demonstrate our acknowledgment of the fact that our responsibility to the Giant Mine site does not end with the exhaustion of the known ore reserve. While Giant currently has something in the order of five years of mineable reserves, it should be pointed out that the Giant Mine has operated for 50 years with a reserve

base not much larger than it currently has.

Most intervenors have proposed a five-year licence term. This recommendation comes from what we perceive to be a genuine public concern for involvement in how the Mine prepares for the end of its operating life. We acknowledge that concern and accept any recommendation for a five-year licence term.

Water Use

Royal Oak has recently commissioned a minewater treatment circuit that, if fully successful, will enable the Giant Mine to make some significant reductions in the amount of fresh water consumed in the mill in 1998. While the plant is new and has yet not proven, Royal Oak is fairly confident that a proposed limit of 1.5 million cubic meters of fresh water plus groundwater can be achieved.

Royal Oak recognizes that there is economic benefit in achieving further reductions in the amount of freshwater consumed at the Giant Mine. Further reductions will extend the projected operating life of the current Tailings Containment Area and defer the cost of constructing new dams.

However, at the present time the Company cannot definitively tell the Board how or whether further reductions beyond the 1.5 million cubic metres can be achieved until it expends resources to explore the technical and economic feasibility of implementing new recycle schemes. We would need time to explore these possibilities.

It would be helpful if during its deliberations, the Board could prioritize the items that the Company will be required to accomplish over the licence term and where possible spread the requirements out over the full licence term.

Security Bonding

Royal Oak acknowledges the public concern over the amount of security bonding currently required under the existing licence. It should be remembered that this level of bonding was increased by 100 per cent over the past licence term.

We have heard the concern expressed by the intervenors that the Board does not have adequate security to cover the full cost of reclamation. However, at the current price of gold it will be difficult, if not impossible, for Royal Oak to fund a large increase in the security deposit in 1998. Royal Oak will need to spend significant resources in 1998 and 1999 to carry out the studies, investigations, pilot plant testing and engineering required to complete and implement the proposed arsenic management plans.

Royal Oak is very concerned with the schedule proposed by DIAND for increasing the amount of bonding required in a new licence. This is the

basis under which the Company has asked the Board to retain the bonding requirement at $400,000 at the beginning of the new licence term. The Company has recommended that any schedule for increased bonding requirements be reviewed and negotiated after the Company has completed its revision of the Abandonment and Restoration Plan in November of 1998.

Royal Oak is not prepared to comment on the abandonment and restoration cost estimates as calculated and presented by Mr. Brodie. These first order reclamation cost estimates appear reasonable but the Company reserves further comment until outstanding studies are completed in 1998.

Effluent Limits

DIAND, Environment Canada and DFO have recommended that the new licence include a reduction in the allowance discharge limit for total ammonia to 10 ppm.

Environment Canada have advised the participants in this hearing that the Metal Mining Liquid Effluent Regulations should be amended in the near future to extend coverage to gold mines. It should be noted that the AQUAMIN process for recommending amendment of the Metal Mining Liquid Effluent Regulations recommends including total ammonia as a parameter to be monitored by not yet regulated. This recommendation was reached on the basis that the mining industry across Canada is having difficulty in treating and removing ammonia from mine wastewater.

While it may be desirable to work towards target effluent limits of 10 ppm for total ammonia, no one knows whether or how these reductions can be achieved.

As indicated by Environment Canada, ammonia in the un-ionized state is significantly more toxic than ammonia in its ionized form. Whether total ammonia is present in waste water as un-ionized or ionized is most often a function of the pH of the water. At a neutral pH of 7.0, ammonia is more likely to be present in the less toxic ionized form. At higher pH's ammonia is more likely to be present in the un-ionized form.

The effective treatment of gold mill effluents requires that the final pH of the waste water be raised by the addition of lime to precipitate the contained heavy metals such as copper and nickel. Consequently, we have a catch-22 situation where if we direct our efforts to lowering heavy metals in the waste water, we reduce the ability to reduce un-ionized ammonia levels. Vice versa, if we lower the pH to treat ammonia, we can expect to see increased heavy metal levels.

Based on the experience at small tonnage underground mines across Canada, we would ask the Board to be cautious in lowering ammonia

effluent limits without some clear indication that the new limits can be technically achieved.

The Board should also take into consideration that any significant reduction in the amount of fresh water used in the plant will reduce the amount of dilution that presently takes place in the tailings impoundment and may increase the concentrations of total ammonia observed. For example, if fresh water consumption is reduced by 20 per cent, then the ratio of minewater to process water discharged to the tailings impoundment will shift. The Mine will, which contains most of the ammonia, will represent a higher proportion of the water discharged into the tailings impoundment.

We believe that some reduction in total ammonia towards 15 ppm can be sustained, but we do not believe that we can consistently achieve effluent levels below 15 ppm.

Royal Oak requests that the Board maintain all other discharge limits at their current level. The limits for these parameters are consistent with Canada's Metal Mining Liquor Effluent Regulations, both currently in existence and as proposed under the AQUAMIN process.

Royal Oak does agree that the inclusion of aquatic toxicity testing for the Mine's effluent is appropriate. Given our limited data base on aquatic toxicity at this mine, it is recommended that this be a monitoring requirement only at this point in time and not a regulatory limit. This is consistent with the pattern established under the new MISA regulations in Ontario as mentioned by Environment Canada in their submission yesterday.

Arsenic Management Plan

Royal Oak will continue to manage the arsenic trioxide storage vaults to keep the material secure while a long-term management option is developed. We have heard the frustration expressed by regulatory agencies and the general public over the time it has taken to come to a conclusion over how this material should be dealt with in the long term.

This is a complex problem and, as you have heard during these hearings, it is not an issue where an off-the-shelf solution can be applied. Royal Oak has made significant advances over the current licence term in coming to grips with this challenge. The Company has made a significant change in its focus of how this challenge should be addressed; specifically, I am referring to the decision to focus its energy on removing and upgrading this product rather than developing techniques to secure it within a flooded mine. The Company has also made a concerned effort to put all information relating to the storage vaults and how they are being managed in the hands of the regulatory agencies and other public interest groups as the evidenced through its involvement in the October workshops. We hope this type of forum can

continue as the solution to this challenge evolve.

Royal Oak does not believe that a credible Arsenic Management Plan can be completed within the first year of the licence term. It will take a minimum of two years to complete all the work involved in the development of the technology that will be required to recover, process and market an upgrade arsenic trioxide product. Mining techniques need to be developed and the field-tested. An upgrading process needs to be developed and piloted-tested. Sufficient product needs to be produced to test and develop a stable market outlet. Techniques have to be developed for stabilizing the dusts that cannot be safely or effectively removed from the underground storage vaults. Techniques have to be developed for recovering gold from the upgrading process sludges and for stabilizing these sludges for disposal.

We also have to assume that not everything will go as planned and so we have to allow some contingency time to investigate alternative management plans.

It is Royal Oak's belief that a detailed proposal adequate for environmental screening, cannot be completed within one year of the licence renewal date. Royal Oak reiterates its position that May 1, 2000 is the earliest realistically achievable date.

Abandonment and Restoration Plan
Royal Oak has committed to update its 1994 Abandonment and Restoration Plan by November of this year, which is six months after the licence renewal date. It is our opinion that this is the minimum amount of time that will be required to provide the level of detail that is required to meet the Board's requirements in a meaningful manner.

Continency Plan
Royal Oak agrees that the Giant Mine Contingency Plan should be updated on an annual basis. We suggest that the date for this submission be made to coincide with the Licence's annual reporting date. Royal Oak commits to update the current contingency plan by April 30, 1998, as part of its commitment to take management action to achieve reductions in the numbers of spill events.

Tailings Management Plan
Royal Oak believes it appropriate to formalize the Tailings Management Plan for the Giant Mine. The Company has presented its plan in conceptual form during its submission. The success of the new minewater treatment plant will have a large influence on the viability of this conceptual plan. Royal Oak would ask the Board for one year to complete this requirement.

Hazardous Waste Management Plan
Royal Oak believes it appropriate to develop a Hazardous Waste Management Plan for the Giant Mine. This plan should inventory hazardous waste such as batteries, chemicals, waste, waste hydrocarbons, asbestos building materials, contaminated maintenance materials from the arsenic trioxide recovery facilities, et cetera, and develop procedures for the ongoing acceptable disposal of these materials. We would ask the Board for one year to complete this requirement.

Mr. Chairman, that completes my summation. I do have it in written form and will definitely pass it to you, so that it is fully in its integrity. Thank you for the opportunity.

MR. WRAY: Thank you, Mr. Connell. At this point in time, I would like to thank all of the participants, in particular the Department of Indian Affairs and Northern Development. I have to say this is probably the best and clearest intervention that we have seen in front of this Board for some time. I would thank all the individuals involved for the manner in which they conducted themselves and for the information that was provided to this Board.

With respect to the Applicant, I would like to thank you for your cooperation. You have certainly not attempted to duck any of the major issues.

Normally at this point in time, I would go over what is about to happen and then we would close these Hearings. That would be the end of the formal part of this process. However, there are a number of outstanding issues that are of major concern to the Board. Therefore, I would direct the Applicant, Royal Oak, to provide to this Board, no later than March 15th, a progress report on the surface contamination study that was in part G, item 11, of the existing licence. I realize in your presentation that you had stated that you would be submitting an additional report by the end of March 1998. I am merely bring that forward by two weeks, so we ask that, that be done by March 15th.

There are other issues, including one of process from this point on. So, in order for the Board to maintain all of its options, this Hearing will not close. Therefore, this Public Hearing is hereby adjourned to March 26, 1998 pursuant to Section 21(4) of the *Northwest Territories Waters Act*. The Board will provide notice of the time and location of the Hearing to the Applicant, Intervenors and any interested parties who provide the Board with a request and an address to which notice may be sent.

This is not to say that this entire process will start all over again. We have closed a certain part of the Hearing, but there are still issues and Board decisions that we may wish to communicate to the public which we feel should be done in a public forum and not within the confines of

our office, as is normally done. Thank you very much for your cooperation. This Hearing is now adjourned. Thank you.

---ADJOURNMENT

LIST OF ATTENDEES

Aldous, Judy	CBC Yellowknife, NT
Allan, Richard	Royal Oak Mines Inc. Yellowknife, NT
Alexie, Robert A.	Gwich'in Land & Water Board Inuvik, NT
Ashbury, Doug	Northern News Services Yellowknife, NT
Barnaby, George	Sahtu Land & Water Board Fort Good Hope, NT
Bengts, Peter	Worker's Compensation Board Yellowknife, NT
Bernard, Monica	Royal Oak Mines Inc. Yellowknife, NT
Bohnet, Sevn	DIAND - Water Resources Division Yellowknife, NT
Breadmore, Ron	DIAND Yellowknife, NT
Brodie, John	DIAND West Vancouver, BC
Broome, Craig	DIAND - South Mackenzie District Yellowknife, NT
Bursey, Glenn	DIAND Dartmouth, NS
Carr, Doug	Yellowknife Health & Social Services Yellowknife, NT
Chouinard, Dr. Sylvain	Stanton Regional Hospital Yellowknife, NT
Chu, Eli	DIAND Yellowknife, NT

Clark, Dave	Dillon Consulting Ltd. Yellowknife, NT
Collins, Brian	DIAND - Water Resources Division Yellowknife, NT
Connell, Larry	Royal Oak Mines Inc. Kirkland, WA
Cook, Greg	DIAND - Water Resources Division Yellowknife, NT
Cottrell, Tom	Mackenzie River Board Edmonton, AB
Craig, Gary	City of Yellowknife Yellowknife, NT
Cullen, W. R.	UBC Chemistry Department Vancouver, BC
Davey, Eric	Dene Nation Yellowknife, NT
Degenhard, Robert	Member of the Public Yellowknife, NT
Dennill, Caroline	DIAND - Communications Yellowknife, NT
Denroche, Alan	Counsel, NWT Water Board Denroche Brydon Yellowknife, NT
Dillon, Eddie	Member, NWT Water Board Tuktoyaktuk, NT
Drygeese, Lena	Tindee Interpreting Yellowknife, NT
Dyer, Lisa	GNWT - RWED Yellowknife, NT
Ebke, L.	Member of the Public Yellowknife, NT
Edgi, Vivian	Sahtu Land & Water Board Fort Good Hope, NT

Emery, D.J.	Member, NWT Water Board Ottawa, ON
English, Colleen	DIAND - Water Resources Division Yellowknife, NT
Erasmus, Chief Bill	Dene Nation Yellowknife, NT
Ferguson, Brian	Gwich'in Land & Water Board Inuvik, NT
Gale, John	Fracflow Consultants Inc. St. John's, NF
Gibson, Dr. John	DIAND - Water Resources Division Saskatoon, SK
Gilchrist, Dr. Ian	Member, NWT Water Board Yellowknife, NT
Govier, George	Sahtu Land & Water Board Fort Good Hope, NT
Grunwald, Alena	DIAND - Water Resources Division Yellowknife, NT
Hamilton, Frank	GNWT - Health & Social Services Yellowknife, NT
Harbicht, Stephen	Environment Canada Yellowknife, NT
Hardisty, Robert	Member, NWT Water Board Fort Simpson, NT
Jackson, Francis	DIAND - Water Resources Division Yellowknife, NT
Jessiman, David	DIAND - Water Resources Division Yellowknife, NT
Johnston, Laura	Member, NWT Water Board Yellowknife, NT
Jones, Dave	Gwich'in Land & Water Board Inuvik, NT

Leevis, Gord	Environment Canada Regina, SK
Lennie, Gordon	Mackenzie Valley Environmental Impact Review Working Group Yellowknife, NT
Livingstone, David	DIAND Yellowknife, NT
Losier, Vicki	NWT Water Board Yellowknife, NT
McCaul, Jim	DIAND Yellowknife, NT
McKee, Gillian	RWED, Government of the NWT Yellowknife, NT
McLeod, Melody	Member, NWT Water Board Yellowknife, NT
McNeely, Patricia	Sahtu Land & Water Board Fort Good Hope, NT
Milburn, David	Northwest Territories Water Board Yellowknife, NT
Morton, Kent	Royal Oak Mines Inc. Yellowknife, NT
Murphy, Brent	EBA Engineering Yellowknife, NT
Muyres, Rick	Sahtu Land & Water Board Norman Wells, NT
Myles, Debra	DIAND Yellowknife, NT
Netherwood, Marshall	Mackenzie Valley Environmental Impact Review Working Group Yellowknife, NT
Nutter, Dave	DIAND Yellowknife, NT

O'Brien, Chris	Ecology North Yellowknife, NT
O'Reilly, Kevin	Member of the Public Yellowknife, NT
O'Shaughnessy, Mike	CBC North Yellowknife, NT
Pagotto, Shannon	DIAND - Water Resources Division Yellowknife, NT
Paquin, Emery	RWED - Government of the NWT Yellowknife, NT
Puznicki, Wayne	DIAND Yellowknife, NT
Regel, Alan	DIAND, Counsel Yellowknife, NT
Robertson, Kelly	RWED - Government of the NWT Yellowknife, NT
Sanderson, Peggy	DIAND - Water Resources Division Yellowknife, NT
Sangris, Chief Fred	Yellowknives Dene Yellowknife, NT
Schultz, Stephen	Royal Oak Mines Inc. Yellowknife, NT
Semple, Dwayne	Gwich'in Land & Water Board Inuvik, NT
Spaulding, Andrew	Ecology North Yellowknife, NT
Stard, John	Royal Oak Mines Inc. Yellowknife, NT
Stephenson, Tasha	Fisheries and Oceans Canada Yellowknife, NT
Stevens, Jim	Sahtu Land & Water Board Fort Good Hope, NT

Strong, Gary	DIAND Yellowknife, NT
Sundberg, Mary Rose	Tindee Interpreting Yellowknife, NT
Stewart, Gordon	Mackenzie Valley Environmental Impact Review Working Group Yellowknife, NT
Talbot, Dave	Member of the Public Yellowknife, NT
Telgen, John	Pido Production Ltd. Yellowknife, NT
Thompson, Neill	DIAND - Water Resources Division Yellowknife, NT
Turner, Bob	North Slave Metis Alliance Yellowknife, NT
Unrau, Darren	DIAND - SMD Yellowknife, NT
Wallace, Larry	Sahtu Land & Water Board Fort Good Hope, NT
Williams, Buddy	GNWT - MACA - Lands Program Yellowknife, NT
Witteman, John	Member of the Public Yellowknife, NT
Wilson, Anne	Environment Canada Yellowknife, NT
Wong, Sylvester	Worker's Compensation Board Yellowknife, NT
Wray, Gordon	Chairman, NWT Water Board Yellowknife, NT