

2001 AQUATIC EFFECTS MONITORING PROGRAM (AEMP)
Workshop Summary - February 4, 2002

The 2001 Annual Environmental Workshop dedicated to the Aquatic Effects Monitoring Program (AEMP) was held in Yellowknife on February 4, 2002. As was provided last year, a summary of the key proposals, comments, and decisions that had been reached are presented herein. This document is not a comprehensive record of all comments and discussions held during the Workshop but is intended to be a record of key comments, suggestions, and responses. Also summarized are the refinements which will be incorporated into the 2002 program.

This document is divided into four sections:

- Section 1 - Describes key refinements, decisions, and comments for the Core Aquatic Effects Monitoring Program.
- Section 2 - Describes baseline data collection as well as proposed aquatic effects monitoring programs for the new developments.
- Section 3 - Describes the proposed process for the re-evaluation of the AEMP scheduled for 2002, commencing with a planning meeting scheduled May 3.
- Section 4 - Describes key proposals, decisions, and comments regarding the Panda Diversion Channel Monitoring Program.

1. Core Aquatic Effects Monitoring Program

There are several changes proposed by BHP Billiton for the Core AEMP:

- *BHP Billiton Proposed Change: Integration of Kodiak Lake and Kodiak Little stream into the Core AEMP program and suspension of Kodiak Lake Specific Effects Monitoring Program.*

Rationale: The Kodiak Lake Sewage Effects Monitoring Study was developed as a Specific Effects Monitoring (SEM) program to monitor for changes resulting from the addition of treated sewage to Kodiak Lake. During the course of the study, realized effects resulted in the relocation of treated sewage effluent from Kodiak Lake to the Long Lake Containment Facility. Realized effects were an increase in nutrient levels, biota abundance, and winter declines in dissolved oxygen. 1999 marked the conclusion of the three-year SEM. A continuation of the SEM Program was implemented during 2000 and 2001 to monitor the residual effects resulting from the deposition of treated sewage effluent to Kodiak Lake. The SEM was limited in scope and focused primarily on those parameters needed to monitor the reversibility of the residual effects. Overall, the results of the 2001 program indicated that Kodiak Lake has mostly recovered from the residual effects of the introduction of treated sewage effluent (and other nutrients in 1997). The results indicated that most parameters that have been monitored reflect baseline conditions. It is expected that utilization of AEMP methodologies will

be adequate to track the few residual effects that remain. Little Lake has recovered from the effects of slight eutrophication. Aeration of Little Lake has been suspended for 2002.

Concern: *Nitrate levels are elevated in Kodiak and Little Lakes. During 2002, nitrate levels in Little Lake were higher than in Kodiak Lake. It would be useful to identify the source.*

BHP Billiton Response: BHP Billiton concurs sampling of runoff to Little Lake from source areas might be useful. For example runoff from the airstrip was identified as a possible source of nitrogen compounds to Little Lake. Consideration will be given to performing such run-off sampling.

Concern: *There was a request that pie charts of phytoplankton and zooplankton be presented as in previous Kodiak Lake reports.*

BHP Billiton Response: Future reporting for phytoplankton and zooplankton would be in the format of the current AEMP report which includes pie charts for the current year of sampling.

Decision: *Starting in 2002, Kodiak Lake and outflow stream will be integrated for the long term into the Core AEMP. Monitoring and sampling methodologies and schedules will be identical to other AEMP lakes and streams. Monitoring of Little Lake is suspended indefinitely.*

- BHP Billiton Proposed Change: *Phytoplankton and zooplankton biomass and taxonomy sampling/analyses to be reduced from three monitoring rounds (July, August, and September) to one monitoring round (August).*

Rationale: Since 1998, seasonal phytoplankton and zooplankton biomass and taxonomy sampling/analyses have been performed. For analyses of effects, only the August data is used. This is because baseline data is available for August only in the Koala Watershed and reference lakes. The phytoplankton/zooplankton data collected for July and September have never been used for effects analyses. Therefore, the value of collecting this data is questionable. As well, the collection and analyses of this seasonal data represents a very significant expenditure of resources that can be better applied to outstanding concerns. During the pre-workshop technical meeting held in December, BHP Billiton and their consultant presented a comparison of means from 'August only' and from 'July, August, and September' combined. The results indicated that there were similar differences among lakes, and that the major relationships among lakes was the same regardless of whether 'August only' or 'July, August, September' values were used. At the request of the IEMA, a subsequent data analysis was performed to determine if seasonal patterns were similar among years for any given lake. The results of this analysis indicated that seasonal patterns were not the same from year to year for most lakes.

Decision: Based on the current level of uncertainty concerning this issue and concern expressed among stakeholders, seasonal phytoplankton and zooplankton biomass and taxonomy sampling will be conducted during 2002 using the same protocols as in previous years. Analyses, however will be performed for August data only. BHP Billiton will collect the July and September samples, however, we will archive these samples pending the results of the planned re-evaluation of the AEMP during 2002. The re-evaluation will be used to determine whether or not analyses of the July and September samples will be completed.

- BHP Billiton Proposed Change: Winter under-ice water quality data to be collected for all AEMP lakes mid-April or early May each year.

Rationale: There has been an expression of concern that little is known about winter under ice water quality. Collection of winter water quality data will address this data gap.

Decision: Winter under-ice water quality sampling and analyses will be implemented as part of the AEMP. The data will be collected using methodologies that are similar or equivalent to those used for the open water AEMP. It should be appreciated that baseline data for winter water quality data is not available; therefore, a statistical effects analyses cannot be performed for winter water quality. However, an attempt will be made to integrate this data into the AEMP 2002 report.

- BHP Billiton Proposed Change: The SNP monitoring location 1616-43 (King Pond discharge to Cujo Lake) to be integrated into the AEMP.

Rationale: The integration of SNP 1616-43 into the AEMP would aid in the detection of potential effects in the Cujo Watershed.

Decision: SNP 1616-43 will be integrated into the AEMP. Water quality samples will be collected at the same time as for other AEMP monitoring locations using AEMP QA/QC methodologies and the results will be included in the 2002 AEMP report. The collection of these samples will be limited by the availability of discharge effluent at the time of AEMP sampling.

2. Proposed Baseline Data Collection and Expanded AEMP Program for Sable Pigeon and Beartooth Developments.

The Sable, Pigeon, and Beartooth Developments are at the licensing stage of regulatory approval. Baseline data has been collected in 1999 and 2001 at new sampling sites to support the future AEMP for the Sable and Pigeon developments. Plans for the continued collection of aquatic baseline data were discussed at the February 4 workshop and previously during a technical planning meeting in December 2001.

Several new monitoring locations were added to the Horseshoe Watershed at the request of the IEMA and others for incorporation into the baseline program for Sable. Added monitoring sites include Ross Lake, Ross Lake outflow stream, and Ulu Lake. In addition, winter water quality was formally incorporated into both the AEMP and future baseline data collection efforts starting this winter. A summary of the baseline program as it is currently designed is provided in Tables 1, 2, and 3 below.

Horseshoe Watershed: For the Horseshoe Watershed, two full years of baseline data will be available before any project activities commence for all sites with the exception of the newly added Ross Lake and outflow. Ulu Lake is not seen as long-term part of the future AEMP for the Sable area, sampling is solely to determine the effects resulting from its proximity to the future waste rock storage area and the open pit. The same effects will be evidenced in Horseshoe Lake. Quantitative baseline data were collected in 2001 (see Rescan 2002), and will be again in 2002. For Ulu Lake, Horseshoe Lake and Outflow, and Logan Lake and Outflow, two full years of summer data will be available. One year of winter data, will also be available for the lakes. With site development activities scheduled to commence in the fall of 2002, the amount and nature of baseline data available for the Horseshoe Watershed by that time will be appropriate to properly evaluate potential effects in this watershed in the future.

Pigeon Watershed: For the Pigeon Watershed, two full years of baseline data will be available before any project activities commence for the two monitored sites. The two sites within this watershed are Pigeon-Fay Stream (downstream of proposed Pigeon Diversion Structure), and Fay Lake. Baseline data have been collected in 1999 (Pigeon-Fay Stream), and 2001 (Pigeon-Fay Stream, Fay Lake), and will be again one more time in the future prior to development activities. Again, the amount and nature of baseline data that will be available prior to project activities will be appropriate to evaluate potential effects from the construction and operation of the Pigeon Diversion Structure.

Beartooth Watershed: For Beartooth Pit, this pit lies within the Koala Watershed, where a comprehensive AEMP has been in place for years. As project activities have been taking place in the vicinity of the future Beartooth Pit, monitoring in the Koala Watershed will continue as post-baseline monitoring. In February of 2002, Kodiak Lake was added to the

AEMP (it was a separate specialized program previously), and this will greatly aid in determining potential pathways of effects to waterbodies downstream of Moose Lake. Kodiak Lake is the first major lake downstream of the future Beartooth Pit.

Table 1: Baseline/AEMP Locations for Sable, Pigeon, Beartooth Development

Sable Pit	Pigeon Pit	Beartooth Pit
Horseshoe Watershed	Pigeon Watershed	Koala Watershed
Ulu Lake (WQ only) for two years	Pigeon-Fay Stream	Lower Panda Diversion Channel
Horseshoe Lake	Fay Lake	Kodiak Lake
Horseshoe Outflow		
Ross Lake		
Ross Outflow		
Logan Lake		
Logan Outflow		

Note: Ross Lake and Outflow were added in early 2002 as the request of the IEMA

Table 2: Sampling Design for Baseline/AEMP Lakes

	Sampling Frequency		
	Annual Basis	Seasonal Basis	
	Yearly	Summer	Winter
Water Quality	<i>every year</i>	<i>3 times (July, Aug., Sept.)</i>	<i>1 time (April)</i>
Physical Limnology	<i>every year</i>	<i>3 times (July, Aug., Sept.)</i>	<i>1 time (April)</i>
Sediment Quality	<i>every 3 years</i>	<i>1 time (Aug.)</i>	
Phytoplankton	<i>every year</i>	<i>3 times (July, Aug., Sept.)</i>	
Zooplankton	<i>every year</i>	<i>3 times (July, Aug., Sept.)</i>	
Lake Benthos	<i>every year</i>	<i>1 time (Aug.)</i>	
Fish Community	<i>every 5 years</i>	<i>1 time (Sept.)</i>	
Fish Habitat	<i>every 5 years</i>	<i>1 time (Sept.)</i>	

Table 3: Sampling Design for Baseline/AEMP Streams

	Sampling Frequency	
	Yearly	Summer
Water Quality	<i>every year</i>	<i>3 times (June, Aug., Sept.)</i>
Stream Benthos	<i>every year</i>	<i>1 time (Aug-Sept.)</i>
Hydrology	<i>every year</i>	<i>continuous</i>

Note: Stream fish community work was removed from the AEMP in February 1998

Concern: *There is a concern regarding the quality of the water that will be discharged from Bearclaw to North Panda Lake.*

BHP Billiton Response: BHPB will be re-directing water around Beartooth Pit through the use of a pipeline and as such there are no direct inputs that will influence water quality. However, given concerns over indirect effects from project activities (fugitive dust and potentially seasonally elevated water levels in Bearclaw Lake) BHPB agrees to establish a Surveillance Network Monitoring (SNP) station at the outlet of the pipeline and to monitor water quality during periods of flow.

Concern: Given the proximity, Bearclaw Lake may be affected by inputs of fugitive dust from Beartooth mining operations. This would be one reason to monitor discharge from Bearclaw Lake more frequently than just at freshet.

BHP Billiton Response: Fugitive dust inputs downstream of Bearclaw are expected to occur primarily during freshet, when the snow pack thaws. However, the integration of fugitive dust studies into the AEMP is an issue that can be discussed during the upcoming planning meeting to re-evaluate the AEMP to be held in early May.

3. Re-Evaluation of the AEMP

Four years of post-baseline data have been collected since 1998 for the Koala Watershed and reference lakes and streams. We are entering the fifth year of the post-baseline data collection. During 2002, BHP Billiton, in consultation with stakeholders, intends to re-evaluate the approach, methodologies, and scope of the AEMP. The main objective of the re-evaluation would be to identify key issues or concerns to date as determined from AEMP results. After key issues or concerns have been identified, proposals would be developed to focus the program on these identified issues and on data collection that supports these issues. It is expected that this re-focusing of the program would result in a reduction in sampling, analysis and reporting, at least in areas not requiring the monitoring effort presently employed in the AEMP over the past several years. Refocusing the AEMP may also result in the identification of data gaps.

Although four years of post baseline data have been collected for the Koala Watershed, only one year of post baseline data has been collected for the Cujo Watershed, downstream of the Misery Pit development. Therefore, an issue that needs to be addressed is how monitoring should evolve in watersheds with new developments and over the long term for established developments. BHP Billiton foresees a reevaluation process for the AEMP that should be performed at intervals (perhaps every five years) over the life-of-mine.

The data evaluation for 2002 would be performed in three major steps, with stakeholder involvement at key points in the process:

1. Synthesize existing AEMP results to identify key project issues and data gaps. The key issues identified must have a strong mine operational

focus and directly relate to environmental management concerns at Ekati. Stakeholders would be involved in the development of key objectives and methodologies used for the results synthesis. A one day planning meeting will be held in early May, 2002.

2. BHP Billiton would perform the results synthesis, identify key issues and develop a preliminary document that outlines the results of the synthesis, key issues, and a proposal for future monitoring. A preliminary draft document would be distributed for information prior to the meeting. Results would be presented to stakeholders at a meeting in August or September 2002. The goal for this meeting would be to develop a consensus on the key issues, discuss the results, and solicit comments on the preliminary proposal.
3. A final draft document would be released to stakeholders in October or November that would outline the overall changes and rationale for the revised AEMP. Stakeholders would be asked to respond in writing with any concerns. BHP Billiton would address any concerns directly with the concerned party. Concerns would be addressed prior to the February 2003 Workshop.

The proposed AEMP program would be presented during the February 2003 Workshop and submitted to the Mackenzie Valley Land and Water Board (MVLWB) for final approval.

4. Panda Diversion Channel Monitoring Program

The open water season of 2002 will mark the fifth consecutive year of habitat monitoring since the initiation of the Panda Diversion Channel Monitoring Program in 1998. The results of the 1998-2001 monitoring programs (BHP, 1999, 2000, 2001 and BHP Billiton, 2002) indicate that the PDC is providing suitable fish habitat and lake connectivity for Arctic grayling and a variety of other fish species, as well as their associated life stage requirements.

For the 2002 monitoring program, BHP Billiton has proposed to adopt more of an observational approach to monitoring rather than continuing with some of the more traditional, intrusive sampling methodologies. Where sufficient data exists, certain aspects of the current PDC monitoring program will be reduced or discontinued in 2002. In addition to being repetitive from a data collection perspective, the methodologies used for some monitoring tasks may also have a negative impact on the aquatic community. For example, the use of fish boxes to monitor grayling movements during spawning, most likely increase overall fish stress and may in some cases act as a barrier to fish migration.

A reduced 2002 program will provide BHP Billiton with an opportunity to synthesize existing PDC data and to identify specific data gaps or project issues.

The results of the data synthesis/evaluation would be presented to DFO and other stakeholders. This would allow the monitoring program to be fine-tuned to address potential concerns and/or unanswered questions with regards to the effectiveness or overall productivity of the PDC.

The following sections outline recommendations and provide rationale in support of an updated 2002 PDC Monitoring Program. It is proposed that specific approaches for the synthesis of existing 1998-2001 data and the development of recommendations for the 2003 Monitoring Program be discussed at a planning meeting to be held in early May 3.

- **Panda Diversion Channel Hydrology**

BHP Billiton Proposed Change: Remove the weekly collection of channel flow/velocity data for the PDC from the 2002-monitoring program.

Rationale: The reduced program will continue to provide valuable hydrological data that will allow the refinement and update of existing hydrograph curves for the PDC and Grizzly Creek, while at the same time reducing unnecessary collection of previously gathered (i.e., repetitive) data.

Decision: Weekly collection of channel flow/velocity data will be removed from the 2002 monitoring program. Water levels would continue to be monitored at the four standardized stream gauging stations for freshet and low flow periods only. In addition, water level recording transducers and data loggers at the Upper PDC, Lower PDC and Grizzly Creek stations would remain operational.

- **Spring Fish Monitoring**

BHP Billiton Proposed Change: Fish sampling at both the Panda (upstream) and Kodiak (downstream) fish boxes be discontinued in 2002.

Rationale: The current data clearly shows that the PDC continues to provide connectivity between Kodiak and North Panda lakes. It is recognized that one or two years of reduced data collection might be beneficial by reducing stress on spring migrating grayling.

Decision: Fish sampling at both the Panda (upstream) and Kodiak (downstream) fish boxes will be discontinued in 2002. The 2002 program will, however, continue to provide detailed spawning assessments of Arctic grayling within the channel by means of visual observations including counts of individuals. Specific observations of grayling spawning will be illustrated on PDC habitat maps and included in the Annual Monitoring Report. Full scale sampling utilizing the fish boxes would resume in 2003 or 2004.

- **Larval Fish Collection**

BHP Billiton Proposed Change: Discontinue active netting of newly emerged grayling larvae at standardized sites within the channel.

Rationale: Length and weight data for newly emerged larval grayling has remained consistent from 1998 to 2001. The removal of this component for one or two years would also reduce stress and mortalities of larval grayling.

Decision: For 2002, active netting of grayling larvae at standardized sites within the channel will be replaced with the documentation and mapping of emergence locations based on visual observations and larval grayling density estimates.

- **Habitat Assessments**

BHP Billiton Proposed Change: For the 2002 Panda Diversion Channel Monitoring Program, it is proposed that detailed habitat assessments be discontinued.

Rationale: Monitoring data from 1998-2001 suggests that channel substrates and in-stream structures are relatively stable and functioning as designed.

Decision: For the 2002 Panda Diversion Channel Monitoring Program, detailed habitat assessments will be discontinued. Detailed habitat assessments include stream morphology/classification assessments, stream flows and spot velocities at constructed habitats. Visual habitat assessments during low and high flow conditions will continue to provide the necessary information to monitor habitat stability and to determine if any maintenance activities are required.

- **YOY Arctic Grayling Sampling**

BHP Billiton Proposed Change: It is proposed that young-of-the-year (YOY) Arctic grayling sampling be reduced in 2002.

Rationale: In the past YOY fish have been collected and/or sampled at least twice a year within the PDC, once in late July by BHP Billiton to fulfill the requirements of the PDC monitoring, and again in late August by the University of Alberta to complete a graduate research project. Scientific papers associated with the YOY research by the University of Alberta are expected to be available in 2002-2003. There is considerable concern that YOY collections, particularly with the use of an electrofisher, are negatively impacting the YOY population. Although the effects of electrofishing on PDC

YOY grayling cannot be quantified, the potential does exist for electrofishing to negatively affect YOY growth. It is for this reason that it is recommended that YOY collections be minimized in 2002. We are not proposing to discontinue YOY sampling in its entirety, as the growth of YOY grayling and overall channel productivity remain important issue.

Comment: The IEMA would like to see quantitative data describing how much smaller YOY were in 2001 and how this compares with natural streams.

BHP Billiton Response: This information is not currently available. Research papers (in press) by the University of Alberta may provide some data that helps to answer this question.

Decision: The number of PDC sampling sites will be reduced in 2002 to minimize undue stress on YOY grayling. Sites will be chosen to be representative of available in-stream habitat found throughout the PDC. Monitoring will be designed with input from DFO and other stakeholders, to address specific issues associated with YOY growth and channel productivity. The proposed 2002 YOY program will be presented to stakeholders for discussion during the AEMP Re-Evaluation planning meeting scheduled on May 3.

- **Annual Benthic Invertebrate And Periphyton Sampling**

Proposed Changes: It is recommended that quantitative benthic invertebrate and periphyton sampling be reduced for the 2002 Panda Diversion Channel Monitoring Program.

Rationale: Monitoring data from 1998 to 2001 has consistently shown an increasingly abundant and wide-ranging benthic invertebrate and periphyton communities throughout the PDC. A reduced sampling program in 2002 will still allow for the evaluation of benthos and periphyton communities at key locations in the channel, while at the same time reduce costs associated with invertebrate and periphyton identification and enumeration.

Decision: Benthos and periphyton communities may be closely linked to YOY grayling survival. Quantitative benthic invertebrate and periphyton sampling will be reduced to coincide with locations where YOY monitoring will be conducted. The proposed 2002 YOY program will be presented to stakeholders for discussion during the AEMP Re-Evaluation planning meeting scheduled in early May.