



Revegetation in cell B of the Long Lake Containment Facility

## HIGHLIGHTS:

- Delays in reclamation research remain a serious concern.
- A timeline for submission of the next Interim Closure and Reclamation Plan has not been established.
- An opportunity to ensure procedural fairness and transparency during review of the financial security held under the Environmental Agreement was lost when the Agency's participation was curtailed by the GNWT.

## CLOSURE AND RECLAMATION

### CURRENT CLOSURE PLAN

Dominion Diamond Ekati Corporation (DDEC) is required to have in place an approved Interim Closure and Reclamation Plan (ICRP) during active mining operations and to periodically report on and update the Plan. The current ICRP was approved in 2011 and anticipates active mining operations until at least 2020.

Reclamation planning is guided by the overall goal of returning the Ekati Mine site to a viable and self-sustaining ecosystem that is compatible with a healthy environment and human activities.

The current plan is to flood the open pits and connecting underground mines to create pit lakes connected with their surrounding watersheds. Ursula Lake, Upper Exeter Lake

and Lac de Gras are identified as potential water sources for flooding, which is expected to take approximately 35 years. Berms will be constructed around the perimeter of the pits to deter wildlife during the flooding process.

The Sable, Pigeon, Panda/Koala/Beartooth, Fox and Misery waste rock storage areas (WRSA) will remain in place after mining operations have ceased. They will be covered with granite and/or glacial till and allowed to revegetate naturally. Their design takes into account their permanency by including a stepped profile and a flat top that prevents snow build-up and encourages growth and maintenance of permafrost over the long term.

The Long Lake Containment Facility (LLCF) processed kimberlite tailings will be re-contoured and capped with a combination of rock and vegetation, and reconnected with the surrounding watershed through a system of drainage channels and ponds. All dikes and dams within the LLCF will eventually be breached to allow water to flow through.

The Panda Dam will continue to divert water through the Panda Diversion Channel (PDC) and will have a spillway to allow freshet to flow to Panda and Koala pit lakes. The Pigeon Stream Diversion will also remain in place to divert stream flow from the Upper Pigeon Stream to Fay Lake.

All buildings, storage tanks, power lines and other physical structures will be removed and either buried in a landfill or shipped off site. Roads, lay down pads and the airstrip will remain in place and decommissioned so they are safe for human and wildlife use after the mine is closed.

# RECLAMATION AND CLOSURE

## 1 RECOMMENDATION

The Agency recommends that, following the Minister of Lands' decision on the Jay Project environmental assessment, DDEC develop a single, integrated Interim Closure and Reclamation Plan for Ekati Mine that incorporates all major developments that have commenced since ICRP Version 2.4 was approved in August 2011.



Agency Directors Emery Paquin and Bill Ross speaking with DDEC's Lukas Novy

### 2015 CHANGES TO THE CLOSURE PLAN

The Wek'èezhìi Land and Water Board (WLWB) made a number of significant decisions at its June 2015 meeting in regard to reclamation planning and activities at Ekati. Some of these include:

- Approval of the Lynx Development and Misery power line closure and reclamation plans;
- Approval of changes to the LLCF closure landscape plan;
- Directing DDEC to consider the types of monitoring and period of time required to demonstrate slope stability of the new Pigeon WRSA cover design. In 2014, the WLWB approved a cap design for the Pigeon WRSA which included using three meters of till covered with one meter of granite. This differs from other WRSAs where a five meter granite cap is to be used;
- Supporting DDEC's commitment to use crushed gravel on sections of the Pigeon WRSA to improve wildlife access while rejecting the removal of wildlife access ramps from its reclamation plan. The suggestion to change the slopes of other WRSA wildlife access ramps at Ekati was also rejected;
- Approval of the change in closure objective for operation and demolition waste landfills (from full permafrost encapsulation to stabilization of inert materials) and requiring DDEC to place a two meter cap on both landfills to address stability concerns; and
- Reviewing the required security estimate. Refer to *Financial Security – Water Licence* for further information.

A timeline for submission of the next ICRP was not established. The WLWB committed to discussions with DDEC regarding an appropriate submission timeline and committed to provide a minimum of six months' notice.

### RECLAMATION ACTIVITIES IN 2015

DDEC continues to conduct progressive reclamation, which means reclamation activities begin as early as possible during operations, starting with areas no longer needed for mine operations.

#### Old Camp

Reclamation of Old Camp continues with completion of the following activities:

- Excavation of a shallow channel and placement of riprap erosion protection to safely route surface flow through the reclaimed area of Phase 1 Pond;
- Re-grading of the esker material in Phase 1 Pond, cleanup of residual liner materials and additional minor housekeeping following spring freshet flow; and
- Completed an updated Environmental Site Assessment of the Old Camp pad to delineate any remaining contaminated soil.

Work to be undertaken in 2016 includes the removal of hydrocarbon contaminated soil and contouring of the Old Camp pad, reclamation of the North Pond of the Phase 1 processed kimberlite containment area, and minor regrading to prevent surface erosion and promote drainage throughout the site. Water quality monitoring within the constructed channel and Larry Lake will be undertaken during spring freshet and again in late summer or fall.





Old Camp

### Koala Underground

Reclamation on three levels of the Koala North underground workings was completed in 2015. DDEC reported that all hazardous materials, debris, garbage and salvageable materials were removed and barricades installed to control access. Koala is now the only active site of the three underground mines (Koala, Koala North and Panda).

### Salvage of Topsoil

Topsoil material was salvaged during development of the Lynx Open Pit and construction of the crusher pad. The material was added to the existing stockpile located in the north portion of the Misery WRSA and will be used for future reclamation activities.

## RECLAMATION RESEARCH AND PLANNING

With the exception of Old Camp, reclamation activities generally remain in the interim planning stage. Key uncertainties, such as water quality, wildlife safety and the sustainability of vegetation cover, remain to be resolved as the environmental consequences and financial costs of unsuccessful reclamation are high.

The ICRP currently identifies eight areas as requiring further research: pit lakes; the underground; waste rock and processed kimberlite storage areas; dams, dikes and channels; buildings and infrastructure; Traditional Knowledge; vegetation; and closure criteria. Currently there are 22 reclamation research plans, each supported by multiple discrete research tasks. While some of the research tasks have been completed and many others are ongoing, 15 tasks scheduled for 2015 were deferred until later in the mine's operational period. As noted in previous annual reports, this slippage in reclamation research continues to be a concern for the Agency.

### Closure and Reclamation Research on Schedule

A summary of the major research completed in 2015 is provided below.

An assessment of the time needed to fill Fox Pit using LLCF water was completed. Results indicate that 15 to 62 years would be required to fill the pit depending on annual precipitation, runoff and evaporation while continuing to provide sufficient flows in downstream lakes. This range could have significant cost and timeframe implications for mine closure.

Research into permafrost growth and long term seepage water quality in the WRSAs is continuing. As part of the current research plans, DDEC provided the WLWB with the following three reports:

- **WRSA Seepage Screening Level Risk Assessment:** The assessment indicates there are currently no unacceptable health risks to aquatic and terrestrial organisms as a result of WRSA seepage.
- **WRSA Seepage Geochemistry Evaluation:** In general, the evaluation concluded that kinetic testing (e.g., use of humidity cell tests) can be used as reasonable approximations of long-term metal leaching and acid generation potential of waste rock.
- **WRSA Thermal Modeling:** The modeling analysis predicted that freezing of the Course Processed Kimberlite storage area can be expected within 20 years. For the Misery WRSA, the newly placed granite cap can be expected to freeze back within 10 years of its placement while long term predictions are that waste rock below the active layer will remain frozen under the 100 year climate change scenario.

Additional information on the management of WRSAs can be found in the Waste Rock and Processed Kimberlite section of this report.

Field-scale cover vegetation trials using barley, triticale and rye crops continued in Cell B of the LLCF in order to observe growth and establish additional organic material in ground cover. Samples of plant tissue and processed kimberlite (PK) 'soil' were then collected and sent for assessment of bioavailability of metals uptake and geochemical analysis. A report on the results will be provided in 2016.

Riparian and upland vegetation monitoring was completed at various sites around the Ekati Mine site including the Pigeon Stream Diversion; Paul Lake lay down; Culvert Camp; Fred's Channel; and the south esker and Tercon lay down areas. In general, ground cover by seeded grasses has been increasing while a number of colonizing herbaceous plants (fireweed) and willow were also noted.

### Closure and Reclamation Research Slippage

As we noted in previous reports, the Agency is concerned that investigations to resolve uncertainties about reclamation strategies are continuing to slip behind schedule, some by many years. Some of these delayed investigations include:

- Identification of pit perimeters requiring barriers and safe shoreline access for pit lakes;
- Location and mitigation of unstable parts of pit walls;
- Development of a pit lake perimeter and connector channel design plan;
- While modelling of pit water quality during and after pit flooding was completed in 2013, the reporting of results to communities and regulators has been further delayed into 2016;
- Development of a conceptual groundwater study;
- Consolidation and freeze concentration testing on high-water-content processed kimberlite. DDEC has noted that the overall need for completion of this study is being re-evaluated;
- While we are pleased that a literature review into the long-term weathering of PK and its effects on vegetation and water quality was completed in 2015, the physical testing of weathered PK

and initial vegetation assessments have been deferred until 2016 and 2017, respectively; and

- No work has been initiated on developing closure objectives and criteria for the long-term geotechnical stability of the WRSAs, LLCF internal drainage channels, dams and dikes, roads, the airstrip; and other various mine infrastructure.

## FINANCIAL SECURITY

### Water Licence

Revised financial security estimates are provided to the WLWB each year through the annual Closure and Reclamation Progress Report. In June 2015, the WLWB approved a security increase of \$2.29 million following review of the ICRP and security updates outlined in the 2014 Progress Report. The WLWB also directed the DDEC to provide additional information in an effort to resolve outstanding issues related to proposed unit costs and to submit detailed scopes of work for all reclamation research plans, amongst other information. In July, DDEC updated unit costs for scarifying and revegetation and provided a revised estimate for reclamation activities associated with the Lynx project. This resulted in a further increase of \$1.09 million to the overall financial security. As a result of these decisions, the financial security currently held by the GNWT for the Ekati Mine is \$259 million.

In their 2015 Closure and Reclamation Progress Report, DDEC proposed a number of financial security updates resulting from revised operational and planning information. If approved, these updates would result in an overall decrease of \$8.86 million to the RECLAIM estimate. Some of the major proposed changes include:

- Relinquishment of security dealing with stabilization of the PDC (decrease of \$2.77 million);
- Lower level of effort to recover granite for reclamation capping (decrease of \$13.2 million);
- Lower annual post-closure Aquatic Effects Monitoring Program costs (decrease of \$1.0 million);
- Greater exposed metasediment in the Misery WRSA (increase of \$8.48 million); and
- Expansion of the coarse rejects storage area (increase of \$1.69 million).

The WLWB has not considered DDEC's proposed changes to the reclamation security at the time of writing this report. We will report on the outcomes of this process in our next Annual Report.

### Environmental Agreement

In addition to the financial security required under the water licence, DDEC is obligated to maintain security with the GNWT Minister of Lands under the Environmental Agreement. This security is intended to be used in the event of any default of obligations under the Agreement by DDEC.

As reported in our 2014-15 Annual Report, a review of the financial security by signatories of the Environmental Agreement, in consultation with the Agency, was under way at the request of DDEC. While we were optimistic that a reasonable level of security would again be established, the positions of the Agency and DDEC at the time of writing last year's annual report were rather far apart (DDEC about \$9.0 million, the Agency about \$47.4 million). A summary of the respective proposals can be found on page 15 of last year's report.



Directors walking to cell B of the LLCF





Unfortunately, the Agency was advised by the GNWT in March 2015 that we would no longer be involved in the process of reviewing the financial security. While we expressed disappointment with this development, the review proceeded with no further opportunity for the Agency to provide meaningful input. The Agency was advised in August 2015, that an updated financial security of \$19.99 million had been established by the GNWT under the Environmental Agreement. This represents a significant decrease of \$22.68 million, or 53%, from the previous financial security.

### AGENCY'S ASSESSMENT

The Agency is pleased that DDEC continues to reclaim the Old Camp. We note that further work is scheduled and hope to see this completed in 2016. In addition, we look forward to DDEC reclaiming other sites that are no longer required for active mining.

The WLWB's review of the 2014 ICRP Annual Progress Report was rigorous as in previous years. The Agency takes particular note of the WLWB's decision to amend Water Licence Schedule 2 to reflect the increase in financial security. While DDEC's overall closure and reclamation performance has been good, the legacy of other mining projects in the North demonstrate that environmental liabilities should never be allowed to exceed the posted security.

Another notable directive from the WLWB was for DDEC to include detailed scopes of work for all reclamation research plans in their next progress report. As noted above, the Agency views the continued slippage in reclamation research as an increasingly serious issue. DDEC must make greater effort towards completing the scheduled planning and research tasks in a timely way.

Under the NWT Mine Closure Guidelines, an updated version of a proponent's ICRP should be developed every three to five years. Since the current ICRP was approved in 2011, additional projects have commenced (e.g., Pigeon Pit, Lynx Pit and Misery power line) and several changes have been made to closure objectives and criteria. The Agency believes these changes, and the passage of time, are sufficient to warrant an update to the current ICRP. Consolidating the reclamation aspects of these new developments and the existing Ekati Mine into a single reclamation plan will help to ensure reclamation research and activities remain consistent and integrated. The Agency also acknowledges that the Jay Project, if approved, will have significant implications for closure planning. For this reason, development of the next ICRP should await the Minister of Lands' pending decision on the Jay Project environmental assessment process.

As noted earlier, a consultative process was initiated at DDEC's request to review the financial security held under the Environmental Agreement. The Agency participated in good faith throughout the process and was extremely disappointed when, in March 2015, the GNWT announced that we would no longer be involved. In our opinion, this represented a lost opportunity. To ensure transparency and procedural fairness, we urge parties to the Environmental Agreement (GNWT, DDEC and Indigenous and Northern Affairs Canada) to allow the full participation of the Agency and our Aboriginal Society Members during any future amendment, cost variance and progress reviews conducted under the Environmental Agreement. ■





Agency Directors at the Pigeon Stream Diversion

### HIGHLIGHTS:

- Potassium SSWQO increased from 41 mg/L to a new level of 64 mg/L, but even this new objective is being reached in Leslie Lake.
- Sable AEMP Design Plan follows the existing AEMP methods for water and sediment quality.
- Additional water sampling sites in the north arm of Lac de Gras are being evaluated by DDEC.

Each year Dominion Diamond Ekati Corporation (DDEC) carries out a number of programs and studies to determine if changes in the lakes and streams downstream of its operations are occurring as a result of mining activities.

In December 2015, the Wek'èezhì Land and Water Board (WLWB) approved the Aquatic Response Framework (ARF). The objective of the ARF is to ensure that water and aquatic life monitoring results are analyzed as part of an early warning system so that changes can be made before impacts become significant or irreversible.

There are three watersheds (Koala-Lac de Gras, King-Cujo, and Pigeon-Fay-Upper Exeter) which may be affected by the current

mining operation. Lakes and streams in these three systems, as well as background sites, are sampled each year under the Aquatic Effects Monitoring Program (AEMP), which is a requirement specified in DDEC's Class A Water Licence. Using information collected through the AEMP, any changing trends in water and sediment quality, benthic macroinvertebrate communities, zooplankton and phytoplankton, as well as fish populations and health, can be identified. A fourth watershed, Sable-Horseshoe, will begin annual monitoring in the upcoming year for receiving lakes downstream of the new Sable development.

Like the previous year, 2014-15 was a relatively dry year. The total precipitation in the Ekati area during the 2014-15 hydrologic year (mid-October 2014 to mid-October 2015) of 265 mm was significantly less than the 16-year average value of 323 mm of precipitation.

## 2015-16 ACTIVITIES

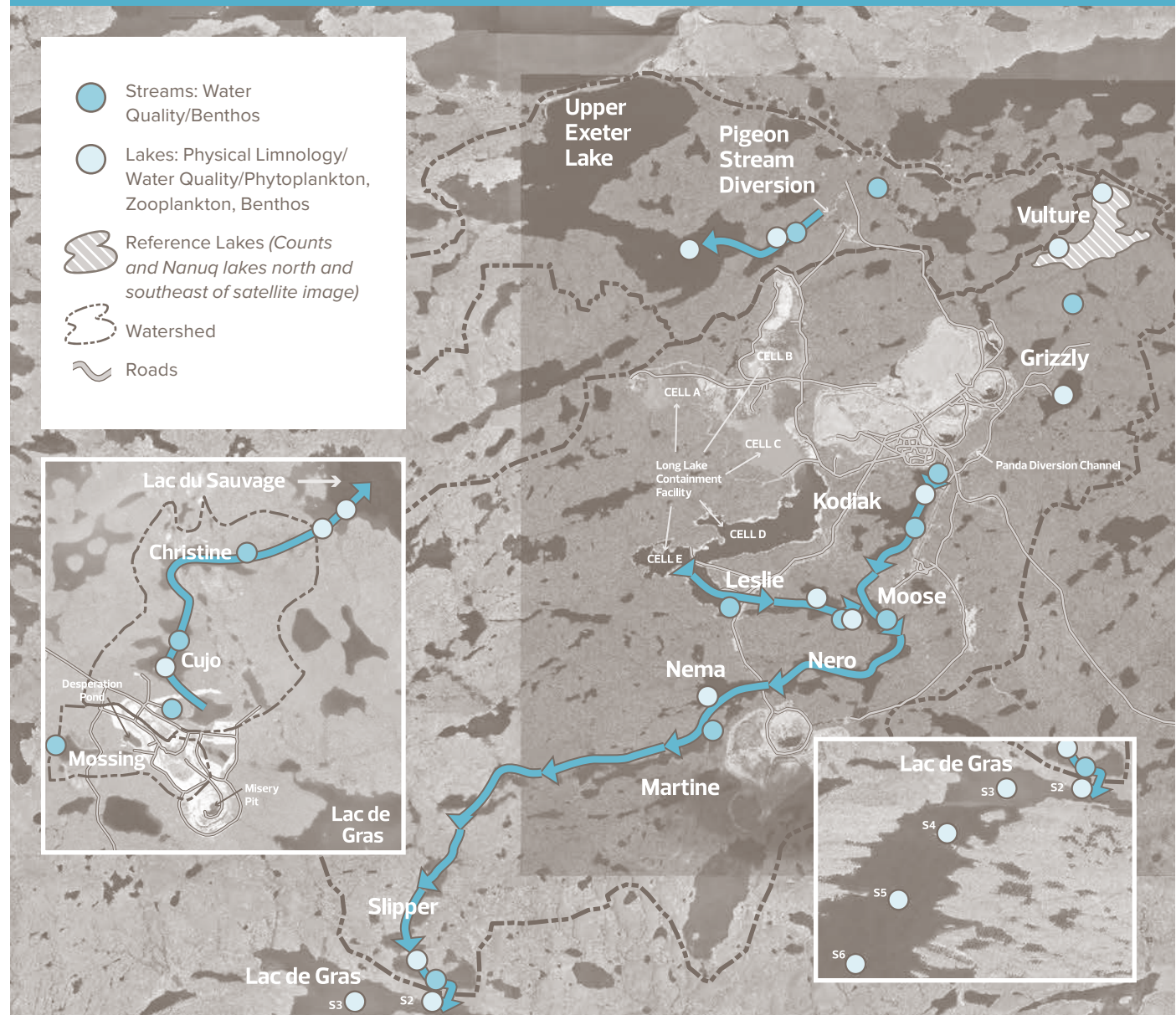
Processed kimberlite, treated sewage, and surface sump water continued to be discharged into the Long Lake Containment Facility (LLCF), while underground minewater and additional processed kimberlite were pumped into the Beartooth Pit. Just over 1 million m<sup>3</sup> of treated water was released from the LLCF between September 4 to September 30, 2015 and entered Koala watershed through Leslie Lake, being progressively diluted as it flowed downstream through Moose Lake, before reaching Lac de Gras (Figure 1). The LLCF effluent comprised the main source of potential water contaminants to the downstream aquatic environment from Ekati Mine.

A second source of potential contamination to the aquatic environment is effluent discharged from the Misery site. Water from King Pond Settling Facility (KPSF) was pumped to Cujo Lake from July 3 to 13, and July 28 to 31, 2015.

Lynx Lake was drained during summer 2015 in preparation for mining, with clean water pumped to Lac de Gras from July 17 to August 24, 2015 and the silted lower-depth water pumped to the KPSF from Sept 3 to 30, 2015.

The final phase of the Panda Diversion Channel stabilization project was completed in 2014 and DDEC considers the channel to be a functioning sustainable stream. However, the Agency believes full restoration is not yet complete as a few remaining rock structures are to be designed and possibly installed in summer 2026, and the long-term geotechnical stabilization of the channel has not been confirmed.

FIGURE 1: AEMP REFERENCE LAKES AND OUTFLOW STREAMS





AEMP MONITORING RESULTS

Each year DDEC reports the results of its AEMP to the WLWB and provides the highlights in its Environmental Agreement and Water Licence Annual Report.

This is the 18th year of monitoring for the Koala-Lac de Gras system and the 15th year for the King-Cujo system (Table 1). The AEMP reference lakes and outflow streams are shown in Figure 1. The effects on water quality for the Koala and King-Cujo watersheds are shown for selected variables in Table 1. This table is adapted from the AEMP Summary Report with additions resulting from the Agency’s review of the monitoring results.

As an early warning system, the 2015 Aquatic Response Framework sets out different thresholds (low, medium and high) for each aquatic parameter. Each threshold requires a defined set of actions, such as the submission of a response plan. The 2015 AEMP is the first time annual monitoring results have been compared to the response framework. This comparison resulted in low action levels being exceeded for dissolved oxygen, chloride, potassium, and phosphate. Low action levels are exceeded when average monthly concentration of a chemical variable is greater than 50% of the water quality benchmark and shows an increasing annual trend. Phytoplankton, zooplankton, and benthos species diversity also exceeded low action levels (i.e., when three consecutive years of significant diversity changes in lakes closest to mine effluent are measured).

SUMMARY OF WATER QUALITY RESULTS

**Dissolved Oxygen:** Under-ice dissolved oxygen levels in Cujo Lake continue to be poor, recording the lowest level since monitoring

began. DDEC has responded by maintaining an increased frequency of oxygen monitoring and removing snow on the lake ice (designed to increase sunlight penetration to increase photosynthesis oxygen production under the ice). A study to be reported in September 2016 will determine the factors causing the hypoxic conditions and will be used to develop new mitigation and management measures. An update to the Aquatic Response Plan (ARP) for under-ice dissolved oxygen will be submitted to the WLWB by December 31, 2016.

**Chloride and Total Dissolved Solids (TDS):** Concentrations have declined from peak values the last 2 years, although they are still high downstream of the LLCF compared to baseline. The decline is likely due to most of the effluent being discharged to Beartooth Pit, thereby reducing the TDS load in the LLCF.

**Potassium:** Average winter concentrations remain above the previous Site Specific Water Quality Objective (SSWQO) of 41 mg/L for the third straight year in Leslie Lake but declined below this value in Moose Lake. Grab samples with the highest concentrations are approaching the newly revised SSWQO of 64 mg/L in Leslie Lake.

**Total Ammonia:** Average concentrations have increased to its highest recorded levels under ice in all impacted lakes downstream of the LLCF, although the means remain an order of magnitude below CCME guidelines for protection of aquatic life. DDEC attributes these elevated ammonia levels to blasting residues, but do not explain why they have spiked in 2015.

**Iron:** Average concentrations of iron under ice in Cujo Lake and Fay Bay rose above CCME guidelines for protection of aquatic life. Iron toxicity can damage internal organs and gills of fish.

4 RECOMMENDATION

The Agency recommends that DDEC expand water quality monitoring further into the north arm of Lac de Gras by incorporating sampling sites S4, S5 and S6 as permanent AEMP stations.

**DDEC Response:** A recommendation to incorporate water quality sampling as far as site S6 in Lac de Gras into the annual Aquatic Effects Monitoring Program (AEMP) has been included in the 2015 AEMP Re-evaluation, which will be submitted to the WLWB on June 30th, 2016.

**Zinc:** Average concentrations of zinc in Lac du Sauvage rose above CCME guidelines under ice in sample station LDS1, but are at detection level in LDS2. The reason for this large difference in concentrations at lake sites in close proximity is uncertain.

**BIOTA RESULTS**  
Slimy Sculpin are sampled every three years. The results are as follows:

- Gonad weight, corrected for body weight (gonadosomatic index), increases in different lake populations farther downstream of the LLCF, suggesting possible reproductive impacts for sculpin in lakes receiving less dilute water from the LLCF.
- Mercury and Selenium could be emerging concerns. Higher tissue concentrations were found in sculpin in monitored lakes than in sculpin in reference lakes, although none were at levels harmful to fish eaters. Several sculpin had selenium levels higher

than BC Ministry of Environment and US Environmental Protection Agency aquatic life guidelines in lakes downstream of the LLCF. The sculpin selenium results were consistent with 2012 results for trout and whitefish (increasing concentrations) in the same downstream lakes.

- Antimony and molybdenum were also elevated in sculpin in Leslie to Nema lakes relative to reference lakes.
- EROD (an enzyme) activity in fish is a sign of exposure to hydrocarbons or organochlorines. There was much less difference in sculpin between lakes in 2015 than in 2012 and there were no significant differences between impacted and reference lakes in 2015. Thus, EROD results suggest sculpin may not have been exposed to hydrocarbons from mining operations in 2015.
- Fish parasites were sampled for in 2007 and 2012. Tapeworm (Ligula) infestation rates were higher in



TABLE 4: MINING EFFECTS ON WATER QUALITY FLOWING THROUGH THE KOALA AND KING-CUJO WATERSHEDS

Parameters Monitored	Parameters elevated in Koala watershed									Parameters elevated in King-Cujo watershed			
	Long Lake Containment Facility → Lac de Gras									King Pond → Lac du Sauvage			
	Leslie	Leslie-Moose	Moose	Moose-Nero	Nema	Nema-Martine	Slipper	Slipper-Lac de Gras	Lac de Gras (S2)	Cujo	Cujo Outflow	Christine-Lac du Sauvage	Lac du Sauvage
pH	●	●	●	●	●	●	●	●	●	●	●	●	
Alkalinity	●	●	●	●	●	●	●	●	●	●	●	●	
Hardness	●		●	●	●	●	●	●	●	●	●	●	
Total Dissolved Solids	●	●	●	●	●	●	●	●	●	●	●	●	
Chloride	●	●	●	●	●	●	●	●	●	●	●	●	
Sulphate	●	●	●	●	●	●	●	●	●	●	●	●	
Potassium	● ★	●	●	●	●	●	●	●	●	●	●	●	
Total Ammonia	●		●	●	●	●	●						
Nitrite	●												
Nitrate	○	○	○	○	○	○	○						
Total Phosphate-P	● ◆	●	● ◆							◆			
Total Organic Carbon	●	●	●	●	●	●	●	○		○	○	○	
Antimony	●	●	●	●	●	●							
Arsenic	●	●	●	●	●	●	●	●		○	○		
Barium	●		●	●	●	●	●	●	●	●	●	●	
Boron	●	●	●	●	●	●	●			●	●	○	
Molybdenum	●	●	●	●	●	●	●	●	●	●	●	●	
Nickel	●	●	●	●	●	●	●	●		●	●		
Selenium	●	●											
Strontium	●	●	●	●	●	●	●	●	●	●	●	●	●
Uranium	●	●	●	●	●	●	●	●		●	●		

This table is adapted from the AEMP report with additions resulting from the Agency's review of the monitoring results.

Koala watershed lakes immediately downstream of LLCF (Leslie and Moose lakes) than in reference lakes. In 2015, tapeworm infestation rates were lower in Leslie and Moose lakes than in two of three reference lakes. In Cujo Lake, downstream from the Misery Pit, over half of the sampled sculpin were infected, like the two previous sampling years.

### OTHER STUDIES AND PLANS

#### Lac de Gras Water Quality Monitoring Stations

Reported in the Agency's 2014-15 Annual Report, a water sampling program was run down the length of the north arm of Lac de Gras, downstream of the Koala watershed in 2013 (Figure 1). This sampling was done again in 2015, to determine if water quality changes caused by the LLCF were reaching beyond S2 and S3 AEMP stations. The results are presented in the AEMP data report but were not evaluated. Reviewers must wait for the AEMP Re-evaluation in June 2016 to find out if DDEC has determined that these additional sampling stations will become permanent AEMP stations.

#### Grizzly Lake

Previous AEMP reports suggest that shifts in the Grizzly Lake zooplankton community composition likely reflect a response to warming of the lake water. However, results from 2015 suggest that the observed changes in 2013 and 2014 were more likely due to natural variability rather than impacts from mining.

#### Pigeon Stream Diversion Monitoring Program

The 2015 Pigeon Stream Diversion (PSD) monitoring program report describes results of the second post-construction year, comparing historical data to post-construction data in order to compare current PSD conditions to baseline conditions. The recently completed Panda Diversion Channel (PDC) monitoring program provides a template for PSD

monitoring. Physical components (stream hydrology, water temperature, physical habitat, and water quality) and biological components (vegetation, particulate organic matter, biological characteristics, and migration patterns) are monitored. The PSD contains spawning, rearing, and feeding habitat that is used by four fish species and it provides a migration corridor for Arctic Grayling.

#### Potassium Response Plan (PRP)

There are no CCME guidelines for potassium, so a site-specific objective (41 mg/L) was developed using methods recommended by CCME. DDEC's original water quality model underestimated the speed at which potassium concentrations would peak at 100% and 103% of the SSWQO under ice in Leslie and Moose lakes respectively, occurring 7 years earlier than predicted. Revised model results predict potassium concentrations will continue to exceed the original potassium SSWQO of 41 mg/L in Leslie and Moose lakes, with steady annual decline beginning in 2020. A PRP was needed to address this problem, which was submitted to the WLWB for approval in March, 2015 and a revised water quality objective was submitted on July 31, 2015. In January, 2016 the WLWB ruled that a new SSWQO of 64 mg/L is acceptable. A revised ARP for potassium must be submitted by June 30, 2016.

A reduction in the estimated percentage solids of fine processed kimberlite (FPK) combined with a later-than-anticipated start to diversion of FPK discharge to Beartooth Pit, resulted in an increase in the volume of FPK water released to the LLCF compared to the model estimate. Potassium concentration from underground operations to Beartooth Pit was also over-predicted in the 2012 model. Lower natural runoff to the LLCF due to a drier-than-average year in 2014 resulted in lower dilution rates within LLCF. All of these factors were

responsible for the 2012 model's underestimate of potassium for the 2012-2014 period.

In Leslie Lake, the first lake downstream of the mine, observed densities of the *Daphnia* (a cladocera genus known to be most sensitive to potassium), have increased since 2010, despite increasing potassium concentrations. However, another genus, *Holopedium*, has been disappearing. This suggests that *Holopedium* may be more sensitive to potassium than *Daphnia*. Toxicity tests used to develop the new revised SSWQO in the PRP used 2 standard species of cladocera normally used in such tests, neither of which are *Holopedium*.

#### Sable AEMP Design Plan

The AEMP design for the Sable Pit follows the methodology of the current AEMP for the whole Ekati Mine site. DDEC proposes to monitor four lakes downstream of the Sable Pit, with another sample site in the ultimate receiving lake, Exeter. The Sable design would monitor changes within the Horseshoe watershed, as that is where most Sable infrastructure will be placed. However, the southwest corner of the Sable Waste Rock Pile extends into Osprey watershed which is not part of the monitoring plan.

### AGENCY ASSESSMENT

The Agency suggests that DDEC update the water quality model for all variables, not just for potassium, because other chemicals could also be showing higher concentrations earlier than their model predicted. The Agency would also like to see DDEC investigate other genus of zooplankton around Ekati Mine. The cladoceran *Daphnia* is used in toxicity testing, it also seems to represent species that are relatively stable in potassium affected lakes. The Agency would like to see another genus of cladoceran investigated in case they are more sensitive to potassium.

The Sable waste rock pile extends into the Osprey watershed. Because of this, the Agency would like DDEC to provide a rationale for not including the Osprey watershed in the AEMP Design Plan for Sable. The Agency is also unsure about the reason for excluding the largest lake (HWL4) between Sable and Exeter lakes from Sable AEMP monitoring.

Cujo Lake has been in hypoxic conditions in 8 of the last 15 years. DDEC suggests that it is likely the fish have adapted to lower oxygen levels and would experience no ill effects. However, the Agency believes the lower oxygen levels may be a factor contributing to the tapeworm infestation rates, as fish are known to be more susceptible to parasites when physically stressed.

The Agency believes that the sampling sites in the north arm of Lac de Gras (S4, S5 and S6) should become permanent AEMP stations for cumulative effects monitoring and assessment in Lac de Gras. Determining whether effluent from Ekati Mine is reaching the end of the north arm prior to entering the main body of Lac de Gras may, together with Diavik Diamond Mine's far-field reference sample stations south of the north arm, help to distinguish the relative contributions of Ekati Mine and Diavik Diamond Mine to possible future degradation of Lac de Gras water.

Traditional Knowledge (TK) in the Sable AEMP is minimal. The current DELT program that TK holders participate in will not be done for Sable because fish monitoring in the Sable-Horseshoe watershed will be focused on small-bodied species rather than harvestable species such as lake trout and whitefish. This results in less TK being used for the Sable AEMP. In general, DDEC should make efforts to incorporate TK in all monitoring of aquatic effects. ■





Agency Directors learning about the in-vessel Brome composter

## HIGHLIGHTS:

- In-vessel composter was installed at the Long Lake Incinerator Building.
- The Conceptual Air Quality and Emissions Monitoring and Management Plan includes thresholds to trigger management responses and actions for exceedances of  $\text{NO}_2$ ,  $\text{PM}^{2.5}$  and TSP.

## ACTIVITIES 2015-16

The Ekati Air Quality Monitoring Program (AQMP) is comprised of the following components: meteorological monitoring (daily); air emissions and greenhouse gas calculations (annually); total suspended particulate (TSP) measurements through high volume air sampling (HVAS) and Partisol samplers (every six days); continuous ambient air monitoring for  $\text{NO}_2$ ,  $\text{SO}_2$ , TSP and  $\text{PM}^{2.5}$ ; dustfall monitoring (summer months); snow chemistry sampling (every three years); and lichen tissue sampling (every three years). The results are reported every three years in concert with the snow and lichen sampling program. The last AQMP was issued in April 2015 for the 2012-2014 reporting period.

## Air Emissions

Every year Dominion Diamond Ekati Corporation (DDEC) calculates air emissions resulting from diesel fuel consumption, and reports them to the National Pollutant Release Inventory (NPRI) and the Greenhouse Gas (GHG) Emissions Reporting Program. Emissions from stationary and mobile sources are calculated based on fuel consumption, and the incinerator emissions are calculated based on fuel consumption and biomass incinerated.

In 2015, overall GHG emissions increased 3.8% from 2014 emissions. Emissions increased from mobile equipment, aviation and blasting because of increased fuel consumption while fuel consumption decreased from power generation and heating, as used lubricating

oil was burned as fuel in heating oil burners across the site.

In October 2015 an in-vessel Brome composter was installed at the Long Lake Incinerator Building to manage a portion of the organic waste produced at Ekati. Since the installation of the composter, Ekati is only operating one incinerator unit for approximately 12 hours per day, which reduced diesel consumption (by approximately 30,000 litres) and GHG emissions. The incinerators continue to operate as per the approved Incinerator Management Plan 2015. The second stack emissions test for the incinerators is scheduled for 2016.

**Ambient Air Quality**

Ambient air quality sampling methodology has improved since the previous reporting period (2011), particularly with regard to quality assurance and quality control (QA/QC) procedures, instrument calibration, sampling methodology, and laboratory procedures. The switch to using Partisol samplers to measure TSP levels appears to have resulted in an improvement in the number of valid samples collected. However, the results of the HVAS and Partisol sampling showed that there still were invalid results of almost 50% in some cases over the 2011-2014 reporting period.

It is not clear how such data loss compares to other air quality monitoring programs in the Northwest Territories or elsewhere. We understand from GNWT-ENR that the typical data loss for PM10 Partisol samplers they operate as part of their air quality monitoring program is about 5%. The implications of such comparatively high data loss from Ekati and what actions DDEC will do to fix the problem remain unclear.



White smoke from the Long Lake Incinerator Building

At the continuous air monitoring (CAM) building, it appears that DDEC is collecting more usable data since data during the previous reporting period covered in the 2011 report were 75% unusable. But there are still some issues. There are a number of time periods where data are missing from the CAM. Some of these periods range up to almost a month. DDEC does not provide any assessment of the effects of such data loss on the variance or robustness of the analysis and conclusions.

**Dustfall Monitoring Program**

Dustfall monitoring results showed that the average concentrations measured at the airport and Long Lake Containment Facility (LLCF) stations were higher in 2013 and 2014 compared to 2012. While the majority of dustfall results were below the British Columbia objective of 2.9 mg/dm<sup>2</sup>/d, there were some exceedances. Given the increasing trend in dust deposition over the past two years, the Agency

recommends that DDEC consider the use of additional mitigation measures to reduce dust dispersion from the LLCF.

The Agency has also suggested that additional dustfall monitoring stations be placed at greater distances from the LLCF and the airport to better gauge what is happening and the effectiveness of mitigation. In particular, the eastern side of LLCF should have additional monitoring stations based on prevailing wind patterns in the summer. Stations are currently west of Cell B and in the western part of Cell A.

**Dust Suppression**

The Agency, Aboriginal groups, and regulators have raised concerns about the effects of fugitive dust on vegetation and caribou, including possible links with the Zone of Influence (ZOI) for the mine on caribou distribution. The dust suppression section of the AQMP provides a brief summary of

what DDEC applied to the roads and airstrip but did not outline any research being done or expected to be undertaken to identify the effectiveness of dust suppression measures on site. This is despite DDEC's commitment to do so. In the Agency's opinion, data gathered from the study would be useful in determining the most effective dust suppressants and frequency of application in order to minimize fugitive dust on roads. In the summer of 2015, DDEC began initial trials on a new dust suppressant EnviroKleen, which shows promise, and they will be expanding this study in 2016.

At the July 2015 air quality management workshop, there was discussion on the lack of protocols, clear triggers and action levels whereby dust mitigation would be required. Mitigation actions currently are based on qualitative judgement by DDEC. For example, DDEC said that visible dust was a health and safety issue for its drivers yet there appears to be no specific thresholds or trigger actions other than complaints from its drivers. Specific and measureable protocols and triggers should be developed as part of the Air Quality and Emissions Monitoring and Management Plan (AQEMMP) for Ekati Mine.

**Lichen Sampling**

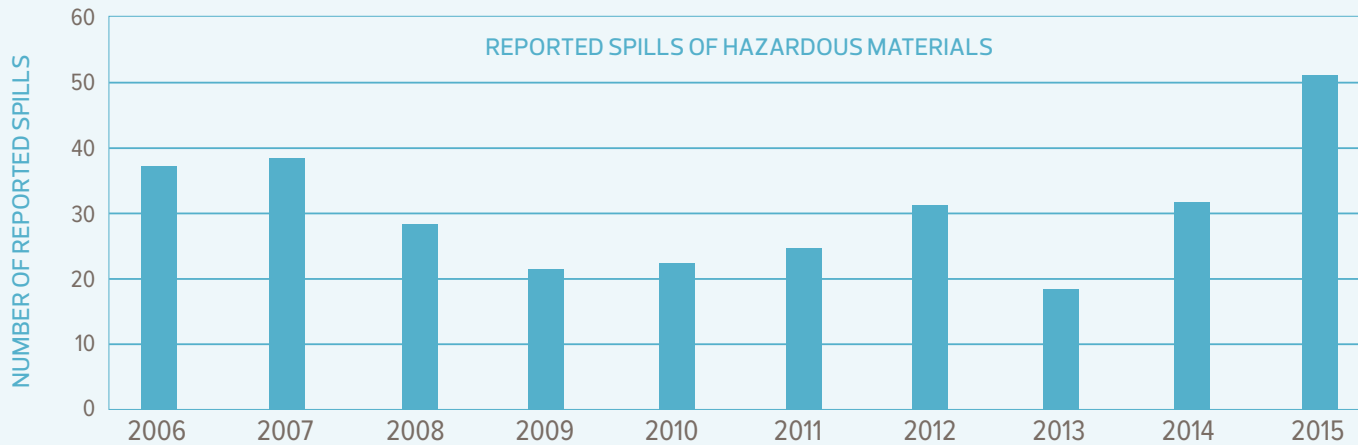
In 2015 the Agency questioned whether taking lichen samples within 300 m of the 2011 sampling sites allows a robust statistical comparison over time. DDEC replied that they do not sample at the exact same location each time so as not to deplete lichen and that sampling within 300 m would have no bearing on the results.

**Snow Chemistry Sampling**

DDEC had previously committed to investigate and report on the probable cause of volatile compound variability in far field snow samples. However, information on this subject could not



## REPORTED SPILLS OF HAZARDOUS MATERIALS



be located in the 2014 AQMP report and we would expect to see it in the next AQMP Report.

### Agency Activities

In 2015 the Agency reviewed the 2014 Ekati AQMP report and provided comments. As part of the Jay Project environmental assessment, DDEC agreed to update the Air Quality and Emissions Monitoring and Management Plan (AQEMMP) and in June submitted a conceptual AQEMMP for the Jay Project to the Mackenzie Valley Environmental Impact Review Board (Review Board). The AQEMMP contained an adaptive management framework with triggers, action levels and the criteria required to trigger management responses and actions for NO<sub>2</sub>, PM<sub>2.5</sub> and TSP. DDEC also committed to further engage with interested parties to further develop the AQEMMP and, at the suggestion of the Agency, held a Jay Project management plan workshop on June 26, 2015. A further meeting was held July 20, 2015 to

discuss the 2014 AQMP Report results and the adaptive management response aspects of the conceptual AQEMMP design plan.

### AGENCY ASSESSMENT

The Agency recognizes that DDEC has made significant improvements in air quality monitoring and management at Ekati and in their efforts to engage parties. DDEC has made commitments to ensure staff and operators undertake adequate QA/QC checks of the equipment and that there are regular schedules for equipment recalibration. They have also agreed to update the AQEMMP and have developed a conceptual AQEMMP that includes adding additional sites around the Jay Project (should it be approved). The AQEMMP would also contain an adaptive management framework with triggers, action levels and criteria required to trigger management responses and actions for NO<sub>2</sub>, PM<sub>2.5</sub> and

Project. And finally, we encourage DDEC to continue to develop a revised AQEMMP collaboratively with interested parties. The Agency has had a long-standing interest in air quality and dust suppression at Ekati Mine. The Agency has pressed DDEC for a number of years to conduct research on dust suppression products and methods. We are pleased that DDEC began initial trials in 2015 on a new dust suppressant EnviroKleen which shows promise, and that they will be expanding this study during 2016.

We continue to suggest that a Traffic Management Plan to reduce fugitive dust be developed which considers mitigation, including vehicle spacing, cameras for monitoring the amount of dust (visibility), and quantitative triggers or thresholds when dust suppressant must be re-applied. We look forward to a dust management best practices document that provides clear guidelines and protocols for the application of suppressants.

Lastly, the Agency is concerned that there are no enforceable air quality standards in the Northwest Territories and no regulatory system to manage air quality. The Agency recommends that the GNWT develop an appropriate and enforceable regulatory framework and system for air quality as soon as possible. ■

TSP. The Agency supports the adaptive management approach. However, we feel its scope should be expanded to include threshold triggers and response actions for dustfall, snow and lichen (longer term trends), as well as dust mitigation. We suggest that additional monitoring locations be incorporated in the program to include the Misery pushback, Lynx Pit, Sable Road and Pit, and the Jay

### SPILLS OF HAZARDOUS MATERIALS

Spills of hazardous materials that exceed quantities set out in the Spill Regulations must be reported to the NWT 24-Hour Spill Report Line. Over the past 10 years, 259 spills have been reported at Ekati including 52 spills, or 20%, occurring in 2015. The most common types of materials spilled are diesel fuel, hydraulic oil, transmission fluid, antifreeze, sewage, fine kimberlite tailings and coarse kimberlite rejects.