



October 27<sup>th</sup>, 2010

Indian and Northern Affairs Canada  
Government of Northwest Territories  
Tlicho Government  
Lutsel K'e Dene Band  
Yellowknives Dene First Nation  
North Slave Metis Alliance

File:S115

**Re: Snap Lake Mine  
2009 Environmental Agreement Annual Report**

DeBeers Canada Inc. is pleased to submit the 2009 Environmental Agreement Annual report as required by the Environmental Requirement made as of the 31<sup>st</sup> day of May, 2004. .

Should you have any questions, comments or require further clarification, please feel free to contact me by phone at (867) 767-8646 or by email at [Alexandra.Hood@ca.debeersgroup.com](mailto:Alexandra.Hood@ca.debeersgroup.com).

Sincerely,  
**DE BEERS CANADA INC.**

A handwritten signature in blue ink that reads "A. Hood".

Alexandra Hood  
**Permitting Coordinator**  
Snap Lake Mine



DE BEERS CANADA INC.  
SUITE 300, 5101-50<sup>th</sup> AVENUE, YELLOWKNIFE, NT X1A 3S8  
TEL 1 (867) 766-7300 FAX 1 (867) 766-7347  
[www.debeerscanada.com](http://www.debeerscanada.com)



# Snap Lake Mine | Environmental Agreement 2009 Annual Report



August 2010



## PLAIN LANGUAGE SUMMARY

The Snap Lake Mine (Mine) is a diamond mine owned and operated by De Beers Canada Inc. (De Beers), and is located about 220 kilometres (km) northeast of Yellowknife, Northwest Territories (NWT). De Beers received regulatory approval for the Mine in 2004, which included an Environmental Agreement. Mining began in 2007 and is expected to continue for 22 years. We have completed six years of environmental monitoring since construction started for the Mine. This annual report for the Mine's Environmental Agreement summarizes the monitoring activities and results from 2009.

Since we received regulatory approval for the Mine in 2004, we have written 32 monitoring and management plans for the Mine. In 2009, we submitted 18 reports. We submitted 12 annual reports, four reports related to habitat compensation under the Fisheries Authorization, three management plans, one geotechnical report, one monitoring program, and one special request for the Minister. A summary of each of these documents can be found in this report.

Here is a summary of what we found in our environmental monitoring studies in 2009.

**Air quality:** When any fuels are burned, greenhouse gases are produced. We measure the amount of greenhouse gases produced by the Mine because they can add to global warming. We produced more greenhouse gases in 2009 than in 2008, 2007, 2006, 2005 or 2004, because De Beers used more diesel fuel in 2009 than in any other year.

**Aquatics:** We found increases, relative to baseline levels, in dissolved salts, nutrients and a few metals in the water in Snap Lake in 2009. The increases in dissolved salts were greater than expected, and resulted from more loading of dissolved salts from the mine dewatering process in the underground mine than originally planned. These changes are not harmful to fish or other life in Snap Lake. We checked the amount and types of algae, and bugs that live in the water and on the bottom of Snap Lake, to see if there were any changes in food for fish compared to previous years. The amount and types of algae and bugs in the water of Snap Lake have changed from year to year, but this may not be related to the mine alone, because similar changes also occur in all lakes. The number of different types of bugs on the bottom of Snap Lake in 2009 was similar to those in previous years, and the Mine only had a small effect on them. We also checked the mud that the bugs live in at the bottom of the lake and found that two nutrients and a few metals were higher.

**Archaeology:** None of the sites discovered near the winter road and Mine were disturbed in 2009.

**Hydrology:** There were slight changes in water levels in Snap Lake which were about the same as other lakes near the area. Water level increases are less than predicted in the EAR and appear more related to climatic conditions than mining influences.

**Hydrogeology and Geochemistry:** The rock types at the Mine have not changed from what we thought they would be. We have discovered that more water is seeping into the underground mine than we thought there would be and as a result, there are more salts in the water. We are looking into different technology alternatives to solve this issue.

**Vegetation:** Satellite pictures were taken of the Mine to check the total size of area impacted by the Mine in 2008. We found that the impact on vegetation was less than we thought it would be. All vegetation communities were impacted less than we expected, except for the esker. We thought only 0.5 hectares (ha) of the esker would be disturbed, but 1.6 ha of the esker was disturbed in the winter of 2001. No further disturbance on the esker is expected to happen. Dustfall exceeded the Alberta Ambient Air Quality Objective for commercial and industrial properties at one sampling location for four consecutive months. This is believed to be a result of dumping in close proximity and the switch from the North American Occupational Safety and Health (NAOSH) hygiene standard to an environmental standard for measurement. Overall, dust does not appear to be having an effect on vegetation at the Mine site.

**Wildlife:** In 2009, monitoring indicators for caribou, grizzly bear and wolverine all indicated low levels of activity in 2009, but this is likely related to the recent declines in the Bathurst caribou herd. We continued to monitor peregrine falcon nests in the area, the number of occupied nests was the lowest yet recorded in 2009, but the total number of chicks observed was within the range observed during the baseline studies. Incidents in 2009 were mostly related to fox and wolverine at site, and some isolated incidents included caribou and grizzly bear. Wildlife mortalities have been very rare at Snap Lake, but in 2009 a ground squirrel, a fox and a wolverine, were all found dead within the mine boundaries.

**Compliance:** There were thirteen inspections conducted by Indian and Northern Affairs (INAC) in 2009. All issues brought up by the Inspector were addressed or are being addressed.

**Mitigative Measures:** Due to the economic downturn in 2009, Snap Lake was operating at a reduced capacity and few mitigative actions occurred. Mitigative measures adopted in 2009 include signage being installed at the SNP stations and repair to the eroded area at the historic Nitrate Storage pad.

**Adaptive Measures:** Adaptive measures adopted in 2009 included continued monitoring of the temporary Nitrate containment facilities, establishment of three new monitoring stations to monitor run-off; ice and sludge was excavated from the water management area to increase capacity at the Water Management Pond.

Improvements to the Ammonia Nitrate Source Control Plan were updated to include off loading procedures, clean up methods, monitoring stations and handling strategies.

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## TRANSLATIONS

### That'in Yati Nezû Benuredi Xa K'yréhtá'is

Snap Lake Tsamba k'é háæâ sí, De Beers Canada Inc, húlye diamond mine heáæâ æat'e, Beghúldesche ts'î yutthç ts'ʔn nónonas náke dech'yn hániáttha heáæâ æat'e. 2004 kú, De Beers tsamba k'é núhúæa xa hê héts'edi sí æedÿri Environmental Agreement húlye, æeyi tth'i bexél æalyá. 2007 k'e búnídhÿr –u, nónonas náke ghay xa beghálada xa sni. Tsamba k'é haáé ghâ húnídhÿr ts'î sôlâgh ghay xa ní-u, ch'adí-u bolni ghâ náide æat'e. Æedÿri æíáágh ghay hant'u Mines Environmental Agreement t'at'u beghálada sí ghâ æereht'ís híltsi sí, níghay 2009 t'at'u ní-u, ch'adí-u bolni-u beghálada sí ghâ t'e.

2004, tsamba k'é núhút'a xa hê nuwéts'edi sí ts'î, tonas náke æeák'éch'a æerehtá'ís híltsi'î æat'e, t'at'u ní-u, ch'adí-u bolni xa dídi sí ghâ. 2009 kú ts'î, harelyø t'á æeák'édíæadhel æerehtá'ís, reports húlye, híltsi'î æat'e. Æíáágh ghay hant'u reports híltsi sí, æeyi hát'i nákeæadhel ditá'ís-u, tu t'a áue nádé sí, bet'áit'ñ Fisheries Authorization húlye gháre, æeyi na náilni sí ghâ dí æerehtá'ís híltsi'î –u, tagh t'at'u beghár æeghálada xa æerehtá'ís híltsi'î-u, æíáágh tthe t'at'u beghálada xa æeyi ghâ æerehtá'ís híáts'î-u, æíáágh t'at'u t'así badi sí ghâ æerehtá'ís híltsi'î-u, tth'i æíáágh K'aladhÿr Néth Theda beba æerehtá'ís ditá'ís, yerekér t'á. Æedÿri harelyø æerehtá'ís sí, æedÿri æerehtá'ís ye thela æat'e. 2008 já t'así holni –u, bek'aunita sí æeyi ghár æedÿri bek'úrilyâ.

**Yí ts'ejí t'at'e:** Táes k'erek'ã dé, greenhouse gas húlye sé, haáé æat'e. Æedÿri hát'e já tsamba k'é greenhouse gas haáé sí, húltá-u, bolni, æeyi hát'i bet'á deæããs ní nídhil æane t'á. Æeyi ghár bek'úrilyâ 2009 xa dé 2008 –u, 2007 – u, 2006 –u, 2005 –u, 2004 æeyi æããzñ greenhouse gas híltsi'î, De Beers 2009 k'e deæániát'e táes k'eriák'ã tá.

**Tu yághe t'así dána:** 2008 xa dé, t'atthe t'aut'e hílé ghár net'î dé, Snap Lake tu yé dedhay-u, t'así ni-u, tth'i satsán-u, æeyi hát'i sí deæániát'eæaze æaja k'é. Tu yé dedhay deæániát'e æajá sí yudagh náridhir xa bunilthÿn æat'e húlí, t'aniát'e hunithÿn sí æããs æaja k'e, níæayaghe tthe beghálada ts'î æʔné æaja æat'e. Æedÿri hat'e sí, Snap Lake t'asi dána bet'á t'asi tsçdhir hat'ele, t'ánchay –u, áue-u. Snap Lake t'así dánishe sí, niáæí, t'at'i-u, t'aniát'e-u, tth'i guaze tu yághe nádé sí, æeyi harelyø nilæí beghár áue t'at'á dana sí k'éníghay ts'i æedû æaja dé xa bolni. Snap Lake yé t'anchay –u, guaze dána sí, æíáágh ghay hant'u æedû æuniáé æunt'e húlí, tsamba k'e háæâ æeyi æúái t'át'ele sã, æeyi begháathÿn tu dátheæâ dólí sí, æeyi tth'i hárá't'e t'á. 2009 ke, tu theæâ bet'ágh

t'at'i guaze dáníye sí, æedû æajaile, æeáéát'ây –u, tsamba k'é theæâ sí t'á sájaile. Tth'i tu theæa betá'agh hatá'és guaze yeyé nádé sí æeyi tth'i nilæñ-u, náke æeák'éch'a ni-u, nay satsán tth'i, æeyi t'a tu tu tadile háæâ sí, æeyyr nár t'a deæániát'e.

**Dýnezás k'é ts'î t'asíe bek'auneta:** 2009 kú xay tîlu haæa gá chu tsamba k'é haæa nár yunís t'at'u náts'ide hîlé sí, hulæâ béhts'édile.

**Ní túé bek'ónelta:** Snap Lake t'aníát'e tu sí, k'áæøaze æaja æunt'e húlí, æeyi nár tu dátheæâ dólí sí, æeyi tth'i hárat'e. Tu yudágh æajá sí, EAR húlye, æeyi beyé t'ane xa sni sí æeyi bek'áæð –u, dû bñt'as æedû æane sni sí æeyi t'át'e æudi, tsamba k'é theæa t'áíle.

**Ní yághe tu hetá'él chu tthetsñ chu:** Tsamba k'é náre t'at'i tthe dólí xa yiddhÿn sí, æedû æat'ele. Ní yághe ts'amba k'é háæâ yé, t'aníát'e tu beyélbî niddhÿn sí, æeyi æeãs tu beyélbî k'é, hat'e t'á tu yé deæániát'e dedhay hulí. Æedÿri jat'e sí, silne ríldzagh xa bek'e æeghálaida æat'e.

**T'anchay dáníshe:** 2009 kú, yudághe ts'i tsamba k'é háæâ sí, benþrihtá'ís hílchu t'aiáya ní t'át'i nilæi xa. Tsamba k'é theæa t'á t'anchay dáníshe t'aníát'e ts'çdhir xa yidhÿn sí, hát'ele k'é. Áésbay tthe húæa, æeyi benás harelyû æeyyr nár t'anchay dólí sí, hótá'þth ts'ñdhir lek'e. Harelyø t'á 0.5 hectares húlye, háíáyâ náílina xa yidhÿn æat'e ni, hat'e húlí, 2001 xay kú harelyø t'á 1.6 hectares húlye náána k'é. Áésbay tthe húæay sí, hót'a náílina xaile sã. Æeyyr nár tthay yaitth'ay sí, yunághá Alberta k'éyághe tsamba k'é hála nár t'aníát'e tthay yaitth'ay húltágh sí dí zá xa badi ghár æeyi k'áæð æat'e k'é bek'úrejâ. Æedÿri t'at'á hájá hunidhÿn sí, nidhíle tthay æaddhir –u, tth'i t'at'u húdzái hultá sí æeyi æedû hultágh æaja æat'e hunidhÿn. Harelyû t'á, tsamba k'é háæâ nár tthay yaitth'ay sí t'á t'anchay dáníshe ts'éde lácháht'íle.

**Tech'adí:** 2009 kú, tsamba k'é háæâ nár æetthþn –u, dléze –u, nághay-u, æat'i badi ghár, æeyi k'áæð æaja k'é 2009 xa, hat'e húlí, æeyi sí æetthÿn (Bathurst

Caribou Herd húlye) k'æð æaja t'at'e sã bunidhÿn. Jíschogh æeyÿr nár bet'ógh dáthela sí æaãð badi, bet'ógh yé æÿyis húlî sí, 2009 æeyi ghay k'e deæããz áãîle, hat'e húlî, t'aníât'e hultá sí, t'atthe ts'ÿn hultá sí, kís æeáéât'e. 2009 k'e tsamba k'é háæâ nár ch'adí het'i huâta xa dé naghídhe –u, nághaye-u, hát'i t'a het'î –u, tth'i halâîle húlî, æetthÿn chu, dléze chu tth'i het'î. Tsamba k'é háæâ nár æâák'é æøâi ch'adí thade, hat'e húlî 2009 xa dé, æíáágh tthÿli –u, æíáágh naghídhe-u, æíáágh nághay-u æeyi hat'i thaidé k'é húlæâ, tsamba k'é háæâ ts'ÿn nidhíle.

**Yati thelá ghár æeghálada:** 2009 k'e Indian and Northern Affairs (INAC) húlye harelyø t'á tagh æadhel k'énedhé æaté nezø huniáæi æat'e. Harelyø t'a ghá yati níla sí, æahdÿn beghálahdáile dé, bek'e æeghálada æat'e.

**Ní tsçdhir tthe beghár æeghálada xa yati xalé:** 2009 kú, harelyø tsÿn tsamba haáé áãîle t'á Snap Lake hanoni bek'a æeghálahdáile, æeyi t'á t'así ts'édhir ch'á badi beghálada sí, k'æð bek'e la hálî. 2009 k'e, t'a la hálî sí, t'a ts'î tu bekauneta dáhála sí, æerehtá'ís daáya –u, tth'i Nitrate húlyé t'a bek'áni sí, senalyá, beghauæâ áája t'á.

**T'así æedû æáne beghár æeghálada xa yati xalé:** T'así æedû æáne begharé æeghálada xa dé, 2009 k'e Nitrate húlye t'a bek'áni sí, æaãû badi-u, tu nalghî dé æatá'ir áinî æeyi tagh ts'ÿn badi xa núúhøt'â-u, tth'i t'a tu sureldhÿn bek'áni háæâ sí ts'î tÿn chu hataés lat'i æatá'ir chu hágér, t'a tu bek'áni k'é deæããâyâ æalne xa

Ammonia Nitrate Source Control Plan húlye sí, net'ñ-u, beghár t'at'ú beghálada xa yati senalyá, t'at'u hálye-u, haitá'ir dé, t'at'u selne-u , t'a t'a badi-u tth'i t'at'u k'ejan ts'érélyi xa

## Snap Lake Nde Hoidi Naa-wo Environmental Agreement

Snap Lake Mine, diamond gha soᓄmbak'e goᓄᓄᓄ sii De Beers Canada Inc. wets'ouᓄ hoᓄt'e, eyi soᓄmbak'e goᓄᓄᓄ sii Yellowknife Northwest Territories gots'ouᓄ 220 kilometres hat...ou echiqᓄ chiqᓄk'e da k'abatsouᓄ ts'ouneᓄ wheᓄᓄ hoᓄt'e. De Beers 2004 k'e la-ia niᓄht...'e gioᓄchi sii Environmental Agreement Nde Hoidi gha, yati hoᓄliᓄ wexeᓄ adla iᓄle. 2007 k'e soᓄmbak'e wets'ouᓄdahatou eyits'ouᓄ iᓄda-ia naᓄᓄ dats'ouᓄ na-kaᓄ ᓄᓄ gots'ouᓄ egha-lageeᓄda giᓄᓄᓄ. Soᓄmbak'e hoh...e xehoiᓄᓄᓄ gots'ouᓄ ek'eᓄtai xᓄ gots'ouᓄ nde hoidi wegodiᓄ nats'iᓄᓄts'ee-la hoᓄt'e. Xo tat'e Mine's Environmental Agreement wet...'a edaaᓄni nde hoidi t'a egha-lats'eeᓄda sii dek'eht...'e ats'eeᓄᓄ, di niᓄht...'e at...'e sii 2009 gha hoᓄt'e.

2004 soᓄmbak'e gha la-ia niᓄht...'e goᓄᓄᓄchiᓄ gots'ouᓄ soᓄmbak'e gha edaaᓄni nde hoidi t'a egha-lats'eeᓄda gha 32 niᓄht...'e hoᓄliᓄ. 2009 k'e 18 niᓄht...'e hoᓄliᓄ. Xo tat'e niᓄht...'e hoh...e 12 niᓄht...'e hoᓄliᓄ, niᓄht...'e diᓄ sii Fisheries Authorization gha at...'e, tai sii management gha at...'e, iᓄ...e sii geotechnical gha at...'e, iᓄ...e sii monitoring gha at...'e eyits'ouᓄ iᓄ...e Minister gha at...'e hoᓄt'e. Di niᓄht...'e k'e wegodiᓄ hazouᓄ dek'eht...'e hoᓄt'e.

2009 k'e di haaᓄni nde hoidi t'a wegodiᓄ at...'e hoᓄt'e.

**Niᓄhts'i:** T...eh t'ala k'eᓄk'ouᓄ nideᓄ, t...ehtsiᓄ iᓄᓄᓄᓄ yat'a gots'ouᓄ at'iᓄ hoᓄt'e. Soᓄmbak'e goᓄᓄᓄ t'a t...ehtsiᓄ edaᓄt...ou hoh...e sii ts'iiᓄhdza, hazouᓄ nde k'e k'ehts'i t'a. 2009 k'e diesel t...eh deᓄᓄ wet'aᓄ agiᓄᓄᓄᓄᓄᓄ t'a t...ehtsiᓄ ...ou hoᓄliᓄ

**Te Tah T'asi:** Dakwe...ou nde k'e edaᓄᓄᓄᓄᓄᓄᓄ iᓄle wegahaᓄ ha nideᓄ, te tah dewa, te tah t'asi dehshe eyits'ouᓄ saᓄᓄᓄ te tah goᓄᓄ...iᓄ sii iᓄᓄᓄᓄ adza. Te tah dewa edanaetso ade ha soᓄni ts'iᓄᓄᓄᓄᓄᓄ iᓄle wenahk'eᓄ natso adza, nde goᓄᓄ...a gots'ouᓄ deᓄᓄᓄ ti siᓄᓄᓄ t'a. T'asi haaᓄni t'a ...adiᓄ haaᓄni koᓄ ...iweᓄ eyits'ouᓄ te t'asi yaeshe gha wets'aᓄᓄᓄᓄ le. Asiᓄ ...iweᓄ diᓄ ek'eᓄt...ou soᓄni ts'iᓄᓄᓄᓄᓄᓄ t'a xᓄ tat'e te eyits'ouᓄ eht...'e tah, dlaᓄᓄ eyits'ouᓄ tehtsaᓄ edaᓄt...ou goᓄᓄ...iᓄ sii wek'aetou. Xo tat'e Snap Lake te tah dlaᓄᓄ eyits'ouᓄ tehtsaᓄ xᓄ ...adiᓄ agot'iᓄ, soᓄmbak'e goᓄᓄᓄ t'a zouᓄ niᓄle, tia yawhela sii hazouᓄ giᓄᓄᓄ ...adiᓄ agot'iᓄ hoᓄt'e. 2009 k'e Snap Lake te tah tehtsaᓄ edaᓄᓄᓄᓄᓄᓄᓄ iᓄle sii, iᓄᓄᓄᓄᓄ xᓄ xᓄᓄᓄ'e, soᓄmbak'e wegaᓄᓄᓄ goᓄᓄᓄ t'a yazea zouᓄ ...adiᓄ adza. Te eht...'e tah tehtsaᓄ k'aetou koᓄ, ...iweᓄ di na-kaᓄ kaᓄᓄᓄ go...iᓄ adza eyits'ouᓄ satsouᓄ sii yazea deᓄᓄᓄ adzal.

**Wha-ehdom Koy k'e-e:** 2009 xo tipli ga-ya eyits'om soymbak'e ga-ya wha-ehdom k'e-e go-ya la sii naedom le.

**Ti K'e-t...s:** Snap Lake te edagoniyi-wha iule sii yazea ...adij adza, tia hazom yawhela e...exe-t'e ...adij adza. EAR wenijht...e k'e edategoniyi-wha agode ha ts'iyi-wom iule wek'a-i, nde adeh-i t'a ney laani, soymbak'e nahk'e.

Ti K'e-t...s eyits'om Kwe-ti: Soymbak'e kwe eda-hot'iy go...iy ts'iyi-wom iule sii aiy...iy ...adij adza le. Nde got...a de-om ti k'e-t...s t'a ti tah kwe-ti ts'om de-om dewa na-tso laani. Si-ts'ee-le gha edaa-ni ...adij weghe-lats'ee-da ha di le sii hats'ee-ta ha hojt'e.

**Iqt'om Dehshe:** 2008 k'e yat'a satellite dae-a t'a soymbak'e gomomom-nde edaijchho wexe-ehdi sii wek'e-hodzo gha wenijht...e i-iy iule. Nde k'e iqt'om deshe sii edaijchho wexe-ehdi ha souni ts'iyi-wom iule wek'a-i wexe-ehdi. Iqt'om hazom ka-a go...iy sii k'a-i wexe-ehdi, what'a zom wexe-ehdi laani. 0.5 hectares what'a haijchho zom wexe-ehdi ha souni ts'iyi-wom iule haa-ni ko 2001 xo k'e 0.6 hectares what'a haijchho wexe-ehdi. We-om gots'om k'achij what'a wexe-ehdi ha le. Eht...e eda-t...om nde k'e na-t...i sii Alberta Ambient Air Quality Objective wenahk'e adza, eht...e na-t...i k'aeta k'e-e go-om ts'om, dij sa-ya gots'om haijt'e. T'asi e...aet...i k'e-e wets'om nijwa le whe-om t'a ney souni gijom eyits'om North American Occupational Safety and Health eyi wet...a wehoidi iule haa-niko eyi sii environmental standard wet...a wehoidi adla t'a ...adij adza gijom. Hazom t'a nide, soymbak'e gomomom-iy iqt'om yaezhe sii wexe-ehdi laani le.

**Tich'adi:** 2009 k'e ekwom, sahcho eyits'om nomgha ...om ts'a-i laani le, Bathurst gots'om ekwom k'a-i adza t'a ney tahko. Eyits'om peregrine falcon det'omcho wet'oh sii wehoidi, di xo 2009 k'e det'omcho wet'oh ...om laani le, haa-niko weza eda-t...om go...e sii aiy...iy. 2009 k'e nomge eyits'om nomgha ts'a-i eyits'om, ekwom eyits'om sahcho sii ts'a-i. Snap Lake tich'adi e...aijwo ts'e-i laani, haa-niko 2009 k'e dlo, nomge eyits'om nomgha soymbak'e ga-ya e...aijwo weghe-t'om.

**La-a Nijht...e Na-a-wo:** 2009 k'e Indian and Northern Affairs gots'a-gijom-de t'a gonijht...e k'agee-htom. La-a Nijht...e K'aehta Doy t'asi hazom ghom da-i-jhke sii weghe wexe gots'iyi-do eyits'om t'asi wehda weghe wexe gots'ee-do ha edexe si-gots'ee-h-i hojt'e.

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**K'aḍiḡ La-aḡ Hoh...e:** 2009 k'eḡ soḡmba hoh...e gha wehodi le agodza t'aḡ Snap Lake k'aḍiḡ la-aḡ hoh...e agiḡḡiḡ-la eyits'oḡ t'asi wehda siiḡ k'aḍiḡ adla. 2009 k'eḡ t'asi k'eḡ eghaḡlats'eeḡda ts'eeḡdi iḡle t'aḡ, la-aḡ k'eḡeḡ niḡht...eḡ dawhela ats'iḡḡiḡ-la eyits'oḡ Kwiḡcho K'eḡhodi Koḡḡi ndeḡ siḡdla hoḡt'e.

**Úadiḡ La-aḡ Hoh...e:** 2009 k'eḡ whaḡlea gots'oḡḡi kwiḡcho k'eḡhodi k'eḡeḡ ḡoḡḡoḡ siiḡ iḡḡ...aḡḡi wehoidi ha, ti, ḡoliḡ eyits'oḡ eht...eḡtiḡ e...aet...eḡ k'eḡeḡ tai hoh...e ha, deḡḡoḡ tiḡ iḡḡoḡḡi t'aḡ siḡḡiḡḡi gha.

Edaaḡni Kwiḡcho K'eḡhodi wenipht...eḡ siḡnadla t'aḡ, edaaḡni k'eḡḡeeḡle, edaaḡni siḡts'iḡḡiḡḡiḡhwhoḡ eyits'oḡ kwiḡcho k'eḡhodi koḡḡi eghaḡlats'eeḡda ha siiḡ dek'eḡht...eḡ agiḡḡiḡla hoḡt'e.

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## ABBREVIATIONS AND ACRONYMS

AMP	Adaptive Management Plan
ANFO	ammonium nitrate and fuel oil
AQEMMP	Air Quality and Emissions Monitoring and Management Plan
AQMP	Air Quality Monitoring Program
ARD	acid rock drainage
BOD	biochemical oxygen demand
C&R	Closure and Reclamation
CCME	Canadian Council of Ministers of the Environment
De Beers	De Beers Canada Inc.
DFO	Fisheries and Oceans Canada
DO	dissolved oxygen
EAR	Environmental Assessment Report
ELC	ecological land classification
EMP	Emissions Management Plan
EMS	Environmental Management System
ENR	Department of Environment and Natural Resources
ERP	Emergency Response Plan
ERT	Emergency Response Team
GHG	greenhouse gas
GNWT	Government of the Northwest Territories
Golder	Golder Associates Ltd.
INAC	Indian and Northern Affairs Canada
LSA	local study area
Mine	Snap Lake Mine
MSDS	Material Safety Data Sheets
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
NO <sub>2</sub>	nitrogen dioxide
NO <sub>x</sub>	oxides of nitrogen
NWT	Northwest Territories
OSWRPKMP	Ore Storage, Waste Rock, and Processed Kimberlite Management Plan
PAG	potentially acid generating
PK	processed kimberlite

PM	particulate matter
PM <sub>10</sub>	particulate matter nominally less than or equal to 10 micrometres (µm) aerodynamic diameter
PM <sub>2.5</sub>	particulate matter nominally less than or equal to 2.5 µm aerodynamic diameter
Project	Snap Lake Project
PSP	permanent sample plot
QA/QC	quality assurance/quality control
RSA	regional study area
S27	Stream 27
S29	Stream 29
SHE OPs	Safety, Health, and Environment Operational Procedures
SLEMA	Snap Lake Environmental Monitoring Agency
SNP	Surveillance Network Program
SO <sub>2</sub>	sulphur dioxide
TDG	transportation of dangerous goods
TDS	total dissolved solids
TSP	total suspended particulate
TSS	total suspended solids
VEC	valued ecosystem component
VMP	Vegetation Monitoring Program
WEMP	Wildlife Effects Monitoring Program

#### UNITS OF MEASURE

%	percent
µg/L	micrograms per litre
µg/m <sup>3</sup>	micrograms per cubic metre
µm	micrometres
cm	centimetre
cm/s	centimetres per second
g	grams
ha	hectares
kg	kilograms
kg/yr	kilograms per year
km	kilometres

km <sup>2</sup>	square kilometres
kt	kilotonnes
kt/yr	kilotonnes per year
L	litres
L/s	litres per second
m	metres
m/s	metres per second
m <sup>2</sup>	square metres
m <sup>3</sup> /d	cubic metres per day
mg/dm <sup>2</sup> /30d	milligrams per square decimetre per 30 days
mg/L	milligrams per litre
mg/station	milligrams per station
mm	millimetre
organisms/m <sup>2</sup>	organisms per square metre
ppmw	parts per million by weight

# 1 INTRODUCTION

De Beers Canada Inc. (De Beers) owns and operates the Snap Lake Mine (Mine). The Mine is located in the Northwest Territories (NWT) approximately 220 kilometres (km) northeast of Yellowknife and 30 km south of MacKay Lake (Figure 1-1).

An Environmental Assessment Report (EAR) for the proposed mine (De Beers 2002a) was completed and submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in February 2002. The MVEIRB in turn completed a review, and recommended that the Mine proceed subject to the implementation of measures to mitigate environmental impacts (MVEIRB 2003). The MVEIRB's report and recommendation was submitted to the Minister of Indian and Northern Affairs (INAC) in July 2003 and received ministerial approval in October 2003. De Beers received the necessary Water License, Land Use Permit, Land Leases, and Environmental Agreement in May 2004 to begin construction and operation of the Mine. Operation of the Mine began in 2007 and is expected to continue for 22 years.

## 1.1 ANNUAL REPORT REQUIREMENTS

As part of its environmental agreement commitments, De Beers must prepare and submit an annual report outlining the results of the previous year's environmental monitoring programs. This report presents a summary of the results of the 2009 Snap Lake Environmental Monitoring Programs.

Article X, Section 10.1 of the Environment Agreement outlines the requirements for the Annual Report submission as follows:

### *10.1 Annual Report*

- a. De Beers shall prepare and submit an annual report (the "Annual Report") to the Parties and the Monitoring Agency for each calendar year during the term of this Agreement.*

**Figure 1-1 Location of Snap Lake Mine, Northwest Territories**

- b. *Each Annual Report shall include the results of Environmental Monitoring Programs, and a rolling summary and analysis of environmental effects data over the life of the Project to illustrate any trends. The actual performance of the Project shall be compared to the results predicted in the environmental assessment and the MVEIRB Report and an evaluation provided as to how De Beers' Adaptive Management has performed to the date of each Annual Report.*
- c. *Each Annual Report shall include, but not be limited to, the following:*
- i. *a comprehensive summary of all supporting information, data and results from the Environmental Monitoring Programs and all studies and research;*
  - ii. *a comprehensive summary of all compliance reports required by the Regulatory Instruments;*
  - iii. *a comprehensive summary of operational activities during the preceding year;*
  - iv. *actions taken or planned to address effects or compliance problems which are set out in the Annual Report;*
  - v. *a comprehensive summary of operational activities for the next year;*
  - vi. *lists and abstracts of all Environmental Plans and Programs;*
  - vii. *verification of accuracy of environmental assessments;*
  - viii. *determination of effectiveness of mitigative measures;*
  - ix. *a comprehensive summary of all Adaptive Management measures taken;*
  - x. *a comprehensive summary of public concerns and responses to public concerns;*
  - xi. *a comprehensive summary of the new technologies investigated;*
  - xii. *the Minister's comments, including any Minister's Report, on the previous Annual Report;*
  - xiii. *a plain English executive summary and translations into Dogrib and Chipewyan using appropriate media.*
- d. *In order to prepare each Annual Report and with a view to both ensuring that an opportunity is provided for early disclosure and discussion of problems and that each Annual Report meets with the requirements of this Agreement, De Beers shall Consult with the Minister, the Monitoring Agency, and the GNWT as De Beers compiles the information and data to be included in such Annual Report.*

Table 1-1 provides a summary of where the requirements of the Environmental Agreement are addressed in the 2009 Environmental Agreement Annual Report.

**Table 1-1 Summary of the Environmental Agreement Annual Report Requirements and Sections Addressing those Requirements in the Annual Report**

<b>Environmental Agreement Section</b>	<b>Requirement in the Environmental Agreement</b>	<b>Section in the 2009 Annual Report</b>
Article X, 10.1, b	Each Annual Report shall include: - the results of Environmental Monitoring Programs - a rolling summary and analysis of environmental effects data over the life of the Mine - the performance of the Mine shall be compared to the results predicted in the environmental assessment and the MVEIRB Report	Section 2 - 2009 Environmental Monitoring Program Summary
Article X, 10.1, b	Each Annual Report shall include: - an evaluation provided as to how De Beers' Adaptive Management has performed to the date of each Annual Report	Section 8 - Summary of Adaptive Measures
Article X, 10.1,c,i	Comprehensive summary of all supporting information, data and results from the Environmental Monitoring Programs and all studies and research	Section 2 - 2009 Environmental Monitoring Program Summary Section 4 - 2009 Report Submissions
Article X, 10.1,c,ii	Comprehensive summary of all compliance reports required by the Regulatory Instruments	Section 5 - Summary of Compliance
Article X, 10.1,c,iii and v	Comprehensive summary of operational activities during the preceding year and next year	Section 6 - Summary of Activities at Snap Lake
Article X, 10.1,c,iv	Actions taken or planned to address effects or compliance problems which are set out in the Annual Report	Section 5 - Summary of Compliance
Article X, 10.1,c,vi	Lists and abstracts of all Environmental Plans and Programs	Section 3 - Summary of Snap Lake Monitoring and Management Plans
Article X, 10.1,c,vii	Verification of accuracy of environmental assessments	Section 2 - 2009 Environmental Monitoring Program Summary
Article X, 10.1,c,viii	Determination of effectiveness of mitigative measures	Section 7 - Summary of Mitigation Measures
Article X, 10.1,c,ix	Comprehensive summary of all Adaptive Management measures taken	Section 8 - Summary of Adaptive Measures
Article X, 10.1,c,x	Comprehensive summary of public concerns and responses to public concerns	Section 9 - Summary of Public Concerns
Article X, 10.1,c,xi	Comprehensive summary of the new technologies investigated	Section 10 - Summary of New Technologies Investigated
Article X, 10.1,c,xii	Minister's Report on the previous Annual Report	Section 1 - Introduction
Article X, 10.1,c,xiii	Plain English executive summary and translations into Dogrib and Chipewyan using appropriate media	Plain Language Summary
Article X, 10.1,d	De Beers shall Consult with the Minister, the Monitoring Agency, and the GNWT as De Beers compiles the information and data to be included in such Annual Report	Section 1.2 - Introduction

Note: MVEIRB= Mackenzie Valley Environmental Impact Review Board; GNWT= Government of the Northwest Territories.

## **1.2 2008 ANNUAL REPORT**

De Beers submitted the 2008 Annual Report to the Minister on March 30, 2010, and distributed it to all Parties and the Snap Lake Environmental Monitoring Agency (SLEMA). Indian and Northern Affairs Canada requested that all Parties forward their comments on the Annual Report indicating whether the report is satisfactory or unsatisfactory. Overall, INAC, North Slave Métis Alliance, SLEMA, and GNWT Department of Environment and Natural Resources (ENR) found the report to be satisfactory with regard to the requirements of the Environmental Agreement. Additional suggestions to improve the document were provided by INAC, these suggestions will be taken into account for future submissions of the Annual Report.

## **2            2009 ENVIRONMENTAL MONITORING PROGRAM SUMMARY**

As required under Article X Section 10.1c (vii) of the Environmental Agreement, this section of the report provides a summary of the 2009 monitoring activities, observations, and comparisons of results with EAR predictions (Table 2-1).

**Table 2-1 Summary of 2009 Snap Lake Mine Environmental Monitoring Programs**

Program	Purpose of the Monitoring Program	Key Activities	Environmental Assessment Report Predictions	Key Results
Air Quality and Emissions Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	<p>Meteorological and hydro-meteorological monitoring</p> <p>Ambient monitoring of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> concentrations</p> <p>Ambient monitoring of dustfall</p> <p>GHG emissions calculations</p>	<p>The maximum predicted SO<sub>2</sub> and NO<sub>x</sub> concentrations were predicted to be below both the applicable NWT air quality standards and the federal objectives.</p> <p>Since the bulk of mining will occur below ground in a wet environment, the particulate emissions are anticipated to be low relative to open pit mining operations. The maximum 24-hour TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> were predicted to be above applicable criteria within and near the active mine area; however, the annual concentrations of these compounds were predicted to be below the respective criteria.</p> <p>Activities and operations at the Project will result in the emission of carbon dioxide and other GHG. The overall GHG emissions (expressed as equivalent CO<sub>2</sub>) from the Project were projected to be 102 kt/yr.</p>	<p>Wind speed, wind direction, and relative humidity were within the long-term ranges for the area. Precipitation at Snap Lake exceeded 30 year Yellowknife climate normals during July, August and September, but was lower than Yellowknife normals during the remainder of the year. Annual average temperatures were within the range of those observed in the past 5 years.</p> <p>The maximum recorded TSP concentration was 194.6 µg/m<sup>3</sup>, observed at TSP Partisol 3 located in the wetlands south of Snap Lake. The average TSP concentration observed across all stations was 17.1 µg/m<sup>3</sup>, which represents a 43% increase from the 2008 average of 12.0 µg/m<sup>3</sup>. The NWT 24-hour TSP standard of 120 µg/m<sup>3</sup> (GNWT 2002) was exceeded once on July 24, 2009 at TSP Partisol 3 (concentration of 194.6 µg/m<sup>3</sup>). Of the 183 samples collected, 111 had observed values above the laboratory detectable limit (61% of total samples). The maximum monitored PM<sub>10</sub> concentration was 50.0 µg/m<sup>3</sup>, observed at Dichotomous Partisol 2 to the south of the ANFO area. The average PM<sub>10</sub> concentration observed across all stations was 24.0 µg/m<sup>3</sup>. The annual average measurement was slightly higher than the 2008 average of 23.8 µg/m<sup>3</sup>. All measurements in 2009 were at or below this guideline. Similar to the TSP results, 59 of 123 samples were below the detection limit. The maximum monitored PM<sub>2.5</sub> concentration was 30.6 µg/m<sup>3</sup>, observed at Dichotomous Partisol 2, south of the ANFO storage area. The average PM<sub>2.5</sub> concentration observed was 13.8 µg/m<sup>3</sup>.</p> <p>The highest monthly NO<sub>2</sub> concentration was 9.0 µg/m<sup>3</sup> during February at Tank passive monitoring site located just west of the tank farm. This peak concentration falls well below the maximum desirable annual level of 60 µg/m<sup>3</sup> set forth in the National Air Quality Objectives (Environment Canada 1981). The single highest SO<sub>2</sub> concentration monitored during 2009 was 1.3 µg/m<sup>3</sup> in January at the Runway passive site. This peak concentration falls well below the maximum annual average objective of 30 µg/m<sup>3</sup> regulated by the GNWT (2002). The comparison of monthly values to annual criteria is conservative as monthly criteria would be expected to be higher.</p> <p>Fuel consumption comprised 24,455,704 L of diesel fuel with a sulphur content of 15 ppmw. Emission rates in 2009 were similar to those for 2008, and the 2009 SO<sub>2</sub> emission rates were lower than in 2008 due to the reduced sulphur content in the diesel fuel.</p>
Aquatic Effects Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	<p>Water and sediment quality monitoring</p> <p>Zooplankton and phytoplankton monitoring</p> <p>Benthic invertebrate monitoring</p> <p>Fish health special study</p> <p>Fish tasting</p> <p>Plume characterization special study</p>	<p>The maximum whole lake average concentrations in Snap Lake of all assessed water quality parameters will remain below water quality guidelines or EAR benchmarks.</p> <p>The maximum total area or volume that could be affected by seepage and runoff would be less than 0.5% of Snap Lake area or volume.</p> <p>The effect on sediment quality is expected to be negligible. Concentrations are expected to stay near baseline levels.</p>	<p><b>Water Quality</b></p> <p>Water quality results from Snap Lake were below water quality guidelines and EAR benchmarks in 2009, with the exception of a number of fluoride results, one iron result and three manganese results. Fluoride concentrations were routinely above the interim CCME guideline for the protection of aquatic life. In cases when fluoride concentrations were above the guideline, they were associated with elevated calcium concentrations and hardness levels, which are expected to reduce the potential for toxicity effects associated with fluoride. The elevated fluoride concentrations were only slightly above the guideline, which is a conservative concentration as the CCME guideline includes a considerable safety factor. Effects to aquatic life due to the observed fluoride concentrations are expected to be negligible. One iron result was above the CCME guideline and the Health Canada aesthetic drinking water guideline and three manganese results were above the aesthetic drinking water guideline. Based on the location where the elevated iron and two highest manganese results were measured, i.e., the northwest arm, the elevated values were unlikely to reflect the effect of the treated effluent, because high concentrations in the northwest arm are inconsistent with the spatial pattern of effluent exposure. The remaining elevated manganese concentration was measured at the bottom of the water column at a diffuser station during open-water conditions. This elevated concentration may be related to the effluent; however, it could also be an anomaly, because the measured concentration was inconsistent with conductivity levels and seasonal patterns. Manganese concentration at this location, which is typically correlated with conductivity, was notably higher than the expected concentration based on conductivity at this station. Furthermore, peak concentrations due to the treated effluent are expected to occur during late ice-covered conditions, when wind-driven mixing is absent, rather than the open-water period.</p> <p>In 2009, one WTP effluent sample and one lake water sample collected at a diffuser station failed a sub-lethal chronic toxicity test for the sensitive water flea species, <i>Ceriodaphnia dubia</i> (IC25). The sub-lethal toxicity observed in the effluent sample is consistent with EAR predictions of potential low-level chronic toxicity in the treated effluent and in the immediate vicinity of the discharge. Some uncertainty exists in the results of the sub-lethal toxicity tests of the lake water at the diffuser site due to an inconsistent dose-response relationship, and differences in water hardness between laboratory controls and test samples.</p> <p>The concentrations and levels of water quality parameters in treated effluent discharges and site runoff to Snap Lake in 2009 were below EAR predictions, with a few exceptions in the WTP, domestic wastewater, and runoff. The higher than predicted concentrations of these parameters in treated effluent did not result in concentrations above guidelines or EAR benchmarks in Snap Lake. Higher than predicted concentrations in runoff are unlikely to cause whole-lake effects in Snap Lake because of the small volumes that enter Snap Lake over a relatively short period each year. Continued monitoring in 2010 will evaluate whether concentrations of these parameters remain above predictions.</p> <p>The following parameters appeared to be increasing in at least one area of Snap Lake in 2009: three physical and conventional parameters (TDS; total alkalinity, and total hardness); eight major ions (bicarbonate, calcium, chloride, fluoride, magnesium, potassium, sodium and sulphate); four nutrients (TKN, ammonia, nitrate and nitrite); and seven metals (barium, boron, lithium, molybdenum, manganese, nickel and strontium). Concentrations of the above parameters are not expected to increase above water quality guidelines, EAR benchmarks, or EAR predictions in the near future, with the exception of the interim CCME guideline for fluoride and possibly manganese.</p>

**Table 2-1 Summary of 2009 Snap Lake Mine Environmental Monitoring Programs (continued)**

Program	Purpose of the Monitoring Program	Key Activities	Environmental Assessment Report Predictions	Key Results
Aquatic Effects Monitoring (continued)				<p>The whole-lake average concentration and cumulative load of TDS from 2005 to 2009 were compared to the annual EAR predictions. Both were higher than predicted; additional information is needed to confirm whether this trend will continue into the future. A review of the EAR predictions will likely be needed in the near-future, which would include updating the predictions for TDS loading and resulting concentrations in Snap Lake. Whole-lake average and maximum concentration of TDS in Snap Lake was below the License limit of 350 mg/L in 2009. The 2009 total phosphorus loading to Snap Lake from the sewage treatment system and water treatment plants was also below the Water License limit of 256 kg.</p> <p>In 2009, the low DO results observed at one station in the northwest arm are unlikely to be related to the treated effluent, because the station with low DO is farther from the diffuser outlet than other stations with no apparent changes in DO. In addition, DO concentrations were also low at this station in 2008, which suggests a factor other than the treated effluent accounting for these findings.</p> <p>Spatial and seasonal patterns were observed in some water quality parameters in Snap Lake. The patterns observed in 2009 can be explained by the discharge of treated effluent and seasonal differences in mixing conditions in Snap Lake. Horizontal patterns included gradual declines in concentration with increasing distance away from the diffuser for TDS and a number of other water quality parameters that were directly associated with treated effluent discharge (i.e., conductivity, most major ions, nitrate, barium, boron, lithium, nickel and strontium). Similar to 2008, concentration gradients within the main basin of Snap Lake for these parameters were less prominent in 2009 compared to gradients observed in the first four years of treated effluent discharges to Snap Lake, from 2004 to 2007.</p> <p><i>Plume</i>- Vertical patterns in field conductivity in 2010 indicated that the plume may no longer be sinking to the bottom of Snap Lake due to a lower density difference between the plume and lake water. Open-water profiles of conductivity indicate that the plume continues to be more evenly mixed throughout the water column during open-water conditions. Near the diffuser, surface waters had a lower conductivity compared to waters below 5 m; however, consistent with 2008, the distinct chemocline observed in 2004 to 2007, around 5 m depth was not present in 2009. Vertical gradients in DO and water temperature were also observed, typically during ice-covered conditions, but these gradients were related primarily to natural lake processes</p> <p><b>Sediment Quality</b></p> <p>Sediment quality monitoring in Snap Lake from 2004 to 2009 documented variability in concentrations of most parameters, both among stations and years, although the 2009 concentration ranges were within a factor of three for most parameters. Elevated concentrations of several parameters at the west end of the northwest arm appeared to be unrelated to Mine activities. Consistent with 2008, the most notable concentration gradient among Snap Lake sampling areas was for available phosphate, which was highest at the diffuser station and decreased markedly with increasing distance. Snap Lake sediments were generally characterized as fine-grained material with elevated TOC concentrations. Northeast Lake sediments exhibited similar characteristics to Snap Lake sediments. Mean concentrations of approximately 40% of the target parameters analyzed in 2009 were higher in Northeast Lake sediments than in Snap Lake sediments.</p> <p>Concentrations of arsenic, cadmium, copper and zinc were above ISQGs at one or more stations in Snap Lake in 2009, and concentrations of cadmium, chromium, copper and zinc were above ISQGs at all stations in Northeast Lake. Similar observations were noted in Snap Lake in previous AEMP years and in 2004 under baseline conditions, which indicate that concentrations of these metals are naturally elevated in both lakes. Chromium concentrations in Snap Lake sediments were above the ISQG in previous years, but not in 2009.</p> <p>Evaluation of spatial and temporal trends in sediment quality did not provide clear evidence of an effect on Snap Lake sediments in areas exposed to treated effluent. Concentrations of available phosphate and sodium varied significantly with bottom conductivity. Bottom conductivity was used as an indicator of effluent exposure. However, additional analysis revealed an effect on sediment quality from exposure to treated effluent was unlikely. Concentrations of available phosphate continued to be elevated in the diffuser area following the large increase that occurred in 2008; concentrations decreased with increasing distance from the diffuser but were still higher than in 2007. Available phosphate concentrations should continue to be monitored for further spatial and temporal changes.</p> <p><b>Phytoplankton/Zooplankton</b></p> <p>Chrysophytes, cyanobacteria, and diatoms have consistently been the dominant phytoplankton groups in Snap Lake between 2004 and 2009, with the proportion of these groups exhibiting seasonal variation. In 2006, an increase in total phytoplankton biomass was primarily related to an increase in cyanobacteria, particularly <i>Aphanizomenon flos-aquae</i>, which was originally thought to be related to nutrient enrichment. However from 2007 to 2009, cyanobacteria biomass in Snap Lake has decreased and microcystin-LR concentrations have remained below the method detection limit, suggesting there may be natural factors that contributed to the 2006 bloom.</p> <p>Significant spatial and temporal variation in total phytoplankton biomass and community composition occur naturally in lakes, and have been observed in Snap Lake between 2004 and 2009. Trend analysis indicated that there has been a shift in phytoplankton biomass-based community composition during this time. While a critical effect size for phytoplankton cannot be established, phytoplankton remains a useful tool for monitoring longer-term changes due to nutrient enrichment in Snap Lake. Continued monitoring of the phytoplankton community is recommended through the open-water season of 2010.</p> <p>Chlorophyll <i>a</i> results to date suggest that the trophic status of Snap Lake has not changed; however, this variable may not be an accurate surrogate of the Snap Lake phytoplankton community. Past analysis of the relationship between lake-wide mean chlorophyll <i>a</i> concentration and mean total phytoplankton biomass was found to be not statistically significant. At this time, continued monitoring of chlorophyll <i>a</i> concentrations is required by the Water License Part G, Condition 2d. Currently, chlorophyll <i>a</i> is not recommended as a surrogate measure of the Snap Lake phytoplankton community, because it may not reliably detect changes in the trophic status of Snap Lake.</p> <p>Calanoid copepods remain the dominant zooplankton group within Snap Lake, with seasonal changes occurring in the biomass of the cyclopoid copepods and rotifers. Cladocerans, also known as water fleas, continue to account for a small proportion of the zooplankton community. A shift in biomass-based community composition has been documented in Snap Lake between 2004 and 2009, but no change in zooplankton biomass was detected over time.</p>

**Table 2-1 Summary of 2009 Snap Lake Mine Environmental Monitoring Programs (continued)**

Program	Purpose of the Monitoring Program	Key Activities	Environmental Assessment Report Predictions	Key Results
Aquatic Effects Monitoring (continued)			<p>The effect of toxicity from changes in sediment and water quality on benthic invertebrates, phytoplankton and zooplankton were predicted to range from negligible to moderate.</p> <p>Snap Lake was predicted to remain mesotrophic (i.e., moderately productive).</p> <p>The effect of changes to Snap Lake and inland lakes and streams was predicted to be negligible for fish abundance and fish health.</p> <p>The permanent diffuser was expected to result in dilution factors that ranged from 34 to 200 across the range of effluent discharges expected over the life of the Project.</p>	<p><b>Benthic Invertebrates</b></p> <p>Differences between Northeast Lake, and the near-field and mid-field exposure areas in Snap Lake in terms of taxa present were minor and not indicative of an adverse effect on the benthic community. Statistical tests comparing benthic community variables among sampling areas detected a significant difference only in evenness, fingernail clam density and density of the midge <i>Microtendipes</i> based on the fall 2009 data. All three significant differences were consistent with nutrient enrichment in Snap Lake. Magnitudes of differences between the Northeast Lake and exposure area means in Snap Lake were greater than the magnitude of variation observed among reference stations in previous years for density variables and dominance. All other variables were within the ranges observed during previous years.</p> <p>Although among-area statistical comparisons between Northeast Lake and exposure areas in Snap Lake provided only limited evidence of effects on the benthic community of Snap Lake, visual evaluation of the differences in abundances of dominant taxa provided additional evidence suggesting a Mine-related effect. Higher total density and densities of dominant taxa including Pisidiidae, <i>Micropsectra</i>, <i>Valvata</i> and <i>Procladius</i>, in the near-field and mid-field areas suggest that nutrient enrichment is occurring in these areas. Higher densities of molluscs are also consistent with increased TDS concentration, which provides a greater amount of major ions used for shell development by these organisms. In addition, trends in benthic community characteristics over time based on late winter data (Golder 2009) indicate that the benthic community is changing over time in a direction consistent with nutrient enrichment.</p> <p>The overall magnitude of the effect on the benthic invertebrate community can be classified as low, because no statistically significant differences were detected in total invertebrate density and richness in the 2009 fall data and taxonomic composition of the community has not changed appreciably compared to baseline conditions. An effect of low magnitude is consistent with EAR predictions.</p> <p><b>Fish Tasting</b></p> <p>Fish tasting was conducted on September 15, 2009, by Elders George Mandeville and Grant Beck of the North Slave Métis Alliance. Fish were caught using rod and tackle on September 14 and 15. All participants reported that the fish tasted good and that the fish were very healthy, "Above Average" to "Average" (good).</p>
Archaeology Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	Aerial archaeological survey	The probability that direct and indirect effects would occur to archaeology sites was rated as negligible.	There were no effects to the archaeology sites in the vicinity of the mine and winter access road.
Hydrology Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	Lake water level and site runoff monitoring	<p>The EAR predicted small increases in the mean water elevation of Snap Lake as a result of mining operations. Predicted increases above baseline conditions ranged from 3.3 to 5.5 cm over the period of operations.</p> <p>Increases in peak flow during the spring runoff are predicted to be negligible, with no effect on channel morphology.</p>	<p>The results indicate that 2009 water levels and streamflow had later than normal peaks resulting in higher than normal water elevations throughout July and August. Snap Lake water levels continue to exhibit similar increases and decreases as other monitored lakes. The EAR predicted small increases in the mean water elevation of Snap Lake as a result of the mining operations. Predicted increases above baseline conditions ranged from 0.033 m to 0.053 m over the period of operations.</p> <p>Annual changes in Snap Lake water levels remain similar to three other monitored lakes in the region. Changes in lake elevation from 2007 to 2009 have remained within a range of previously measured changes and appear to be less than predicted in the EAR for the construction period and early years of operation. Impacts to the water level remain negligible.</p>

**Table 2-1 Summary of 2009 Snap Lake Mine Environmental Monitoring Programs (continued)**

Program	Purpose of the Monitoring Program	Key Activities	Environmental Assessment Report Predictions	Key Results
Hydrogeology and Geochemistry Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	Seepage survey and visual inspection of the site Supplemental sampling of rock	<p>Geochemical characterization completed during the EAR demonstrates that the kimberlite unit at Snap Lake can be classified as non-PAG.</p> <p>During construction and operations, groundwater inflows to the underground mine workings will result in a minor decrease (up to 5%) in deep groundwater levels; however there will be little or no change in the overall quantity of deep groundwater. Groundwater levels will decrease progressively during Project construction and operations, but will be reversed within one month of mine closure.</p> <p>The residual changes in deep groundwater quality due to the underground mine are limited to a small portion (less than 5%) of the LSA during post-closure. There will be no change to deep groundwater quality during construction and operations.</p> <p>Mine affected groundwater was predicted to have a pH of 11.9 and elevated concentrations of aluminum (468 µg/L), chromium (313 µg/L), and molybdenum (81 µg/L) relative to baseline groundwater quality. The high pH and elevated metal concentrations are expected to decline in the long-term; however, the duration is uncertain and could be much greater than 100 years.</p> <p>Changes in shallow groundwater quality will result from a small volume of seepage from the North Pile and the water management pond, resulting in localized effects, originating on the northwest peninsula and seeping into Snap Lake which will be greatest during operations, and decreasing after decommissioning as reclamation proceeds.</p>	<p>The results of geochemical analysis of mine rock samples and water quality samples collected from the Snap Lake Mine did not identify significant changes in A/ARD conditions in 2009 relative to trends observed during previous annual reporting periods. No visible signs of acidic drainage were observed during the site inspections conducted during the 2009 monitoring period. The geochemical evaluation of the main rock types at the Mine (i.e., granite, metavolcanic and kimberlite) has not changed as a result of the visual surveys and geochemical analysis of Mine rock and confirmation geochemistry samples conducted in 2009.</p> <p>New construction included the AN storage facility, the cement storage pad, the permanent accommodation complex rock pad, localized lifts of rock that were placed at the WMP and an access road to the future East Cell. Granitic rock samples collected from these locations contained less than 0.17% sulphide sulphur. Of the 76 samples of granite collected from the underground Mine in 2009, only three samples contained greater than 0.17% sulphur. Rock identified as PAG was directed to the North Pile for deposition.</p> <p>The perimeter embankments of the North Pile continued to be raised with PK coarse and grits. Deposition of PK slimes in the Starter Cell continued during 2009. PK slimes continue to emanate from a diversion ditch in the vicinity of SP1. Furthermore, PK slimes have accumulated in TS1 and TS2. Discharge of PK slimes to the North Pile sumps should be minimized to the extent possible. PK coarse and grits were identified on the haul road between the Process Plant and North Pile. Runoff from this location should continue to be monitored.</p> <p>Areas where metavolcanic had been placed during previous monitoring periods, which were re-evaluated in 2009 include the FAR rock pad and metavolcanic rock in the perimeter embankment of the North Pile. Ongoing monitoring of runoff water from these locations is recommended. The sulphur content of the 14 metavolcanic samples collected during 2009 varied from &lt;0.02% to 0.52%. During 2009, no new areas of metavolcanic placement outside the perimeter of the North Pile were identified.</p> <p>Downstream bog water quality continues to improve at SNP 02-07 and SNP 02-09 as a result of previous remediation activities at the Emulsion Pad. AN bags will be moved to the AN storage facility to prevent future discharges.</p> <p>Minewater inflow rates were lower than EAR predictions during 2009 monitoring period. Total dissolved solids loading trends continue to track well with the EAR predictions; however, elevated inflow rates during initial mine development did result in slightly higher initial loadings than values predicted in the EAR.</p>
Vegetation Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	Calculation of direct impacts to total area and ELC area Satellite data interpretation Soil sampling Dust fall deposition monitoring	<p>At full development, the EAR predicted a total disturbance of 218.8 ha in the LSA and 83.7 ha in the RSA (excluding the LSA).</p> <p>39% of ELC units were predicted to be lost or altered in the LSA.</p> <p>Effects from habitat loss or alteration to rare plant potential were considered to be moderate, and effects on traditional plant potential were considered to be low.</p> <p>The effect of air emissions, including dust, on vegetation health were predicted to be low for the ELC components assessed and for rare and traditional plant health.</p> <p>The effect of the Project on vegetation biodiversity was predicted to be low for all vegetation communities assessed.</p>	<p>A QuickBird satellite image was used to compare the total disturbance area in 2008 with predictions made in the EAR. Disturbance of the LSA and esker complex, as of July 2008, was 155.4 ha (11% of the LSA), which, to date, is below the predicted disturbance area, and therefore the Detailed ELC Monitoring Program is not triggered and modifications to the monitoring program are not needed at this time.</p> <p>Estimates of the disturbance to ELC units were calculated by using both Landsat Thematic Mapper in 2002 and QuickBird satellite imagery in 2008 to compare the Mine footprint with the vegetation types known to be present before start-up construction of the Mine. At full development, there is a predicted total disturbance of 218.8 ha in the LSA and 83.7 ha in the RSA, excluding the LSA. The RSA disturbance consists of the impact to the esker borrow site and associated winter esker access road, and the 35 km winter access Snap Lake Spur Road to the Tibbitt-to-Contwoyto winter road. The total area occupied or impacted by the LSA on July 2008 was 155.4 ha, which represents 71% of the maximum predicted extent of the Mine. For the RSA, construction activities have impacted 2.5 ha or 3% of the expected disturbed area.</p> <p>None of the ELC units have received a greater proportionate disturbance than predicted in the EAR as of July 2008, with the exception of the esker complex. As reported in previous VMP's, the area of disturbance to the esker was expected to be 0.5 ha; however, the actual disturbance was 1.6 ha. Granular material was removed from this esker in the winter of 2000-2001. No further disturbance to this esker is anticipated and none was recorded as occurring up to 2008. Overall, the disturbance covers 11% of the LSA which is below the predicted 15%. The Detailed ELC Monitoring Program is not triggered and modifications to the monitoring program are not needed at this time.</p> <p>During the 2004 and 2005 field surveys, 11 PSPs were established at existing disturbed sites to determine the rate and effectiveness of natural recovery as a revegetation method (i.e., natural revegetation relying on invasion or colonization by local species). Disturbed sites included the quarry at the esker, the air strip, and the old base camp. The established PSPs were assessed in 2008 and a total of 59 plant species naturally colonized the reclamation PSPs; an increase of five additional species from 2006. These plant species were similar to the plant species observed in the control and treatment PSPs for the Triggered Monitoring Programs. Due to the slow growth rates and colonization of vegetation in the arctic, reclamation surveys are not required annually. Reclamation PSPs were surveyed in 2008 and will be surveyed every five years thereafter. They will be assessed for changes in vegetation community composition and changes in soil properties or chemistry over time.</p>

**Table 2-1 Summary of 2009 Snap Lake Mine Environmental Monitoring Programs (continued)**

Program	Purpose of the Monitoring Program	Key Activities	Environmental Assessment Report Predictions	Key Results
Vegetation Monitoring (continued)				<p>Monthly dustfall was collected in the months of February to November, excluding December and January when the field samples were frozen at the time of collection. The four monitoring stations on the Mine footprint frequently had the highest total deposition rates which were expected because they were located near areas of high operational activity, which included blasting.</p> <p>The maximum deposition rate of 1,220 mg/dm<sup>2</sup>/30d was recorded at DF010 in May 2009. The rest of the dustfall deposition rates were relatively low in May and all were within the Alberta Ambient Air Quality Objective (AENV 2005). Fourteen samples exceeded the 158 mg/dm<sup>2</sup>/30d guideline for commercial and industrial properties, with consecutive exceedences at DF010 for the months of March, April, May and June.</p> <p>In past years dustfall was measured using a NAOSH hygiene standard. In 2009, dustfall was measured using an environmental standard making comparison to past years misleading.</p> <p>These results cannot be used solely to ascertain whether dustfall is affecting vegetation communities. The Alberta dustfall criteria were developed in 1975 to address aesthetic concerns associated with elevated dustfall levels (Long Fu, 2006, pers. comm.). However, there are no scientifically defensible relationships between these dustfall criteria and discernible effects on vegetation communities.</p> <p>There were no sign of dust accumulation or impacts to vegetation in surveyed control or treatment PSPs in 2008. However, dust accumulation and localized plant stress was observed around the airstrip, particularly on the east and west ends. This may indicate that dust impacts are localized to the area immediately surrounding the airstrip due to chronic dust generation and dispersal; however, based on observation alone, it cannot be concluded if dust is a causation, contributing, or nonfactor in the impaired plant health.</p>
Wildlife Effects Monitoring	Verify the accuracy of impact predictions made in the EAR and meet regulatory requirements and corporate commitments.	<p>A comprehensive analysis conducted on data conducted to date (2004 to 2007)</p> <p>Surveys specific to each of the VEC species to assess changes to abundance and distribution</p> <p>On-site monitoring and wildlife management to avoid and document wildlife injuries and mortalities</p>	<p>Based on estimates of home range size and the area of the Project lease in which wildlife habitat will be disturbed, the effect of direct habitat loss was predicted to be low for each of the current VEC species (i.e., &lt;1% for caribou, grizzly bears, and wolves, &lt;5% for waterfowl, &lt;10% for wolverines and 22% for falcons).</p> <p>The effect of indirect habitat loss on VEC species from dust was predicted to be low.</p> <p>The effects of blasting, human, vehicle and aircraft traffic, habitat fragmentation and increased access on wildlife movement and behaviour was expected to be negligible to low for all VEC species.</p> <p>The effects of wildlife attraction, wildlife-human interactions, vehicle collisions, toxic spills, and increased access for hunting and trapping on wildlife abundance were predicted to range from negligible to moderate for VEC species. Moderate effects were predicted for raptors, wolverines and barren ground grizzly bears.</p>	<p>Data collected to date have not indicated any changes to caribou group size or density, although the between-year variation in these measures is very high. There was evidence of avoidance. The occurrence of nursery groups was also influenced by distance to the Mine, and there is a lower likelihood of observing nursery groups near the Mine. Caribou behaviour (from aerial surveys) was explained largely by environmental factors rather than proximity to the Mine.</p> <p>There was some indication that the probability of detecting fresh grizzly bear sign occurrence has decreased both over time and with distance from the Mine, in sedge wetland habitats. Bear sign occurrence varied by year in riparian plots, and also increased with distance to the Mine, indicating avoidance. The likelihood of observing wolverine snow-tracks was related to environmental conditions and the distance from the Mine. The likelihood of observing tracks increased with proximity to the Mine, indicating that wolverine are being attracted to the Mine. There may also be a temporal decline in the occurrence of wolverine within the study area. Falcon continue to nest and reproduce in the study area. The number of nests in the study area is too low to draw firm conclusions about the effect of the Mine. In general, the results support the predictions made in the EAR that the indirect effects from the Mine on wildlife would be low. Some of the uncertainty associated with the results may be reduced with time. In the EAR, low impacts were defined as within the range of natural variation. There have been numerous occurrences of wildlife species within the Mine footprint, but mitigation, waste management, and deterrent actions have been successful at limiting injury or death to these species. The effect of the Mine on wildlife abundance has therefore been negligible to low, which supports the predictions made in the EAR.</p> <p>As of July 2008, the footprint of the Mine was 155.4 ha, and no deviation is expected from the predicted area of disturbance at full Mine development. The results support the impact prediction made in the EAR.</p> <p>The area within approximately 100 m of the project footprint may experience some impacts due to dust, but the environmental consequence is equivalent to that predicted in the EAR.</p>

Note:

A/ARD = acid/alkaline rock drainage  
 AN = Ammonium Nitrate  
 AEMP = Aquatic Effects Monitoring Program  
 ANFO = ammonium nitrate and fuel oil  
 CCME = Canadian Council of Ministers of the Environment  
 CO<sub>2</sub> = carbon dioxide ;  
 DO= dissolved oxygen  
 EAR = Environmental Assessment Report  
 ELC = ecological land classification  
 FAR = fresh air raise  
 GHG = greenhouse gas  
 ha = hectares ;  
 ISQG = Interim Sediment Quality Guidelines  
 kg = kilograms

kt/yr = kilotonnes per year  
 L = litre  
 LSA = local study area  
 m = metre  
 mg/dm<sup>2</sup>/30d = milligrams per square decimetre per 30 days  
 mg/L = milligrams per litre  
 PM<sub>10</sub> = particulate matter with particle diameter nominally smaller than 10 micrometres (µm)  
 PM<sub>2.5</sub> = particulate matter with particle diameter nominally smaller than 2.5 µm  
 ppmw = parts per million by weight  
 NO<sub>2</sub> = nitrogen dioxide  
 PAG = potentially acid generating  
 PK= processed kimberlite  
 PSPs = permanent sample plots

RSA = regional study area  
 SO<sub>2</sub> = sulphur dioxide  
 TDS = total dissolved solids  
 TKN = Total Kjeldahl Nitrogen  
 TOC= total organic carbon  
 TSP = total suspended particulate  
 VMP = Vegetation Monitoring Program  
 WMP = Water Management Pond  
 WTP = Water Treatment Plant  
 < = less then  
 % = percent.  
 µg/L = micrograms per litre  
 µg/m<sup>3</sup> = micrograms per cubic metre

### **3 SUMMARY OF SNAP LAKE MONITORING AND MANAGEMENT PLANS**

De Beers Canada Inc. (De Beers) has developed a total of 25 compliance reports (11 Monitoring Programs [Section 3.1] and 14 Management Plans [Section 3.2]) for the Mine to meet the requirements under its regulatory approvals and corporate commitments. The monitoring programs were developed to verify the impact predictions made in the Mine's EAR (De Beers 2002a) for the construction, operation, and closure phases of the Mine. The management plans were developed to outline operational practices and procedures for mitigating impacts associated with the Mine.

This section contains a brief summary of each of the monitoring and management plans that De Beers has produced as part of their regulatory and corporate commitments. Table 3-1 provides a list of all monitoring and management requirements, submission dates, approvals, and status.

**Table 3-1 Summary of Compliance Reports Required Under the Snap Lake Mine's Regulatory Approvals**

Compliance Reports	Source of Requirement	Current Submission Date	Approval Date	Status	Annual Report Section
Adaptive Management Plan (AMP)	Water License Part B, Item 5u, Item 12, and Item 13	27-Aug-04	N/A	In compliance. Updates to the AMP are to be provided in the Water License Annual Report. To date, updates have not been necessary.	Section 3.2.1
Air Quality Monitoring Program (AQMP) and Emissions Management Plan (EMP)	Environmental Agreement, Article VI, Section 6.3d and e and Article VII, Section 7.2a Water License, Surveillance Network Program (SNP), Section D, Item 1, 2 and 3	02-Nov-09	25-Aug-08	In compliance. This document was submitted to the GNWT (ENR), INAC, SLEMA and Environment Canada as one Plan known as the Air Quality and Emissions Monitoring and Management Plan (AQEMMP). Comment was received in February 2007. A meeting between Golder, De Beers and ENR occurred on March 6, 2007. Final revisions are being completed.	Section 3.1.1 and Section 3.2.2
Aquatic Effects Monitoring Program (AEMP)	Water License, Part B, Item 5t, and Part G Environmental Agreement, Article VII, Section 7.2h	March 2009	No response	In compliance. Under the Water License, the AEMP will be reviewed every five years.	Section 3.1.2
Best Management Practices Plan for Ammonia Source Control	Water License, Part F, Item 23	29-Nov-04	N/A	In compliance. De Beers submitted a letter to the MVLWB outlining the Best Management Practices for Ammonia Source Control. This plan is currently under review by DeBeers Canada.	Section 3.2.3
Interim Closure and Reclamation (C&R) Plan "Revision A"	Water License, Part I, Item 1 and 2 Land Use Permit, Part C, Item 74	28-Jan -06	31-May-06	In compliance. The C&R Plan will continue to be updated and refined as the Mine approaches final closure in approximately 2027.	Section 3.2.4
Compensation Design Plan and TSS Monitoring Program for the Water Intake and Mine water Outlet	Fisheries Authorization 4.3	07-Jun-05	23-July-05	In compliance. No update or changes required at this time.	Section 3.1.3
Construction and Monitoring Program for S27	Fisheries Authorization 4.3	02-Mar-06	05-Apr-06	In compliance. No update or changes required at this time.	Section 3.1.4
Domestic Waste and Sewage Management Plan	Water License, Part E, Item 10 Environmental Agreement, Article VI, Section 6.3a(v)	16-Dec-06	15-Feb-07	In compliance. Plan was submitted in November and reviewer comments will be incorporated into the document as required.	Section 3.2.5
Emergency Response Plan (ERP)	Water License, Part H, Item 1 Land Use Permit, Part C, Item 77 Environmental Agreement, Article VI, Section 6.3a(iii)	12-Jun-2009	No response	In compliance. The ERP is reviewed annually. Modified ERPs will be submitted as necessary to reflect new developments and comments from reviewers. This plan is currently under review by DeBeers Canada.	Section 3.2.6

Compliance Reports	Source of Requirement	Current Submission Date	Approval Date	Status	Annual Report Section
Environmental Health Monitoring Program	Environmental Agreement, Article VII, Section 7.2d	30-Sept-03	N/A	This Plan currently does not require approval. It is a trigger program that will not be activated unless dustfall amounts monitored through the AQEMMP are greater than EAR predictions for three consecutive months.	Section 3.1.5
Fish Health Monitoring Plan	Fisheries Authorization 5.8	14-Jul-09	Mar-10	The Fish Health Monitoring Plan was incorporated into the AEMP. Discussions regarding the path forward with fish health are in progress with DFO.	Section 3.1.2
Groundwater Quantity and Quality Monitoring Program	Water License, Part F, Item 5 and 6	15-Sept-05	24-Oct-05	In compliance. Updates to Groundwater Quantity and Quality Monitoring Program are to be provided in the Water License Annual Report. To date, no updates have been necessary.	Section 3.1.6
Hazardous Materials Management Plan	Water License, Part E, Item 14	Mar-06	No response	Plan was submitted in November and reviewer comments will be incorporated into the document as required.	Section 3.2.7
High TDS Response Plan	Fisheries Authorization 5.6.5	N/A	N/A	Not required unless TDS exceeds 350 mg/L in Snap Lake at any depth during three consecutive sampling events.	N/A
Hydrology Monitoring Program	Environmental Agreement, Article VII, Section 7.2g	Jul-09	N/A	This Plan is currently under De Beers review to reflect the hydro-meteorological program.	Section 3.1.7
North Pile Monitoring Program	Environmental Agreement, Article VII, Section 7.2e	Mar-09	No response	This Plan is included as part of the Ore Storage, Waste Rock and Processed Kimberlite Management Plan. Currently being updated by De Beers.	Section 3.2.8
Ore Storage, Waste Rock and Processed Kimberlite Management Plan	Water License, Part E, Items 3-8 Environmental Agreement, Article VI, 6.3a (vii)	18-Nov-08	31-Oct-05	This Plan is currently being reviewed by De Beers. A revised plan was submitted, and DeBeers Canada is currently incorporating reviewer comments as required.	Section 3.2.8
Quality Assurance/Quality Control Management Plan	Water License- SNP- Part B- Items 23 to 25	22-Mar-06	30-Apr-06	In compliance. This Plan is reviewed annually and modified as necessary under the SNP Program.	Section 3.2.9
Quarry Management Plan	Environmental Agreement, Article VI, Section 6.3a (vi) Land Use Permit Part C Item 6	28-Feb-02	N/A	The Quarry Management Plan was submitted as part of the EAR (Appendix III.5). To date the Quarry Management Plan has not been updated because De Beers does not intend to quarry the esker. A Quarry Management Plan will be designed prior to excavation of the esker.	Section 3.2.10
Reclamation Research Plan	Water License - part I, Item 6	28-Jan -06	31-May-06	In compliance. Submitted as part of the C&R Plan.	Section 3.2.4
Restoration Plan	Land Lease Item 15	28-Jan -06	31-May-06	In compliance. Submitted as part of the C&R Plan.	Section 3.2.4
Sampling Plan for TDS, calcium, and chloride	Fisheries Authorization 5.6 Water License, Part F, Item 12	17-Mar-05	21-Feb-06	In compliance.	Section 3.2.11

Compliance Reports	Source of Requirement	Current Submission Date	Approval Date	Status	Annual Report Section
Spill Contingency Plan	Water License, Part H- Item 1 Land Lease, Item 45 Land Use Permit, Part C, Item 77 Environmental Agreement, Article VI, Section 6.3a (ii)	Aug-09	No response	In compliance. The Spill Contingency Plan is reviewed annually. Modified Spill Contingency Plans will be submitted as necessary.	Section 3.2.12
Vegetation Monitoring Program	Environmental Agreement, Article VII, Section 7.2b	01-Apr-05	Nov-09	The VMP has never been approved. De Beers is in the process of updating the document to incorporate changes suggested by the GNWT and Environment Canada for the AQEMMP that directly link to the VMP.	Section 3.1.9
Water Intake Monitoring Program	Fisheries Authorization 5.0	31-May-05	22-July-05	In compliance. This Plan was approved by DFO.	Section 3.1.10
Water Management Plan	Water License- Part F, Item 4 Environmental Agreement, Article VI, Section 6.3a(iv)	21-Mar-05	5-May-05	The document was submitted and DBC currently incorporating reviewer comments as required.	Section 3.2.13
Wildlife Management Plan	Environmental Agreement, Article VI, Section 6.3a(ix), f, and g	30-Nov-07	Under De Beers review	De Beers re-submitted in November 2007 after responding to comments received in February 2007. Additional comments were received in February 2007. These are currently under De Beers review.	Section 3.2.14
Wildlife Effects Monitoring Program	Land Use Permit, Part C, Item 36 Environmental Agreement, Article VII, Section 7.2c	Nov-2009	N/A	The Plan has not received comment from the GNWT.	Section 3.1.11

Note: GNWT = Government of the Northwest Territories; INAC= Indian and Northern Affairs Canada; SLEMA= Snap Lake Environmental Monitoring Agency; MVLWB = Mackenzie Valley Land and Water Board; S27 = Stream 27; TSS = total suspended solids; EAR = Environmental Assessment Report; DFO = Fisheries and Oceans Canada; TDS = total dissolved solids; mg/L = milligrams per litre.

<sup>(a)</sup> Regulatory Requirements are as follows :Mackenzie Valley Land and Water Board Class A Water License MV20001L2-0002 (issued April 2004); Environmental Agreement (issued May 2004); Type "A" Land Use Permit (issued June 2004); Northwest Territories Land Lease #75m/10-1-2, #75m/10-2-2; 75 m/10-3-2; #75m/10-4-2 (issued June 2004); DFO Fisheries Authorization SC00196 (updated August 2006); DFO Approval of Fish Screen for the Temporary Water Intake SC99123-A2 (issued September 2004); DFO Approval for Permanent Water Intake SC00196-7.1 (issued August 2004).

## **3.1 MONITORING PROGRAMS**

### **3.1.1 Air Quality Monitoring Program**

The Air Quality Monitoring Program (AQMP) is a requirement of Article VI, Section 7.2 a) of the Environmental Agreement and Section D (Surveillance Network Program [SNP]), of the Mine's Water License.

The initial draft of the AQMP was prepared in September 2003 and updated in September 2005 based on feedback from the GNWT and Environment Canada. A draft of an Emissions Management Plan (EMP) was submitted to the GNWT ENR and Environment Canada in February 2006 and upon receipt of feedback on this draft document from GNWT ENR and Environment Canada in April and August 2006, these two documents have been harmonized into one document, the Air Quality and Emissions Monitoring and Management Plan (AQEMMP) to demonstrate the linkages between the two programs. The data from the two programs will be presented together each year in the annual report. This plan was submitted in November 2009 to GNWT, Indian and Northern Affairs Canada (INAC), and SLEMA. Comments on this draft have yet to be received.

### **3.1.2 Aquatic Effects Monitoring Program**

The Aquatic Effects Monitoring Program (AEMP) is a requirement of the Water License and Environmental Agreement. A draft AEMP was submitted to the Mackenzie Valley Land and Water Board (MVLWB) in July 2004 and an updated AEMP was submitted in June 2005. This Plan was approved in July 2005.

The purpose of the AEMP is to meet requirements in Part G of the Water License, Section 7.2h) of the Environmental Agreement, related corporate commitments, and to compare Mine-related effects with EAR predictions. Mine monitoring will measure future changes in water and sediment quality, including dissolved oxygen (DO) concentrations within Snap Lake, and effects to the following biological receptors:

- fish health;
- fish taste;
- benthic invertebrate community;
- phytoplankton and zooplankton communities; and
- fish habitat.

The primary study area is Snap Lake, which receives treated effluent from the combined water treatment plant and sewage treatment plant discharges. A reference lake (Northeast Lake) was selected in November 2005 and was approved by the MVLWB in May 2006. It is sampled as part of the annual AEMP field program.

De Beers submits an Annual Report for the AEMP as part of the Water License Annual Report to the MVLWB and Fisheries and Oceans Canada (DFO) by March 31 of each year. This Annual Report describes the AEMP activities that took place in the previous year, including monitoring results for all components listed above and any special studies as required.

### **3.1.2.1 Water and Sediment Quality**

The principal objective of the water and sediment quality component of the AEMP is to provide information that will allow De Beers to evaluate changes in water quality of Snap Lake resulting from the construction, operation, and closure of the Mine. This component of the AEMP focuses on monitoring and analysis of changes in concentrations of specific parameters in the water column (water quality) and lake bottom sediments (sediment quality).

The focus of the water quality program is changes in the following four parameter types:

- nutrients;
- DO;
- total dissolved solids (TDS) and major ions; and
- metals, ammonia, nitrate, and other contaminants.

The sediment quality program monitors for changes in the following parameters in lake bottom sediments:

- nutrients;
- total metals; and
- particle size.

### **3.1.2.2 Fish Health**

The principal objective of the fish health component of the AEMP for the Mine is to answer the study question: "Will fish health be affected by the changes in

water quality in Snap Lake and will any change be greater than that stated in the EAR?” This question is related to the following direct effects:

- lake-wide increases in TDS;
- slight increases in the concentration of hexavalent chromium in the mixing zone and, potentially, in sediments; and
- reduced DO concentrations during winter in deeper areas of Snap Lake.

Fisheries and Oceans Canada has requested that De Beers investigate fish health using non-lethal sampling of juvenile fish to augment adult fish health results. Two special studies have been designed to determine if a non-lethal juvenile fish health study is feasible:

- adult fish health monitoring using Environment Canada’s Environmental Effects Monitoring program protocols for metal mining; and
- a juvenile fish special study using non-lethal sampling methods.

The decision whether to use juvenile lake trout and round whitefish for fish health monitoring will be based on:

- the catchability of the fish;
- the effect size to be detected and statistical power; and
- discussions with DFO about the ecological relevance of Lake Trout, Round Whitefish and Lake Chub versus other fish species.

### **3.1.2.3 Benthic Invertebrates**

The principal objective of the benthic invertebrate community component of the AEMP for the Mine is to answer the question: “Will the benthic invertebrate community be affected by the changes in water and sediment quality in Snap Lake and will any change be greater than those stated in the EAR?” This question is related to the same direct effects as fish health.

Effects monitoring for benthic invertebrates will include comparisons of Snap Lake with a reference lake, evaluation of trends over time, and evaluation of spatial trends within Snap Lake in relation to the effluent diffuser. Temporal trends in Snap Lake will be examined to evaluate whether observed trends in the benthic invertebrate community are consistent with mine discharge-related effects.

### **3.1.2.4 Phytoplankton and Zooplankton**

Both phytoplankton and zooplankton (plankton) communities can be useful indicators of environmental stress because of their rapid turnover times. However, the inherent variability within the plankton community poses a challenge and a limitation to its usefulness as a monitoring tool. The existing dynamics of the Snap Lake plankton communities, like all Arctic lakes, are not well understood. Therefore, the purpose of the plankton component of the AEMP is to collect data annually, with particular emphasis on assessing the following variables within Snap Lake during the open-water season:

- community composition (abundance and percent composition);
- biomass; and
- concentrations of microcystin, which is a cyanotoxin.

### **3.1.2.5 Plume Characterization Special Study**

The principal objective of the plume characterization special study of the AEMP for the Mine is to meet Part G, Item 3f) of the Water License. A plume characterization study is required to assess the performance of the outfall diffuser and to determine the distribution of the diffuser plume in Snap Lake under a variety of conditions (including under-ice in late winter). The purpose of the plume characterization special study is to determine the following:

- the level of near-field mixing achieved;
- the effect of effluent accumulation in Snap Lake on the effectiveness of the diffuser; and
- consistency with EAR predictions in the level of mixing achieved by the diffuser.

Treated effluent is being discharged from the Mine to Snap Lake via a submerged, multi-port diffuser. Effluent mixing is driven by turbulent mixing resulting from the multi-port diffuser outfall and the ambient lake currents. The results of each plume characterization study will be reviewed and if the results are inconclusive or indicate the potential for aquatic effects (e.g., much lower than expected rates of initial dilution), then the need for further surveys or the frequency of monitoring would be investigated.

### **3.1.2.6 Fish Tasting**

Fish tasting is an informal annual gathering of members of Aboriginal organizations and De Beers' staff at the Mine site to taste fish from Snap Lake. The principal objective of the fish tasting is to determine if the flavour and texture of the fish in the lake is acceptable to community members.

### **3.1.3 Compensation Design Plan and Construction Total Suspended Solids Monitoring Plan for the Water Intake and Mine water Outlet at Snap Lake**

As part of the Mine, De Beers constructed two structures in Snap Lake on the northwest peninsula:

- a water intake to draw freshwater from Snap Lake for camp use; and
- a mine water outlet to discharge effluent treated from the water treatment plant and the sewage treatment plant into Snap Lake.

Fisheries and Oceans Canada issued an Authorization for Works or Undertakings Affecting Fish Habitat (SC00196) for the Mine in 2004, which was subsequently updated in 2006. This Fisheries Authorization (SC00196) contains requirements for addressing the fish habitat losses and gains during the Mine's construction. Section 4.3 of the Fisheries Authorization requires that De Beers submit a Compensation Design Plan for each of the fish compensation works for the Mine. The Compensation Design Plan is to contain the following elements:

- a description of activities for the construction of the water intake and mine water outlet in relation to fish habitat compensation works;
- detailed engineering designs;
- general schematics of final designs;
- construction schedule;
- contingencies for construction activities; and
- a summary of how De Beers has incorporated comments from Aboriginal groups into the Plan.

Section 3.0 of the Fisheries Authorization requires that De Beers mitigate against the harmful alteration, disruption or destruction of fish habitat beyond that which is named in the Fisheries Authorization. Construction activities that take place in and near water may have the potential to increase total suspended solids (TSS), which may affect fish habitat as silt is deposited on the lake bottom (a process

referred to as sedimentation). Sections 18 and 19 of the SNP of the Water License requires that TSS and turbidity be monitored during construction of the water intake and mine water outlet in the vicinity of SNP Station 02-22 (mine water outlet) and SNP Station 02-23 (water intake). These sections of the Water License also specify that the manner and frequency of sampling be established by DFO.

These monitoring requirements are addressed in the Construction TSS Monitoring Plan, which is part of the Compensation Design Plan for the water intake and mine water outlet. This plan outlines the approach to measure and monitor the level of suspended sediments in Snap Lake near the water intake and mine water outlet during construction, including monitoring the effectiveness of TSS control measures (silt curtains). It also identifies conditions under which additional mitigation measures are required. This consolidated plan was submitted to DFO in June 2005 and was subsequently approved in July 2005.

Data sheets and photographs obtained to document functioning of the silt curtains will be retained on-site. Water quality data collected at these SNP stations will be reported to the MVLWB in the De Beers monthly SNP report.

### **3.1.4 Construction and Monitoring Plan for Stream 27**

As discussed in Section 3.1.3, compensation for habitat losses is required under Section 4.3 of the Fisheries Authorization (SC00196) for the Mine. The construction of a sedimentation pond berm for the North Pile will eliminate the flow from Inland Lake 6 to Stream 29 (S29) for the life of the Mine; with flow being restored at Mine closure.

To compensate for the temporary loss of habitat in S29, De Beers has proposed undertaking habitat compensation activities in Stream 27 (S27). Activities proposed in S27 (i.e., removal of fish migration barrier), would result in the creation of access to new stream habitat to fish from Snap Lake, and would minimize the disturbance to existing fish habitat. An increase in foraging, spawning, rearing, and nursery habitat for Arctic Grayling is expected with the removal of the blockage, for a total increase of 225 habitat units. The proposed habitat compensation at S27 was the option preferred by Aboriginal groups that visited the site in July 2004 and was also acceptable to DFO during a site visit in August 2005.

The Construction and Monitoring Plan for S27 was submitted March 2006 to DFO and approved in April 2006. This plan contains a description of the pre-construction monitoring of S27, construction activities in the stream, and post-

construction monitoring to achieve the physical and ecological criteria for the habitat compensation program success (as outlined in Appendix I of Construction and Monitoring Plan for S27). The physical habitat alteration will be deemed successful if:

- the blockage is manually removed such that there is surface water sufficient for fish passage along the area of the blockage of S27 from IL10 to Snap Lake for a period greater than 5 days during freshet; and
- the channel size in the area of the blockage is approximately 0.25 m wide (wide enough for an adult fish to pass).

The removal of the blockage in S27 will be considered to be successful in creating fish habitat from an ecological perspective if:

- Arctic Grayling, identified by life stage if possible, are found above the former area of the barrier after the initial 5 days of freshet or other life stages of fish are identified during other periods; and
- no adult Arctic grayling are observed stranded above the blockage during the late June survey.

The blockage in S27 was removed manually in September 2006 and plant material and rocks were removed from the stream bed and/or relocated within the stretch of the stream to construct a channel that is approximately 0.25 metres (m) wide to allow adult fish passage. Section 4.6 of the Mine's Fisheries Authorization, requires that an as-built report be submitted within six months of the completion of the construction works in the stream. The as-built report for S27 was submitted in July, 2007.

The blockage to S27 was successfully removed in September 2006. At the same time, channel modifications were made above the blockage and a rock weir at the outlet of IL10 was constructed. This weir will serve to prolong the period of freshet and ensure adequate flows during grayling spawning, incubation and early life stages. Post-construction monitoring occurred during the spring of 2007. Results of pre-and post-construction monitoring were reported to DFO in October 2007. In 2008, DeBeers monitored Stream 27 to ensure there were no obstructions.

### **3.1.5 Environmental Health Monitoring Program**

The draft Environmental Health Monitoring Program was submitted to the GNWT and Environment Canada in September 2003. The objective of the

Environmental Health Monitoring Program is to respond to triggers initiated from the air quality component. If dustfall monitoring conducted as part of the AQMP (i.e., the updated AQEMMP) shows dust amounts greater than predicted in the EAR and the Alberta guideline (since there is no NWT standard for dustfall) for more than three consecutive months, the Environmental Health Monitoring Program would be activated. If triggered, the Program is also designed to evaluate the potential uptake of chemicals from dust into plants and snow and subsequent ingestion by wildlife (the chemical analysis is collected as part of the VMP).

The following components are included in the Environmental Health Monitoring Program:

- uptake of metals and polycyclic aromatic hydrocarbons in vascular plants and deposition to lichens;
- deposition of dust on snow; and
- a wildlife health risk assessment.

At this time the Environmental Health Monitoring Program has not been triggered and therefore, the Plan has not been updated. The results of the Environmental Health Monitoring Program will be part of the annual environmental monitoring report for the Environmental Agreement for the year in which monitoring activities are conducted.

### **3.1.6 Groundwater Quantity and Quality Monitoring Program**

As required by the Water License, the Groundwater Quantity and Quality Monitoring Program was submitted to the MVLWB in August 2004, and subsequently updated from regulatory feedback in September 2005. It was approved in October 2005.

This monitoring plan has three primary objectives:

- to provide information that will allow De Beers to assess the mine water and seepage water quality for comparison against predictions made in the EAR;
- to comply with groundwater-related requirements in Part F, Section 5 and Part E, Section 9 of the Water License; and
- to meet corporate commitments and the terms of the Environmental Agreement related to groundwater monitoring.

The monitoring program monitors groundwater from three sources:

- mine water;
- seepage from the water management pond; and
- seepage from the North Pile.

This plan also includes a seepage survey, which is a semi annual survey of seepage from storage areas and the Water Management Pond.

Consistent with the other environmental monitoring requirements under the Water License, the annual groundwater requirements as part of the Water License Annual Report will be submitted by March 31 of each calendar year.

### **3.1.7 Hydrology Monitoring Program**

Section 7.2 (g) of the Environmental Agreement for the Mine includes a requirement for a Hydrology Monitoring Program. Hydrology-related requirements of the Mine's Water License are as follows:

- provide data for components of the overall Mine water balance, specifically, estimates and measurements of precipitation and runoff;
- monitor water elevations in Snap Lake during the open-water season;
- provide flow or water level data for selected locations under Parts A, B, and C of the SNP;
- provide quality assurance/quality control (QA/QC) for selected equipment used for flow or water level measurements;
- evaluate Mine impacts to Snap Lake by monitoring outflow from Snap Lake; and
- collect meteorological data (precipitation and evaporation).

A draft Hydrology Monitoring Program document was prepared in December 2004. This document is in the process of being updated to reflect the hydro-meteorological monitoring program component that was added in the spring of 2005.

Water elevation and streamflow are monitored near the Mine to meet three principal objectives as follows:

- confirm EAR predictions related to changes in lake water levels and streamflows;
- provide flow and water level information for fish habitat compensation monitoring and to provide an annual water balance and lake level data for water quality monitoring; and
- fulfill requirements of the Mine's Water License and the Environmental Agreement.

Consistent with the other environmental monitoring requirements under the Water License, the annual hydrology requirements as part of the Water License Annual Report will be submitted by March 31 of each calendar year.

### **3.1.8 North Pile Monitoring Program**

The North Pile Monitoring Program (geotechnical stability and deformation, and temperature monitoring) was incorporated into the Ore Storage, Processed Kimberlite, and Waste Rock Management Plan (OSPKWRMP) as outlined in Section 3.2.8 of this report.

### **3.1.9 Vegetation Monitoring Program**

This Vegetation Monitoring Program (VMP) is a requirement of the Mine's Environmental Agreement (Article VII, 7.2b) and provides support for the C&R research and monitoring requirements outlined in Part I of the Mine's Water License. This Plan also provides research and monitoring details, linked to the C&R Plan. A draft VMP was prepared for the Mine in April 2005 and submitted with the 2005 Environmental Agreement Annual Report Supplement in May 2007. This Plan is currently being updated.

To comply with regulatory requirements, De Beers has designed the VMP to address the following objectives:

- verify the accuracy of impact predictions made in the EAR;
- implement, through the Environmental Management System (EMS), operational practices that mitigate disturbance to native vegetation;
- determine the effectiveness of mitigation measures implemented through the EMS;
- consider and incorporate where possible, traditional knowledge;
- establish action levels or triggers for early warning signs to implement adaptive management and mitigation measures where appropriate;

- provide opportunities for the involvement and active participation of aboriginal parties in the implementation of the VMP; and
- design studies and data collection techniques that are consistent with, and will contribute to, understanding and managing vegetation effects and ensuring effective reclamation.

To meet these objectives, three vegetation monitoring studies will be conducted as follows:

- 1) Area of Impact Monitoring Program (monitoring the total area of direct impact due to the Mine);
- 2) Ecological Land Classification (ELC) Area Monitoring Program (monitoring the change in the ELC area due to the Mine); and
- 3) Reclamation Monitoring Program (monitoring the success of revegetation and reclamation activities).

Two additional triggered monitoring programs may be implemented, when necessary, if specific action levels set out in the VMP are exceeded:

- 1) Detailed ELC Monitoring Program; and
- 2) Effects of Dustfall on the VMP.

### **3.1.10 Water Intake Monitoring Program**

The water intake screen was authorized by DFO on August 27, 2004 pursuant to the Mine's Fisheries Authorization (SC00196). A number of conditions were listed in the approval, including the development of a fish screen monitoring program and reporting schedule, which is subject to DFO approval prior to implementation, and is required within three months of the issuance of the approval. The Water Intake Monitoring Program was submitted in May 2005 and approved by DFO on July 22, 2005.

The fish screen monitoring program is comprised of two components: a physical component and a biological component.

The physical monitoring of the intake screen includes two steps:

- construction/post-construction monitoring, which includes documenting the fabrication details for the screen, and ensuring there are no gaps

greater than 2.5 millimetres (mm) between the screen and the intake pipe; and

- operational monitoring, which includes monitoring approach velocity and to determining if any fouling of the screen is occurring.

The biological monitoring component is species and life-stage dependent. The objective of the biological monitoring program is to demonstrate that 25 mm burbot (the target species and life stage for this monitoring program) are not being impinged or entrained by the screen during its operation. The biological monitoring component involves two steps:

- monitoring for the presence of larval burbot in Snap Lake in the area of the screen; and
- monitoring behind the screen to determine if fish are being entrained.

The proposed duration of the monitoring program is two years, with the objective that all of the necessary physical and biological measurements would be carried out in the first year. The first year of monitoring occurred in 2007.

### **3.1.11 Wildlife Effects Monitoring Program**

A Wildlife Effects Monitoring Program (WEMP) was submitted to the GNWT in July 2004. The principal purpose of the WEMP for the Mine is to meet Condition 36 of the Land Use Permit and to comply with relevant Articles in the Environmental Agreement (e.g., Articles VII and VIII) and related corporate commitments. To comply with the relevant terms and conditions stated in the Land Use Permit and Environmental Agreement, De Beers has designed the WEMP to address the following objectives:

- verify the accuracy of impact predictions made in the EAR;
- implement, through the EMS, operational practices that mitigate disturbance to wildlife and wildlife habitat, including migratory birds and their nesting areas, species at risk, and caribou;
- determine the effectiveness of mitigation measures implemented through the EMS;
- consider and incorporate where possible, traditional knowledge;
- establish action levels or triggers for early warning signs to implement adaptive management and mitigation measures where appropriate;
- provide opportunities for the involvement and active participation of aboriginal parties in the implementation of the WEMP;

- design studies and data collection techniques that are consistent with, and will contribute to, understanding and managing regional cumulative effects; and
- develop and review the WEMP in collaboration with the GNWT ENR.

To achieve the principal purpose of the WEMP, monitoring of Mine-related effects will include measuring the following environmental components grouped under three main headings:

- Wildlife Habitat
  - direct change of habitat types associated with the mine footprint;
  - indirect change of habitat value for caribou and grizzly bears within the zone of influence of the Mine;
- Disturbance to Wildlife
  - caribou number, movement, distribution, behaviour, and group composition during the northern and post-calving migrations;
  - seasonal use of preferred grizzly bear habitat within the study area;
  - relative abundance of wolverines in the study area;
  - presence of wolf dens and raptor nest sites within 2 kilometres (km) of the Mine;
  - occupancy and nest success of falcons within the study area; and
- Wildlife Incidents
  - number of mine-related incidents with wildlife.

During the WEMP, De Beers will record all incidental observations of rare or new species (i.e., species that have expanded their range to include the study area). De Beers will provide an annual monitoring report that summarizes the data collected under the WEMP during each year. As experience has shown that significant patterns associated with effects from mining operations and natural factors are typically not apparent with data collected during one- to two-year periods, the annual monitoring report will be expanded every three years to include a discussion of the cumulative results for each component of the monitoring program.

## **3.2 MANAGEMENT PLANS**

### **3.2.1 Adaptive Management Plan**

Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. The Adaptive Management Plan (AMP) is a requirement of Part B Items 12 and 13 of the Water License. An AMP was submitted in August 2004 to the MVLWB. Environmental Management Programs are key mechanisms of the Mine's EMS through which the Mine achieves environmental objectives and targets, focuses and coordinates staff efforts on key issues of concern, and demonstrates environmental performance. Gradually the components of the AMP will become programs within the EMS, ensuring that adaptive management will be captured in the Mine's formal management process.

The five functional areas of the EMS are defined in the International Organization for Standardization as Environmental Policy, Planning, Implementation and Operation, Checking and Corrective Action, and Management Review. The AMP is a critical component of the overall structure of Checking and Corrective Actions.

The AMP component of Checking and Corrective Action activities within the EMS include:

- the development of procedures for monitoring and tracking the key characteristics of operations that can have a significant impact on the environment;
- the review and assessment of operational success in meeting established targets that had been created to minimize environmental risk as a result of internal review and those stemming from third party external review (e.g., EAR, auditing); and
- the establishment of a process for investigating and correcting non-conformances and taking corrective and preventive action to ensure that they do not re-occur.

The Water License also requires that the AMP include details pertaining monitoring, thresholds, and mitigation measures for the following:

- uncertainty in lake mixing and density stratification;
- geotechnical performance of the North Pile;
- nutrient enrichment of Snap Lake; and

- increase in TSS.

Monitoring is integral to the AMP, both as a means of identifying potential risks initially, but also as a tool to assess the effectiveness of solutions and further revisions to these solutions. The Plan will be incorporated into the EMS, and as such, will be subject to periodic review within the adaptive framework of the EMS. The next review of the AMP plan will be complete by June 2010.

### **3.2.2 Air Quality and Emissions Monitoring and Management Plan**

As outlined in Section 3.1.1 (Air Quality Monitoring Program), a draft of an EMP was submitted to the GNWT and Environment Canada in February 2006. Upon receipt of feedback on this draft document from GNWT and Environment Canada in April and August 2006, this document was harmonized with the AQMP into one document, the AQEMMP, to demonstrate the linkages between the two programs. The data from the two programs will be presented together each year in the annual report. The original EMP portion of the AQEMMP meets the requirements as outlined in Article VI, Section 6.3 items d) and e) and Article VII, Section 7.2a(i) of the Environment Agreement. The AQEMMP was submitted to the GNWT and Environment Canada in November 2007. De Beers received comment in February 2007. A meeting occurred between GNWT (ENR), De Beers and Golder Associates Ltd. (Golder) on March 6, 2007 to improve and agree to a final AQEMMP. The AQEMMP was submitted August 25, 2007.

The AQMP concentrates on the following five main components:

1. on-site meteorological monitoring, which consists of hourly measurements of wind speed, wind direction, solar radiation, temperature, relative humidity, and rainfall;
2. on-site hydro-meteorological monitoring, which calculates and records lake evaporation rates to calculate the Snap Lake water balance;
3. ambient monitoring of total suspended particulate (TSP) and fine particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) that consists of 24-hour average values;
4. ambient monitoring of dustfall; and
5. passive monitoring of SO<sub>2</sub> and NO<sub>2</sub>.

The EMP focuses on the following three main components:

1. emissions estimates of NO<sub>x</sub>, SO<sub>2</sub> particulate matter (PM), and greenhouse gases (GHGs) were calculated based on annual fuel consumption;
2. annual fuel use summary; and
3. emissions mitigation strategies, which includes the fugitive dust abatement program.

De Beers will provide an annual report that summarizes the air quality monitoring and air emissions data collected during each year. To ensure that the AQEMMP is effective, it will be reviewed every 5 years in cooperation with the signatories to the Environmental Agreement.

### **3.2.3 Best Management Practices Plan for Ammonia Source Control**

As per the requirement of the Water License under Part F, Item 23 for a plan to control the source of ammonia in effluent discharge; Safety, Health and Environment Operational Procedures (SHE OPs) and action plans have been designed by De Beers to control and monitor ammonia discharge in current mine water effluent from the Snap Lake underground mine. This plan will be updated in 2010.

The Explosive Conservation Procedure highlights the general nature of the overall operational monitoring controls in place within the EMS, while the Environmental Monitoring Program highlights the adaptive management protocol within the EMS to both monitor and respond to fluctuating ammonia levels in mine water discharge samples. Both programmes were scheduled for expansion in 2005, in conjunction and in time with the North Pile construction and development activities to include routine monitoring of sump collection water and diversion to the water management pond and finally the water treatment plant.

### **3.2.4 Interim Mine and Closure and Reclamation Plan**

Mining is considered to be a temporary use of the land. At closure, the mine site and the land affected by the mining operations are to be reclaimed to achieve the following objectives, in order of priority:

- protect public health and safety;
- prevent or mitigate environmental degradation caused by mining related activities at the Mine; and

- ensure that upon the end of mining and processing activities, the Mine site is returned to site's original use or an acceptable alternative that considers community input and values and can be used by future generations.

A Preliminary Mine C&R Plan was submitted to the MVLWB in February 2003. This Plan was updated with the Interim Mine C&R Plan to meet the specific requirements contained in Part I, Item 1 of the Water License. This C&R Plan was submitted in February 2005 and following regulators' comments was re-submitted in January 2006 and approved in May 2006. This plan will be updated in 2010, and also includes a Revegetation Plan.

Reclamation cannot totally remove the entire disturbance caused by development and operation of the mine, but it prevents degradation of the surrounding water, air and land after mine closure. The targeted post-closure land use for the Mine is wildlife habitat. This end land use is a reflection of the current use of the tundra area surrounding the Mine site by wildlife (both resident and migratory) and traditional activities of the local communities and First Nations.

As such, the C&R Plan is considered to be a "living" document. It is anticipated that the plan will undergo several further major revisions over the next 22 years. While meeting Water License requirements, it will continue to be updated and refined as the Mine moves through construction, commissioning, into operation and approaches final closure in 2027. The level of detail of C&R planning contained within the Plan will continue to increase with each revision. Those revisions will incorporate the lessons learned from the planned reclamation research and from progressive reclamation of the North Pile as the initial cells are completed. In addition, the revisions will also reflect the input from local communities, First Nations and other stakeholders who have an interest in how the Mine is ultimately reclaimed.

### **3.2.5 Domestic Waste and Sewage Management Plan**

A Domestic Waste and Sewage Management Plan for the Mine was submitted to the MVLWB in June 2004 as a requirement of the Water License (Part E, Section 10) and the Environmental Agreement (Article VI, Section 6.3a[v]). A subsequent update of the Plan was submitted in December 2006 and was approved in February 2007. In line with the De Beers EMS and the AMP, this Plan is iterative in nature and is subject to revision due to operational changes and or continual improvement(s). This plan was updated and resubmitted in November 2009.

The overall goal of this Plan is to create a framework for the proper handling and disposal of wastes, the minimization of potentially adverse impacts on the environment, and compliance with the Mine's Water License and other regulatory guidelines for waste management. To meet this overall goal, the Plan has been developed to address the following three specific objectives:

- to describe domestic wastes generated at the Mine;
- to outline practices and procedures for the collection, storage, transport, and disposal of those wastes; and
- to present monitoring and mitigation procedures for domestic wastes.

As the Mine is located in a remote site, considerable volumes of materials are transported and stored on-site to ensure availability of supplies during the periods when winter road access is not available. To address this volume of waste, the waste management strategy for construction and operations will continue to focus on the following:

- reduction of the amount of material consumed wherever possible. These measures include the following:
  - use of bulk containers for items used in large quantities (i.e., lube oil, cooking oil, beverages);
  - tire recycling (where opportunities exist);
  - use of waste oil for heat generation; and
  - appropriate separation of waste for on-site and off-site disposal;
- replacing hazardous solvents with less hazardous soy-based solvents that reduce occupational exposure to solvent vapour (i.e., using refillable pump bottles instead of aerosol cans and using rechargeable batteries);
- effective and efficient disposal of waste on-site;
- appropriate storage of waste awaiting removal from site; and
- transportation of waste to an appropriate off-site facility for reuse, recycling, or disposal.

As part of the overall continuous improvement process for the Mine site, De Beers has SHE OPs integrated within the Mine EMS system. These operational procedures are reviewed on a regular basis and updates are completed as required on an ongoing basis. The Plan will be incorporated into the EMS, and as such, is being subject to periodic review within the adaptive framework of the EMS.

### 3.2.6 Emergency Response Plan

As per Part H, Item 1 of the Water License and Article VI, Section 6.3a [iii], the Emergency Response Plan (ERP) was submitted to the MVLWB in September 2005, and approved in October 2005. It was updated and re-submitted in June 2007 and approved in August 2007. It will be reviewed and updated in 2010. The ERP contains specific procedures for potential emergency situations at the Mine. In the ERP each procedure is a stand-alone document, below is a list of the procedures in the ERP:

- Announcing Emergencies by Radio: Radio Procedure for Announcing Emergencies.
- Alarms: Alarms at the Mine.
- Medical: Medevac Procedure.
- Emergency Communications Protocol for Site: Procedure for IT personnel.
- Medical Emergencies on Site – Surface and Underground: Trained Emergency Response Team (ERT) List.
- Trained First Aid Personnel List: Underground Emergencies:
  - Emergency Preparedness and Response Plan for Underground.
- Water Treatment Plant Emergencies: Water Treatment Plant Emergencies – Medical, Fire or Spill.
- Fire: Fire Evacuation Procedures for the Snap Lake Main Camp Complex; Fire in the Main Camp Complex - Management & ERT Duties; Fires On-Site (not including the Main Camp or Skid Camp Complex) – Management and ERT Duties; Fires Off-Site – Management Duties.
- Aircraft –Helicopter Crash at Site: Aircraft or Helicopter Crash at Site – Management and ERT Duties.
- Spill Response: Short Form – Spill Response Procedure (for posting).
- Wildlife: Wildlife Encounters; Caribou on Roads or Runway; Dealing with Bear Sightings, Encounters or a Bear in Camp – ERT; Encountering Wildlife Carcasses.
- Ice Road Emergencies: Emergency Response Procedures for Medical, Fire, and Spill Response; Emergencies on the Mine Spur Ice Road; Vehicle Through the Ice.
- Weather Procedures: Cold Weather Safety; Ice/Winter Road, Reduced Visibility and White-Outs.

### 3.2.7 Hazardous Materials Management Plan

Waste management is an important component of the De Beers' EMS and Environmental Policy. As per Part E, Item 14 of the Water License, the Hazardous Materials Management Plan was submitted to the MVLWB in June 2004. It was revised and then re-submitted in January 2005. The plan was approved in February 2005. The document was reviewed by De Beers, and was resubmitted to the MVLWB in November 2009.

De Beers' overall waste management policy is based on the following principles:

- health and safety of all site employees and visitors is paramount;
- reduction, reuse and recycling of waste materials;
- adherence to applicable regulations and waste handling guidelines required under the *Environmental Protection Act* (GNWT Department of Resources, Wildlife and Economic Development) is mandatory;
- treatment, disposal, and management of waste will be performed on-site to the maximum practical and economic extent in order to minimize the volume of waste shipped off-site;
- proactive management of wastes that may attract wildlife and to minimize the interaction between humans and wildlife;
- a materials procurement policy that stipulates which types of materials are prohibited on site, due to known unacceptable waste products, and will require that products with minimal waste generation be given priority over alternatives where economic and practical; and
- waste management principles and procedures will form a fundamental component of personnel site orientation and education. Environmental awareness training and waste management training will form part of the EMS.

Procedures outlined in this program are enforced by site management personnel, through regular site inspections and auditing. Construction and services contracts also include contractual requirements to comply with site waste management procedures.

The majority of hazardous materials that will be used during the construction phases of the Mine can be grouped into the following three site categories:

- petroleum, oils and lubricants;
- explosives; and

- other hazardous chemicals.

An inventory control of all hazardous materials is conducted on-site by Materials Management. Logistics is responsible for insuring that Transportation of Dangerous Goods (TDG) paperwork is completed as required by TDG legislation. This includes shipments of hazardous materials received at the Snap Lake mine, as well as hazardous waste materials that are shipped off-site for disposal. Contractors are required to submit copies of Material Safety Data Sheets (MSDS) to Materials Management for all hazardous materials prior to, or accompanying all shipments to the Mine. Material Safety Data Sheets are submitted to a service provider who uploads the MSDS to a customized on-line collection which can be easily accessed by contractors and employees. Contractors are also required to maintain copies of MSDS applicable to their contracts and ensure copies are available to their crews.

Compliance with all environmental laws, regulations, guidelines, and best management practices as well as the Mine EMS, will be monitored using the following mechanisms:

- environmental inspections;
- environmental audits (internal and external);
- communication with regulatory authorities (federal, provincial, regional, and municipal); and
- communication with De Beers' Corporate Legal Department and other De Beers' facilities.

### **3.2.8 Ore Storage, Waste Rock, and Processed Kimberlite Management Plan**

The Ore Storage, Waste Rock, and Processed Kimberlite Management Plan (OSWRPKMP) is a requirement of the Mine's Water License (Part E items 3 to 8). The OSWRPKMP was initially submitted in December 2004 and was updated with the planning and development of three phases of the Mine's North Pile Waste Rock and Processed Kimberlite Storage Facility, which includes the schedule, location and quantities of stockpiles, operational procedures for the pile development, waste management (hydrocarbon contaminated soils and solid waste management) and monitoring programs in October 2005. It was also approved in October 2005. The OSWRPKMP was revised by DeBeers in 2009, and was resubmitted to the MVLWB in November 2009.

The OSWRPKMP consists of the following monitoring programs related to the North Pile:

- geotechnical stability and deformation;
- temperature monitoring (thermal conditions of the waste rock pile using thermistors);
- hydrology (measuring surface runoff); and
- hydrogeology and geochemistry (evaluation of flow and geochemistry of seepage from the North Pile Starter Cell).

The OSWRPKMP includes the Acid Rock Drainage and the Geochemical Characterization Plan as an appendix, which discusses the assessment of potentially acid generating (PAG) rock and the monitoring and managing of this rock. This Plan is reviewed annually and is currently being updated.

### **3.2.9 Quality Assurance Quality Control Management Plan**

This QA/QC Plan is a requirement of the Water License SNP Section (Part B, Items 23 to 25). The Plan addresses the analysis of blanks and certified reference material and replicate sampling to assess accuracy, precision and field contamination during environmental effects monitoring. The Plan was submitted in July 2004, revised and re-submitted in March 2006 and approved in April 2006. The plan was updated in October 2008. This plan will be reviewed and resubmitted to the MVLWB in 2010.

Field sampling procedures including sample site locations and designations, sampling equipment and methods along with sample handling procedures including preservation, sample identification, and shipping protocols are discussed. Water sampling frequency, monitoring requirements, laboratory requirements (including laboratory accreditation, detection limits, methodology and reporting procedures), and SNP reporting requirements are also described.

The AEMP and the Monitoring Plan for TDS, calcium, and chloride include all SNP Stations located within Snap Lake, specifically SNP Stations 02-18, 02-20, and 02-21. Because sampling, including QA/QC is described in detail in these and other plans, details related to SNP Stations 02-18, 02-20 and 02-21 are not included in the QA/QC Plan.

The QA/QC Plan is reviewed annually and modified as necessary, as per Part B, item 24 of the Water License SNP.

### **3.2.10 Quarry Management Plan**

The Quarry Management Plan is a required under the Environmental Agreement (Article VI, Section 6.3a, [vi]) and under the Land Use Permit (Part C, Item 6). A Quarry Management Plan was submitted as part of the EAR (Appendix III.5). As there are no plans to quarry the esker, this plan has not been updated. A Quarry Management Plan will be designed prior to excavation of the esker.

### **3.2.11 Sampling Plan for Total Dissolved Solids, Calcium, and Chloride**

The Sampling Plan for Total Dissolved Solids, Calcium, and Chloride is a requirement of the Water License (Part F, Item 12) and the Fisheries Authorization (Section 5.6). This plan was submitted to the MVLWB and DFO in August 2004. It was revised in March 2005 and it received approval in May 2005. This plan is currently under review by DeBeers.

The primary objective of this document is to outline a sampling plan that will allow De Beers to monitor for compliance with the whole-lake average TDS limit (350 milligrams per litre [mg/L]) and include a framework for forecasting TDS, calcium and chloride concentrations in Snap Lake that will allow De Beers to anticipate future concentrations in Snap Lake, and implement mitigation measures as early as possible, should they be required. The Plan also includes sampling electrical conductivity since it is strongly correlated with TDS, calcium, and chloride.

A mass balance model will also be used to forecast the maximum whole-lake average TDS concentrations in Snap Lake that could occur over the life of operations. The mass balance model forecasts will be updated annually. The maximum forecast TDS concentrations will provide an early warning indicator for the management of TDS levels as part of the AMP and the Mine's EMS.

Results of the TDS, Calcium, and Chloride Sampling Plan will be reported annually to the MVLWB as part of the AEMP Annual Report on March 31 and to DFO in the Annual TDS Monitoring Report, submitted July 31.

### **3.2.12 Spill Contingency Plan**

The Spill Contingency Plan is a requirement of the Mine's Environmental Agreement (Article VI, Section 6.3a [ii]), Water License (Part H Item 1), and Land Leases. This Plan was initially submitted in 2004 and was approved in July

2005. It has been reviewed and updated annually, and was revised and resubmitted to the MVLWB in 2009.

The purpose of this Spill Contingency Plan is to:

- facilitate the prompt, efficient and safe clean-up of materials used during the construction and operation of the Mine;
- identify the members, responsibilities and reporting procedures of the Snap Lake ERT in the event of an emergency or spill; and
- provide support and information on available resources, facilities and trained personnel in the event that a spill or an emergency occur.

This plan deals with the following types of materials that are handled on the Mine site:

- fuels, oils, lubricants and other petroleum products;
- compressed gases;
- explosives;
- process and water treatment chemicals; and
- effluents and slurries.

The Spill Contingency Plan outlines contact information, response organization, training courses taken by spill response teams, and reporting responsibilities. An overview of spill response exercises for the response team is also included. It provides a brief description of the major facilities found at the site that have the greatest potential to have a large or environmentally significant spill and preventative measures to avoid environmental incidents, including clean-up strategies. Basic emergency response actions and procedures and basic spill response theory and actions are also outlined in the Spill Contingency Plan. The Spill Contingency Plan provides a list of all spill response equipment and a list of support documents used in preparation of this plan.

Of all the facilities at the site, those having the greatest potential for spills include the following:

- fuel storage and transfer systems;
- chemical and explosives storage and transfer systems;
- hazardous materials handling and storage facility;
- water treatment and management systems;

- sewage treatment system; and
- auxiliary systems (pipelines).

Basic procedures and decontamination steps during any spill response have been established, and Action Plans and SHE OPs have been developed for liquid and fuel spills on land, water, snow, and ice. General spill response equipment, including small and large kits are available on-site to assist in spill response. The Spill Contingency Plan is reviewed annually and updated as needed.

### **3.2.13 Water Management Plan**

The Water Management Plan is a requirement of the Mine's Water License and Environmental Agreement. A Plan was submitted initially in August 2004 and was updated in March 2005 for the Phase 1 Pre-production Program, commencing in 2004, through construction in 2006 and up to, but not including commissioning of the permanent water treatment plant. The Plan was revised and resubmitted to the MVLWB in November 2009. The Water Management plan will be revised and resubmitted in June, 2010.

The Water Management Plan has two principal objectives:

- to minimize the impacts of the Mine on the quantity of surface water; and
- to minimize the impacts of the Mine on the quality of surface and groundwater.

The Water Management Plan contains three sections:

- a listing of water management objectives, strategies to implement objectives, and minimum water management standards;
- a tabulated estimate of the water balance (gains and losses of water on-site) and a brief description of each component of the water balance; and
- an outline of the water management system.

As water management planning requires a multidisciplinary understanding of water-related issues (e.g., water quality, water quantity, contingency planning, and environmental monitoring), aspects of its management are found in other monitoring plans including the OSWRPKMP, Sampling Plan for Total Dissolved Solids, Calcium, and Chloride, Groundwater Quantity and Quality Monitoring

Program, the Hydrology Monitoring Program and the AEMP. This Plan was updated with the water balance information for operations.

### **3.2.14 Wildlife Management Plan**

The Environmental Agreement (Article VI, Section 6.3f) requires that a Wildlife Management Plan be developed for the Mine. The draft Wildlife Management Plan was submitted in December 2006. Responses from regulators and other parties were received in February 2007. Responses were incorporated into the Plan and re-submitted November 8, 2007. Comments were received in February 2007, which are currently under De Beers review. The intent of the plan is to highlight mitigation measures used by De Beers to limit potential impacts on wildlife, and promote and facilitate wildlife safety. Mitigation measures associated with the various stages of the Mine are emphasized to illustrate the connection between Mine activities, potential effects on wildlife, and the various adaptive management and mitigation measures. To meet the requirements of the Environmental Agreement, on-site wildlife management, waste and odour management and caribou protection are addressed in this document.

The plan has been developed in consultation with the GNWT and SLEMA as per the Environmental Agreement specifications. The Agreement also states there should be an environmental monitoring program to support the process of adaptive management. The WEMP (Section 3.1.11) was submitted to the GNWT in July 2004, and has been on-going since March 2001.

De Beers is committed to maintaining wildlife safety on the Mine site and will continuously evaluate and update mitigation strategies as necessary.

## 4 2009 REPORT SUBMISSIONS

De Beers Canada Inc. (De Beers) submitted 18 reports and technical memorandums in 2009 as required under their Water License, Land Use Permit, Environmental Agreement, Fisheries Authorization and Land Lease. Table 4-1 provides the full list of Reports and Plans submitted in 2007. This section provides abstracts of the Annual Reports and Non-Annual Reports (i.e., As-Built and Detailed Design Reports and monitoring reports under the Fisheries Authorization related to habitat compensation). Abstracts have not been included for the updates to the monitoring and management plans as these are outlined in Section 3.

**Table 4-1 Summary of 2009 Report Submissions for the Snap Lake Mine**

Submission Title	Date of Submission	Report Section
2008 Hydrology Monitoring Program Annual Report	November 2009	4.1.3
2008 Vegetation Monitoring Program Annual Report	November 2009	4.1.4
2008 Wildlife Effects Monitoring Program Annual Report	November 2009	4.1.5
2008 Type A Water License Water License Annual Report	August 2009	4.1.6
2008 Acid Rock Drainage and Geochemistry Annual Monitoring Report	October 2009	4.1.7
2009 Dam Inspection Report	July 2009	4.1.8
2008 Aquatic Effects Monitoring Program Annual Report	August 2009	4.1.9
2009 Dissolved Oxygen Annual Monitoring Report	August 2009	4.1.10
2009 Total Dissolved Solids Monitoring Near Fish Habitat Compensation Areas in Snap Lake	August 2009	4.1.11

### 4.1 ANNUAL SUBMISSIONS

#### 4.1.1 2008 Environmental Agreement Annual Report

The Snap Lake Mine (Mine) is a diamond mine owned and operated by De Beers, and is located about 220 kilometres (km) northeast of Yellowknife, NWT. De Beers received regulatory approval for the Mine in 2004, which included an Environmental Agreement. Mining began in 2007 and is expected to continue for 22 years. We have completed five years of environmental monitoring since construction started for the Mine. This annual report for the Mine's Environmental Agreement summarizes the monitoring activities and results from 2008.

Since we received regulatory approval for the Mine in 2004, we have written 32 monitoring and management plans for the Mine. In 2008, we submitted 18 reports. We submitted twelve annual reports, four reports related to habitat compensation under the Fisheries Authorization, three management plans, one geotechnical report, one monitoring program, and one special request for the Minister. A summary of each of these documents can be found in this report. Here is a summary of what we found in our environmental monitoring studies in 2008.

**Air quality:** When any fuels are burned, GHGs are produced. We measure the amount of greenhouse gases produced by the Mine because they can add to global warming. We produced more GHGs in 2008 than in 2007, 2006, 2005 or 2004, because De Beers used more diesel fuel in 2008 than in any other year.

**Aquatics:** We found small increases in dissolved salts, nutrients and a few metals in the water in Snap Lake in 2008, compared to previous years. The increases in dissolved salts and nutrients were greater than expected, and resulted from more activity in the underground mine than originally planned. These changes are not harmful to fish or other life in Snap Lake. We checked the amount and types of algae, and bugs that live in the water and on the bottom of Snap Lake, to see if there were any changes in food for fish compared to previous years. The amount and types of algae and bugs in the water of Snap Lake have changed from year to year, but this may not be related to the mine alone, because similar changes also occur in all lakes. The number of different types of bugs on the bottom of Snap Lake in 2008 was similar to those in previous years, and the Mine only had a small effect on them. We also checked the mud that the bugs live in at the bottom of the lake and found that levels of a nutrient and a few metals were higher in a small area near the diffuser compared to the rest of the lake. However, even near the diffuser, levels were well below those that would harm bugs.

**Archaeology:** None of the sites discovered near the winter road and Mine were disturbed in 2008.

**Hydrology:** There were slight changes in water levels in Snap Lake which were about the same as other lakes near the area. These results are what we expected, in that the Mine would not have much or any effect on water levels.

**Hydrogeology and Geochemistry:** The rock types at the Mine have not changed from what we thought they would be. We have discovered that more water is seeping into the underground mine than we thought there would be and

as a result, there are more salts in the water. We are looking into different technology alternatives to solve this issue.

**Vegetation:** We took satellite pictures of the Mine to check the total size of area impacted by the Mine in 2008. We found that the impact on vegetation was less than we thought it would be. All vegetation communities were impacted less than we expected, except for the esker. We thought only 0.5 hectares (ha) of the esker would be disturbed, but 1.6 ha of the esker was disturbed in the winter of 2001. No further disturbance on the esker is expected to happen. Overall, dust does not appear to be having an effect on vegetation at the Mine site.

**Wildlife:** Wildlife results in 2008 were similar to results from previous years. In 2008, caribou and grizzly bears appeared to avoid the Mine, and wolverine appeared to be attracted to the mine. We continued to monitor peregrine falcon nests in the area, there has been no change in the number of falcon nests or the number of chicks born each year. In 2008, none of the valued species have been killed because of the Mine. In general, the Mine has not changed wildlife abundance.

**Compliance:** There were seventeen inspections conducted by Indian and Northern Affairs (INAC) in 2008. All issues brought up by the Inspector were addressed or are being addressed.

**Mitigative Measures:** Mitigative measures adopted in 2008 include replacement of select Ford trucks with a fleet of Kubota or Toyota trucks to reduce fuel consumption and to lower GHG emissions. Motion-sensitive light switches were installed in administrative offices, and temporary site infrastructure was removed and/or optimized. The ammonium nitrate (AN) storage pad liner was also extended and berms were re-established around the perimeter.

**Adaptive Management:** Adaptive measures adopted in 2008 included construction of a new Waste Management Area, extension of the HDPE liner at the existing AN storage area adjacent the Emulsion Plant, relocation of the large weather haven (Big Top) to an new area for cement storage; and construction of an U/G Fuel Bay to reduce mine equipment re-fuelling incidents due to cold weather. Improvements made to the sewage treatment system included installation of a new lift station between the sewage treatment plants and Water Treatment Plant, placement of membrane bio reactor 1 and 4 into "idle" mode due to a reduction in camp population, modification of the pipeline between the Water Management Pond and the Water Treatment Plant to enable flow to be re-directed through the temporary Water Treatment Plant as contingency,

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improvement of the sand filters in the Water Treatment Plant; and installation of a flow meter in the Potable Water Treatment Plant.

## **4.1.2 Air Quality, Meteorological Monitoring and Emissions Reporting 2008 Annual Summary**

### **Why do we conduct air quality and meteorological monitoring at Snap Lake?**

The principal objective of the Air Quality, Meteorological Monitoring and Emissions Reporting Annual Summary is to comply with the SNP Section D of the Water License (MV2001L2-0002), Article VI Sections 6.3 items d) and e) and Article VI Section 7.2 part a) of the Environmental Agreement, and related corporate commitments including the Snap Lake EMS.

This report provides the results of the air quality and meteorological monitoring programs that were active at Snap Lake during 2007. This document fulfills the annual reporting requirements outlined in the Air Quality and Emissions Management and Monitoring Plan (AQEMMP) (De Beers 2008). Changes to the original Plan (De Beers 2005a) were made in 2007 and 2008 to align with design recommendations from Environment Canada and the GNWT ENR (GNWT and Environment Canada 2006).

### **What did we monitor in 2008?**

In 2008, the monitoring program included the following components:

- Meteorological monitoring – Hourly measurements of wind speed, wind direction, solar radiation, temperature, relative humidity, and rainfall were collected from instruments mounted on a 10 metre (m) tower;
- Particulate monitoring – 24-hour average values of TSP, PM nominally less than or equal to 2.5 µm (micrometres) aerodynamic diameter (PM<sub>2.5</sub>) and PM nominally less than or equal to 10 µm aerodynamic diameter (PM<sub>10</sub>) sampled once every six days between March and December; and
- Passive gas monitoring – Passive gas sampling began in January and continued through December; monthly samples were collected for nitrogen dioxide (NO<sub>2</sub>) and sulphur dioxide (SO<sub>2</sub>).

### **What were the results of the 2008 meteorological and air quality monitoring program?**

- Meteorological monitoring – Wind speed, wind direction, and relative humidity were within the long-term ranges for the area. Precipitation at Snap Lake exceeded 30 year Yellowknife climate normals during July,

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August and September, but was lower than Yellowknife normals during the remainder of the year (Environment Canada 2009). Temperatures were slightly cooler than those observed in the past 5 years.

- Particulate monitoring – The maximum monitored TSP concentration was 95.64 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ), observed at TSP Partisol 3 located in the wetlands south of Snap Lake. The average TSP concentration observed across all stations was  $6.18 \mu\text{g}/\text{m}^3$ . The NWT 24-hour TSP standard of  $120 \mu\text{g}/\text{m}^3$  (GNWT 2002) was not exceeded during 2008. The maximum monitored  $\text{PM}_{10}$  concentration was  $122.55 \mu\text{g}/\text{m}^3$ , observed at Dichotomous Partisol 2 to the south of the ammonium nitrate and fuel oil (ANFO) area. The average  $\text{PM}_{10}$  concentration observed across all stations was  $42.74 \mu\text{g}/\text{m}^3$ . The applicable 24-hour concentration guideline for  $\text{PM}_{10}$  in the NWT is  $50 \mu\text{g}/\text{m}^3$ . It has been adopted from other Canadian jurisdictions including the Government of British Columbia, and the Government of Newfoundland and Labrador. This guideline was exceeded on 25 occasions, with 19 of those occurring at Dichotomous Partisol 2. The maximum monitored  $\text{PM}_{2.5}$  concentration was  $50.93 \mu\text{g}/\text{m}^3$ , observed at Dichotomous Partisol 2, south of the ANFO storage area. The average  $\text{PM}_{2.5}$  concentration observed between both  $\text{PM}_{2.5}$  stations was limited to  $0.1 \mu\text{g}/\text{m}^3$ . Of the 86 samples collected, 33 values were above the detectable limit. The 24-hour guideline concentration for the NWT is  $30 \mu\text{g}/\text{m}^3$ . This guideline was exceeded once during the monitoring period.
- Passive Monitoring – The highest monthly  $\text{NO}_2$  concentration was  $35.6 \mu\text{g}/\text{m}^3$  during January at Tank passive monitoring site located just west of the tank farm. This peak concentration falls well below the maximum desirable annual level of  $60 \mu\text{g}/\text{m}^3$  set forth in the National Air Quality Objectives (Environment Canada 1981). The single highest  $\text{SO}_2$  concentration monitored during 2008 was  $7.9 \mu\text{g}/\text{m}^3$  in August at West Shore passive site, located west of Snap Lake. This peak concentration falls well below the maximum annual average objective of  $30 \mu\text{g}/\text{m}^3$  regulated by the GNWT (2002). The comparison of monthly values to annual criteria is conservative as monthly criteria would be expected to be higher.
- Snap Lake Mine emissions – Fuel consumption comprised 20,785,812 litres (L) of diesel fuel with a sulphur content of 70 parts per million by weight (ppmw). Emission rates were generally higher in 2008 from 2007 estimates primarily due to increased power requirements of the fully operational facility.

### **4.1.3 Hydrology Monitoring 2008 Annual Report**

#### **Why do we monitor water elevation and streamflow at Snap Lake?**

Water elevation and streamflow are monitored near the Mine to meet three principal objectives as follows:

1. To fulfill requirements of the Water License (Number MV2001L2-0002), including Part B, Section 5a, Part B, Section 5b, Part B, Section 5n, Part B, Section 8, and Part G, Section 2 and to fulfill the requirements of the Environmental Agreement (Section 7.2g).
2. To confirm EAR predictions related to changes in lake water levels and streamflows.
3. To provide flow and water level information for fish habitat compensation monitoring and to provide an annual water balance and lake level data for water quality monitoring.

#### **What did we monitor in 2008 at Snap Lake?**

In 2008, water level data were collected at four stations in the Snap Lake drainage area and at one station at each of the following lakes; the 1999 Reference Lake, North Lake and Northeast Lake. Additional flow data was collected from their outflow channels and on smaller streams that flow into Snap Lake.

#### **What are the results of the 2008 Streamflow and Lake Elevation Monitoring Program?**

The results indicate that 2008 water levels and streamflow were near normal in terms of stream discharge and water levels. Snap Lake water elevations remained within the normal range, and exhibited similar increases and decreases as other monitored lakes. The EAR predicted small increases in the mean water elevation of Snap Lake as a result of the mining operations. Predicted increases above baseline conditions ranged from 0.033 to 0.053 m over the period of operations.

Annual changes in Snap Lake water levels remained similar to three other monitored lakes in the region. Changes in lake elevation from 2007 to 2008 have remained within the range of previously measured changes and appear to be less than predicted in the EAR for the construction period. Mine –related impacts to the water level of Snap Lake remain negligible.

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## **4.1.4 Vegetation Monitoring Program 2008 Annual Report**

### **Why do we monitor vegetation at Snap Lake?**

A Vegetation Monitoring Program (VMP) is a requirement of the Mine's Environmental Agreement (Article VII, 7.2b) and provides support for the C&R monitoring requirements as outlined in Part I of the Mine's Water License (MV2001L2-0002). A Vegetation Monitoring Program was prepared for the Mine in 2005 (De Beers 2005b).

### **What did we monitor at Snap Lake in 2008?**

De Beers has implemented and maintains a VMP for the Mine which includes both annual vegetation monitoring (Area of Impact, ELC Area, and Reclamation Monitoring Programs) and two triggered monitoring studies (Detailed ELC and Effects of Dustfall on Vegetation Monitoring Programs). In addition to complying with the requirements of the Environmental Agreement and the Water License, the VMP has been designed to verify the accuracy of the impact predictions made in the EAR (De Beers 2002a). It also provides information to the Snap Lake EMS (De Beers 2002b) and supports De Beers commitment to mitigate impacts during Mine planning and operation (De Beers 2005b).

This report summarizes the results of the fifth year of the annual vegetation monitoring programs (Area of Impact, ELC and Reclamation Monitoring). In addition, baseline data collected for future triggered programs (Detailed ELC and Dustfall Effects on Vegetation) is presented. Triggered programs are additional field programs that are initiated if established action levels (i.e., triggers) are exceeded. Adaptive management and mitigation measures are implemented, where appropriate, only when the defined trigger is surpassed.

### **What were the results of the Monitoring Programs?**

#### **Area of Impact**

A QuickBird satellite image was used to compare the total disturbance area in 2008 with predictions made in the EAR (De Beers 2002a). At full development, the EAR predicted that the mine footprint would disturb approximately 250 ha of soil and vegetation, and that most of the disturbance would occur within the local study area (LSA) (De Beers 2002a). Due to the difference in accuracy between the 1994 and 2002 land cover classifications, the expected area of disturbance to each vegetation community (land cover type) was re-calculated by overlaying the mine plan from the EAR on the 2002 ELC map. The revised calculations predicted that the mine footprint would disturb 218.8 ha of habitat at full development or 15 percent (%) of the LSA. The current disturbance of the LSA and esker complex, as of July 2008, is 155.4 ha (11% of the LSA), which to date

is below the predicted disturbance area, and therefore the Detailed ELC Monitoring Program is not triggered and modifications to the monitoring program are not needed at this time.

### **ELC Area Monitoring**

Estimates of the disturbance to ELC units were calculated by using both Landsat Thematic Mapper in 2002 and QuickBird satellite imagery in 2008 to compare the mine footprint with the vegetation types known to be present before start-up construction of the mine. At full development, there is a predicted total disturbance of 218.8 ha in the LSA and 83.7 ha in the regional study area (RSA), excluding the LSA. The RSA disturbance consists of the impact to the esker borrow site and associated winter esker access road, and the 35 km winter access Snap lake Spur Road to the Tibbitt-Contwoyto winter road. The total area occupied or impacted by the LSA on July 2008 was 155.4 ha, which represents 71% of the maximum predicted extent of the Mine. For the RSA, construction activities have impacted 2.5 ha or 3% of the expected disturbed area.

None of the ELC units have received a greater proportionate disturbance than predicted in the EAR (De Beers 2002a) as of July 2008, with the exception of the esker complex. As reported in previous VMP's, the area of disturbance to the esker was expected to be 0.5 ha; however, the actual disturbance was 1.6 ha. Granular material was removed from this esker in the winter of 2000-2001. No further disturbance to this esker is anticipated and none was recorded as occurring up to 2008. Overall, the disturbance covers 11% of the LSA which is below the predicted 15%. The Detailed ELC Monitoring Program is not triggered and modifications to the monitoring program are not needed at this time.

### **Reclamation Monitoring**

During the 2004 and 2005 field surveys, 11 permanent sample plots (PSPs) were established at existing disturbed sites to determine the rate and effectiveness of natural recovery as a revegetation method (i.e., natural revegetation relying on invasion or colonization by local species). Disturbed sites included the quarry at the esker, the air strip, and the old base camp.

The established PSPs were assessed in 2008 and a total of 59 plant species naturally colonized the reclamation PSPs; an increase of 5 additional species from 2006. These plant species were similar to the plant species observed in the control and treatment PSPs for the Triggered Monitoring Programs.

Due to the slow growth rates and colonization of vegetation in the arctic, reclamation surveys are not required annually. Reclamation PSPs were

surveyed in 2008 and will be surveyed every five years thereafter. They will be assessed for changes in vegetation community composition and changes in soil properties or chemistry over time.

## **What were the results of the Triggered Monitoring Programs?**

### **Detailed ELC Monitoring Program**

Treatment and control PSPs were surveyed from 2004 to 2006, and in 2008 to collect baseline data which will be compared to data collected in the future during subsequent monitoring programs and, if implemented, Triggered Monitoring Programs. Treatment and control PSPs of the same ELC type were found to have similar species diversity. The open spruce forest had the highest diversity with 40 species in the treatment PSPs and 30 species in the control PSPs. No triggered monitoring programs have been initiated thus far.

### **Dustfall Monitoring Data**

Monthly dustfall was collected in the months of June to December, excluding October when the field samples were not accessible. The three monitoring stations on the mine footprint frequently had the highest total deposition rates which were expected because they were located near areas of high construction activity, which included blasting.

The maximum deposition rate of 143 milligrams per square decimetre per 30 days ( $\text{mg}/\text{dm}^2/30\text{d}$ ) was recorded at DF-011 in July 2008. The rest of the dustfall deposition rates were relatively low in July and all were within the Ambient Air Quality Objective (AENV 2005). The results from other months and at all stations were below Alberta Ambient Air Quality Objective (AENV 2005) with none of the 26 samples exceeding the  $158 \text{ mg}/\text{dm}^2/30\text{d}$  guideline for commercial and industrial properties.

Overall, there was an upward trend in dustfall deposition rate when compared to 2006 and 2007. The average total dustfall rate in 2008 was 6% higher than that observed in 2007 and 43% higher than 2006. It is important to note that every year has not had the same number of samples for comparison.

These results cannot be used solely to ascertain whether dustfall is affecting vegetation communities. The Alberta dustfall criteria were developed in 1975 to address aesthetic concerns associated with elevated dustfall levels (Long Fu, 2006, pers. comm.). However, there are no scientifically defensible relationships between these dustfall criteria and discernible effects on vegetation communities.

There were no sign of dust accumulation or impacts to vegetation in surveyed control or treatment PSPs in 2008. However, dust accumulation and localized plant stress was observed around the airstrip, particularly on the east and west

ends. This may indicate that dust impacts are localized to the area immediately surrounding the airstrip due to chronic dust generation and dispersal; however, based on observation alone, it cannot be concluded if dust is a causation, contributing, or nonfactor in the impaired plant health. Wildlife Effects Monitoring Program 2008 Annual Report

### **Why do we monitor wildlife at Snap Lake?**

In accordance with the Mine's WEMP (De Beers 2004a), commitments made in the EAR (De Beers 2002a), and the Mine's Environmental Agreement (De Beers 2004b), a WEMP report will be completed each year. Because of the large degree of natural variation inherent in ecosystems, it is often difficult to detect indirect effects with only one or two years of data. Therefore, a more comprehensive analysis and discussion of all data from the WEMP will be completed every three years, beginning with this report. For the intermediate years, the annual reports will present findings from that year, and summarize cumulative data collected up to that year. If critical issues become apparent in the shorter term, then a discussion of these issues will be presented in annual reports.

This report presents a full analysis of baseline and construction phase wildlife data gathered from 1999 to 2008.

### **What did we monitor at Snap Lake in 2008?**

The wildlife study area is defined by a circle with a radius of 31 km, centered on the Mine site, and equivalent to 3,019 square kilometres (km<sup>2</sup>). Baseline data, collected from 1999 to 2004, were used to provide estimates of the natural variation in species presence, abundance, distribution, and habitat use in the study area. With the commencement of construction in 2005, the objective of the wildlife program changed from studying baseline conditions to monitoring for direct (e.g., habitat loss, wildlife interactions, and mortality) and indirect (e.g., disturbance to behaviour and distribution) effects from the Mine.

### **Valued Ecosystem Components and Effects Monitoring**

Consistent with other mining developments in the NWT, wildlife studies focused on Valued Ecosystem Components (VECs). Criteria for choosing VECs were based on the ecological, social, cultural, and economic aspects of the ecosystem. For the environmental assessment, VECs included caribou, barren-ground grizzly bears, wolves, fox, wolverine, upland breeding birds (passerines, shorebirds, and ptarmigans), raptors, waterfowl, and habitat important to these species.

- During the monitoring of Mine-related effects, a subset of VECs were selected, and have been designated as Effects Monitoring Species:
- Wildlife habitat;
- caribou;
- grizzly bears (and black bears);
- wolverine; and
- raptors.

As described in the WEMP (De Beers 2004a), Mine-related changes to Effects Monitoring Species and their associated measurement endpoints or indicator variables (e.g., abundance, distribution, probability of occurrence) must be sensitive to human disturbance and distinguishable from natural environmental factors. For some VECs, such as upland birds, waterfowl, fox, and wolves, it was determined that measurement endpoints would not have the precision to separate indirect Mine-effects from natural variation. However, all VECs are included in the monitoring of direct Mine-related interactions (e.g., use of deterrents) and mortality. In addition, data collected on the occupancy and productivity of historic and new wolf dens in the study area will be provided to the GNWT ENR to contribute to the regional database, but is not considered part of the WEMP.

### **What are the results collected during baseline and construction (1999-2007) at Snap Lake?**

#### **Vegetation Loss**

Based on the July 2008 satellite image and the June 2007 esker quarry survey, the estimated area directly impacted by Mine in the LSA or core Mine site is 155.4 ha, or approximately 71 percent (%) of the expected disturbed area. A further 60.9 ha of disturbance is expected before the Mine footprint reaches maximum extent, much of which will be associated with the development of the North Pile waste rock storage area. With the exception of esker habitat, Mine-related disturbance to vegetation types is below the predicted maximum. Currently, the largest amount of disturbance, by area, has been to heath tundra/boulder, which is the dominant land cover type in the LSA. Esker habitat has been disturbed by 1.1 ha more than anticipated. The disturbance was associated with the granular material borrow site at the esker south of the Mine, where a total of 2.5 ha were disturbed (boulder, heath tundra/boulder and water were also disturbed at this site). Granular material was removed from this esker along the esker access road during the winter of 2000. No further disturbance to this esker is anticipated.

## **Caribou**

The Mine is located within the migratory range of the Bathurst and Ahiak caribou herds. The Bathurst herd's calving grounds are near Bathurst Inlet, Nunavut, and the Ahiak calve further east near the Queen Maud Gulf. Each forms a discrete herd during calving and rut, but may overlap during the migratory and winter periods. Caribou are of great cultural and economic importance to aboriginal groups in the area, and are an important source of food for residents of Nunavut and the NWT. Caribou are also an important prey species for other wildlife such as bears, wolverine, and wolves. The Bathurst and Ahiak herds may be exposed to mining activities at Snap Lake during their northern migration to the calving grounds, and during the subsequent post-calving migration and rut. Because Snap Lake is near the treeline, caribou may also be present in the study area during the winter.

Caribou monitoring at Snap Lake consists of aerial surveys conducted during the northern migration, and post-calving migration. Surveys are flown along seven transect lines, spaced 8 km apart, running in a north-south direction. Usually, two to six surveys are completed during each migration period, until the caribou leave the study area. During these surveys, wildlife biologists and community members record information on the number, location, behaviour, group composition (males, females, and calves), and habitat type of caribou. Caribou tracks and trails in the snow are also documented.

During the northern migration, observed caribou numbers ranged from 1 to over 3,800 during baseline (1999 to 2004), between 40 and approximately 300 during construction (2005 to 2007) and 76 during operation (2008). During the post-calving period, estimated caribou numbers ranged between approximately 300 to 6,900 during baseline, between 1 and approximately 6,500 during construction and none in the first year of operation in 2008. This indicates a relatively high level of variation in caribou numbers across years, with no consistent trends over time.

Since 1999, the number of caribou observed per area surveyed (mean density) ranged from close to zero to 1 during the northern migration, and 3.62 caribou per km<sup>2</sup> during the post-calving migration. In 2008, 76 caribou were recorded in 6 groups during the northern migration, while none were recorded during the post-calving migration.

## **Bears**

Both grizzly bears and black bears can occur within the study area. Bear signs are monitored to determine if the Mine influences the activity and distribution of bears in the study area. Occurrences of bear signs, which include tracks, scat,

digs, beds, hair, dens, and prey remains, are recorded by observers in plots placed throughout the study area.

From 2001 to 2008, a total of 432 plot surveys for bear sign were conducted, including 229 sedge wetland plots, and 203 riparian plots. A total of 116 fresh bear signs were detected in 66 of the 229 sedge wetland plots, and 113 fresh signs were detected in 68 of 203 riparian plots. In both habitats, the number of sign per plot was highest in 2001, mostly due to the high number of tracks detected. Scats and digs were the next most frequently observed sign type. The number of signs per plot varied annually between habitat types ranging from 0.2 to 2.0. Due to lack of helicopter availability, only 29 sedge wetland plots were surveyed in 2008.

### **Wolverine**

Snow-track surveys were used to study the presence and relative activity of wolverine in the study area from 1999 to 2008. A new snow-track method using multiple 4 km transects in habitats preferred by wolverine was implemented in 2003. This method was adopted to resolve some of the limitations of the previous method, and to determine if wolverine are attracted to or avoid the Mine. This report presents data gathered from 2003 to 2008.

From 2003 to 2008, the number of transects surveyed per year ranged from 12 to 50, accounting for between 48 and 200 km of survey distance. Overall, the results indicate a fairly even distribution of tracks throughout the study area from 2003 to 2008, although transects closer to the south and east of the Mine appear to have a higher frequency of detections. No wolverine were observed on a transect and no wolverine dens were found in 2008.

Mean track densities ranged from 0.21 in 2003 and 2004 to 0.01 in 2008. Overall, the mean TDI decreased with each year, although the associated variances indicate that the track densities may not statistically differ between every year. In addition, snow tracking conditions in 2008 were poor relative to previous years as indicated by the average number of days since threshold wind speed or snowfall.

The proportion of transects with wolverine tracks ranged from 24% in 2008 to 67% in 2003. Over the last four years (2005 to 2008), the proportion of transects with wolverine tracks has been lower than in 2003 and 2004.

A single wolverine was harvested by a hunter while staying at the Mackay Lake Lodge (Mandeville, F. 2009 pers. comm.). No information on specific date,

harvest location, sex, age, or condition of the wolverine was available. Mackay lake lodge is located 30 km north-northeast of the Mine site.

### **Raptors**

Surveys of raptor nest sites were conducted from 1999 to 2007 to determine if the Mine influences the distribution, occupancy rate, nest success, and productivity of raptors within the study area. Fourteen nest sites have been identified within the study area, and range from 8 km to 29 km from the Mine footprint.

Fifteen raptor nest sites have been identified within the study area since 1999, although not all of these sites have been occupied every year. In 2008, there was a new potential nesting site observed during the spring bear survey. A peregrine was observed flying in the area of Portage Bay. No nesting platform was observed, although occupancy was inferred from the visible white wash on the cliff face. The distance from these nest sites to the Mine footprint ranges from 8 km (Reference Lake) to 30 km (Munn C and Portage Bay). In 2008, peregrine falcons, gyrfalcons and ravens each occupied 6, 1, and 3 nests, respectively. No rough-legged hawk or bald eagle nests were found in 2008.

From 2000 to 2008, occupancy at raptor nest sites (not including ravens, eagles, and kestrels) varied from 50% in 2003 to 92% in 2005 (Table 6-2). Chicks were produced in every year and productivity ranged from 0.25 to 2.33 chicks per occupied site. Nest success ranged from 25% in 2001 and 2005 to 83% in 2000 and 2003. In 2008, two peregrine falcon nests were successful in producing 2 fledglings each. No fledglings were produced at the nest site occupied by the gyrfalcon.

### **Wildlife Incidents**

In 2008, there were 18 wildlife incidents associated with the Mine. Animals involved in incidents include wolverine (9), fox species (7), black bear (1), and an unidentified small raptor.

The majority of the wolverine incidents occurred at the accommodation complex near the kitchen, where wolverines had gained access to areas under the building. Food attractants, heat, and inadequate skirting were identified as factors leading to access. Wolverines had frequently visited the kitchen grease trap area where remnants of past grease spills were present. Site staff inspected building skirting and identified numerous locations where wildlife could gain access. ENR visited the Mine site in May 2008 and expressed concern that the skirting appeared to be insufficient and inadequate to prevent access by wildlife.

Noisemakers were sufficient to deter wolverine in most instances. Rubber bullets were used on two occasions. A wolverine retreated under a building and could not be flushed out in one instance. Wolverines, though observed on site a number of times, had only been deterred twice before 2008. On June 26<sup>th</sup>, a wolverine was observed running with a fox kit in its mouth and being chased by an adult fox.

The fox incidents took place all around the Mine site in contrast to last year when the majority of incidents occurred at the Waste Management Area. A natal den was discovered in a road culvert on site. Staff observed up to seven kits at the den. A lunch bag was observed at the culvert entrance and site staff were reminded not to feed wildlife or leave food outside. Although fewer fox incidents and observations were reported in 2008 compared to previous years, this should not be interpreted as a decrease in fox activity on site. It is likely that site staff have become habituated to the presence of foxes and thus are not reporting observations as often. As well, fewer deterrent measures followed observations of foxes compared to previous years resulting in fewer reported incidents. Site staff have been reminded to report all wildlife sightings.

A black bear was observed near Dam 2 on July 1st and reported to security. Environment and Emergency Response Team staff were dispatched to deter the bear. The bear was next observed approximately 1 km from camp and moving away from site in a southerly direction. Incidents involving bear sightings at camp include one black bear in 2008, two black bears in 2007, and a grizzly bear in 2005, which were all successfully deterred.

A small raptor was found dead near the Fresh Air Vent Raise on June 29<sup>th</sup>. The carcass was dried out making identification difficult. The carcass was collected and ENR was notified but did not request that the carcass be sent to them. This is the second mortality involving raptors on site. In May 2004, an American kestrel was observed weak and later found dead; ENR suspected that starvation was the cause of death.

Since 1999, no incidents have been reported for wolves. The only incident involving caribou occurred in 2005 when caribou were observed on and around the airstrip for a two week period in August.

#### **4.1.5 2008 Type A Water License Annual Report**

The 2008 Water License Annual Report addresses the annual reporting requirements under Water License MV2001L2-002 issued by the MVLWB in May

2004. The 2008 Water License Annual Report was submitted on August 31, 2009.

The 2008 Water License Annual Report consists of a main document addressing the following:

- monthly and annual quantities of freshwater removed from Snap Lake;
- monthly and annual quantities of discharge from the Water Treatment Plant;
- monthly and annual quantities of treated sewage effluent discharged from the sewage treatment plant;
- monthly and annual quantities of water pumped to the North Pile;
- monthly and annual quantities of mine water pumped from the mine to the Water Treatment Plant;
- monthly and annual quantities of water pumped into and out of the Water Management Pond;
- monthly and annual estimates of seepage and evaporation losses from the water control and collection system;
- monthly and annual estimates and measurements of precipitation and runoff;
- monthly elevations of water in Snap Lake during ice-free conditions;
- monthly elevations of water in the Water Management Pond;
- annual quantities of processed kimberlite (PK);
- annual quantities of PK placed as underground backfill;
- annual quantities and locations of Mine rock placed in the North Pile;
- summary of construction activities;
- an updated mine plan showing all underground excavation and backfilling locations;
- summary of all work carried out under the OSWRPKMP;
- summary of modifications or maintenance work on water control and collection system;
- summary and explanation of changes to Water and Sewage Treatment Plants;
- summary of the SNP and a summary of activities at each station;
- report on studies requested by the MVLWB;
- approved revisions to Spill Contingency Plan;

- spills and unauthorized discharges;
- spill training and communications exercises;
- annual hydrogeological modelling; and,
- changes or updates to the AMP.

The appendices of the 2008 Water License Annual Report are as follows:

- 2008 Dam Inspection Report (Section 4.1.8);
- Detailed Tabular Summaries of the 2008 Water Quality Data for the SNP Stations;
- 2008 Emergency Response and Spill Contingency Plan
- 2008 Fish Tasting Event Summary; and,
- 2008 Annual Report for the Aquatic Effects Monitoring Program (AEMP) (Section 4.1.9).

#### **4.1.6 2008 Acid Rock Drainage and Geochemistry Monitoring Report**

The Mine is owned and operated by De Beers. Monitoring of acid/alkaline rock drainage (A/ARD) at the Mine is required in support of Type A Water License (MV2001L2-0002). Ongoing aspects of ARD monitoring program include: monitoring of site runoff/seepage; conducting an annual site inspection by a qualified hydrogeochemist to review material placement and identify signs of incipient acid generation (if any); and preparing an annual report describing the environmental conditions on site with emphasis on the presence of acid/alkaline drainage. This report summarizes the results of ARD and geochemical monitoring conducted during 2008, comprising the fourth year of reporting.

This report fulfills the annual reporting requirement as required under the Type A Water License Part B, Section 5k):

*“The Licensee shall file an Annual Report with the Board no later than March 31 of the year following the calendar year reported which shall contain the following information ... 5k) updated results of ARD and related geochemical test work.”*

This report also fulfills the reporting requirement under the Type A Water License Part B, Section 5j) pertaining to the reporting for seepage surveys:

*“...j) summary of all work carried out under the Ore Storage, Waste Rock and Processed Kimberlite Management Plan including the results of seepage surveys of the kimberlite ore storage stockpiles, North Pile, and Water Management Pond.”*

Under the Type A Water License, an ARD and Geochemical Characterization Plan for the Mine was submitted to the MVLWB as part of the OSWRPKMP in October 2005. Data in this report have been presented and reported in accordance with the ARD Plan.

Primary study areas for the 2008 ARD and Geochemistry Monitoring Report are as follows:

- the underground mine and surface facilities, including the North Pile; the WMP, and associated areas;
- the explosive storage facility;
- the kimberlite ore stockpile; and
- site infrastructure (i.e., roads, rock pads, and any areas where rock has been disturbed or deposited).

Significant conclusions and recommendations resulting from the 2008 ARD and geochemistry monitoring program include the following:

## **Conclusions**

- The results of geochemical analysis of mine rock samples and water quality samples collected from the Snap Lake Mine did not identify significant changes in A/ARD conditions in 2008 relative to trends observed during previous annual reporting periods. Significant changes relative to the EA predictions were not noted.
- No visible signs of acidic drainage were observed during the site inspections conducted during the 2008 monitoring period. The geochemical evaluation of the main rock types at the Mine (i.e., granite, metavolcanic and kimberlite) has not changed as a result of the visual surveys and geochemical analysis of mine rock and confirmation geochemistry samples conducted in 2008.
- Relatively little construction took place at the Mine in 2008, compared to previous monitoring periods. Granitic rock used in the construction of rock pads (i.e., the communications tower rock pad, permanent camp base and North Pile perimeter embankment near SP1) appeared to consist of mine muck, excavated from the underground mine workings.

All samples of granitic construction rock, contained less than 0.17% sulphide.

- Although most metavolcanic construction rock was placed in the North Pile Starter cell during the 2008 monitoring period, metavolcanic rock was identified at within a rock pad outside the North Pile starter cell and within a portion of the perimeter embankment of the North Pile. Testing of three samples of metavolcanic rock in the a rock pad south of SP1 and in the perimeter embankment near SP1 show low potential for acid generation in these samples; however, due to the variability of sulphide content in the metavolcanic rock this material must further tested to confirm that it is indeed non-acid generating (Non-AG). If the results of supplemental testing indicate this material is PAG, it should be relocated within the North Pile.
- Metavolcanic rock in the Fresh Air Raise (FAR) rock pad consists of in situ rock that was blasted during pad construction. This rock contains elevated sulphide concentrations, and represents a potential source of acid generation. Runoff from the FAR pad discharges to Snap Lake. Ongoing monitoring of rock at this location is required.
- Processed kimberlite coarse and grits were identified on the haul road between the Process Plant and North Pile during both site inspections conducted in 2008. Runoff from portions of the haul roads is not directed to the WMP or the North Pile.
- During both site visits conducted during 2008, PK slimes were noted outside the north perimeter embankment of the North Pile starter cell north of TS1. Discharge of PK slimes to the sumps should be minimized to the extent possible.
- Remediation of the explosive storage pad resulted in an improvement of downstream bog water quality (i.e., SNP 02-07 and SNP 02-09) during the 2008 monitoring period. To the extent possible, explosives should be stored in designated areas (i.e., the explosive storage pad) to prevent the release of nitrate and ammonia in site runoff.
- Minewater inflow rates were lower than EAR (De Beers 2002a) predictions during 2008 monitoring period. Currently total dissolved solids (TDS) loading trends are tracking well with the EA predictions, however elevated inflow rates during initial mine development did result in slightly higher initial loadings than values predicted in the EAR.

## Recommendations

In accordance with the ARD and Geochemistry Characterization Plan, recommendations for ongoing adaptive management based on the results of ARD monitoring and trends in mass loading include:

- A separate stockpile of clean granite should continue to be available to ensure that operators and mine managers have access to a readily-available source of Non-AG construction material.
- Locations where PAG materials or iron-stained granite and metavolcanic rock has been identified during the current and previous monitoring periods (i.e., FAR rock pad, roads in the vicinity of the WMP, diffuser outflow and fresh water intake) should continue to be monitored for signs of acid generation or metal leaching. Remedial action may be necessary at these locations should runoff begin to show the effects of acid generation. It should be noted that locations where PAG material has been identified will require remediation at or before closure.
- Metavolcanic rock should not be used in the outer perimeter berms of the North Pile, or within 50 meters (m) of the toe of the North Pile perimeter embankments unless it is first demonstrated to be Non-AG. The metavolcanic rock identified in the rock pad south of SP1, and in the perimeter embankment near SP1 should be further tested to confirm that it does not have a potential for acid generation. Should the results of supplemental testing indicate that this material has a potential for long-term acid generation, it should be relocated and replaced with clean granite fill.
- Runoff from non-point source discharges that do not report to the WMP should continue to be monitored. If runoff located downstream of these locations reports elevated concentrations of acidity or dissolved metals, then remedial measures such as relocation of the source material to the North Pile may be required.
- To the extent practical, PK coarse and grits on the haul road between the Process Plant should be removed from the roadways and placed within the North Pile. Furthermore, practical measures should be taken to minimize the amount of PK that occurs on the haul roads and/or runoff from the haul roads should be directed to the WMP catchment or North Pile.
- It is recommended that location SNP 02-03 (site runoff reporting to the WMP) be re-established at an appropriate location. This monitoring location was eliminated as a result of the relocation of the kimberlite ore stockpiles during the construction of the pad for the Permanent Camp Complex.
- Long term mine and site water loading trends and predictions should be updated once sufficient information is available to reasonably update minewater inflow predictions and sufficient operational monitoring data is available. Site water trends should continue to be monitored and loading rates should be evaluated routinely as additional operational monitoring information is available.
- Net Acid Generation (NAG) test, as referenced in *List of Potential Information Requirements in Metal Leaching and Acid Rock Drainage*

*Assessment and Mitigation Work.* W A Price, 2005. Natural Resources Canada, mine environmental neutral drainage (MEND) Report 5.10E, should continue to be used in future ARD assessments of the Mine.

- The results of geochemical evaluation conducted during the EAR and during subsequent annual monitoring periods indicate that not all metavolcanic rock is PAG. It may be possible to use some metavolcanic rock for construction, provided appropriate confirmation testing is conducted to segregate Non-AG from PAG rock. The wording of the Ore Storage Waste Rock Processed Kimberlite management Plan (OSWRPKMP) should be clarified to more specifically reflect that metavolcanic rock can be used in construction outside of the North Pile if it is demonstrated to have less than 0.17 wt.% sulphide (i.e., the existing classification criterion for granitic construction rock). This is supported by the geochemical data in both the EAR and from ongoing monitoring. This clarification will provide better guidance for management of areas where naturally occurring metavolcanic rock has been encountered (i.e., FAR rock pad), while still being protective of the environmental considerations on the site.

#### **4.1.7 2008 Dam Inspection Report**

The geotechnical dam inspection and preparation of this summary report are required in partial satisfaction of De Beers' Water License obligations. The 2008 Dam Inspect Report was submitted separate from the Water License Annual Report. The purpose of the inspection is to visually assess the performance of the structures from a geotechnical and hydrotechnical perspective and to bring deficiencies and points of concern to De Beers' attention.

Mr. Holger Hartmaier of BGC Engineering conducted the inspection on July 8, 2008. Both dams were in satisfactory condition; no settlement or deformations were noted in the visual observation. Some minor disturbance of the upstream erosion protection was noted on Dam 1. The majority of Dam 2 is covered with PK grits and kimberlite stockpiles on the upstream side of access road construction materials on the downstream side preventing direct observation of the dam. Recommendations made during this inspection were that the small depression on the upstream slope near the midpoint of Dam 1 should be re-graded. Overall both dams are in satisfactory condition.

#### **4.1.8 Aquatic Effects Monitoring Program 2008 Annual Report**

The AEMP is a requirement of Part G of the Water License for the Mine. Components of the AEMP must also comply with Part F of the Water License

and Section 5 of the Fisheries Authorization for the Mine. The MVLWB approved the AEMP in July 2005. An annual report, summarizing the yearly AEMP activities, must be submitted to the MVLWB by March 31 of the following year. This document represents the fifth annual AEMP report for the Mine and presents the results of the 2008 program.

The core of the AEMP is monitoring of water quality, plankton, sediment quality, benthic invertebrate community, fish tasting, and fish health. All monitoring components, with the exception of fish health, are undertaken annually. Fish health monitoring occurs on a five-year cycle. It began in 2004; consequently, there is no fish health section in the 2008 AEMP Annual Report. The fish tasting program was conducted by De Beers in 2008, and is reported in Appendix E of the AEMP.

Special studies generally occur once or as needed and include research activities that support effects monitoring. The 2008 AEMP Annual Report includes the 2008 Plume Characterization Special Study.

The primary study area for monitoring in 2008 was Snap Lake. The MVLWB approved Northeast Lake as the reference lake for the AEMP in April 2006; accordingly, monitoring in Northeast Lake has been integrated into the Snap Lake AEMP. Water quality monitoring in Northeast Lake began in 2006 and results are presented in Section 2 of this report. Sediment quality and benthic invertebrate community monitoring were also conducted Northeast Lake in 2008.

### ***Site Activities in 2008***

Major construction activities and milestones achieved during 2008 included the following:

- construction of a pad for the permanent accommodations;
- de-watering of IL6 to prepare for East Cell construction;
- continued construction of the North Pile Starter Cell;
- construction of a new Waste Management Area;
- extension of the high density polyethylene liner at the existing AN storage area adjacent to the Emulsion Plant;
- development of the rock quarry adjacent the airstrip;
- development of the Return Air Raise (RAR) (located northeast of the portal on the opposite shore of Snap Lake);
- commissioned the underground crusher and associated conveyor to the process plant;

- construction of an underground fuel bay; and
- construction of underground ore pass chutes.

As required under Part G, Item 7 of the Water License, De Beers has reviewed the site activities from 2004 to 2008. Minor spills and leaks that occurred on site during this period were contained and mitigated, which prevented an influence on the results of the AEMP.

### ***Water Quality***

The primary objectives of the water quality component are to characterize and interpret water quality in Snap Lake in 2008; to verify and update the EAR predictions (De Beers 2002a); and to recommend changes to the water quality component of the AEMP for future years.

Field activities in 2008 included quarterly water quality monitoring (twice during ice-covered and twice during open-water conditions) at seventeen stations in Snap Lake, five stations in Northeast Lake, and one downstream station. Monthly monitoring was completed at three stations near the diffuser in Snap Lake for conventional parameters, major ions, nutrients and metals, as well as organics and bacteria. Toxicity samples were collected at three diffuser stations during both ice-covered and open-water conditions. Additionally, monthly water quality monitoring was completed at selected stations in Snap Lake during ice-covered conditions for TDS and DO. Three inland lakes and one stream flowing into Snap Lake were sampled monthly during open-water conditions for acidification-related parameters.

Water quality results from Snap Lake were below water quality guidelines and EAR benchmarks in 2008, with the exception of one silver result and a number of fluoride results. The silver result appears to be an anomalous result, possibly due to contamination of the sample. Fluoride concentrations in the near-field area were occasionally above the interim Canadian Council of Ministers of the Environment (CCME) guideline for the protection of aquatic life. In cases when fluoride concentrations were above the guideline, they were associated with elevated calcium concentrations and hardness levels, which are expected to reduce the potential for toxicity effects from fluoride. The elevated fluoride concentrations are only slightly above the guideline [0.12 milligrams per litre (mg/L)] and the CCME guideline includes a considerable safety factor. Effects to aquatic life due to the observed fluoride concentrations are expected to be negligible.

Water quality results from Snap Lake in 2008 were below the maximum EAR predictions. No toxicity effects were observed in samples collected from the diffuser stations in 2008 and limited toxicity effects were observed in the discharge, which is consistent with EAR predictions.

The concentrations and levels in discharges to Snap Lake were below EAR predictions in 2008, with a few exceptions in the water treatment plant, domestic wastewater, and runoff. The higher than predicted concentrations of the parameters in treated domestic wastewater and minewater effluent did not result in concentrations above guidelines or EAR benchmarks in Snap Lake. The higher than predicted concentrations in runoff are unlikely to cause whole-lake effects in Snap Lake because of the small volumes that enter Snap Lake, over a relatively short period.

The following parameters appeared to be increasing in at least one area of Snap Lake in 2008:

- four physical and conventional parameters (TDS, total alkalinity, bicarbonate alkalinity and total hardness);
- seven major ions (calcium, chloride, fluoride, magnesium, potassium, sodium and sulphate);
- two nutrients (ammonia and nitrate); and
- six metals (barium, boron, lithium, molybdenum, manganese and strontium).

Concentrations of the above parameters are not expected to increase above water quality guidelines, EAR benchmarks, or EAR predictions in the near future, with the exception of the interim CCME guideline for fluoride. As described above, near-field fluoride concentrations in 2008 were occasionally above the interim CCME guideline for the protection of aquatic life. Future concentrations of fluoride are not likely to be a concern for the reasons described above (i.e., increasing hardness and safety factor inherent in the guideline).

The whole-lake average concentration and cumulative load of TDS from 2005 to 2008 were compared to EAR predictions. Both were higher than predicted; additional data are needed to confirm whether this trend will continue into the future and in particular, to determine whether the maximum predicted TDS concentration is likely to be exceeded during the life of the mine. Whole-lake average concentrations of TDS in Snap Lake (ranging from 92 mg/L in July to 120 mg/L in April) were well below the License limit of 350 mg/L in 2008.

In 2008, decreases in surface and bottom DO concentrations over the winter in the main basin of Snap Lake were consistent with, or less than, EAR predictions. In addition, it appears that the treated effluent may be increasing bottom concentrations of DO relative to bottom concentrations in the northwest arm and baseline concentrations. Additional DO monitoring is needed to confirm this pattern.

Spatial and seasonal patterns were observed in some water quality parameters in Snap Lake. The patterns observed in 2008 can be explained by the discharge of treated effluent and seasonal differences in mixing conditions in Snap Lake. Horizontal patterns included gradual declines in concentration with increasing distance away from the diffuser in TDS and a number of other parameters that were at elevated concentrations in the treated effluent. Compared to previous years (2004 to 2007), concentration gradients within the main basin of Snap Lake for these parameters were less prominent in 2008. However, concentrations in the northwest arm continue to be notably lower compared to the main basin due to the hydraulic isolation of this arm from the main basin. Seasonal differences between ice-covered and open-water conditions were also less prominent in 2008 compared to previous years. The reduction in the ranges of seasonal and spatial differences can be attributed to the reduction in differences between concentrations in Snap Lake (which have increased since 2004) and the effluent discharged to Snap Lake. As spatial variability in Snap Lake decreases, the monitoring effort spent on detecting spatial differences within Snap Lake will likely be shifted to identifying the downstream extent of effluent-related water quality changes.

### ***Phytoplankton and Zooplankton***

The objectives of the plankton component of the AEMP were to evaluate whether the Mine has affected plankton community composition and biomass in Snap Lake, and to determine whether the Mine discharge is causing nutrient enrichment in the lake.

“Plankton” is a general term referring to small, usually microscopic organisms that live suspended in the open water. Phytoplankton are open water algae and cyanobacteria, and zooplankton are microscopic animals. Both phytoplankton and zooplankton communities have the potential to be useful early indicators of environmental change because of their rapid turnover rates; however, the inherent variability within the plankton community poses a challenge. This variability may limit the usefulness of the plankton community as a monitoring tool. Intensive sampling of plankton is required to collect meaningful data.

The MVEIRB identified nutrient enrichment of Snap Lake as a key environmental issue associated with the Mine. Nutrient enrichment would cause a change in lake productivity. Increased productivity may increase the proportion of cyanobacteria within the phytoplankton community, which can potentially lead to elevated levels of microcystin, a liver toxin, that can be produced by several common genera of cyanobacteria.

Nine stations were sampled for plankton in Snap Lake in 2008, three times during the open-water season. Samples were collected at six stations in the main basin and three stations in the northwest arm. Five stations were sampled in Northeast Lake at stations also sampled by other AEMP components, two times during the open-water season. Samples were analyzed for phytoplankton and zooplankton abundance, community composition and biomass, and concentrations of microcystin and chlorophyll *a*. Monitoring of picoplankton (including heterotrophic bacteria and pico-cyanobacteria) and flagellates was incorporated into the 2008 plankton program in both lakes, as a pilot study to evaluate the usefulness of these plankton components as early-warning indicators of nutrient enrichment.

Chrysophytes, cyanobacteria, and diatoms consistently have been the dominant phytoplankton groups in Snap Lake between 2004 and 2008, with the proportion of these groups exhibiting seasonal variation. In 2006, an increase in total phytoplankton biomass was primarily related to an increase in cyanobacteria, particularly *A. flos-aquae*, which may be related to nutrient enrichment. However, since that time (i.e., 2007 and 2008), cyanobacteria biomass in Snap Lake has decreased and microcystin-LR concentrations have remained below the method detection limit, suggesting there may be natural factors that contributed to the 2006 bloom.

Significant spatial (between sampling sites) and temporal (between seasons and between years) variation in total phytoplankton biomass and community composition occurs naturally in lakes, and has been observed in Snap Lake between 2004 and 2008. Trend analysis indicated that there has been a shift in phytoplankton community composition (based on biomass) during this time. While a critical effect size for phytoplankton cannot be established, it remains a useful tool for monitoring longer-term changes due to nutrient enrichment in Snap Lake. Continued monitoring of the phytoplankton community is recommended through the open water season of 2009.

Chlorophyll *a* (a photosynthetic pigment in algae) results to date suggest that the trophic status of Snap Lake has not changed; however, this variable may not be an accurate surrogate of the Snap Lake phytoplankton community. Past analysis

of the relationship between lake-wide mean chlorophyll *a* concentration and mean total phytoplankton biomass was found to be not statistically significant. At this time, continued monitoring of chlorophyll *a* concentrations is required by the Water License (Part G, Item 2d). However, it is not recommended as a surrogate measure of the Snap Lake phytoplankton community, because it may not reliably detect changes in the trophic status of Snap Lake.

Calanoid copepods remain the dominant zooplankton group within Snap Lake, with seasonal changes occurring in the biomass of the cyclopoid copepods and rotifers. Cladocerans (water fleas) continue to account for a small proportion of the zooplankton community. A shift in community composition (based on biomass) has been documented in Snap Lake between 2004 and 2008.

Based on the results to date, continuing plankton monitoring using the current sampling design and monitoring endpoints is recommended, with a re-evaluation of the effectiveness of the plankton program after analysis of the picoplankton pilot study data (i.e., 2010).

### ***Sediment Quality***

The objective of the sediment quality monitoring component of the AEMP was to characterize the quality of bottom sediments in Snap Lake and Northeast Lake, to determine whether Mine-related spatial or temporal changes in sediment quality were occurring, and to make recommendations regarding program refinement.

Bottom sediment sampling was conducted in March-April 2008, in conjunction with sampling for the benthic invertebrate component. Sediments were sampled from 18 stations located in five areas of Snap Lake and from five stations located in Northeast Lake, which was sampled for sediment quality for the first time in 2008.

Sediment sampling procedures were the same as those used in 2007. Using an Ekman grab, samples of the top 5-centimetres (cm) layer of sediment were collected as composite samples from all 23 stations. In addition, bulk samples consisting of the entire grab contents were collected at 9 of the 18 Snap Lake stations, to facilitate comparison with sampling methods used prior to 2007. Because sedimentation rates in Arctic and sub-Arctic lakes tend to be very slow, sampling the top 5 cm of sediment is more appropriate for targeting recent changes in sediment chemistry, whereas sediment quality data from bulk samples are likely dominated by sediment chemistry characteristic of the period

before Mine activity. A comparison of the results obtained using the two sampling techniques was performed.

Significant differences in analyte concentrations in top 5 cm samples relative to bulk samples were identified for 2 of the 43 parameters evaluated: antimony concentrations were higher in the top 5 cm samples and thallium concentrations were higher in the bulk samples. Overall mean percent differences relative to bulk samples ranged from 0 to 31 % for all but two parameters; for antimony and thallium (the two parameters that were significantly different), these differences were 100% and 12%, respectively. Although available sulphate had the highest overall mean percent difference (103%) between sampling methods, this difference was not statistically significant. For most parameters, the overall mean percent differences were similar in 2008 to those reported in 2007. Results from the two years of comparison of the two sample methods indicate that, for the majority of parameters, concentrations were generally similar based on mean values and that sampling only the top 5 cm of sediment in future years should provide more representative data without adversely affecting comparability to historical bulk sediment data.

Sediment quality monitoring in Snap Lake from 2004 to 2008 documented variability in concentrations of most parameters, both among stations and years, although in 2008 concentration ranges were within a factor of three for most parameters. The most notable concentration gradient among Snap Lake sampling areas was for available phosphate, which was highest at the diffuser station and decreased markedly with increasing distance. Snap Lake sediments were generally characterized as fine-grained material with elevated total organic carbon (TOC) concentrations. Northeast Lake sediments exhibited similar characteristics to Snap Lake sediments. Mean concentrations of close to half the target parameters analyzed in 2008 were higher in Northeast Lake sediments than in Snap Lake sediments.

Concentrations of cadmium, chromium, copper and zinc were above Interim Sediment Quality Guidelines (ISQGs) at two or more stations in Snap Lake and Northeast Lake in 2008. Similar observations were noted in Snap Lake in previous AEMP years and in 2004 under baseline conditions, which indicate that concentrations of these metals are naturally elevated in both lakes. One Snap Lake mid-field station had a zinc concentration in the bulk sample that was above the Probable Effect Level (PEL); this also occurred in 2007 and in 2004 under baseline conditions.

Evaluation of spatial and temporal trends in sediment quality did not provide clear evidence of an effect on Snap Lake sediments in areas exposed to treated Mine

effluent. Concentrations of approximately two-thirds of the sediment quality parameters analyzed in 2008 varied significantly with concurrently measured bottom conductivity. However, additional analysis revealed an effect on sediment quality from exposure to treated effluent was unlikely for most parameters. Only sodium and strontium were identified as potentially increasing in sediments with increasing exposure to treated Mine effluent. There was a large increase in the concentration of available phosphate in the diffuser area between 2007 and 2008; concentrations decreased with increasing distance from the diffuser but were still higher than in 2007. Prior to 2008, concentrations had increased slightly at the diffuser between 2005 and 2007 but had decreased during the same time period at the other sampling areas. Available phosphate concentrations should be monitored for further spatial and temporal changes.

Temporal trends consistent with a Mine-related effect were observed as increasing mean concentrations of bismuth, copper, sodium and strontium in the near-field and mid-field areas over time, although only the increases for sodium and strontium were statistically significant.

Results of the 2008 program indicated that the diffuser, near-field and mid-field areas had nearly equal concentrations of treated effluent, and that the far-field area was approaching this range. Therefore, future statistical testing should focus on detecting trends over time, rather than within-lake spatial trends. The inclusion of a reference lake is appropriate; however, the fact that concentrations of close to half the target parameters were higher in Northeast Lake sediments than in Snap Lake was a confounding factor in the interpretation of results. Inclusion of Northeast Lake as a reference lake should still allow future comparisons of temporal trends between the two lakes, thereby controlling for long-term regional trends.

### ***Benthic Invertebrate Community***

The objectives of the 2008 Snap Lake benthic invertebrate program were to determine if the benthic invertebrate community was affected by changes in water and sediment quality in Snap Lake, and to compare observed changes to EAR predictions.

Benthic invertebrate samples were collected at 13 stations in Snap Lake and 5 stations in Northeast Lake during late winter (March and April) 2008, when ice cover was still present on both lakes. Samples were analyzed for taxonomic composition and biomass. Benthic community variables were compared among sampling areas within Snap Lake and between the two lakes, and over time in the near-field and mid-field areas.

Differences between Northeast Lake, and the near-field and far-field exposure areas in Snap Lake in terms of taxa present were minor and not indicative of an adverse effect on the benthic community. Statistical tests comparing benthic community variables among sampling areas detected a significant difference only in diversity, evenness and density of the midge *Microtendipes*, which was absent from the Northeast Lake. Magnitudes of differences between the Northeast Lake and exposure area means in Snap Lake were below the magnitude of variation observed among reference stations in previous years, with the exception of density variables.

Results of among-year comparisons of benthic community summary variables were inconsistent between the near-field and mid-field areas. No significant differences were detected in total density, richness and evenness in the near-field area. However, among-year comparisons found significant declines in diversity (2007) and increases in dominance (2007) in the near-field area compared to 2004 (baseline). In the mid-field area, density and richness were significantly higher in 2008, evenness was significantly lower in both 2007 and 2008 and dominance was significantly higher in 2007 compared to 2006 (the year prior to effluent reaching the mid-field area).

Although among-area comparisons between Northeast Lake and exposure areas in Snap Lake provided no clear evidence of effects on the benthic community of Snap Lake, trends in benthic community characteristics over time indicate that the community is changing over time. The type of change observed in 2007 was consistent with potential nutrient enrichment originating from effluent discharge, although increases in TDS and major ions also may have contributed to these changes. The declining trend in diversity and evenness reversed in the near-field area in 2008, but not in the mid-field area. As a result, the link to nutrient enrichment is not as clear based on the 2008 results, and the observed patterns in the near-field and mid-field areas may also reflect natural year-to-year variation.

The overall magnitude of the effect on the benthic invertebrate community can be characterized as low, because no statistically significant differences were detected in total invertebrate density and richness in 2008; as well, no significant difference was detected among years in total density and richness in the near-field area, which receives the greatest exposure to the treated Mine effluent; and taxonomic composition of the Snap Lake benthic community has not changed appreciably compared to baseline conditions. An effect of low magnitude is consistent with EAR predictions.

The 2007 and 2008 conductivity data indicate that effluent has reached two of the three stations in the northwest arm, and is expected to reach the entire northwest arm in the future. Therefore, Northeast Lake will be used as a reference area in future AEMP surveys. Although the benthic invertebrate community of Northeast Lake is similar to that of Snap Lake, some natural differences exist between these lakes (e.g., higher relative abundance of Sphaeriidae in Northeast Lake). Therefore, although within-year spatial comparisons are still recommended for future AEMP cycles, testing for Mine-related effects will be more appropriately based on temporal trends than spatial variation.

### ***Plume Characterization Special Study***

The objectives of the 2008 plume characterization studies were to meet the De Beers Snap Lake Water License requirement for a plume characterization study and to determine the number of habitat units lost to the zone of turbulence created by the diffuser. As noted below, the second objective was not addressed in 2008.

Field work was not completed specifically for the plume study in 2008. Water quality data collected as part of the AEMP water quality monitoring program provided sufficient information to meet the objectives of the plume study, with the exception of measuring velocities to characterize the zone of turbulence near the permanent diffuser. Current velocity and direction near the diffuser were not measured in 2008, because the diffuser was not fixed in place, occasionally breaking the lake surface water. This prevented accurate current velocity measurements and resulted in health and safety issues close to the diffuser.

Data analysis focused on delineating the location and extent of the treated effluent plume under ice-covered and open-water conditions, by reviewing the depth profiles of conductivity throughout Snap Lake and mapping the horizontal patterns of conductivity. Diffuser performance was evaluated by comparing calculated dilution factors to those predicted in the EAR.

The location and extent of the treated effluent plume in Snap Lake were different between ice-covered and open-water conditions in 2008. Due primarily to wind-driven mixing, the treated effluent was mixed vertically in the vicinity of the diffuser during open-water conditions. Conductivity levels during open-water conditions generally decreased with distance from the diffuser. Conductivity levels were similar in the north and south basins, and lower in the northwest arm of Snap Lake.

During ice-covered conditions, near-bottom conductivity levels showed a greater difference between the north and south basin of Snap Lake. Conductivity values near the bottom of Snap Lake were greater than at the surface (i.e., immediately under the ice). There was some initial mixing from the diffuser during ice-covered conditions. However, a general lack of turbulence in the water column caused the plume to sink to the bottom, resulting in higher conductivity levels at the bottom.

In 2008, the observed dilution factors around the permanent diffuser (45 to 263) were above the range predicted in the EAR (42 to 98) for all months. Therefore, the permanent diffuser performed as predicted or better during both ice-covered and open-water conditions.

The zone of turbulence could not be measured near the diffuser in Snap Lake in 2008 because the diffuser was not fixed in a permanent position. When the diffuser is permanently fixed into position, a field program will be developed to delineate the zone of turbulence.

#### **4.1.9 Dissolved Oxygen 2009 Annual Monitoring Report**

##### **Why Do We Monitor Dissolved Oxygen in Snap Lake?**

Dissolved oxygen (DO) concentrations in water are often used to gauge the overall health of the aquatic environment. DO refers to the amount of oxygen that is present in a given quantity of water. Fish and other aquatic biota living in Snap Lake use the oxygen that is dissolved in the water, much like people use the oxygen in the air they breathe. As part of the environmental assessment, De Beers predicted that the discharge of treated effluent to Snap Lake could result in a small decrease in the amount of DO in lake water, but that concentrations would remain at a level that is healthy for aquatic life in Snap Lake.

DO in Snap Lake is monitored to ensure that concentrations remain at a level that is healthy for aquatic organisms. DO is measured more often during the ice-covered period because concentrations tend to be lower under-ice than during the open-water season where the water surface is directly exposed to air and wind actively promotes re-aeration of the lake water. Potential Mine effects to Snap Lake from the discharge of treated effluent may be more easily discernable during ice-covered conditions, when wind-induced re-aeration is absent.

DO monitoring is required under the authority of the Water License, Environmental Agreement, Fisheries Authorization (FA), and Environmental Agreement.

### **What Did We Do in 2008 - 2009?**

Between July 2008 and June 2009, profiles of DO were measured throughout the water column at a number of monitoring stations in Snap Lake and Northeast Lake. The stations included several relatively deep locations in Snap Lake because DO concentrations tend to be lower in deeper waters.

DO was measured in July and August during the open-water period, and in February, March, late April/early May and June during ice-covered conditions. DO concentrations were compared with the minimum concentration required for fish and aquatic biota to remain healthy. Also, the changes in concentration of DO during the period of ice cover in 2009 were compared with the changes observed in previous years, and with the changes predicted in the EAR for Snap Lake Mine (Mine).

### **What Did We Learn?**

DO monitoring during the open-water season of 2008 and ice-covered period of 2009 confirmed that the concentrations of DO in Snap Lake were at levels considered healthy for fish and other aquatic organisms. Overall, DO concentrations in Snap Lake during the open-water and ice-covered seasons have not decreased since the beginning of minewater discharge.

We will continue to monitor DO while the Mine is operating to confirm that levels remain within the healthy range for the fish and other aquatic biota living in Snap Lake.

## **4.1.10 Total Dissolved Solids Monitoring Near Fish Habitat Compensation Areas in Snap Lake**

### **Why Do We Monitor Total Dissolved Solids?**

Total dissolved solids are defined as the measure of the total amount of dissolved matter in water, such as calcium, magnesium, carbonates, bicarbonates, metallic compounds, etc. The amount of solids dissolved in natural water varies with water type. The salt water in oceans, for instance, has a much higher concentration of TDS than freshwater in Arctic lakes, such as Snap Lake. High concentrations of TDS can be harmful to fish and other aquatic organisms if they are not adapted to these levels.

An increase in the concentration of TDS in Snap Lake water was predicted in the Mine environmental assessment (De Beers 2002a). Most of the water discharged from the Water Treatment Plant into Snap Lake is sourced from groundwater, which has higher concentrations of TDS than the water in the lake.

The environmental assessment predicted that over the life of the Mine, the average concentration of TDS in Snap Lake would remain below 350 mg/L. The concentration of TDS in Snap Lake is monitored on an on-going basis to confirm that it remains below the 350 mg/L maximum that was predicted in the environmental assessment.

### **What Did We Do in 2008 and 2009?**

Water samples and water column profile measurements were collected during open-water and ice-covered conditions near the three habitat compensation structures, from July 2008 to June 2009. Water samples and profile measurements were collected in July, August and September, during open-water conditions of 2008 from AEMP and SNP stations. During the month of August 2008, water samples and profile measurements were only collected at the SNP stations, which were the three stations closest to the diffuser that discharges treated effluent from the Water Treatment Plant. Safety concerns due to thin ice prevented sampling from October to December 2008. During 2009 ice-covered conditions, water samples and profile measurements were collected in February, March, late April/early May and June at the SNP stations. Water samples were collected at most other AEMP stations in February and late April/early May 2009.

### **What Did We Learn?**

Monitoring during the open-water period of 2008, and during the 2009 ice-covered period, confirmed that the concentrations of TDS near the three fish habitat compensation structures, and throughout Snap Lake, were below 350 mg/L. To confirm that the concentration remains below the predicted maximum and within a healthy range for aquatic life in Snap Lake, monitoring of TDS in Snap Lake will continue over the life of the Mine.

## **4.1.11 Benthic Invertebrate Community**

The objectives of the 2008 Snap Lake benthic invertebrate program were to determine if the benthic invertebrate community was affected by changes in water and sediment quality in Snap Lake, and to compare observed changes to EAR predictions.

Benthic invertebrate samples were collected at 13 stations in Snap Lake and 5 stations in Northeast Lake during late winter (March and April) 2008, when ice cover was still present on both lakes. Samples were analyzed for taxonomic composition and biomass. Benthic community variables were compared among sampling areas within Snap Lake and between the two lakes, and over time in the near-field and mid-field areas.

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## **4.2 NON-ANNUAL REGULATORY REPORTING REQUIREMENTS**

### **4.2.1 Water Intake and Minewater Outlet Embankments Post Construction Habitat Compensation Monitoring Report**

In 2005, De Beers Canada Inc. (De Beers) began construction of the water intake and minewater outlet at the Snap Lake Mine (Mine). Although these structures were designed to minimize the change or loss of existing fish habitat, some fish habitat along the shore of Snap Lake was lost during installation of the pipes for the water intake and minewater outlet. To make up for the loss, new fish habitat was constructed by placing clean, large rocks (cobble and boulders) on top of the water intake and minewater outlet pipes. The large rock placed on the water intake and minewater outlet pipes increased the amount of shoreline area available for fish at two locations in the lake.

De Beers conducted pre-construction (2005) and post-construction (2007 and 2008) fish and fish habitat monitoring at the intake and outlet locations. A variety of fish species were observed using the new habitat after construction was complete. More fish were seen after construction of the new shoreline habitat than before construction began. Monitoring of the new habitat will continue for one more year (2009) to ensure fish keep using these new areas.

### **4.2.2 Stream 27 Habitat Compensation Monitoring Report**

One small stream (Stream 29) near Snap Lake will lose feeding habitat for Arctic grayling due to the construction of a rock berm as part of the De Beers Canada Inc. (De Beers) Snap Lake Mine. To make up for the loss of this habitat, habitat improvements were designed and implemented on another nearby stream, (Stream 27). The use of habitat in S27 by fish was limited by stream flow, low

water levels in early summer, and the presence of natural barriers to fish passage. Habitat improvements to increase the potential of the stream to provide spawning and rearing habitat for fish species from Snap Lake were installed on S27 in fall 2007. A natural barrier (alder rootwad) was removed to increase stream flows and fish passage, and a rock weir was constructed at the head of the stream to moderate water levels during the spring freshet.

Use of the stream by fish was monitored before and after removal of the rootwad barrier. After the blockage was removed and the weir constructed, Arctic grayling were observed spawning in S27 in both 2007 and 2008. Arctic grayling eggs hatched in the stream, and juvenile fish were observed throughout the stream in spring and summer. The compensation work conducted at S27 is considered to be successful, as fish are not trapped in stream at low flows, and are able to spawn and rear in areas upstream from the old barrier. De Beers will continue to monitor the habitat in the stream and to stabilize the rock weir and rock wall as required.

## **5 SUMMARY OF COMPLIANCE**

In addition to the submissions discussed in previous sections, Table 5-1 provides a summary of the Indian and Northern Affairs Canada (INAC) site inspections in 2009. The areas of the Mine that were inspected during each inspection are listed, followed by recommendations, comments and requests made by the Inspector. Observations by the Inspector concerning items that were recommendations or required action on previous inspection reports are also included. The table also provides a summary of the De Beers Canada Inc. (De Beers) response to the Inspector requests. The complete INAC Inspection reports can be found on the MVLWB public registry.

**Table 5-1 Summary of Compliance, 2008**

Inspection Date	Inspection Report	De Beers Response
January 7 <sup>th</sup> , 2009	The following were inspected: <ul style="list-style-type: none"> <li>• Water Management Pond;</li> <li>• Sewage Treatment Plant;</li> <li>• Temporary Sump 1-4;</li> <li>• Waste Management Area,</li> <li>• Fuel Handling and Storage;</li> <li>• Procon's Shop;</li> <li>• Explosives Storage;</li> <li>• Laydown area;</li> <li>• Winter Road Activity (from the mine site to Portage 8)</li> </ul>	N/A
	1. Food finding way into burn pit; Spills are going unreported in the underground mine	N/A
February 6, and 17th 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• Land Use:</li> <li>• Winter Road,</li> <li>• Waste Management</li> <li>• Water Use: General Conditions;</li> <li>• Waste Management</li> </ul>	N/A
	1. Consideration must be made that snow dumped into TS 4 not impede water movement; ensure snow doesn't build up at Dam 1; remedy AN storage shortcomings	Report to inspector on high nitrate levels in the north pile collection ditch and at SNPs 02-09 & 02-07.3
March 16th, 2009	<ul style="list-style-type: none"> <li>• Water License: General Conditions;</li> <li>• Construction conditions;</li> <li>• Waste and Water management</li> </ul>	N/A
	1. Storage structures used to store bulk explosives appears to be unable to contain AN and associated run-off;	N/A
	2. a waste management facility listed in the Water license has yet to be built	N/A
April 15 <sup>th</sup> , 2009,	The following areas were inspected: <ul style="list-style-type: none"> <li>• Water License: General Conditions (metres)</li> <li>• Waste management (containment structures)</li> </ul>	N/A
	1. Storage structures used to store bulk explosives appears to be unable to contain AN and associated run-off	N/A
	2. Inspector requires: Data from SNP-02 (December onwards); causes of elevated N in North Pile collection ditch	N/A

**Table 5-1 Summary of Compliance, 2008 (continued)**

Inspection Date	Inspection Report	De Beers Response
May 6 <sup>th</sup> and 13 <sup>th</sup> 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• General conditions (Spill response)</li> <li>• Waste Management</li> <li>• Dam 1</li> <li>• Surface Water collection system</li> <li>• Closure and Reclamation</li> </ul>	N/A
	1. Action is needed to progress towards a permanent resolution of the AN storage shortcomings.	N/a
June 4th, 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• General conditions (Ammonia, Turbidity)</li> <li>• Construction: Bulk Nitrate Storage</li> <li>• Waste Management</li> <li>• Dam 1</li> <li>• Surface Water Runoff Collection System</li> </ul>	N/A
	1. The storage structure used since 2006 to store bulk explosives appears to be unable to ensure containment of AN and associated runoff.	N/A
July 30 <sup>th</sup> , 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• General Conditions (Ammonia, Turbidity)</li> <li>• Bulk Nitrate Storage Building</li> <li>• Waste Management</li> </ul>	N/A
	1. The storage structure used since 2006 to store bulk explosives appears to be unable to ensure containment of AN and associated runoff.	N/A
	2. To date only a portion of the 2008 Annual Report has been provided (AEMP and ARD Report missing).	N/A
August 24 <sup>th</sup> , 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• General Conditions (Ammonia and Turbidity)</li> <li>• Bulk Nitrate Storage Building</li> <li>• Waste Management</li> <li>• Surface Water Runoff Collection System</li> <li>• Temporary AN Storage</li> <li>• Closure and Reclamation Plan</li> </ul>	Discussions initiated with Lands Admin to resolve boundary issues.
	1. The storage structure used since 2006 to store bulk explosives appears to be unable to ensure containment of AN and associated runoff.	Work initiated.
	2. To date only a portion of the 2008 Annual Report has been provided (AEMP and ARD Report missing).	Work initiated.

**Table 5-1 Summary of Compliance, 2008 (continued)**

Inspection Date	Inspection Report	De Beers Response
September 1 <sup>st</sup> , 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• Bulk Nitrate Storage Building</li> <li>• General Conditions (Maintaining SNP signage)</li> <li>• Water Runoff Collection System (Sumps)</li> <li>• Temporary AN Storage</li> <li>• Diffuser</li> <li>• Spill-09-301</li> </ul>	N/A
	1. The storage structure used since 2006 to store bulk explosives appears to be unable to ensure containment of AN and associated runoff.	N/A
	2. To date only a portion of the 2008 Annual Report has been provided ( ARD Report missing).	N/A
October 28 <sup>th</sup> , 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• Underground Fuel storage facility</li> <li>• Bulk Nitrate Storage Building</li> <li>• Waste management</li> <li>• Surface Water Run off Collection System (Sumps)</li> <li>• Dam 1</li> <li>• Temporary AN Storage</li> </ul>	N/A
	1. Ensure that bulk nitrate material temporarily stored on the historic AN storage pad are used up as soon as possible. The storage structure used since 2006 to store bulk explosives appears to be unable to ensure containment of AN and associated runoff.	N/A
December 19th, 2009	The following areas were inspected: <ul style="list-style-type: none"> <li>• Underground Fuel storage facility</li> <li>• Bulk Nitrate Storage Building</li> <li>• Waste management</li> <li>• Surface Water Run off Collection System (Sumps)</li> <li>• Dam 1</li> <li>• Temporary AN Storage</li> </ul>	N/A
	1. Ensure that bulk nitrate material temporarily stored on the historic AN storage pad are used up as soon as possible. The storage structure used since 2006 to store bulk explosives appears to be unable to ensure containment of AN and associated runoff.	N/A

## **6 SUMMARY OF ACTIVITIES AT SNAP LAKE**

### **6.1 2009 CONSTRUCTION ACTIVITIES**

Phase II construction was initiated in 2005 and continued through 2006 and 2007. In 2008 De Beers Canada Inc. (De Beers) initiated the process of moving from the Construction Phase to the Operations Phase. In 2009 De Beers Canada Inc. reached peak production. Construction milestones achieved during 2009 include:

- continuation of phase 3 development of the 4 metres (m) raise on the Starter cell;
- 95 percent (%) complete for lift on East Cell sump access road;
- constructed access road into South Quarry for PAG deposition;
- assisted with work on anchoring of diffuser line into Snap Lake;
- completion of electrical distribution, and AN Storage building construction;
- remove ice from WMP to gain volume;
- reinforced retaining wall at bigtop currently used as batch plant;
- built transformer, and laydown pad around site;
- reinforced, and cemented kitchen floor, and assisted with installation of new dishwashers;
- replaced silt screens at drainage ditch leading into temporary sump 1;
- closed off unused culvert in starter cells;
- installed level monitors into Starter cell sumps;
- installed starter cell monitoring stations;
- reinforced armouring around starter cell embankments;
- pumped out IL6 in preparation of 2010 construction;
- assisted in grading, and construction of embankments at organics laydown area;
- assisted in moving of AN into AN storage; and
- constructed rock pad for the permanent camp.

## **6.2 2010 CONSTRUCTION AND OPERATIONAL ACTIVITIES**

Operation activities planned for 2010 include:

- East Cell development (North Pile); and
- Construct permanent accommodations by October 2010

## **7 SUMMARY OF MITIGATIVE MEASURES**

De Beers Canada Inc. (De Beers) strives for continual improvement in all its operations. During Phase III construction of the Snap Lake Mine (Mine) in 2009 De Beers encountered issues that required mitigation. However, due to the economic down turn in 2009, DeBeers Canada Inc. went into maintenance mode and no mitigation measures were carried out.

## **8 SUMMARY OF ADAPTIVE MEASURES**

No adaptive measures were carried out in 2009.

## **9 SUMMARY OF PUBLIC CONCERNS**

There were no concerns brought forward by the public for 2009.

## **10 SUMMARY OF NEW TECHNOLOGIES INVESTIGATED**

No new technologies were investigated in 2009.

## 11 REFERENCES

- AENV (Alberta Environment). 2005. Alberta Ambient Air Quality Objectives. Environmental Protection and Enhancement Act. Submitted April 2005.
- De Beers (De Beers Canada Mining Inc.). 2002a. Snap Lake Diamond Project: Environmental Assessment Report. Submitted to the Mackenzie Valley Environmental Impact Review Board. February 2002.
- De Beers. 2002b. Snap Lake Diamond Project Environmental Management System.
- De Beers. 2004a. De Beers Snap Lake Diamond Project: Wildlife Effects Monitoring Program. Prepared for De Beers Canada Mining Inc. by Golder Associates Ltd. Yellowknife, NWT.
- De Beers. 2004b. Environmental Agreement: De Beers Snap Lake Diamond Project. Effective May 31, 2004. Between: Her Majesty the Queen in Right of Canada, the Government of the Northwest Territories, De Beers Canada Mining Inc., Dogrib Treaty 11 Council, Lutsel K'e Dene Band, Yellowknives Dene First Nation, and North Slave Métis Alliance.
- De Beers. 2005a. Snap Lake Project. Air Quality Monitoring Program. Submitted to the GNWT and Environment Canada. September 2005.
- De Beers. 2005b. Snap Lake Project Vegetation Monitoring Plan. Prepared for De Beers Canada Inc. by Golder Associates Ltd. Calgary, AB, March 2005.
- De Beers. 2008. Air Quality and Emissions Management and Monitoring Plan. August 2008.
- Environment Canada. 1981. The Clean Air Act – Compilation of Regulations And Guidelines. Regulations, Codes And Protocols Report EPS 1-AP-81-1. Air Pollution Control Division.
- Environment Canada. 2009. National Inventory Report: 1990-2007, Greenhouse Gas Sources and Sinks in Canada. Greenhouse Gas Division. April 2009.

GNWT. 2002. Guideline for Ambient Air Quality Standards in the Northwest Territories. Department of Resources, Wildlife and Economic Development. December 2002.

GNWT and EC (Environment Canada). 2006. Response Letter to De Beers Canada Inc: Re: Snap Lake Project – Air Quality and Emissions Management Plan and Air Quality Monitoring Plan. April 3, 2006.

MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2003. Report of Environmental Assessment and Reasons for Decision on the De Beers Canada Mining Inc. Snap Lake Diamond Project. July 24, 2003.

### ***Personal Communications***

Fu, L. 2006. Alberta Environment – Sr. Policy Analyst. Edmonton Alberta. Personal Communication with Natalie Cooper – April 18, 2006.

Mandeville, F. 2009. Wildlife and Environment Division, Environment & Natural Resource, Government of the Northwest Territories- Manager. Personal Communication - April 23, 2009.



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