# TECHNICAL MEMORANDUM

**DATE** September 14, 2012 **PROJECT No.** 11-1365-0012.3030.40/DCN-089

**TO** Veronica Chisholm
De Beers Canada Inc.

**CC** Amy Langhorne and John Faithful, Golder Associates Ltd.

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**WATER QUALITY OBJECTIVES (WQO) AND SEDIMENT QUALITY OBJECTIVES (SQO) FOR THE PROPOSED GAHCHO KUÉ PROJECT – RECOMMENDATIONS**

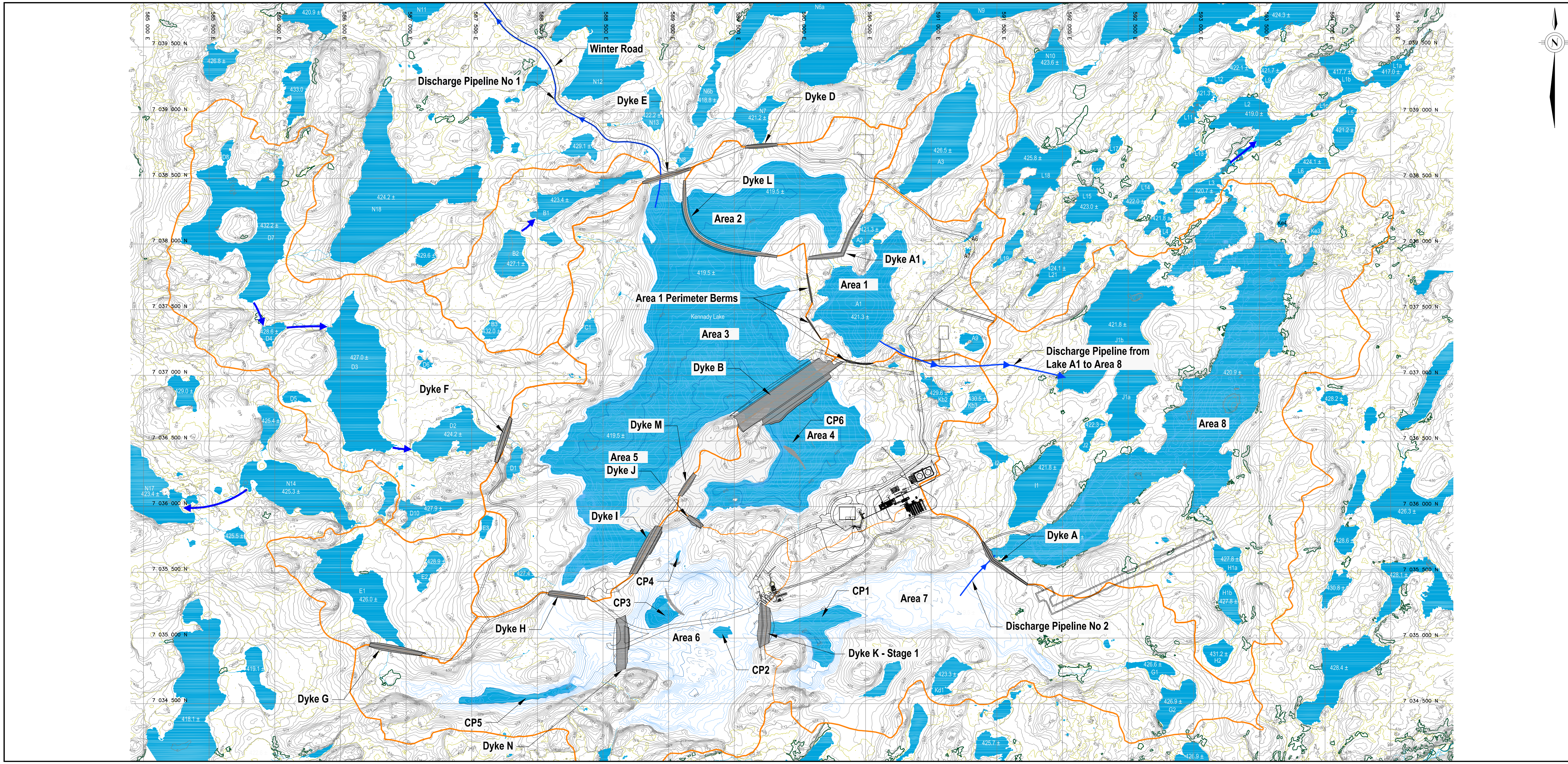
## 1.0 INTRODUCTION

During the Technical Sessions as part of the Mackenzie Valley Environmental Impact Review Board process for the proposed Gahcho Kué Project (Project) held on May 22 to 25, 2012, De Beers Canada Inc. (De Beers) made a commitment to develop water quality objectives (WQO) and sediment quality objectives (SQO) for the proposed Project (MVEIRB 2012, Commitment #5). The Mackenzie Valley Land and Water Board (Board), on behalf of all Boards in the NWT, notes (MVLWB 2011, footnote p 10) that the *Northwest Territories Waters Act* refers in subsection 4(c) to 'water quality standards', not water quality objectives; however, such standards are believed to be "*equivalent to the more widely accepted term "water quality objective" which has been defined by the Canadian Council of Ministers of the Environment (CCME) as: "a numerical concentration or narrative statement that has been established to support and protect the designated uses of water at a specified site." (CCME (1999), Canadian Environmental Quality Guidelines. Guidelines and Standards Division, Winnipeg, MB.)*."

De Beers' commitment to develop WQO and SQO is based on the above definition of such objectives, as provided by the MVLWB (2011). WQO are derived to provide the basis for effluent quality criteria (EQC). The purpose of this technical memorandum is to provide recommendations to De Beers regarding their above commitment, based on the WQO and SQO development process outlined in a previous technical memorandum (Golder 2012a). These two technical memoranda serve to inform discussions on the development of details for the Aquatic Effects Monitoring Program (AEMP) that will be resolved during the regulatory process.

## 2.0 OVERVIEW OF THE WATER MANAGEMENT PLAN

Water management is a key component of the proposed Project because the diamond-bearing kimberlite pipes are located underneath Kennady Lake. The key activities associated with the water management plan are the dewatering of Areas 2 to 7 of Kennady Lake to allow for the safe mining of the ore bodies, and the subsequent refilling of Kennady Lake when operations are complete. Figures 1a and 1b provides an overview of the Project area related to detailed information on planned development.




## LEGEND

| | | | | | |
|---|---|---|---|---|---|
| 430 | Existing Ground Contours<br>5m Index - 1m Intermediate | | Marsh Area | | Lake/Pond |
| | | | Scrub | | |
| 415 | Bathymetry Contours<br>5m Index - 1m Intermediate | | Sub-watershed Boundary | | |
| | | | Drainage Flow Direction | | |
| CP | Collection Pond | | Discharge Pipeline | | |
| | Winter Road | | | | |

NOTES

Base data source: EBA Figure 4.2 - Stage 1 - Initial Lake Dewatering (June-July, 2013)

Source: Adapted from Figure 3.9-1 of De Beers 2010

# GAHCHO KUÉ PROJECT

## Water Management Areas, Dykes, Collection Ponds, and Lakes Associated with the Project

| | |
|---|---|
| PROJECTION: UTM Zone 12 | DATUM: NAD83 |
| SCALE: 500 0 500 METRES | DE BEERS CANADA |
| FILE No: P2011-Other-001-CAD-Fig1 | DATE: March 3, 2012 |
| JOB No: 11-1365-0001 | REVISION No: 4 |
| OFFICE: GOLD - SAS | DRAWN: BDS/TAH |
| CHECK: JF | Figure 1a |

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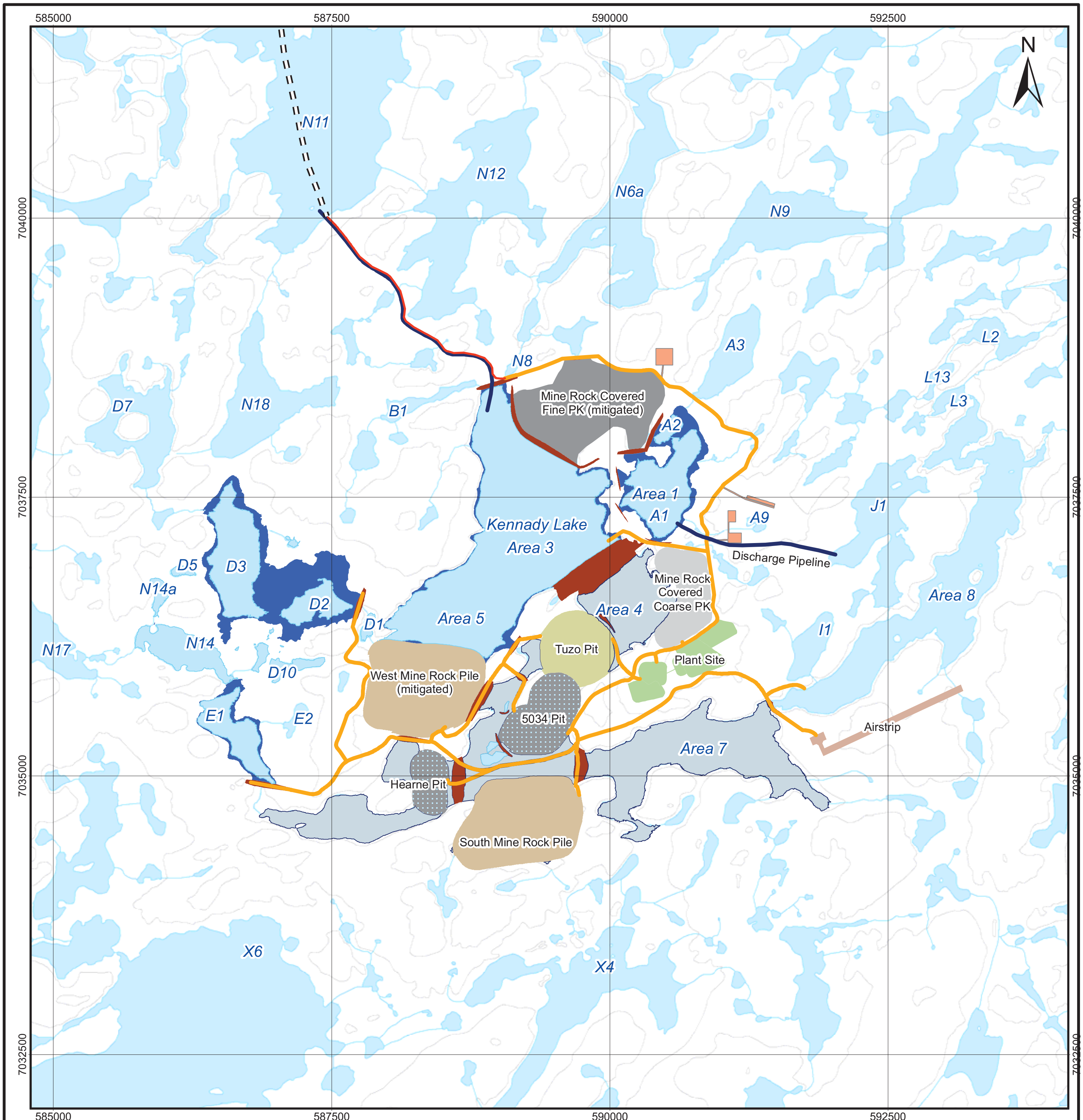


## LEGEND

| | | | | | |
|---|---|---|---|---|---|
| | Waterbody | | **Project Footprint** | | Dyke or Berm |
| | Watercourse | | Service Road | | Fine PK Containment Facility |
| N12 | Lake Identifier | | Site Road | | Flooded Area |
| | Contour (10m interval) | | Water Pipeline | | Mine Rock Pile |
| = = | Proposed Winter Access Road | | Airstrip | | Open Pit |
| | | | Back-filled Pit | | Plant Site |
| | | | Building | | Water |
| | | | Coarse PK Pile | | |
| | | | De-watered Lake Bed | | |

NOTES
Source: adapted from Figure 1.3-2 of De Beers 2010
Base data source: National Topographic Base Data (NTDB) 1:50,000
PK = Processed Kimberlite

# GAHCHO KUÉ PROJECT

## Project Area

| PROJECTION: UTM Zone 12 | DATUM: NAD83 | De Beers CANADA |
|---|---|---|
| Scale: 1:50,000 500 250 0 500 Metres | | |
| FILE No: E2011-Perm-001-GIS | | DATE: February 7. 2012 |
| JOB NO: 11-1365-0001 | REVISION NO: 1 | **Figure 1b** |
| OFFICE: GOLD-CAL | DRAWN: AD | CHECK: JF |

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The area within the Kennady Lake watershed that will be disturbed as part of the proposed Project activities is Kennady Lake. A large part of the lake (Areas 2 to 7) will be isolated from the remainder of the Kennady Lake watershed by a series of dykes (see Figure 1a), establishing the controlled area in which mine activities will be focussed. The small watersheds upstream of Kennady Lake (i.e., A, B, D, and E watersheds) will be unaffected by the Project, but will be diverted away from the controlled area, and the most downstream region of Kennady Lake (Area 8) will be separated from the lake by Dyke A, which will be constructed at the narrows between Areas 7 and 8. More specifically, watershed A will be diverted to Lake J1b, which flows to Area 8, and the B, D, and E watersheds will be diverted to the adjacent N watershed.

Dewatering of Kennady Lake will be timed to occur during the construction phase (two years) and the initial years of the operations phase. In Years -2 and -1, water will be pumped from Area 3 to Lake N11, and Area 7 to Area 8. In the first year of dewatering, water will be pumped to both receiving water body locations. In the second year of construction, it is assumed that water only from Area 3 will be pumped to Lake N11. This is because the depth of Areas 6 and 7 is much less than Area 3, and following the first year of dewatering, the water level will be low enough to interact with the lake bed and suspend bed sediment to levels that will no longer meet regulatory discharge benchmarks.

During operations, water from Area 3 will be pumped to Lake N11 for the first three years or while water quality meets regulatory discharge thresholds.

Following closure, the upper watersheds will be reconnected to Kennady Lake, and Kennady Lake refilled. It is also planned that supplemental water will be sourced from Lake N11 to accelerate the refilling of the lake, resulting in Kennady Lake being filled in approximately nine years. Once Kennady Lake has been refilled and WQO are achieved, Dyke A will be removed and Kennady Lake will be reconnected to Area 8 and the downstream waters.

Proposed WQO are therefore considered for Lake N11 during dewatering in construction and for pumped discharge during the early years of operations, and for Kennady Lake once the lake is refilled and reconnected to Area 8 and downstream waters. Proposed WQO are not considered for Area 8 during construction or operations as pumped water from Area 7 and diverted water from Area 1 (Lake A1) are expected to possess similar chemistry to Area 8.

## 3.0 OVERALL GOALS OF WATER QUALITY MANAGEMENT

The overall goals of water quality management are as follows, comprising narrative statements developed from the aquatic ecosystem assessment endpoints from the 2012 EIS Supplement (De Beers 2012):

- Kennady Lake
  - Water quality changes as a result of Project activities will not significantly affect the suitability of Kennady Lake in post-closure to support viable aquatic ecosystems
  - Water quality changes as a result of Project activities will not significantly affect the return of populations of lake trout, northern pike, and Arctic grayling in Kennady Lake in post-closure
  - Water quality changes as a result of Project activities will not negatively affect traditional and non-traditional uses of Kennady Lake in post-closure
- Lake N11 and Downstream Waters

- Water quality changes as a result of Project activities will not significantly affect the suitability of Lake N11 and downstream waterbodies to support viable aquatic ecosystems
- Water quality changes as a result of Project activities will not significantly affect populations of lake trout, northern pike, and Arctic grayling in Lake N11 and downstream waters
- Water quality changes as a result of Project activities will not negatively affect traditional and non-traditional uses of Kennady Lake in post-closure

Numeric chemical benchmarks including WQO provide one basis for judging whether these overall goals will be met. As such, chemical benchmarks used for screening are a means to achieve the above goals but not an end in themselves.

All water quality parameters as identified in the 2012 EIS Supplement (De Beers 2012) will be monitored as part of the AEMP and will be compared to predicted concentrations, baseline/reference concentrations, and applicable water quality guidelines for each parameter. These benchmarks are provided in Tables 1 and 2. Thus, all water quality parameters will be monitored and assessed against defined chemical benchmarks. In addition, for a few of these parameters, specifically for a few substances of potential concern (SOPCs), WQO to serve as the basis for deriving EQC are also recommended based on predicted maximum concentrations as outlined below.

# 4.0 METHODS

## 4.1 Water Quality Objectives

Twelve substances of potential concern (SOPCs) in Kennady Lake waters after closure when the lake has been refilled, were identified as described in the previous technical memorandum (Golder 2012a), based on De Beers (2012). In Lake N11 waters during the three years of discharge during operations, nine of the 12 Kennady Lake SOPCs were determined of potential concern in those waters (De Beers 2012). Listed below are the 12 Kennady Lake waters SOPCs, with the nine applicable to Lake N11 indicated by an asterisk:

- Total dissolved solids (TDS)*;
- Fluoride;
- Antimony*;
- Barium*;
- Beryllium*;
- Cadmium*;
- Chromium;
- Cobalt*;
- Copper;
- Manganese*;
- Strontium*; and
- Vanadium*.

**Table 1 Substances of Potential Concern and Other Parameters Assessed for Water Quality Objectives for Kennady Lake Based on Predicted Whole Lake Mixed Concentration**

| Substance | Units | Regional Baseline Values | | | | | Maximum Projected Concentration | | Within Baseline Range (Y/N) | Chronic Water Quality Guidelines[b] | Within WQGs (Y/N) | Proposed AEMP Benchmark | Interim WQO (Y/N) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum[a] | Median[a] | n (detects) | n (non-detects) | Kennady Lake | Area 8 | | | | | | |
| **Conventional Parameters** | | | | | | | | | | | | | | |
| Total Dissolved Solids[c] | mg/L | <2.0 | 84 | 18 | 288 | 75 | 145 | 96 | N | >350 | Y | TBD | N | To be determined (TBD) based on Snap Lake testing |
| Hardness | mg/L as $CaCO_3$ | 0.5 | 14 | 5 | 368 | 72 | 85 | 56 | N | - | - | - | N | Hardness is an ETMF |
| Total organic carbon | mg/L | <1.0 | 30 | 3.8 | 325 | 3 | - | - | N | - | - | - | N | Total organic carbon is an ETMF |
| Dissolved organic carbon | mg/L | <1.0 | 36 | 3.8 | 246 | 1 | - | - | N | - | - | - | N | Dissolved organic carbon is an ETMF |
| **Major Ions** | | | | | | | | | | | | | | |
| Calcium | mg/L | 0.1 | 5.6 | 1.2 | 425 | 24 | 27 | 17 | N | - | - | - | N | Component of TDS |
| Chloride | mg/L | <0.1 | 6.3 | 0.9 | 227 | 238 | 64 | 39 | N | 120 | Y | 120 | N | benchmark 226 mg/L at 40 mg/L hardness from Elphick et al. (2011) |
| Fluoride[c] | mg/L | <0.005 | 0.1 | 0.04 | 199 | 235 | 0.13 | 0.11 | N | 0.12 | N | 0.12 | Y | |
| Magnesium | mg/L | 0.26 | 2.2 | 0.54 | 376 | 49 | 4.6 | 3.1 | N | - | - | - | N | Component of TDS |
| Potassium | mg/L | 0.24 | 1.2 | 0.46 | 323 | 88 | 2.8 | 2 | N | 41[d] | Y | 41 | N | |
| Sodium | mg/L | 0.33 | 4.4 | 0.6 | 315 | 96 | 15 | 9.9 | N | - | - | - | N | Component of TDS |
| Sulphate | mg/L | 0.00029 | 11 | 1.0 | 252 | 209 | 20 | 13.2 | N | 100[e] | Y | 100 | N | SSWQO for Ekati = 160[f] |
| **Nutrients** | | | | | | | | | | | | | | |
| Nitrogen - Nitrate | mg N/L | <0.001 | 0.83 | 0.019 | 165 | 309 | 2 | 1.1 | N | 2.93 | Y | 2.93 | N | See text; and, SSWQO for Ekati = 6.5[g] |
| Nitrogen - Ammonia | mg N/L | <0.005 | 0.22 | 0.015 | 176 | 278 | 1.9 | 1.0 | N | 1.83[h] | N | 1.83 | N | See text; US EPA (2002) chronic guideline = 0.88[h,i] |
| Phosphorus, dissolved | mg/L | <0.001 | 0.19 | 0.003 | 139 | 154 | 0.011 | 0.01 | Y | - | - | 0.19 | N | See text |
| Phosphorus, total | mg/L | <0.001 | 0.12 | 0.004 | 175 | 213 | 0.011 | 0.01 | Y | - | - | 0.12 | N | See text |
| **Total Metals** | | | | | | | | | | | | | | |
| Aluminum[c] | mg/L | 0.0028 | 0.24 | 0.009 | 427 | 50 | 0.092 | 0.061 | Y | 0.005 - 0.100[j] | Y | 0.24 | N | |
| Antimony[c] | mg/L | <0.00002 | 0.0021 | 0.00012 | 222 | 258 | 0.0008 | 0.00058 | Y | 0.02[k] | Y | 0.0021 | N | |
| Arsenic | mg/L | 0.00005 | 0.0015 | 0.00013 | 367 | 114 | 0.0024 | 0.0015 | N | 0.005 | Y | 0.005 | N | |
| Barium | mg/L | 0.00025 | 0.022 | 0.0023 | 399 | 82 | 0.03 | 0.02 | N | 1[e] | Y | 1 | Y | |
| Beryllium[c] | mg/L | 0.00001 | 0.00001 | 0.00001 | 1 | 480 | 0.00014 | 0.00011 | N | 0.0053[e] | Y | 0.0053 | Y | |
| Boron | mg/L | <0.001 | 0.013 | 0.002 | 236 | 245 | 0.11 | 0.079 | N | 1.5 | Y | 1.5 | N | |
| Cadmium[c] | mg/L | <0.000002 | 0.000085 | 0.000009 | 61 | 411 | 0.000045 | 0.00004 | Y | 0.00023[l,i] | Y | 0.000085 | N | CCME WQG in revision; see Golder (2012c) |
| Chromium[c] | mg/L | <0.00006 | 0.0027 | 0.00013 | 85 | 393 | 0.001 | 0.0007 | Y | 0.001 | Y | 0.0027 | Y | Cr speciation needed; WQG listed is for CrVI; CrIII WQG = 0.0089 |
| Cobalt[c] | mg/L | <0.000005 | 0.0032 | 0.000045 | 193 | 288 | 0.0014 | 0.00097 | Y | 0.004[e] | Y | 0.0032 | N | |
| Copper[c] | mg/L | 0.00025 | 0.015 | 0.0006 | 328 | 151 | 0.0023 | 0.0023 | Y | 0.002[l,i] | N | 0.015 | N | For more information, see Golder (2012d) |
| Iron | mg/L | 0.004 | 1.28 | 0.035 | 371 | 103 | 0.19 | 0.14 | Y | 0.3 | Y | 1.28 | N | |
| Lead | mg/L | <0.000005 | 0.001 | 0.000023 | 175 | 306 | 0.00034 | 0.00025 | Y | 0.0024[l,i] | Y | 0.001 | N | |

**Table 1 Substances of Potential Concern and Other Parameters Assessed for Water Quality Objectives for Kennady Lake Based on Predicted Whole Lake Mixed Concentration (continued)**

| Substance | Units | Regional Baseline Values | | | | | Maximum Projected Concentration | | Within Baseline Range (Y/N) | Chronic Water Quality Guidelines[(b)] | Within WQGs (Y/N) | Proposed AEMP Benchmark | Interim WQO (Y/N) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum[(a)] | Median[(a)] | n (detects) | n (non-detects) | Kennady Lake | Area 8 | | | | | | |
| Manganese[(c)] | mg/L | 0.0005 | 0.44 | 0.0036 | 457 | 17 | 0.043 | 0.034 | Y | 0.7[(e)] | Y | 0.438 | N | |
| Mercury | mg/L | <0.0000006 | 0.00009 | 0.000004 | 53 | 313 | 0.00001 | 0.000012 | Y | 0.000026 | Y | 0.00009 | N | |
| Molybdenum | mg/L | <0.00004 | 0.0012 | 0.0001 | 36 | 445 | 0.007 | 0.0042 | N | 0.073 | Y | 0.073 | N | SSWQO for Ekati = 19[(m)] |
| Nickel | mg/L | <0.00006 | 0.013 | 0.00029 | 418 | 63 | 0.0048 | 0.0032 | Y | 0.043[(l,i)] | Y | 0.013 | N | |
| Selenium[(c)] | mg/L | <0.00001 | 0.003 | 0.00009 | 16 | 465 | 0.00017 | 0.0002 | Y | 0.001 | Y | 0.003 | N | |
| Silver[(c)] | mg/L | 0.0000005 | 0.00088 | 0.000005 | 46 | 332 | 0.000061 | 0.000095 | Y | 0.0001 | Y | 0.00088 | N | |
| Strontium[(c)] | mg/L | 0.0035 | 0.026 | 0.0074 | 406 | - | 0.03 | 0.047 | N | - | - | TBD | N | Testing to determine WQO for Snap Lake underway |
| Thallium | mg/L | <0.000002 | 0.0001 | 0.000003 | 45 | 325 | 0.00005 | 0.000042 | Y | 0.0008 | Y | 0.0001 | N | |
| Uranium | mg/L | <0.000002 | 0.0003 | 0.00001 | 170 | 296 | 0.0016 | 0.0011 | N | 0.015 | Y | 0.015 | N | |
| Vanadium[(c)] | mg/L | <0.00005 | 0.0025 | 0.0002 | 52 | 428 | 0.0027 | 0.0021 | N | 0.006[(k)] | Y | 0.006 | Y | SSWQO for Ekati = 0.03[(n)]; Environment Canada and Health Canada (2010) no effects threshold = 0.12 |
| Zinc[(c)] | mg/L | 0.0001 | 0.063 | 0.0018 | 314 | 167 | 0.008 | 0.0066 | Y | 0.03 | Y | 0.063 | N | |

Note: The term “metals” includes metalloids such as arsenic and non-metals such as selenium. Projected concentrations for Area 8 are provided for information only; baseline and WQG comparisons were based on the maximum projected concentrations for Kennady Lake.

(a) Maximum and median concentrations are based on detected values.
(b) From CCME (1999, with updates to 2012) unless noted.
(c) Substances of potential concern (SOPCs).
(d) Rescan (2012a).
(e) BCMOE (2006).
(f) Rescan (2012b; at a hardness of 40 mg/L as $CaCO_3$).
(g) Rescan (2012c; at a hardness of 60 mg/L as $CaCO_3$).
(h) Dependent on pH and temperature (assumed pH of 7.5 and 15°C, to give most conservative guideline).
(i) U.S. EPA (2002).
(j) Dependent on pH (assumed pH = 7.5).
(k) Ontario Ministry of Environment and Energy (1994).
(l) Dependent on hardness (assumed hardness = 80 mg/L as $CaCO_3$).
(m) Rescan (2012d).
(n) Rescan (2012e).

WQG = water quality guideline; WQO = water quality objective; SSWQO = site specific water quality objective; CCME = Canadian Council of Ministers of the Environment; BC = British Columbia; Cr = chromium; U.S. EPA = United States Environmental Protection Agency; ETMF = exposure and toxicity modifying factors; AEMP = aquatic effects monitoring program; < = less than; mg/L = milligrams per litre; $CaCO_3$ = calcium carbonate; TDS = total dissolved solids; TBD = to be determined; - = not applicable.

**Table 2 Substances of Potential Concern Assessed for Water Quality Objectives for Lake N11 Based on Maximum Predicted Concentration at the Edge of a 200 m IDZ**

| Substance | Units | Regional Baseline Values | | | | | Maximum Projected Concentration | | Within Baseline Range (Y/N) | Chronic Water Quality Guideline[b] | Within WQGs (Y/N) | Proposed AEMP Benchmark | Interim WQO (Y/N) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | Median | n (detects) | n (non-detects) | Lake N11 | Lake 410 | | | | | | |
| **Conventional Parameters** | | | | | | | | | | | | | | |
| Total Dissolved Solids[c] | mg/L | <2.0 | 84 | 18 | 288 | 75 | 57 | 31 | Y | - | - | 84 | N | Snap Lake Water License Limit = 350 |
| Hardness | mg/L as $CaCO_3$ | 0.5 | 14 | 5 | 368 | 72 | 32 | 14 | N | - | - | - | N | Hardness is an ETMF |
| Total organic carbon | mg/L | <1.0 | 30 | 3.8 | 325 | 3 | - | - | N | - | - | - | N | Total organic carbon is an ETMF |
| Dissolved organic carbon | mg/L | <1.0 | 36 | 3.75 | 246 | 1 | - | - | N | - | - | - | N | Dissolved organic carbon is an ETMF |
| **Major Ions** | | | | | | | | | | | | | | |
| Calcium | mg/L | 0.1 | 5.6 | 1.2 | 425 | 24 | 9.6 | 4.1 | N | - | - | - | N | Component of TDS |
| Chloride | mg/L | <0.1 | 6.3 | 0.9 | 227 | 238 | 22 | 7.9 | N | 120 | Y | 120 | N | Benchmark = 226 at 40 mg/L hardness from Elphick et al. (2011) |
| Fluoride[c] | mg/L | <0.005 | 0.1 | 0.04 | 199 | 235 | 0.05 | 0.04 | Y | 0.12 | Y | 0.1 | N | |
| Magnesium | mg/L | 0.26 | 2.2 | 0.54 | 376 | 49 | 1.8 | 0.94 | Y | - | - | 2.2 | N | Component of TDS |
| Potassium | mg/L | 0.24 | 1.2 | 0.46 | 323 | 88 | 1 | 0.63 | Y | 41[d] | - | 1.2 | N | |
| Sodium | mg/L | 0.33 | 4.4 | 0.6 | 315 | 96 | 5.4 | 2.4 | N | - | - | - | N | Component of TDS |
| Sulphate | mg/L | 0.00029 | 11 | 1.0 | 252 | 209 | 5.7 | 2.7 | Y | 100[e] | Y | 11 | N | SSWQO for Ekati = 160[f] |
| **Nutrients** | | | | | | | | | | | | | | |
| Nitrogen - Nitrate | mg N/L | <0.001 | 0.83 | 0.019 | 165 | 309 | 1.5 | 0.6 | N | 2.93 | Y | 2.93 | N | See text; and, SSWQO for Ekati = 6.5[g] |
| Nitrogen - Ammonia | mg N/L | <0.005 | 0.22 | 0.015 | 176 | 278 | 1.4 | 0.54 | N | 1.83[h] | N | 1.83 | N | See text; US EPA (2002) chronic guideline = 0.88[h,i] |
| Phosphorus, dissolved | mg/L | <0.001 | 0.19 | 0.003 | 139 | 154 | 0.007 | 0.005 | Y | - | - | 0.19 | N | See text |
| Phosphorus, total | mg/L | <0.001 | 0.12 | 0.004 | 175 | 213 | 0.009 | 0.006 | Y | - | - | 0.12 | N | See text |
| **Total Metals** | | | | | | | | | | | | | | |
| Aluminum[c] | mg/L | 0.0028 | 0.24 | 0.009 | 427 | 50 | 0.029 | 0.025 | Y | 0.005 - 0.100[j] | Y | 0.24 | N | |
| Antimony[c] | mg/L | <0.00002 | 0.0021 | 0.00012 | 222 | 258 | 0.00035 | 0.00016 | Y | 0.02[k] | Y | 0.0021 | N | |
| Arsenic | mg/L | 0.00005 | 0.0015 | 0.00013 | 367 | 114 | 0.00074 | 0.00034 | Y | 0.005 | Y | 0.0015 | N | |
| Barium | mg/L | 0.00025 | 0.022 | 0.0023 | 399 | 82 | 0.01 | 0.0056 | Y | 1[e] | Y | 0.022 | N | |
| Beryllium[c] | mg/L | 0.00001 | 0.00001 | 0.00001 | 1 | 480 | 0.000072 | 0.000073 | N | 0.0053[e] | Y | 0.0053 | Y | |
| Boron | mg/L | <0.001 | 0.013 | 0.002 | 236 | 245 | 0.026 | 0.013 | N | 1.5 | Y | 1.5 | N | |
| Cadmium[c] | mg/L | <0.000002 | 0.000085 | 0.000009 | 61 | 411 | 0.000024 | 0.000022 | Y | 0.00011[l,i] | Y | 0.000085 | N | CCME WQG in revision; see Golder (2012c) |
| Chromium[c] | mg/L | <0.00006 | 0.0027 | 0.00013 | 85 | 393 | 0.0004 | 0.00026 | Y | 0.001 | Y | 0.0027 | N | Cr speciation needed; WQG listed is for CrVI; CrIII WQG = 0.0089 |
| Cobalt[c] | mg/L | <0.000005 | 0.0032 | 0.000045 | 193 | 288 | 0.00036 | 0.0003 | Y | 0.004[e] | Y | 0.0032 | N | |
| Copper[c] | mg/L | 0.00025 | 0.015 | 0.0006 | 328 | 151 | 0.0015 | 0.0014 | Y | 0.002[l,i] | Y | 0.015 | N | For more information, see Golder (2012d) |
| Iron | mg/L | 0.004 | 1.28 | 0.035 | 371 | 103 | 0.09 | 0.07 | Y | 0.3 | Y | 1.28 | N | |
| Lead | mg/L | <0.000005 | 0.001 | 0.000023 | 175 | 306 | 0.00011 | 0.00009 | Y | 0.001[l,i] | Y | 0.001 | N | |
| Manganese[c] | mg/L | 0.0005 | 0.438 | 0.0036 | 457 | 17 | 0.014 | 0.0098 | Y | 0.7[e] | Y | 0.438 | N | |
| Mercury | mg/L | <0.0000006 | 0.00009 | 0.000004 | 53 | 313 | 0.0000062 | 0.0000061 | Y | 0.000026 | Y | 0.00009 | N | |
| Molybdenum | mg/L | <0.00004 | 0.0012 | 0.0001 | 36 | 445 | 0.0016 | 0.00062 | N | 0.073 | Y | 0.073 | N | SSWQO for Ekati = 19[m] |

**Table 2 Substances of Potential Concern Assessed for Water Quality Objectives for Lake N11 Based on Maximum Predicted Concentration at the Edge of a 200-m IDZ (continued)**

| Substance | Units | Regional Baseline Values | | | | | Maximum Projected Concentration | | Within Baseline Range (Y/N) | Chronic Water Quality Guideline[b] | Within WQGs (Y/N) | Proposed AEMP Benchmark | Interim WQO (Y/N) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | Median | n (detects) | n (non-detects) | Lake N11 | Lake 410 | | | | | | |
| Nickel | mg/L | <0.00006 | 0.013 | 0.00029 | 418 | 63 | 0.0012 | 0.00086 | Y | 0.019[l,i] | Y | 0.013 | N | |
| Selenium[c] | mg/L | <0.00001 | 0.003 | 0.00009 | 16 | 465 | 0.00006 | 0.00006 | Y | 0.001 | Y | 0.003 | N | |
| Silver[c] | mg/L | 0.0000005 | 0.00088 | 0.000005 | 46 | 332 | 0.00002 | 0.000019 | Y | 0.0001 | Y | 0.00088 | N | |
| Strontium[c] | mg/L | 0.0035 | 0.026 | 0.0074 | 406 | - | 0.017 | 0.012 | Y | - | - | 0.026 | N | Testing to determine WQO for Snap Lake underway |
| Thallium | mg/L | <0.000002 | 0.0001 | 0.000003 | 45 | 325 | 0.000049 | 0.000028 | Y | 0.0008 | Y | 0.0001 | N | |
| Uranium | mg/L | <0.000002 | 0.0003 | 0.00001 | 170 | 296 | 0.00037 | 0.00017 | N | 0.015 | Y | 0.015 | N | |
| Vanadium[c] | mg/L | <0.00005 | 0.0025 | 0.0002 | 52 | 428 | 0.00051 | 0.00039 | Y | 0.006[k] | Y | 0.0025 | N | SSWQO for Ekati = 0.03[n]; Environment Canada and Health Canada (2010) no effects threshold = 0.12 |
| Zinc[c] | mg/L | 0.0001 | 0.063 | 0.00175 | 314 | 167 | 0.0035 | 0.003 | Y | 0.03 | Y | 0.063 | N | |

Notes: The term "metals" includes metalloids such as arsenic and non-metals such as selenium. Projected concentrations for Lake 410 are provided for information only; baseline and WQG comparisons were based on the maximum projected concentrations for Lake N11.

(a) Maximum and median concentrations are based on detected values.
(b) From CCME (1999, with updates to 2012) unless noted.
(c) Substances of potential concern (SOPCs).
(d) Rescan (2012a).
(e) BCMOE (2006).
(f) Rescan (2012b; at a hardness of 40 mg/L as $CaCO_3$).
(g) Rescan (2012c; at a hardness of 60 mg/L as $CaCO_3$).
(h) Dependent on pH and temperature (assumed 15ºC, to give most conservative guideline).
(i) U.S. EPA (2002).
(j) Dependent on pH (assumed pH = 7.5).
(k) Ontario Ministry of Environment and Energy (1994).
(l) Dependent on hardness (assumed hardness = 30 mg/L as $CaCO_3$).
(m) Rescan (2012d).
(n) Rescan (2012e).

IDZ = initial dilution zone; WQG = water quality guideline; WQO = water quality objective; SSWQO = site specific water quality objective; CCME = Canadian Council of Ministers of the Environment; BC = British Columbia; U.S. EPA = United States Environmental Protection Agency; ETMF = exposure and toxicity modifying factors; AEMP = aquatic effects monitoring program; m = meter; < = less than; mg/L = milligrams per litre; $CaCO_3$ = calcium carbonate; TDS = total dissolved solids; TBD = to be determined; - = not applicable

The SOPCs discussed in Section 4.1 were assessed following CCME (2003, 2007) guidance, focusing on providing, where necessary, conservative numerical values that protect aquatic fauna in the receiving environment without providing an unnecessarily high level of conservatism that restricts development without providing any additional environmental protection. All other EIS water quality parameters were also assessed not because of potential concerns but rather to provide information requested by aboriginal communities and regulatory agencies.

The initial assessment consisted of three steps:

1. Comparison of maximum predicted concentrations and their CCME WQGs or other benchmarks to natural regional baseline/reference concentrations. Figure 2 shows the regional areas from which baseline/reference data were gathered.

2. Recommendation of an appropriate path forward, including benchmarks for all parameters and WQO where such may be needed.

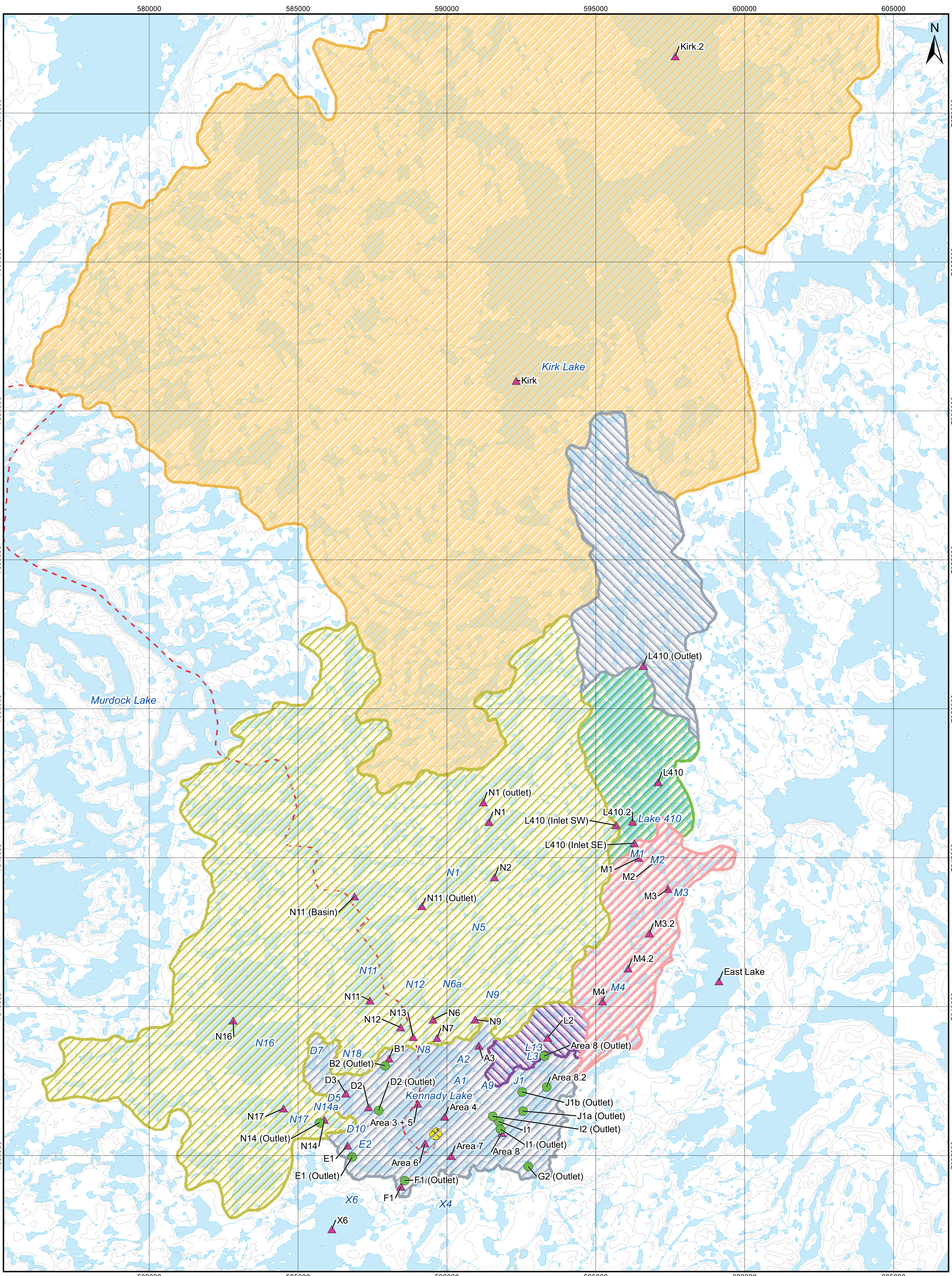
3. A subsequent comparison of maximum predicted whole lake mixed concentrations in Kennady Lake or of maximum predicted concentrations at the edge of a 200 metre (m) initial dilution zone (IDZ) in Lake N11 to CCME water quality guidelines (WQGs) or, where such do not exist for some substances, the nearest equivalent benchmarks.

   As the Project develops and additional data and information become available, modeling will be refined within Kennady Lake prior to closure. The 200 m IDZ for Lake N 11 was determined based on modelling (Golder 2012c), which indicated that water quality in Lake N11 would be met at this distance from the initial discharge.

   The IDZ assessment was conducted for two basins: a south basin and a north basin, in which the latter has improved dilution potential due to this discharge point being downstream of two major supplemental inflow sources. The IDZ maximum concentrations were derived based on modelling and assumptions contained in Golder (2012c) and are the maximum concentrations based on the water management plan (peak discharge concentrations from the water management pond are timed to occur in Year 3, the final year of planned discharge from the water management pond to Lake N11).

The above process follows recommendations by Aboriginal Affairs and Northern Development Canada (AANDC; Jenkins 2012): "*AANDC encourages proponents to consider existing background concentrations and concentrations predicted as a result of their project as well as CCME guidelines when proposing SSWQOs [site specific WQOs] for a development*." The above process also follows the CCME (2003) Background Concentration Adjustment approach to establishing SSWQOs on the basis of the range of background conditions of the substance of interest.

The WQO for Area 8 were not considered, as during the initial phase of dewatering, water quality in Area 7 that will be pumped to Area 8 and diverted water from the A watershed to Area 8 are expected to possess similar chemistry to that in Area 8. The only factor that will play a part in decision-making regarding discharge to Area 8 is total suspended solids (TSS). An objective for TSS has not yet been provided, but it is assumed that this threshold will be consistent with thresholds applied to discharge for other northern diamond mines, e.g., on the order of approximately 25 milligrams per litre (mg/L).

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**LEGEND**

- Gahcho Kué Project
- Winter Access Road
- Watercourse
- Waterbody
- Contour (10m interval)
- Freshet Field Program Location
- Water and Sediment Sample Location

**Watershed Boundary**

- Kennady Lake Watershed
- L Watershed
- M Watershed
- N Watershed
- Lake 410 Watershed
- P Watershed
- Kirk Lake Watershed

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000

## GAHCHO KUÉ PROJECT

## Surface Water and Sediment Quality Sampling Locations

| | | | |
|---|---|---|---|
| PROJECTION: UTM Zone 12 | | DATUM: NAD83 | DE BEERS CANADA |
| Scale: 1:125,000 (1 0.5 0 1 Kilometres) | | | |
| FILE No: B2011-SWQ-002-GIS | | | DATE: February 29, 2012 |
| JOB NO: 11-1365-0001 | REVISION NO: 1 | | Figure 2 |
| OFFICE: GOLD-CAL | DRAWN: SK | CHECK: JF | |

## 4.2 Sediment Quality Objectives

Twelve substances of potential concern (SOPCs) in sediments were identified:

- Antimony;
- Arsenic;
- Barium;
- Beryllium;
- Cadmium;
- Chromium;
- Cobalt;
- Copper;
- Manganese;
- Strontium;
- Vanadium; and
- Zinc.

Note that this list of SOPCs differs from that for water in Kennady Lake by the deletion of the conventional parameter, TDS, and the major ion, fluoride, neither of which are of concern for sediment toxicity, and the addition of zinc and arsenic. The latter two substances were not identified as SOPCs in the water column for either Kennady Lake or Lake N11; however, they were included in the consideration of SQO to address aboriginal and regulator concerns regarding potential accumulation and toxicity of this metal (zinc) and metalloid (arsenic) in sediments. As for water quality, a wider list of parameters than solely the SOPCs will be compared during the AEMP to CCME sediment quality guidelines (SQGs) where such are available and to baseline concentrations.

There are no predictions for concentrations of these SOPCs in sediments; such predictions are challenging and fraught with a high degree of uncertainty. Thus, comparisons to predictions were not possible. The only comparisons possible, and which were undertaken, were to baseline concentrations, CCME sediment quality guidelines (SQGs) and/or, the nearest equivalent benchmarks.

## 4.3 Exposure and Toxicity Modifying Factors

Information on key exposure and toxicity modifying factors (ETMFs) that may influence the bioavailability of SOPCs to aquatic receptors was summarized. CCME (2007) notes the need to account not only for natural background concentrations of naturally occurring substances, but also for the influence of ETMFs.

# 5.0 FINDINGS

## 5.1 Water Quality Objectives

Table 1 summarizes the assessment of the 12 water SOPCs and all other parameters as described in Section 4.1 based on maximum predicted whole lake mixed concentrations in Kennady Lake. Table 2 provides the same assessment, but for maximum concentrations of the nine water SOPCs for that water body and all other parameters as described in Section 4.1 - at the edge of a 200 m IDZ in Lake N11.

Based on maximum predicted whole lake mixed concentrations in Kennady Lake, interim WQO are recommended for five SOPCs: fluoride, barium, beryllium, chromium, and vanadium. These interim WQO would be based for fluoride on the CCME WQG, for chromium on the maximum measured regional baseline concentration, and for barium, beryllium, and vanadium on British Columbia (BC) or Ontario WQGs (there are no CCME WQGs for these three substances).

Based on maximum predicted concentrations at the edge of a 200 m IDZ (north and south basins) in Lake N11, an interim WQO is recommended for one SOPC: beryllium – based on the BC WQG.

## 5.2 Sediment Quality Objectives

Table 3 summarizes the assessment of the 12 sediment SOPCs as described in Section 4.2. As noted in the table, no predictions are possible regarding future sediment quality concentrations of the 12 SOPCs. SQO are not recommended; rather, it is recommended that the AEMP assess trends in these sediment SOPCs and in other measured sediment parameters and compare these to CCME SQGs (available for five SOPCs), other benchmarks (available for eight SOPCs including those for which CCME SQGs are available), and to measured baseline concentrations. Note that baseline data indicate natural exceedances of all CCME interim sediment quality guidelines (ISQGs) available for the SOPCs.

## 5.3 Exposure and Toxicity Modifying Factors

Table 4 summarizes information on the three key ETMFs (Section 4.3) for both Kennady Lake and Lake N11, and suggests how these could be used in future.

**Table 3 Substances of Potential Concern Assessed for Sediment Quality Objectives**

| Substances of Potential Concern | Units | CCME Sediment Quality Guideline[a] | Other Benchmark | Baseline Sediment Range | Maximum Predicted Concentration | Path Forward |
|---|---|---|---|---|---|---|
| ***Total Metals*** | | | | | | |
| Antimony | mg/kg dw[b] | - | U.S. EPA screening: 2[c] | <1 | No predictions possible | Recommend AEMP assess trends and compare to CCME SQGs if available and/or to other benchmarks as noted, and to baseline range.<br>Note SQGs and other benchmarks based on total metals concentrations and do not account for bioavailability.<br>Note also that natural exceedances occur for all metals that have CCME SQGs: arsenic, cadmium, chromium, copper, and zinc. |
| Arsenic | mg/kg dw | ISQG: 5.9; PEL: 17 | U.S. EPA screening: 9.8[c] | <1 to 8.7 | No predictions possible | |
| Barium | mg/kg dw | - | - | 18 to 101 | No predictions possible | |
| Beryllium | mg/kg dw | - | - | <0.4 to 0.7 | No predictions possible | |
| Cadmium | mg/kg dw | ISQG: 0.6; PEL: 3.5 | U.S. EPA screening: 0.99[c] | <0.1 to 0.7 | No predictions possible | |
| Chromium | mg/kg dw | ISQG: 37.3; PEL: 90 | U.S. EPA screening: 43.4[c] | 7 to 82 | No predictions possible | |
| Cobalt | mg/kg dw | - | U.S. EPA screening: 50[c] | 3 to 22 | No predictions possible | |
| Copper | mg/kg dw | ISQG: 35.7; PEL: 197 | U.S. EPA screening: 31.6[c] | 7 to 110 | No predictions possible | |
| Manganese | mg/kg dw | - | U.S. EPA screening: 460[c] | 150 to 525 | No predictions possible | |
| Strontium | mg/kg dw | - | - | 16 to 19 | No predictions possible | |
| Vanadium | mg/kg dw | - | - | 7 to 47 | No predictions possible | |
| Zinc | mg/kg dw | ISQG: 123; PEL: 315 | U.S. EPA screening: 121[c] | 11 to 170 | No predictions possible | |

Notes: A dash (-) indicates no SQG or benchmark. The term “metals” includes metalloids such as arsenic and non-metals such as selenium.
(a) Canadian Environmental Quality Guidelines (CCME 1999, updated 2012).
(b) mg/kg dw = milligrams per kilograms dry weight.
(c) www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm Accessed August 10, 2012

SQG = sediment quality guideline; SQO = sediment quality objective; CCME = Canadian Council of Ministers of the Environment; AEMP = Aquatic Effects Monitoring Program; ISQG = interim sediment quality guideline; PEL = probable effects level; U.S. EPA = United States Environmental Protection Agency; < = less than; mg/L = milligrams per litre.

**Table 4 Exposure Toxicity Modifying Factors for Kennady Lake and Lake N11**

| Exposure Toxicity Modifying Factors | Units | Baseline Range Kennady Lake | Baseline Range Lake N11 | Predicted | Comments | Path Forward |
|---|---|---|---|---|---|---|
| pH | - | 5.2 to 8.0 | 6.1 to 6.8 | 6.5 to 9.0 | pH can modify SOPC bioavailability | Assess potential effects on exposure and bioavailability if interim WQO exceeded |
| Hardness | mg/L as $CaCO_3$ | 1.2 to 13 | 3.9 to 7.6 | Maximum 85 (Kennady Lake), and 32 (Lake N11) | Increasing hardness will reduce metals toxicity in water | Revise interim WQO that are hardness-based as hardness increases – at Water License Renewals |
| Total Organic Carbon (TOC) | mg/L | 0.5 to 10 | 3.1 to 4.4 | Predictions not possible; however, expected to increase with increased productivity | Increasing TOC will reduce metals toxicity in water and sediments | Assess potential effects on exposure and bioavailability if interim WQO exceeded |

Notes: A dash (-) indicates not applicable. The term “metals” includes metalloids such as arsenic and non-metals such as selenium.
SOPC = substances of potential concern; WQO = water quality objective; mg/L = milligrams per litre; mg/L as $CaCO_3$ = milligrams per litre as calcium carbonate.

# 6.0 DISCUSSION

## 6.1 Nitrogen Species are Not Substances of Potential Concern

Nitrogen species such as ammonium ($NH_4$) and nitrate ($NO_3$) are common SOPCs at mine sites in Northern Canada as a result of explosives usage. Nitrogen species are projected to increase in the water management pond (WMP) during operations. They are evaluated in Tables 1 and 2 but are not considered SOPCs at the proposed Gahcho Kué diamond mine project (Project) for the following reasons:

- Maximum projected $NH_4$ and $NO_3$ concentrations in the WMP during the dewatering period (respectively 8.0 and 8.4 mg/L as N) are not expected to result in exceedances of CCME WQGs in any downstream receiving waterbodies.
- The Project Water Management Plan calls for a significant portion of the $NH_4$ and $NO_3$ stored in the WMP during operations to be directed to the Tuzo Pit at closure, where they will become isolated in the deeper regions of the pit following refilling of Kennady Lake. At closure, a large proportion of the water stored in the water management pond will be transferred to Tuzo pit to expedite refilling of this facility. This water will possess a large mass of residual nitrogen, so its transfer will reduce the potential nitrogen-nutrient concentrations in the refilled Kennady Lake. The water transferred to Tuzo Pit will be isolated from the overlying Kennady Lake water through the rapid development of a pycnocline (chemocline) in the lower portion of the pit. The remaining mass of residual nitrogen is then diluted by natural runoff and supplemental water pumped from Lake N11, all of which have naturally low ammonia concentrations.
- Maximum projected $NH_4$ and $NO_3$ concentrations following reconnection of Kennady Lake to the downstream watersheds are predicted to be below CCME WQGs.

Once refilling is completed, modelled water chemistry in Kennady Lake and downstream waters indicate that nutrient concentrations will be below concentrations that could potentially exert a negative effect to aquatic life in Kennady Lake or the downstream watersheds.

## 6.2 Purpose of WQG/WQO and SQG/SQO Including Other Benchmarks

The WQG/WQO, SQG/SQO, and other benchmarks are used for screening. Such screening provides two possible conclusions:

- if concentrations of measured parameters are below their respective guideline, objective or benchmark, there is no concern for potential toxicity to exposed aquatic fauna; or
- if concentrations are above their respective guideline, objective or benchmark, there is potential for toxicity to exposed aquatic fauna and additional investigations are required to determine whether this could realistically occur.

For instance, the CCME SQGs comprise both interim sediment quality guidelines (ISQGs) and probable effects levels (PELs). If a sediment parameter is measured at concentrations below its ISQG, toxicity is not expected; above its ISQG, toxicity is possible. If a sediment parameter is measured at concentrations above its PEL, toxicity is likely but not certain.

CCME (1991) states that the Canadian WQGs are (p 1) “one of a series of management tools” with the goal of (p 5) “the protection and maintenance of all forms of aquatic life and all aquatic life states in the freshwater environment." CCME (2007; Part I-2) states that the WQGs are "meant to protect all forms of aquatic life and all aspects of the aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term". The WQGs are used largely as benchmarks for water quality in receiving environments, do not have legal status for compliance monitoring, and are not equivalent to end-of-pipe discharge limits or standards. As noted by CCME (2003, p 5), they are "science-based targets" and are (CCME 2003, p 6) "designed to be conservative". Thus, per CCME (2011, p 1) "when ambient concentrations are below the CWQG [Canadian Water Quality Guideline], adverse effects are not expected to occur in the aquatic environment." Similarly, per CCME (2012), WQGs "are defined as numerical concentrations or narrative statements that are recommended as levels that should result in negligible risk to biota, their functions, or any interactions that are integral to sustaining the health of ecosystems and the designated resource uses they support."

Canadian WQGs typically employ a relatively high degree of conservatism to account for variables that might modify the risk of adverse effects in the environment. They are based on laboratory toxicity tests that typically provide "worst case" information compared to field conditions (Chapman 2000). Per CCME (2007, Part I-3), a WQG "does not factor in bioavailability and is thus highly conservative". Bioavailability is defined (CCME 2007, Part I-3) "as the portion of a substance such as a chemical that is immediately available for uptake by organisms." Similarly, SQGs do not factor in bioavailability.

## 6.3 Receiving Environment Screening for the Proposed Gahcho Kué Project

As per Section 5.1, interim WQO are recommended for five SOPCs in Kennady Lake and one SOPC in Lake N11. The wording "interim" is used as the recommended WQO comprise conservative adoption of either maximum baseline concentrations or generic benchmarks. Thus, these are not site-specific WQO as described by CCME (2003), with the possible exception of the Background Concentration Approach for chromium in Kennady Lake. However, note that speciation analyses are recommended for chromium (Table 1) to determine whether a WQO is in fact required for Kennady Lake (a chromium WQO is not required for Lake N11). It is presently conservatively assumed that the more bioavailable and toxic Cr VI will predominate in Kennady Lake waters; however, it is more likely that the less bioavailable and toxic Cr III will predominate in those waters, as is the case for Snap Lake.

Interim WQO provide the basis for EQC and as benchmarks for screening per Section 6.2, above. For parameters not requiring WQO, other screening benchmarks are proposed. Screening will occur as part of the AEMP: all measured substances in receiving waters will be compared to benchmarks and assessed for any trends over time.

SQO are not needed or recommended at this time (Table 3). Instead, as part of the AEMP, all measured substances in sediments will be compared to CCME SQGs (and/or other benchmarks) and baseline concentrations, and assessed for any trends over time.

## 6.4 Future Reassessment of Water Quality Objectives and Sediment Quality Objectives

As part of the cyclical AEMP Revision Process, it is recommended that the need for WQO and SQO be re-evaluated as more data become available over time. This re-evaluation would comprise adaptive management as recommended by the Board. De Beers is similarly implementing adaptive management at Snap Lake, using the CCME (2003) Recalculation Approach to determine a site-specific strontium WQO, the CCME (2003) Water

Effects Ratio Approach to determine a site-specific nitrate WQO, and the CCME (2003) Resident Species Approach to determine a site-specific TDS WQO.

In terms of developing SSWQOs, CCME (2003) has identified four approaches that are described below, which could be considered, as appropriate and necessary, during future WQO and SQO re-evaluation:

- the Background Concentration Approach;
- the Recalculation Approach;
- the Water Effects Ratio (WER) Approach; and
- the Resident Species Approach.

1. Background Concentration Adjustment

The background concentration approach involves establishing a SSWQO on the basis of the range of background conditions of the variable of interest. This approach is typically implemented in cases where there are naturally-elevated concentrations of the variable of interest.

2. Recalculation

Using the Recalculation Approach, the existing generic benchmark is recalculated after limiting the dataset to available toxicological data for species that are considered relevant to the site (i.e., resident species or suitable surrogates representing taxa for which toxicological data are not available). Species that are not relevant (e.g., tropical species and amphibians in Northern environments) are excluded from the dataset in order to provide appropriate representation of the biological community found at a specific site. The CCME (2007) preferred approach is to develop a species sensitivity distribution (SSD), expressed as a concentration that is expected to be safe for the majority of species, specifically the HC5 value, which denotes a concentration that is hazardous to no more than 5% of species in the community (Posthuma et al. 2002).

Applying the SSD approach provides three major advantages in SSWQO development, because it:

- enables more recent studies to be included in the toxicity database;
- enables exclusion of non-resident species with poor ecological relevance to the region; and
- facilitates the consideration of site-specific modifying factors in the screening of relevant toxicity studies.

3. Water Effects Ratio

Using the Water Effects Ratio (WER) Approach, site and laboratory waters are used in parallel toxicity tests in which the substance of interest is introduced to the water to measure the effect that site water has on the toxicity to one or more species. A difference in sensitivity of test organisms between the test waters provides an indication that the site water modifies the toxicity of the substance of interest. This provides technical justification to alter the water quality benchmark to account for that difference, because WQGs or similar benchmarks are typically derived from toxicity tests conducted in standardized laboratory water.

A related method entails laboratory assessment of the influence of specific ETMFs on the concentration-response relationships in sensitive species. By conducting these tests over a range of exposure conditions (both toxicant and ETMF) it is often possible to develop relationships that can be used to convert the results of other laboratory studies to better reflect the water quality conditions of the site of interest.

4. Resident Species

Using the Resident Species Approach, species that occur in the environment are tested to evaluate whether they are different in sensitivity from those that have been used to derive the existing benchmark. Side-by-side comparisons of sensitive experimental species (as determined from historical testing) and resident species can be conducted, and results used to make inferences regarding the relative sensitivities of species. This approach is helpful where the toxicological data set is limited in terms of representation of site-relevant species.

## 7.0 CLOSURE

We trust this technical memorandum provides you with the information you require at this time. Should you have any questions, or require further information please contact the undersigned.

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PMC/JF/kl

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