APPENDIX H

CELL 15 WATER BALANCE AND ACIDITY ASSESSMENT

CELL 15 WATER BALANCE

GOLDER ASSOCIATES

Golder Associates

TECHNICAL MEMORANDUM

CELEBRATING 50 YEARS in 2010

DATE February 10, 2011 **PROJECT No.** 10-1118-0030 (5000)

TO Debbie Berthelot, Reclamation Manager
Rio Algom Limited

CC Art Coggan

FROM Peter Merry, Shiu Kam **EMAIL** pmerry@golder.com

QUIRKE TMA
CELL 15 WATER BALANCE

1.0 INTRODUCTION

Golder Associates (Golder) was retained by Rio Algom Limited (Rio Algom) to complete a water balance study for Cell 15 at Quirke Tailings Management Area (TMA). The water balance was based on available historical data in order to determine seepage losses from Cell 15.

This memorandum describes the development of the water balance and calculations to estimate seepage losses from Cell 15. It also includes a discussion on current seepage from Cell 14 as compared with historical estimates prior to applying the till cover over the majority of Cell 14 in 2003.

2.0 BACKGROUND

Quirke TMA is a terraced water-covered facility consisting of five cells separated by earth and rockfill dykes founded on tailings. Water from Gravel Pit Lake flows into Cell 14 and then cascades via spillways on the internal dykes from Cell 14 to Cell 18 where water is treated and is then discharged into a series of settling ponds. Final discharge from the TMA is to the Serpent River. Aside from minor external seepage that occurs at the perimeter dams, groundwater movements are easterly towards the lowest cell (Cell 18). The cell levels drop an average of 3.5 m from west to east. A minimum water cover depth of 0.6 m was selected to safeguard the exposure of the tailings during drought conditions. Internal seepage through and under the dykes can affect the water cover on the deposited tailings. Historically, the inflow from Gravel Pit Lake has been used to maintain a stable water cover on the tailings, especially in Cell 14.

The tailings cells and internal dykes were constructed during the period of 1992 to 1995. Cell 14 has been flooded since 1993. During the initial filling of Cell 14 up to 10 L/s was estimated to flow into the old landfill south of the east arm of Dam L. Field observations suggested that the water likely entered the overburden aquifer and emerged in Cell 16 through the granular main dyke and the original rockfill main dam that were founded on the overburden. Dyke 15 was completed in 1994 followed by Dykes 16 and 17 in 1995. During the early stage of filling Cell 15 in 1995 and 1996 substantial water loss from the cell was noted. Seepage occurred through the dykes as well as through the granular overburden that underlies the tailings. Dyke seepage is typically variable depending on the nature of the deposited tailings and the configuration of the original rockfill dyke foundation. Old cross dykes that have been buried are potentially major seepage pathways as well.

Several measures have been implemented to reduce the dyke seepage. During the construction of Dyke 15, a till cut-off trench was installed at each of the known old cross-dyke locations. This was followed by the installation of till berms upstream of these locations in 1997. The berms were intended to increase the seepage pathway to reduce the risk of piping through the till blanket that was placed during initial construction. About 100 m of Dyke 14 near the north abutment was also sealed with a till berm in 1997. Upon remediation it was still evident that Cell 14 and 15 were both experiencing a greater than expected water loss due to seepage.

In 2003, Rio Algom drained Cell 14 and placed a 0.3 m thick till blanket on the upstream face of Dyke 14 and applied a silty sand diffusion barrier (also some till) to the accessible areas of the Cell. Approximately 68% of the cell was covered. This work was intended to reduce seepage loss from the Cell and to minimize the upward release of radium from the porewater in the tailings into the water cover above. Rockfill was added on the till blanket along Dyke 14 for erosion protection. Cell 14 was re-flooded in early 2004.

No water deficit problems are evident for Cells 16, 17 and 18 which are constantly recharged by the upstream cells. Following the installation of the till blanket in Cell 14, Rio Algom reported a significant reduction in seepage from Cell 14.

Several studies have been carried out to assess the hydrologic condition of the flooded cells with respect to water cover fluctuation.

- Golder Associates Ltd., 1992. "Probabilistic Assessment of the Long-Term Performance of the Quirke Mine Waste Management Area". Report to Rio Algom Limited, July 1992.
- Golder Associates Ltd., 1994. "Interim Assessment of the Hydrogeological Performance of Cell No. 14, Quirke Mine Waste Management Area". Report to Rio Algom Limited, July 1994.
- Golder Associates Ltd., 1997. "Summary of Water Budget Analyses". Technical memorandum to Rio Algom Limited, January 1997.
- Cumming Cockburn Limited, 2000. "Weather Analysis - Quirke". Report to Rio Algom Limited, February 1999.
- Cumming Cockburn Limited, 2000. "Water Budget Analysis for Quirke WMA Additional Watersheds". Report to Rio Algom Limited, May 2000.
- Rio Algom Limited, 2001. "Quirke Tailings Management Area, Cell 14, Cell 15 and Gravel Pit Lake Watershed Augmentation and Johnston Creek Diversion". September 2001.
- Golder Associates Ltd., 2002. "Water Budget Review and Remediation Options Evaluation, Cells 14 and 15 Quirke WMA". Technical memorandum to Billiton BHP, January 2002.

3.0 WATER BALANCE MODEL

This section describes the water balance model which was used to predict seepage losses from Cell 14 and Cell 15. The analysis was performed for selected time periods with reliable data. The significant inflow components to the system are direct precipitation on the pond, surface runoff from surrounding areas within the watershed, and direct inflow from Gravel Pit Lake. The outflow components from the system are evaporation from the pond surface, seepage losses through the perimeter dams and their foundations (Dams K1, K2, and J), direct discharge to Cell 16 over the Dyke No. 15 spillway, and seepage loss through Dyke 15 and its foundation.

3.1 Water Balance Parameters

The water balance model was based on available climate data, monitoring records, and historical reports. Below is a summary of the information used in the model.

Precipitation and Evaporation Data

Precipitation data was provided by Rio Algom from 1970 to 2009. The water balance analysis was completed from 2005 to 2009, after the till blanket was placed in Cell 14 and the cell was flooded. The weather data for this period was obtained from Environment Canada through the Elliot Lake Station A. Additional information on the temperature and snowfall accumulations were available for this period. A summary of the precipitation data is provided on Sheet 2 in Appendix A.

Evaporation data was collected from the report entitled "Weather Analysis - Quirke" completed by Cummings Cockburn Limited (CCL) in 1999. The evaporation data was transposed from Amos, Quebec (AES, Environment Canada, 1998) and was compared with evaporation data from the Quirke TMA. The average yearly evaporation rate for the Quirke site was 692 mm/yr. Monthly evaporation data is found on Sheet 3 in Appendix A.

Runoff from Contributing Watersheds

Figure 1 illustrates the Quirke TMA and contributing watershed areas. The watershed areas were taken from CCL (1998) and compared with areas measured from recent AutoCAD drawings. A runoff coefficient of 60% was used for the natural ground runoff surrounding the tailings facility and 100% for the pond surface. Sheet 4 in Appendix A contains the areas of the contributing watersheds for Cell 14 and Cell 15.

Flow from the Gravel Pit Lake

Rio Algom provided flow information from Gravel Pit Lake from 1990 to 2009. For the period of interest, measurements were recorded 4 to 5 times a month throughout the year which provided a good indication of the volume of water entering Cell 14. Sheet 9 in Appendix A contains the average flow rates.

Seepage

Seepage through Dams K1 & K2 and Dam J were assumed to be 2.5 L/s (Golder, 1994) and 1 L/s (assumed), respectively. No other seepage into or out of the system was included in this analysis. Sheet 8 in Appendix A contains the summary of the seepage rates. No seepage was assumed from Gravel Pit Lake to Cell 14 through Dam L due to the low hydraulic gradient. It should be noted that a portion of the seepage from Cell 14 reports to Cell 16 directly through the granular overburden at depth (Golder 1994).

Flow through the Culverts

Based on information from Denison Environmental Services, water frequently flows through the culverts on Dyke 14 but has not been allowed to flow through the culverts from Cell 15 to Cell 16 since 2005. This is an operating practice that has been implemented since 2005 to reduce the volume of water put through the system. However based on the record of water levels, it appears that the Cell 15 pond level had been above the spillway invert for short durations and discharge might have occurred.

Calculating the volume of water discharging through the culverts is very sensitive to the duration of discharge and depth of flow through the culverts. It was therefore assumed the dyke did not overflow as reported by Denison Environmental Services, which could result in a slightly higher seepage estimate than actual.

Estimates for Cell 14 seepage are therefore difficult to determine based on the limited knowledge of discharge through the active spillway on Dyke 14. Time periods with water level below the spillway were used to estimate the seepage. Results are discussed in Section 3.2.2.

3.2 Water Balance Model Results

3.2.1 Combined Cell 14 and 15

The water balance was completed on the combined Cell 14 and Cell 15 system to determine the seepage rate from Cell 15. This approach was implemented to eliminate the uncertainty with actual discharge through the culverts on Dyke 14. However, as discussed previously, the calculated seepage may not be entirely through or beneath Dyke 15 as it may be travelling through the landfill from Cell 14 and bypassing Cell 15 or through the gravel overburden that underlies the tailings.

The analysis was completed on an annual basis for 4 years as broken down below:

- October 2005 to September 2006;
- October 2006 to September 2007;
- October 2007 to September 2008; and
- October 2008 to September 2009.

The water balance for the combined Cell 14 and Cell 15 system revealed that seepage rates from Cell 15 are in the range of 37 to 51 L/s. A sensitivity analyses on the evaporation rate (+/- 10%) and natural ground runoff coefficients (+/- 10%) were completed. The results of the water balance model and sensitivity analysis are provided in Table 1.

Table 1: Calculated Seepage Rates 2005 to 2009

Year	Calculated Seepage Rates (L/s)				
	Average Conditions	+10% Evaporation	-10% Evaporation	Runoff Coefficient = 50%	Runoff Coefficient = 70%
Oct 2005 to Sept 2006	44	42	46	43	45
Oct 2006 to Sept 2007	51	49	53	50	52
Oct 2007 to Sept 2008	37	35	39	36	38
Oct 2008 to Sept 2009	47	45	49	46	48

A change in evaporation of +/- 10% equates to a change in seepage of ± 2 L/s, respectively. A change in runoff coefficient by -/+ 10% typically equates to a change in seepage of ± 1L/s. This indicates that the seepage rate is not highly sensitive to the changes in evaporation and run-off coefficients.

3.2.2 Cell 14

A water balance was completed on Cell 14 during two summer periods, each 3 months in length, when zero discharge through the spillway on Dyke 14 was observed. The results are shown on Sheet 13 in Appendix A. The average seepage loss from Cell 14 was calculated at 46 L/s. This value is not considered accurate given the performance of the cells and knowledge that there is less seepage from Cell 14 than Cell 15 as evident by the volume of water that overflows Cell 14 to Cell 15 through the culverts on Dyke 14 but there is no overflow from Cell 15 to Cell 16. To more accurately estimate the seepage from Cell 14, a longer time period with accurate discharge flows is required.

Also included on Sheet 13 is a sensitivity analysis that is based on an annual water balance and assumes various discharge rates through the culverts on Dyke 14. The results indicate that assuming zero discharge through the culverts, the seepage rate is expected to vary between 35.5 and 44.4 L/s, which is less than the calculated values discussed above on the 3 month analysis and further defends the limits of a short analysis period. The minimum calculated seepage on the annual balance of 35.5 L/s could be inferred as the actual maximum seepage rate from Cell 14 assuming near zero discharge through the culverts on Dyke 14 during the modelled year. The difference between the 35.5 L/s and the other calculated seepage rates (41.9 L/s, 43.7 L/s, and 44.4 L/s) could be actual discharge rates through the culverts on Dyke 14. Similar to the discussions presented above, the calculated seepage from Cell 14 could occur as: seepage through Dyke 14, seepage through the tailings beneath Dyke 14, deep seepage through the granular overburden beneath the tailings, and seepage through the landfill to Cell 16.

3.3 Water Balance Model Limitations

The precision of the information collected was inadequate to complete the water balance on a monthly basis. The limitations of the model are provided in the following list:

- Water levels records for the cells were available only once a month and during some months not available at all. Fluctuations in the water level can result in significant differences in the calculations of storage volume. Estimating the seepage on a monthly basis is difficult because a small change in water level of +/- centimetres can result in significant differences in volumes and therefore calculated seepage rates.
- Flow through the culverts on the active spillway from Cell 14 to Cell 15 was not available. Detailed measurements would be required to increase confidence in the modelled results.

The water balance completed on an annual basis provides a good representation of the average seepage rate because the water level fluctuations over the course of the year typically can be ignored (i.e., no net change in cell storage).

3.4 Conclusions

Based on the analysis completed, the seepage rate from the combined Cell 14 and Cell 15 is approximately 45 L/s which is consistent with historical estimates. This loss is a combination of the following:

- From Cell 14 through the landfill to Cell 16;
- From Cell 14 through the gravel overburden beneath the tailings to Cell 16;
- Through Dyke 15; and
- Beneath Dyke 15.

Of the four likely seepage pathways, those from Cell 14 bypassing to Cell 16 are likely minor as a result of the till blanket placed on Cell 14 in 2003.

The total seepage from Cell 14 is estimated on the order of 35 l/sec.

Peter Merry, P.Eng.
Geotechnical Engineer

Shiu Kam, P.Eng.
Principal

MT/WPM/SNK/dh
Attachments: Figure 1
Appendix A – Water Balance

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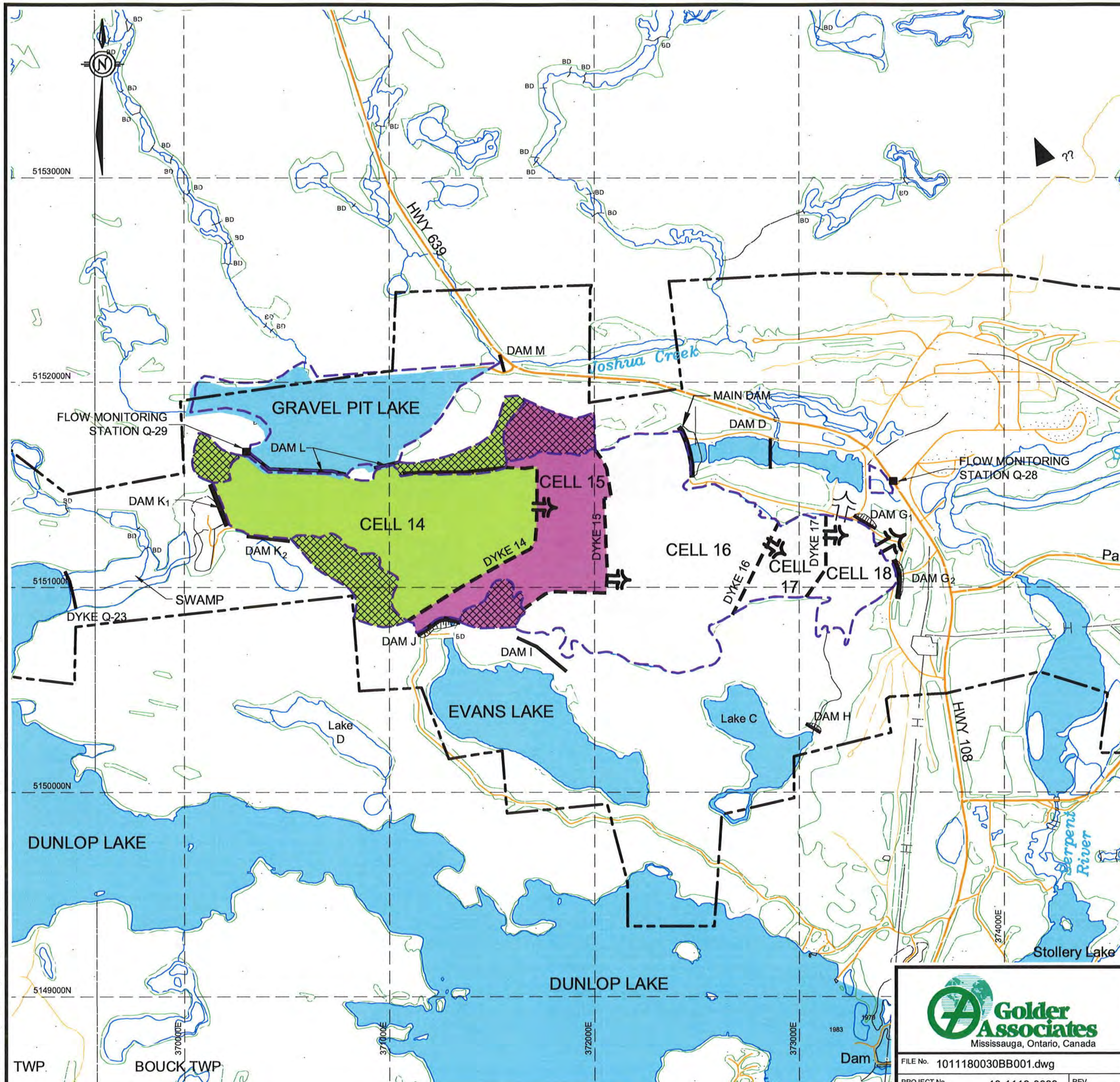
Figures



LEGEND:

- SPILLWAY
- ROAD
- CREEK/DRAINAGE DITCH AND FLOW DIRECTION
- DAM
- INTERNAL DYKE
- TAILINGS MANAGEMENT AREA
- RIO ALGOM PROPERTY LIMITS
- NATURAL GROUND
- CELL 14 WATERSHED
- CELL 15 WATERSHED

NOTES:

1. ELEVATIONS ARE REFERENCED TO LOCAL DATUM.
2. DATUM IS UTM NAD27, ZONE 17.

REFERENCES:

1. ONTARIO BASE MAPS, SHEET No.s 2017360051400 AND 2017370051400 SCALE 1:20,000 METRIC, PROVIDED BY AGGMAP INC. ON OCTOBER 4, 2002.

400 0 400 800
SCALE 1:20,000 METRES

Golder Associates
Mississauga, Ontario, Canada

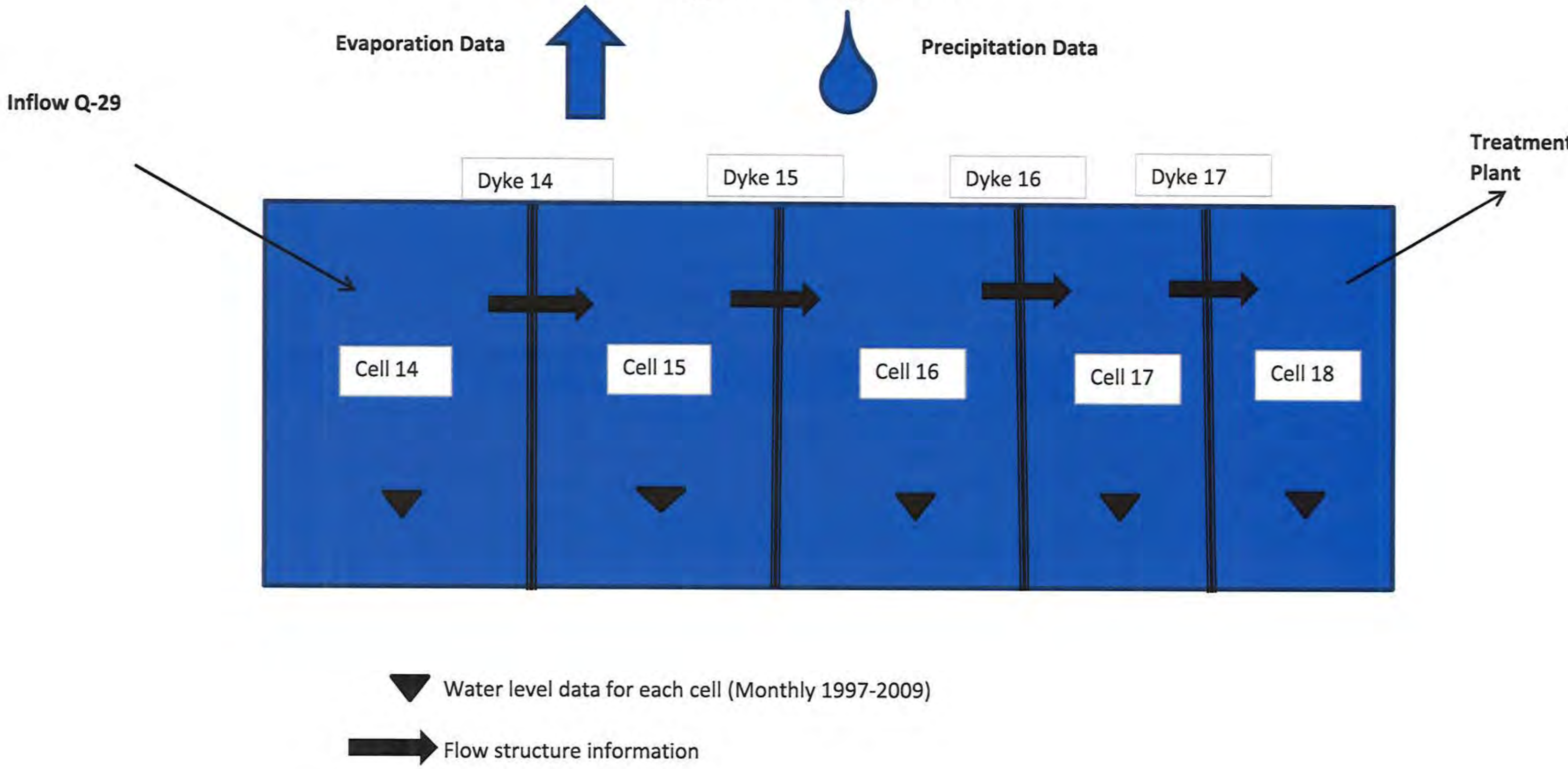
SCALE	AS SHOWN	TITLE	QUIRKE TAILINGS MANAGEMENT AREA AND CONTRIBUTING WATERSHEDS TO CELLS 14 AND 15
DATE	Jun. 7, 2010		
DESIGN	MT		
CAD	JS		
FILE No. 1011180030BB001.dwg	CHECK WPM	RIO ALGOM LIMITED MILLIKAN PROPERTY	FIGURE 1
PROJECT No. 10-1118-0030 REV. -	REVIEW SK		

PLOT DATE: June 7, 2010
FILENAME: T:\Projects\2010\10-1118-0030 (RAL, Elliot Lake)\-BB-\1011180030BB001.dwg

APPENDIX A

Water Balance

Sheet 1
Flow Logic Diagram



	Spillway Invert (m)	Culvert Invert (m)
Dyke 14	378.51	377.77
Dyke 15	374.49	373.74
Dyke 16	370.25	369.67
Dyke 17	366.14	365.66
Dyke 18	365.30	

Reference:

1. Spillway and Culvert information provided by Rio Algom Limited on January 11, 2011. Filename "Quirke Water Balance.xls". The information is based on Surveys completed by Torrance between 2007 and 2008. The 2007 Torrance survey covered all dykes and 2008 Torrance survey covered Dykes 16 and 17 following maintenance work.

Sheet 2
Precipitation Data

Meteorological Station(s)	Elliot Lake Station A

Historical Precipitation			Factored Runoff		
Month	Year	Precipitation per Month	From natural ground	From ponds	Monthly runoff coefficient [1]
			60%	100%	
			Factored runoff used in the flow model	Factored runoff used in the flow model	Expressed as a % of accumulation
		(mm)	(mm)	(mm)	(%)
Oct	2005	69.4	41.6	69.4	100
Nov	2005	141.2	84.7	141.2	100
Dec	2005	42.9	25.7	42.9	0
Jan	2006	85.0	51.0	85.0	0
Feb	2006	60.7	36.4	60.7	0
Mar	2006	50.9	30.5	50.9	80
April	2006	65.8	39.5	65.8	100
May	2006	91.4	54.8	91.4	100
June	2006	59.8	35.9	59.8	100
July	2006	85.2	51.1	85.2	100
Aug	2006	110.0	66.0	110.0	100
Sept	2006	121.2	72.7	121.2	100
Oct	2006	111.2	66.7	111.2	100
Nov	2006	75.0	45.0	75.0	100
Dec	2006	124.1	74.5	124.1	0
Jan	2007	41.7	25.0	41.7	0
Feb	2007	21.0	12.6	21.0	0
Mar	2007	63.4	38.0	63.4	80
April	2007	71.0	42.6	71.0	100
May	2007	29.9	17.9	29.9	100
June	2007	66.2	39.7	66.2	100
July	2007	89.4	53.6	89.4	100
Aug	2007	58.0	34.8	58.0	100
Sept	2007	53.2	31.9	53.2	100
Oct	2007	149.6	89.8	149.6	100
Nov	2007	89.0	53.4	89.0	100
Dec	2007	100.2	60.1	100.2	0
Jan	2008	149.3	89.6	149.3	0
Feb	2008	79.2	47.5	79.2	0
Mar	2008	65.4	39.2	65.4	80
April	2008	122.2	73.3	122.2	100
May	2008	93.4	56.0	93.4	100
June	2008	90.4	54.2	90.4	100
July	2008	48.2	28.9	48.2	100
Aug	2008	65.0	39.0	65.0	100
Sept	2008	64.2	38.5	64.2	100
Oct	2008	56.2	33.7	56.2	100
Nov	2008	105.8	63.5	105.8	100
Dec	2008	186.4	111.8	186.4	0
Jan	2009	45.2	27.1	45.2	0
Feb	2009	78.1	46.9	78.1	0
Mar	2009	62.6	37.6	62.6	80
April	2009	92.9	55.7	92.9	100
May	2009	100.0	60.0	100.0	100
June	2009	79.4	47.6	79.4	100
July	2009	160.0	96.0	160.0	100
Aug	2009	114.0	68.4	114.0	100
Sept	2009	53.4	32.0	53.4	100
Oct	2009	182.6	109.6	182.6	100
Nov	2009	58.6	35.2	58.6	100
Dec	2009	100.5	60.3	100.5	0

Notes:
1 Runoff coefficient based on daily temperatures and accumulated snow values.

Sheet 3

Evaporation Data

Meteorological Station(s)	
	- From Amos, Quebec
	-
	-

Evaporation				
Month		Annual selected for flow modelling (mm/yr)		691.8
		Lake evaporation used in flow model		
	Pan Evaporation	Evaporation Multiplier	Monthly distribution	Factored Evaporation used in the model
	(mm)	1.00	(% of total)	(mm)
Oct	42.1	42.1	6.1	42.1
Nov	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0
Jan	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0
April	0.0	0.0	0.0	0.0
May	121.1	121.1	17.5	121.1
June	156.9	156.9	22.7	156.9
July	150.6	150.6	21.8	150.6
Aug	136.4	136.4	19.7	136.4
Sept	84.7	84.7	12.2	84.7
TOTAL	**691.8**	**691.8**	**100.0**	**691.8**

Notes:
1) Evaporation Data from "Weather Analysis-Quirke" (CCL, 1999)

Sheet 4
Watershed Areas

Area	Facility	Watershed Area (ha)	Watershed Area % of total	Watershed Area (ha)	Watershed Area (m^2)	Runoff source	Flow Number
1	Cell 14	86.0	26	22.0	220,000	Natural ground	R1
			74	64.0	640,000	Pond surface	R2
2	Cell 15	40.0	33	13.0	130,000	Natural ground	R3
			68	27.0	270,000	Pond surface	R4
3	Cell 16	102.0	26	27.0	270,000	Natural ground	R5
			74	75.0	750,000	Pond surface	R6
4	Cell 17	19.0	37	7.0	70,000	Natural ground	R7
			63	12.0	120,000	Pond surface	R8
5	Cell 18	45.0	69	31.0	310,000	Natural ground	R9
			31	14.0	140,000	Pond surface	R10
Total Area		**292.0**			**1,920,000**	**Pond surface**	
					1,000,000	**Natural ground**	

Notes:
Catchment areas taken from "Dam Breach Analysis for Quirke WMA System" (CCL, 1999)

Sheet 5
Flows Associated with Runoff from Precipitation
Subwatershed: Cell 14

		Factored Precipitation (mm)			Runoff #	Runoff Flow (m^3 / month) — Cell 14 Natural Ground				Cell 14 Pond Surface			
					Area (m^2)	220,000				640,000			
Month	Year	From natural ground	From ponds	Monthly runoff expressed as % of the total accumu-lation (If less than 100% it is because of freeze-up)	Month	Available runoff (area x factored runoff)	Total available runoff (available plus runoff not discharged the previous month)	R1 Actual monthly runoff (total available x % runoff)	Left over each month (total available -actual runoff)	Available runoff (area x factored runoff)	Total available runoff (available plus runoff not discharged the previous month)	R2 Actual monthly runoff (total available x % runoff)	Left over each month (total available -actual runoff)
Oct	2005	41.6	69.4	100	Oct	9,161	9,161	9,161	0	44,416	44,416	44,416	0
Nov	2005	84.7	141.2	100	Nov	18,640	18,640	18,640	0	90,374	90,374	90,374	0
Dec	2005	25.7	42.9	0	Dec	5,663	5,663	0	5,663	27,456	27,456	0	27,456
Jan	2006	51.0	85.0	0	Jan	11,220	16,883	0	16,883	54,400	81,856	0	81,856
Feb	2006	36.4	60.7	0	Feb	8,012	24,895	0	24,895	38,848	120,704	0	120,704
Mar	2006	30.5	50.9	80	March	6,719	31,614	25,291	6,323	32,576	153,280	122,624	30,656
April	2006	39.5	65.8	100	April	8,686	15,008	15,008	0	42,112	72,768	72,768	0
May	2006	54.8	91.4	100	May	12,065	12,065	12,065	0	58,496	58,496	58,496	0
June	2006	35.9	59.8	100	June	7,894	7,894	7,894	0	38,272	38,272	38,272	0
July	2006	51.1	85.2	100	July	11,246	11,246	11,246	0	54,528	54,528	54,528	0
Aug	2006	66.0	110.0	100	Aug	14,520	14,520	14,520	0	70,400	70,400	70,400	0
Sept	2006	72.7	121.2	100	Sept	15,998	15,998	15,998	0	77,568	77,568	77,568	0
Oct	2006	66.7	111.2	100	Oct	14,678	14,678	14,678	0	71,168	71,168	71,168	0
Nov	2006	45.0	75.0	100	Nov	9,900	9,900	9,900	0	48,000	48,000	48,000	0
Dec	2006	74.5	124.1	0	Dec	16,381	16,381	0	16,381	79,424	79,424	0	79,424
Jan	2007	25.0	41.7	0	Jan	5,504	21,886	0	21,886	26,688	106,112	0	106,112
Feb	2007	12.6	21.0	0	Feb	2,772	24,658	0	24,658	13,440	119,552	0	119,552
Mar	2007	38.0	63.4	80	March	8,369	33,026	26,421	6,605	40,576	160,128	128,102	32,026
April	2007	42.6	71.0	100	April	9,372	15,977	15,977	0	45,440	77,466	77,466	0
May	2007	17.9	29.9	100	May	3,947	3,947	3,947	0	19,136	19,136	19,136	0
June	2007	39.7	66.2	100	June	8,738	8,738	8,738	0	42,368	42,368	42,368	0
July	2007	53.6	89.4	100	July	11,801	11,801	11,801	0	57,216	57,216	57,216	0
Aug	2007	34.8	58.0	100	Aug	7,656	7,656	7,656	0	37,120	37,120	37,120	0
Sept	2007	31.9	53.2	100	Sept	7,022	7,022	7,022	0	34,048	34,048	34,048	0
Oct	2007	89.8	149.6	100	Oct	19,747	19,747	19,747	0	95,744	95,744	95,744	0
Nov	2007	53.4	89.0	100	Nov	11,748	11,748	11,748	0	56,960	56,960	56,960	0
Dec	2007	60.1	100.2	0	Dec	13,226	13,226	0	13,226	64,128	64,128	0	64,128
Jan	2008	89.6	149.3	0	Jan	19,708	32,934	0	32,934	95,552	159,680	0	159,680
Feb	2008	47.5	79.2	0	Feb	10,454	43,388	0	43,388	50,688	210,368	0	210,368
Mar	2008	39.2	65.4	80	March	8,633	52,021	41,617	10,404	41,856	252,224	201,779	50,445
April	2008	73.3	122.2	100	April	16,130	26,535	26,535	0	78,208	128,653	128,653	0
May	2008	56.0	93.4	100	May	12,329	12,329	12,329	0	59,776	59,776	59,776	0
June	2008	54.2	90.4	100	June	11,933	11,933	11,933	0	57,856	57,856	57,856	0
July	2008	28.9	48.2	100	July	6,362	6,362	6,362	0	30,848	30,848	30,848	0
Aug	2008	39.0	65.0	100	Aug	8,580	8,580	8,580	0	41,600	41,600	41,600	0
Sept	2008	38.5	64.2	100	Sept	8,474	8,474	8,474	0	41,088	41,088	41,088	0
Oct	2008	33.7	56.2	100	Oct	7,418	7,418	7,418	0	35,968	35,968	35,968	0
Nov	2008	63.5	105.8	100	Nov	13,966	13,966	13,966	0	67,712	67,712	67,712	0
Dec	2008	111.8	186.4	0	Dec	24,605	24,605	0	24,605	119,296	119,296	0	119,296
Jan	2009	27.1	45.2	0	Jan	5,966	30,571	0	30,571	28,928	148,224	0	148,224
Feb	2009	46.9	78.1	0	Feb	10,309	40,880	0	40,880	49,984	198,208	0	198,208
Mar	2009	37.6	62.6	80	March	8,263	49,144	39,315	9,829	40,064	238,272	190,618	47,654
April	2009	55.7	92.9	100	April	12,263	22,092	22,092	0	59,456	107,110	107,110	0
May	2009	60.0	100.0	100	May	13,200	13,200	13,200	0	64,000	64,000	64,000	0
June	2009	47.6	79.4	100	June	10,481	10,481	10,481	0	50,816	50,816	50,816	0
July	2009	96.0	160.0	100	July	21,120	21,120	21,120	0	102,400	102,400	102,400	0
Aug	2009	68.4	114.0	100	Aug	15,048	15,048	15,048	0	72,960	72,960	72,960	0
Sept	2009	32.0	53.4	100	Sept	7,049	7,049	7,049	0	34,176	34,176	34,176	0
Oct	2009	109.6	182.6	100	Oct	24,103	24,103	24,103	0	116,864	116,864	116,864	0
Nov	2009	35.2	58.6	100	Nov	7,735	7,735	7,735	0	37,504	37,504	37,504	0
Dec	2009	60.3	100.5	0	Dec	13,266	13,266	0	13,266	64,320	64,320	0	64,320

Sheet 6
Flows Associated with Runoff from Precipitation
Subwatershed: Cell 15

		Factored Precipitation (mm)			Runoff	Runoff Flow (m³ / month) Cell 15 Natural Ground				Cell 15 Pond Surface			
					Area (m²)	130,000				270,000			
Month	Year	From natural ground	From ponds	Monthly runoff expressed as % of the total accumu-lation (If less than 100% it is because of freeze-up)	Month	Available runoff (area x factored runoff)	Total available runoff (available plus runoff not discharged the previous month)	R3 Actual monthly runoff (total available x % runoff)	Left over each month (total available -actual runoff)	Available runoff (area x factored runoff)	Total available runoff (available plus runoff not discharged the previous month)	R4 Actual monthly runoff (total available x % runoff)	Left over each month (total available -actual runoff)
Oct	2005	41.6	69.4	100	Oct	5,413	5,413	5,413	0	18,738	18,738	18,738	0
Nov	2005	84.7	141.2	100	Nov	11,014	11,014	11,014	0	38,127	38,127	38,127	0
Dec	2005	25.7	42.9	0	Dec	3,346	3,346	0	3,346	11,583	11,583	0	11,583
Jan	2006	51.0	85.0	0	Jan	6,630	9,976	0	9,976	22,950	34,533	0	34,533
Feb	2006	36.4	60.7	0	Feb	4,735	14,711	0	14,711	16,389	50,922	0	50,922
Mar	2006	30.5	50.9	80	March	3,970	18,681	14,945	3,736	13,743	64,665	51,732	12,933
April	2006	39.5	65.8	100	April	5,132	8,869	8,869	0	17,766	30,699	30,699	0
May	2006	54.8	91.4	100	May	7,129	7,129	7,129	0	24,678	24,678	24,678	0
June	2006	35.9	59.8	100	June	4,664	4,664	4,664	0	16,146	16,146	16,146	0
July	2006	51.1	85.2	100	July	6,646	6,646	6,646	0	23,004	23,004	23,004	0
Aug	2006	66.0	110.0	100	Aug	8,580	8,580	8,580	0	29,700	29,700	29,700	0
Sept	2006	72.7	121.2	100	Sept	9,454	9,454	9,454	0	32,724	32,724	32,724	0
Oct	2006	66.7	111.2	100	Oct	8,674	8,674	8,674	0	30,024	30,024	30,024	0
Nov	2006	45.0	75.0	100	Nov	5,850	5,850	5,850	0	20,250	20,250	20,250	0
Dec	2006	74.5	124.1	0	Dec	9,680	9,680	0	9,680	33,507	33,507	0	33,507
Jan	2007	25.0	41.7	0	Jan	3,253	12,932	0	12,932	11,259	44,766	0	44,766
Feb	2007	12.6	21.0	0	Feb	1,638	14,570	0	14,570	5,670	50,436	0	50,436
Mar	2007	38.0	63.4	80	March	4,945	19,516	15,612	3,903	17,118	67,554	54,043	13,511
April	2007	42.6	71.0	100	April	5,538	9,441	9,441	0	19,170	32,681	32,681	0
May	2007	17.9	29.9	100	May	2,332	2,332	2,332	0	8,073	8,073	8,073	0
June	2007	39.7	66.2	100	June	5,164	5,164	5,164	0	17,874	17,874	17,874	0
July	2007	53.6	89.4	100	July	6,973	6,973	6,973	0	24,138	24,138	24,138	0
Aug	2007	34.8	58.0	100	Aug	4,524	4,524	4,524	0	15,660	15,660	15,660	0
Sept	2007	31.9	53.2	100	Sept	4,150	4,150	4,150	0	14,364	14,364	14,364	0
Oct	2007	89.8	149.6	100	Oct	11,669	11,669	11,669	0	40,392	40,392	40,392	0
Nov	2007	53.4	89.0	100	Nov	6,942	6,942	6,942	0	24,030	24,030	24,030	0
Dec	2007	60.1	100.2	0	Dec	7,816	7,816	0	7,816	27,054	27,054	0	27,054
Jan	2008	89.6	149.3	0	Jan	11,645	19,461	0	19,461	40,311	67,365	0	67,365
Feb	2008	47.5	79.2	0	Feb	6,178	25,639	0	25,639	21,384	88,749	0	88,749
Mar	2008	39.2	65.4	80	March	5,101	30,740	24,592	6,148	17,658	106,407	85,126	21,281
April	2008	73.3	122.2	100	April	9,532	15,680	15,680	0	32,994	54,275	54,275	0
May	2008	56.0	93.4	100	May	7,285	7,285	7,285	0	25,218	25,218	25,218	0
June	2008	54.2	90.4	100	June	7,051	7,051	7,051	0	24,408	24,408	24,408	0
July	2008	28.9	48.2	100	July	3,760	3,760	3,760	0	13,014	13,014	13,014	0
Aug	2008	39.0	65.0	100	Aug	5,070	5,070	5,070	0	17,550	17,550	17,550	0
Sept	2008	38.5	64.2	100	Sept	5,008	5,008	5,008	0	17,334	17,334	17,334	0
Oct	2008	33.7	56.2	100	Oct	4,384	4,384	4,384	0	15,174	15,174	15,174	0
Nov	2008	63.5	105.8	100	Nov	8,252	8,252	8,252	0	28,566	28,566	28,566	0
Dec	2008	111.8	186.4	0	Dec	14,539	14,539	0	14,539	50,328	50,328	0	50,328
Jan	2009	27.1	45.2	0	Jan	3,526	18,065	0	18,065	12,204	62,532	0	62,532
Feb	2009	46.9	78.1	0	Feb	6,092	24,157	0	24,157	21,087	83,619	0	83,619
Mar	2009	37.6	62.6	80	March	4,883	29,039	23,232	5,808	16,902	100,521	80,417	20,104
April	2009	55.7	92.9	100	April	7,246	13,054	13,054	0	25,083	45,187	45,187	0
May	2009	60.0	100.0	100	May	7,800	7,800	7,800	0	27,000	27,000	27,000	0
June	2009	47.6	79.4	100	June	6,193	6,193	6,193	0	21,438	21,438	21,438	0
July	2009	96.0	160.0	100	July	12,480	12,480	12,480	0	43,200	43,200	43,200	0
Aug	2009	68.4	114.0	100	Aug	8,892	8,892	8,892	0	30,780	30,780	30,780	0
Sept	2009	32.0	53.4	100	Sept	4,165	4,165	4,165	0	14,418	14,418	14,418	0
Oct	2009	109.6	182.6	100	Oct	14,243	14,243	14,243	0	49,302	49,302	49,302	0
Nov	2009	35.2	58.6	100	Nov	4,571	4,571	4,571	0	15,822	15,822	15,822	0
Dec	2009	60.3	100.5	0	Dec	7,839	7,839	0	7,839	27,135	27,135	0	27,135

Sheet 7
Evaporation Losses

Lake Evaporation (mm)	Evaporation Losses (m^3 / month)			
	Location	**From Cell 14**	**From Cell 15**	**Total**
	Flow #	**E1**	**E2**	
	Area (m^2)	640,000	270,000	
42.1	**Oct**	26,944	11,367	38,311
0.0	**Nov**	0	0	0
0.0	**Dec**	0	0	0
0.0	**Jan**	0	0	0
0.0	**Feb**	0	0	0
0.0	**Mar**	0	0	0
0.0	**April**	0	0	0
121.1	**May**	77,504	32,697	110,201
156.9	**June**	100,416	42,363	142,779
150.6	**July**	96,384	40,662	137,046
136.4	**Aug**	87,296	36,828	124,124
84.7	**Sept**	54,208	22,869	77,077
691.8	**TOTAL**	**442,752**	**186,786**	**629,538**

Sheet 8

Seepage Flows

Location		Through Dam K1 and K2[1]	Through Dam J	Total
Seepage #		S1	S2	
Seepage estimate (m^3/day)		216	86	
Days/ month	Month	Seepage (m^3 / month)		
31	Oct	6,696	2,678	9,374
30	Nov	6,480	2,592	9,072
31	Dec	6,696	2,678	9,374
31	Jan	6,696	2,678	9,374
28	Feb	6,048	2,419	8,467
31	Mar	6,696	2,678	9,374
30	April	6,480	2,592	9,072
31	May	6,696	2,678	9,374
30	June	6,480	2,592	9,072
31	July	6,696	2,678	9,374
31	Aug	6,696	2,678	9,374
30	Sept	6,480	2,592	9,072
365	TOTAL	**78,840**	**31,536**	**110,376**

Notes: 1 Seepage through Dam based on "Interim Assessment of Hydrogeologic Performance of Cell No. 14" (Golder, 1994)

Sheet 9

Flows from Gravel Pit Lake

Volumetric Flows into Cell 14 from Gravel Pit Lake

Month	Days Per Month	Year	Average Flow Rate[1] (L/s)	Average Flow Volume (m³)
				F1
Oct	31	2005	23.42	62,728
Nov	30	2005	25.00	64,800
Dec	31	2005	25.00	66,960
Jan	31	2006	25.00	66,960
Feb	28	2006	25.00	60,480
Mar	31	2006	56.25	150,660
April	30	2006	87.50	226,800
May	31	2006	33.00	88,387
June	30	2006	77.50	200,880
July	31	2006	32.40	86,780
Aug	31	2006	23.50	62,942
Sept	30	2006	17.55	45,483
Oct	31	2006	52.00	139,277
Nov	30	2006	97.50	252,720
Dec	31	2006	31.25	83,700
Jan	31	2007	1.00	2,678
Feb	28	2007	0.00	0
Mar	31	2007	25.00	66,960
April	30	2007	70.00	181,440
May	31	2007	28.48	76,270
June	30	2007	33.00	85,536
July	31	2007	48.00	128,563
Aug	31	2007	42.50	113,832
Sept	30	2007	9.25	23,976
Oct	31	2007	0.00	0
Nov	30	2007	31.00	80,352
Dec	31	2007	7.50	20,088
Jan	31	2008	46.80	125,349
Feb	28	2008	46.80	113,219
Mar	31	2008	14.00	37,498
April	30	2008	19.20	49,766
May	31	2008	13.50	36,158
June	30	2008	17.50	45,360
July	31	2008	40.00	107,136
Aug	31	2008	40.00	107,136
Sept	30	2008	22.90	59,346
Oct	31	2008	32.75	87,718
Nov	30	2008	35.00	90,720
Dec	31	2008	28.00	74,995
Jan	31	2009	0.00	0
Feb	28	2009	0.00	0
Mar	31	2009	50.00	133,920
April	30	2009	25.00	64,800
May	31	2009	40.00	107,136
June	30	2009	45.00	116,640
July	31	2009	37.50	100,440
Aug	31	2009	35.00	93,744
Sept	30	2009	32.50	84,240
Oct	31	2009	30.00	80,339
Nov	30	2009	35.00	90,720
Dec	31	2009	33.75	90,396

Notes:

1. Data provided by Rio Algom. Filename: "Quirke Water Balance.xls"

Sheet 10

Historical Water Levels

Area of Cell 14	640,000	m^2
Area of Cell 15	270,000	m^2

Month	Year	Water Level Elevation in Cell 14[1]	Change in Water Storage in Cell 14	Water Level Elevation in Cell 15[1]	Change in Water Storage in Cell 15
		(m)	(m^3)	(m)	(m^3)
Oct	2005	377.63	0	373.23	0
Nov	2005	377.63	0	373.24	3,915
Dec	2005	377.60	-19,200	373.27	7,425
Jan	2006	377.60	0	373.30	8,100
Feb	2006	377.60	0	373.30	0
Mar	2006	378.10	320,000	373.30	0
April	2006	378.20	64,000	374.10	216,000
May	2006	378.18	-12,800	374.08	-5,400
June	2006	377.93	-160,000	373.97	-28,800
July	2006	377.93	0	373.87	-28,800
Aug	2006	377.80	-83,200	373.76	-28,800
Sept	2006	377.70	-64,000	373.60	-43,200
Oct	2006	377.58	-76,800	373.50	-27,000
Nov	2006	377.55	-19,200	373.43	-18,900
Dec	2006	377.60	32,000	373.40	-8,100
Jan	2007	377.60	0	374.06	178,200
Feb	2007	377.60	0	373.90	-43,200
Mar	2007	377.80	128,000	373.78	-32,400
April	2007	377.80	0	373.79	2,700
May	2007	377.80	0	373.82	8,100
June	2007	377.64	-102,400	373.60	-59,400
July	2007	377.60	-25,600	373.40	-54,000
Aug	2007	377.57	-19,200	373.24	-43,200
Sept	2007	377.47	-64,000	373.08	-43,200
Oct	2007	377.51	25,600	373.06	-5,400
Nov	2007	377.54	19,200	373.14	21,600
Dec	2007	377.50	-25,600	373.10	-10,800
Jan	2008	377.50	0	373.10	0
Feb	2008	377.50	0	373.10	0
Mar	2008	377.50	0	373.10	0
April	2008	377.60	64,000	374.10	270,000
May	2008	377.64	25,600	374.05	-13,500
June	2008	377.52	-76,800	373.91	-37,800
July	2008	377.46	-38,400	373.77	-37,800
Aug	2008	377.53	44,800	373.77	0
Sept	2008	377.48	-32,000	373.52	-67,500
Oct	2008	377.46	-12,800	373.40	-32,400
Nov	2008	377.46	0	373.41	2,700
Dec	2008	377.50	25,600	373.40	-2,700
Jan	2009	377.50	0	373.40	0
Feb	2009	377.50	0	373.40	0
Mar	2009	377.60	64,000	373.40	0
April	2009	377.60	0	374.00	162,000
May	2009	377.52	-51,200	373.96	-10,800
June	2009	377.52	0	373.90	-16,200
July	2009	377.48	-25,600	373.87	-8,100
Aug	2009	377.50	12,800	373.77	-27,000
Sept	2009	377.46	-25,600	373.56	-56,700
Oct	2009	377.54	51,200	373.51	-13,500
Nov	2009	377.50	-25,600	373.61	27,000
Dec	2009	377.50	0	373.66	13,500

Notes:
1) Historical water levels provided by Rio Algom in Excel format. Filename "Quirke Water Balance.xls". Some water levels were interpreted by Golder for missing or ambiguous data.

Sheet 11
Flow Summary
Subwatershed: Cell 14 and Cell 15

		Flows (m^3/month)								
		R1	R2	-E1	R3	R4	-E2	-S1	-S2	+F1
Month	Year	Direct Precipitation onto Cell 14	Runoff into Cell 14	Evaporation on Pond Surface from Cell 14	Direct Precipitation onto Cell 15	Runoff into Cell 15	Evaporation on Pond Surface of Cell 15	Seepage under Dam K1 and K2	Seepage under Dam J	Flow from Gravel Pit
Oct	2005	44,416	9,161	26,944	18,738	5,413	11,367	6,696	2,678	62,728
Nov	2005	90,374	18,640	0	38,127	11,014	0	6,480	2,592	64,800
Dec	2005	0	0	0	0	0	0	6,696	2,678	66,960
Jan	2006	0	0	0	0	0	0	6,696	2,678	66,960
Feb	2006	0	0	0	0	0	0	6,048	2,419	60,480
Mar	2006	122,624	25,291	0	51,732	14,945	0	6,696	2,678	150,660
April	2006	72,768	15,008	0	30,699	8,869	0	6,480	2,592	226,800
May	2006	58,496	12,065	77,504	24,678	7,129	32,697	6,696	2,678	88,387
June	2006	38,272	7,894	100,416	16,146	4,664	42,363	6,480	2,592	200,880
July	2006	54,528	11,246	96,384	23,004	6,646	40,662	6,696	2,678	86,780
Aug	2006	70,400	14,520	87,296	29,700	8,580	36,828	6,696	2,678	62,942
Sept	2006	77,568	15,998	54,208	32,724	9,454	22,869	6,480	2,592	45,483
Oct	2006	71,168	14,678	26,944	30,024	8,674	11,367	6,696	2,678	139,277
Nov	2006	48,000	9,900	0	20,250	5,850	0	6,480	2,592	252,720
Dec	2006	0	0	0	0	0	0	6,696	2,678	83,700
Jan	2007	0	0	0	0	0	0	6,696	2,678	2,678
Feb	2007	0	0	0	0	0	0	6,048	2,419	0
Mar	2007	128,102	26,421	0	54,043	15,612	0	6,696	2,678	66,960
April	2007	77,466	15,977	0	32,681	9,441	0	6,480	2,592	181,440
May	2007	19,136	3,947	77,504	8,073	2,332	32,697	8,896	2,678	76,270
June	2007	42,368	8,738	100,416	17,874	5,164	42,363	6,480	2,592	85,536
July	2007	57,216	11,801	96,384	24,138	6,973	40,662	6,696	2,678	128,563
Aug	2007	37,120	7,656	87,296	15,660	4,524	36,828	6,696	2,678	113,832
Sept	2007	34,048	7,022	54,208	14,364	4,150	22,869	6,480	2,592	23,976
Oct	2007	95,744	19,747	26,944	40,392	11,669	11,367	6,696	2,678	0
Nov	2007	56,960	11,748	0	24,030	6,942	0	6,480	2,592	80,352
Dec	2007	0	0	0	0	0	0	6,696	2,678	20,088
Jan	2008	0	0	0	0	0	0	6,696	2,678	125,349
Feb	2008	0	0	0	0	0	0	6,048	2,419	113,219
Mar	2008	201,779	41,617	0	85,126	24,592	0	6,696	2,678	37,498
April	2008	128,653	26,535	0	54,275	15,680	0	6,480	2,592	49,766
May	2008	59,776	12,329	77,504	25,218	7,285	32,697	6,696	2,678	36,158
June	2008	57,856	11,933	100,416	24,408	7,051	42,363	6,480	2,592	45,360
July	2008	30,848	6,362	96,384	13,014	3,760	40,662	6,696	2,678	107,136
Aug	2008	41,600	8,580	87,296	17,550	5,070	36,828	6,696	2,678	107,136
Sept	2008	41,088	8,474	54,208	17,334	5,008	22,869	6,480	2,592	59,346
Oct	2008	35,968	7,418	26,944	15,174	4,384	11,367	6,696	2,678	87,718
Nov	2008	67,712	13,966	0	28,566	8,252	0	6,480	2,592	90,720
Dec	2008	0	0	0	0	0	0	6,696	2,678	74,995
Jan	2009	0	0	0	0	0	0	6,696	2,678	0
Feb	2009	0	0	0	0	0	0	6,048	2,419	0
Mar	2009	190,618	39,315	0	80,417	23,232	0	6,696	2,678	133,920
April	2009	107,110	22,092	0	45,187	13,054	0	6,480	2,592	64,800
May	2009	64,000	13,200	77,504	27,000	7,800	32,697	6,696	2,678	107,136
June	2009	50,816	10,481	100,416	21,438	6,193	42,363	6,480	2,592	116,640
July	2009	102,400	21,120	96,384	43,200	12,480	40,662	6,696	2,678	100,440
Aug	2009	72,960	15,048	87,296	30,780	8,892	36,828	6,696	2,678	93,744
Sept	2009	34,176	7,049	54,208	14,418	4,165	22,869	6,480	2,592	84,240
Oct	2009	116,864	24,103	26,944	49,302	14,243	11,367	6,696	2,678	80,339
Nov	2009	37,504	7,735	0	15,822	4,571	0	6,480	2,592	90,720
Dec	2009	0	0	0	0	0	0	6,696	2,678	90,396

Sheet 12
Calculated Seepage
Sub watershed: Combined Cell 14 and Cell 15

Year	Total Flow from Gravel Pit Lake	Total Precipitation	Total Evaporation	Seepage Through Dams J, K1, K2	Change in Pond Volume	Total Seepage	Average Seepage Rate	Sensitivity Analysis			
								+10% Evap	-10% Evap	Runoff Coefficient on Natural Ground = 50%	Runoff Coefficient on Natural Ground = 70%
	m^3	m^3	m^3	m^3	m^3	m^3	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)
Oct 2005 to Sept 2006	1,183,861	1,101,531	629,538	110,376	145,240	**1,400,238**	**44.4**	42.4	46.4	43.3	45.5
Oct 2006 to Sept 2007	1,154,953	900,592	629,538	110,376	-287,600	**1,603,231**	**50.8**	48.8	52.8	49.7	52.0
Oct 2007 to Sept 2008	781,409	1,250,032	629,538	110,376	125,200	**1,166,327**	**37.0**	35.0	39.0	35.9	38.0
Oct 2008 to Sept 2009	954,353	1,270,080	629,538	110,376	-2,000	**1,486,519**	**47.1**	45.1	49.1	46.1	48.2

Sheet 13
Calculated Seepage

Sub watershed: Cell 14

Year	Total Flow from Gravel Pit Lake	Total Precipitation	Total Evaporation	Seepage Through Dams K1, K2	Change in Pond Volume	Overflow from Cell 14 to Cell 15	Total Seepage	Average Seepage Rate
	m³	m³	m³	m³	m³	m³	m³	(L/s)
Sep 2008 to Nov 2008	237,784	174,626	81,152	19,656	-44,800	0	**356,402**	**45.3**
Jul 2009 to Sep 2009	278,424	252,753	168,448	19,872	-38,400	0	**381,257**	**48.0**

Year	Total Flow from Gravel Pit Lake	Total Precipitation	Total Evaporation	Seepage Through Dams K1, K2	Change in Pond Volume	Assumed Overflow from Cell 14 to Cell 15	Total Seepage	Average Seepage Rate
	m³	m³	m³	m³	m³	m³	m³	(L/s)
Oct 2005 to Sept 2006	1,183,861	759,270	442,752	78,840	44,800	0	**1,376,739**	**43.7**
Oct 2006 to Sept 2007	1,154,953	620,765	442,752	78,840	-147,200	0	**1,401,326**	**44.4**
Oct 2007 to Sept 2008	781,409	861,629	442,752	78,840	6,400	0	**1,115,046**	**35.4**
Oct 2008 to Sept 2009	954,353	875,448	442,752	78,840	-12,800	0	**1,321,009**	**41.9**

Year	Total Flow from Gravel Pit Lake	Total Precipitation	Total Evaporation	Seepage Through Dams K1, K2	Change in Pond Volume	Assumed Overflow from Cell 14 to Cell 15 (25 l/s for 3 months)	Total Seepage	Average Seepage Rate
	m³	m³	m³	m³	m³	m³	m³	(L/s)
Oct 2005 to Sept 2006	1,183,861	759,270	442,752	78,840	44,800	197,100	**1,179,639**	**37.4**
Oct 2006 to Sept 2007	1,154,953	620,765	442,752	78,840	-147,200	197,100	**1,204,226**	**38.2**
Oct 2007 to Sept 2008	781,409	861,629	442,752	78,840	6,400	197,100	**917,946**	**29.1**
Oct 2008 to Sept 2009	954,353	875,448	442,752	78,840	-12,800	197,100	**1,123,909**	**35.6**

Year	Total Flow from Gravel Pit Lake	Total Precipitation	Total Evaporation	Seepage Through Dams K1, K2	Change in Pond Volume	Assumed Overflow from Cell 14 to Cell 15 (25 l/s for 6 months)	Total Seepage	Average Seepage Rate
	m³	m³	m³	m³	m³	m³	m³	(L/s)
Oct 2005 to Sept 2006	1,183,861	759,270	442,752	78,840	44,800	394,200	**982,539**	**31.2**
Oct 2006 to Sept 2007	1,154,953	620,765	442,752	78,840	-147,200	394,200	**1,007,126**	**31.9**
Oct 2007 to Sept 2008	781,409	861,629	442,752	78,840	6,400	394,200	**720,846**	**22.9**
Oct 2008 to Sept 2009	954,353	875,448	442,752	78,840	-12,800	394,200	**926,809**	**29.4**

ACIDITY RELEASE CONTROLS AT QUIRKE CELL 15

ECOMETRIX INCORPORATED

ACIDITY RELEASE CONTROLS AT QUIRKE CELL 15

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ACIDITY RELEASE CONTROLS AT QUIRKE CELL 15

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EXECUTIVE SUMMARY

The Quirke Site (the Site) is a decommissioned uranium mine property located approximately 13 km north of the City of Elliot Lake and immediately north of Dunlop Lake. The Site is owned and managed by Rio Algom Limited (RAL). The Quirke tailings were divided into cells and flooded at decommissioning.

EcoMetrix Incorporated (EcoMetrix) was retained by RAL to complete a study that focused on acidity release from periodically exposed tailings in Cell 15 at the Quirke Tailings Management Area (TMA). The study was completed in response to the October 2007 inspection report from the Canadian Nuclear Safety Commission (CNSC) that recommended RAL review the water balance issue associated with the partial loss of water cover in Cell 15 during parts of the year. As part of the review, it was recommended that the potential acidity loads from the periodically exposed tailings in Cell 15 be addressed.

The objectives of the study were to estimate potential acidity loads from the periodically exposed tailings and to determine whether or not the loads contribute important amounts of acidity to the TMA.

Sampling was conducted at five stations in Cell 15 to obtain representative tailings and water samples to quantify concentrations of constituents associated with acid generation. Tailings samples were collected from areas that had been or could potentially be partially exposed from the loss of the water cover in Cell 15. The analyses on the tailing solids included ABA and metals to estimate the degree of sulphide oxidation and inventories of leachable metals. Shake flask tests were also completed on the tailings solids to estimate the concentrations of soluble acidity and other constituents.

The results from the field sampling program and laboratory testing indicated that some of the periodically exposed tailings exhibited trends that are consistent with on-going sulphide oxidation and thus acid generation in addition to the historical acidity and soluble oxidation products that had accumulated in the beached tailings prior to flooding.

Areas of periodically exposed tailings were estimated from bathymetric and elevation survey data. The results for the measured soluble acidities in the shallow tailings were used to calculate potential acidity loads and corresponding lime demands from the tailings to the water cover in Cell 15. The estimated acidity loads represented potential lime demands of approximately 1 to 5 tonnes of CaO per annum.

A water balance was completed to estimate the average annual flow rates from Cells 14 and 15. The flow data, together with on-going water quality monitoring data at the outflows of Cell 14 and Cell 15, were used to estimate actual acidity loads in terms of lime demand. The on-going monitoring data showed that the average acidity concentrations in the cells were approximately 1 to 2 mg/L as $CaCO_3$. At this concentration, the total lime demand for

Cell 14 was 0.88 tonnes of CaO per annum and the incremental lime demand for Cell 15 was 1.14 tonnes per year.

When compared to the total operating lime use at the Quirke ETP, the estimated lime demands represented about 1 to 3% of the minimum annual lime use of 145 tonnes of CaO per year (2001 to 2009). Therefore, the periodically exposed tailings in Cell 15 contribute little to no measureable acidity loads for the impoundment, overall. Collectively, these results showed that the acidity load from Cell 15 is almost negligible and has little to no influence on the lime use for pH control at the Quirke TMA.

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1.0 INTRODUCTION

The Quirke Site (the Site) is a decommissioned uranium mine property located approximately 13 km north of the City of Elliot Lake and immediately north of Dunlop Lake (**Figure 1.1**). The Site is owned and managed by Rio Algom Limited (RAL). The Quirke tailings were divided into cells and flooded at decommissioning.

EcoMetrix Incorporated (EcoMetrix) was retained by RAL to complete a study that focused on acidity release from periodically exposed tailings in Cell 15 at the Quirke Tailings Management Area (TMA). The study was completed in response to the October 2007 inspection report from the Canadian Nuclear Safety Commission (CNSC) that recommended RAL review the water balance issue associated with the partial loss of water cover during parts of the year in Cell 15. As part of the review it was recommended that the potential acidity loads from the periodically exposed tailings in Cell 15 be addressed.

1.1 Objectives and Scope of Work

The objectives of the study were to estimate potential acidity loads from the periodically exposed tailings and to determine whether or not the loads contribute important amounts of acidity to the TMA.

The scope of work for this investigation included the following:

- collection and characterization of tailings from Cell 15 in areas that have been periodically exposed to air as a result of declines in water elevations;
- leachability assessment of acidity and other oxidation products from the near surface tailings;
- assessment of potential sources of acidity, including acidity release from the periodically exposed tailings;
- estimation of acidity loads that reflect spatial and temporal changes in water cover;
- comparison of acidity loads to the operating capacity of the Quirke Treatment System; and
- evaluation of the requirement for the mitigation of acid release from Cell 15 tailings.

2.0 BACKGROUND

The following section provides general background information on the Quirke TMA, the generation and release of acidity from tailings, as well as a summary of relevant trends observed for acidity from routine monitoring at the Quirke TMA.

2.1 Quirke TMA Tailings and Configuration

The Quirke mine and mill operated from 1956 to 1961, and in 1968 the mine was re-opened and operated until closure in August 1990. The Quirke mill produced approximately 42 million tonnes of tailings that were placed in the TMA.

The milling process consisted of a hot dilute sulphuric acid leach followed by removal of the uranium via precipitation of ammonium diuranate (yellow cake). Prior to discharge to the TMA, the acidic wastes (i.e., tailings) generated during the milling process were neutralized with lime to pH values of 8.5 to 10.5. The ore contained pyrite as an accessory mineral. Therefore, the tailings were sulphide bearing with little or no neutralization potential and consequently potentially acid generating. During operation the tailings were exposed and unsaturated conditions developed at shallow depths within the tailings. The unsaturated zone allowed oxygen and precipitation to enter the tailings, initiating acid generation, resulting in acidic porewater in the unsaturated zone. Upon closure, the tailings were flooded by raising the original dams to mitigate acid generation. Cell 14 was flooded by raising Dyke 14 between 1991 and 1992 (**Figure 2.1**). Downstream of Cell 14, Cells 15 and 16 were flooded in 1994 by raising Dykes 15 and 16; and Cell 17 was flooded in 1995 by raising Dyke 17 (Golder, 1996).

The Quirke TMA consists of five terraced flooded cells (Cells 14 to 18) within a bedrock-rimmed basin, separated by engineered, low permeability dykes that were constructed on the existing tailings (**Figure 2.1**). The cell elevations drop an average of 3.5 m per cell resulting in an elevation change of 14 m between Cell 14 and Cell 18, the final downstream cell. **Figure 2.2** provides a schematic of the cross-sectional profile of the Quirke TMA and the flow conditions within the flooded basin. The changes in water elevations across the TMA induced subsurface flow (seepage) through the tailings below the internal dykes.

Previous water balance calculations showed that the water cover could be partially lost in Cell 14 during some periods of the year because of seepage losses from Cell 14. To maintain appropriate water cover, modifications were completed to reduce seepage losses from Cell 14 to Cell 15. In 1997, a till blanket was applied to selected sections on the upstream side of Dyke 14 that reduced the seepage rate to approximately 50 L/s (CCL, 2000). In 2003, the till blanket was extended at Dyke 14 and a diffusion barrier was applied to 68% of the cell, further reducing seepage losses to approximately 35 L/s (Golder, 2011).

As a result of lower seepage flows, the water cover in Cell 15 is partially lost during some periods of some years. In 1997, a till blanket was also applied to selected sections of the upstream side of Dyke 15 in an effort to reduce seepage losses to Cell 16. Despite the addition of the till cover, loss of water cover in Cell 15 during some parts of low precipitation years has occurred, resulting in periodic seasonal exposure of small areas of tailings and loss of saturation in the associated surface layers.

2.2 Acidity Generation

Acidity generation occurs when sulphide bearing minerals are exposed to water and oxygen. Exposed and unsaturated sulphide minerals undergo oxidation, resulting in the liberation of hydrogen ions, acidity and metals into the porewater. The highest rates of oxidation and the largest quantities of acidity and other oxidation products are generally produced closest to the tailings surface. It is well known that oxygen transport is generally rate-limiting in submerged sulphide tailings and that oxygen ingress into the tailings is controlled to a large degree by the moisture content and degree of saturation in exposed tailings (INAP, 2011). An oxidation zone in sulphide tailings can extend from a few centimeters to a few metres below surface depending on the moisture content of the tailings. Acidity generation typically occurs in the uppermost portion of tailings where oxygen and water can readily infiltrate or diffuse into the tailings. Below the zone of effective saturation, such as the water table or the top of the capillary fringe, acidity generation is generally negligible due to the slow transport of oxygen through water.

Acid generation in tailings over a long period of time typically results in the depletion of sulphide and associated metals in the shallow tailings, with less depletion at depth. Because the oxidation products produced via sulphide oxidation accumulate in the porewater within the tailings, trends that are observed in the tailings are also reflected in the porewater. When sulphide oxidation and acid generation occur, porewater typically exhibits acidic pH values and elevated sulphate and iron concentrations in the zones that also exhibit sulphide and metal depletion.

The Quirke tailings were exposed for many years during operation and prior to flooding. The tailings, therefore, generated acid and other oxidation products that resided in the tailings porewater and were likely transported slowly downward through the tailings with time until flooding occurred.

2.3 Conceptual Model for the Reclamation of Quirke Tailings

After closure, and as part of the reclamation plan, the tailings were divided into cells by dykes and sequentially flooded beginning with Cell 14. The design of the TMA resulted in a 14 m elevation change from Cell 14 at the west of the basin to Cell 18 at the east end of the basin. The changes in elevation between the cells induced subsurface flow (seepage) through the tailings from upstream cells to downstream cells. Seepage is generally concentrated near the dykes because the shortest travel paths for subsurface water flow represent the highest hydraulic gradients that control the flow. The flow conditions within the flooded tailings basin at Quirke are shown schematically in **Figure 2.2**.

Cell to cell seepage occurs through the tailings below the internal dykes and results in the flow of tailings porewater downward at the upstream cells and upward at the downstream cells. Although seepage beneath the dykes does not result in release to the receiving environment, historic oxidation products are released to the respective downstream cells. The reason for and the expected behaviour associated with these releases are shown schematically in **Figure 2.3**.

When the tailings were initially flooded, the oxidation zones containing elevated concentrations of iron, acidity and sulphate, together with low pH values were likely a few meters deep in the near-surface tailings (**Figure 2.3a**). When the tailings were flooded, some oxidation products present in the near-surface porewater would have been released by an “initial flush” that resulted from flooding of the cells. This flushing would have diminished with time as the original porewater in the seepage zones was replaced by the overlying waters. Once the tailings were flooded, oxidation of the sulphides in the tailings would have been controlled by diffusion of dissolved oxygen from the water column into the flooded tailings, a very slow process that generally has a negligible effect on the quality of the overlying water. In uni-level basins, such as the Panel and Stanleigh TMAs, this initial release of historic porewater acidity was treated by a two to three year period of in-situ lime addition during flooding within the basins. Basin waters at those TMAs have remained near neutral.

At the multi-level Quirke facility, soon after flooding, seepage flow below the dykes, initiated by the differences in water elevations between adjoining cells would have represented substantial flow of acidic porewater to the overlying waters in the downstream cells. Diffusion of dissolved oxidation products in the near-surface porewaters would have been driven by the elevated concentrations in the tailings but was likely a less significant contributor of acidity to the water covers in the cells. Diffusion is a slow transfer process; therefore flow would dominate the transfer of soluble constituents and have a greater effect on the resident soluble masses of oxidation products in the upper zone of the tailings soon after flooding. The flow rates in the tailings are likely on the order of one to five metres per year, therefore, it will require many years to move porewater from the shallow zone of the upstream tailings to the tailings-water interface in the downstream cell. Nevertheless, it is expected that, over time subsurface flushing and the releases of oxidation products will decrease. This will be reflected by decreased acidity concentrations in the basin water. In addition, diffusive transport of oxidation products from the tailings to the overlying water will also decrease with time as the concentration gradients decrease. Therefore, the acidity loadings to the water covers in the cells are expected to decline with time.

2.4 Acidity Release from Periodically Exposed Tailings

Some oxidation of the tailings will occur when the tailings are exposed and become unsaturated as a result of periodically declining water levels. The release of these oxidation products may contribute some acidity loads to the TMA. Oxidation products produced in the unsaturated tailings could potentially be released via two mechanisms. The first mechanism is referred to as porewater flushing that occurs during precipitation events. The downward movement, or infiltration, of water in the near surface zone effectively displaces porewater as seepage and runoff into the basin water. Oxidation products may also be released from the tailings porewater by a rinsing effect caused by water level fluctuations. Both mechanisms were considered in this assessment of acidity loadings to Cell 15 and the magnitude and implications of such loadings are presented and discussed in this report.

2.5 Routine Monitoring Data

This section discusses the routine monitoring of basin water and porewater in each cell at the Quirke TMA. Time-trend plots for selected constituents in porewater and basin water are presented in **Figures 2.4 and 2.5**. The complete data sets are provided in **Appendix 1**.

2.5.1 Porewater Quality

Acidity concentrations measured in the porewater up-gradient and down-gradient of each dyke are presented as time-trend plots in **Figure 2.4**. The up-gradient acidity concentrations are presented as closed symbols and down-gradient concentrations are presented as open symbols.

Acidity concentrations in the porewater in Cell 14 are represented by piezometer nest DK14-4 that is located along the upstream side of Dyke 14. Acidity concentrations in the shallow porewater have decreased from approximately 500 mg/L in 1994 to values less than the detection of 1 mg/L in 2009. No statistical trends have been observed in the porewater from the deeper piezometers that have screen elevations below the water elevation in Cell 16 (DK14-4A) (Minnow, 2011). The short-term increase in acidity concentrations in 2004 and 2005 were likely the result of the dewatering of Cell 14 for the placement of the diffusion barrier in 2003.

Down-gradient of Dyke 14, acidity concentrations in porewater in Cell 15 are represented by piezometer nest DK14-5. The data show that acidity concentrations in the shallow porewater have decreased from approximately 300 mg/L to less than the detection limit of 1 mg/L between 1994 and 2009. The low acidity concentrations at DK14-5 confirm the passage of the post-flooding acidity front.

Acidity concentrations in the porewater in Cell 15 upstream of Dyke 15 are represented by piezometer nest DK15-1. Acidity concentrations in the porewater have shown a consistent decreasing trend since 1995, after the cell was flooded. Between 2006 and 2009, average acidity concentrations at DK15-1 have decreased from 476 to 213 mg/L.

Down-gradient of Dyke 15, acidity concentrations in porewater in Cell 16 are represented by piezometer nest DK15-2. Acidity concentrations in the porewater have shown a consistent decreasing trend since 1996, with values of approximately 5,000 mg/L in 1996 that have decreased to values of about 1,000 mg/L in 2009. Between 2006 and 2009, average acidity values at DK15-2 have decreased from 2,175 to 897 mg/L.

Acidity concentrations in the porewater in Cell 16 upstream of Dyke 16 are represented by piezometer nest DK16-1. Acidity concentrations in the porewater have shown a consistent decreasing trend since 1996, after the cell was flooded. In 1996, acidity concentrations in the range of 104 to 870 mg/L were measured at DK16-1. These values have decreased to between 6 and 21 mg/L in 2009.

Down-gradient of Dyke 16, acidity concentrations in porewater in Cell 17 are represented by piezometer nest DK16-2. Acidity concentrations in the porewater have shown a consistent decreasing trend since 1996. Average acidity values at DK16-2 have decreased from 357 mg/L in 1996 to 13 mg/L in 2009.

Acidity concentrations in the porewater in Cell 17 upstream of Dyke 17 are represented by piezometer nest DK17-1. Down-gradient of Dyke 17, acidity concentrations in porewater in Cell 18 are represented by piezometer nest DK17-2. Porewater samples from DK17-1 and DK17-2 are collected below the water elevation of Cell 18. Acidity concentrations measured in piezometers with screen elevations between 358 and 361 masl (DK17-1B, C and DK17-2C, D) have acidity concentrations less the detection limit of 1 mg/L. These porewaters are reflective of residual process water in the tailings (Minnow, 2011). The deeper piezometers at DK17-2 (DK17-2A, B) exhibit acidic porewater with an average acidity value of 1,230 mg/L.

In general, porewater quality within the Quirke TMA has shown significant improvement over time. Porewater monitoring at the Quirke facility indicates that subsurface flushing and release of acidity is nearing completion in Cells 14 and 15, and is progressing in the downstream cells (**Figure 2.4**). Subsurface flushing of acidity from the porewater is reflected by decreasing trends of acidity and sulphate in the basin water (**Figure 2.5**).

2.5.2 Basin Surface Water Quality

Acidity and sulphate concentrations and pH values measured in the outflow from each cell are presented as time-trend plots in **Figure 2.5**.

Closure of the Quirke mill and flooding of the Quirke TMA (early 1990s) reduced acidity concentrations upstream of the treatment plant by orders of magnitude (**Figure 2.5**). . Flooding and in-situ liming of Cells 16 and 17 maintains near neutral pH values in all of the cells, except Cell 18 where the pH is maintained between 3.5 and 7.0 to assist in Ra-226 removal during the treatment process. However, neither Cell 14 nor Cell 15 have required in-situ lime addition to maintain neutral pH values in the basin waters since 2000.

Acidity concentrations in Cell 14 have remained less than 10 mg/L since 1993, with an average value of 1 mg/L between 2006 and 2009. Acidity concentrations in Cell 15 have remained less than 15 mg/L since 1996, with an average value of 2 mg/L between 2006 and 2009. The low acidity concentrations in Cells 14 and 15 are reflected by near neutral pH and low sulphate values in the basin waters (**Figure 2.5**).

Since 1996, acidity concentrations in Cells 16 and 17 have shown significant decreases and have remained less than 51 mg/L and acidity concentrations in Cell 18 have ranged from 1 to 99 mg/L. Average acidity concentrations in Cells 16, 17 and 18 were 11, 12 and 14 mg/L, respectively, between 2006 and 2009. The low acidity and near neutral pH values observed in **Figure 2.5** for Cells 16, 17 and 18 reflect in-situ lime additions to Cells 16 and 17.

Increasing sulphate concentrations from Cell 14 (less than 20 mg/L) to Cell 18 (greater than 1,500 mg/L) reflect continued flushing of historic oxidation products. **Figure 2.5** indicates a long-term decreasing trend in sulphate concentrations in Cell 18 that has been statistically confirmed in the 2006 through 2009 TOMP reporting period (Minnow, 2011).

3.0 FIELD SAMPLING AND LABORATORY TESTING

Sampling was conducted at five stations in Cell 15 to obtain representative samples to quantify concentrations of constituents associated with acid generation. Tailings samples were collected from areas that have been or could potentially be partially exposed from the loss of the water cover in Cell 15. The locations of the sampling stations are presented in **Figure 3.1**.

3.1 Field Sampling Methods

3.1.1 Core Sample Collection

Tailings were collected using a 4-inch K-B coring device at five stations in the west area of Cell 15 (**Figure 3.1**). Sampling stations represented areas where beached tailings existed or may potentially exist depending on the elevation of the water cover. The sampling stations were chosen to represent areas where acidity may have developed as a result of loss of saturation and oxidation of the tailings. Three sampling stations were located along the downstream toe of Dyke 14 (QC15-1, QC15-2 and QC15-3), were flooded at the time of sampling and are exposed to seepage form Cell 14. Sampling Stations QC15-4 and QC15-5 were located near a historic deposition beach at the southeast corner of Cell 15. Samples at QC15-5 were collected from the beached tailings, while the samples at QC15-4 were collected from an adjacent near-shore area (QC15-4).

The cores were sectioned at 10 cm intervals to depths of 30 to 50 cm. Each 10 cm section was placed into a dedicated Ziploc bag, stored at 4°C and transported to the EcoMetrix Laboratory for further testing.

3.1.2 Basin Water Sample Collection

Basin water samples were collected as grab samples from the top of the water column from four of the five sampling stations. Basin water sampling stations included QC15-1, QC15-2, QC15-3 and QC15-4. Basin water was not sampled at QC15-5 because this sampling station was located on beached tailings.

Basin water samples were field filtered through 0.45 µm nylon filters and the pH of the basin water samples was measured and recorded. Water samples were then transferred into sample bottles supplied by SGS Lakefield Laboratories (SGS Lakefield). Water samples to be analysed for metals and Ra-226 were preserved with nitric acid and all samples were stored at 4°C until analysis.

Basin water samples were sent to SGS Lakefield for chemical analyses that included acidity, Ra-226, metals and sulphate.

3.2 Laboratory Testing Methods

The tailings samples were homogenized and sub-sampled at the EcoMetrix Laboratory. Rinse pH was measured on one set of sub-samples. A second set of sub-samples were submitted to SGS Lakefield for Acid Base Accounting (ABA), Ra-226 and metals analyses.

The wet tailings from each sampling station were subjected to short-term leach (Shake Flask) tests using distilled water. The leach tests used a 3:1 water:solids ratio (approximately 300 mL of water to 100 g of material). The samples were constantly agitated for approximately 24 hours prior to extraction of leachate samples. After agitation, leachate samples were filtered (0.45 µm), and samples for Ra-226 and metals analyses were acidified (HNO_3), prior to submission for analyses to SGS Lakefield.

The liquid fractions from the leach tests were analysed for pH, acidity, Ra-226 and metals to evaluate the key indicators of acidity releases to basin water. The leach test methods were generally consistent with those described in the “Draft Guidelines for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia” (Price, 1997).

4.0 QUALITY ASSURANCE/QUALITY CONTROL

A detailed data quality assessment (DQA) was completed by EcoMetrix to evaluate the quality of the data collected during the Cell 15 field campaign. This section provides a summary of the QA/QC for selected constituents that are discussed in this report. Data quality results for the selected constituents are summarized in **Tables 4.1 to 4.3**. Data quality results for all of the constituents analysed are provided in **Appendix 2**.

The precision for the duplicate and replicate samples were evaluated by calculating the relative percent difference (RPD) as follows:

$$RPD = \frac{2|C_1 - C_2|}{C_1 + C_2} \times 100\%$$

where: C_1 = sample concentration; and

C_2 = replicate (or duplicate) concentration.

The Data Quality Objectives (DQO) for solids samples and supernatant water from shake flask tests were less than or equal to a RPD value of 40%.

For duplicate/replicate samples having concentrations less than five times the detection limit, the DQO was the absolute difference (AD) between the sample and duplicate/replicate that should not have been greater than the detection limit value.

Blind duplicates and replicates of solids and water samples, as well as a laboratory blank sample (distilled water), were submitted to SGS Lakefield. Duplicate and replicate samples were labeled as QC15-6. The duplicate samples were solids sample splits from a selected core section. The replicate samples were supernatant water from replicate shake flask tests conducted on replicate core sections. The calculated RPD or AD values for selected constituents are presented in **Tables 4.1 and 4.2**.

4.1 Tailings Solids Data Quality Assessment

The DQA for selected constituents in tailings solids duplicates from Core09-QC15-4 (20-30) and Core09-QC15-2 (10-20) are summarized in **Table 4.1**. On average, the DQO of 40% was achieved for all selected constituents (neutralization potential, sulphide-sulphur, aluminum, iron and manganese), with the exception of sulphide-sulphur (Sulphide-S) that had an average RPD value of 71%. The DQO for sulphide-S was exceeded in one sample with an RPD value of 116%. As sulphide-S is a supporting constituent and is not used in the calculations for acidity loads, there are no impacts on the interpretation of the results.

4.2 Shake Flask Test Data Quality Assessment

The DQA for selected constituents in supernatant water from shake flask tests from replicates of core samples Core09-QC15-2 (10-20) and Core09-QC15-4 (10-20) are summarized in **Table 4.2**. On average, the DQO of 40% was achieved for all selected constituents (acidity, sulphate, aluminum, iron and manganese). The DQO was exceeded for acidity in one replicate sample with an RPD value of 104%. The DQO was exceeded for iron in one replicate sample with an RPD value of 76%. As these individual values were only marginally above the data quality objectives, there are no impacts on the interpretation of the results.

4.3 Blank Sample Data Quality Assessment

One blank sample was subjected to the shake flask test procedure that included the 24-hour leach and filtration to determine potential cross-contamination between samples. The results for selected constituents in the blank are provided in **Table 4.3**. Acidity, sulphate and manganese concentrations exceeded DQOs in the blank sample, with concentrations of 6, 0.6 and 0.00049 mg/L, respectively. Aluminum and iron concentrations were less than detection limits of 0.01 mg/L. The sulphate and manganese data were considered acceptable because the concentrations in the blank sample were at least 2 orders of magnitude less than the sulphate and manganese concentrations measured in the samples from Cell 15 (sulphate range = 32 to 1,500 mg/L; manganese range = 0.018 to 3.49 mg/L). The acidity data were considered acceptable because the blank sample was collected from water that was exposed to the atmosphere and carbon dioxide. Carbon dioxide dissolves in water to form carbonic acid that can be detected as low level acidity.

4.4 Anomalous pH and Acidity in Basin Water Samples

The chemical results from basin water samples are summarized in **Table 4.4**. The results show anomalously low pH values between 3.4 and 4.3 compared to monitoring data for Cell 15 outflow. The routine outflow samples have typically exhibited average pH values of about 7 since 2005. The acidity values were also anomalously high with an average of about 36 mg/L compared to an average of about 2 mg/L since 2005. In addition, the standard deviation for the four sulphate concentrations was only about 3% of the average value, suggesting that the water cover is well mixed, whereas the standard deviation for acidity values was on the order of 40%, indicating larger variability. Upon further investigation, the source of the anomalous pH and acidity values was found. The four basin water samples were collected in sample bottles that were previously acidified with nitric acid in preparation for storage of samples for metals analysis. The bottles were rinsed three times in the field before collection of the samples for pH and acidity. However this rinsing was insufficient to remove all traces of nitric acid. The pH and acidity values for the Cell 15 basin water samples collected by EcoMetrix in September 2009 were, therefore, ignored and were not used in this study.

4.5 Laboratory Quality Assurance and Quality Control

Laboratory QA/QC included analysis of laboratory blank and laboratory duplicate samples. The Certificates of Analysis, including internal laboratory QA/QC results are provided in **Appendix 3** and indicate that the data have acceptable accuracy and precision.

5.0 RESULTS

Selected results from the September 2009 field sampling program are presented in **Figures 5.1 and 5.2** and are summarized in **Tables 5.1 to 5.3**. Concentrations of selected constituents in tailings are provided in **Figure 5.1** as depth profiles. **Figure 5.2** presents depth profiles for selected soluble constituents from the leach tests. A summary of selected constituent concentrations in the basin water at each sampling station that had overlying water is provided in **Table 5.3**. A complete compilation of the data is provided as Certificates of Analysis in **Appendix 3**.

5.1 Acid Base Accounting and Metals Contents

Selected results from the ABA and metals analyses on the tailings are summarized in **Table 5.1** and presented as depth profiles in **Figure 5.1**.

Tailings samples collected along the north toe of Dyke 14 (QC15-1 and QC15-2) are characterized by depressed rinse pH (5.0 to 6.3) and low residual sulphide-S contents (0.11 to 0.82%). Iron and manganese concentrations at QC15-1 and QC15-2 in the surface samples were elevated with concentrations of 13,000 and 17,000 mg/kg and 12 and 11 mg/kg, respectively (**Figure 5.1**). The results for rinse pH, sulphide-S, iron and manganese are consistent with the surface precipitation of oxidation products in Cell 15 that originated from Cell 14 seepage.

A similar but less pronounced characterization occurs at the centre toe of Dyke 14 (QC15-3) where rinse pH values and sulphide-S were similar to those measured at QC15-1 and QC15-2. The pH values ranged from 4.2 to 4.9 and sulphide-S contents ranged from 1.8 to 4.5%. Iron concentrations at QC15-3 were higher compared to those measured at QC15-1 and QC15-2 and ranged from 29,000 to 46,000 mg/kg. However, the trends for iron concentrations with depth were consistent with the trends observed at QC15-1 and QC15-2. Surface concentrations of aluminum (1,300 mg/kg) and manganese (232 mg/kg) are notably highest at QC15-3 and may reflect construction sand and materials imported to this location during dyke construction.

Tailings collected from the exposed beach in the southeast corner of Cell 15 (QC15-5) are characterized by a uniformly depressed pH (3.0 to 3.2) and increasing sulphide-S and iron concentrations with depth. These results are consistent with surface oxidation of the beached tailings and the downward migration of oxidation products. The near shore saturated tailings (QC15-4) are also characterized by depressed rinse pH values (3.3 to 4.8) and elevated sulphide-S concentrations ranging from 1.4 to 9.6%. The lowest rinse pH value was measured in the 20 to 30 cm section and the highest sulphide-S concentration in the 10 to 20 cm interval.

The NP contents measured in the samples collected from Cell 15 were low and ranged from 3.0 to 4.5 kg $CaCO_3$/t. The results for carbonate from the ABA analysis (**Table 5.1**) indicate that generally no NP was attributable to carbonate bearing minerals. It is likely that most, if not all, of the measured NP in the Quirke tailings is considered to be unavailable NP and, therefore, the tailings contain little to no effective neutralizing potential. The lack of effective neutralizing potential in the tailings is consistent with the use of sulphuric acid during the milling process to recover uranium.

5.2 Leach Testing

Shake flask tests were completed to estimate soluble concentrations of selected constituents in the tailings porewater. The soluble concentrations are presented as depth profiles in **Figure 5.2** and the values are summarized in **Table 5.2**. The values were calculated to units of mg of soluble constituent per kg of tailings or mg/kg.

Leachate from tailings samples collected along the north toe of Dyke 14 (QC15-1 and QC15-2) had pH values in the range of 3.0 to 6.1 and released between 27 and 116 mg/kg of acidity. Soluble sulphate concentrations ranged from 319 to 6,787 mg/kg and were highest in the QC15-2 surface layers.

Leachate pH values (4.5 to 4.8) and acidity concentrations (42 to 72 mg/kg) from the solids collected at the center toe of Dyke 14 (QC15-3) were generally consistent at all depths compared to trends from other sampling stations. Soluble sulphate ranged from 2,885 to 5,308 mg/kg, with the highest values measured at depth. The maximum soluble manganese concentration of 17 mg/kg from the surface tailings was consistent with the elevated manganese content of 232 mg/kg measured in the solids.

Leachate pH values were lowest (2.7 to 3.1) and soluble acidity concentrations were highest (70 to 191 mg/kg) in the samples collected from the exposed tailings at station QC15-5. Leachate pH values were moderately high (3.2 to 4.2) and soluble acidity concentrations lower (43 to 115 mg/kg) from the saturated tailings at station QC15-4 compared to those measured from samples at QC15-5. Concentrations of soluble iron and aluminum from the exposed tailings at QC15-5 were generally an order of magnitude higher than the soluble concentrations from other sampling stations (iron range = <0.04 to 0.64 mg/kg; aluminum range = <0.04 to 1.08 mg/kg).

In general, the trends among constituents and locations are generally consistent with sulphide oxidation, whereby samples that exhibited low pH values in the leachate also exhibited higher concentrations of acidity, iron and aluminum.

5.3 Basin Surface Water Samples

A summary of selected constituent concentrations in the basin water at each sampling station that had overlying water is provided in **Table 5.3**. The concentrations of selected constituents in the basin water were constant between sampling stations. Sulphate concentrations ranged from 570 to 600 mg/L. The iron and aluminum concentrations ranged from 0.06 to 0.16 mg/L and less than 0.01 to 0.02 mg/L, respectively. Manganese concentrations in the samples collected from Cell 15 ranged between 0.21 and 0.31 mg/L. Acidity values were calculated using the average pH value from routine monitoring from 2006 through 2009 and basin water data for aluminum, iron and manganese measured from the 2009 field campaign. Calculated acidity values ranged from 0.6 to 1.2 mg/L as $CaCO_3$.

6.0 ACIDITY IN CELL 15

The following section discusses the available acidity in the periodically exposed and unsaturated tailings and their potential to generate acidity. Acidity loads calculated from the shake flask test and on-going monitoring data are also discussed in this section.

6.1 Available Acidity in Periodically Exposed Tailings

It is clear from the results that the sulphidic tailings in Cell 15 may be a potential source of acidity loads to the Quirke TMA if they become unsaturated and exposed to the atmosphere. The results from the ABA and short-term leach testing at some locations in Cell 15 exhibited trends that were consistent with on-going sulphide oxidation. Specifically, the samples collected at QC15-5 and QC15-4 showed acidic pH values throughout the depth profiles as well as evidence of historic sulphide and iron depletion in the shallow tailings (**Figure 5.1**). These trends were reflected by elevated concentrations of soluble oxidation products, such as acidity, iron and aluminum, measured in the short-term leach tests (**Figure 5.2**). The soluble acidity concentrations at these locations showed that between 50 and 190 mg of acidity (as $CaCO_3$) per kg of tailings are in soluble form and may be available to be released into the basin water.

The results from QC15-1 and QC15-2 showed neutral to slightly acidic pH values with comparatively low sulphide and iron contents over the depth profile (**Figure 5.1**). These results imply that historic generation and releases of acidity prior to basin filling may have depleted the sulphide and iron at these locations. Even with lower sulphide concentrations measured in the solids, the acidity produced during short-term leach tests from the solids collected at the toe of Dyke 14 resulted in acidity concentrations between 30 and 115 mg/kg.

The average soluble acidity from all of the short-term leach tests was approximately 80 mg of acidity per kg of tailings.

6.2 Bathymetric Study in Cell 15

The water elevations in Cell 15 have been measured regularly since 1997 and are presented in **Figure 6.1** and tabulated in **Appendix 1**. Monitoring data have shown that water levels in Cell 15 fluctuate between 374.4 and 372.6 masl. The lowest recorded elevation of 372.6 masl occurred in April 2001 (**Figure 6.1**) and was a 1 in 50 year return drought event (Pers. Comm., Golder Associates, 2011). Since 2002, the water elevations have remained above 373.0 masl.

A bathymetric study in Cell 15 was conducted by Torrance Surveying Ltd. Cell 15 was divided into three separate Areas (A, B and C) as presented in **Figure 6.2**. The bathymetry data were used to determine the areas of tailings that would be potentially exposed at three selected water elevations including 373.0, 372.5 and 372.0 masl. These elevations were selected to reflect conditions 0.5 m above and 0.5 m below the 1 in 50 year return drought event observed between 2000 and 2001.

Figures 6.3 to 6.5 illustrate the locations of potentially exposed tailings. **Table 6.1** tabulates the areas of exposed tailings at the three water elevations for Areas A, B and C. The results show that at water elevations between 373.0 and 372.0 masl, the exposed tailings generally exist in the areas along the toe of Dyke 14 and the southwest corner of Cell 15. The total areas of exposed tailings were estimated to be approximately 37,800, 52,600 and 74,000 m^2 at water elevations of 373.0, 372.5 and 372.0 masl, respectively. The exposed tailings areas estimated for each of these elevations were used to estimate the potential acidity loads from the tailings to Cell 15 and to estimate the lime demand that could be required to neutralize the acidity loads.

6.3 Acidity Load and Lime Demand

Soluble acidity loads were calculated using the data from the short-term leach tests to estimate the maximum acidity load that could potentially be released from the periodically exposed tailings on an annual basis. Not all of the soluble acidity in the tailings will be released to the basin water each year. Some porewater may be flushed from the tailings as the water level increases and re-floods tailings after a dry, exposed period, but not all pore water will be displaced. It was conservatively assumed that the pore water to a maximum depth of 55 cm of tailings could be flushed annually, corresponding to the porewater above 372.5 masl. The annual acidity loads in tonnes of $CaCO_3$ per year from the tailings to the basin water are presented in **Table 6.2**. Calculations of annual acidity loads at water elevations of 373.0 and 372.5 masl were completed using the cut volumes of 9,322 and 31,606 m^3 for exposed tailings (**Table 6.1**). The cut volumes were used because they provide representative depths of about 20 to 55 cm for tailings above the specified water elevations that may potentially oxidize when exposed. The cut volume of 62,775 m^3 at a water elevation of 372.0 masl represented an average depth of about 85 cm and would not be representative of practical depths for oxidation in these wet tailings. Therefore the acidity load calculations were completed using the total area of exposed tailings times an effective flushing depth of 55 cm.

A maximum value of 55 cm was considered to be conservative because although some areas of tailings may be exposed at the surface, tailings below the surface will remain relatively saturated near the surface. This is especially true for tailings at the base of Dyke 14 where upstream seepage will maintain a degree of saturation that is likely much less than 55 cm below the tailings surface even when tailings are exposed.

Three soluble acidity values were considered for the acidity load calculations to provide a conservative range of potential acidity loads. The maximum soluble acidity value measured from the short-term leach tests was 190 mg/kg. The average leachable amount of acidity from QC15-4 and QC15-5, the two sampling stations most likely to have periodically exposed tailings, was 115 mg/kg. The average soluble acidity measured from all of the samples was 80 mg/kg.

Calculated acidity loads to Cell 15 from the periodically exposed tailings were converted to a lime equivalent and compared to the results to the total lime used at the Quirke TMA. The total areas of exposed tailings estimated from the bathymetric study along with the calculated acidity loads were used to estimate the annual lime demands for varying water elevations in Cell 15. The estimated lime demands are also presented in **Table 6.2**.

At a water elevation of 373.0 masl, the maximum estimated lime demand would be 1.3 tonnes of CaO per year. A water elevation of 372.5 masl would correspond to a maximum lime demand of be 4.4 tonnes of CaO per annum. If extreme drought conditions were to exist and if the water elevation in Cell 15 decreased to 372.0 masl, the maximum annual lime demand would be approximately 5.6 tonnes CaO per annum. Considering a more representative acidity concentration of 80 mg/kg, the annual lime demand would be 2.4 tonnes of CaO.

These estimates show that potential lime demands for a range of water elevations fall in a relatively small range of approximately 1 to 6 tonnes of CaO per year.

6.4 Influence of Acidity Loads on Quirke Operating Limits

The total amount of lime used annually for direct lime addition to the cells and that used at the Quirke ETP since 1997 are presented in **Table 6.3**. The total annual lime use at Quirke prior to 2001, including in-basin lime addition and lime used in the treatment plant, was between 1,093 and 1,524 tonnes of CaO per year. In 2001, the lime supply changed resulting in improved lime distribution and lime use accounting. Since 2001, the annual lime use at Quirke has ranged from 145 to 217 tonnes of CaO per year. The potential acidity loads from the periodically exposed tailings represent approximately 1 to 4% of the minimum annual lime use.

6.5 Basin Water pH and Acidity in Cell 15

Monitoring at the outflow from Cell 15 to Cell 16 has been on-going since 1995. Time-trend plots of routine monitoring at the outflow from Cell 15 to Cell 16 for pH and acidity are presented in **Figure 2.5**. The trends shown in **Figure 2.5** reflect important processes as well as water management activities that have occurred since flooding.

It is clear that there is a potential for acidity generation from periodically exposed tailings in Cell 15. However, time-trend plots for pH and acidity measured at the outflow of Cell 15 presented in **Figure 2.5** indicate that acidity concentrations have exhibited a decreasing trend since 2003 and that the periodically exposed tailings appear to have little influence on the basin water quality exiting Cell 15.

During mining operations and prior to flooding of the tailings, sulphide oxidation and acidity generation resulted in the accumulation of oxidation products in the tailings porewater. In 1994, when the basin began filling, flushing of historic oxidation products from the shallow tailings occurred and seepage from upstream cells to downstream cells was initiated. The elevated acidity concentrations observed shortly after flooding (1995 to 2002) are consistent with the expected flushing and seepage of historic oxidation products from the tailings porewater. Because acidic pH values occurred between 1995 and 2000, lime was periodically applied directly to Cell 15 to neutralize the water cover. The elevated pH values observed at that time were the result of direct lime addition. Since 2000, in-situ lime addition has not been required because the pH at the outflow of Cell 15 has remained near neutral. The neutral pH conditions are also reflected by low acidity concentrations. Since 2002, the acidity concentrations in Cell 15 have remained between less than the detection limit of 1 mg/L and 5 mg/L (**Figure 2.5**), with an overall average of 2 mg/L.

The recent trends in pH and acidity imply that acidity loads from the periodically exposed tailings represent little to no contributions of acidity to the basin water in Cell 15. Acidity concentrations in the outflow from Cell 15 have been decreasing since 2003 to values at the detection limit of 1 mg/L, suggesting that there are no important on-going acidity contributions to the basin water in Cell 15.

6.6 Water Balance and Lime Demands for Cells 14 and 15

Annual flow rates were calculated in order to develop a mass balance for acidity loads from Cells 14 and 15. The estimated flow rates are based on measured flows into and out of the Quirke basin as well as the estimated natural inputs to each cell. The results are presented in **Table 6.4**.

The annual flow rate for Cell 14 is dependent on the input from Gravel Pit Lake (Q-29) and the net natural input (NNI) from precipitation and runoff minus evaporation. The annual flow rate for Cell 15 is maintained by the inflow from Cell 14 and the NNI. The NNI for the TMA was estimated from the average annual outflow from the Quirke TMA at Cell 18 (Q-05) less the average annual input from Gravel Pit Lake (Q-29). The values used for the average annual flows from Gravel Pit Lake (Q-29) and Cell 18 (Q-05) represent the average measured flow rates from 2006 through 2009. Only the flow rates since 2006 were considered for this investigation to remain consistent with the Serpent River Watershed State of the Environment reporting cycle.

The NNI for Cells 14 and 15 were calculated as the fraction of the total NNI based on the percentage of the watershed each cell represents. The total flow rates for Cell 14 and Cell 15 were calculated as the total input to the Cell plus the respective NNI. Calculated annual flow rates for Cells 14 and 15 were approximately 1,600,000 and 1,800,000 m^3/yr, respectively (**Table 6.4**).

Acidity loads in terms of lime demand (i.e. tonnes of CaO per year) were calculated using the average flow rates and acidity data from the outflows of Cells 14 and 15 for the 2006 through 2009 time period. During that time, the average acidity concentrations in Cells 14 and 15 were 1 and 2 mg/L, respectively.

The cumulative lime demand for Cell 14 and Cell 15 are presented in **Table 6.5** together with the incremental lime demand for Cell 15. The lime demand for Cell 14 was 0.88 tonnes of CaO per year. The total lime demand for Cell 15 was 2.02 t/a (as CaO), with an incremental lime demand of 1.14 t/a (as CaO) that represents the difference between the acidity load entering and that leaving Cell 15.

The total annual average lime demand for Cell 14 represents about 1% of the minimum operating lime consumption rate of 145 tonnes per year. The incremental lime demand from Cell 15 of 1.14 t/a (as CaO) also represents approximately 1% of the minimum lime consumption rate. These results indicate that the lime demands for Cells 14 and 15 represent only a small fraction of the total acidity treated by the Quirke Treatment System.

These calculations also indicate that the actual acidity loads from the periodically exposed tailings are consistent with the minimum estimate of 1 t/a (as CaO) and that the maximum estimate of 6 t/a (as CaO) has not been observed in Cell 15 since 2001.

7.0 CONCLUSIONS

The objectives of this investigation were to estimate potential acidity loads from the periodically exposed tailings in Quirke Cell 15 and to determine whether or not the loads contribute important amounts of acidity to the TMA.

The results from the field sampling program and laboratory testing indicated that some of the periodically exposed tailings exhibit trends that are consistent with on-going sulphide oxidation and thus acid generation.

Estimated potential acidity loads, in terms of lime demand (i.e. tonnes of CaO per year), calculated from the areas of exposed tailings were in the range of 1 to 6 tonnes of CaO per annum and represent approximately 1 to 4% of the minimum operating lime use of 145 tonnes of CaO per year (2005 to 2009). These potential acidity loads indicate that periodic exposure of Cell 15 tailings would contribute little to no measureable acidity to the TMA.

Flow data together with on-going water quality monitoring data at the outflows of Cell 14 and Cell 15 were used to estimate acidity loads and lime demands. The estimated incremental lime demand for Cell 15 was about 1 tonne of CaO per year. The lime demands for Cells 14 and 15 each represented about 1% of the minimum operating lime consumption rate of 145 tonnes of CaO per year. These results indicate that the acidity loads to the Quirke TMA originating from Cell 15 have been very small.

Collectively, these results showed that the acidity load from Cell 15 is almost negligible and has little to no influence on the lime use for pH control at the Quirke TMA.

8.0 REFERENCES

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TABLES

Table 4.1: Data Quality Assessment Summary for Selected Constituents in Tailings Solids

Analysis	Units	Method Detection Limit	RPD Data Quality Objective	Sample ID Core09-QC15-4 (20-30)	Duplicate ID Core09-QC15-6 (0-10)	RPD (%) or AD	Sample ID Core09-QC15-2 (10-20)	Duplicate ID Core09-QC15-6 (10-20)	RPD (%) or AD	Average RPD or AD	Count
Acid Base Accounting											
Neutralization Potential	t $CaCO_3$/1000t	--	≤ 40%	3.0	4.0	29	3.3	3.5	6	17	2
Sulphide-Sulphur	%	0.1	≤ 40%	2.11	7.94	**116**	0.28	0.36	25	**71**	2
Metals											
Aluminum	mg/kg	1	≤ 40%	170	180	6	170	180	6	6	2
Iron	mg/kg	0.5	≤ 40%	54,000	66,000	20	4,200	4,400	5	12	2
Manganese	mg/kg	0.05	≤ 40%	0.48	0.56	15	0.31	0.43	32	24	2

Notes:

RPD - relative percent difference; is calculated for analytes with concentrations greater than or equal to five times the detection limit and should be less than or equal to 40%

AD - absolute difference; for samples having concentrations less than five times the detection limit, the difference between the sample and duplicate, or difference between the sample or duplicate and the detection limit if either the sample or duplicate analyte concentration is below detection limit; should not be greater then the detection limit

"--" Indicates method detection limit not applicable

Boldface type and shaded indicates that Data Quality Objective was not achieved

Table 4.2: Detailed Data Quality Assessment for Constituents in Supernatant Water from Shake Flask Tests

Analysis	Units	Method Detection Limit	RPD Data Quality Objective	Sample ID Core09-QC15-2 (10-20)	Replicate ID Core09-QC15-6 (10-20)	RPD (%) or AD	Sample ID Core09-QC15-4 (10-20)	Replicate ID Core09-QC15-6 (20-30)	RPD (%) or AD	Average RPD or AD	Count
Conventional Parameters											
Acidity (as $CaCO_3$)	mg/L	2	≤ 40%	13	41	**104**	30	27	11	34	2
Sulphate	mg/L	0.2	≤ 40%	1500	1200	22	48	48	0	11	2
Metals											
Aluminum	mg/L	0.01	≤ 40%	<0.01	0.05	BD	0.28	0.32	13	13	1
Iron	mg/L	0.01	≤ 40%	0.02	0.05	0.03	0.09	0.20	**76**	38	2
Manganese	mg/L	0.00001	≤ 40%	0.0311	0.0299	4	0.0274	0.0261	5	4	2

Notes:

RPD - relative percent difference; is calculated for analytes with concentrations greater than or equal to five times the detection limit and should be less than or equal to 40%

AD - absolute difference; for samples having concentrations less than five times the detection limit, the difference between the sample and duplicate, or difference between the sample or duplicate and the detection limit if either the sample or duplicate analyte concentration is below detection limit; should not be greater then the detection limit

Boldface type and shaded indicates that Data Quality Objective was not achieved

Table 4.3: Detailed Data Quality Assessment for Constituents in the Blank Sample

Analysis	Units	Detection Limit	Data Quality Objective	Blank
Convential Parameters				
Acidity (as $CaCO_3$)	mg/L	2	4	**6**
Sulphate (SO_4)	mg/L	0.1	0.2	**0.6**
Metals				
Aluminum (Al)	mg/L	0.01	0.02	<0.01
Iron (Fe)	mg/L	0.01	0.02	<0.01
Manganese (Mn)	mg/L	0.00001	0.00002	**0.00049**

Notes:

Boldface type and shaded indicates that Data Quality Objective was not achieved

Table 4.4: Basin Water pH and Acidity Values in Cell 15 Samples in September 2009

Sample ID	pH (pH units)	Acidity (mg/L as $CaCO_3$)
Average at Cell 15 Outflow	**6.8**	**2**
Count	13	13
SW09-QC15-1	3.9	22
SW09-QC15-2	4.3	27
SW09-QC15-3	3.7	44
SW09-QC15-4	3.4	50

Notes:
SW - Basin water
Average calculated from routine monitoring data from 2006 through 2009

Table 5.1: Summary of Selected ABA and Metals Results for Tailings Solids

Sample ID	Rinse pH	Neutralization Potential	Acid Potential	NP/AP	Sulphide-Sulphur	Carbonate (CO_3)	Iron	Aluminum	Manganese
	pH units	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	--	(%)	(%)	(mg/kg)	(mg/kg)	(mg/kg)
CORE 09-QC-15-1 (0-10)	5.90	4.5	10.9	0.41	0.35	<0.005	13,000	710	12
CORE 09-QC-15-1 (10-20)	6.15	3.4	7.12	0.48	0.23	<0.005	3,300	500	2.6
CORE 09-QC-15-1 (20-30)	5.93	4.0	9.59	0.42	0.31	<0.005	4,100	830	2.3
CORE 09-QC-15-1 (30-40)	5.46	3.1	9.69	0.32	0.31	<0.005	4,000	260	1.9
CORE 09-QC-15-2 (0-10)	6.31	3.9	3.32	1.17	0.11	<0.005	17,000	330	11
CORE 09-QC-15-2 (10-20)	6.06	3.5	8.84	0.40	0.28	<0.005	4,400	180	0.43
CORE 09-QC-15-2 (20-30)	5.83	3.3	15.3	0.22	0.49	<0.005	5,700	150	0.14
CORE 09-QC-15-2 (30-40)	5.00	3.3	25.7	0.13	0.82	<0.005	9,600	170	0.47
CORE 09-QC-15-3 (0-10)	4.54	3.2	56.5	0.06	1.81	0.014	46,000	1,300	232
CORE 09-QC-15-3 (10-20)	4.20	3.2	140	0.02	4.50	<0.005	36,000	180	4.1
CORE 09-QC-15-3 (20-30)	4.67	3.7	83.5	0.04	2.67	<0.005	32,000	140	0.53
CORE 09-QC-15-3 (30-40)	4.86	3.6	86.8	0.04	2.78	<0.005	29,000	150	0.47
CORE 09-QC-15-4 (0-10)	4.76	4.1	44.1	0.09	1.41	<0.005	36,000	200	4.5
CORE 09-QC-15-4 (10-20)	4.16	3.4	300	0.01	9.60	<0.005	63,000	160	0.60
CORE 09-QC-15-4 (20-30)	3.25	3.0	66.1	0.05	2.11	<0.005	54,000	170	0.48
CORE 09-QC-15-4 (30-40)	4.03	3.2	172	0.02	5.50	<0.005	94,000	190	0.73
CORE 09-QC-15-5 (0-10)	3.04	4.0	13.8	0.29	0.44	<0.005	6,400	150	1.9
CORE 09-QC-15-5 (10-20)	3.14	4.1	138	0.03	4.41	<0.005	59,000	140	0.50
CORE 09-QC-15-5 (20-30)	3.16	3.3	99.9	0.03	3.20	<0.005	60,000	150	0.69
CORE 09-QC-15-5 (30-40)	3.10	4.3	168	0.03	5.38	<0.005	110,000	170	1.1
CORE 09-QC-15-5 (40-50)	3.09	4.2	290	0.01	9.29	<0.005	110,000	170	1.1

Notes:
"--" denotes parameter does not have units

Table 5.2: Summary of Selected Soluble Constituent Concentrations

Sample ID	pH	Acidity	Sulphate	Iron	Aluminum	Manganese
	pH units	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Core09-QC15-1 (0-10)	5.20	42	421	0.37	0.05	0.92
Core09-QC15-1 (10-20)	2.95	116	319	0.09	0.56	0.16
Core09-QC15-1 (20-30)	6.06	67	544	<0.04	0.29	0.12
Core09-QC15-1 (30-40)	4.95	49	2,775	0.08	0.08	0.09
Core09-QC15-2 (0-10)	6.08	27	6,787	<0.05	<0.05	0.66
Core09-QC15-2 (10-20)	5.33	52	6,040	0.08	<0.04	0.13
Core09-QC15-2 (20-30)	4.84	60	372	0.08	0.20	0.11
Core09-QC15-2 (30-40)	3.51	76	1,042	0.12	0.52	0.18
Core09-QC15-3 (0-10)	4.78	44	2,885	<0.05	<0.05	17
Core09-QC15-3 (10-20)	4.81	72	3,765	0.04	<0.04	0.74
Core09-QC15-3 (20-30)	4.45	48	5,220	<0.04	<0.04	0.24
Core09-QC15-3 (30-40)	4.74	42	5,308	<0.04	0.04	0.16
Core09-QC15-4 (0-10)	4.23	43	295	0.09	0.09	0.83
Core09-QC15-4 (10-20)	3.17	115	185	0.35	1.08	0.11
Core09-QC15-4 (20-30)	3.19	102	173	0.64	0.68	0.09
Core09-QC15-4 (30-40)	3.17	45	134	0.48	0.22	0.07
Core09-QC15-5 (0-10)	2.71	151	219	3.54	7.01	0.58
Core09-QC15-5 (10-20)	2.96	139	127	25.0	3.50	0.28
Core09-QC15-5 (20-30)	3.14	170	158	43.3	3.62	0.39
Core09-QC15-5 (30-40)	2.94	70	136	37.5	2.68	0.34
Core09-QC15-5 (40-50)	2.93	191	153	42.6	2.09	0.35

Notes:
mg/kg - mg of soluble constituent per kg of tailings

Table 5.3: Summary of Selected Constituent Concentrations in Basin Water in Cell 15

Parameter	Units	SW09 QC15-1	SW09 QC15-2	SW09 QC15-3	SW09 QC15-4
Acidity (as $CaCO_3$)[a]	mg/L	0.7	0.6	0.9	1.2
Sulphate	mg/L	570	570	570	600
Iron	mg/L	0.10	0.06	0.16	0.18
Aluminum	mg/L	<0.01	<0.01	<0.01	0.02
Manganese	mg/L	0.207	0.214	0.214	0.310

Notes:
SW - Basin water
[a] Acidity calculated from the average routine monitoring pH value and iron, aluminum and manganese concentrations
Auminum concentrations that were reported as less than the detection were assumed to be equal to 0.01 mg/L.
Average routine monitoring pH value was calculated for the 2005 through 2009 time period.

Table 6.1: Estimated Areas and Cut Volumes of Potentially Exposed Tailings

Water Elevation (masl)	Area	Average Area (m^2)[a]	Total Area (m^2)	Cut Volume (m^3)	Total Cut Volume (m^3)
373.0	A	22,266	37,772	3,873	9,322
	B	350		37	
	C	15,156		5,412	
372.5	A	35,890	52,591	18,126	31,606
	B	1,524		479	
	C	15,178		13,001	
372.0	A	55,458	74,023	40,527	62,775
	B	3,387		1,659	
	C	15,178		20,589	

Notes:

Data Provided by Torrence Surveying

[a] Represent the average of area calculated using donut area and rectangle area methods

Table 6.2: Potential Annual Acidity Loads from Periodically Exposed Tailings

Concentration of Acidity	Annual Acidity Load	Annual Lime Demand
(mg/kg as $CaCO_3$)	(t-$CaCO_3$/a)	(t-CaO/a)
Water Elevation of 373.0 m[a]		
190	2.30	1.29
115	1.39	0.78
80	0.97	0.54
Water Elevation of 372.5 m[b]		
190	7.81	4.37
115	4.73	2.65
80	3.29	1.84
Water Elevation of 372.0 m[b]		
190	10.06	5.63
115	6.09	3.41
80	4.23	2.37

Notes:

[a] Calculated from Total Cut Volume (Table 6.1)

[b] Calculated from Total Area (Table 6.1) times assumed flushing depth of 0.5 m

Bulk density is equal to 1,300 kg/m^3 (Golder, 1991)

Areas and Cut Volumes provided by Torrence Surveying

Table 6.3: Total Annual Lime Use at the Quirke Effluent Treatment Plant

Year	Lime Use (tonnes - CaO)						
	Cell 15	Cell 16 S	Cell 16 N	Cell 17	Cell 18	Quirke ETP	Total
1997	115	728	0	129	45	76	1,093
1998	62	799	0	214	97	53	1,225
1999	58	1,198	0	206	0	63	1,524
2000	28	933	0	149	0	84	1,194
2001	0	118	0	32	0	67	217
2002	0	93	0	19	0	91	203
2003	0	135	0	25	0	56	216
2004	0	150	0	16	0	42	208
2005	0	107	0	7	0	36	151
2006	0	46	48	5	0	47	145
2007	0	85	47	6	0	46	184
2008	0	54	89	5	0	42	190
2009	0	54	62	4	0	37	157

Notes:

Lime supply changed in 2001 resulting in improved lime distribution and accounting

No in basin lime addition to Cell 15 required since 2000 because of near neutral basin water

Lime is not added to Cell 18 to maintain an influent pH of 5.0 to the Quirke Effluent Treatment Plant

Table 6.4: Water Balance Calculations for Cell 14 and Cell 15 Watersheds

Annual Flow (m^3/year)			Surface Area (ha)			Annual Flow (m^3/year)			
Q-29[a]	Q-05[b]	Natural TMA Flow Q-05 to Q-29	TMA Watershed	Cell 14 Watershed	Cell 15 Watershed	Cell 14 NNI[c]	Cell 14 Total Flow	Cell 15 NNI[c]	Cell 15 Total Flow
1,053,077	2,786,883	1,733,806	292	86	40	510,641	1,563,718	237,508	1,801,226

Notes:

[a] Q-29 represents average inflow from Gravel Pit Lake for the 2006 through 2009 time period

[b] Q-05 represents average outflow from Cell 18 for the 2006 through 2009 time period

[c] NNI = Net Natural Input (Precipitation + Runoff - Evaporation)

Surface Area values from CCL (1999)

Table 6.5: Acidity Loadings for Cell 14 and Cell 15 from Routine Basin Water Monitoring Data

Acidity Concentration Measure in Surface Water		Acidity Load (tonnes-CaO/a)	Incremental Acidity Load (tonnes-CaO/a)
Cell 14			
[a]Average	1	0.88	0.88
Count	15	--	--
Cell 15			
[a]Average	2	2.02	1.14
Count	13	--	--

Notes:
[a] Average for 2006 through 2009 period
Flow values from Table 6.4 used to calculate Loads

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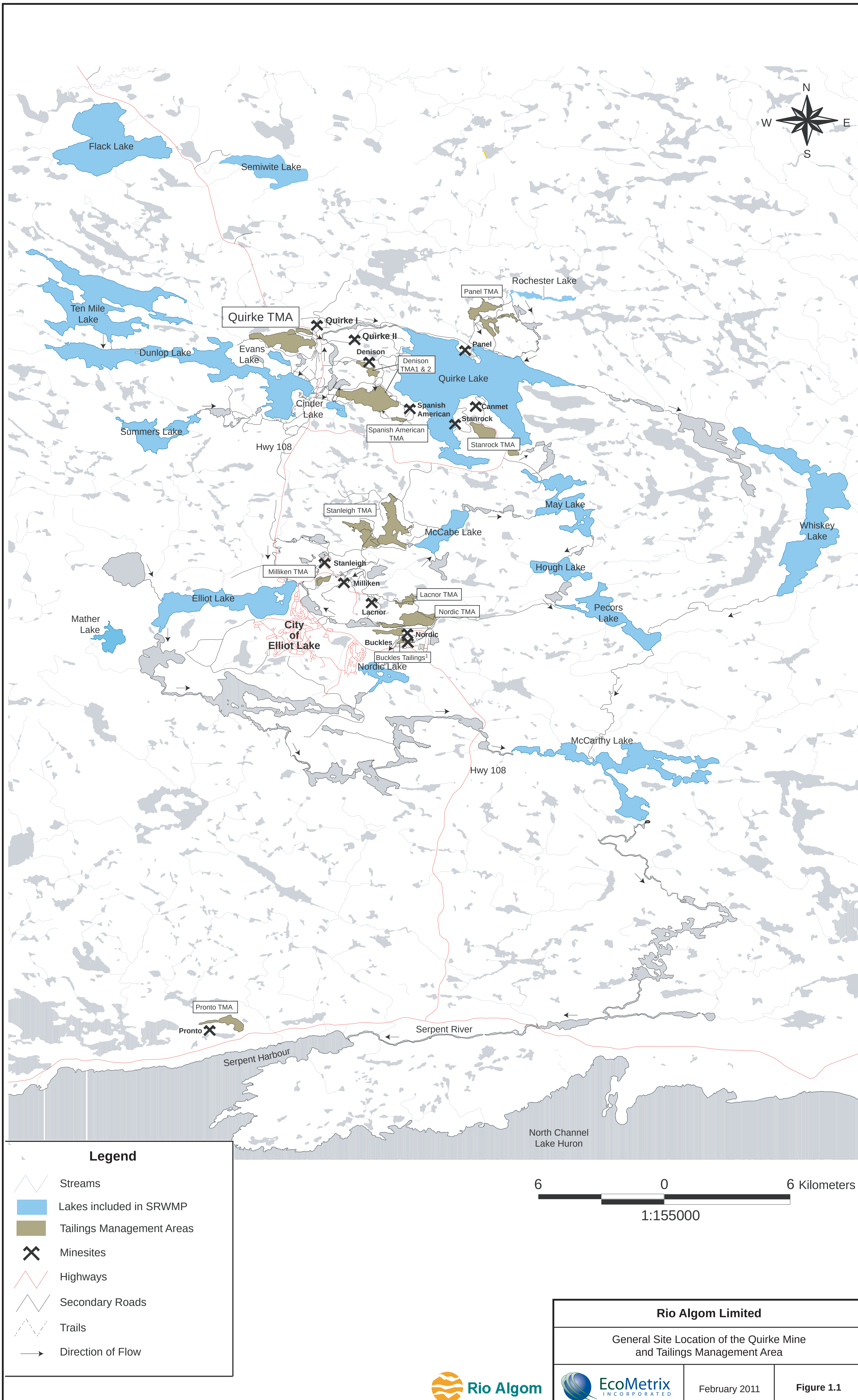
FIGURES



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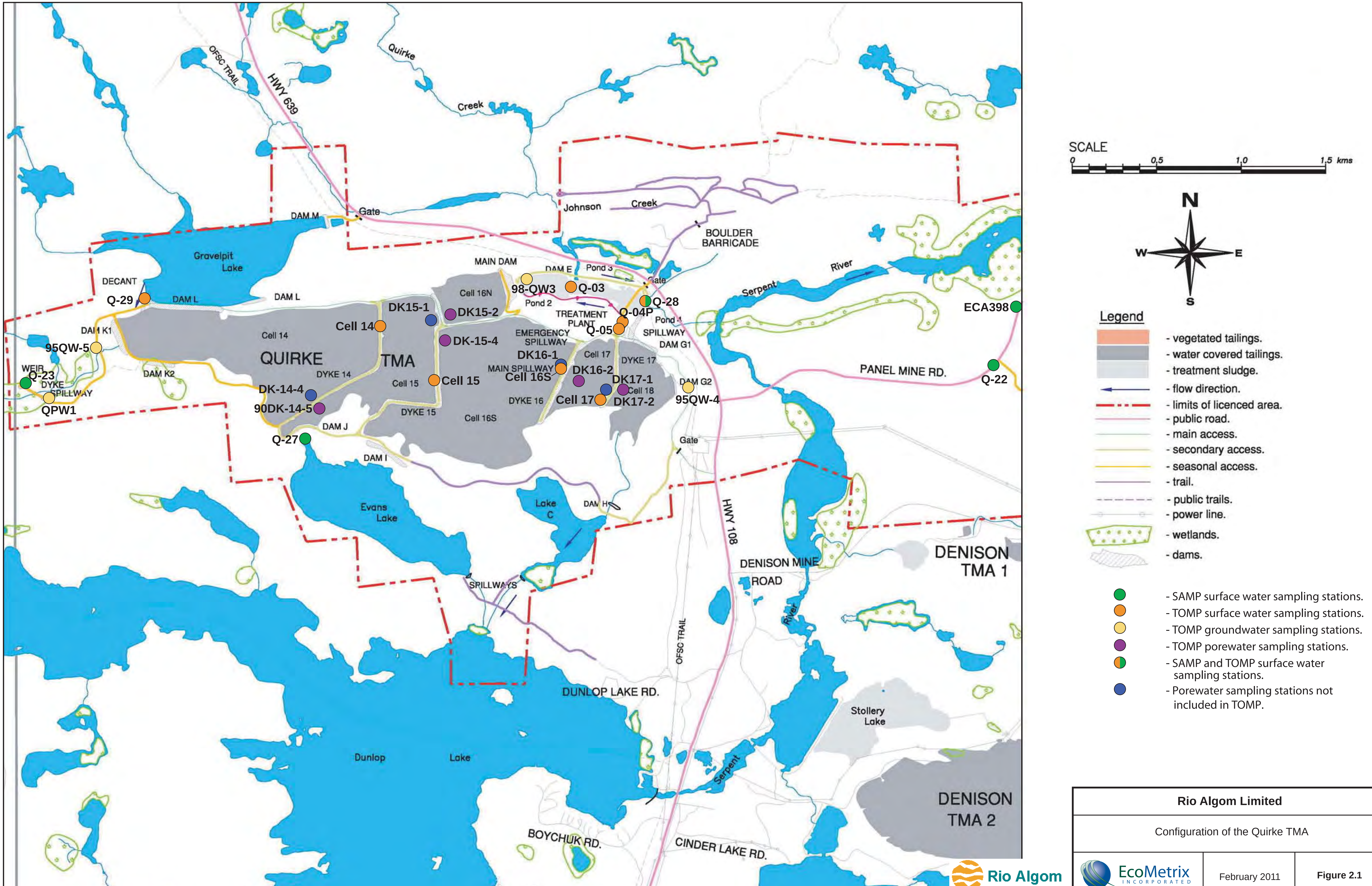
General Site Location of the Quirke Mine and Tailings Management Area

February 2011

Figure 1.1



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Configuration of the Quirke TMA

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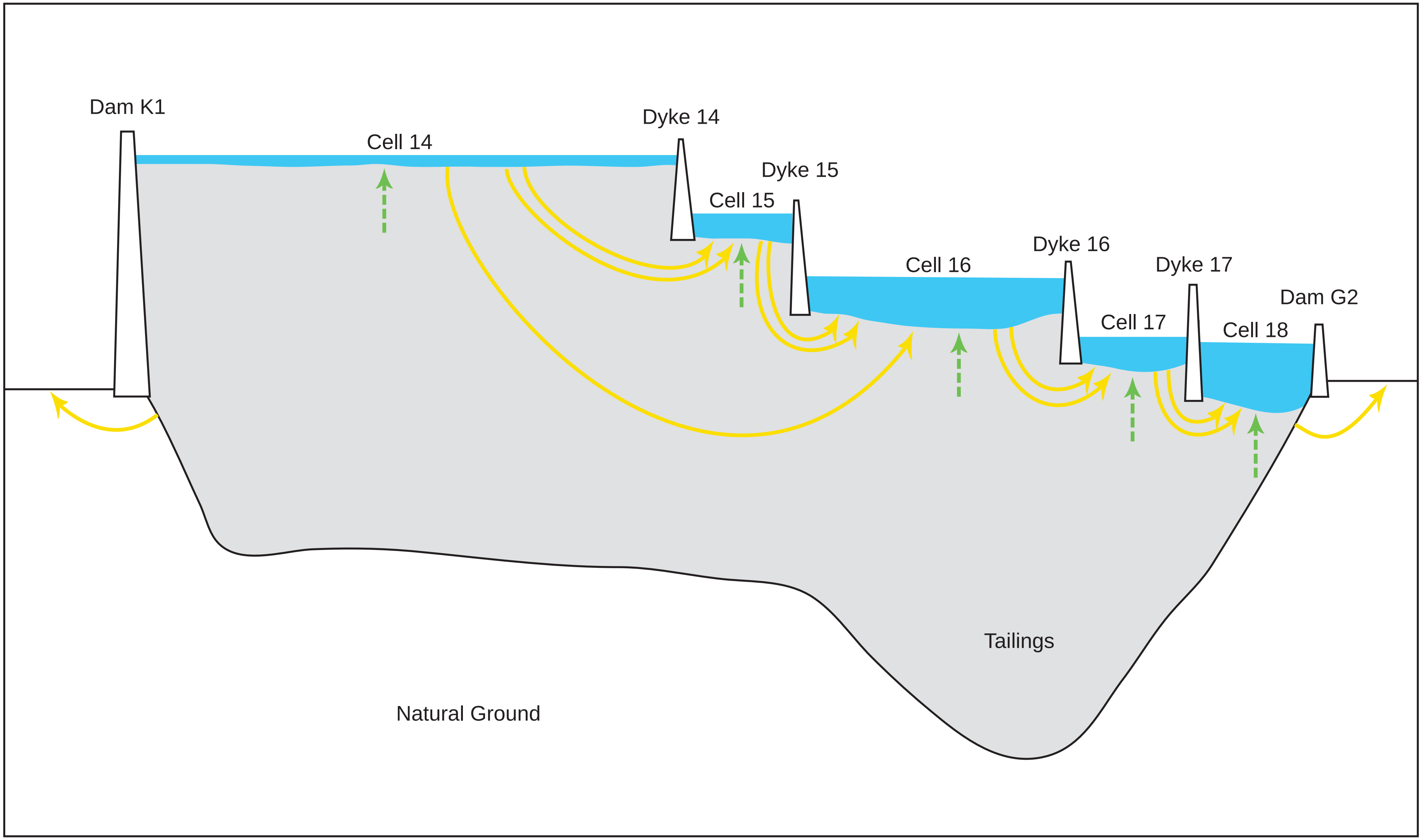

Tailings
Water
Seepage
Diffusion

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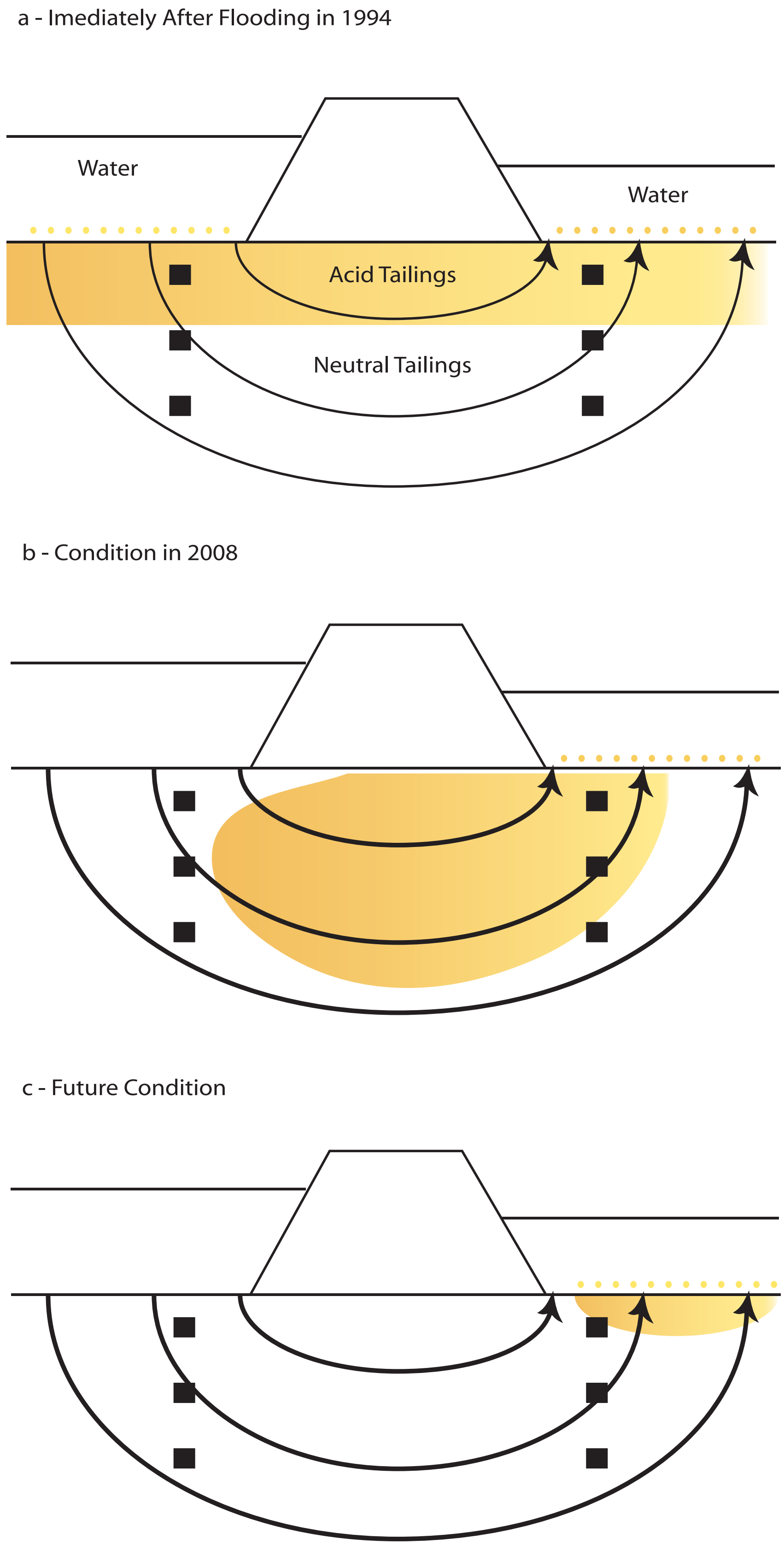
Schematic Cross-section Flow Conditions in the Flooded Tailings at the Quirke TMA		
EcoMetrix INCORPORATED	February 2011	**Figure 2.2**



Acidic High Iron Water

Monitoring Well Screens

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Schematic Cross-section with Detailed Acidity Flow Below Dykes at the Qurike TMA

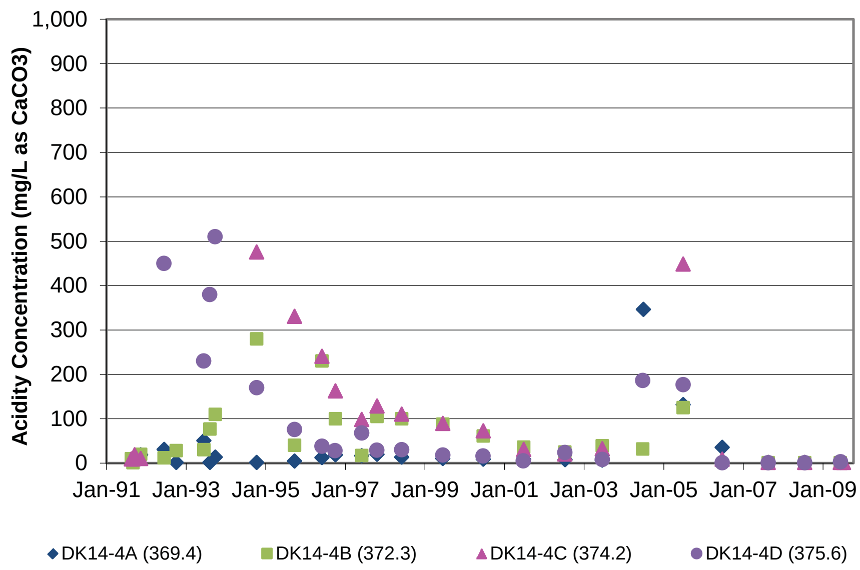
February 2011

Figure 2.3

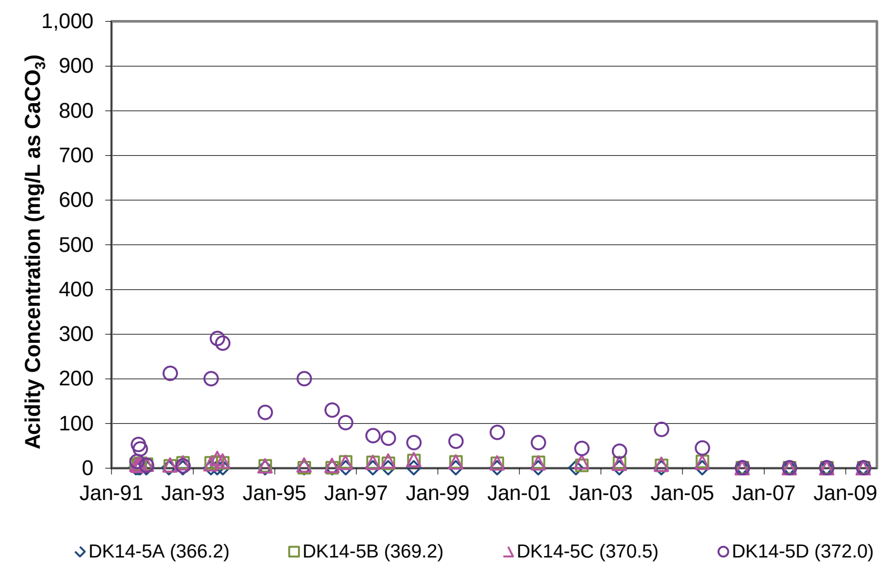
PIEZOMETERS UP-GRADIENT OF DYKES

PIEZOMETERS DOWN-GRADIENT OF DYKES

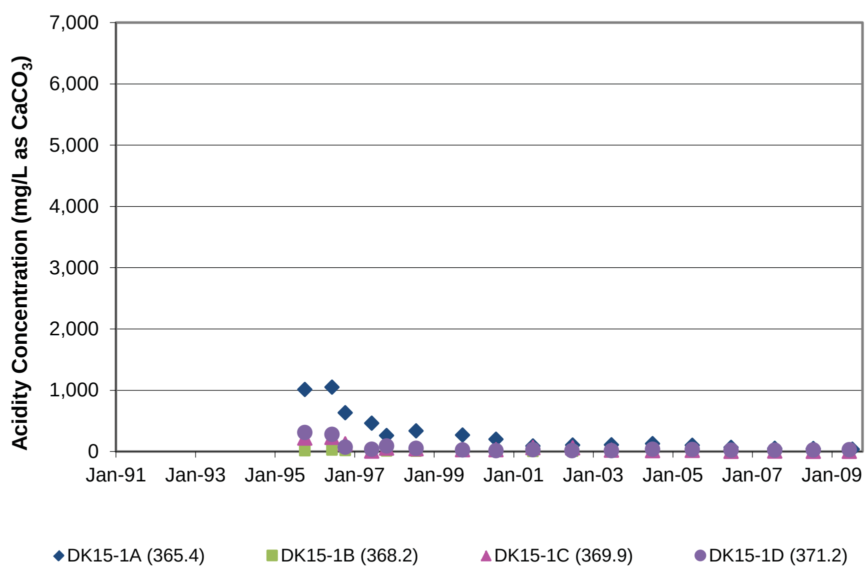
DK14-4



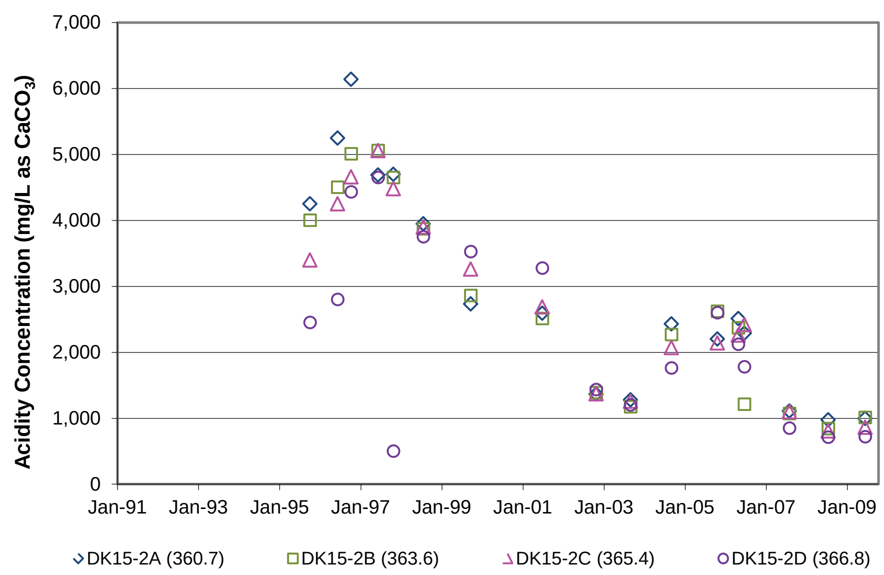
DK14-5



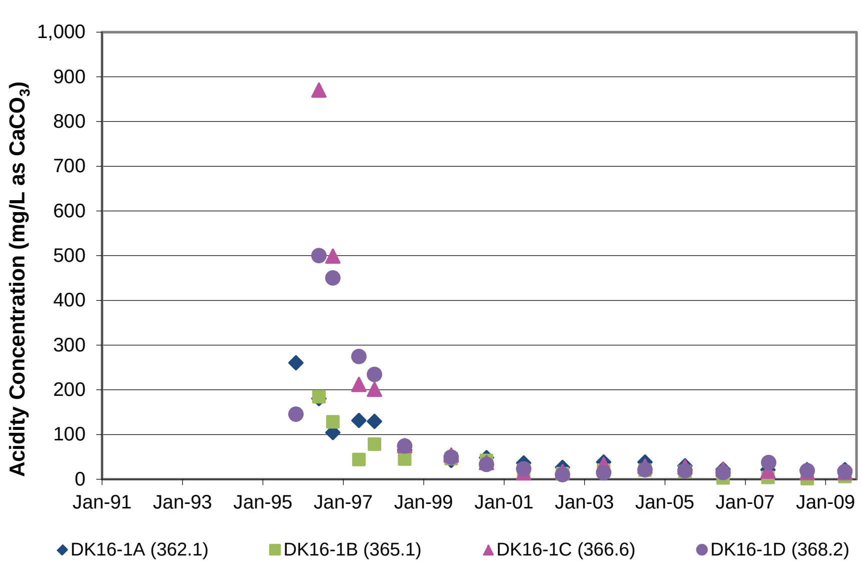
DK15-1



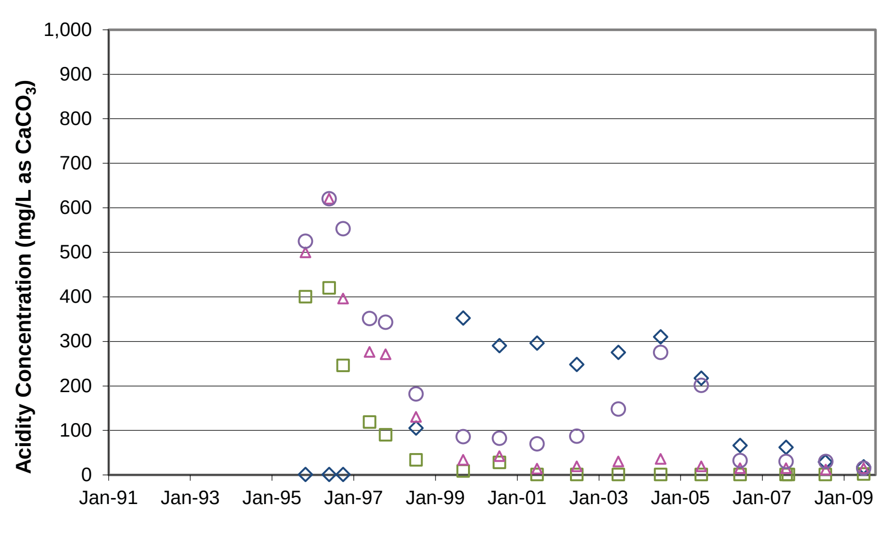
DK15-2



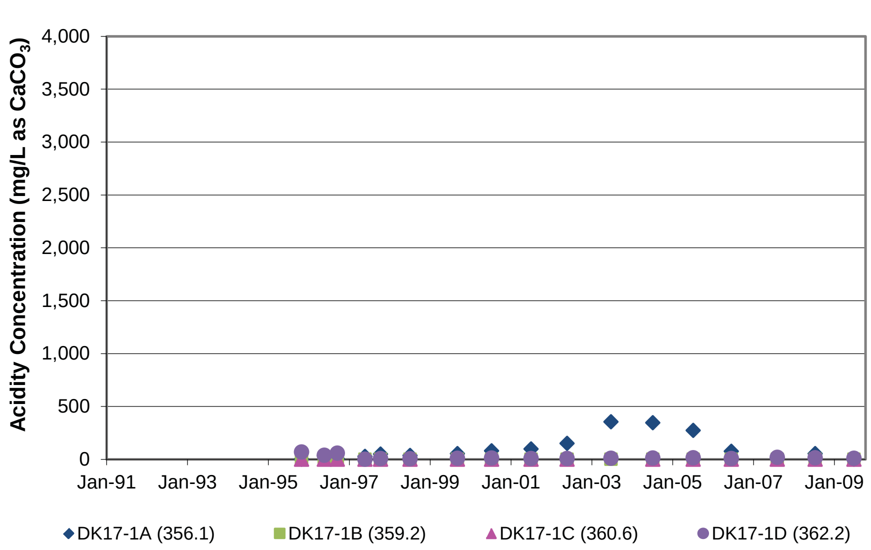
DK16-1



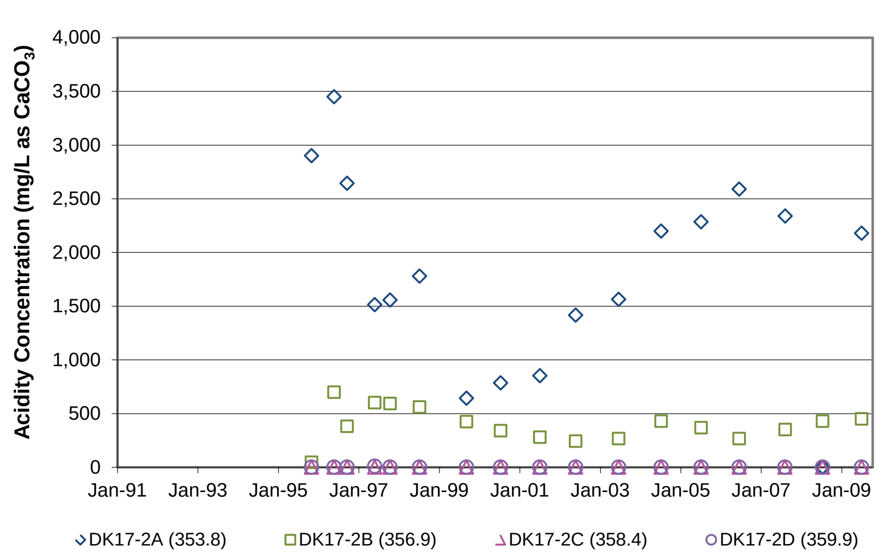
DK16-2



DK17-1



DK17-2



Notes: Some data for DK14-4 prior to 1994 are not shown
Some data for DK16-1 prior to 1996 are not shown

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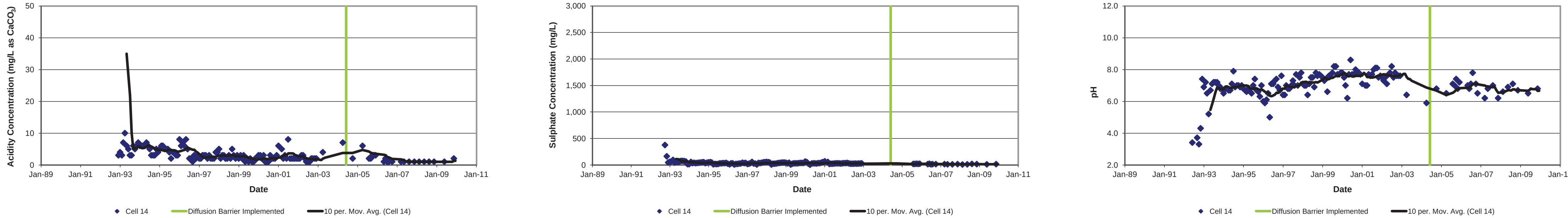
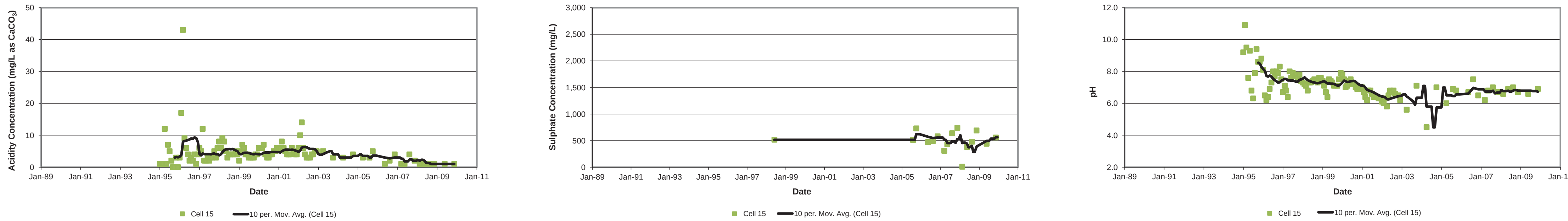
Time-Trend Plots of Acidity Concentrations in Porewater at the Quirke TMA		
EcoMetrix INCORPORATED	February 2011	**Figure 2.4**

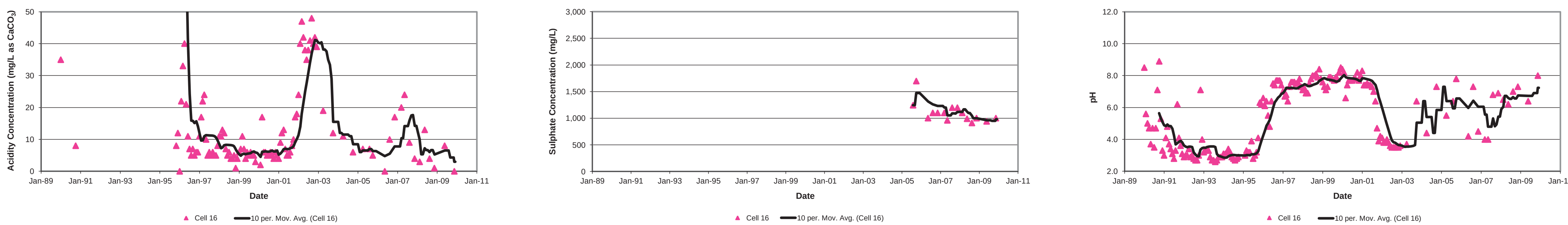
a) Cell 14 Outflow



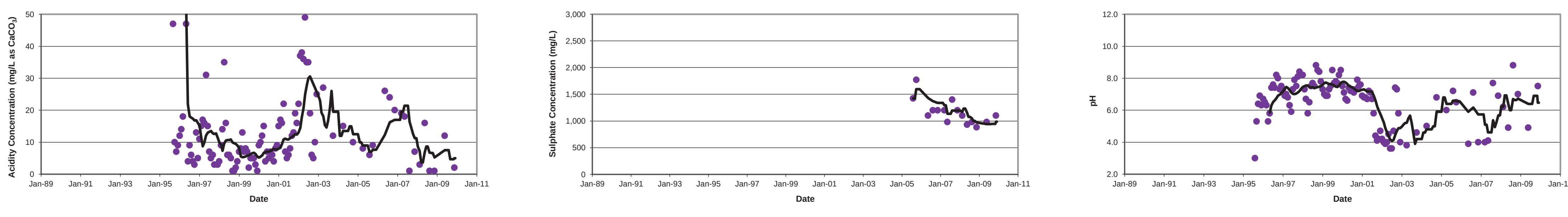
b) Cell 15 Outflow



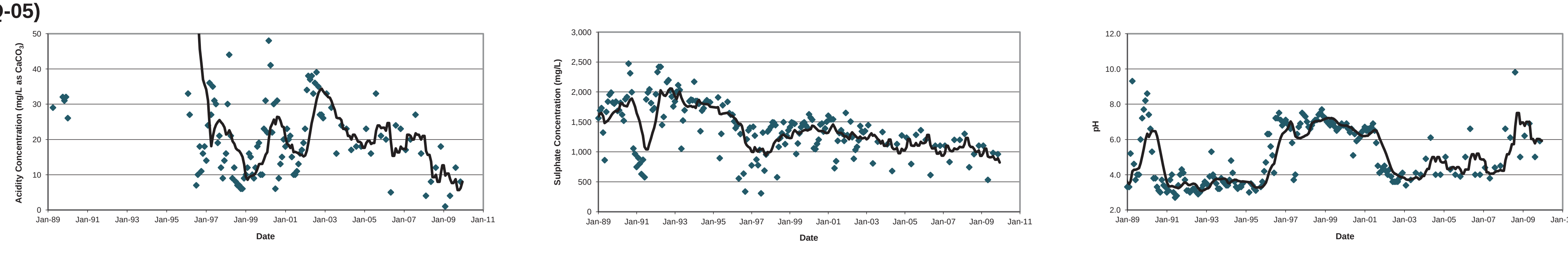
c) Cell 16 Outflow



d) Cell 17 Outflow



e) Cell 18 Outflow to ETP (Q-05)



Note: Some data prior to 1996 are not shown

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Rio Algom Limited		
Routine Monitoring Data for Selected Constituents from the Quirke TMA		
EcoMetrix INCORPORATED	February 2011	**Figure 2.5**

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Quirke Cell 15 Sampling Stations

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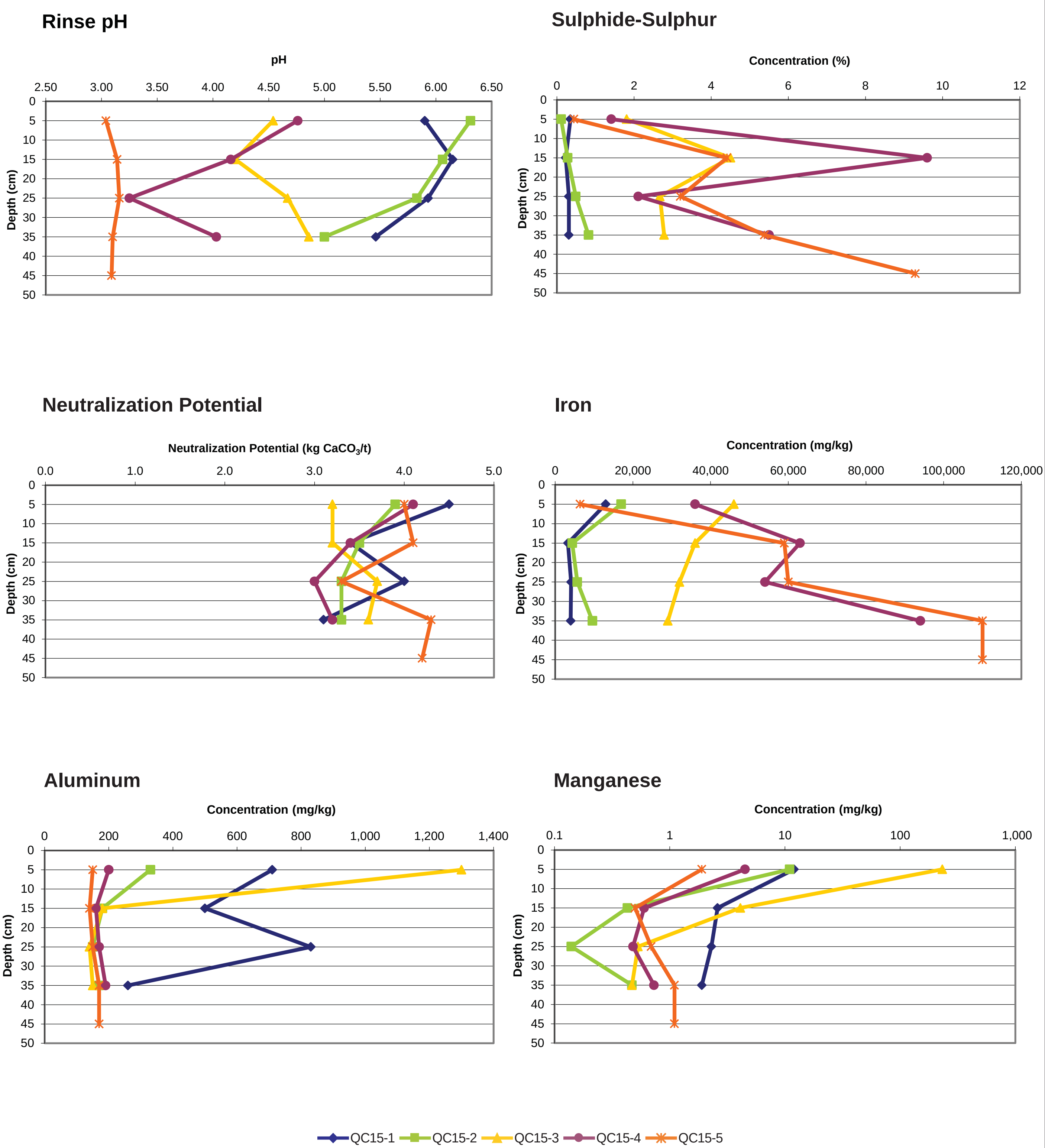
Figure 3.1



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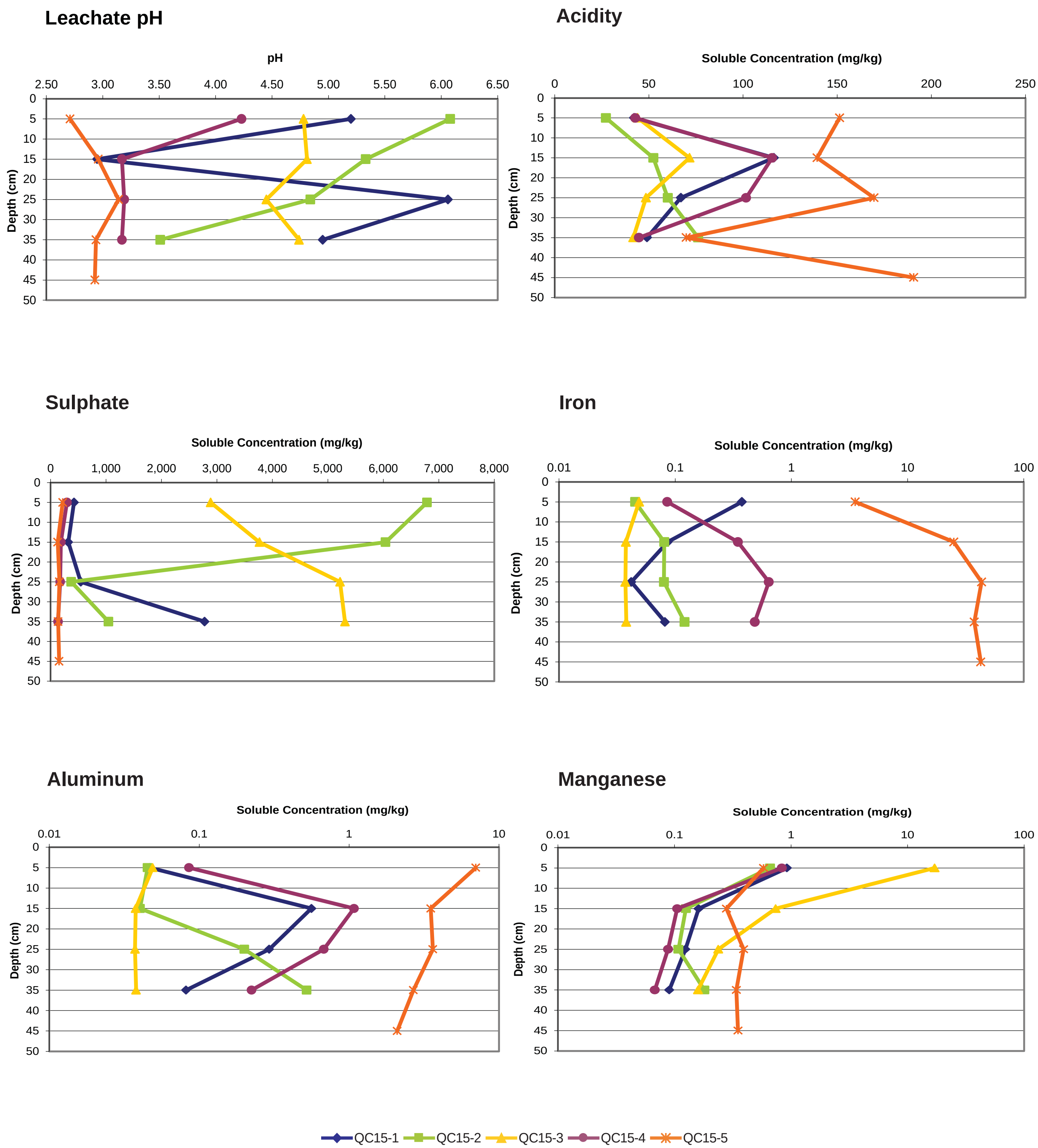
Depth Profiles for Selected Constituents in Tailings Soilds

Rio Algom | EcoMetrix INCORPORATED | February 2011 | **Figure 5.1**



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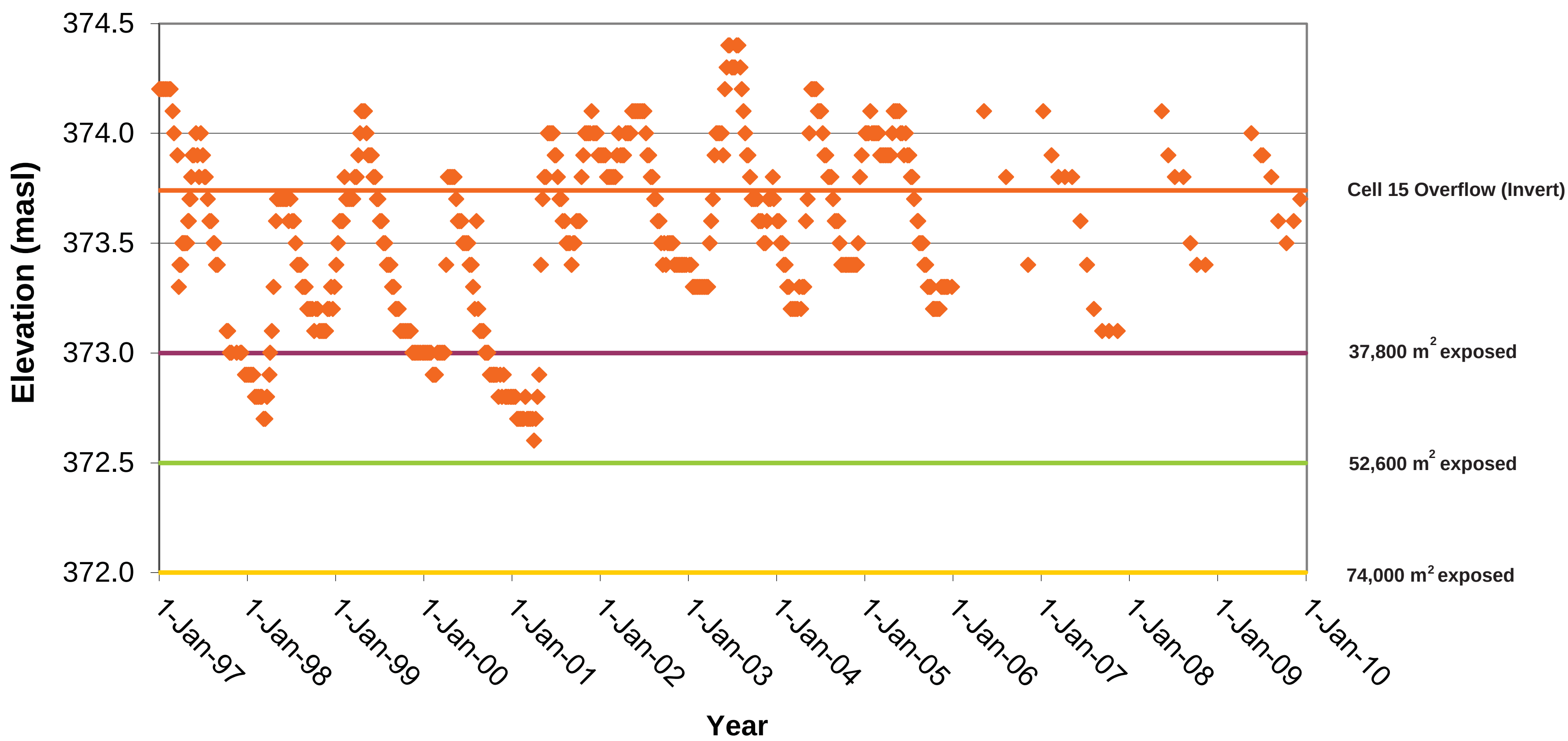
Depth Profiles for Selected Soluble Constituents

Rio Algom | EcoMetrix INCORPORATED | February 2011 | **Figure 5.2**



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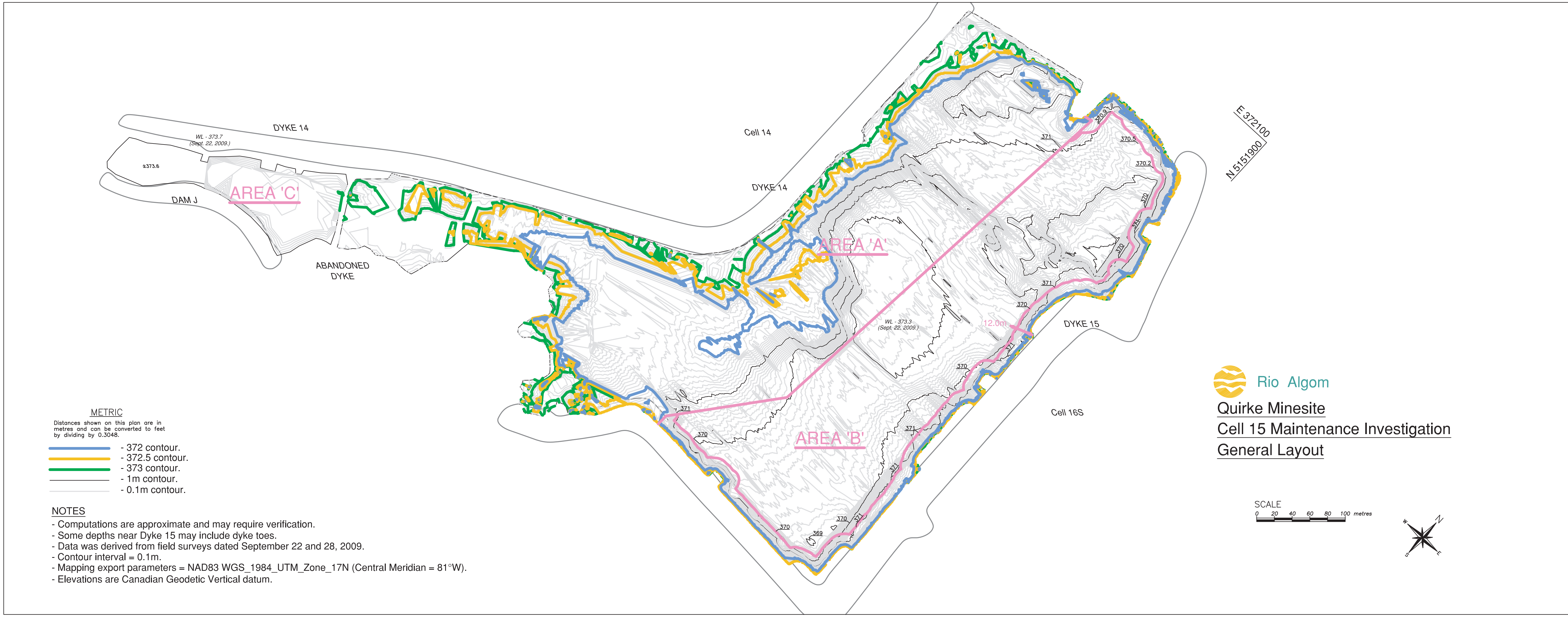
Rio Algom Limited		
Time-Trend Plot for Water Elevations in Cell 15		
EcoMetrix INCORPORATED	February 2011	**Figure 6.1**



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torrance@inorth.on.ca

PLAN	DATE	REFERENCE
Ebenau	October 6, 2009	205-018

2005\205-018\quirke\2009\Cell 15\sound (2000)

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Areas A, B and C Surveyed in the Bathymetric Study

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Figure 6.2

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Quirke Minesite
Cell 15 Maintenance Investigation
Contour Elevation 373

SCALE 0 10 20 30 40 50 metres

METRIC
Distances shown on this plan are in metres and can be converted to feet by dividing by 0.3048.

- 1.0 - Estimated depths.
- 0m cut - limit of computaion.
- 0.1 contour interval.
- 1.0 contour interval.
- Areas below grade.
- Exposed Tailings

NOTES
- Computations are approximate and may require verification.
- Some depths near Dyke 15 may include dyke toes.
- Data was derived from field surveys dated September 22 and 28, 2009.
- Contour interval = 0.1m.
- Mapping export parameters = NAD83 WGS_1984_UTM_Zone_17N (Central Meridian = 81°W).
- Elevations are Canadian Geodetic Vertical datum.

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PLAN	DATE	REFERENCE
Ebenau	October 6, 2009	205-018

2005\205-018\quirke\2009\Cell 15\sound (373)

Rio Algom

Rio Algom Limited

Estimated Area of Exposed Tailings at Water Elevation 373.0 masl

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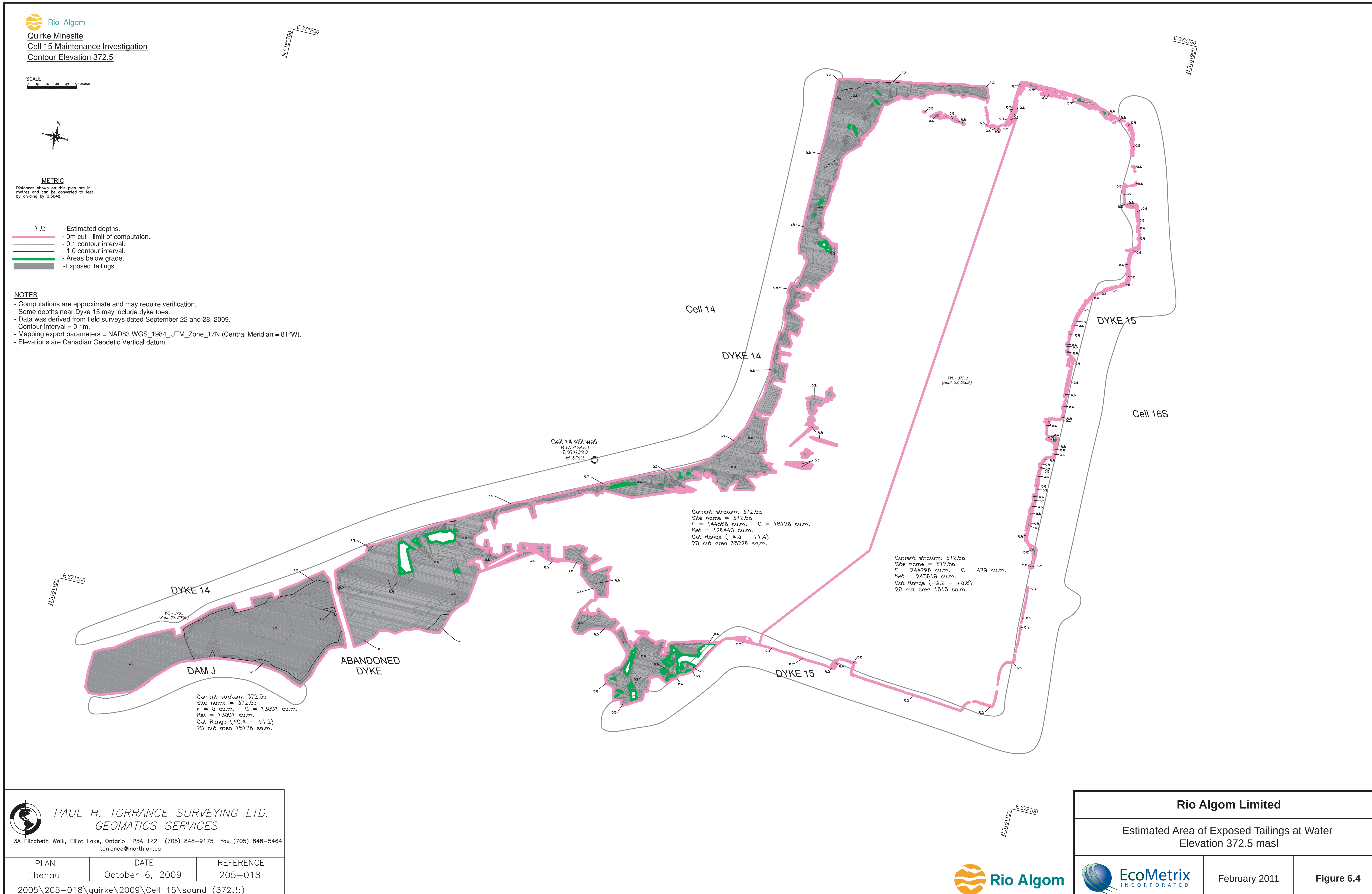
Figure 6.3


Rio Algom
Quirke Minesite
Cell 15 Maintenance Investigation
Contour Elevation 372.5
SCALE
METRIC
Distances shown on this plan are in metres and can be converted to feet by dividing by 0.3048.
1.0 - Estimated depths.
- 0m cut - limit of computaion.
- 0.1 contour interval.
- 1.0 contour interval.
- Areas below grade.
-Exposed Tailings
NOTES
- Computations are approximate and may require verification.
- Some depths near Dyke 15 may include dyke toes.
- Data was derived from field surveys dated September 22 and 28, 2009.
- Contour interval = 0.1m.
- Mapping export parameters = NAD83 WGS_1984_UTM_Zone_17N (Central Meridian = 81°W).
- Elevations are Canadian Geodetic Vertical datum.
Cell 14
DYKE 14
DYKE 15
Cell 16S
DAM J
ABANDONED DYKE
Cell 14 still well
N 5151345.7
E 371602.3
El 378.3
E 371200
N 5151700
E 372100
N 5151900
E 371100
N 5151100
N 5151100
E 372100
WL - 373.3 (Sept. 22, 2009.)
WL - 373.7 (Sept. 22, 2009.)
Current stratum: 372.5a
Site name = 372.5a
F = 144566 cu.m. C = 18126 cu.m.
Net = 126440 cu.m.
Cut Range (-4.0 - +1.4)
2D cut area 35226 sq.m.
Current stratum: 372.5b
Site name = 372.5b
F = 244298 cu.m. C = 479 cu.m.
Net = 243819 cu.m.
Cut Range (-9.2 - +0.8)
2D cut area 1515 sq.m.
Current stratum: 372.5c
Site name = 372.5c
F = 0 cu.m. C = 13001 cu.m.
Net = 13001 cu.m.
Cut Range (+0.4 - +1.2)
2D cut area 15178 sq.m.
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torrance@inorth.on.ca
PLAN Ebenau
DATE October 6, 2009
REFERENCE 205-018
2005\205-018\quirke\2009\Cell 15\sound (372.5)
Rio Algom
Rio Algom Limited
Estimated Area of Exposed Tailings at Water Elevation 372.5 masl
EcoMetrix INCORPORATED
February 2011
Figure 6.4

Rio Algom

Quirke Minesite

Cell 15 Maintenance Investigation

Contour Elevation 372

SCALE 0 10 20 30 40 50 metres

METRIC

Distances shown on this plan are in metres and can be converted to feet by dividing by 0.3048.

- 1.0 - Estimated depths.
- 0m cut - limit of computaion.
- 0.1 contour interval.
- 1.0 contour interval.
- Areas below grade.
- Exposed Tailings

NOTES

- Computations are approximate and may require verification.
- Some depths near Dyke 15 may include dyke toes.
- Data was derived from field surveys dated September 22 and 28, 2009.
- Contour interval = 0.1m.
- Mapping export parameters = NAD83 WGS_1984_UTM_Zone_17N (Central Meridian = 81°W).
- Elevations are Canadian Geodetic Vertical datum.

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torrance@inorth.on.ca

PLAN	DATE	REFERENCE
Ebenau	October 6, 2009	205-018

2005\205-018\quirke\2009\Cell 15\sound (372)

Rio Algom

Rio Algom Limited		
Estimated Area of Exposed Tailings at Water Elevation 372.0 masl		
EcoMetrix Incorporated	February 2011	Figure 6.5

APPENDIX 1

Compilation of Routine Monitoring Data at the Quirke TMA

Table A1.1: Routine Monitoring Data for Basin Water in Cell 14

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
1-Jun-92	3.4	75	
1-Sep-92	3.7	65	
1-Oct-92	3.3	120	374.0
1-Nov-92	4.3	57	161.0
1-Dec-92	7.4	3	45.0
1-Jan-93	6.9	4	60.0
1-Feb-93	7.2	3	68.0
1-Mar-93	6.5	7	94.0
1-Apr-93	5.2	10	45.0
1-May-93	6.7	6	64.0
1-Jun-93	7.1	5	57.0
1-Jul-93	7.2	3	64.0
1-Aug-93	7.2	3	76.0
1-Sep-93	7.2	6	75.0
1-Oct-93	7.0	5	73.0
1-Nov-93	6.8	6	64.0
1-Dec-93	6.8	7	16.0
1-Jan-94	6.5	6	13.0
1-Feb-94	6.8	6	56.0
1-Mar-94	6.8	6	33.0
1-Apr-94	6.7	6	41.0
1-May-94	6.7	7	33.0
1-Jun-94	7.1	6	36.0
1-Jul-94	7.9	5	40.0
1-Aug-94	6.9	3	44.0
1-Sep-94	7.0	3	47.0
1-Oct-94	7.0	3	51.0
1-Nov-94	6.9	5	33.0
1-Dec-94	7.0	4	41.0
1-Jan-95	6.8	5	48.0
1-Feb-95	6.7	6	53.0
1-Mar-95	6.6	6	44.0
1-Apr-95	6.8	5	9.0
1-May-95	6.6	5	18.0
1-Jun-95	6.5	5	14.0
1-Jul-95	7.0	4	19.0
1-Aug-95	7.4	2	29.0
1-Sep-95	6.7	4	30.0
1-Oct-95	6.6	4	32.0
1-Nov-95	6.3	3	35.0
1-Dec-95	7.0	3	38.0
1-Jan-96	6.0	8	21.0
1-Feb-96	5.9	6	10.0
1-Mar-96	6.1	7	31.0
1-Apr-96	6.5	6	31.0
1-May-96	5.0	8	5.0
1-Jun-96	7.1	5	19.0
1-Jul-96	7.1	2	19.0
1-Aug-96	7.3	2	25.0
1-Sep-96	7.4	1	25.0
1-Oct-96	6.9	3	40.0
1-Nov-96	6.7	2	35.0
1-Dec-96	7.6	3	38.0
1-Jan-97	6.4	2	19.0
1-Feb-97	6.4	2	23.0
1-Mar-97	7.0	3	35.0
1-Apr-97	6.8	3	56.0
1-May-97	6.8	3	26.0
1-Jun-97	7.0	2	25.5
1-Jul-97	7.3	3	5.0
1-Aug-97	7.0	2	38.0
1-Sep-97	7.7	2	33.0
1-Oct-97	7.0	2	42.0
1-Nov-97	7.5	4	49.0
1-Dec-97	7.8	4	51.0
1-Jan-98	7.1	5	56.0
1-Feb-98	7.0	2	51.0
1-Mar-98	7.0	3	44.0
1-Apr-98	6.4	3	5.0
1-May-98	7.1	2	22.4
1-Jun-98	7.5	2	21.0
1-Jul-98	7.5	3	26.4
1-Aug-98	6.9	2	31.8
1-Sep-98	7.8	5	37.0
1-Oct-98	7.6	3	42.2

Table A1.1: Routine Monitoring Data for Basin Water in Cell 14

Date	pH	Acidity	Sulphate
	(pH units)	(mg/L as $CaCO_3$)	(mg/L)
1-Nov-98	7.7	2	45.5
1-Dec-98	7.6	3	43.6
1-Jan-99	7.5	2	42.5
1-Feb-99	7.3	3	29.9
1-Mar-99	7.4	2	39.4
1-Apr-99	6.6	3	7.6
1-May-99	7.6	1	23.5
1-Jun-99	7.7	2	28.0
1-Jul-99	7.8	1	30.0
1-Aug-99	8.2	2	30.1
1-Sep-99	8.2	1	33.0
1-Oct-99	7.7	1	35.6
1-Nov-99	7.7	2	38.5
1-Dec-99	7.8	2	38.3
1-Jan-00	7.8	3	63.8
1-Feb-00	7.5	3	53.6
1-Mar-00	7.0	2	22.4
1-Apr-00	6.2	3	4.8
1-May-00	7.7	1	25.7
1-Jun-00	8.6	<1	27.8
1-Jul-00	7.7	1	29.2
1-Aug-00	7.7	3	25.1
1-Sep-00	8.0	2	33.9
1-Oct-00	7.8	2	34.7
1-Nov-00	7.8	2	43.1
1-Dec-00	7.7	3	53.0
1-Jan-01	7.1	6	67.2
1-Feb-01	0.0		
1-Mar-01	7.0	5	56.3
1-Apr-01	7.0	2	18.2
1-May-01	7.7	3	21.4
1-Jun-01	7.6	2	22.4
1-Jul-01	7.7	8	25.2
1-Aug-01	8.0	2	30.0
1-Sep-01	8.1	2	28.9
1-Oct-01	8.1	2	28.1
1-Nov-01	7.5	2	27.3
1-Dec-01	7.6	2	30.1
1-Jan-02	7.5	2	34.3
1-Feb-02	7.3	2	34.8
1-Mar-02	7.5	3	35.6
1-Apr-02	7.1	3	29.7
1-May-02	7.7	2	22.5
1-Jun-02	7.8	1	23.1
1-Jul-02	8.2	1	20.4
1-Aug-02	7.5	1	26.7
1-Sep-02	7.8	2	23.0
1-Oct-02	7.6	2	24.4
1-Nov-02	7.6	2	25.7
1-Dec-02	7.6	2	30.3
1-Jan-03			
1-Feb-03			
1-Mar-03			
1-Apr-03	6.4	4	
1-May-03			
1-Jun-03			
1-Jul-03			
1-Apr-04	5.9	7	
1-Oct-04	6.8	2	
1-Apr-05	6.5	6	
1-Aug-05	7.1	2	18.3
1-Sep-05	7.0	2	19.3
1-Oct-05	7.4	3	22.0
1-Nov-05	6.8	3	20.0
1-Dec-05	7.2	3	21.9
1-May-06	7.0	1	15.0
1-Jun-06	6.8	2	21.0
1-Jul-06	7.1	1	12.0
1-Aug-06	7.8	1	13.0
1-Oct-06	7.1	1	13.0
1-Nov-06	6.5		
14-Mar-07	6.2	1	16.0
11-Apr-07			
10-May-07	6.8	1	10.0
13-Jun-07			

Table A1.1: Routine Monitoring Data for Basin Water in Cell 14

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
11-Jul-07			
8-Aug-07	7.0	1	12.0
12-Sep-07			
10-Oct-07			
14-Nov-07	6.2	1	16.0
13-Feb-08	6.6	1	8.6
15-May-08	6.9	1	9.7
11-Jun-08			
9-Jul-08			
13-Aug-08	7.1	1	18.0
10-Sep-08			
8-Oct-08			
12-Nov-08	6.7	<1.0	15
21-May-09	6.5	<1.0	11
30-Jun-09			
8-Jul-09			
12-Aug-09			
9-Sep-09			
14-Oct-09			
12-Nov-09	6.8	2	15.0
9-Dec-09			

Table A1.2: Routine Monitoring Data for Basin Water in Cell 15

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
1-Jan-95	9.2	1	
1-Feb-95	10.9	1	
1-Mar-95	9.5	1	
1-Apr-95	7.6	12	
1-May-95	9.3	1	
1-Jun-95	6.8	7	
1-Jul-95	6.3	5	
1-Aug-95	7.9	2	
1-Sep-95	9.4	0	
1-Oct-95	8.6	0	
1-Nov-95	8.6	3	
1-Dec-95	8.8	0	
1-Jan-96	8.1	3	
1-Feb-96	6.5	17	
1-Mar-96	6.2	43	
1-Apr-96	6.4	9	
1-May-96	6.9	6	
1-Jun-96	7.3	4	
1-Jul-96	8.0	2	
1-Aug-96	7.7	3	
1-Sep-96	8.0	2	
1-Oct-96	7.9	4	
1-Nov-96	8.3	1	
1-Dec-96	7.5	4	
1-Jan-97	6.7	6	
1-Feb-97	7.1	5	
1-Mar-97	6.8	12	
1-Apr-97	6.4	2	
1-May-97	8.0	2	
1-Jun-97	7.6	3	
1-Jul-97	7.9	2	
1-Aug-97	7.7	3	
1-Sep-97	7.8	3	
1-Oct-97	7.6	5	
1-Nov-97	7.8	3	
1-Dec-97	7.4	6	
1-Jan-98	7.3	8	
1-Feb-98	7.2	6	
1-Mar-98	7.1	9	
1-Apr-98	6.8	8	
1-May-98	7.3	5	
1-Jun-98	7.3	3	517
1-Jul-98	7.4	4	
1-Aug-98	7.5	4	
1-Sep-98	7.4	4	
1-Oct-98	7.3	4	
1-Nov-98	7.6	5	
1-Dec-98	7.6	4	
1-Jan-99	7.4	2	
1-Feb-99	7.1	5	
1-Mar-99	6.7	7	
1-Apr-99	6.4	6	
1-May-99	7.5	4	
1-Jun-99	7.4	4	
1-Jul-99	7.3	3	
1-Aug-99	7.1	3	
1-Sep-99	7.1	3	
1-Oct-99	7.1	3	
1-Nov-99	7.5	4	
1-Dec-99	7.9	4	
1-Jan-00	7.8	6	
1-Feb-00	7.5	6	
1-Mar-00	7.0	6	
1-Apr-00	7.1	7	
1-May-00	7.4	4	
1-Jun-00	7.5	3	
1-Jul-00	7.2	3	
1-Aug-00	7.2	4	
1-Sep-00	7.0	4	
1-Oct-00	6.9	5	
1-Nov-00	7.0	5	
1-Dec-00	6.9	6	
1-Jan-01	7.0	6	
1-Feb-01	6.7	6	
1-Mar-01	6.4	8	
1-Apr-01	6.2	6	

Table A1.2: Routine Monitoring Data for Basin Water in Cell 15

Date	pH	Acidity	Sulphate
	(pH units)	(mg/L as $CaCO_3$)	(mg/L)
1-May-01	6.8	5	
1-Jun-01	6.8	4	
1-Jul-01	6.6	4	
1-Aug-01	6.4	4	
1-Sep-01	6.4	6	
1-Oct-01	6.4	5	
1-Nov-01	6.3	4	
1-Dec-01	6.3	4	
1-Jan-02	6.1	6	
1-Feb-02	6.0	10	
1-Mar-02	6.3	14	
1-Apr-02	5.8	6	
1-May-02	6.5	4	
1-Jun-02	6.8	3	
1-Jul-02	6.7	3	
1-Aug-02	6.8	3	
1-Sep-02	6.6	4	
1-Oct-02	6.5	4	
1-Nov-02	6.5	5	
1-Dec-02	6.2	5	
1-Jan-03			
1-Feb-03			
1-Mar-03			
1-Apr-03	5.6	5	
1-May-03			
1-Jun-03			
1-Jul-03			
1-Aug-03			
1-Sep-03			
1-Oct-03	7.1	3	
1-Nov-03			
1-Dec-03			
1-Jan-04			
1-Feb-04			
1-Mar-04			
1-Apr-04	4.5	3	
1-May-04			
1-Jun-04			
1-Jul-04			
1-Aug-04			
1-Sep-04			
1-Oct-04	7.0	4	
1-Nov-04			
1-Dec-04			
1-Jan-05			
1-Feb-05			
1-Mar-05			
1-Apr-05	6.0	3	
1-May-05			
1-Jun-05			
1-Jul-05			
1-Aug-05	6.9	3	515
1-Sep-05			
1-Oct-05	6.8	5	730
1-Nov-05			
1-Dec-05			
10-May-06	6.7	1	470
9-Aug-06	7.5	2	490
8-Nov-06	6.5	4	580
10-Jan-07			
14-Feb-07			
14-Mar-07	6.2	1	310
11-Apr-07			
10-May-07	6.8	1	430
13-Jun-07			
11-Jul-07			
8-Aug-07	7.0	4	640
12-Sep-07			
10-Oct-07			
14-Nov-07	6.7	2	740
12-Dec-07			
9-Jan-08			
13-Feb-08	6.6	1	9
12-Mar-08			
9-Apr-08			
15-May-08	6.9	1	380

Table A1.2: Routine Monitoring Data for Basin Water in Cell 15

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
11-Jun-08			
9-Jul-08			
13-Aug-08	7.0	1	480
10-Sep-08			
8-Oct-08			
12-Nov-08	6.7	<1.0	690
21-May-09	6.6	<1.0	440
30-Jun-09			
8-Jul-09			
12-Aug-09			
9-Sep-09			
14-Oct-09			
12-Nov-09	6.9	<1.0	560
9-Dec-09			

Table A1.3: Routine Monitoring Data for Basin Water in Cell 16

Date	pH	Acidity	Sulphate
	(pH units)	(mg/L as $CaCO_3$)	(mg/L)
1-Jan-90	8.5	35	
1-Feb-90	5.6	154	
1-Mar-90	5.0	132	
1-Apr-90	4.7	214	
1-May-90	3.7	388	
1-Jun-90	4.7	242	
1-Jul-90	3.5	775	
1-Aug-90	4.7	359	
1-Sep-90	7.1	91	
1-Oct-90	8.9	8	
1-Nov-90	5.3	122	
1-Dec-90	3.3	247	
1-Jan-91	3.0	379	
1-Feb-91	4.1	393	
1-Mar-91	4.8	339	
1-Apr-91	3.7	559	
1-May-91	3.4	1115	
1-Jun-91	3.1	652	
1-Jul-91	2.8	788	
1-Aug-91	3.3	666	
1-Sep-91	6.2	159	
1-Oct-91	4.1	645	
1-Nov-91	3.6	946	
1-Dec-91	3.1	1700	
1-Jan-92	2.9	2175	
1-Feb-92	3.0	2075	
1-Mar-92	3.0	2197	
1-Apr-92	3.4	680	
1-May-92	2.9	1196	
1-Jun-92	3.0	1002	
1-Jul-92	2.8	788	
1-Aug-92	2.7	1249	
1-Sep-92	2.7	1008	
1-Oct-92	3.0	740	
1-Nov-92	7.1	125	
1-Dec-92	4.0	238	
1-Jan-93	3.2	813	
1-Feb-93	3.3	1428	
1-Mar-93	3.4	1584	
1-Apr-93	3.3	618	
1-May-93	2.9	1039	
1-Jun-93	2.7	1010	
1-Jul-93	2.7	1093	
1-Aug-93	2.6	1163	
1-Sep-93	2.7	1109	
1-Oct-93	2.9	772	
1-Nov-93	2.9	691	
1-Dec-93	2.9	744	
1-Jan-94	3.1	936	
1-Feb-94	3.1	858	
1-Mar-94	3.1	1009	
1-Apr-94	3.4	731	
1-May-94	3.2	602	
1-Jun-94	2.9	507	
1-Jul-94	2.8	742	
1-Aug-94	2.7	641	
1-Sep-94	2.8	662	
1-Oct-94	2.9	613	
1-Feb-95	3.0	700	
1-Mar-95	3.3	275	
1-Apr-95	3.2	295	
1-May-95	3.2	311	
1-Jun-95	3.9	259	
1-Jul-95	2.8	321	
1-Aug-95	3.0	257	
1-Sep-95	3.2	183	
1-Oct-95	4.1	89	
1-Nov-95	6.3	8	
1-Dec-95	6.2	12	
1-Jan-96	6.6	16	
1-Feb-96	6.1	22	
1-Mar-96	6.4	33	
1-Apr-96	5.5	40	
1-May-96	4.8	21	
1-Jun-96	6.4	11	
1-Jul-96	7.5	7	

Table A1.3: Routine Monitoring Data for Basin Water in Cell 16

Date	pH	Acidity	Sulphate
	(pH units)	(mg/L as $CaCO_3$)	(mg/L)
1-Aug-96	7.4	5	
1-Sep-96	7.7	7	
1-Oct-96	7.7	5	
1-Nov-96	7.7	6	
1-Dec-96	7.4	6	
1-Jan-97	7.0	11	
1-Feb-97	6.7	17	
1-Mar-97	6.8	22	
1-Apr-97	6.4	24	
1-May-97	7.3	10	
1-Jun-97	7.6	5	
1-Jul-97	7.6	6	
1-Aug-97	7.6	5	
1-Sep-97	7.5	6	
1-Oct-97	7.6	5	
1-Nov-97	7.8	5	
1-Dec-97	7.3	8	
1-Jan-98	7.1	11	
1-Feb-98	7.2	11	
1-Mar-98	6.9	13	
1-Apr-98	6.9	12	
1-May-98	7.5	7	
1-Jun-98	7.8	5	
1-Jul-98	8.0	6	
1-Aug-98	8.0	4	
1-Sep-98	8.1	4	
1-Oct-98	7.9	5	
1-Nov-98	8.4	1	
1-Dec-98	7.8	4	
1-Jan-99	7.6	6	
1-Feb-99	7.3	7	
1-Mar-99	7.1	11	
1-Apr-99	7.3	7	
1-May-99	7.9	4	
1-Jun-99	7.9	6	
1-Jul-99	7.8	5	
1-Aug-99	7.7	6	
1-Sep-99	7.9	5	
1-Oct-99	7.8	5	
1-Nov-99	8.2	3	
1-Dec-99	8.5	0	
1-Jan-00	8.4	0	
1-Feb-00	8.2	2	
1-Mar-00	6.6	17	
1-Apr-00	7.4	6	
1-May-00	7.7	6	
1-Jun-00	7.7	5	
1-Jul-00	7.7	5	
1-Aug-00	7.8	6	
1-Sep-00	7.8	5	
1-Oct-00	8.2	4	
1-Nov-00	7.7	6	
1-Dec-00	8.0	5	
1-Jan-01	8.3	4	
1-Feb-01	7.4	9	
1-Mar-01	7.4	12	
1-Apr-01	7.5	13	
1-May-01	7.4	7	
1-Jun-01	7.4	5	
1-Jul-01	7.3	5	
1-Aug-01	7.0	6	
1-Sep-01	6.4	8	
1-Oct-01	4.7	10	
1-Nov-01	3.9	17	
1-Dec-01	4.2	18	
1-Jan-02	4.1	24	
1-Feb-02	3.8	40	
1-Mar-02	3.8	47	
1-Apr-02	4.0	42	
1-May-02	3.8	38	
1-Jun-02	3.6	35	
1-Jul-02	3.5	38	
1-Aug-02	3.5	41	
1-Sep-02	3.5	48	
1-Oct-02	3.5	40	
1-Nov-02	3.5	42	

Table A1.3: Routine Monitoring Data for Basin Water in Cell 16

Date	pH	Acidity	Sulphate
	(pH units)	(mg/L as $CaCO_3$)	(mg/L)
1-Dec-02	3.6	39	
1-Jan-03			
1-Feb-03			
1-Mar-03			
1-Apr-03	3.7	19	
1-May-03			
1-Jun-03			
1-Jul-03			
1-Aug-03			
1-Sep-03			
1-Oct-03	6.4	12	
1-Nov-03			
1-Dec-03			
1-Jan-04			
1-Feb-04			
1-Mar-04			
1-Apr-04	4.4	11	
1-May-04			
1-Jun-04			
1-Jul-04			
1-Aug-04			
1-Sep-04			
1-Oct-04	7.3	6	
1-Nov-04			
1-Dec-04			
1-Jan-05			
1-Feb-05			
1-Mar-05			
1-Apr-05	5.5	7	
1-May-05			
1-Jun-05			
1-Jul-05			
1-Aug-05	6.4	7	1245
1-Sep-05			
1-Oct-05	7.8	5	1697
1-Nov-05			
1-Dec-05			
10-May-06	4.2	14	1000
9-Aug-06	7.3	10	1100
8-Nov-06	4.5	17	1100
10-Jan-07			
14-Feb-07			
14-Mar-07	4.0	20	1100
11-Apr-07			
10-May-07	4.0	24	960
13-Jun-07			
11-Jul-07			
8-Aug-07	6.8	9	1200
12-Sep-07			
10-Oct-07			
14-Nov-07	6.9	4	1200
12-Dec-07			
9-Jan-08			
13-Feb-08	6.5	3	1100
12-Mar-08			
9-Apr-08			
15-May-08	6.2	13	990
11-Jun-08			
9-Jul-08			
13-Aug-08	7.0	4	910
10-Sep-08			
8-Oct-08			
12-Nov-08	7.3	1	1000
21-May-09	6.4	8	940
30-Jun-09			
31-Jul-09			
28-Aug-09			
30-Sep-09			
31-Oct-09			
12-Nov-09	8.0	<1	1000
30-Nov-09			

Table A1.4: Routine Monitoring Data for Basin Water in Cell 17

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
1-Aug-95	3	300	
1-Sep-95	5.3	47	
1-Oct-95	6.4	10	
1-Nov-95	6.9	7	
1-Dec-95	6.3	9	
1-Jan-96	6.7	12	
1-Feb-96	6.5	14	
1-Mar-96	6.3	18	
1-Apr-96	5.3	51	
1-May-96	5.8	47	
1-Jun-96	7.4	4	
1-Jul-96	7.6	9	
1-Aug-96	7.4	6	
1-Sep-96	8.2	4	
1-Oct-96	8	3	
1-Nov-96	7.3	13	
1-Dec-96	7.5	5	
1-Jan-97	7.3	11	
1-Feb-97	6.9	15	
1-Mar-97	7	17	
1-Apr-97	6.8	16	
1-May-97	6.3	31	
1-Jun-97	5.9	15	
1-Jul-97	7.3	7	
1-Aug-97	7.9	5	
1-Sep-97	7.5	6	
1-Oct-97	8.1	3	
1-Nov-97	8.4	0	
1-Dec-97	8.2	3	
1-Jan-98	8.2	4	
1-Feb-98	7.3	9	
1-Mar-98	6.7	14	
1-Apr-98	5.8	35	
1-May-98	6.5	16	
1-Jun-98	7.5	6	
1-Jul-98	7.7	6	
1-Aug-98	7.5	5	
1-Sep-98	8.8	1	
1-Oct-98	8.5	1	
1-Nov-98	8.4	2	
1-Dec-98	7.8	4	
1-Jan-99	7.3	7	
1-Feb-99	7	8	
1-Mar-99	6.9	13	
1-Apr-99	6.9	7	
1-May-99	7.3	8	
1-Jun-99	7.5	7	
1-Jul-99	8.5	2	
1-Aug-99	7.7	5	
1-Sep-99	7.8	5	
1-Oct-99	7.7	5	
1-Nov-99	8.2	3	
1-Dec-99	8.5	1	
1-Jan-00	7.5	9	
1-Feb-00	7.1	10	
1-Mar-00	6.7	12	
1-Apr-00	6.6	15	
1-May-00	7.4	4	
1-Jun-00	7.2	7	
1-Jul-00	7.3	5	
1-Aug-00	7.1	7	
1-Sep-00	7.3	6	
1-Oct-00	7.9	4	
1-Nov-00	7.5	8	
1-Dec-00	7.6	9	
1-Jan-01	6.9	15	
1-Feb-01	6.8	17	
1-Mar-01	6.8	16	
1-Apr-01	6.7	22	
1-May-01	7.2	7	
1-Jun-01	7.1	5	
1-Jul-01	6.7	6	
1-Aug-01	5.8	8	
1-Sep-01	4.4	12	
1-Oct-01	4.1	13	
1-Nov-01	4.2	19	

Table A1.4: Routine Monitoring Data for Basin Water in Cell 17

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
1-Dec-01	4.7	16	
1-Jan-02	4.2	22	
1-Feb-02	4	37	
1-Mar-02	3.9	38	
1-Apr-02	4	36	
1-May-02	4.5	49	
1-Jun-02	3.6	35	
1-Jul-02	3.6	35	
1-Aug-02	4.7	19	
1-Sep-02	7.4	6	
1-Oct-02	7.3	5	
1-Nov-02	5.8	10	
1-Dec-02	4	25	
1-Jan-03			
1-Feb-03			
1-Mar-03			
1-Apr-03	3.8	27	
1-May-03			
1-Jun-03			
1-Jul-03			
1-Aug-03			
1-Sep-03			
1-Oct-03	4.6	12	
1-Nov-03			
1-Dec-03			
1-Jan-04			
1-Feb-04			
1-Mar-04			
1-Apr-04	5	15	
1-May-04			
1-Jun-04			
1-Jul-04			
1-Aug-04			
1-Sep-04			
1-Oct-04	6.8	10	
1-Nov-04			
1-Dec-04			
1-Jan-05			
1-Feb-05			
1-Mar-05			
1-Apr-05	6	8	
1-May-05			
1-Jun-05			
1-Jul-05			
1-Aug-05	7.2	6	1422
1-Sep-05			
1-Oct-05	6.5	9	1768
1-Nov-05			
1-Dec-05			
10-May-06	3.9	26	1100
9-Aug-06	7.1	24	1200
8-Nov-06	4	20	1200
10-Jan-07			
14-Feb-07			
14-Mar-07	4	19	1200
11-Apr-07			
10-May-07	4.1	18	980
13-Jun-07			
11-Jul-07			
8-Aug-07	7.7	<1	1400
12-Sep-07			
10-Oct-07			
14-Nov-07	6.9	7	1200
12-Dec-07			
9-Jan-08			
13-Feb-08	6.2	3	1100
12-Mar-08			
9-Apr-08			
15-May-08	4.9	16	930
11-Jun-08			
9-Jul-08			
13-Aug-08	8.8	<1	980
10-Sep-08			
8-Oct-08			
12-Nov-08	7	<1.0	880
21-May-09	4.9	12	980

Table A1.4: Routine Monitoring Data for Basin Water in Cell 17

Date	pH (pH units)	Acidity (mg/L as $CaCO_3$)	Sulphate (mg/L)
30-Jun-09			
31-Jul-09			
28-Aug-09			
30-Sep-09			
31-Oct-09			
12-Nov-09	7.5	2	1100
30-Nov-09			

Table A1.5: Routine Monitoring Data in Piezometers at DK14-4

DK14-4A (369.4 masl)		DK14-4B (372.3 masl)		DK14-4C (374.2 masl)		DK14-4D (375.6 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
22/11/1991	18	29/08/1991	10	29/08/1991	9	22/06/1992	450
23/06/1992	30	12/09/1991	<1	12/09/1991	9	22/06/1993	230
13/10/1992	<1	27/09/1991	8	27/09/1991	18	16/08/1993	380
23/06/1993	50	22/11/1991	20	22/11/1991	10	04/10/1993	510
18/08/1993	<1	23/06/1992	12	23/06/1992	4500	20/10/1994	170
05/10/1993	13	13/10/1992	28	23/06/1993	3350	03/10/1995	76
20/10/1994	<1	23/06/1993	30	18/08/1993	4000	10/06/1996	38
03/10/1995	4	18/08/1993	77	05/10/1993	3450	08/10/1996	28
11/06/1996	12	05/10/1993	110	20/10/1994	475	09/06/1997	68
11/10/1996	18	20/10/1994	280	03/10/1995	330	25/10/1997	29
10/06/1997	16	03/10/1995	40	11/06/1996	240	11/06/1998	30
28/10/1997	19	11/06/1996	230	11/10/1996	162	23/06/1999	18
11/06/1998	13	11/10/1996	100	09/06/1997	98	27/06/2000	16
23/06/1999	10	10/06/1997	17	28/10/1997	128	29/06/2001	5
28/06/2000	8	28/10/1997	105	11/06/1998	110	17/07/2002	24
03/07/2001	8	11/06/1998	100	23/06/1999	89	25/06/2003	8
18/07/2002	7	23/06/1999	88	28/06/2000	72	30/06/2004	186
25/06/2003	6	28/06/2000	61	03/07/2001	30	05/07/2005	177
05/07/2004	346	03/07/2001	36	17/07/2002	20	28/06/2006	<1
05/07/2005	131	17/07/2002	25	25/06/2003	32	24/08/2007	<1
28/06/2006	35	25/06/2003	39	05/07/2004	1106	23/07/2008	<1
24/08/2007	<1	30/06/2004	32	05/07/2005	448	17/06/2009	3
24/07/2008	<1	05/07/2005	125	28/06/2006	8		
15/06/2009	<1	24/08/2007	<1	24/08/2007	<1		
		24/07/2008	<1	23/07/2008	<1		
		15/06/2009	<1	16/06/2009	<1		
				14/07/2009	<1		

Table A1.6: Routine Monitoring Data in Piezometers at DK14-5

DK14-5A (366.2 masl)		DK14-5B (369.2 masl)		DK14-5C (370.5 masl)		DK14-5D (372.0 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
20/08/1991	<1	20/08/1991	8	29/08/1991	8	29/08/1991	15
11/09/1991	<1	11/09/1991	6	11/09/1991	6	11/09/1991	53
26/09/1991	<1	26/09/1991	11	26/09/1991	9	26/09/1991	43
22/11/1991	<1	22/11/1991	9	22/11/1991	9	22/11/1991	6
10/06/1992	<1	22/06/1992	5	22/06/1992	7	22/06/1992	212
13/10/1992	<1	13/10/1992	12	13/10/1992	12	13/10/1992	5
22/06/1993	<1	22/06/1993	12	22/06/1993	10	22/06/1993	200
16/08/1993	<1	16/08/1993	14	16/08/1993	22	16/08/1993	290
05/10/1993	<1	04/10/1993	12	04/10/1993	16	04/10/1993	280
20/10/1994	<1	20/10/1994	5	20/10/1994	5	20/10/1994	125
03/10/1995	<1	03/10/1995	1	03/10/1995	7	03/10/1995	200
11/06/1996	<1	10/06/1996	<1	10/06/1996	6	10/06/1996	130
10/10/1996	<1	08/10/1996	14	08/10/1996	13	08/10/1996	102
09/06/1997	<1	09/06/1997	13	09/06/1997	13	09/06/1997	73
25/10/1997	<1	25/10/1997	11	25/10/1997	16	25/10/1997	67
11/06/1998	<1	11/06/1998	17	11/06/1998	19	11/06/1998	57
22/06/1999	<1	23/06/1999	14	23/06/1999	14	23/06/1999	60
27/06/2000	<1	27/06/2000	11	27/06/2000	12	27/06/2000	80
29/06/2001	<1	29/06/2001	13	29/06/2001	12	29/06/2001	57
31/05/2002	<1	22/07/2002	6	22/07/2002	14	22/07/2002	44
24/06/2003	<1	24/06/2003	12	24/06/2003	11	24/06/2003	38
05/07/2004	<1	06/07/2004	6	06/07/2004	9	06/07/2004	87
05/07/2005	<1	05/07/2005	15	05/07/2005	13	05/07/2005	45
28/06/2006	<1	28/06/2006	<1	29/06/2006	<1	29/06/2006	<1
24/08/2007	<1	24/08/2007	<1	24/08/2007	<1	24/08/2007	<1
23/07/2008	<1	24/07/2008	<1	24/07/2008	<1	23/07/2008	<1
16/06/2009	<1	17/06/2009	<1	15/06/2009	<1	17/06/2009	<1

Table A1.7: Routine Monitoring Data in Piezometers at DK15-1

DK15-1A (365.4 masl)		DK15-1B (368.2 masl)		DK15-1C (369.9 masl)		DK15-1D (371.2 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
12/10/1995	1010	12/10/1995	12	12/10/1995	220	12/10/1995	310
17/06/1996	1050	17/06/1996	25	17/06/1996	230	17/06/1996	280
17/10/1996	632	17/10/1996	18	17/10/1996	124	17/10/1996	70
16/06/1997	462	16/06/1997	8	16/06/1997	5	16/06/1997	37
31/10/1997	259	31/10/1997	9	31/10/1997	57	31/10/1997	88
28/07/1998	337	28/07/1998	7	28/07/1998	45	28/07/1998	50
28/09/1999	269	28/09/1999	4	28/09/1999	27	28/09/1999	25
31/07/2000	199	31/07/2000	8	31/07/2000	29	31/07/2000	12
04/07/2001	90	04/07/2001	3	04/07/2001	61	04/07/2001	28
04/07/2002	104	04/07/2002	4	04/07/2002	60	27/06/2002	13
26/06/2003	108	26/06/2003	4	26/06/2003	21	26/06/2003	14
07/07/2004	129	07/07/2004	3	07/07/2004	14	07/07/2004	36
05/07/2005	102	05/07/2005	6	05/07/2005	18	05/07/2005	34
26/06/2006	66	26/06/2006	<1	26/06/2006	<1	26/06/2006	22
02/08/2007	51	02/08/2007	<1	02/08/2007	4	02/08/2007	22
21/07/2008	47	21/07/2008	<1	21/07/2008	<1	21/07/2008	24
17/06/2009	<1	16/06/2009	<1	16/06/2009	<1	16/06/2009	29
13/07/2009	38						

Table A1.8: Routine Monitoring Data in Piezometers at DK15-2

DK15-2A (360.7 masl)		DK15-2B (363.6 masl)		DK15-2C (365.4 masl)		DK15-2D (366.8 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
12/10/1995	4250	12/10/1995	4000	12/10/1995	3400	12/10/1995	2450
17/06/1996	5250	17/06/1996	4500	17/06/1996	4250	17/06/1996	2800
17/10/1996	6140	17/10/1996	5010	17/10/1996	4660	17/10/1996	4430
16/06/1997	4690	16/06/1997	5060	16/06/1997	5060	16/06/1997	4650
31/10/1997	4700	31/10/1997	4650	31/10/1997	4480	31/10/1997	500
28/07/1998	3950	28/07/1998	3870	28/07/1998	3900	28/07/1998	3750
28/09/1999	2732	28/09/1999	2860	28/09/1999	3262	28/09/1999	3525
04/07/2001	2593	04/07/2001	2512	04/07/2001	2687	04/07/2001	3275
31/10/2002	1366	31/10/2002	1389	31/10/2002	1371	31/10/2002	1432
05/09/2003	1280	05/09/2003	1172	05/09/2003	1256	05/09/2003	1202
08/09/2004	2430	08/09/2004	2270	08/09/2004	2070	08/09/2004	1760
26/10/2005	2200	26/10/2005	2620	26/10/2005	2140	26/10/2005	2600
04/05/2006	2510	04/05/2006	2370	04/05/2006	2260	04/05/2006	2120
26/06/2006	2290	26/06/2006	1210	26/06/2006	2420	26/06/2006	1780
07/08/2007	1110	07/08/2007	1070	07/08/2007	1100	07/08/2007	848
21/07/2008	976	21/07/2008	840	21/07/2008	805	21/07/2008	711
17/06/2009	996	17/06/2009	1010	17/06/2009	864	17/06/2009	719

Table A1.9: Routine Monitoring Data in Piezometers at DK16-1

DK16-1A (362.1 masl)		DK16-1B (365.1 masl)		DK16-1C (366.6 masl)		DK16-1D (368.2 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
07/11/1995	260	07/11/1995	1400	07/11/1995	1100	07/11/1995	145
04/06/1996	180	04/06/1996	184	04/06/1996	870	04/06/1996	500
08/10/1996	104	08/10/1996	128	08/10/1996	499	08/10/1996	450
02/06/1997	131	02/06/1997	44	02/06/1997	212	02/06/1997	274
20/10/1997	129	20/10/1997	78	20/10/1997	201	20/10/1997	234
22/07/1998	65	22/07/1998	45	22/07/1998	75	22/07/1998	74
16/09/1999	42	16/09/1999	46	16/09/1999	54	16/09/1999	49
03/08/2000	48	03/08/2000	42	03/08/2000	37	03/08/2000	33
06/07/2001	36	06/07/2001	20	06/07/2001	14	06/07/2001	23
24/06/2002	26	24/06/2002	12	24/06/2002	17	24/06/2002	10
02/07/2003	38	02/07/2003	20	02/07/2003	33	02/07/2003	14
12/07/2004	38	12/07/2004	20	13/07/2004	29	13/07/2004	21
11/07/2005	30	11/07/2005	17	11/07/2005	27	11/07/2005	19
22/06/2006	22	22/06/2006	3	22/06/2006	22	22/06/2006	15
02/08/2007	21	02/08/2007	4	02/08/2007	18	08/08/2007	37
23/07/2008	21	24/07/2008	<1	24/07/2008	15	24/07/2008	19
01/07/2009	21	01/07/2009	6	01/07/2009	15	01/07/2009	17

Table A1.10: Routine Monitoring Data in Piezometers at DK16-2

DK16-2A (356.8 masl)		DK16-2B (359.9 masl)		DK16-2C (361.4 masl)		DK16-2D (362.9 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
07/11/1995	<1	07/11/1995	400	07/11/1995	500	07/11/1995	525
04/06/1996	<1	04/06/1996	420	04/06/1996	620	04/06/1996	620
08/10/1996	<1	08/10/1996	246	08/10/1996	396	08/10/1996	553
02/06/1997		02/06/1997	119	02/06/1997	276	02/06/1997	351
23/10/1997		23/10/1997	90	23/10/1997	271	23/10/1997	343
22/07/1998	105	22/07/1998	34	22/07/1998	130	22/07/1998	182
16/09/1999	352	16/09/1999	9	16/09/1999	34	16/09/1999	86
03/08/2000	290	03/08/2000	28	03/08/2000	42	03/08/2000	82
06/07/2001	296	06/07/2001	<1	06/07/2001	14	06/07/2001	70
25/06/2002	248	25/06/2002	<1	25/06/2002	19	25/06/2002	87
02/07/2003	275	02/07/2003	<1	02/07/2003	30	02/07/2003	148
13/07/2004	310	13/07/2004	<1	13/07/2004	36	13/07/2004	275
11/07/2005	217	11/07/2005	<1	11/07/2005	19	11/07/2005	201
23/06/2006	66	23/06/2006	<1	23/06/2006	15	23/06/2006	32
08/08/2007	62	08/08/2007	<1	08/08/2007	15	08/08/2007	30
24/07/2008	29	28/08/2007	<1	28/07/2008	12	28/07/2008	30
01/07/2009	18	24/07/2008	<1	01/07/2009	15	01/07/2009	15
		01/07/2009	2				

Table A1.11: Routine Monitoring Data in Piezometers at DK17-1

DK17-1A (356.1 masl)		DK17-1B (359.2 masl)		DK17-1C (360.6 masl)		DK17-1D (362.2 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
07/11/1995	<1	07/11/1995	<1	07/11/1995	<1	07/11/1995	70
31/05/1996	35	31/05/1996	<1	31/05/1996	<1	31/05/1996	38
26/09/1996	5	26/09/1996	<1	26/09/1996	<1	26/09/1996	58
02/06/1997	27	02/06/1997	<1	02/06/1997	<1	02/06/1997	<1
20/10/1997	49	20/10/1997	<1	20/10/1997	<1	20/10/1997	9
14/07/1998	36	14/07/1998	<1	14/07/1998	<1	14/07/1998	6
14/09/1999	55	14/09/1999	<1	14/09/1999	<1	14/09/1999	11
19/07/2000	81	19/07/2000	<1	19/07/2000	<1	19/07/2000	13
09/07/2001	98	09/07/2001	<1	09/07/2001	<1	09/07/2001	8
31/05/2002	150	31/05/2002	<1	31/05/2002	<1	31/05/2002	7
01/07/2003	356	01/07/2003	<1	01/07/2003		01/07/2003	10
13/07/2004	346	13/07/2004	<1	13/07/2004	<1	13/07/2004	12
12/07/2005	274	12/07/2005	<1	12/07/2005	<1	12/07/2005	14
21/06/2006	75	21/06/2006	<1	21/06/2006	<1	21/06/2006	8
10/08/2007	14	10/08/2007	<1	10/08/2007	<1	10/08/2007	20
17/07/2008	55	17/07/2008	<1	17/07/2008	<1	17/07/2008	15
02/07/2009	<1	02/07/2009	<1	02/07/2009	<1	02/07/2009	11

Table A1.12: Routine Monitoring Data in Piezometers at DK17-2

DK17-2A (353.8 masl)		DK17-2B (356.9 masl)		DK17-2C (358.4 masl)		DK17-2D (359.9 masl)	
Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)	Date	Acidity (mg/L as $CaCO_3$)
07/11/1995	2900	07/11/1995	46	07/11/1995	<1	07/11/1995	<1
31/05/1996	3450	31/05/1996	700	31/05/1996	<1	31/05/1996	<1
26/09/1996	2643	26/09/1996	382	26/09/1996	<1	26/09/1996	<1
02/06/1997	1513	02/06/1997	603	02/06/1997	<1	02/06/1997	10
20/10/1997	1557	20/10/1997	593	20/10/1997	<1	20/10/1997	<1
14/07/1998	1780	14/07/1998	560	14/07/1998	<1	14/07/1998	<1
14/09/1999	644	14/09/1999	424	14/09/1999	<1	14/09/1999	<1
19/07/2000	785	19/07/2000	341	19/07/2000	<1	19/07/2000	<1
09/07/2001	853	09/07/2001	280	09/07/2001	<1	09/07/2001	<1
31/05/2002	1416	31/05/2002	243	31/05/2002	<1	31/05/2002	<1
25/06/2003	1563	25/06/2003	268	25/06/2003	<1	25/06/2003	<1
14/07/2004	2199	14/07/2004	429	14/07/2004	<1	14/07/2004	<1
12/07/2005	2284	12/07/2005	369	12/07/2005	<1	12/07/2005	<1
22/06/2006	2590	22/06/2006	267	22/06/2006	<1	22/06/2006	<1
13/08/2007	2340	13/08/2007	351	10/08/2007	<1	10/08/2007	<1
18/07/2008	<1	18/07/2008	429	18/07/2008	<1	18/07/2008	<1
06/07/2009	2180	06/07/2009	451	06/07/2009	<1	06/07/2009	<1

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
2-Jan-97	374.2	373.7	373.9
7-Jan-97	374.2	373.7	373.9
14-Jan-97	374.2	373.7	373.9
21-Jan-97	374.2	373.7	373.9
28-Jan-97	374.2	373.7	373.9
4-Feb-97	374.2	373.7	373.9
12-Feb-97	374.2	373.7	373.9
18-Feb-97	374.2	373.7	373.9
26-Feb-97	374.1	373.7	373.9
4-Mar-97	374.0	373.7	373.9
18-Mar-97	373.9	373.7	373.9
24-Mar-97	373.3	373.7	373.9
27-Mar-97	373.4	373.7	373.9
31-Mar-97	373.4	373.7	373.9
3-Apr-97	373.4	373.7	373.9
7-Apr-97	373.5	373.7	373.9
10-Apr-97	373.5	373.7	373.9
14-Apr-97	373.5	373.7	373.9
17-Apr-97	373.5	373.7	373.9
21-Apr-97	373.5	373.7	373.9
28-Apr-97	373.5	373.7	373.9
2-May-97	373.6	373.7	373.9
5-May-97	373.6	373.7	373.9
8-May-97	373.7	373.7	373.9
12-May-97	373.7	373.7	373.9
15-May-97	373.8	373.7	373.9
20-May-97	373.9	373.7	373.9
26-May-97	373.9	373.7	373.9
3-Jun-97	374.0	373.7	373.9
10-Jun-97	373.9	373.7	373.9
17-Jun-97	373.8	373.7	373.9
24-Jun-97	374.0	373.7	373.9
2-Jul-97	373.9	373.7	373.9
9-Jul-97	373.8	373.7	373.9
14-Jul-97	373.8	373.7	373.9
22-Jul-97	373.7	373.7	373.9
29-Jul-97	373.6	373.7	373.9
5-Aug-97	373.6	373.7	373.9
15-Aug-97	373.5	373.7	373.9
19-Aug-97	373.5	373.7	373.9
26-Aug-97	373.4	373.7	373.9
2-Sep-97	373.4	373.7	373.9
9-Oct-97	373.1	373.7	373.9
14-Oct-97	373.1	373.7	373.9
21-Oct-97	373.0	373.7	373.9
28-Oct-97	373.0	373.7	373.9
19-Nov-97	373.0	373.7	373.9
5-Dec-97	373.0	373.7	373.9
9-Dec-97	373.0	373.7	373.9
23-Dec-97	372.9	373.7	373.9
30-Dec-97	372.9	373.7	373.9
6-Jan-98	372.9	373.7	373.9
13-Jan-98	372.9	373.7	373.9
20-Jan-98	372.9	373.7	373.9
27-Jan-98	372.9	373.7	373.9
3-Feb-98	372.8	373.7	373.9
10-Feb-98	372.8	373.7	373.9
17-Feb-98	372.8	373.7	373.9
25-Feb-98	372.8	373.7	373.9
3-Mar-98	372.8	373.7	373.9
10-Mar-98	372.7	373.7	373.9
17-Mar-98	372.7	373.7	373.9
24-Mar-98	372.8	373.7	373.9
3-Apr-98	372.9	373.7	373.9
7-Apr-98	373.0	373.7	373.9
14-Apr-98	373.1	373.7	373.9
21-Apr-98	373.3	373.7	373.9
1-May-98	373.6	373.7	373.9
5-May-98	373.7	373.7	373.9
12-May-98	373.7	373.7	373.9
19-May-98	373.7	373.7	373.9
26-May-98	373.7	373.7	373.9
2-Jun-98	373.7	373.7	373.9
9-Jun-98	373.7	373.7	373.9
16-Jun-98	373.7	373.7	373.9

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
23-Jun-98	373.6	373.7	373.9
30-Jun-98	373.7	373.7	373.9
7-Jul-98	373.6	373.7	373.9
14-Jul-98	373.6	373.7	373.9
21-Jul-98	373.5	373.7	373.9
28-Jul-98	373.4	373.7	373.9
4-Aug-98	373.4	373.7	373.9
11-Aug-98	373.4	373.7	373.9
18-Aug-98	373.3	373.7	373.9
25-Aug-98	373.3	373.7	373.9
1-Sep-98	373.3	373.7	373.9
8-Sep-98	373.2	373.7	373.9
15-Sep-98	373.2	373.7	373.9
22-Sep-98	373.2	373.7	373.9
29-Sep-98	373.2	373.7	373.9
6-Oct-98	373.1	373.7	373.9
13-Oct-98	373.2	373.7	373.9
20-Oct-98	373.2	373.7	373.9
27-Oct-98	373.1	373.7	373.9
3-Nov-98	373.1	373.7	373.9
10-Nov-98	373.1	373.7	373.9
17-Nov-98	373.1	373.7	373.9
24-Nov-98	373.1	373.7	373.9
1-Dec-98	373.2	373.7	373.9
8-Dec-98	373.2	373.7	373.9
15-Dec-98	373.3	373.7	373.9
22-Dec-98	373.2	373.7	373.9
29-Dec-98	373.3	373.7	373.9
5-Jan-99	373.4	373.7	373.9
12-Jan-99	373.5	373.7	373.9
19-Jan-99	373.6	373.7	373.9
26-Jan-99	373.6	373.7	373.9
2-Feb-99	373.6	373.7	373.9
9-Feb-99	373.8	373.7	373.9
16-Feb-99	373.7	373.7	373.9
23-Feb-99	373.7	373.7	373.9
2-Mar-99	373.7	373.7	373.9
9-Mar-99	373.7	373.7	373.9
16-Mar-99	373.7	373.7	373.9
23-Mar-99	373.8	373.7	373.9
30-Mar-99	373.8	373.7	373.9
6-Apr-99	373.9	373.7	373.9
13-Apr-99	374.0	373.7	373.9
20-Apr-99	374.1	373.7	373.9
27-Apr-99	374.1	373.7	373.9
4-May-99	374.1	373.7	373.9
11-May-99	374.0	373.7	373.9
18-May-99	373.9	373.7	373.9
25-May-99	373.9	373.7	373.9
1-Jun-99	373.9	373.7	373.9
8-Jun-99	373.8	373.7	373.9
15-Jun-99	373.8	373.7	373.9
22-Jun-99	373.7	373.7	373.9
29-Jun-99	373.7	373.7	373.9
6-Jul-99	373.6	373.7	373.9
13-Jul-99	373.6	373.7	373.9
20-Jul-99	373.5	373.7	373.9
27-Jul-99	373.5	373.7	373.9
3-Aug-99	373.4	373.7	373.9
10-Aug-99	373.4	373.7	373.9
17-Aug-99	373.4	373.7	373.9
24-Aug-99	373.3	373.7	373.9
31-Aug-99	373.3	373.7	373.9
7-Sep-99	373.2	373.7	373.9
14-Sep-99	373.2	373.7	373.9
21-Sep-99	373.2	373.7	373.9
28-Sep-99	373.1	373.7	373.9
5-Oct-99	373.1	373.7	373.9
12-Oct-99	373.1	373.7	373.9
19-Oct-99	373.1	373.7	373.9
26-Oct-99	373.1	373.7	373.9
2-Nov-99	373.1	373.7	373.9
9-Nov-99	373.1	373.7	373.9
16-Nov-99	373.0	373.7	373.9
23-Nov-99	373.0	373.7	373.9

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
30-Nov-99	373.0	373.7	373.9
7-Dec-99	373.0	373.7	373.9
14-Dec-99	373.0	373.7	373.9
21-Dec-99	373.0	373.7	373.9
29-Dec-99	373.0	373.7	373.9
4-Jan-00	373.0	373.7	373.9
11-Jan-00	373.0	373.7	373.9
18-Jan-00	373.0	373.7	373.9
25-Jan-00	373.0	373.7	373.9
1-Feb-00	373.0	373.7	373.9
8-Feb-00	372.9	373.7	373.9
15-Feb-00	372.9	373.7	373.9
22-Feb-00	372.9	373.7	373.9
29-Feb-00	373.0	373.7	373.9
7-Mar-00	373.0	373.7	373.9
14-Mar-00	373.0	373.7	373.9
21-Mar-00	373.0	373.7	373.9
28-Mar-00	373.0	373.7	373.9
4-Apr-00	373.4	373.7	373.9
11-Apr-00	373.8	373.7	373.9
18-Apr-00	373.8	373.7	373.9
25-Apr-00	373.8	373.7	373.9
2-May-00	373.8	373.7	373.9
9-May-00	373.8	373.7	373.9
16-May-00	373.7	373.7	373.9
23-May-00	373.6	373.7	373.9
30-May-00	373.6	373.7	373.9
6-Jun-00	373.6	373.7	373.9
13-Jun-00	373.5	373.7	373.9
20-Jun-00	373.5	373.7	373.9
27-Jun-00	373.5	373.7	373.9
4-Jul-00	373.5	373.7	373.9
11-Jul-00	373.4	373.7	373.9
19-Jul-00	373.4	373.7	373.9
25-Jul-00	373.3	373.7	373.9
1-Aug-00	373.2	373.7	373.9
8-Aug-00	373.6	373.7	373.9
15-Aug-00	373.2	373.7	373.9
22-Aug-00	373.1	373.7	373.9
29-Aug-00	373.1	373.7	373.9
5-Sep-00	373.1	373.7	373.9
12-Sep-00	373.0	373.7	373.9
19-Sep-00	373.0	373.7	373.9
26-Sep-00	373.0	373.7	373.9
3-Oct-00	372.9	373.7	373.9
10-Oct-00	372.9	373.7	373.9
17-Oct-00	372.9	373.7	373.9
18-Oct-00	372.9	373.7	373.9
24-Oct-00	372.9	373.7	373.9
31-Oct-00	372.9	373.7	373.9
7-Nov-00	372.8	373.7	373.9
14-Nov-00	372.9	373.7	373.9
21-Nov-00	372.8	373.7	373.9
28-Nov-00	372.9	373.7	373.9
5-Dec-00	372.8	373.7	373.9
12-Dec-00	372.8	373.7	373.9
19-Dec-00	372.8	373.7	373.9
27-Dec-00	372.8	373.7	373.9
2-Jan-01	372.8	373.7	373.9
9-Jan-01	372.8	373.7	373.9
16-Jan-01	372.8	373.7	373.9
23-Jan-01	372.7	373.7	373.9
30-Jan-01	372.7	373.7	373.9
6-Feb-01	372.7	373.7	373.9
13-Feb-01	372.7	373.7	373.9
20-Feb-01	372.7	373.7	373.9
27-Feb-01	372.8	373.7	373.9
6-Mar-01	372.7	373.7	373.9
13-Mar-01	372.7	373.7	373.9
20-Mar-01	372.7	373.7	373.9
28-Mar-01	372.7	373.7	373.9
3-Apr-01	372.6	373.7	373.9
10-Apr-01	372.7	373.7	373.9
17-Apr-01	372.8	373.7	373.9
24-Apr-01	372.9	373.7	373.9

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
1-May-01	373.4	373.7	373.9
9-May-01	373.7	373.7	373.9
16-May-01	373.8	373.7	373.9
23-May-01	373.8	373.7	373.9
30-May-01	374.0	373.7	373.9
6-Jun-01	374.0	373.7	373.9
13-Jun-01	374.0	373.7	373.9
20-Jun-01	374.0	373.7	373.9
27-Jun-01	373.9	373.7	373.9
4-Jul-01	373.9	373.7	373.9
11-Jul-01	373.8	373.7	373.9
18-Jul-01	373.7	373.7	373.9
25-Jul-01	373.7	373.7	373.9
31-Jul-01	373.6	373.7	373.9
8-Aug-01	373.6	373.7	373.9
15-Aug-01	373.5	373.7	373.9
22-Aug-01	373.5	373.7	373.9
29-Aug-01	373.5	373.7	373.9
5-Sep-01	373.4	373.7	373.9
12-Sep-01	373.5	373.7	373.9
19-Sep-01	373.5	373.7	373.9
26-Sep-01	373.6	373.7	373.9
3-Oct-01	373.6	373.7	373.9
10-Oct-01	373.6	373.7	373.9
17-Oct-01	373.8	373.7	373.9
24-Oct-01	373.9	373.7	373.9
31-Oct-01	374.0	373.7	373.9
7-Nov-01	374.0	373.7	373.9
14-Nov-01	374.0	373.7	373.9
21-Nov-01	374.0	373.7	373.9
28-Nov-01	374.1	373.7	373.9
5-Dec-01	374.0	373.7	373.9
12-Dec-01	374.0	373.7	373.9
19-Dec-01	374.0	373.7	373.9
26-Dec-01	373.9	373.7	373.9
2-Jan-02	373.9	373.7	373.9
9-Jan-02	373.9	373.7	373.9
16-Jan-02	373.9	373.7	373.9
23-Jan-02	373.9	373.7	373.9
30-Jan-02	373.8	373.7	373.9
6-Feb-02	373.8	373.7	373.9
13-Feb-02	373.8	373.7	373.9
20-Feb-02	373.8	373.7	373.9
27-Feb-02	373.8	373.7	373.9
6-Mar-02	373.8	373.7	373.9
13-Mar-02	373.9	373.7	373.9
20-Mar-02	374.0	373.7	373.9
27-Mar-02	373.9	373.7	373.9
3-Apr-02	373.9	373.7	373.9
10-Apr-02	373.9	373.7	373.9
17-Apr-02	374.0	373.7	373.9
24-Apr-02	374.0	373.7	373.9
1-May-02	374.0	373.7	373.9
8-May-02	374.0	373.7	373.9
15-May-02	374.1	373.7	373.9
22-May-02	374.1	373.7	373.9
29-May-02	374.1	373.7	373.9
5-Jun-02	374.1	373.7	373.9
12-Jun-02	374.1	373.7	373.9
19-Jun-02	374.1	373.7	373.9
26-Jun-02	374.1	373.7	373.9
3-Jul-02	374.1	373.7	373.9
10-Jul-02	374.0	373.7	373.9
17-Jul-02	373.9	373.7	373.9
24-Jul-02	373.9	373.7	373.9
31-Jul-02	373.8	373.7	373.9
7-Aug-02	373.8	373.7	373.9
14-Aug-02	373.7	373.7	373.9
21-Aug-02	373.7	373.7	373.9
28-Aug-02	373.6	373.7	373.9
4-Sep-02	373.6	373.7	373.9
11-Sep-02	373.5	373.7	373.9
18-Sep-02	373.4	373.7	373.9
25-Sep-02	373.5	373.7	373.9
2-Oct-02	373.4	373.7	373.9

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
9-Oct-02	373.5	373.7	373.9
16-Oct-02	373.5	373.7	373.9
23-Oct-02	373.5	373.7	373.9
30-Oct-02	373.5	373.7	373.9
6-Nov-02	373.4	373.7	373.9
13-Nov-02	373.4	373.7	373.9
20-Nov-02	373.4	373.7	373.9
27-Nov-02	373.4	373.7	373.9
4-Dec-02	373.4	373.7	373.9
11-Dec-02	373.4	373.7	373.9
18-Dec-02	373.4	373.7	373.9
25-Dec-02	373.4	373.7	373.9
6-Jan-03	373.4	373.7	373.9
13-Jan-03	373.4	373.7	373.9
20-Jan-03	373.3	373.7	373.9
27-Jan-03	373.3	373.7	373.9
3-Feb-03	373.3	373.7	373.9
10-Feb-03	373.3	373.7	373.9
17-Feb-03	373.3	373.7	373.9
24-Feb-03	373.3	373.7	373.9
3-Mar-03	373.3	373.7	373.9
10-Mar-03	373.3	373.7	373.9
17-Mar-03	373.3	373.7	373.9
24-Mar-03	373.3	373.7	373.9
31-Mar-03	373.5	373.7	373.9
7-Apr-03	373.6	373.7	373.9
14-Apr-03	373.7	373.7	373.9
21-Apr-03	373.9	373.7	373.9
28-Apr-03	374.0	373.7	373.9
5-May-03	374.0	373.7	373.9
12-May-03	374.0	373.7	373.9
20-May-03	374.0	373.7	373.9
26-May-03	373.9	373.7	373.9
2-Jun-03	374.2	373.7	373.9
9-Jun-03	374.3	373.7	373.9
16-Jun-03	374.4	373.7	373.9
23-Jun-03	374.4	373.7	373.9
1-Jul-03	374.3	373.7	373.9
7-Jul-03	374.3	373.7	373.9
14-Jul-03	374.3	373.7	373.9
21-Jul-03	374.4	373.7	373.9
28-Jul-03	374.4	373.7	373.9
5-Aug-03	374.3	373.7	373.9
11-Aug-03	374.2	373.7	373.9
18-Aug-03	374.1	373.7	373.9
25-Aug-03	374.0	373.7	373.9
2-Sep-03	373.9	373.7	373.9
8-Sep-03	373.9	373.7	373.9
15-Sep-03	373.8	373.7	373.9
22-Sep-03	373.7	373.7	373.9
29-Sep-03	373.7	373.7	373.9
6-Oct-03	373.7	373.7	373.9
14-Oct-03	373.7	373.7	373.9
20-Oct-03	373.6	373.7	373.9
27-Oct-03	373.6	373.7	373.9
3-Nov-03	373.6	373.7	373.9
10-Nov-03	373.5	373.7	373.9
17-Nov-03	373.5	373.7	373.9
24-Nov-03	373.6	373.7	373.9
1-Dec-03	373.7	373.7	373.9
8-Dec-03	373.7	373.7	373.9
17-Dec-03	373.8	373.7	373.9
22-Dec-03	373.7	373.7	373.9
5-Jan-04	373.6	373.7	373.9
12-Jan-04	373.6	373.7	373.9
19-Jan-04	373.5	373.7	373.9
26-Jan-04	373.5	373.7	373.9
2-Feb-04	373.4	373.7	373.9
9-Feb-04	373.4	373.7	373.9
16-Feb-04	373.3	373.7	373.9
23-Feb-04	373.3	373.7	373.9
1-Mar-04	373.2	373.7	373.9
8-Mar-04	373.2	373.7	373.9
15-Mar-04	373.2	373.7	373.9
22-Mar-04	373.2	373.7	373.9

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
29-Mar-04	373.2	373.7	373.9
5-Apr-04	373.3	373.7	373.9
12-Apr-04	373.2	373.7	373.9
19-Apr-04	373.3	373.7	373.9
26-Apr-04	373.3	373.7	373.9
3-May-04	373.6	373.7	373.9
10-May-04	373.7	373.7	373.9
17-May-04	374.0	373.7	373.9
25-May-04	374.2	373.7	373.9
31-May-04	374.2	373.7	373.9
7-Jun-04	374.2	373.7	373.9
14-Jun-04	374.2	373.7	373.9
21-Jun-04	374.1	373.7	373.9
28-Jun-04	374.1	373.7	373.9
5-Jul-04	374.1	373.7	373.9
12-Jul-04	374.0	373.7	373.9
19-Jul-04	373.9	373.7	373.9
26-Jul-04	373.9	373.7	373.9
3-Aug-04	373.8	373.7	373.9
9-Aug-04	373.8	373.7	373.9
16-Aug-04	373.8	373.7	373.9
23-Aug-04	373.7	373.7	373.9
30-Aug-04	373.6	373.7	373.9
7-Sep-04	373.6	373.7	373.9
13-Sep-04	373.6	373.7	373.9
20-Sep-04	373.5	373.7	373.9
27-Sep-04	373.4	373.7	373.9
4-Oct-04	373.4	373.7	373.9
12-Oct-04	373.4	373.7	373.9
18-Oct-04	373.4	373.7	373.9
25-Oct-04	373.4	373.7	373.9
1-Nov-04	373.4	373.7	373.9
8-Nov-04	373.4	373.7	373.9
15-Nov-04	373.4	373.7	373.9
22-Nov-04	373.4	373.7	373.9
29-Nov-04	373.4	373.7	373.9
6-Dec-04	373.5	373.7	373.9
13-Dec-04	373.8	373.7	373.9
20-Dec-04	373.9	373.7	373.9
4-Jan-05	374.0	373.7	373.9
10-Jan-05	374.0	373.7	373.9
17-Jan-05	374.0	373.7	373.9
24-Jan-05	374.1	373.7	373.9
31-Jan-05	374.0	373.7	373.9
7-Feb-05	374.0	373.7	373.9
14-Feb-05	374.0	373.7	373.9
21-Feb-05	374.0	373.7	373.9
28-Feb-05	374.0	373.7	373.9
7-Mar-05	373.9	373.7	373.9
14-Mar-05	373.9	373.7	373.9
21-Mar-05	373.9	373.7	373.9
28-Mar-05	373.9	373.7	373.9
4-Apr-05	373.9	373.7	373.9
11-Apr-05	373.9	373.7	373.9
18-Apr-05	373.9	373.7	373.9
25-Apr-05	374.0	373.7	373.9
2-May-05	374.1	373.7	373.9
9-May-05	374.1	373.7	373.9
16-May-05	374.1	373.7	373.9
24-May-05	374.1	373.7	373.9
30-May-05	374.0	373.7	373.9
6-Jun-05	374.0	373.7	373.9
13-Jun-05	373.9	373.7	373.9
20-Jun-05	374.0	373.7	373.9
27-Jun-05	373.9	373.7	373.9
4-Jul-05	373.9	373.7	373.9
11-Jul-05	373.8	373.7	373.9
18-Jul-05	373.8	373.7	373.9
25-Jul-05	373.7	373.7	373.9
8-Aug-05	373.6	373.7	373.9
10-Aug-05	373.6	373.7	373.9
15-Aug-05	373.5	373.7	373.9
22-Aug-05	373.5	373.7	373.9
29-Aug-05	373.5	373.7	373.9
6-Sep-05	373.4	373.7	373.9

Table A1.13: Cell 15 Water Elevations

Date	Elevation (masl)	Invert (masl)	Spillway (masl)
12-Sep-05	373.4	373.7	373.9
19-Sep-05	373.3	373.7	373.9
26-Sep-05	373.3	373.7	373.9
3-Oct-05	373.3	373.7	373.9
11-Oct-05	373.2	373.7	373.9
12-Oct-05	373.2	373.7	373.9
17-Oct-05	373.2	373.7	373.9
24-Oct-05	373.2	373.7	373.9
31-Oct-05	373.2	373.7	373.9
7-Nov-05	373.2	373.7	373.9
14-Nov-05	373.3	373.7	373.9
21-Nov-05	373.3	373.7	373.9
28-Nov-05	373.3	373.7	373.9
5-Dec-05	373.3	373.7	373.9
12-Dec-05	373.3	373.7	373.9
19-Dec-05		373.7	
29-Dec-05	373.3	373.7	373.9
10-May-06	374.1	373.7	373.9
9-Aug-06	373.8	373.7	373.9
8-Nov-06	373.4	373.7	373.9
10-Jan-07	374.1	373.7	373.9
14-Feb-07	373.9	373.7	373.9
14-Mar-07	373.8	373.7	373.9
11-Apr-07	373.8	373.7	373.9
10-May-07	373.8	373.7	373.9
13-Jun-07	373.6	373.7	373.9
11-Jul-07	373.4	373.7	373.9
8-Aug-07	373.2	373.7	373.9
12-Sep-07	373.1	373.7	373.9
10-Oct-07	373.1	373.7	373.9
14-Nov-07	373.1	373.7	373.9
15-May-08	374.1	373.7	373.9
11-Jun-08	373.9	373.7	373.9
9-Jul-08	373.8	373.7	373.9
13-Aug-08	373.8	373.7	373.9
10-Sep-08	373.5	373.7	373.9
8-Oct-08	373.4	373.7	373.9
12-Nov-08	373.4	373.7	373.9
21-May-09	374.0	373.7	373.9
30-Jun-09	373.9	373.7	373.9
8-Jul-09	373.9	373.7	373.9
12-Aug-09	373.8	373.7	373.9
9-Sep-09	373.6	373.7	373.9
14-Oct-09	373.5	373.7	373.9
12-Nov-09	373.6	373.7	373.9
9-Dec-09	373.7	373.7	373.9

Table A1.14: Flow Data for Gravel Pit Lake Inflow to Cell 14 (Q-29)

2006		2007		2008		2009	
Date	Flow (L/s)	Date	Flow (L/s)	Date	Flow (L/s)	Date	Flow (L/s)
3-Jan-06	25	2-Jan-07	5	2-Jan-08	50	5-Jan-09	0
9-Jan-06	25	8-Jan-07	0	7-Jan-08	50	12-Jan-09	0
16-Jan-06	25	15-Jan-07	0	14-Jan-08	60	19-Jan-09	0
23-Jan-06	25	22-Jan-07	0	21-Jan-08	60	26-Jan-09	0
30-Jan-06	25	29-Jan-07	0	29-Jan-08	14	2-Feb-09	0
6-Feb-06	25	5-Feb-07	0	4-Feb-08	14	9-Feb-09	0
13-Feb-06	25	12-Feb-07	0	11-Feb-08	14	17-Feb-09	0
20-Feb-06	25	19-Feb-07	0	19-Feb-08	14	23-Feb-09	0
27-Feb-06	25	26-Feb-07	0	25-Feb-08	14	2-Mar-09	0
6-Mar-06	25	5-Mar-07	0	3-Mar-08	18	9-Mar-09	0
13-Mar-06	25	12-Mar-07	0	10-Mar-08	18	16-Mar-09	50
20-Mar-06	25	19-Mar-07	0	17-Mar-08	20	23-Mar-09	100
27-Mar-06	150	26-Mar-07	100	24-Mar-08	20	31-Mar-09	100
3-Apr-06	150	2-Apr-07	100	31-Mar-08	20	6-Apr-09	100
10-Apr-06	25	9-Apr-07	100	7-Apr-08	20	13-Apr-09	0
17-Apr-06	25	16-Apr-07	100	14-Apr-08	20	20-Apr-09	0
24-Apr-06	150	23-Apr-07	25	21-Apr-08	20	27-Apr-09	0
1-May-06	25	30-Apr-07	25	28-Apr-08	15	4-May-09	0
8-May-06	20	7-May-07	25	5-May-08	15	11-May-09	55
15-May-06	20	10-May-07	25	12-May-08	15	19-May-09	55
23-May-06	20	14-May-07	25	20-May-08	14	25-May-09	50
29-May-06	80	22-May-07	35	26-May-08	10	1-Jun-09	50
5-Jun-06	80	28-May-07	32	2-Jun-08	10	8-Jun-09	50
12-Jun-06	80	4-Jun-07	37	9-Jun-08	10	15-Jun-09	50
19-Jun-06	80	11-Jun-07	35	16-Jun-08	25	22-Jun-09	40
26-Jun-06	70	18-Jun-07	30	23-Jun-08	25	29-Jun-09	35
4-Jul-06	50	25-Jun-07	30	2-Jul-08	35	6-Jul-09	40
10-Jul-06	40	3-Jul-07	30	7-Jul-08	35	13-Jul-09	35
17-Jul-06	25	9-Jul-07	35	14-Jul-08	40	20-Jul-09	40
24-Jul-06	25	16-Jul-07	35	21-Jul-08	45	27-Jul-09	35
31-Jul-06	22	23-Jul-07	40	28-Jul-08	45	4-Aug-09	35
8-Aug-06	22	30-Jul-07	100	5-Aug-08	40	10-Aug-09	35
14-Aug-06	25	7-Aug-07	40	11-Aug-08	40	17-Aug-09	35
21-Aug-06	22	13-Aug-07	45	18-Aug-08	40	24-Aug-09	35
28-Aug-06	25	20-Aug-07	45	25-Aug-08	40	31-Aug-09	35
5-Sep-06	25	27-Aug-07	40	2-Sep-08	40	8-Sep-09	35
11-Sep-06	23	4-Sep-07	37	8-Sep-08	35	15-Sep-09	35
18-Sep-06	0	10-Sep-07	0	15-Sep-08	45	21-Sep-09	30
25-Sep-06	22	17-Sep-07	0	22-Sep-08	40	29-Sep-09	30
2-Oct-06	25	24-Sep-07	0	29-Sep-08	35	5-Oct-09	30
10-Oct-06	25	1-Oct-07	0	6-Oct-08	0	14-Oct-09	30
16-Oct-06	10	9-Oct-07	0	14-Oct-08	48	19-Oct-09	30
23-Oct-06	100	15-Oct-07	0	20-Oct-08	48	26-Oct-09	30
30-Oct-06	100	22-Oct-07	0	27-Oct-08	35	2-Nov-09	35
6-Nov-06	90	29-Oct-07	0	3-Nov-08	35	9-Nov-09	35
13-Nov-06	100	5-Nov-07	0	10-Nov-08	35	16-Nov-09	35
20-Nov-06	100	12-Nov-07	42	17-Nov-08	35	23-Nov-09	35
27-Nov-06	100	19-Nov-07	42	24-Nov-08	35	30-Nov-09	35
4-Dec-06	100	26-Nov-07	40	1-Dec-08	35	7-Dec-09	35
11-Dec-06	25	3-Dec-07	35	8-Dec-08	35	14-Dec-09	35
18-Dec-06	0	10-Dec-07	30	15-Dec-08	35	21-Dec-09	35
27-Dec-06	0	17-Dec-07	35	22-Dec-08	35	29-Dec-09	30
		24-Dec-07	50	29-Dec-08	0		

Table A1.15: Flow Data for Cell 18 Inflow to the Effluent Treatment Plant (Q-05)

2006		2007		2008		2009	
Date	Flow	Date	Flow	Date	Flow	Date	Flow
	(L/s)		(L/s)		(L/s)		(L/s)
3-Jan-06	110	2-Jan-07	153	2-Jan-08	102	2-Jan-09	127
4-Jan-06	110	3-Jan-07	155	3-Jan-08	102	5-Jan-09	127
5-Jan-06	110	4-Jan-07	94	4-Jan-08	100	6-Jan-09	129
6-Jan-06	110	5-Jan-07	94	7-Jan-08	102	7-Jan-09	131
9-Jan-06	108	8-Jan-07	94	8-Jan-08	102	8-Jan-09	131
10-Jan-06	108	9-Jan-07	94	9-Jan-08	103	9-Jan-09	131
11-Jan-06	108	10-Jan-07	91	10-Jan-08	103	12-Jan-09	129
12-Jan-06	108	11-Jan-07	91	11-Jan-08	102	13-Jan-09	125
13-Jan-06	108	12-Jan-07	91	14-Jan-08	103	14-Jan-09	125
16-Jan-06	108	15-Jan-07	91	15-Jan-08	105	15-Jan-09	131
17-Jan-06	108	16-Jan-07	94	16-Jan-08	105	16-Jan-09	129
18-Jan-06	105	17-Jan-07	91	17-Jan-08	105	19-Jan-09	129
19-Jan-06	107	18-Jan-07	91	18-Jan-08	105	20-Jan-09	150
20-Jan-06	105	19-Jan-07	94	21-Jan-08	102	21-Jan-09	159
23-Jan-06	105	22-Jan-07	91	22-Jan-08	105	22-Jan-09	161
24-Jan-06	105	23-Jan-07	94	23-Jan-08	105	23-Jan-09	157
25-Jan-06	105	24-Jan-07	91	24-Jan-08	105	26-Jan-09	155
26-Jan-06	105	25-Jan-07	91	25-Jan-08	105	27-Jan-09	155
27-Jan-06	107	26-Jan-07	91	28-Jan-08	105	28-Jan-09	153
30-Jan-06	105	29-Jan-07	89	29-Jan-08	135	29-Jan-09	155
31-Jan-06	105	30-Jan-07	94	30-Jan-08	135	30-Jan-09	155
1-Feb-06	105	31-Jan-07	91	31-Jan-08	135	2-Feb-09	149
2-Feb-06	105	1-Feb-07	91	1-Feb-08	137	3-Feb-09	148
3-Feb-06	105	2-Feb-07	91	4-Feb-08	139	4-Feb-09	142
6-Feb-06	105	5-Feb-07	86	5-Feb-08	139	5-Feb-09	95
7-Feb-06	105	6-Feb-07	86	6-Feb-08	139	6-Feb-09	99
8-Feb-06	105	7-Feb-07	86	7-Feb-08	139	9-Feb-09	102
9-Feb-06	105	8-Feb-07	91	8-Feb-08	139	10-Feb-09	104
10-Feb-06	105	9-Feb-07	89	11-Feb-08	139	11-Feb-09	102
13-Feb-06	105	12-Feb-07	86	12-Feb-08	132	12-Feb-09	102
14-Feb-06	103	13-Feb-07	89	13-Feb-08	136	13-Feb-09	102
15-Feb-06	103	14-Feb-07	86	14-Feb-08	137	17-Feb-09	102
16-Feb-06	103	15-Feb-07	86	15-Feb-08	137	18-Feb-09	102
17-Feb-06	103	16-Feb-07	89	19-Feb-08	137	19-Feb-09	102
20-Feb-06	103	19-Feb-07	91	20-Feb-08	135	20-Feb-09	99
21-Feb-06	103	20-Feb-07	91	21-Feb-08	137	23-Feb-09	97
22-Feb-06	103	21-Feb-07	94	22-Feb-08	134	24-Feb-09	98
23-Feb-06	103	22-Feb-07	94	25-Feb-08	134	25-Feb-09	99
24-Feb-06	103	23-Feb-07	96	26-Feb-08	134	26-Feb-09	100
27-Feb-06	103	26-Feb-07	94	27-Feb-08	134	27-Feb-09	100
28-Feb-06	103	27-Feb-07	94	28-Feb-08	132	2-Mar-09	102
1-Mar-06	103	28-Feb-07	94	29-Feb-08	132	3-Mar-09	100
2-Mar-06	103	1-Mar-07	94	3-Mar-08	132	4-Mar-09	99
3-Mar-06	100	2-Mar-07	93	4-Mar-08	132	5-Mar-09	99
6-Mar-06	98	5-Mar-07	91	5-Mar-08	132	6-Mar-09	99
7-Mar-06	98	6-Mar-07	94	6-Mar-08	132	9-Mar-09	97
8-Mar-06	98	7-Mar-07	93	7-Mar-08	132	10-Mar-09	99
9-Mar-06	98	8-Mar-07	93	10-Mar-08	129	11-Mar-09	99
10-Mar-06	98	9-Mar-07	93	11-Mar-08	130	12-Mar-09	100
13-Mar-06	98	12-Mar-07	93	12-Mar-08	129	13-Mar-09	100
14-Mar-06	98	13-Mar-07	94	13-Mar-08	129	16-Mar-09	100
15-Mar-06	98	14-Mar-07	94	14-Mar-08	130	17-Mar-09	100
16-Mar-06	98	15-Mar-07	94	17-Mar-08	129	18-Mar-09	97
17-Mar-06	98	16-Mar-07	94	18-Mar-08	127	19-Mar-09	99
20-Mar-06	98	19-Mar-07	91	19-Mar-08	127	20-Mar-09	99
21-Mar-06	98	20-Mar-07	91	20-Mar-08	125	23-Mar-09	97
22-Mar-06	96	21-Mar-07	94	24-Mar-08	123	24-Mar-09	97
23-Mar-06	96	22-Mar-07	94	25-Mar-08	125	25-Mar-09	97
24-Mar-06	98	23-Mar-07	94	26-Mar-08	125	26-Mar-09	96
27-Mar-06	98	26-Mar-07	94	27-Mar-08	125	27-Mar-09	96
28-Mar-06	98	27-Mar-07	94	28-Mar-08	125	30-Mar-09	98
29-Mar-06	96	28-Mar-07	94	31-Mar-08	122	31-Mar-09	98
30-Mar-06	98	29-Mar-07	94	1-Apr-08	125	1-Apr-09	98
31-Mar-06	98	30-Mar-07	94	2-Apr-08	125	2-Apr-09	97
3-Apr-06	98	2-Apr-07	94	3-Apr-08	125	3-Apr-09	99
4-Apr-06	98	3-Apr-07	94	4-Apr-08	125	6-Apr-09	100
5-Apr-06	100	4-Apr-07	93	7-Apr-08	122	7-Apr-09	100
6-Apr-06	100	5-Apr-07	94	8-Apr-08	122	8-Apr-09	100
7-Apr-06	100	6-Apr-07	93	9-Apr-08	127	9-Apr-09	100
10-Apr-06	100	9-Apr-07	91	10-Apr-08	125	13-Apr-09	97
11-Apr-06	100	10-Apr-07	91	11-Apr-08	127	14-Apr-09	100
12-Apr-06	100	11-Apr-07	91	14-Apr-08	127	15-Apr-09	100
13-Apr-06	102	12-Apr-07	91	15-Apr-08	129	16-Apr-09	100
17-Apr-06	102	13-Apr-07	96	16-Apr-08	129	17-Apr-09	100
18-Apr-06	103	16-Apr-07	96	17-Apr-08	129	20-Apr-09	100
19-Apr-06	103	17-Apr-07	96	18-Apr-08	132	21-Apr-09	102
20-Apr-06	103	18-Apr-07	94	21-Apr-08	132	22-Apr-09	102
21-Apr-06	103	19-Apr-07	96	22-Apr-08	132	23-Apr-09	105
24-Apr-06	101	20-Apr-07	94	23-Apr-08	132	24-Apr-09	105

Table A1.15: Flow Data for Cell 18 Inflow to the Effluent Treatment Plant (Q-05)

2006		2007		2008		2009	
Date	Flow (L/s)	Date	Flow (L/s)	Date	Flow (L/s)	Date	Flow (L/s)
25-Apr-06	100	23-Apr-07	96	24-Apr-08	132	27-Apr-09	105
26-Apr-06	100	24-Apr-07	96	25-Apr-08	132	28-Apr-09	107
27-Apr-06	100	25-Apr-07	96	28-Apr-08	132	29-Apr-09	107
28-Apr-06	100	26-Apr-07	92	29-Apr-08	132	30-Apr-09	105
1-May-06	100	27-Apr-07	92	30-Apr-08	132	1-May-09	105
2-May-06	100	30-Apr-07	92	1-May-08	132	4-May-09	105
3-May-06	97	1-May-07	93	2-May-08	132	5-May-09	107
4-May-06	97	2-May-07	92	5-May-08	132	6-May-09	105
5-May-06	95	3-May-07	92	6-May-08	132	7-May-09	105
8-May-06	100	4-May-07	90	7-May-08	132	8-May-09	105
9-May-06	95	7-May-07	88	8-May-08	132	11-May-09	105
10-May-06	97	8-May-07	46	9-May-08	132	12-May-09	102
11-May-06	95	9-May-07	44	12-May-08	132	13-May-09	102
12-May-06	97	10-May-07	44	13-May-08	129	14-May-09	100
15-May-06	95	11-May-07	44	14-May-08	132	15-May-09	105
16-May-06	100	14-May-07	47	15-May-08	129	19-May-09	102
17-May-06	100	15-May-07	44	16-May-08	132	20-May-09	102
18-May-06	100	16-May-07	47	20-May-08	129	21-May-09	102
19-May-06	100	17-May-07	44	21-May-08	127	22-May-09	105
23-May-06	100	18-May-07	44	22-May-08	129	25-May-09	105
24-May-06	100	22-May-07	44	23-May-08	129	26-May-09	100
25-May-06	102	23-May-07	46	26-May-08	129	27-May-09	102
26-May-06	100	24-May-07	47	27-May-08	129	28-May-09	102
29-May-06	102	25-May-07	46	28-May-08	127	29-May-09	105
30-May-06	100	28-May-07	47	29-May-08	127	1-Jun-09	102
31-May-06	102	29-May-07	46	30-May-08	127	2-Jun-09	102
1-Jun-06	100	30-May-07	46	2-Jun-08	125	3-Jun-09	102
2-Jun-06	100	31-May-07	44	3-Jun-08	70	4-Jun-09	102
5-Jun-06	100	1-Jun-07	46	4-Jun-08	71	5-Jun-09	102
6-Jun-06	100	4-Jun-07	46	5-Jun-08	71	8-Jun-09	100
7-Jun-06	100	5-Jun-07	42	6-Jun-08	70	9-Jun-09	102
8-Jun-06	100	6-Jun-07	42	9-Jun-08	71	10-Jun-09	100
9-Jun-06	99	7-Jun-07	42	10-Jun-08	72	11-Jun-09	100
12-Jun-06	100	8-Jun-07	42	11-Jun-08	72	12-Jun-09	100
13-Jun-06	100	11-Jun-07	42	12-Jun-08	72	15-Jun-09	100
14-Jun-06	100	12-Jun-07	47	13-Jun-08	72	16-Jun-09	100
15-Jun-06	100	13-Jun-07	44	16-Jun-08	71	17-Jun-09	100
16-Jun-06	96	14-Jun-07	44	17-Jun-08	85	18-Jun-09	100
19-Jun-06	97	15-Jun-07	44	18-Jun-08	86	19-Jun-09	100
20-Jun-06	95	18-Jun-07	44	19-Jun-08	86	22-Jun-09	100
21-Jun-06	95	19-Jun-07	44	20-Jun-08	86	23-Jun-09	100
22-Jun-06	95	20-Jun-07	44	23-Jun-08	86	24-Jun-09	50
23-Jun-06	69	21-Jun-07	47	24-Jun-08	86	25-Jun-09	52
26-Jun-06	69	22-Jun-07	47	25-Jun-08	88	26-Jun-09	51
27-Jun-06	70	25-Jun-07	47	26-Jun-08	88	29-Jun-09	52
28-Jun-06	70	26-Jun-07	47	27-Jun-08	88	30-Jun-09	52
29-Jun-06	69	27-Jun-07	47	1-Jul-08	88	2-Jul-09	52
30-Jun-06	69	28-Jun-07	47	2-Jul-08	88	3-Jul-09	52
4-Jul-06	69	29-Jun-07	42	3-Jul-08	88	6-Jul-09	53
5-Jul-06	69	3-Jul-07	42	4-Jul-08	88	7-Jul-09	54
6-Jul-06	69	4-Jul-07	42	7-Jul-08	88	8-Jul-09	54
7-Jul-06	70	5-Jul-07	42	8-Jul-08	88	9-Jul-09	54
10-Jul-06	69	6-Jul-07	44	9-Jul-08	88	10-Jul-09	54
11-Jul-06	69	9-Jul-07	44	10-Jul-08	88	13-Jul-09	54
12-Jul-06	120	10-Jul-07	44	11-Jul-08	88	14-Jul-09	54
13-Jul-06	120	11-Jul-07	42	14-Jul-08	88	15-Jul-09	54
14-Jul-06	120	12-Jul-07	44	15-Jul-08	86	16-Jul-09	53
17-Jul-06	120	13-Jul-07	44	16-Jul-08	86	17-Jul-09	54
18-Jul-06	115	16-Jul-07	44	17-Jul-08	86	20-Jul-09	54
19-Jul-06	115	17-Jul-07	44	18-Jul-08	86	21-Jul-09	56
20-Jul-06	115	18-Jul-07	44	21-Jul-08	86	22-Jul-09	56
21-Jul-06	115	19-Jul-07	44	22-Jul-08	86	23-Jul-09	56
24-Jul-06	110	20-Jul-07	44	23-Jul-08	86	24-Jul-09	56
25-Jul-06	110	23-Jul-07	44	24-Jul-08	86	27-Jul-09	56
26-Jul-06	108	24-Jul-07	44	25-Jul-08	88	28-Jul-09	56
27-Jul-06	110	25-Jul-07	44	28-Jul-08	86	29-Jul-09	54
28-Jul-06	30	26-Jul-07	44	29-Jul-08	88	30-Jul-09	54
31-Jul-06	28	27-Jul-07	43	30-Jul-08	86	31-Jul-09	56
1-Aug-06	27	30-Jul-07	44	31-Jul-08	86	4-Aug-09	56
3-Aug-06	124	31-Jul-07	44	1-Aug-08	86	5-Aug-09	56
4-Aug-06	125	1-Aug-07	44	5-Aug-08	86	6-Aug-09	54
8-Aug-06	120	2-Aug-07	44	6-Aug-08	72	7-Aug-09	54
9-Aug-06	150	3-Aug-07	44	7-Aug-08	90	10-Aug-09	56
10-Aug-06	150	7-Aug-07	44	8-Aug-08	92	11-Aug-09	56
11-Aug-06	143	8-Aug-07	44	11-Aug-08	95	12-Aug-09	75
14-Aug-06	134	9-Aug-07	46	12-Aug-08	95	13-Aug-09	76
15-Aug-06	132	10-Aug-07	46	13-Aug-08	97	14-Aug-09	76
16-Aug-06	147	13-Aug-07	44	14-Aug-08	95	17-Aug-09	75
17-Aug-06	144	14-Aug-07	44	15-Aug-08	95	18-Aug-09	75

Table A1.15: Flow Data for Cell 18 Inflow to the Effluent Treatment Plant (Q-05)

2006		2007		2008		2009	
Date	Flow	Date	Flow	Date	Flow	Date	Flow
	(L/s)		(L/s)		(L/s)		(L/s)
18-Aug-06	142	15-Aug-07	46	18-Aug-08	95	19-Aug-09	75
21-Aug-06	130	16-Aug-07	46	19-Aug-08	95	20-Aug-09	75
22-Aug-06	150	17-Aug-07	44	20-Aug-08	92	21-Aug-09	74
23-Aug-06	147	20-Aug-07	44	21-Aug-08	95	24-Aug-09	75
24-Aug-06	140	21-Aug-07	44	22-Aug-08	95	25-Aug-09	75
25-Aug-06	51	22-Aug-07	44	25-Aug-08	92	26-Aug-09	75
28-Aug-06	50	23-Aug-07	44	26-Aug-08	90	27-Aug-09	73
29-Aug-06	35	24-Aug-07	46	27-Aug-08	95	28-Aug-09	73
30-Aug-06	31	27-Aug-07	46	28-Aug-08	92	31-Aug-09	73
31-Aug-06	31	28-Aug-07	46	29-Aug-08	92	1-Sep-09	75
1-Sep-06	45	29-Aug-07	44	2-Sep-08	92	2-Sep-09	75
5-Sep-06	45	30-Aug-07	42	3-Sep-08	95	3-Sep-09	90
6-Sep-06	54	31-Aug-07	42	4-Sep-08	90	4-Sep-09	90
7-Sep-06	54	4-Sep-07	47	5-Sep-08	92	8-Sep-09	90
8-Sep-06	60	5-Sep-07	47	8-Sep-08	92	9-Sep-09	92
11-Sep-06	60	6-Sep-07	47	9-Sep-08	89	10-Sep-09	92
12-Sep-06	58	7-Sep-07	47	10-Sep-08	90	11-Sep-09	92
13-Sep-06	61	10-Sep-07	42	11-Sep-08	90	14-Sep-09	90
14-Sep-06	58	11-Sep-07	47	12-Sep-08	90	15-Sep-09	92
15-Sep-06	58	12-Sep-07	47	15-Sep-08	97	16-Sep-09	90
18-Sep-06	40	13-Sep-07	47	16-Sep-08	97	17-Sep-09	92
19-Sep-06	40	14-Sep-07	47	17-Sep-08	94	18-Sep-09	90
20-Sep-06	60	17-Sep-07	47	18-Sep-08	92	21-Sep-09	87
21-Sep-06	60	18-Sep-07	47	19-Sep-08	94	22-Sep-09	89
22-Sep-06	20	19-Sep-07	45	22-Sep-08	92	23-Sep-09	91
25-Sep-06	65	20-Sep-07	45	23-Sep-08	67	24-Sep-09	89
26-Sep-06	26	21-Sep-07	45	24-Sep-08	69	25-Sep-09	88
27-Sep-06	29	24-Sep-07	45	25-Sep-08	65	28-Sep-09	89
28-Sep-06	32	25-Sep-07	47	26-Sep-08	67	29-Sep-09	90
29-Sep-06	31	26-Sep-07	47	29-Sep-08	65	30-Sep-09	85
2-Oct-06	32	27-Sep-07	47	30-Sep-08	65	1-Oct-09	70
3-Oct-06	32	28-Sep-07	47	1-Oct-08	55	2-Oct-09	70
4-Oct-06	32	1-Oct-07	42	2-Oct-08	55	5-Oct-09	73
5-Oct-06	32	2-Oct-07	42	3-Oct-08	53	6-Oct-09	70
6-Oct-06	32	3-Oct-07	42	6-Oct-08	53	7-Oct-09	74
10-Oct-06	36	4-Oct-07	42	7-Oct-08	53	8-Oct-09	73
11-Oct-06	37	5-Oct-07	42	8-Oct-08	55	9-Oct-09	70
12-Oct-06	35	9-Oct-07	45	9-Oct-08	55	14-Oct-09	74
13-Oct-06	38	10-Oct-07	46	10-Oct-08	55	15-Oct-09	73
16-Oct-06	37	11-Oct-07	46	14-Oct-08	54	16-Oct-09	75
17-Oct-06	37	12-Oct-07	46	15-Oct-08	55	19-Oct-09	75
18-Oct-06	40	15-Oct-07	45	16-Oct-08	55	20-Oct-09	75
19-Oct-06	40	16-Oct-07	45	17-Oct-08	55	21-Oct-09	75
20-Oct-06	40	17-Oct-07	47	20-Oct-08	55	22-Oct-09	75
23-Oct-06	40	18-Oct-07	44	21-Oct-08	55	23-Oct-09	73
24-Oct-06	42	22-Oct-07	47	22-Oct-08	55	26-Oct-09	75
25-Oct-06	42	23-Oct-07	66	23-Oct-08	58	27-Oct-09	75
26-Oct-06	42	24-Oct-07	106	24-Oct-08	55	28-Oct-09	75
27-Oct-06	42	25-Oct-07	106	27-Oct-08	55	29-Oct-09	75
30-Oct-06	42	26-Oct-07	110	28-Oct-08	55	30-Oct-09	75
31-Oct-06	42	29-Oct-07	112	29-Oct-08	58	2-Nov-09	77
1-Nov-06	42	30-Oct-07	113	30-Oct-08	58	3-Nov-09	77
2-Nov-06	42	31-Oct-07	108	31-Oct-08	55	4-Nov-09	77
3-Nov-06	44	1-Nov-07	108	3-Nov-08	55	5-Nov-09	80
6-Nov-06	44	2-Nov-07	108	4-Nov-08	58	6-Nov-09	100
7-Nov-06	47	5-Nov-07	105	5-Nov-08	55	9-Nov-09	130
8-Nov-06	44	6-Nov-07	0	6-Nov-08	58	10-Nov-09	130
9-Nov-06	44	7-Nov-07	106	7-Nov-08	58	11-Nov-09	130
10-Nov-06	44	8-Nov-07	108	10-Nov-08	55	12-Nov-09	130
13-Nov-06	44	9-Nov-07	108	11-Nov-08	55	13-Nov-09	135
14-Nov-06	44	12-Nov-07	105	12-Nov-08	55	16-Nov-09	141
15-Nov-06	44	14-Nov-07	0	13-Nov-08	55	17-Nov-09	141
16-Nov-06	44	15-Nov-07	0	14-Nov-08	55	18-Nov-09	143
17-Nov-06	43	16-Nov-07	106	17-Nov-08	58	19-Nov-09	141
20-Nov-06	42	19-Nov-07	0	18-Nov-08	58	20-Nov-09	141
21-Nov-06	42	20-Nov-07	104	19-Nov-08	55	23-Nov-09	140
22-Nov-06	42	21-Nov-07	104	20-Nov-08	58	24-Nov-09	136
23-Nov-06	44	22-Nov-07	104	21-Nov-08	55	25-Nov-09	136
24-Nov-06	42	23-Nov-07	104	24-Nov-08	65	26-Nov-09	139
27-Nov-06	42	26-Nov-07	104	25-Nov-08	64	27-Nov-09	139
28-Nov-06	45	27-Nov-07	104	26-Nov-08	63	30-Nov-09	139
29-Nov-06	65	28-Nov-07	104	27-Nov-08	63	1-Dec-09	139
30-Nov-06	65	29-Nov-07	102	28-Nov-08	63	2-Dec-09	136
1-Dec-06	65	30-Nov-07	100	1-Dec-08	63	3-Dec-09	136
4-Dec-06	64	3-Dec-07	102	2-Dec-08	63	4-Dec-09	136
5-Dec-06	64	4-Dec-07	104	3-Dec-08	63	7-Dec-09	136
6-Dec-06	62	5-Dec-07	104	4-Dec-08	63	8-Dec-09	136

Table A1.15: Flow Data for Cell 18 Inflow to the Effluent Treatment Plant (Q-05)

2006		2007		2008		2009	
Date	Flow (L/s)	Date	Flow (L/s)	Date	Flow (L/s)	Date	Flow (L/s)
7-Dec-06	64	6-Dec-07	101	5-Dec-08	65	9-Dec-09	136
8-Dec-06	64	7-Dec-07	101	8-Dec-08	65	10-Dec-09	136
11-Dec-06	64	10-Dec-07	96	9-Dec-08	65	11-Dec-09	134
12-Dec-06	64	11-Dec-07	104	10-Dec-08	67	14-Dec-09	131
13-Dec-06	79	12-Dec-07	99	11-Dec-08	66	15-Dec-09	131
14-Dec-06	96	13-Dec-07	101	12-Dec-08	65	16-Dec-09	129
15-Dec-06	160	14-Dec-07	101	15-Dec-08	65	17-Dec-09	129
18-Dec-06	164	17-Dec-07	99	16-Dec-08	65	18-Dec-09	131
19-Dec-06	164	18-Dec-07	99	17-Dec-08	85	21-Dec-09	129
20-Dec-06	165	19-Dec-07	102	18-Dec-08	90	22-Dec-09	129
21-Dec-06	164	20-Dec-07	100	19-Dec-08	85	23-Dec-09	85
22-Dec-06	164	21-Dec-07	100	22-Dec-08	85	24-Dec-09	85
27-Dec-06	158	24-Dec-07	104	23-Dec-08	90	29-Dec-09	87
28-Dec-06	158	27-Dec-07	104	24-Dec-08	87	30-Dec-09	88
29-Dec-06	158	28-Dec-07	104	29-Dec-08	130	31-Dec-09	88
		31-Dec-07	102	30-Dec-08	130		
				31-Dec-08	130		

APPENDIX 2

Detailed Data Quality Assessment

Table A2.1: Data Quality Assessment Summary for Selected Constituents in Solids

Analysis	Units	Method Detection Limit	RPD Data Quality Objective	Sample ID Core09-QC15-4 (20-30)	Duplicate ID Core09-QC15-6 (0-10)	RPD (%) or AD	Sample ID Core09-QC15-2 (10-20)	Duplicate ID Core09-QC15-6 (10-20)	RPD (%) or AD
Conventional Parameters									
Sulphate (SO_4)	%	0.1	≤ 40%	0.1	0.1	0	0.3	0.3	0
Acid Base Accounting									
Neutralization Potential (NP)	t $CaCO_3$/1000t	--	≤ 40%	3.0	4.0	29	3.3	3.5	6
Acid Potential (AP)	t $CaCO_3$/1000t	3.1	≤ 40%	66.1	248	**116**	15.3	11.2	**4.1**
Sulphur (S)	%	0.1	≤ 40%	8.14	8.26	1	0.583	0.492	17
Sulphate-S	%	0.1	≤ 40%	6.02	0.32	**180**	0.30	0.13	0.2
Sulphide-S	%	0.1	≤ 40%	2.11	7.94	**116**	0.28	0.36	0.1
Carbon	%	0.005	≤ 40%	0.065	0.015	**0.050**	0.022	0.015	**0.007**
Carbonate (CO_3)	%	0.005	≤ 40%	<0.005	<0.005	BD	<0.005	<0.005	BD
Metals									
Radium-226 (Ra-226)	Bq/g	0.01	≤ 40%	5.8	7.2	22	7.2	6.3	13
Silver (Ag)	mg/kg	0.7	≤ 40%	0.8	1.0	0.2	<0.7	<0.7	BD
Aluminum (Al)	mg/kg	1	≤ 40%	170	180	6	170	180	6
Arsenic (As)	mg/kg	1	≤ 40%	34	40	16	13	14	7
Barium (Ba)	mg/kg	0.05	≤ 40%	74	76	3	280	300	7
Beryllium (Be)	mg/kg	0.1	≤ 40%	<0.1	<0.1	BD	<0.1	<0.1	BD
Bismuth (Bi)	mg/kg	0.5	≤ 40%	7.5	8.6	14	5.6	5.9	5
Calcium (Ca)	mg/kg	1	≤ 40%	88	73	19	1300	1200	8
Cadmium (Cd)	mg/kg	0.05	≤ 40%	0.88	1.1	22	0.08	0.09	0.01
Cerium (Ce)	mg/kg	0.006	≤ 40%	140	150	7	320	310	3
Cobalt (Co)	mg/kg	0.3	≤ 40%	98	130	28	7.3	7.1	3
Chromium (Cr)	mg/kg	0.5	≤ 40%	<0.5	<0.5	BD	<0.5	<0.5	BD
Cesium (Cs)	mg/kg	0.01	≤ 40%	0.24	0.35	37	0.27	0.27	0
Copper (Cu)	mg/kg	0.1	≤ 40%	78	53	38	43	39	10
Iron (Fe)	mg/kg	0.5	≤ 40%	54000	66000	20	4200	4400	5
Gallium (Ga)	mg/kg	0.03	≤ 40%	0.75	0.80	6	1.7	1.7	0
Germanium (Ge)	mg/kg	0.3	≤ 40%	2.6	3.1	18	1.2	1.3	8
Hafnium (Hf)	mg/kg	0.1	≤ 40%	0.5	0.6	18	0.5	0.5	0
Indium (In)	mg/kg	0.01	≤ 40%	<0.01	<0.01	BD	<0.01	<0.01	BD
Potassium (K)	mg/kg	1	≤ 40%	120	130	8	170	180	6
Lanthanum (La)	mg/kg	0.001	≤ 40%	78	88	12	180	180	0
Lithium (Li)	mg/kg	0.1	≤ 40%	<0.1	<0.1	BD	<0.1	<0.1	BD
Lutetium (Lu)	mg/kg	0.001	≤ 40%	0.015	0.018	18	0.040	0.043	7
Magnesium (Mg)	mg/kg	1	≤ 40%	7	8	13	7	7	0
Manganese (Mn)	mg/kg	0.05	≤ 40%	0.48	0.56	15	0.31	0.43	32
Molybdenum (Mo)	mg/kg	0.5	≤ 40%	4.2	3.1	30	2.4	4.5	**61**
Sulphur (S)	mg/kg	1	≤ 40%	71000	86000	19	5700	5400	5
Sodium (Na)	mg/kg	1	≤ 40%	3	3	0	6	6	0
Niobium (Nb)	mg/kg	0.7	≤ 40%	2.6	2.8	0.2	1.9	1.9	0.0
Nickel (Ni)	mg/kg	1	≤ 40%	42	54	25	3	3	0
Lead (Pb)	mg/kg	0.7	≤ 40%	290	310	7	250	250	0
Phosphorous (P)	mg/kg	5	≤ 40%	66	68	3	150	150	0
Rubidium (Rb)	mg/kg	0.004	≤ 40%	0.98	1.2	20	1.6	1.7	6
Antimony (Sb)	mg/kg	1	≤ 40%	<1	<1	BD	<1	<1	BD
Scandium (Sc)	mg/kg	0.2	≤ 40%	<0.2	<0.2	BD	<0.2	<0.2	BD
Selenium (Se)	mg/kg	1	≤ 40%	2	1	1	<1	<1	BD
Tin (Sn)	mg/kg	6	≤ 40%	<6	<6	BD	<6	<6	BD
Strontium (Sr)	mg/kg	0.01	≤ 40%	3.1	3.3	6	6.7	6.8	1
Tantalum (Ta)	mg/kg	0.01	≤ 40%	0.10	0.19	62	0.16	0.17	6
Terbium (Tb)	mg/kg	0.01	≤ 40%	0.37	0.40	8	0.96	0.97	1
Tellurium (Te)	mg/kg	0.1	≤ 40%	0.3	0.3	0	<0.1	<0.1	BD
Thorium (Th)	mg/kg	0.01	≤ 40%	23	27	16	42	42	0
Titanium (Ti)	mg/kg	0.2	≤ 40%	27	28	4	37	38	3
Thallium (Tl)	mg/kg	3	≤ 40%	<3	<3	BD	<3	<3	BD
Uranium (U)	mg/kg	3	≤ 40%	7.2	8.0	1	3.8	3.9	0
Vanadium (V)	mg/kg	0.1	≤ 40%	0.1	0.1	0.0	0.2	0.2	0.0
Tungsten (W)	mg/kg	1	≤ 40%	19	25	27	2	2	0
Yttrium (Y)	mg/kg	0.1	≤ 40%	2.9	3.2	10	6.7	6.9	3
Ytterbium (Yb)	mg/kg	0.1	≤ 40%	0.12	0.14	0.0	0.35	0.37	0.0
Zinc (Zn)	mg/kg	0.1	≤ 40%	4.4	5.1	15	6.0	7.8	26
Zirconium (Zr)	mg/kg	5	≤ 40%	9	9	0	8	8	0

Notes:

RPD - relative percent difference; is calculated for analytes with concentrations greater than or equal to five times the detection limit and should be less than or equal to 40%

AD - absolute difference; for samples having concentrations less than five times the detection limit, the difference between the sample and duplicate, or difference between the sample or duplicate and the detection limit if either the sample or duplicate analyte concentration is below detection limit; should not be greater then the detection limit

BD - Sample and/or replicate had analyte concentrations below detection limit

Boldface type and shaded indicates that Data Quality Objective was not achieved

Table A2.2: Detailed Data Quality Assessment for Constituents in Short-Term Leachate Waters

Analysis	Units	Method Detection Limit	RPD Data Quality Objective	Sample ID Core09-QC15-2 (10-20)	Replicate ID Core09-QC15-6 (10-20)	RPD (%) or AD	Sample ID Core09-QC15-4 (10-20)	Replicate ID Core09-QC15-6 (20-30)	RPD (%) or AD
Conventional Parameters									
Acidity (as $CaCO_3$)	mg/L	2	≤ 20%	13	41	**104**	30	27	11
Sulphate (SO_4)	mg/L	0.2	≤ 20%	1500	1200	**22**	48	48	0
Hardness (as $CaCO_3$)	mg/L	0.5	≤ 20%	1440	1196	19	38.1	39.1	3
Metals									
Radium-226 (Ra-226)	Bq/L	0.01	≤ 20%	1.4	1.3	7	3.7	3.3	11
Aluminum (Al)	mg/L	0.01	≤ 20%	<0.01	0.05	BD	0.28	0.32	13
Arsenic (As)	mg/L	0.0002	≤ 20%	0.0060	0.0074	**21**	0.0380	0.0370	3
Barium (Ba)	mg/L	0.00001	≤ 20%	0.0239	0.0286	18	0.0480	0.0427	12
Beryllium (Be)	mg/L	0.00002	≤ 20%	<0.00002	<0.00002	BD	0.00002	0.00003	0.00001
Boron (B)	mg/L	0.0002	≤ 20%	0.0149	0.0150	1	0.0086	0.0083	4
Bismuth (Bi)	mg/L	0.00001	≤ 20%	0.00012	0.00023	**63**	0.00095	0.00090	5
Calcium (Ca)	mg/L	0.03	≤ 20%	574	478	18	14.6	15.0	3
Cadmium (Cd)	mg/L	0.000003	≤ 20%	0.00127	0.00152	18	0.000619	0.000614	1
Cobalt (Co)	mg/L	0.000002	≤ 20%	0.0173	0.0181	5	0.0218	0.0208	5
Chromium (Cr)	mg/L	0.0005	≤ 20%	<0.0005	<0.0005	BD	<0.0005	<0.0005	BD
Copper (Cu)	mg/L	0.0005	≤ 20%	0.0056	0.0214	**117**	0.0121	0.0070	**53**
Iron (Fe)	mg/L	0.01	≤ 20%	0.02	0.05	0.03	0.09	0.20	**76**
Potassium (K)	mg/L	0.01	≤ 20%	2.91	2.87	1	1.64	1.72	5
Lithium (Li)	mg/L	0.002	≤ 20%	<0.002	0.002	BD	<0.002	<0.002	BD
Magnesium (Mg)	mg/L	0.003	≤ 20%	0.479	0.487	2	0.412	0.423	3
Manganese (Mn)	mg/L	0.00001	≤ 20%	0.0311	0.0299	4	0.0274	0.0261	5
Molybdenum (Mo)	mg/L	0.00001	≤ 20%	0.00104	0.00082	**24**	0.00192	0.00228	17
Sodium (Na)	mg/L	0.01	≤ 20%	0.76	0.67	13	0.46	0.49	6
Nickel (Ni)	mg/L	0.0001	≤ 20%	0.0392	0.0391	0	0.0093	0.0096	3
Lead (Pb)	mg/L	0.00002	≤ 20%	<0.01	<0.01	BD	<0.01	<0.01	BD
Phosphorous (P)	mg/L	0.01	≤ 20%	3.06	3.54	15	13.5	12.1	11
Antimony (Sb)	mg/L	0.0002	≤ 20%	0.0012	0.0014	15	0.0040	0.0038	5
Selenium (Se)	mg/L	0.001	≤ 20%	0.002	0.002	0	0.007	0.007	0
Sulphur (S)	mg/L	0.01	≤ 20%	5.88	5.56	6	3.06	3.31	8
Silicon (Si)	mg/L	0.01	≤ 20%	486	408	17	17.8	18.5	4
Tin (Sn)	mg/L	0.00001	≤ 20%	<0.00001	<0.00001	BD	0.00011	0.00011	0
Strontium (Sr)	mg/L	0.0001	≤ 20%	0.240	0.196	20	0.0040	0.0038	5
Titanium (Ti)	mg/L	0.0001	≤ 20%	0.0012	0.0010	18	0.0035	0.0038	8
Thallium (Tl)	mg/L	0.0002	≤ 20%	0.0017	0.0020	16	0.0006	0.0006	0
Uranium (U)	mg/L	0.000001	≤ 20%	0.00342	0.0139	**121**	0.122	0.139	13
Vanadium (V)	mg/L	0.00003	≤ 20%	<0.00003	0.00004	BD	<0.00003	<0.00003	BD
Zinc (Zn)	mg/L	0.001	≤ 20%	0.058	0.091	44	0.003	0.007	**0.004**

Notes:

RPD - relative percent difference; is calculated for analytes with concentrations greater than or equal to five times the detection limit and should be less than or equal to 40%

AD - absolute difference; for samples having concentrations less than five times the detection limit, the difference between the sample and duplicate, or difference between the sample or duplicate and the detection limit if either the sample or duplicate analyte concentration is below detection limit; should not be greater then the detection limit

BD - Sample and/or replicate had analyte concentrations below detection limit

Boldface type and shaded indicates that Data Quality Objective was not achieved

Table A2.3: Detailed Data Quality Assessment for Constituents in the Blank Sample

Analysis	Units	Detection Limit	Data Quality Objective	Blank
Convential Parameters				
Acidity (as $CaCO_3$)	mg/L	2	4	**6**
Sulphate (SO_4)	mg/L	0.1	0.2	**0.6**
Hardness (as $CaCO_3$)	mg/L	0.5	1.0	<0.5
Metals				
Radium-226 (Ra-226)	Bq/L	0.01	0.02	<0.01
Aluminum (Al)	mg/L	0.01	0.02	<0.01
Arsenic (As)	mg/L	0.0002	0.0004	**0.0007**
Barium (Ba)	mg/L	0.00001	0.00002	**0.00060**
Beryllium (Be)	mg/L	0.00002	0.00004	<0.00002
Boron (B)	mg/L	0.0002	0.0004	0.0004
Bismuth (Bi)	mg/L	0.00001	0.00002	**0.00003**
Calcium (Ca)	mg/L	0.03	0.06	0.05
Cadmium (Cd)	mg/L	0.000003	0.000006	**0.000011**
Cobalt (Co)	mg/L	0.000002	0.000004	**0.000260**
Chromium (Cr)	mg/L	0.0005	0.0010	<0.0005
Copper (Cu)	mg/L	0.0005	0.0010	**0.0068**
Iron (Fe)	mg/L	0.01	0.02	<0.01
Potassium (K)	mg/L	0.01	0.02	<0.01
Lithium (Li)	mg/L	0.002	0.004	<0.002
Magnesium (Mg)	mg/L	0.003	0.006	<0.003
Manganese (Mn)	mg/L	0.00001	0.00002	**0.00049**
Molybdenum (Mo)	mg/L	0.00001	0.00002	**0.00009**
Sodium (Na)	mg/L	0.01	0.02	0.02
Nickel (Ni)	mg/L	0.0001	0.0002	**0.0006**
Lead (Pb)	mg/L	0.00002	0.00004	**0.0968**
Phosphorous (P)	mg/L	0.01	0.02	<0.01
Antimony (Sb)	mg/L	0.0002	0.0004	<0.0002
Selenium (Se)	mg/L	0.001	0.002	<0.001
Sulphur (S)	mg/L	0.01	0.02	0.02
Silicon (Si)	mg/L	0.01	0.02	<0.01
Tin (Sn)	mg/L	0.00001	0.00002	<0.00001
Strontium (Sr)	mg/L	0.0001	0.0002	<0.0001
Titanium (Ti)	mg/L	0.0001	0.0002	0.0001
Thallium (Tl)	mg/L	0.0002	0.0004	<0.0002
Uranium (U)	mg/L	0.000001	0.000002	**0.000464**
Vanadium (V)	mg/L	0.00003	0.00006	<0.00003
Zinc (Zn)	mg/L	0.001	0.002	0.001

Notes:
Boldface type and shaded indicates that Data Quality Objective was not achieved

APPENDIX 3

Certificates of Analysis for the 2009 Field and Laboratory Data

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Tuesday, October 27, 2009

Date Rec. : 09 October 2009
LR. Ref. : **CA10156-OCT09**

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: CORE 09-QC-15-1 (0-10)	6: CORE 09-QC-15-1 (10-20)	7: CORE 09-QC-15-1 (20-30)	8: CORE 09-QC-15-1 (30-40)	9: CORE 09-QC-15-2 (0-10)
Sample Date & Time					07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09
Paste pH [units]	22-Oct-09	09:00	25-Oct-09	14:15	5.53	5.15	5.05	4.66	5.88
Fizz Rate [---]	22-Oct-09	09:00	25-Oct-09	14:15	1	1	1	1	1
Sample [weight(g)]	22-Oct-09	09:00	25-Oct-09	14:15	1.96	1.96	2.03	1.96	2.02
HCl added [mL]	22-Oct-09	09:00	25-Oct-09	14:15	20.00	20.00	20.00	20.00	20.00
HCl [Normality]	22-Oct-09	09:00	25-Oct-09	14:15	0.10	0.10	0.10	0.10	0.10
NaOH [Normality]	22-Oct-09	09:00	25-Oct-09	14:15	0.10	0.10	0.10	0.10	0.10
NaOH to [pH=8.3 mL]	22-Oct-09	09:00	25-Oct-09	14:15	18.25	18.66	18.38	18.78	18.43
Final pH [units]	22-Oct-09	09:00	25-Oct-09	14:15	0.98	1.37	1.08	1.38	1.17
NP [t CaCO3/1000t]	22-Oct-09	09:00	25-Oct-09	14:15	4.5	3.4	4.0	3.1	3.9
AP [t CaCO3/1000 t]	25-Oct-09	14:15	25-Oct-09	14:15	10.9	7.12	9.59	9.69	3.32
Net NP [t CaCO3/1000 t]	25-Oct-09	14:15	25-Oct-09	14:15	-6.39	-3.72	-5.59	-6.59	0.58
NP/AP [ratio]	25-Oct-09	14:15	25-Oct-09	14:15	0.41	0.48	0.42	0.32	1.17
S [%]	21-Oct-09	10:46	21-Oct-09	11:11	0.375	0.385	0.352	0.473	0.461
SO4-S [%]	21-Oct-09	10:46	22-Oct-09	10:40	0.03	0.16	0.04	0.16	0.35
Sulphide-S [%]	21-Oct-09	10:46	22-Oct-09	10:40	0.35	0.23	0.31	0.31	0.11
C [%]	21-Oct-09	10:46	21-Oct-09	11:11	0.148	0.045	0.058	0.021	0.116
CO3 [%]	21-Oct-09	10:46	25-Oct-09	14:02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

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```
*NP (Neutralization Potential)
 = 50 x (N of HCL x Total HCL added - N NaOH x NaOH added)
   ------------------------------------------------------
                        Weight of Sample

*AP (Acid Potential) = % Sulphide Sulphur x 31.25
*Net NP (Net Neutralization Potential) = NP-AP
NP/AP Ratio = NP/AP
*Results expressed as tonnes CaCO3 equivalent/1000 tonnes of material
Samples with a % Sulphide value of <0.01 will be calculated using a 0.01 value.

Sulphur analysis performed following BC ARD Guidelines (Price 1997)
```

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**10: CORE 09-QC-15-2 (10-20)**	**11: CORE 09-QC-15-2 (20-30)**	**12: CORE 09-QC-15-2 (30-40)**	**13: CORE 09-QC-15-3 (0-10)**	**14: CORE 09-QC-15-3 (10-20)**	**15: CORE 09-QC-15-3 (20-30)**	**16: CORE 09-QC-15-3 (30-40)**	**17: CORE 09-QC-15-4 (0-10)**	**18: CORE 09-QC-15-4 (10-20)**
Sample Date & Time	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09
Paste pH [units]	5.11	5.09	4.10	5.20	4.16	4.77	4.52	4.72	3.72
Fizz Rate [---]	1	1	1	1	1	1	1	1	1
Sample [weight(g)]	2.00	2.04	2.03	1.97	1.96	2.04	2.03	2.00	1.97
HCl added [mL]	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
HCl [Normality]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH [Normality]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH to [pH=8.3 mL]	18.58	18.64	18.68	18.73	18.75	18.50	18.54	18.34	18.64
Final pH [units]	1.24	1.28	1.21	1.14	1.01	1.05	0.93	0.98	1.14
NP [t CaCO3/1000t]	3.5	3.3	3.3	3.2	3.2	3.7	3.6	4.1	3.4
AP [t CaCO3/1000 t]	8.84	15.3	25.7	56.5	140	83.5	86.8	44.1	300
Net NP [t CaCO3/1000 t]	-5.34	-11.99	-22.39	-53.31	-137.30	-79.84	-83.15	-39.96	-296.64
NP/AP [ratio]	0.40	0.22	0.13	0.06	0.02	0.04	0.04	0.09	0.01
S [%]	0.583	0.801	1.000	2.29	4.58	3.64	3.49	3.57	10.6
SO4-S [%]	0.30	0.31	0.18	0.48	0.08	0.96	0.72	2.16	1.04
Sulphide-S [%]	0.28	0.49	0.82	1.81	4.50	2.67	2.78	1.41	9.60
C [%]	0.022	0.017	0.022	0.356	0.026	0.015	0.026	0.190	0.061
CO3 [%]	< 0.005	< 0.005	< 0.005	0.014	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

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Analysis	**19: CORE 09-QC-15-4 (20-30)**	**20: CORE 09-QC-15-4 (30-40)**	**21: CORE 09-QC-15-5 (0-10)**	**22: CORE 09-QC-15-5 (10-20)**	**23: CORE 09-QC-15-5 (20-30)**	**24: CORE 09-QC-15-5 (30-40)**	**25: CORE 09-QC-15-5 (40-50)**	**26: CORE 09-QC-15-6 (0-10)**	**27: CORE 09-QC-15-6 (10-20)**
Sample Date & Time	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09
Paste pH [units]	3.30	3.32	3.00	3.02	2.97	2.81	2.81	3.27	4.70
Fizz Rate [---]	1	1	1	1	1	1	1	1	1
Sample [weight(g)]	1.99	2.00	2.02	1.96	2.01	2.00	2.01	1.99	2.01
HCl added [mL]	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
HCl [Normality]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH [Normality]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH to [pH=8.3 mL]	18.80	18.73	18.39	18.40	18.67	18.29	18.30	18.42	18.60
Final pH [units]	1.23	0.97	1.09	1.31	1.05	1.15	1.07	1.04	1.04
NP [t CaCO3/1000t]	3.0	3.2	4.0	4.1	3.3	4.3	4.2	4.0	3.5
AP [t CaCO3/1000 t]	66.1	172	13.8	138	99.9	168	290	248	11.2
Net NP [t CaCO3/1000 t]	-63.09	-168.82	-9.77	-133.75	-96.62	-163.98	-285.98	-244.10	-7.66
NP/AP [ratio]	0.05	0.02	0.29	0.03	0.03	0.03	0.01	0.02	0.31
S [%]	8.14	12.9	0.521	8.69	5.61	10.9	13.8	8.26	0.492
SO4-S [%]	6.02	7.40	0.08	4.28	2.42	5.54	4.50	0.32	0.13
Sulphide-S [%]	2.11	5.50	0.44	4.41	3.20	5.38	9.29	7.94	0.36
C [%]	0.065	0.066	0.123	0.055	0.016	0.055	0.051	0.015	0.015
CO3 [%]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

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Sample Date & Time			07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09
BaSO4 Calc. using Ba* [µg/g]	---	---	290	310	290	310	440	510	320
BaSO4 Calc. using SO4** [µg/g]	---	---	2430	2430	2430	4860	26700	7290	2430
Sulphate [%]	26-Oct-09	09:36	0.1	0.1	0.1	0.2	1.1	0.3	0.1
Silver [µg/g]	21-Oct-09	13:04	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Aluminum [µg/g]	21-Oct-09	13:04	710	500	830	260	330	180	150
Arsenic [µg/g]	21-Oct-09	13:04	11	10	11	10	13	14	13
Barium [µg/g]	21-Oct-09	13:04	170	180	170	180	260	300	190
Beryllium [µg/g]	21-Oct-09	13:04	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Bismuth [µg/g]	21-Oct-09	13:04	1.8	1.1	1.5	2.6	6.0	5.9	3.7
Calcium [µg/g]	21-Oct-09	13:04	250	130	210	730	4500	1200	210
Cadmium [µg/g]	21-Oct-09	13:04	0.31	0.09	0.13	< 0.05	0.29	0.09	0.10
Cerium [µg/g]	20-Oct-09	16:07	200	220	210	220	280	310	250
Cobalt [µg/g]	21-Oct-09	13:04	8.8	6.3	6.7	6.6	5.1	7.1	11
Chromium [µg/g]	21-Oct-09	13:04	1.0	< 0.5	0.6	0.9	0.8	< 0.5	< 0.5
Cesium [µg/g]	20-Oct-09	16:07	0.15	0.12	0.23	0.40	0.38	0.27	0.14
Copper [µg/g]	21-Oct-09	13:04	27	21	22	30	29	39	37
Iron [µg/g]	21-Oct-09	13:04	13000	3300	4100	4000	17000	4400	5700
Gallium [µg/g]	20-Oct-09	16:07	1.2	1.2	1.2	1.3	1.7	1.7	1.4
Germanium [µg/g]	20-Oct-09	16:07	1.2	1.0	0.9	1.0	1.6	1.3	1.1
Hafnium [µg/g]	20-Oct-09	16:07	0.3	0.3	0.3	0.4	0.6	0.5	0.4
Indium [µg/g]	20-Oct-09	16:07	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Potassium [µg/g]	21-Oct-09	13:04	77	68	80	130	260	180	130
Lanthanum [µg/g]	20-Oct-09	16:07	110	120	120	130	150	180	140
Lithium [µg/g]	21-Oct-09	13:04	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1	< 0.1
Lutetium [µg/g]	20-Oct-09	16:07	0.17	0.15	0.084	0.019	0.36	0.043	0.023
Magnesium [µg/g]	21-Oct-09	13:04	42	17	23	49	37	7	6
Manganese [µg/g]	21-Oct-09	13:04	12	2.6	2.3	1.9	11	0.43	0.14
Molybdenum [µg/g]	21-Oct-09	13:04	7.0	5.4	5.2	4.1	9.0	4.5	5.0
Sulphur [µg/g]		11:12	3200	2100	3000	4600	5300	5400	6300
Sodium [µg/g]	21-Oct-09	13:04	4	3	4	9	14	6	3

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Niobuim [µg/g]	20-Oct-09	16:07	1.3	1.1	1.0	1.2	2.2	1.9	1.4
Nickel [µg/g]	21-Oct-09	13:04	6	5	6	3	4	3	4
Lead [µg/g]	21-Oct-09	13:04	140	98	130	150	300	250	150
Phosphorus [µg/g]	21-Oct-09	13:04	100	100	100	110	130	150	120
Rubidium [µg/g]	20-Oct-09	16:07	0.83	0.81	0.92	1.3	2.5	1.7	1.2
Antimony [µg/g]	21-Oct-09	13:04	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Scandium [µg/g]	20-Oct-09	16:07	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.2	< 0.2
Selenium [µg/g]	21-Oct-09	13:04	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Tin [µg/g]	21-Oct-09	13:04	< 6	< 6	< 6	< 6	< 6	< 6	< 6
Strontium [µg/g]	21-Oct-09	13:04	3.8	3.7	3.8	4.5	7.7	6.8	4.8
Tantalum [µg/g]	20-Oct-09	16:07	0.04	0.05	0.04	0.06	0.04	0.17	0.11
Terbium [µg/g]	20-Oct-09	16:07	1.1	0.95	0.68	0.58	2.2	0.97	0.69
Tellerium [µg/g]	20-Oct-09	16:07	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Thorium [µg/g]	20-Oct-09	16:07	25	24	23	28	48	42	31
Titanium [µg/g]	21-Oct-09	13:04	28	24	29	57	66	38	24
Thallium [µg/g]	21-Oct-09	13:04	< 3	< 3	< 3	< 3	< 3	< 3	< 3
Uranium [µg/g]	20-Oct-09	16:07	29	5.8	5.5	2.0	29	3.9	4.0
Vanadium [µg/g]	21-Oct-09	13:04	0.9	0.6	0.9	0.8	0.5	0.2	0.2
Tungsten [µg/g]	21-Oct-09	13:04	4	1	2	1	6	2	2
Yttrium [µg/g]	21-Oct-09	13:04	13	7.7	4.8	3.7	32	6.9	4.7
Ytterbium [µg/g]	20-Oct-09	16:07	1.4	1.2	0.68	0.16	2.8	0.37	0.20
Zinc [µg/g]	21-Oct-09	13:04	22	11	23	4.7	16	7.8	5.0
Zirconium [µg/g]	21-Oct-09	15:00	6	< 5	5	8	13	8	6

Ra226 subcontracted to Becquerel Labs.
* BaSO4 Calculation based on Ba values and assumes all Ba is in BaSO4 form.
** BaSO4 Calculation based on SO4 values and assumes all SO4 is in BaSO4 form.

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Sample Date & Time	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09
BaSO4 Calc. using Ba* [µg/g]	320	220	220	170	200	150	120	130
BaSO4 Calc. using SO4** [µg/g]	2430	7290	17000	17000	17000	2430	2430	2430
Sulphate [%]	0.1	0.3	0.7	0.7	0.7	0.1	0.1	0.1
Silver [µg/g]	< 0.7	< 0.7	1.2	< 0.7	< 0.7	< 0.7	0.9	0.8
Aluminum [µg/g]	170	1300	180	140	150	200	160	170
Arsenic [µg/g]	13	29	21	18	18	25	36	34
Barium [µg/g]	190	130	130	100	120	90	70	74
Beryllium [µg/g]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Bismuth [µg/g]	6.3	8.1	11	6.2	6.1	4.9	9.3	7.5
Calcium [µg/g]	250	1600	4700	3100	3200	250	92	88
Cadmium [µg/g]	0.15	0.82	0.58	0.54	0.50	0.63	1.1	0.88
Cerium [µg/g]	250	190	200	170	170	190	130	140
Cobalt [µg/g]	16	44	66	60	54	58	120	98
Chromium [µg/g]	< 0.5	2.3	0.7	< 0.5	< 0.5	0.8	< 0.5	< 0.5
Cesium [µg/g]	0.25	0.33	0.22	0.15	2200	0.22	0.15	0.24
Copper [µg/g]	37	43	76	59	67	62	74	78
Iron [µg/g]	9600	46000	36000	32000	29000	36000	63000	54000
Gallium [µg/g]	1.4	1.2	1.1	0.93	0.94	1.1	0.72	0.75
Germanium [µg/g]	1.3	2.2	2.1	1.9	1.7	2.1	2.9	2.6
Hafnium [µg/g]	0.4	0.5	0.7	0.5	0.5	0.5	0.6	0.5
Indium [µg/g]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Potassium [µg/g]	210	160	120	110	120	83	110	120
Lanthanum [µg/g]	140	100	120	95	97	110	75	78
Lithium [µg/g]	< 0.1	0.2	0.3	0.3	0.1	< 0.1	< 0.1	< 0.1
Lutetium [µg/g]	0.030	0.41	0.040	0.021	0.021	0.025	0.016	0.015
Magnesium [µg/g]	7	48	9	6	6	9	7	7
Manganese [µg/g]	0.47	232	4.1	0.53	0.47	4.5	0.60	0.48
Molybdenum [µg/g]	3.0	10	5.6	8.6	5.5	20	13	4.2
Sulphur [µg/g]	10000	20000	43000	38000	35000	34000	83000	71000
Sodium [µg/g]	5	5	4	3	3	3	3	3

OnLine LIMS

SGS

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LR Report : CA10157-OCT09

Analysis	12: CORE 09-QC-15-2 (30-40)	13: CORE 09-QC-15-3 (0-10)	14: CORE 09-QC-15-3 (10-20)	15: CORE 09-QC-15-3 (20-30)	16: CORE 09-QC-15-3 (30-40)	17: CORE 09-QC-15-4 (0-10)	18: CORE 09-QC-15-4 (10-20)	19: CORE 09-QC-15-4 (20-30)
Niobuim [µg/g]	1.8	2.8	4.1	2.8	2.7	3.5	2.7	2.6
Nickel [µg/g]	7	16	28	27	24	25	47	42
Lead [µg/g]	220	350	510	260	250	140	310	290
Phosphorus [µg/g]	130	120	95	77	82	160	63	66
Rubidium [µg/g]	1.8	1.3	1.3	0.96	0.92	0.64	0.76	0.98
Antimony [µg/g]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Scandium [µg/g]	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Selenium [µg/g]	< 1	< 1	< 1	< 1	< 1	< 1	1	2
Tin [µg/g]	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6
Strontium [µg/g]	5.5	4.3	6.0	4.9	5.2	3.3	2.9	3.1
Tantalum [µg/g]	0.10	0.08	0.18	0.14	0.12	0.24	0.08	0.10
Terbium [µg/g]	0.77	1.6	0.63	0.47	0.48	0.54	0.36	0.37
Tellerium [µg/g]	< 0.1	0.2	0.2	0.2	0.2	0.1	0.3	0.3
Thorium [µg/g]	36	69	44	34	34	37	24	23
Titanium [µg/g]	36	49	42	29	30	27	26	27
Thallium [µg/g]	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3
Uranium [µg/g]	3.1	44	9.2	5.9	4.1	16	8.2	7.2
Vanadium [µg/g]	0.2	2.0	0.2	0.1	0.1	0.7	< 0.1	0.1
Tungsten [µg/g]	4	17	13	12	10	14	22	19
Yttrium [µg/g]	5.3	17	4.4	3.5	3.6	4.1	3.0	2.9
Ytterbium [µg/g]	0.27	3.4	0.33	0.17	0.17	0.20	0.12	0.12
Zinc [µg/g]	2.9	15	5.0	4.0	4.3	3.3	4.5	4.4
Zirconium [µg/g]	6	13	14	8	8	12	9	9

Ra226 subcontracted to Becquerel Labs.
* BaSO4 Calculation based on Ba values and assumes all Ba is in BaSO4 form.
** BaSO4 Calculation based on SO4 values and assumes all SO4 is in BaSO4 form.

Chris Sullivan, B.Sc., C.Chem
Project Specialist
Environmental Services, Analytical

OnLine LIMS

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Ecometrix
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Canada, L5N 2L8
Phone: 905-794-2325, Fax:905-794-2338

Tuesday, October 27, 2009

Date Rec. : 09 October 2009
LR. Ref. : **CA10157-OCT09**

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**20: CORE 09-QC-15-4 (30-40)**	**21: CORE 09-QC-15-5 (0-10)**	**22: CORE 09-QC-15-5 (10-20)**	**23: CORE 09-QC-15-5 (20-30)**	**24: CORE 09-QC-15-5 (30-40)**	**25: CORE 09-QC-15-5 (40-50)**	**26: CORE 09-QC-15-6 (0-10)**	**27: CORE 09-QC-15-6 (10-20)**
Sample Date & Time	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09	07-Oct-09
BaSO4 Calc. using Ba* [µg/g]	120	220	140	130	110	120	130	480
BaSO4 Calc. using SO4** [µg/g]	2430	2430	2430	2430	2430	2430	2430	7290
Sulphate [%]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3
Silver [µg/g]	1.4	< 0.7	0.7	0.8	1.4	1.6	1.0	< 0.7
Aluminum [µg/g]	190	150	140	150	170	170	180	170
Arsenic [µg/g]	55	13	28	31	55	61	40	13
Barium [µg/g]	71	130	81	75	66	70	76	280
Beryllium [µg/g]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Bismuth [µg/g]	12	2.9	5.5	6.1	11	12	8.6	5.6
Calcium [µg/g]	92	52	18	18	24	25	73	1300
Cadmium [µg/g]	1.6	0.09	0.93	0.95	1.9	1.8	1.1	0.08
Cerium [µg/g]	130	250	170	150	130	130	150	320
Cobalt [µg/g]	180	12	110	110	210	210	130	7.3
Chromium [µg/g]	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cesium [µg/g]	0.29	0.14	0.13	0.13	0.53	0.15	0.35	0.27
Copper [µg/g]	86	16	67	64	82	82	53	43
Iron [µg/g]	94000	6400	59000	60000	110000	110000	66000	4200
Gallium [µg/g]	0.67	1.3	0.90	0.81	0.65	0.66	0.80	1.7
Germanium [µg/g]	4.1	1.1	2.8	3.0	4.7	4.6	3.1	1.2
Hafnium [µg/g]	0.6	0.3	0.4	0.5	0.6	0.5	0.6	0.5
Indium [µg/g]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Potassium [µg/g]	140	100	98	110	120	130	130	170
Lanthanum [µg/g]	73	150	100	88	74	77	88	180
Lithium [µg/g]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Lutetium [µg/g]	0.015	0.017	0.014	0.014	0.015	0.015	0.018	0.040
Magnesium [µg/g]	9	6	5	6	7	8	8	7
Manganese [µg/g]	0.73	1.9	0.50	0.69	1.1	1.1	0.56	0.31
Molybdenum [µg/g]	9.2	7.5	6.9	2.8	27	10	3.1	2.4
Sulphur [µg/g]	130000	5700	78000	80000	150000	150000	86000	5700
Sodium [µg/g]	3	3	2	2	3	3	3	6

OnLine LIMS

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LR Report : CA10157-OCT09

Analysis	**20: CORE 09-QC-15-4 (30-40)**	**21: CORE 09-QC-15-5 (0-10)**	**22: CORE 09-QC-15-5 (10-20)**	**23: CORE 09-QC-15-5 (20-30)**	**24: CORE 09-QC-15-5 (30-40)**	**25: CORE 09-QC-15-5 (40-50)**	**26: CORE 09-QC-15-6 (0-10)**	**27: CORE 09-QC-15-6 (10-20)**
Niobuim [µg/g]	3.2	1.4	2.0	2.4	3.0	2.9	2.8	1.9
Nickel [µg/g]	74	4	45	45	90	89	54	3
Lead [µg/g]	340	170	310	310	330	380	310	250
Phosphorus [µg/g]	61	130	81	67	59	62	68	150
Rubidium [µg/g]	1.1	0.60	0.56	0.67	0.70	0.71	1.2	1.6
Antimony [µg/g]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Scandium [µg/g]	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Selenium [µg/g]	2	< 1	1	1	5	4	1	< 1
Tin [µg/g]	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6
Strontium [µg/g]	3.4	3.3	3.2	3.2	3.2	3.5	3.3	6.7
Tantalum [µg/g]	0.11	0.07	0.07	0.08	0.10	0.09	0.19	0.16
Terbium [µg/g]	0.33	0.65	0.45	0.40	0.35	0.34	0.40	0.96
Tellerium [µg/g]	0.5	< 0.1	0.2	0.3	0.5	0.5	0.3	< 0.1
Thorium [µg/g]	24	31	29	25	26	26	27	42
Titanium [µg/g]	34	16	18	20	24	25	28	37
Thallium [µg/g]	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3
Uranium [µg/g]	8.1	4.4	3.0	3.6	5.6	5.9	8.0	3.8
Vanadium [µg/g]	< 0.1	0.2	< 0.1	0.1	< 0.1	< 0.1	0.1	0.2
Tungsten [µg/g]	35	3	21	22	42	41	25	2
Yttrium [µg/g]	2.7	4.6	3.5	2.9	2.8	2.8	3.2	6.7
Ytterbium [µg/g]	0.12	0.14	0.11	0.11	0.12	0.12	0.14	0.35
Zinc [µg/g]	7.0	1.9	3.6	4.2	6.7	9.9	5.1	6.0
Zirconium [µg/g]	12	< 5	6	7	9	8	9	8

Ra226 subcontracted to Becquerel Labs.
* BaSO4 Calculation based on Ba values and assumes all Ba is in BaSO4 form.
** BaSO4 Calculation based on SO4 values and assumes all SO4 is in BaSO4 form.

Chris Sullivan, B.Sc., C.Chem
Project Specialist
Environmental Services, Analytical

OnLine LIMS

ANALYSIS REPORT

Becquerel LABORATORIES

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Mississauga, Ontario
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Batch: T09-01484.0

Date: 30-Nov-2009

Lakefield Research Ltd.

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Lakefield, ON, K0L 2H0

attn:Chris Sullivan

Phone: (705) 652-2038
FAX: (705) 652-1918

Client Ref.
Oct 10157.R09
P.O: 17820

23 rock samples Sampled: 07-Oct-2009 Received: 21-Oct-2009

Results of Analysis

Sample	Test	Result	Units	Date	Method
CORE 09-QC-15-1 (0-10)	Ra-226	3.5	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-1 (10-20)	Ra-226	3.7	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-1 (20-30)	Ra-226	4.1	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-1 (30-40)	Ra-226	4.9	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-2 (0-10)	Ra-226	9.0	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-2 (10-20)	Ra-226	7.2	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-2 (20-30)	Ra-226	6.1	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-2 (30-40)	Ra-226	6.8	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-3 (0-10)	Ra-226	4.5	Bq/g	29-Nov-2009	ALPHA
CORE 09-QC-15-3 (10-20)	Ra-226	6.1	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-3 (20-30)	Ra-226	5.7	Bq/g	22-Nov-2009	ALPHA
CORE 09-QC-15-3 (30-40)	Ra-226	5.2	Bq/g	29-Nov-2009	ALPHA
CORE 09-QC-15-4 (0-10)	Ra-226	3.8	Bq/g	29-Nov-2009	ALPHA
CORE 09-QC-15-4 (10-20)	Ra-226	6.3	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-4 (20-30)	Ra-226	5.8	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-4 (30-40)	Ra-226	6.5	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-5 (0-10)	Ra-226	4.3	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-5 (10-20)	Ra-226	5.2	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-5 (20-30)	Ra-226	5.1	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-5 (30-40)	Ra-226	6.5	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-5 (40-50)	Ra-226	4.8	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-6 (0-10)	Ra-226	7.2	Bq/g	23-Nov-2009	ALPHA
CORE 09-QC-15-6 (10-20)	Ra-226	6.3	Bq/g	23-Nov-2009	ALPHA

ANALYSIS REPORT

Becquerel Laboratories Inc.
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Mississauga, Ontario
Canada, L5N 5L9

Phone: (905) 826-3080
FAX: (905) 826-4151

Batch: T09-01484.0

Date: 30-Nov-2009

Methods: ALPHA BQ-RAD-ALPHA alpha-particle spectrometry

Units: Bq/g Becquerels per gram

These results relate only to the samples analysed and only to the items tested.

30-Nov-2009 approved by: Donald D. Burgess

Donald D. Burgess PhD
Senior Scientist, Division Supervisor

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Wednesday, November 18, 2009

Date Rec. : 21 October 2009
LR Report: **CA11276-OCT09**
Reference: 09-1662 Rio Algom

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: Core09-QC15-1 (0-10)	6: Core09-QC15-1 (10-20)	7: Core09-QC15-1 (20-30)	8: Core09-QC15-1 (30-40)	9: Core09-QC15-2 (0-10)	10: Core09-QC15-2 (10-20)	11: Core09-QC15-2 (20-30)	12: Core09-QC15-2 (30-40)
Sample Date & Time					15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09
Temperature Upon Receipt [°C]	---	---	---	---	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Sulphate [mg/L]	26-Oct-09	13:29	02-Nov-09	12:16	90	74	130	680	1500	1500	93	260
Acidity [mg/L as CaCO3]	03-Nov-09	09:13	04-Nov-09	15:55	9	27	16	12	6	13	15	19
Hardness [mg/L as CaCO3]	23-Oct-09	07:54	26-Oct-09	11:13	98.5	77.4	137	680	1440	1440	104	276
Aluminum [mg/L]	23-Oct-09	07:54	26-Oct-09	11:12	0.01	0.13	0.07	0.02	< 0.01	< 0.01	0.05	0.13
Arsenic [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0030	0.0168	0.0318	0.0038	0.0026	0.0060	0.0157	0.0061
Barium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0882	0.0769	0.0699	0.0292	0.0307	0.0239	0.0685	0.0385
Beryllium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00004	0.00015	0.00012	0.00003	< 0.00002	< 0.00002	< 0.00002	0.00005
Boron [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0509	0.0302	0.0336	0.0104	0.0622	0.0149	0.0168	0.0226
Bismuth [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00002	0.00002	0.00003	0.00009	0.00002	0.00012	0.00038	0.00014
Calcium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	37.9	29.9	53.8	272	575	574	40.9	109
Cadmium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.000121	0.00355	0.00459	0.000530	0.000168	0.00127	0.00201	0.000746
Cobalt [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0345	0.275	0.372	0.00691	0.0443	0.0173	0.00823	0.0188
Chromium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0005	0.0072	0.0026	0.0150	0.0015	0.0056	0.0194	0.124
Iron [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.08	0.02	< 0.01	0.02	< 0.01	0.02	0.02	0.03
Potassium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	2.18	2.01	1.98	1.96	3.69	2.91	2.07	3.14
Lithium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Magnesium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.914	0.691	0.628	0.449	1.30	0.479	0.445	0.747
Manganese [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.197	0.0374	0.0296	0.0221	0.146	0.0311	0.0270	0.0450
Molybdenum [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00027	0.00020	0.00032	0.00041	0.00025	0.00104	0.00057	0.00019
Sodium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.29	0.47	0.45	0.52	0.83	0.76	0.57	0.54
Nickel [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0635	0.500	0.662	0.0137	0.155	0.0392	0.0127	0.0236

OnLine LIMS

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LR Report : CA11276-OCT09

Analysis	**1: Analysis Start Date**	**2: Analysis Start Time**	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: Core09-QC15-1 (0-10)**	**6: Core09-QC15-1 (10-20)**	**7: Core09-QC15-1 (20-30)**	**8: Core09-QC15-1 (30-40)**	**9: Core09-QC15-2 (0-10)**	**10: Core09-QC15-2 (10-20)**	**11: Core09-QC15-2 (20-30)**	**12: Core09-QC15-2 (30-40)**
Phosphorus [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lead [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0129	0.667	1.25	1.72	0.0398	3.06	1.01	2.08
Sulphur [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	33.3	27.9	47.7	234	486	486	35.4	97.1
Antimony [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.0002	0.0007	0.0009	0.0004	< 0.0002	0.0012	0.0014	0.0008
Selenium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.001	< 0.001	< 0.001	0.002	0.002	0.002	< 0.001	0.002
Silica [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	6.96	5.14	5.94	3.77	12.2	5.88	6.36	5.12
Tin [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.00007	< 0.00001
Strontium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.0446	0.0316	0.0404	0.118	0.258	0.240	0.0446	0.0758
Titanium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0005	0.0004	0.0004	0.0007	0.0008	0.0012	0.0050	0.0014
Thallium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0008	0.0019	0.0040	0.0004	0.0019	0.0017	0.0018	0.0019
Uranium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00523	0.00845	0.00751	0.00290	0.00779	0.00342	0.00268	0.0135
Vanadium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00003	< 0.00003	0.00005	< 0.00003	0.00004	< 0.00003	< 0.00003	< 0.00003
Zinc [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.008	0.507	0.725	0.021	0.013	0.058	0.027	0.075

Ra226 subcontracted to Becquerel Labs.

Dianne Griffin
Project Specialist

OnLine LIMS

SGS Lakefield Research Limited
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Ecometrix
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6800 Campobello Road
Mississauga, Ontario
L5N 2L8, Canada

Phone: 905-794-2325
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Wednesday, November 18, 2009

Date Rec. : 21 October 2009
LR Report: **CA11276-OCT09**
Reference: 09-1662 Rio Algom

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	13: Core09-QC15-3 (0-10)	14: Core09-QC15-3 (10-20)	15: Core09-QC15-3 (20-30)	16: Core09-QC15-3 (30-40)	17: Core09-QC15-4 (0-10)	18: Core09-QC15-4 (10-20)	19: Core09-QC15-4 (20-30)	20: Core09-QC15-4 (30-40)
Sample Date & Time					15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09
Temperature Upon Receipt [°C]	---	---	---	---	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Sulphate [mg/L]	26-Oct-09	13:29	02-Nov-09	12:16	590	1000	1400	1400	69	48	46	36
Acidity [mg/L as CaCO3]	03-Nov-09	09:13	04-Nov-09	15:55	9	19	13	11	10	30	27	12
Hardness [mg/L as CaCO3]	23-Oct-09	07:54	26-Oct-09	11:13	580	1020	1380	1390	75.4	38.1	33.4	28.6
Aluminum [mg/L]	23-Oct-09	07:54	26-Oct-09	11:12	< 0.01	< 0.01	< 0.01	0.01	0.02	0.28	0.18	0.06
Arsenic [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0012	0.0051	0.0048	0.0043	0.0009	0.0380	0.0646	0.157
Barium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0330	0.0303	0.0310	0.0481	0.112	0.0480	0.0592	0.0760
Beryllium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	0.00002	< 0.00002	< 0.00002
Boron [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0317	0.0115	0.0104	0.0114	0.0234	0.0086	0.0073	0.0079
Bismuth [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00001	0.00008	0.00010	0.00012	0.00004	0.00095	0.00079	0.00161
Calcium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	229	409	552	556	29.0	14.6	12.8	10.9
Cadmium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00262	0.00239	0.00161	0.000444	0.000014	0.000619	0.000531	0.000305
Cobalt [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0334	0.0413	0.0330	0.0159	0.0150	0.0218	0.0101	0.0042
Chromium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0042	0.0023	0.0025	0.0019	0.0021	0.0121	0.0164	0.0025
Iron [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.01	0.01	< 0.01	< 0.01	0.02	0.09	0.17	0.13
Potassium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	2.61	1.97	2.33	2.93	1.44	1.64	1.65	1.64
Lithium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.002	0.004	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Magnesium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	1.89	0.395	0.364	0.368	0.724	0.412	0.365	0.318
Manganese [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	3.49	0.196	0.0637	0.0420	0.195	0.0274	0.0234	0.0182
Molybdenum [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00003	0.00071	0.00144	0.00156	0.00038	0.00192	0.00246	0.00404
Sodium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.62	0.58	0.63	0.63	0.55	0.46	0.43	0.43
Nickel [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0528	0.0395	0.0426	0.0250	0.0088	0.0093	0.0060	0.0038

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Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

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LR Report : CA11276-OCT09

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	13: Core09-QC15-3 (0-10)	14: Core09-QC15-3 (10-20)	15: Core09-QC15-3 (20-30)	16: Core09-QC15-3 (30-40)	17: Core09-QC15-4 (0-10)	18: Core09-QC15-4 (10-20)	19: Core09-QC15-4 (20-30)	20: Core09-QC15-4 (30-40)
Phosphorus [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03
Lead [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0535	2.27	2.60	2.56	0.0474	13.5	14.4	8.79
Sulphur [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	200	348	468	472	26.2	17.8	17.1	13.1
Antimony [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.0002	0.0015	0.0018	0.0019	0.0003	0.0040	0.0029	0.0026
Selenium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.001	0.003	0.004	0.007	< 0.001	0.007	0.008	0.009
Silica [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	6.44	4.25	5.93	7.45	4.85	3.06	3.78	4.22
Tin [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00001	< 0.00001	< 0.00001	0.00006	< 0.00001	0.00011	0.00014	0.00010
Strontium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.0973	0.125	0.192	0.198	0.0317	0.0040	0.0068	0.0116
Titanium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0005	0.0007	0.0013	0.0018	0.0009	0.0035	0.0042	0.0065
Thallium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0006	0.0013	0.0004	< 0.0002	0.0005	0.0006	0.0004	0.0003
Uranium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0106	0.00784	0.00360	0.00158	0.000791	0.122	0.127	0.03115
Vanadium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00003	< 0.00003	< 0.00003	< 0.00003	< 0.00003	< 0.00003	< 0.00003	0.00011
Zinc [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.034	0.053	0.036	0.016	0.003	0.003	0.002	0.003

Ra226 subcontracted to Becquerel Labs.

Dianne Griffin
Project Specialist

OnLine LIMS

SGS

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Final Report

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Sample Date & Time					15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09	15-Oct-09
Temperature Upon Receipt [°C]	---	---	---	---	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Sulphate [mg/L]	26-Oct-09	13:29	02-Nov-09	12:16	55	32	42	37	41	1200	48	0.6
Acidity [mg/L as CaCO3]	03-Nov-09	09:13	04-Nov-09	15:55	38	35	45	19	51	41	27	6
Hardness [mg/L as CaCO3]	23-Oct-09	07:54	26-Oct-09	11:13	22.9	4.2	3.9	3.4	3.2	1196	39.1	< 0.5
Aluminum [mg/L]	23-Oct-09	07:54	26-Oct-09	11:12	1.76	0.88	0.96	0.73	0.56	0.05	0.32	< 0.01
Arsenic [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0084	0.0069	0.0129	0.0053	0.0027	0.0074	0.0370	0.0007
Barium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0596	0.0902	0.0906	0.117	0.100	0.0286	0.0427	0.00060
Beryllium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00009	0.00005	0.00006	0.00004	0.00005	0.00002	0.00003	< 0.00002
Boron [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0063	0.0027	0.0032	0.0028	0.0026	0.0150	0.0083	0.0004
Bismuth [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00018	0.00040	0.00068	0.00054	0.00042	0.00023	0.00090	0.00003
Calcium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	8.46	1.35	1.17	1.00	0.94	478	15.0	0.05
Cadmium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.000069	0.000018	0.000019	0.000011	0.000010	0.00152	0.000614	0.000011
Cobalt [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0304	0.0176	0.0219	0.0197	0.0211	0.0181	0.0208	0.000260
Chromium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.109	0.130	0.0981	0.0625	0.0518	0.0214	0.0070	0.0068
Iron [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.89	6.28	11.5	10.2	11.4	0.05	0.20	< 0.01
Potassium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	1.98	1.40	1.68	1.58	1.53	2.87	1.72	< 0.01
Lithium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002	< 0.002	< 0.002
Magnesium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.444	0.194	0.246	0.214	0.206	0.487	0.423	< 0.003
Manganese [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.146	0.0702	0.104	0.0924	0.0938	0.0299	0.0261	0.00049
Molybdenum [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00026	0.00015	0.00024	0.00020	0.00017	0.00082	0.00228	0.00009
Sodium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.49	0.44	0.43	0.44	0.46	0.67	0.49	0.02
Nickel [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0173	0.0085	0.0102	0.0091	0.0097	0.0391	0.0096	0.0006

OnLine LIMS

Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

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Phone: 705-652-2000 FAX: 705-652-6365

LR Report : CA11276-OCT09

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	21: Core09-QC15-5 (0-10)	22: Core09-QC15-5 (10-20)	23: Core09-QC15-5 (20-30)	24: Core09-QC15-5 (30-40)	25: Core09-QC15-5 (40-50)	26: Core09-QC15-6 (10-20)	27: Core09-QC15-6 (20-30)	28: Core09-QC15-6 (30-40)
Phosphorus [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lead [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	8.87	11.2	9.30	9.28	9.27	3.54	12.1	0.0968
Sulphur [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	20.5	12.4	15.9	14.8	15.2	408	18.5	0.02
Antimony [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0007	0.0013	0.0014	0.0010	0.0008	0.0014	0.0038	< 0.0002
Selenium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.001	0.005	0.006	0.006	0.007	0.002	0.007	< 0.001
Silica [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	3.74	3.45	4.53	4.36	4.27	5.56	3.31	< 0.01
Tin [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.00002	< 0.00001	< 0.00001	< 0.00001	0.00006	< 0.00001	0.00011	< 0.00001
Strontium [mg/L]	23-Oct-09	07:54	26-Oct-09	11:13	0.0144	0.0085	0.0110	0.0115	0.0107	0.196	0.0038	< 0.0001
Titanium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0013	0.0012	0.0016	0.0016	0.0014	0.0010	0.0038	0.0001
Thallium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.0015	0.0006	0.0005	0.0004	0.0004	0.0020	0.0006	< 0.0002
Uranium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.161	0.0311	0.0425	0.0213	0.0117	0.0139	0.139	0.000464
Vanadium [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	< 0.00003	< 0.00003	< 0.00003	< 0.00003	< 0.00003	0.00004	0.00003	< 0.00003
Zinc [mg/L]	22-Oct-09	14:59	25-Oct-09	14:20	0.012	0.013	0.006	0.005	0.004	0.091	0.007	0.001

Ra226 subcontracted to Becquerel Labs.

Dianne Griffin
Project Specialist

OnLine LIMS

Becquerel LABORATORIES

ANALYSIS REPORT

Becquerel Laboratories Inc.
6790 Kitimat Rd., Unit 4
Mississauga, Ontario
Canada, L5N 5L9

Phone: (905) 826-3080
FAX: (905) 826-4151

Batch: T09-01511.0

Date: 23-Nov-2009

Lakefield Research Ltd.

185 Concession St., Postal Bag 4300
Lakefield, ON, K0L 2H0

attn: Brian Graham

Phone: (705) 652-2038
FAX: (705) 652-1918

Client Ref.Oct 11276
P.O: 44250

24 water samples Sampled: 15-Oct-2009 Received: 28-Oct-2009

Results of Analysis

Sample	Test	Result	Units	Date	Method
Core09-QC15-1 (0-10)	Ra-226	2.5	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-1 (10-20)	Ra-226	3.4	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-1 (20-30)	Ra-226	3.2	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-1 (30-40)	Ra-226	1.4	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-2 (0-10)	Ra-226	1.5	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-2 (10-20)	Ra-226	1.4	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-2 (20-30)	Ra-226	4.4	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-2 (30-40)	Ra-226	2.5	Bq/l	13-Nov-2009	ALPHA
Core09-QC15-3 (0-10)	Ra-226	1.2	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-3 (10-20)	Ra-226	1.4	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-3 (20-30)	Ra-226	1.4	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-3 (30-40)	Ra-226	2.1	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-4 (0-10)	Ra-226	5.4	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-4 (10-20)	Ra-226	3.7	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-4 (20-30)	Ra-226	5.0	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-4 (30-40)	Ra-226	4.5	Bq/l	15-Nov-2009	ALPHA
Core09-QC15-5 (0-10)	Ra-226	5.3	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-5 (10-20)	Ra-226	7.0	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-5 (20-30)	Ra-226	3.5	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-5 (30-40)	Ra-226	4.5	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-5 (40-50)	Ra-226	4.2	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-6 (10-20)	Ra-226	1.3	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-6 (20-30)	Ra-226	3.3	Bq/l	16-Nov-2009	ALPHA
Core09-QC15-6 (30-40)	Ra-226	< 0.01	Bq/l	16-Nov-2009	ALPHA

Becquerel
LABORATORIES

ANALYSIS REPORT

Becquerel Laboratories Inc.
6790 Kitimat Rd., Unit 4
Mississauga, Ontario
Canada, L5N 5L9

Phone: (905) 826-3080
FAX: (905) 826-4151

Batch: T09-01511.0

Date: 23-Nov-2009

Methods: ALPHA BQ-RAD-ALPHA alpha-particle spectrometry

Units: Bq/l Becquerels per litre

These results relate only to the samples analysed and only to the items tested.

23-Nov-2009 approved by: ______________________
Donald D. Burgess PhD
Senior Scientist, Division Supervisor

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October 14, 2009

Date Rec. : 01 October 2009
LR Report : **CA10064-OCT09**
Project : 09-1663

CERTIFICATE OF ANALYSIS
Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: SW09 QC15-1	6: SW09 QC15-2	7: SW09 QC15-3	8: SW09 QC15-4	9: SW09 EC-2T	10: SW09 EC-2B
Sample Date & Time					28-Sep-09	28-Sep-09	28-Sep-09	28-Sep-09	28-Sep-09	28-Sep-09
Temperature Upon Receipt [°C]	---	---	---	---	9.0	9.0	9.0	9.0	9.0	9.0
Sulphate [mg/L]	02-Oct-09	19:39	06-Oct-09	14:22	570	570	570	600	85	36
Acidity [mg/L as CaCO3]	02-Oct-09	15:00	05-Oct-09	15:14	22	27	44	50	67	16
Total Organic Carbon [mg/L]	05-Oct-09	09:40	06-Oct-09	13:53	---	---	---	---	11.4	11.7
Total Inorganic Carbon [mg/L]	05-Oct-09	14:35	08-Oct-09	12:46	---	---	---	---	< 1.0	< 1.0
Hardness [mg/L as CaCO3]	05-Oct-09	09:00	05-Oct-09	13:19	529	535	532	549	17.0	16.8
Aluminum [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	< 0.01	< 0.01	< 0.01	0.02	0.03	< 0.01
Arsenic [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0010	0.0009	0.0009	0.0011	0.0007	0.0007
Barium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0334	0.0301	0.0300	0.0296	0.108	0.114
Beryllium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00006	< 0.00002	0.00002	< 0.00002	0.00003	0.00002
Boron [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.113	0.113	0.115	0.116	0.0076	0.0072
Bismuth [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00004	0.00002	0.00001	< 0.00001	0.00002	0.00002
Calcium [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	202	205	204	210	5.69	5.63
Cadmium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.000074	0.000051	0.000039	0.000031	0.000046	0.000056
Cobalt [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00558	0.00464	0.0106	0.0122	0.00655	0.00196
Chromium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0017	0.0014	0.0013	0.0016	0.0037	0.0029
Iron [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	0.10	0.06	0.16	0.18	0.07	0.04
Potassium [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	10.8	11.0	10.9	11.9	0.31	0.32
Lithium [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	0.008	0.008	0.008	0.009	< 0.002	< 0.002
Magnesium [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	5.69	5.79	5.77	6.19	0.670	0.663

OnLine LIMS

SGS Lakefield Research Limited
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LR Report : **CA10064-OCT09**

Analysis	**1: Analysis Start Date**	**2: Analysis Start Time**	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: SW09 QC15-1**	**6: SW09 QC15-2**	**7: SW09 QC15-3**	**8: SW09 QC15-4**	**9: SW09 EC-2T**	**10: SW09 EC-2B**
Manganese [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.207	0.214	0.214	0.310	0.0315	0.0319
Molybdenum [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00319	0.00409	0.00368	0.00533	0.00018	0.00008
Sodium [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	2.38	2.42	2.37	2.59	1.59	1.58
Nickel [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0067	0.0067	0.0067	0.0068	0.0022	0.0022
Phosphorus [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lead [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00151	0.00098	0.00194	0.00548	0.00699	0.00391
Sulphur [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	157	160	160	166	4.64	4.63
Antimony [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0017	0.0010	0.0093	0.0106	0.0086	0.0016
Selenium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Silica [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	5.46	5.55	5.54	5.55	0.59	0.60
Tin [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00002	0.00012	0.00002	0.00025	< 0.00001	< 0.00001
Strontium [mg/L]	05-Oct-09	09:00	05-Oct-09	13:19	0.159	0.161	0.160	0.166	0.0122	0.0122
Titanium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0005	0.0004	0.0005	0.0004	0.0004	0.0001
Thallium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Uranium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.0143	0.0116	0.0144	0.0219	0.000654	0.00079
Vanadium [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.00009	0.00004	0.00004	< 0.00003	0.00007	0.00007
Zinc [mg/L]	02-Oct-09	14:45	05-Oct-09	13:19	0.005	0.004	0.004	0.004	0.004	0.005

Ra226 subcontracted to Becquerel Labs.

Chris Sullivan, B.Sc., C.Chem
Project Specialist
Environmental Services, Analytical

OnLine LIMS

Copy to : #1

ANALYSIS REPORT

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Batch: T09-01382.0

Date: 20-Oct-2009

Lakefield Research Ltd.

185 Concession St., Postal Bag 4300
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Client Ref.Oct 10064
P.O: 17820

6 water samples Sampled: 28-Sep-2009 Received: 06-Oct-2009 Page 1 of 1

Results of Analysis

Sample	Test	Result	Units	Date	Method
SW09 QC15-1	Ra-226	0.42	Bq/l	17-Oct-2009	ALPHA
SW09 QC15-2	Ra-226	0.45	Bq/l	18-Oct-2009	ALPHA
SW09 QC15-3	Ra-226	0.46	Bq/l	18-Oct-2009	ALPHA
SW09 QC15-4	Ra-226	0.45	Bq/l	18-Oct-2009	ALPHA
SW09 EC-2T	Ra-226	0.78	Bq/l	18-Oct-2009	ALPHA
SW09 EC-2B	Ra-226	0.85	Bq/l	18-Oct-2009	ALPHA

Methods: ALPHA BQ-RAD-ALPHA alpha-particle spectrometry

Units: Bq/l Becquerels per litre

These results relate only to the samples analysed and only to the items tested.

20-Oct-2009 approved by: ______________________
Donald D. Burgess PhD
Senior Scientist, Division Supervisor

APPENDIX 4

Compilation of Laboratory Shake Flask Test Data

Table A4.1: Shake Flask Test Set-Up and Results

RESULTS	Units	Core09-QC15-1 (0-10)	Core09-QC15-1 (10-20)	Core09-QC15-1 (20-30)	Core09-QC15-1 (30-40)	Core09-QC15-2 (0-10)	Core09-QC15-2 (10-20)	Core09-QC15-2 (20-30)	Core09-QC15-2 (30-40)	Core09-QC15-3 (0-10)	Core09-QC15-3 (10-20)	Core09-QC15-3 (20-30)	Core09-QC15-3 (30-40)	Core09-QC15-4 (0-10)	Core09-QC15-4 (10-20)	Core09-QC15-4 (20-30)	Core09-QC15-4 (30-40)	Core09-QC15-5 (0-10)	Core09-QC15-5 (10-20)	Core09-QC15-5 (20-30)	Core09-QC15-5 (30-40)	Core09-QC15-5 (40-50)
MOISTURE CONTENT																						
Set A																						
Mass of Tray	g	1.34	1.33	1.34	1.31	1.32	1.33	1.32	1.32	1.33	1.35	1.31	1.32	1.31	1.32	1.31	1.32	1.34	1.31	1.32	1.31	1.32
Sample mass Start SA#1	g	35.00	36.49	28.50	21.18	38.20	26.89	20.92	23.40	31.40	26.12	26.91	27.36	26.6	24.94	23.96	27.04	32.11	50.59	23.62	27.91	25.01
Sample mass End	g	25.21	28.73	23.11	15.57	28.37	21.91	17.32	19.26	21.86	22.58	23.28	23.39	20.79	21.00	20.77	23.50	26.69	41.16	20.40	24.13	21.70
Moisture content		0.291	0.221	0.198	0.282	0.267	0.195	0.184	0.188	0.317	0.143	0.142	0.152	0.230	0.167	0.141	0.138	0.176	0.191	0.144	0.142	0.140
Set B																						
Mass of Tray	g	1.35	1.33	1.30	1.32	1.32	1.34	1.33	1.310	1.30	1.33	1.32	1.31	1.32	1.31	1.32	1.33	1.33	1.33	1.33	1.32	1.33
Sample mass Start SA#1	g	53.79	37.50	31.32	27.72	39.36	18.02	28.01	26.68	40.92	18.56	28.6	24.23	22.33	20.45	27.87	26.58	30.88	36.01	20.35	28.42	27.65
Sample mass End	g	39.19	29.51	24.57	23.94	29.34	14.86	23.03	21.90	29.21	16.05	24.91	20.79	17.45	17.36	24.03	23.14	25.32	29.66	17.54	24.65	23.96
Moisture content		0.278	0.221	0.225	0.143	0.263	0.189	0.187	0.188	0.296	0.146	0.135	0.150	0.232	0.161	0.145	0.136	0.188	0.183	0.148	0.139	0.140
Set C																						
Mass of Tray	g	1.33	1.31	1.33	1.31	1.33	1.33	1.33	1.31	1.31	1.33	1.31	1.31	1.33	1.31	1.32	1.32	1.32	1.33	1.32	1.32	1.32
Sample mass Start SA#1	g	40.03	27.67	23.06	24.45	42.01	27.69	27.82	25.02	46.41	22.58	27.35	30.70	31.37	29.11	30.07	26.47	31.27	36.65	30.1	27.05	31.34
Sample mass End	g	28.91	20.83	17.94	20.57	31.21	22.60	22.84	20.60	32.04	19.51	23.73	26.44	24.42	24.38	25.70	23.14	25.72	29.80	25.75	23.59	27.24
Moisture content		0.287	0.259	0.236	0.168	0.265	0.193	0.188	0.186	0.319	0.144	0.139	0.145	0.231	0.170	0.152	0.132	0.185	0.194	0.151	0.134	0.137
Moisture Content Average		**0.286**	**0.234**	**0.220**	**0.198**	**0.265**	**0.192**	**0.186**	**0.187**	**0.310**	**0.144**	**0.139**	**0.149**	**0.231**	**0.166**	**0.146**	**0.135**	**0.183**	**0.189**	**0.148**	**0.139**	**0.139**
SHAKE FLASK SET-UP																						
Mass of Bottle	g	38.67	38.59	38.64	38.98	38.62	38.22	38.59	38.83	38.81	39.01	38.82	38.87	39.21	38.69	39.02	38.76	38.88	39.08	38.84	38.73	38.65
Mass of Sample Added	g	131.2	130.41	131.27	130.04	130.74	130.79	130.59	130.32	130.74	130.00	130.38	130.14	131.14	131.62	130.79	130.19	130.57	131.86	130.87	132.25	130.04
Water Added	mL	401.34	400.23	400.04	400.11	400.07	400.10	401.04	400.07	400.24	400.08	400.59	400.38	400.79	400.48	401.40	401.48	400.60	400.50	400.93	400.55	400.58
Total Mass (measured)	g	571.20	569.22	569.95	569.14	569.42	569.11	570.22	569.23	569.78	569.08	569.79	569.39	571.15	570.79	571.21	570.44	570.04	571.43	570.64	571.52	569.26
Equiv Dry Mass	g	93.74	99.93	102.44	104.33	96.07	105.62	106.29	105.89	90.15	111.23	112.30	110.73	100.83	109.75	111.72	112.56	106.65	106.88	111.53	113.92	111.99
Mass Water in Sample	mL	37.46	30.48	28.83	25.71	34.67	25.17	24.30	24.43	40.59	18.77	18.08	19.41	30.31	21.87	19.07	17.63	23.92	24.98	19.34	18.33	18.05
Total Water	mL	438.80	430.71	428.87	425.82	434.74	425.27	425.34	424.50	440.83	418.85	418.67	419.79	431.10	422.35	420.47	419.11	424.52	425.48	420.27	418.88	418.63
ANALYSIS																						
pH	pH Units	5.20	2.95	6.06	4.95	6.08	5.33	4.84	3.51	4.78	4.81	4.45	4.74	4.23	3.17	3.19	3.17	2.71	2.96	3.14	2.94	2.93
Sulphate (SO4)	mg/L	90	74	130	680	1500	1500	93	260	590	1000	1400	1400	69	48	46	36	55	32	42	37	41
Acidity (as CaCO3)	mg/L	9	27	16	12	6	13	15	19	9	19	13	11	10	30	27	12	38	35	45	19	51
Hardness (as CaCO3)	mg/L	98.5	77.4	137	680	1440	1440	104	276	580	1020	1380	1390	75.4	38.1	33.4	28.6	22.9	4.2	3.9	3.4	3.2
Radium-226	Bq/L	2.5	3.4	3.2	1.4	1.5	1.4	4.4	2.5	1.2	1.4	1.4	2.1	5.4	3.7	5.0	4.5	5.3	7.0	3.5	4.5	4.2
Aluminum (Al)	mg/L	0.01	0.13	0.07	0.02	<0.01	<0.01	0.05	0.13	<0.01	<0.01	<0.01	0.01	0.02	0.28	0.18	0.06	1.76	0.88	0.96	0.73	0.56
Arsenic (As)	mg/L	0.0030	0.0168	0.0318	0.0038	0.0026	0.0060	0.0157	0.0061	0.0012	0.0051	0.0048	0.0043	0.0009	0.0380	0.0646	0.157	0.0084	0.0069	0.0129	0.0053	0.0027
Barium (Ba)	mg/L	0.0882	0.0769	0.0699	0.0292	0.0307	0.0239	0.0685	0.0385	0.0330	0.0303	0.0310	0.0481	0.112	0.0480	0.0592	0.0760	0.0596	0.0902	0.0906	0.117	0.100
Beryllium (Be)	mg/L	0.00004	0.00015	0.00012	0.00003	<0.00002	<0.00002	<0.00002	0.00005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	<0.00002	<0.00002	0.00009	0.00005	0.00006	0.00004	0.00005
Boron (B)	mg/L	0.0509	0.0302	0.0336	0.0104	0.0622	0.0149	0.0168	0.0226	0.0317	0.0115	0.0104	0.0114	0.0234	0.0086	0.0073	0.0079	0.0063	0.0027	0.0032	0.0028	0.0026
Bismuth (Bi)	mg/L	0.00002	0.00002	0.00003	0.00009	0.00002	0.00012	0.00038	0.00014	<0.00001	0.00008	0.00010	0.00012	0.00004	0.00095	0.00079	0.00161	0.00018	0.00040	0.00068	0.00054	0.00042
Calcium (Ca)	mg/L	37.9	29.9	53.8	272	575	574	40.9	109	229	409	552	556	29.0	14.6	12.8	10.9	8.46	1.35	1.17	1.00	0.94
Cadmium (Cd)	mg/L	0.000121	0.00355	0.00459	0.000530	0.000168	0.00127	0.00201	0.000746	0.00262	0.00239	0.00161	0.000444	0.000014	0.000619	0.000531	0.000305	0.000069	0.000018	0.000019	0.000011	0.000010
Cobalt (Co)	mg/L	0.0345	0.275	0.372	0.00691	0.0443	0.0173	0.00823	0.0188	0.0334	0.0413	0.0330	0.0159	0.0150	0.0218	0.0101	0.0042	0.0304	0.0176	0.0219	0.0197	0.0211
Chromium (Cr)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper (Cu)	mg/L	0.0005	0.0072	0.0026	0.0150	0.0015	0.0056	0.0194	0.124	0.0042	0.0023	0.0025	0.0019	0.0021	0.0121	0.0164	0.0025	0.109	0.130	0.0981	0.0625	0.0518
Iron (Fe)	mg/L	0.08	0.02	<0.01	0.02	<0.01	0.02	0.02	0.03	<0.01	0.01	<0.01	<0.01	0.02	0.09	0.17	0.13	0.89	6.28	11.5	10.2	11.4
Potassium (K)	mg/L	2.18	2.01	1.98	1.96	3.69	2.91	2.07	3.14	2.61	1.97	2.33	2.93	1.44	1.64	1.65	1.64	1.98	1.40	1.68	1.58	1.53
Lithium (Li)	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium (Mg)	mg/L	0.914	0.691	0.628	0.449	1.30	0.479	0.445	0.747	1.89	0.395	0.364	0.368	0.724	0.412	0.365	0.318	0.444	0.194	0.246	0.214	0.206
Manganese (Mn)	mg/L	0.197	0.0374	0.0296	0.0221	0.146	0.0311	0.0270	0.0450	3.49	0.196	0.0637	0.0420	0.195	0.0274	0.0234	0.0182	0.146	0.0702	0.104	0.0924	0.0938
Molybdenum (Mo)	mg/L	0.00027	0.00020	0.00032	0.00041	0.00025	0.00104	0.00057	0.00019	0.00003	0.00071	0.00144	0.00156	0.00038	0.00192	0.00246	0.00404	0.00026	0.00015	0.00024	0.00020	0.00017
Sodium (Na)	mg/L	0.29	0.47	0.45	0.52	0.83	0.76	0.57	0.54	0.62	0.58	0.63	0.63	0.55	0.46	0.43	0.43	0.49	0.44	0.43	0.44	0.46
Nickel (Ni)	mg/L	0.0635	0.500	0.662	0.0137	0.155	0.0392	0.0127	0.0236	0.0528	0.0395	0.0426	0.0250	0.0088	0.0093	0.0060	0.0038	0.0173	0.0085	0.0102	0.0091	0.0097
Lead (Pb)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorous (P)	mg/L	0.0129	0.667	1.25	1.72	0.0398	3.06	1.01	2.08	0.0535	2.27	2.60	2.56	0.0474	13.5	14.4	8.79	8.87	11.2	9.30	9.28	9.27
Antimony (Sb)	mg/L	33.3	27.9	47.7	234	486	486	35.4	97.1	200	348	468	472	26.2	17.8	17.1	13.1	20.5	12.4	15.9	14.8	15.2
Selenium (Se)	mg/L	<0.0002	0.0007	0.0009	0.0004	<0.0002	0.0012	0.0014	0.0008	<0.0002	0.0015	0.0018	0.0019	0.0003	0.0040	0.0029	0.0026	0.0007	0.0013	0.0014	0.0010	0.0008
Sulphur (S)	mg/L	<0.001	<0.001	<0.001	0.002	0.002	0.002	<0.001	0.002	0.001	0.003	0.004	0.007	<0.001	0.007	0.008	0.009	0.001	0.005	0.006	0.006	0.007
Silicon (Si)	mg/L	6.96	5.14	5.94	3.77	12.2	5.88	6.36	5.12	6.44	4.25	5.93	7.45	4.85	3.06	3.78	4.22	3.74	3.45	4.53	4.36	4.27
Tin (Sn)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00007	<0.00001	<0.00001	<0.00001	<0.00001	0.00006	<0.00001	0.00011	0.00014	0.00010	0.00002	<0.00001	<0.00001	<0.00001	0.00006
Strontium (Sr)	mg/L	0.0446	0.0316	0.0404	0.118	0.258	0.240	0.0446	0.0758	0.0973	0.125	0.192	0.198	0.0317	0.0040	0.0068	0.0116	0.0144	0.0085	0.0110	0.0115	0.0107
Titanium (Ti)	mg/L	0.0005	0.0004	0.0004	0.0007	0.0008	0.0012	0.0050	0.0014	0.0005	0.0007	0.0013	0.0018	0.0009	0.0035	0.0042	0.0065	0.0013	0.0012	0.0016	0.0016	0.0014
Thallium (Tl)	mg/L	0.0008	0.0019	0.0040	0.0004	0.0019	0.0017	0.0018	0.0019	0.0006	0.0013	0.0004	<0.0002	0.0005	0.0006	0.0004	0.0003	0.0015	0.0006	0.0005	0.0004	0.0004
Uranium (U)	mg/L	0.00523	0.00845	0.00751	0.00290	0.00779	0.00342	0.00268	0.0135	0.0106	0.00784	0.00360	0.00158	0.000791	0.122	0.127	0.03115	0.161	0.0311	0.0425	0.0213	0.0117
Vanadium (V)	mg/L	<0.00003	<0.00003	0.00005	<0.00003	0.00004	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.00011	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003
Zinc (Zn)	mg/L	0.008	0.507	0.725	0.021	0.013	0.058	0.027	0.075	0.034	0.053	0.036	0.016	0.003	0.003	0.002	0.003	0.012	0.013	0.006	0.005	0.004
SOLUBLE AMOUNT																						
Sulphate (SO4)	mg/kg	421	319	544	2775	6787	6040	372	1042	2885	3765	5220	5308	295	185	173	134	219	127	158	136	153
Acidity (as CaCO3)	mg/kg	42	116	67	49	27	52	60	76	44	72	48	42	43	115	102	45	151	139	170	70	191
Hardness (as CaCO3)	mg/kg	461.1	333.6	574	2775	6516	5798	416	1106	2836	3841	5145	5270	322.4	146.6	125.7	106.5	91.2	16.7	14.7	12.5	12.0
Radium-226	Bq/g	0.012	0.015	0.013	0.006	0.007	0.006	0.018	0.010	0.006	0.005	0.005	0.008	0.023	0.014	0.019	0.017	0.021	0.028	0.013	0.017	0.016
Aluminum (Al)	mg/kg	0.05	0.56	0.29	0.08	<0.05	<0.04	0.20	0.52	<0.05	<0.04	<0.04	0.04	0.09	1.08	0.68	0.22	7.01	3.50	3.62	2.68	2.09
Arsenic (As)	mg/kg	0.0140	0.0724	0.1331	0.0155	0.0118	0.0242	0.0628	0.0245	0.0059	0.0192	0.0179	0.0163	0.0038	0.1462	0.2431	0.585	0.0334	0.0275	0.0486	0.0195	0.0101
Barium (Ba)	mg/kg	0.4129	0.3314	0.2926	0.1192	0.1389	0.0962	0.2741	0.1543	0.1614	0.1141	0.1156	0.1824	0.479	0.1847	0.2228	0.2830	0.2372	0.3591	0.3414	0.430	0.374
Beryllium (Be)	mg/kg	0.00019	0.00065	0.00050	0.00012	<0.00009	<0.00008	<0.00008	0.00020	<0.00010	<0.00008	<0.00007	<0.00008	<0.00009	0.00008	<0.00008	<0.00007	0.00036	0.00020	0.00023	0.00015	0.00019
Boron (B)	mg/kg	0.2383	0.1302	0.1407	0.0424	0.2815	0.0600	0.0672	0.0906	0.1550	0.0433	0.0388	0.0432	0.1000	0.0331	0.0275	0.0294	0.0251	0.0107	0.0121	0.0103	0.0097
Bismuth (Bi)	mg/kg	0.00009	0.00009	0.00013	0.00037	0.00009	0.00048	0.00152	0.00056	<0.00005	0.00030	0.00037	0.00045	0.00017	0.00366	0.00297	0.00599	0.00072	0.00159	0.00256	0.00199	0.00157
Calcium (Ca)	mg/kg	177.4	128.9	225.2	1110	2602	2311	163.7	437	1120	1540	2058	2108	124.0	56.2	48.2	40.6	33.68	5.37	4.41	3.68	3.51
Cadmium (Cd)	mg/kg	0.000566	0.01530	0.01922	0.002163	0.000760	0.00511	0.00804	0.002991	0.01281	0.00900	0.00600	0.001683	0.000060	0.002382	0.001999	0.001136	0.000275	0.000072	0.000072	0.000040	0.000037
Cobalt (Co)	mg/kg	0.1615	1.185	1.557	0.02820	0.2005	0.0697	0.03294	0.0754	0.1633	0.1555	0.1230	0.0603	0.0641	0.0839	0.0380	0.0156	0.1210	0.0701	0.0825	0.0724	0.0789
Chromium (Cr)	mg/kg	<0.0023	<0.0022	<0.0021	<0.0020	<0.0023	<0.0020	<0.0020	<0.0020	<0.0024	<0.0019	<0.0019	<0.0019	<0.0021	<0.0019	<0.0019	<0.0019	<0.0020	<0.0020	<0.0019	<0.0018	<0.0019
Copper (Cu)	mg/kg	0.0023	0.0310	0.0109	0.0612	0.0068	0.0225	0.0776	0.497	0.0205	0.0087	0.0093	0.0072	0.0090	0.0466	0.0617	0.0093	0.434	0.518	0.3697	0.2298	0.1936
Iron (Fe)	mg/kg	0.37	0.09	<0.04	0.08	<0.05	0.08	0.08	0.12	<0.05	0.04	<0.04	<0.04	0.09	0.35	0.64	0.48	3.54	25.00	43.3	37.5	42.6
Potassium (K)	mg/kg	10.20	8.66	8.29	8.00	16.70	11.72	8.28	12.59	12.76	7.42	8.69	11.11	6.16	6.31	6.21	6.11	7.88	5.57	6.33	5.81	5.72
Lithium (Li)	mg/kg	<0.009	<0.009	<0.008	<0.008	<0.009	<0.008	<0.008	<0.008	<0.010	0.015	0.007	<0.008	<0.009	<0.008	<0.008	<0.007	<0.008	<0.008	<0.008	<0.007	<0.007
Magnesium (Mg)	mg/kg	4.279	2.978	2.629	1.833	5.88	1.929	1.781	2.995	9.24	1.487	1.357	1.395	3.095	1.585	1.374	1.184	1.767	0.772	0.927	0.787	0.770
Manganese (Mn)	mg/kg	0.922	0.1612	0.1239	0.0902	0.661	0.1252	0.1081	0.1804	17.07	0.738	0.2375	0.1592	0.834	0.1054	0.0881	0.0678	0.581	0.2795	0.392	0.3397	0.3506
Molybdenum (Mo)	mg/kg	0.00126	0.00086	0.00134	0.00167	0.00113	0.00419	0.00228	0.00076	0.00015	0.00267	0.00537	0.00591	0.00162	0.00739	0.00926	0.01504	0.00103	0.00060	0.00090	0.00074	0.00064
Sodium (Na)	mg/kg	1.36	2.03	1.88	2.12	3.76	3.06	2.28	2.16	3.03	2.18	2.35	2.39	2.35	1.77	1.62	1.60	1.95	1.75	1.62	1.62	1.72
Nickel (Ni)	mg/kg	0.2973	2.155	2.772	0.0559	0.701	0.1578	0.0508	0.0946	0.2582	0.1487	0.1588	0.0948	0.0376	0.0358	0.0226	0.0141	0.0689	0.0338	0.0384	0.0335	0.0363
Lead (Pb)	mg/kg	<0.05	<0.04	<0.04	<0.04	<0.05	<0.04	<0.04	<0.04	<0.05	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.11	<0.04	<0.04	<0.04	<0.04	<0.04
Phosphorous (P)	mg/kg	0.0604	2.875	5.23	7.02	0.1801	12.32	4.04	8.34	0.2616	8.55	9.69	9.71	0.2027	51.9	54.2	32.73	35.31	44.6	35.04	34.12	34.65
Antimony (Sb)	mg/kg	155.9	120.2	199.7	955	2199	1957	141.7	389.3	978	1310	1745	1789	112.0	68.5	64.4	48.8	81.6	49.4	59.9	54.4	56.8
Selenium (Se)	mg/kg	<0.0009	0.0030	0.0038	0.0016	<0.0009	0.0048	0.0056	0.0032	<0.0010	0.0056	0.0067	0.0072	0.0013	0.0154	0.0109	0.0097	0.0028	0.0052	0.0053	0.0037	0.0030
Sulphur (S)	mg/kg	<0.005	<0.004	<0.004	0.008	0.009	0.008	<0.004	0.008	0.005	0.011	0.015	0.027	<0.004	0.027	0.030	0.034	0.004	0.020	0.023	0.022	0.026
Silicon (Si)	mg/kg	32.58	22.15	24.87	15.39	55.2	23.68	25.45	20.52	31.49	16.00	22.11	28.24	20.74	11.78	14.23	15.71	14.89	13.73	17.07	16.03	15.96
Tin (Sn)	mg/kg	<0.00005	<0.00004	<0.00004	<0.00004	<0.00005	<0.00004	0.00028	<0.00004	<0.00005	<0.00004	<0.00004	0.00023	<0.00004	0.00042	0.00053	0.00037	0.00008	<0.00004	<0.00004	<0.00004	0.00022
Strontium (Sr)	mg/kg	0.2088	0.1362	0.1691	0.482	1.167	0.966	0.1785	0.3039	0.4758	0.471	0.716	0.751	0.1355	0.0154	0.0256	0.0432	0.0573	0.0338	0.0414	0.0423	0.0400
Titanium (Ti)	mg/kg	0.0023	0.0017	0.0017	0.0029	0.0036	0.0048	0.0200	0.0056	0.0024	0.0026	0.0048	0.0068	0.0038	0.0135	0.0158	0.0242	0.0052	0.0048	0.0060	0.0059	0.0052
Thallium (Tl)	mg/kg	0.0037	0.0082	0.0167	0.0016	0.0086	0.0068	0.0072	0.0076	0.0029	0.0049	0.0015	<0.0008	0.0021	0.0023	0.0015	0.0011	0.0060	0.0024	0.0019	0.0015	0.0015
Uranium (U)	mg/kg	0.02448	0.03642	0.03144	0.01184	0.03525	0.01377	0.01073	0.0541	0.0518	0.02952	0.01342	0.00599	0.003382	0.469	0.478	0.11599	0.641	0.1238	0.1601	0.0783	0.0437
Vanadium (V)	mg/kg	<0.00014	<0.00013	0.00021	<0.00012	0.00018	<0.00012	<0.00012	<0.00012	<0.00015	<0.00011	<0.00011	<0.00011	<0.00013	<0.00012	<0.00011	0.00041	<0.00012	<0.00012	<0.00011	<0.00011	<0.00011
Zinc (Zn)	mg/kg	0.037	2.185	3.035	0.086	0.059	0.234	0.108	0.301	0.166	0.200	0.134	0.061	0.013	0.012	0.008	0.011	0.048	0.052	0.023	0.018	0.015