Supporting Document M1

Estimates of Flow and Arsenic Releases from Surface and Underground Sources (SRK, 2005)

Giant Mine

Estimates of Flow and Arsenic Releases from Surface & Underground Sources

Prepared for

Department of Indian Affairs and Northern Development

Prepared by

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Estimates of Flow and Arsenic Releases from Surface and Underground Sources

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1 Introduction

A series of calculations were completed to estimate flows and rates of arsenic release from the surface and underground sources under current and post-closure conditions.

The water and load balance is presented in two parts:

- calculations to estimate flows and arsenic release from surface sources and any discharges from the underground mine to Baker Creek, Yellowknife Bay, the underground workings, and the effluent treatment plant.
- calculations to estimate flow and arsenic release from the underground mine.

The calculations were balanced such that net flows to the underground workings from the surface model are equal to inflows used in the underground model. However, for ease of calculation, they are not directly linked.

Calculations are presented for current and post-closure conditions. The post-closure estimates reflect long-term conditions, after the proposed remediation activities have been completed and arsenic concentrations in the surface runoff reach levels that are acceptable for direct discharge. Therefore, the long-term arsenic releases from surface facilities are assumed to be discharged directly to the receiving environment. It was assumed that partial dewatering of the underground mine would be maintained, with water levels fluctuating below the base of the open pits to approximately the 425 level. Flows from the underground workings would continue to be treated.

2 Surface Sources

2.1 Methods

2.1.1 Flows

The surface of the mine site was divided into a series of small watershed areas or “catchments” reflecting runoff from the different components of the mine (Figure M.1). Catchments for Baker Creek upstream of the mine, Trapper Creek upstream of the mine, and for the smaller unnamed tributaries on the west side of Baker Creek were delineated using regional topographic maps. Those within the mine area were delineated using the detailed 2003 topography. The areas for each of the catchments are provided in the calculation tables in Appendix M1.

Rates of surface and shallow groundwater flow from each catchment were estimated by multiplying the surface areas by the annual runoff, which reflects the predominant ground conditions within the catchment. Regional catchments were assigned a runoff of 56 mm, reflecting the average annual runoff observed in Baker Creek. Local mine site catchments were assigned an annual runoff of 100 mm. The higher value applied to the mine site was intended to reflect increased runoff resulting

from the relatively sparse vegetation, hilly topography and relative lack of ponded water on the mine site. Figure M.2 shows the runoff assumption for each of the catchments within the mine site area.

The surface and shallow groundwater flows were apportioned to Baker Creek, Yellowknife Bay, the Effluent Treatment Plant (ETP), and/or the underground mine on the basis of drainage patterns or water management activities. Percent estimates of surface runoff to each of these areas under current conditions are shown in Figures M.3 to M.6, with details provided in Appendix M1.

The rate of flow to the deeper groundwater system was estimated by multiplying the footprint areas by the estimated infiltration rates. The infiltration rates varied from zero in the regional catchments to 55 mm in catchments that are fully within the envelope of the surface drillholes. Catchments that were partially within the drill envelope were assigned a value based on the proportion of area that was within the drill envelope. The Northwest Pond was assigned an infiltration of 417 mm to account for the large amount of seepage losses observed from this area (800 m^3/day). Figure M.7 shows the infiltration rates applied to each of the catchments within the mine site area, under current conditions. All of the deep groundwater flow was assumed to report to the mine workings.

Flows from the Effluent Treatment Plant (ETP) were estimated based on the average volume of water treated from 2000 to 2004 (750,000 m^3/year).

Table M.1 provides a summary of the runoff and groundwater infiltration rates used in the calculations for current conditions. The values are presented in units of millimetres per year and as a percentage of the total precipitation.

Table M.1: Summary of Estimated Annual Runoff and Infiltration – Current Conditions.

Calculation Inputs	Catchments*	mm/year	% of Precipitation
Precipitation	All	280	100
Runoff (surface and shallow groundwater)			
Regional Mean Annual Runoff	B1, C1, D1, E1, G1, PL	56	20
Local Mean Annual Runoff	all others	100	36
Infiltration to Mine			
Regional Catchments	B1, C1, D1, E1, E2, G1, T1, T2, BB1, BB2, YK1	0	0
Within area of influence of dewatered mine	STP1, CTP1, NTP1, M1, M2, M3, M4, M5, M7	7.5	3
Within mine drill envelope	PP2, BP1, BP2, BP3, BP4, BP5, BC1b, AP1, AP2, CP1	55	20
Partially within drill envelope	PP1, BC1a, BC1c, BC2, BC3, M6,	12-36	4-13
Inflows from NW Pond Catchment	NWTP	417	149**

* See Figure M.1
** Includes infiltration from the pond

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The proposed remediation activities will result in some changes to the drainage patterns and water management activities. Notably, surface runoff from the tailings areas and contaminated water in the vicinity of the mill will reach sufficient quality that it can be discharged directly to the environment, and the tailings will be re-graded such that most of the tailings runoff will drain into Baker Creek. Both of these changes will result in a greater amount of runoff to Baker Creek. Assumed changes to the percentage distributions of surface runoff from each catchment to Baker Creek, the Effluent Treatment Plant, the Underground mine or Yellowknife Bay under post-closure conditions are summarized in Figure M.8.

The proposed remediation activities will also result in some changes to the estimates of deep groundwater infiltration, which were characterized by the following changes to the water balance inputs:

- Drainage of the Northwest Pond will reduce the amount of groundwater infiltration to 14 mm (from 417 mm under current conditions).
- Dewatering and covering of the polishing pond will reduce deep groundwater infiltration to 14 mm (from 31 mm under current conditions).
- The frozen section of the B1 pit will be backfilled with contaminated soil. The unfrozen section of the B1 pit will be backfilled with waste rock and clean borrow material and will be graded and compacted to promote runoff. This will reduce infiltration in the B1 pit to 14 mm (from 55 mm under current conditions), and will result in the runoff being directed to Baker Creek rather than into the underground workings.

The above changes are also summarized in Figure M.8.

Flows from the underground mine will be reduced due to the above activities and partial flooding of the mine. This will result in a significant reduction in flows to the Effluent Treatment Plant. The flows to and from the Effluent Treatment Plant were taken from the underground flow and load calculations presented in Section 3. These were conservatively rounded to 365,000 m^3/year or 1000 m^3/day in the calculations of loading from the Effluent Treatment Plant.

2.1.2 Source Concentrations

Arsenic source concentrations were estimated for each of the catchment areas based on the results of the surface water quality monitoring programs and seep surveys presented in Supporting Documents B2 and B3.

Post-closure estimates of concentrations were made on the basis of the proposed remediation activities in each catchment. In general, it was assumed that arsenic concentrations in seepage and runoff would be 0.5 mg/L or less before being allowed to discharge to the environment.

A summary of source concentrations for current and post-closure conditions is provided in Table M.2 and Figures M.9 and M.10.

2.1.3 Arsenic Load Estimates

Arsenic loadings from surface and groundwater flows to Baker Creek, Yellowknife Bay, the Effluent Treatment Plant and the underground mine were estimated by multiplying the respective flow rates by the source concentrations in each catchment.

Where possible, check points were built into the calculations, enabling calculated arsenic loadings to be compared to measured flows and concentrations at various points in the system. Check points at the mouth of Trapper Creek and at the mouth of Baker Creek were particularly useful because they are part of the routine monitoring program so there was sufficient data to provide independent estimates of arsenic loadings at these locations.

The calculation spreadsheets for current and future conditions are provided in Appendix M1 and M2.

Table M.2: Summary of Estimated Source Concentrations

Description	Catchment*	Arsenic Concentration (mg/L)	
		Current	Post-Closure
Baker Creek Upstream of Mine (measured concentrations)	B1	0.026	0.026
Tributaries in Mine Area (measured concentrations)	D1, E2, E1, G1	0.025 to 0.079	0.025 to 0.079
Effluent Treatment Plant discharge (SNP Monitoring Data)	ETP	0.38	0.38
Typical runoff from undisturbed areas near sites (seep surveys)	C1, PL, NWTP2, NWTP3, BC2, BC3, T2, YK1	0.2	0.2
Slightly influenced by mine wastes (seep surveys)	M3, BP4, BP5, BB1, BB2	0.5	0.5
	BC1a, M2	0.5	0.2
Moderately influenced by mine wastes, contaminated soils or pit walls (seep surveys)	BC1c, BP1ii, BP2, AP1, AP2, CP1,	1	1
	BP1i, M7, BC1b, M6, M5	1	0.5
	M4, T1	1	0.2
Polishing pond catchment runoff	PP1i	0.2	0.5
Vertical seepage from Polishing Pond	PP1ii	5	5
Lateral seepage from Northwest Pond (seep surveys)	NWTPi	2.0	0.5
Vertical seepage from Northwest Pond (underground sampling data)	NWTPii	7	7
Seepage from other tailings areas (seep surveys)	STP1ii, CTP1ii, NTP1ii	4	4
	PP2, BP3, STP1i, STP2, CTP1i, NTP1i,	4	0.5
Heavily contaminated soil in mill area (seep surveys)	M1	10	0.5

* See Figure M.1 for catchments near mine

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2.2 Results

2.2.1 Current Water and Arsenic Balance

Detailed results of the water and load balance for current conditions, including estimates of flows to the underground mine are provided in Appendix M1.

Table M.3 summarizes the measured and estimated arsenic loadings along each section of Baker Creek. The results indicate the most significant sources of loading to Baker Creek are sources upstream of the mine, and the effluent treatment plant. The estimated loads for these two areas were calibrated to the monitored loadings at these locations, and were therefore expected to be in agreement. Estimated loadings at Trapper Creek were approximately 36 kg/year higher than the monitored loadings. This suggests that the estimated flow rates or concentrations from this area are high, and that seepage rates from the Northwest Pond may be lower than estimated. Estimated arsenic loadings of 800 kg/year at the mouth of Baker Creek were comparable to the average value of 840 kg/year calculated from the monitoring data.

Direct runoff to Yellowknife Bay from the mine site catchments is estimated to contribute an additional 110 kg/year of arsenic, of which approximately 65 kg/year can be attributed to areas influenced by surface activities. Therefore, the total loading to Yellowknife Bay from Baker Creek and the mine site is estimated to be approximately 910 kg/year.

Table M.3: Arsenic Loadings to Baker Creek and Yellowknife Bay by Location

Location along Baker Creek	Average Annual Flow (m^3/year)	Arsenic Release (kg/year)		%Total Load to Baker Creek
		Measured (Calculated from 2004 Monitoring Data)	Estimated from Water and Arsenic Balance	
Baker Creek Upstream of Giant Mine	7,098,000	227	224	28
Trapper Creek (including the Northwest Pond)	418,000	42	78	10
Effluent Treatment Plant	750,000	285	285	36
Polishing/Settling Pond Area	42,000	na	44	5
Runoff/seepage from catchments between Baker Creek Pond and Mill Area	75,000	na	37	5
Runoff/seepage from Mill Area catchments	19,000	na	21	3
Runoff/seepage from catchments downstream of Mill Area to mouth of Creek	524,000	na	111	14
Total Inputs at mouth of Baker Creek	**8,925,000**	**839**	**800**	**100**
Direct Runoff to Yellowknife Bay	296,000	na	110	
Total Inputs to Yellowknife Bay	**9,221,000**	**na**	**910**	

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Table M.4 presents arsenic loadings in Baker Creek from 2000 to 2003 as calculated from the monitoring data. There is substantial year to year variability, with generally higher loadings in wetter years such as 2001 and 2002. However, total arsenic loading in a typical year (such as 2003) are comparable to the value estimated from the water and arsenic balance.

Table M.5 summarizes the estimated arsenic loadings to Baker Creek and Back Bay from each of the major surface sources. Upstream sources comprise approximately 224 kg/year, or 28% of the total arsenic loading to Baker Creek. An additional 67 kg/year or 8% can be attributed to tributaries upstream of Trapper Lake and to the west of Baker Creek. Discharge of water from the Effluent Treatment Plant contributes 285 kg/year, or 36% of the total arsenic loading to Baker Creek, and other mine site sources contributes approximately 224 kg/year or 28% of the loading to Baker Creek.

Table M.4: Summary of Arsenic Loadings from Years 2000 to 2003

Year	Total Flow (m^3/year)	Average Concentration (mg/L)	Measured Arsenic Loading (kg/year)
2000	na*	0.28	na
2001	18,000,000	0.10	1800
2002	13,900,000	0.08	1100
2003	9,900,000	0.07	730

Notes: * 2000 was likely a low flow year. However, the WSC records appear to have some missing data, and reliable flow estimates were not available.

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Table M.5: Arsenic Loadings to Baker Creek by Source

Sources to Baker Creek	Average Annual Flow (m^3/year)	Estimated Arsenic Loadings (kg/year)
Baker Creek Upstream of Giant Mine	7,098,000	224
Tributaries to Baker Creek Adjacent to Giant Mine	846,000	67
Effluent Treatment Plant (ETP)	750,000	285
Runoff from Surface Mine Facilities to Baker Creek	231,000	224
Total Inputs to Baker Creek	8,925,000	800

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A more detailed breakdown of estimated arsenic loadings from the mine site sources (excluding the Effluent Treatment Plant) is shown in Table M.6. The estimated contributions from the Northwest Pond and the Settling/Polishing Ponds comprise approximately half of these loadings. A small amount of the arsenic loading can be attributed to the heavily contaminated soils in the mill area, and the remainder to runoff from other areas.

Table M.6: Arsenic Loadings from Surface Mine Sources (excluding Upstream Baker Creek and the Effluent Treatment Plant)

Source	Flow (m^3/year)	Estimated Arsenic Loadings (kg/year)
Northwest Tailings Pond	29,000	55
Polishing Pond/Settling Pond Area	42,000	44
Upstream of Mill	75,000	37
Mill Area	19,000	21
Downstream of Mill (mostly runoff)	67,000	67
Total Surface Contributions to Baker Creek	231,000	224

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One implication of the results shown in Tables M.5 and M.6 is that reducing either the flow or the arsenic concentration coming from the Effluent Treatment Plant would lead to the largest reduction in overall arsenic release. Alternatively, if the Effluent Treatment Plant discharge is moved to Yellowknife Bay, as proposed, there would be a significant reduction in arsenic loading to Baker Creek. Some further reduction in arsenic releases could be achieved by removal of contaminated soil and by covering the tailings areas.

However, a substantial portion of the arsenic loading in Baker Creek comes from upstream sources and larger undisturbed catchments adjacent to the mine. Arsenic releases from those areas are most likely due to soil and sediment contaminated by historical atmospheric releases from the roaster. While these sources are expected to diminish over time, it may take several decades and possibly hundreds of years before all of the arsenic from these sources is flushed from the system.

2.2.2 Post-Closure Water and Arsenic Balance

Table M.7 summarizes the estimates of future arsenic loading from each of the major sources on the site. Arsenic sources upstream of the mine and in the tributaries are assumed to remain unchanged from current conditions. Of the remaining sources, surface facilities on the mine, including the tailings areas, contaminated soil, roads and waste rock would contribute approximately 193 kg/year of arsenic to Baker Creek, and an additional 69 kg/year to Yellowknife Bay. Although the remediation activities would result in lower source concentrations in many of the catchments, the estimated post-closure loadings are only slightly lower than the current loadings. The main reason for this is that flows that were previously directed to the underground workings or to the treatment plant are assumed to be directly discharged to the environment at an arsenic concentration of

0.5 mg/L. The arsenic loading from the treatment plant would be substantially lower than that from the current treatment plant (139 kg/year as compared to 285 kg/year under current conditions), primarily due to the reduction in flows. In addition, the treatment plant discharge would directed to Yellowknife Bay rather than Baker Creek.

In total, the surface remediation activities are estimated to reduce arsenic loadings in Baker Creek from current levels of approximately 800 kg/year to approximately 484 kg/year. Total mine site loads to Yellowknife Bay are estimated to be reduced from 910 kg/year to approximately 692 kg/year. Concentration in surface runoff from all sources is expected to decrease as readily soluble contaminants are flushed from the system and discharge concentrations fall below the assumed 0.5 mg/L. Therefore, long-term reductions in arsenic loading are likely to be greater than these estimates suggest.

A more detailed breakdown of estimated current and future flows and arsenic loadings from each of the mine components (excluding the Effluent Treatment Plant) is shown in Table M.8.

Table M.7: Post-Remediation Arsenic Loadings to Baker Creek and Yellowknife Bay by Location

Sources to Baker Creek	Average Annual Flow (m^3/year)	Estimated Arsenic Release (kg/year)	
		Current	Future
Baker Creek Upstream of Giant Mine	7,098,000	224	224
Tributaries from West of Giant Mine	846,000	67	67
Current Effluent Treatment Plant	na	285	0
Runoff from Giant Mine Surface Facilities to Baker Creek	389,000	224	193
Total Inputs to Baker Creek	8,333,000	800	484
Direct Runoff to Yellowknife Bay	291,000	110	69
New Water Treatment Plant	365,000	Na	139
Total Inputs to Yellowknife Bay	8,989,000	910	692

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Table M.8: Arsenic Loadings to Baker Creek from Remediated Surface Sources

Site Components	Flow (m^3/year)		Arsenic Release (kg/year)	
	Current	Future	Current	Future
NW Pond Area	29,000	76,000	55	36
Polishing/Settling Pond Area	42,000	42,000	44	21
South, Central and North Tailings Area	na	68,000	na	34
Upstream of Mill	75,000	85,000	37	21
Mill Reach	19,000	47,000	21	17
Downstream of Mill (mostly runoff)	67,000	71,000	67	64
Total to Baker Creek	231,000	389,000	224	193

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Checked by: QJK

3 Underground Sources

3.1 Methods

A separate set of calculations was used to estimate the arsenic loading originating within the underground mine workings. Detailed calculation sheets are provided in Appendix M3.

Estimates of flows to the underground mine from surface sources were taken from the surface calculations. The amount assumed to be entering the underground workings was the sum of the flows from the northwest pond and infiltration from catchments within the drill envelope. Estimates of lateral groundwater flows are described in Supporting Documents C1 and C2. Flows and arsenic loading from the Northwest Pond were assumed to move conservatively through the mine workings, while all other flows were assumed to interact with the underground sources.

The surface and groundwater flows were generally apportioned based on the footprint or cross sectional area of the source (for vertical and lateral flows, respectively). In the estimates of current conditions, vertical flow through the arsenic chambers and stopes was adjusted to account for the relatively high arsenic releases observed in the underground water and load balance.

In the estimates of post-closure conditions, the vertical and cross sectional areas of each of the underground sources were adjusted to reflect partially flooded conditions in the mine. Because the mine will be used to provide storage for seasonal inflows, two scenarios were carried through in the calculations, one reflecting minimum expected water levels (to the 425 Level) of the mine workings, and one reflecting maximum expected water levels (below the base of the open pits). In addition, flows through the arsenic chambers were set to zero to account for freezing, and flows from the Northwest Pond were reduced to a nominal infiltration rate of 0.014 m/year to account for drainage of the pond and placement of covers.

A summary of vertical and lateral flows through the mine workings is provided in Table M.9.

Table M.9: Summary of Underground Flows for Current and Future Conditions

Arsenic Sources	Flow (m^3/year)			Flow (m^3/day)		
	Current	Flood to 425 Level	Flood to Base of Pits	Current	Flood to 425 Level	Flood to Base of Pits
Vertical Flow						
arsenic dust - funnelled flow from pits	2,200	0	0	6.0	0	0
arsenic dust - infiltration from Baker Creek	2,200	0	0	6.0	0	0
roaster tailing backfill	19,000	17,000	17,000	52	45	45
flotation tailings backfill	19,000	17,000	17,000	52	45	45
waste rock backfill	69,000	60,000	60,000	188	163	163
regional bedrock/mine walls	46,000	40,000	40,000	126	109	109
Northwest Tailings Pond	292,000	9,900	9,900	800	27	27
Subtotal (Vertical)	449,000	142,000	142,000	1,231	390	390
Lateral Flow						
arsenic dust	0	0	0	0	0	0
roaster tailing backfill	0	34,000	26,000	0.0	93	72
flotation tailings backfill	0	34,000	26,000	0.0	93	72
waste rock backfill	0	86,000	67,000	0.0	235	183
bedrock/tunnels	431,000	57,000	45,000	1,180	156	122
Subtotal (Lateral)	431,000	210,000	164,000	1,180	576	450
TOTAL	880,000	353,000	307,000	2,411	966	840

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Checked by:QJK

Source concentrations used in the calculations were based on data from the mine water sampling programs (Supporting Document B1), the solids testing programs (Supporting Document B4).

Source concentrations for the arsenic trioxide areas are summarized in Table M.10. Source concentrations for unsaturated (current) conditions are based on the maximum concentrations observed at the face of the bulkheads (Supporting Document B1). Source concentrations for flooded conditions are based on solubility tests completed by CANMET (2000).

Table M.10: Source Concentrations for Arsenic Trioxide Dust

Source	Arsenic Concentration (mg/L)	
	Unsaturated Conditions	Flooded Conditions
Arsenic Chambers (5°C)	4000	4700 to 9000
Deep Disposal (10°C)	na	5600 to 9600

Source: CANMET (2000)

Prepared by: KSS
Checked by: DBM

Source concentrations for the other underground sources are summarized in Table M.11. Source concentrations for unsaturated (current) conditions are based on analyses of seepage from known sources in the mine (Supporting Document B1). Source concentrations for flooded conditions are based on the leach extraction tests described under the solids testing programs (Supporting Document B4). These concentrations are appropriate for the first several pore volumes of water through the system. However, with the exception of the roaster tailings, these concentrations are expected to slowly decrease over time as stored oxidation products are flushed from the solids. As discussed in Supporting Document B4, the roaster tailings contain significant amounts of arsenic associated with secondary iron oxide minerals. Reductive dissolution of the iron oxides will provide a long term source of dissolved arsenic in the roaster tailings.

Table M.11: Source Concentrations for Other Sources in the Underground Mine

Source	Arsenic Concentration (mg/L)	
	Unsaturated Conditions	Flooded Conditions
Backfilled flotation tailings	5	5
Backfilled roaster tailings	5	10
Backfilled waste rock	1.5	1.5
Bedrock and mine walls	0.05	1.5

Source: Supporting Documents B1 and B4.

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In all cases, estimates of arsenic loadings were obtained by multiplying the flows (Table M.9) by the corresponding source concentrations (Tables M.10 and M.11). Calculation sheets for each of the scenarios are provided in Appendix M3.

3.2 Results

The resulting estimates of current and post-closure flow and arsenic loadings from the underground workings are summarized in Table M.12.

Consistent with the findings of the underground water sampling programs, the Northwest Pond and the arsenic chambers are currently the single largest sources of arsenic loading to the underground workings, contributing 2,000 and 17,500 kg/year, respectively. Total flows from the underground workings are approximately 880,000 m^3/year. At present, all of the flows from the underground workings are pumped to the Northwest Pond and stored for seasonal water treatment.

Remediation of the Northwest Pond and partial flooding of the workings will result in a significant reduction in inflows to the mine. As a result, the amount of water that will need to be pumped from the mine water management system and treated will be approximately 307,000 to 353,000 m^3/year (810 to 970 m^3/day). These flows were conservatively rounded to 1000 m^3/day to estimate the rate of discharge from the Effluent Treatment Plant (see Section 2).

Isolation of the arsenic chambers by ground freezing, and removal of the Northwest Pond seepage, will result in a substantial reduction in arsenic loadings. Residual loadings in the underground workings would be on the order of 890-1050 kg/year. The average arsenic concentration in the minewater would be approximately 3 mg/L, reflecting inputs from the various backfill materials. It is assumed that this water would require treatment prior to release into the environment. However, the estimated arsenic concentration is strongly dependent on how much water flows through the backfill materials. It is possible that preferential flow through cleaner areas of the mine will result in concentrations that may eventually allow direct discharge.

Table M.12: Estimates of Flow and Arsenic Loadings from the Underground Workings under Current and Future Conditions

Arsenic Sources	Flow (m^3/year)			Arsenic Loadings (kg/year)		
	Current	425	100	Current	425	100
Vertical Flow						
arsenic dust - funnelled flow from pits	2,200	0	0	8,760	0	0
arsenic dust - infiltration from Baker Creek	2,200	0	0	8,760	0	0
roaster tailing backfill	19,000	17,000	17,000	96	83	83
flotation tailings backfill	19,000	17,000	17,000	96	83	83
waste rock backfill	69,000	60,000	60,000	103	89	89
regional bedrock/mine walls	46,000	40,000	40,000	2	2	2
Northwest Tailings Pond	292,000	9,900	9,900	2,044	69	69
Subtotal (Vertical)	449,000	142,000	142,000	19,861	326	326
Lateral Flow						
arsenic dust	0	0	0	0	0	0
roaster tailing backfill	0	34,000	26,000	0	338	264
flotation tailings backfill	0	34,000	26,000	0	169	132
waste rock backfill	0	86,000	67,000	0	128	100
bedrock/tunnels	431,000	57,000	45,000	646	86	67
Subtotal (Lateral)	431,000	210,000	164,000	646	721	563
TOTAL	880,000	353,000	307,000	20,507	1047	889

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Checked by: QJK

4 Summary and Conclusions

Calculations were presented to estimate flows and rates of arsenic release from the surface and underground sources under current and post-remediation conditions.

The calculations of surface loading indicate that, under current conditions:

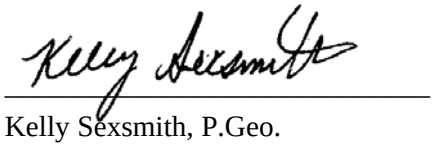
- sources upstream of the mine comprise approximately 224 kg/year, or 28% of the total arsenic loading to Baker Creek.
- Tributaries upstream of Trapper Lake and to the west of Baker Creek contribute an additional 67 kg/year or 8% of the loading to Baker Creek
- The Effluent Treatment Plant contributes 285 kg/year, or 36% of the total arsenic loading to Baker Creek, and,
- Other mine site sources contribute approximately 224 kg/year or 28% of the loading to Baker Creek.

An additional 110 kg/year can be attributed to direct runoff from the mine site catchments directly to Yellowknife Bay, resulting in total loads from the Baker Creek and mine site catchments of approximately 910 kg/year.

The remediation activities are expected to reduce contributions from the Effluent Treatment Plant to approximately 139 kg/year, contributions from the other sources to Baker Creek to approximately 193 kg/year, and contributions in direct runoff to Yellowknife Bay to approximately 69 kg/year. In addition, the Effluent Treatment Plant will discharge directly to Yellowknife Bay. These changes result in a total reduction in loading to Baker Creek from approximately 800 kg/year to 484 kg/year, and a reduction in loading to Yellowknife Bay from approximately 910 kg/year to 692 kg/year.

The calculations of underground loading indicate that the Northwest Pond and the arsenic chambers are the largest sources of arsenic from the underground mine. Currently, total flows from the mine are on the order of 880,000 m^3/year, and total arsenic loadings are approximately 20,000 kg/year. At present, all of the flows from the underground workings are pumped to the Northwest Pond and stored for seasonal water treatment. Following remediation, flows from the underground mine are expected to be reduced to 307,000 to 330,000 m^3/year (840 to 970 m^3/day), and arsenic loads are expected to be reduced to 890 to 1050 kg/year. Although the mine water will still need to be treated, it is possible that preferential flow through cleaner areas of the mine will result in concentrations that may someday reach levels that would be acceptable for discharge.

This report, **"Estimates of Flow and Arsenic Releases from Surface and Underground Sources"**, has been prepared by SRK Consulting (Canada) Inc.



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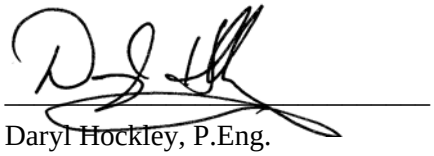
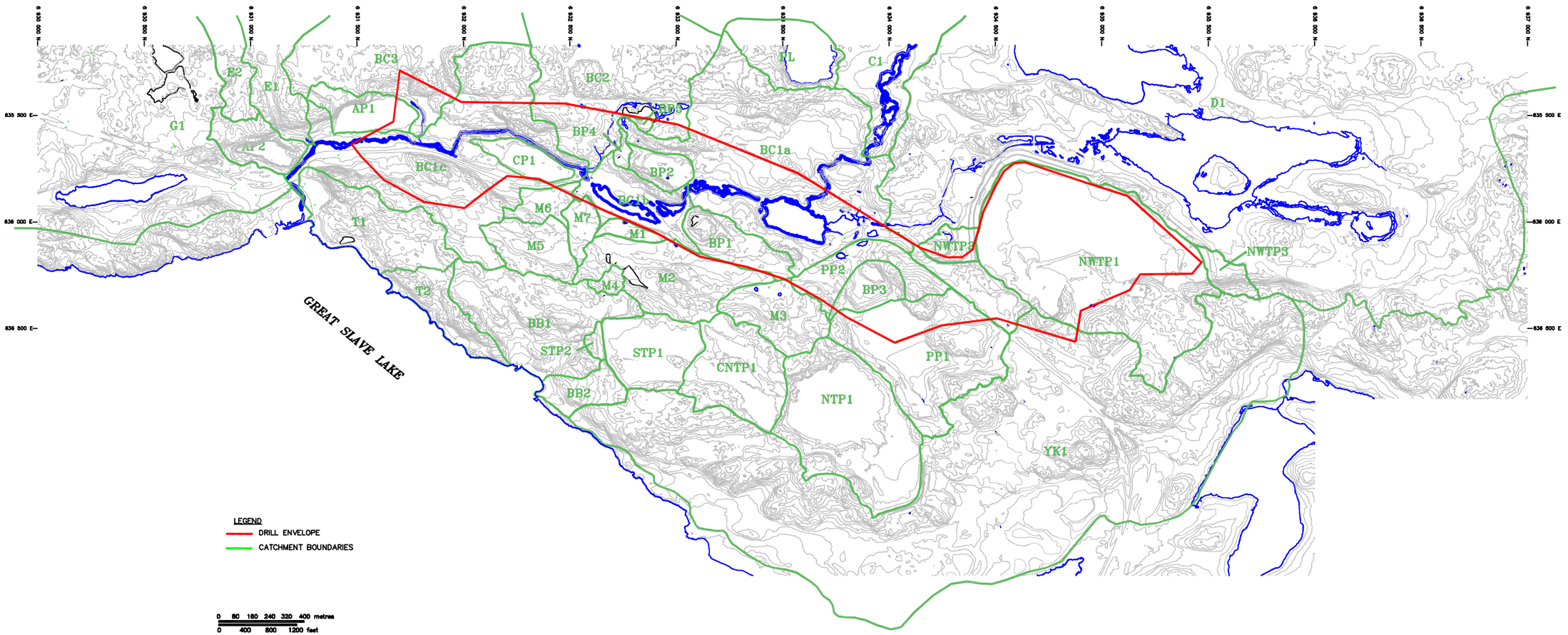


Daryl Hockley, P.Eng.
Principal

5 References

CANMET, 2000. A Review of Arsenic Disposal Practices for the Giant Mine, Yellowknife, Northwest Territories, Riveros, P. A. and J. E. Dutrizac

Figures



LEGEND

DRILL ENVELOPE

CATCHMENT BOUNDARIES

0 80 160 240 320 400 metres

0 400 800 1200 feet

1:20,000

0.5m contour interval
2003 aerial survey base map

File Ref: CATCHMENT SITE PLAN.DWG

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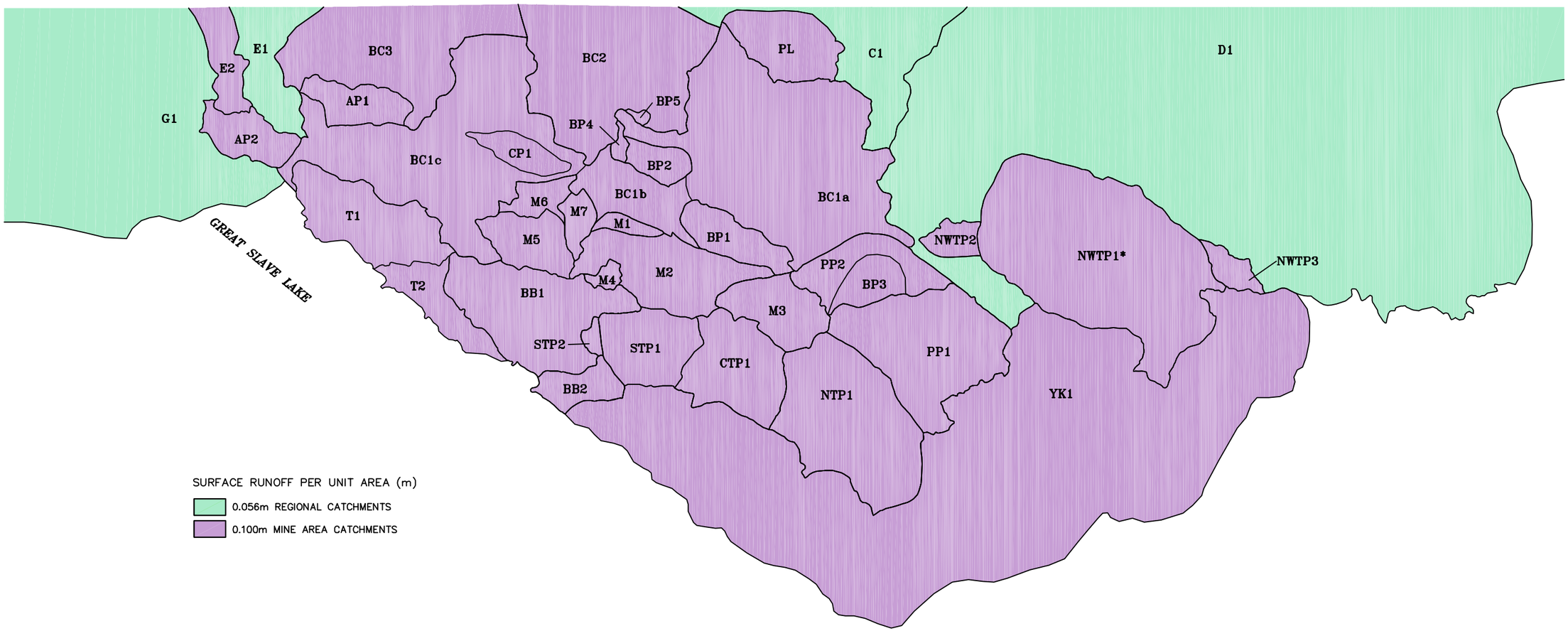
Giant Mine Remediation Plan

Mine Site Catchment Areas

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.12	May 2005	KSS	M.1



File Ref: Imac\1c1001.12 Giant Mine 2003-2004\Acad Drawings\B50\Color_Giant_surface_Catchments-2004.dwg

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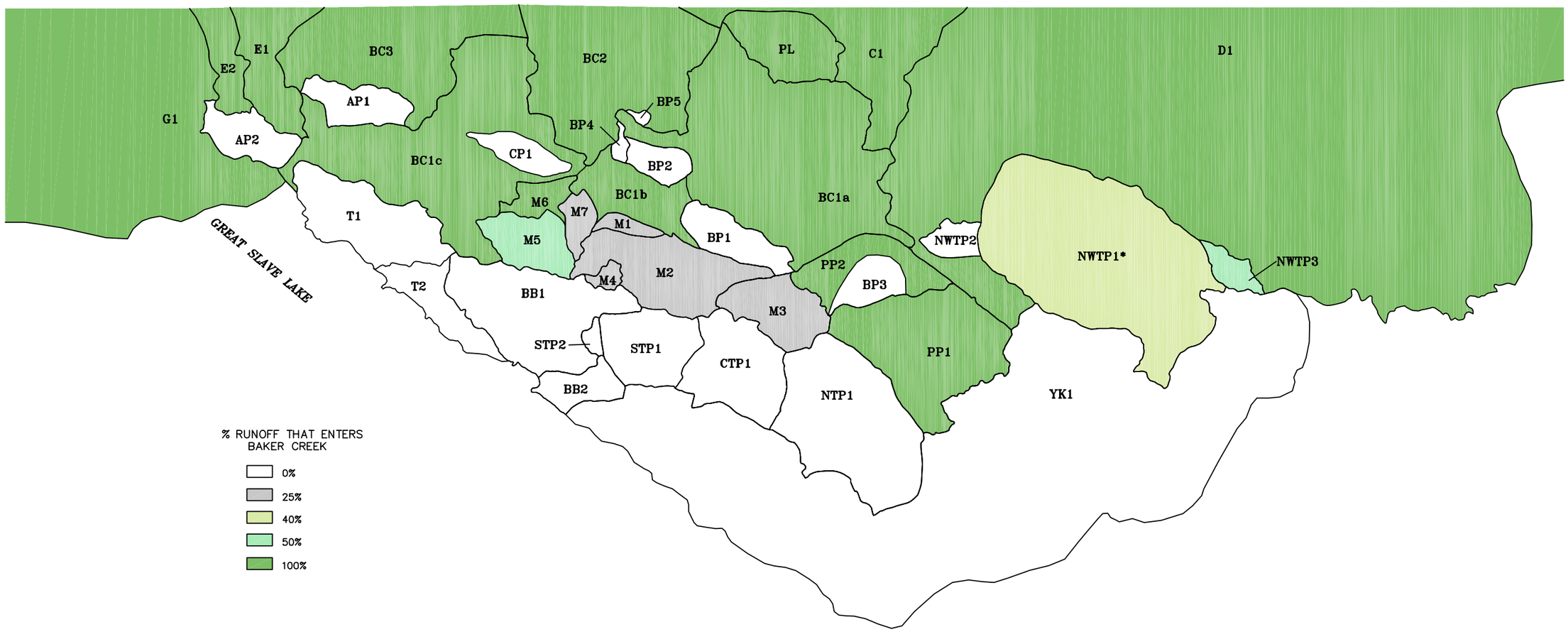
Giant Mine Remediation Plan

Assumed Surface Runoff

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.13	May 2005	KSS	M.2



File Ref: Inac\1c1001.12 Giant Mine 2003-2004\Acad Drawings\B50\Color_Giant_surface_Catchments-2004.dwg

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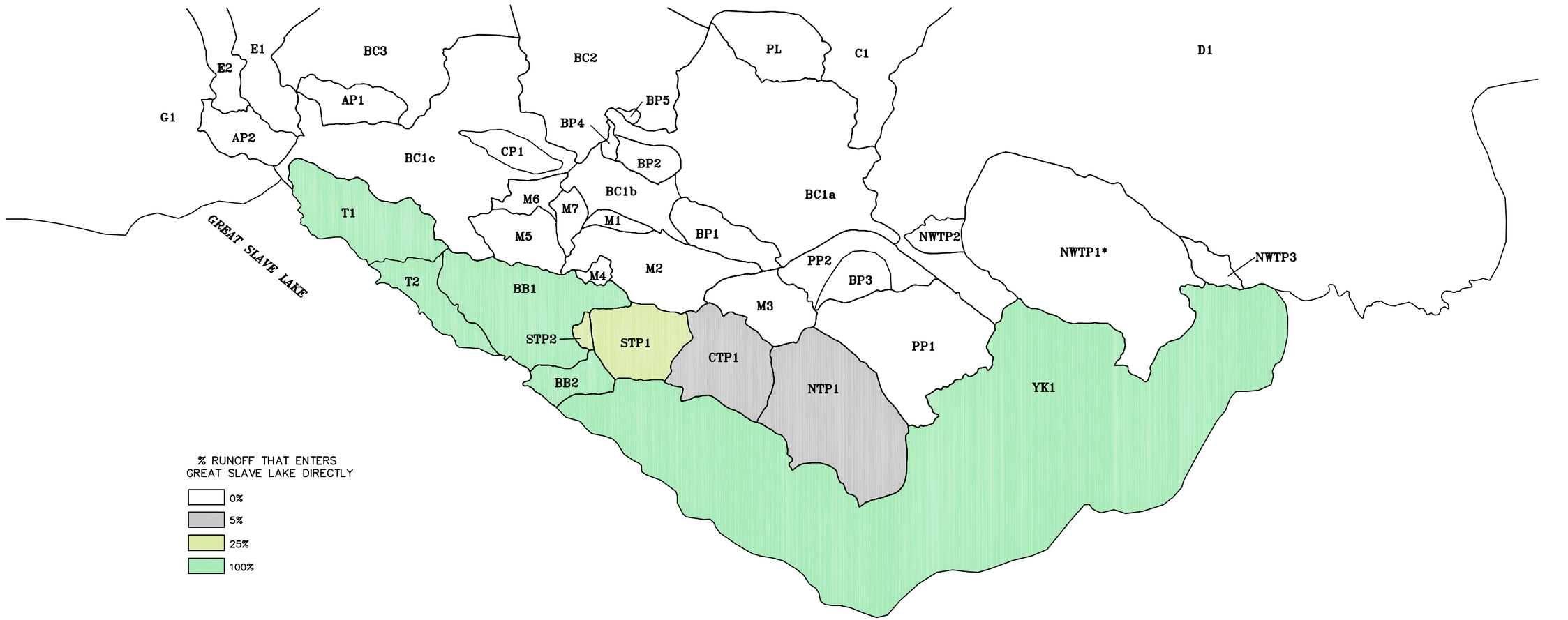
Giant Mine Remediation Plan

Percent Runoff that Reports to Baker Creek Current Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.12.B5	May 2005	KSS	M.3



File Ref: Inac\1c1001.12 Giant Mine 2003-2004\Acad Drawings\B50\Color_Giant_surface_Catchments-2004.dwg

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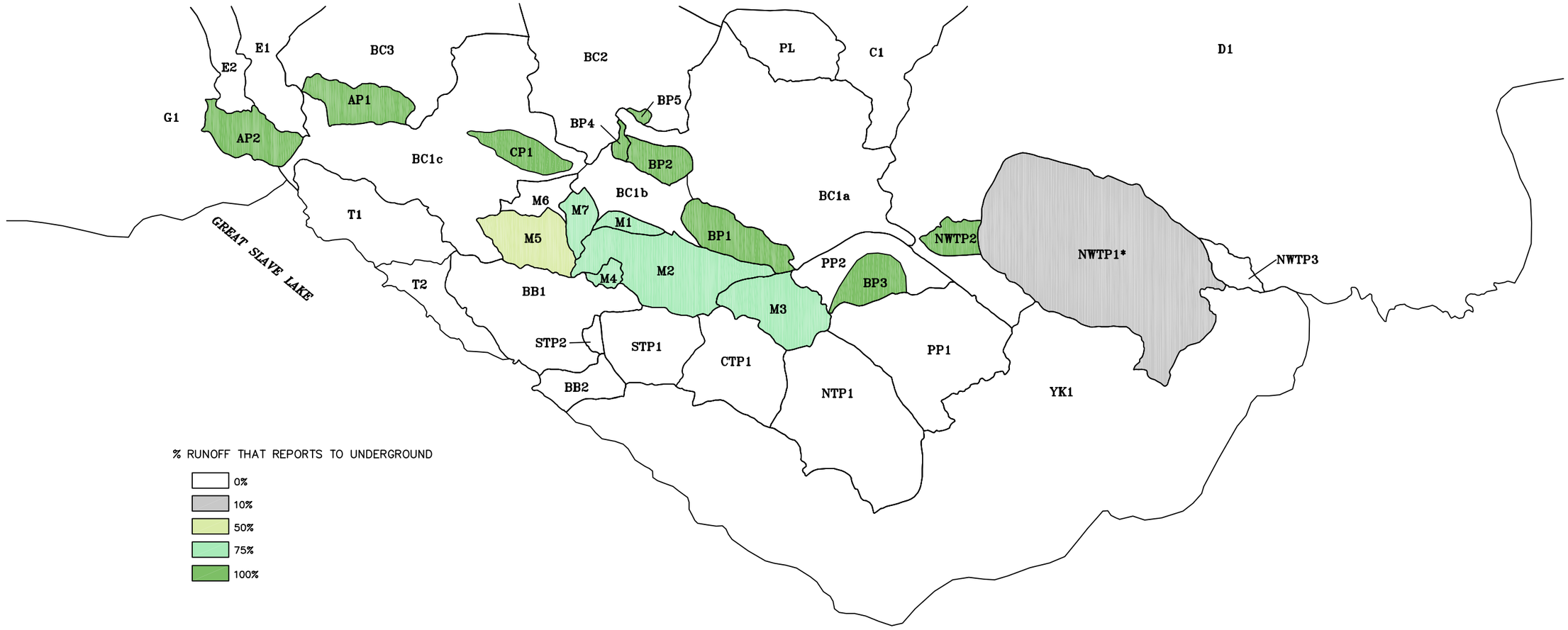
Giant Mine Remediation Plan

Percent Runoff that Reports to Great Slave Lake Current Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.12.B5	May 2005	KSS	M.4



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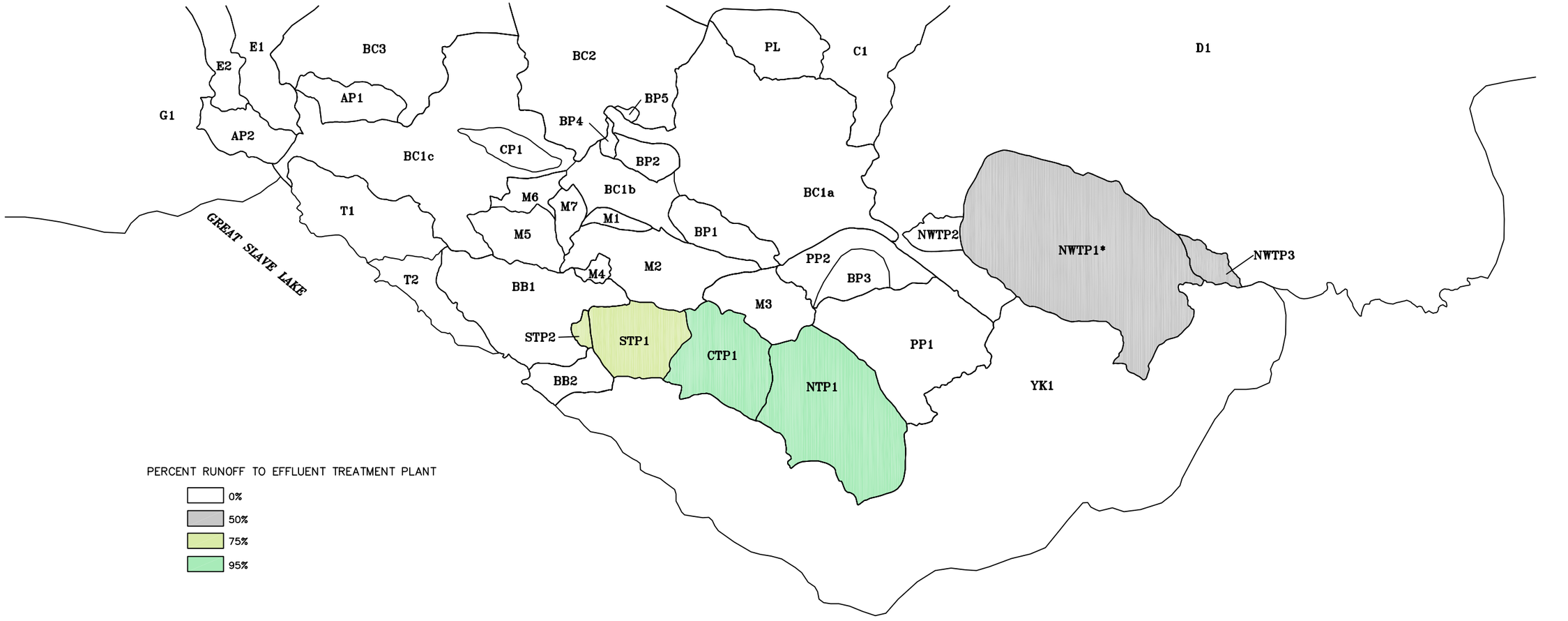
Giant Mine Remediation Plan

Percent Runoff that Reports to Underground Current Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.12.B5	May 2005	KSS	M.5



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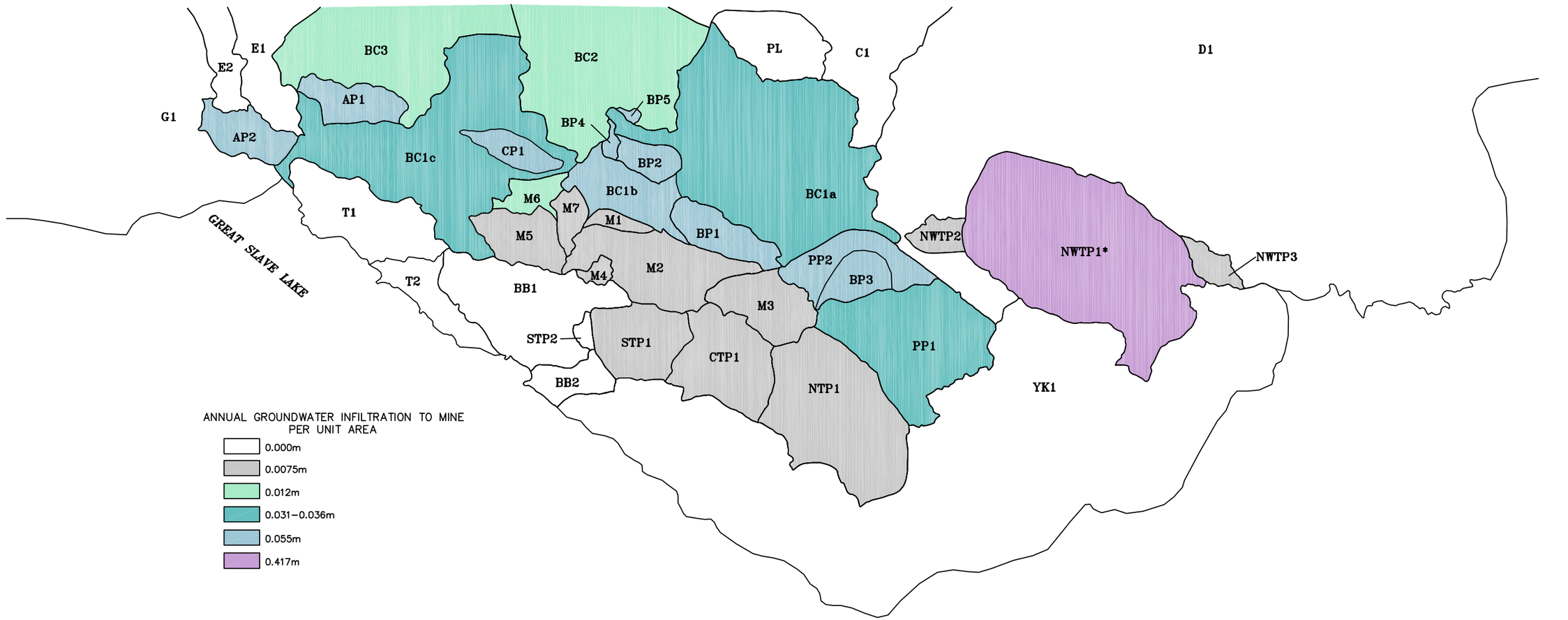
Giant Mine Remediation Plan

Percent Runoff that Reports to Effluent Treatment Plant Current Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.12.B5	May 2005	KSS	M.6



File Ref: Inac\1c1001.12 Giant Mine 2003-2004\Acad Drawings\B50\Color_Giant_surface_Catchments-2004.dwg

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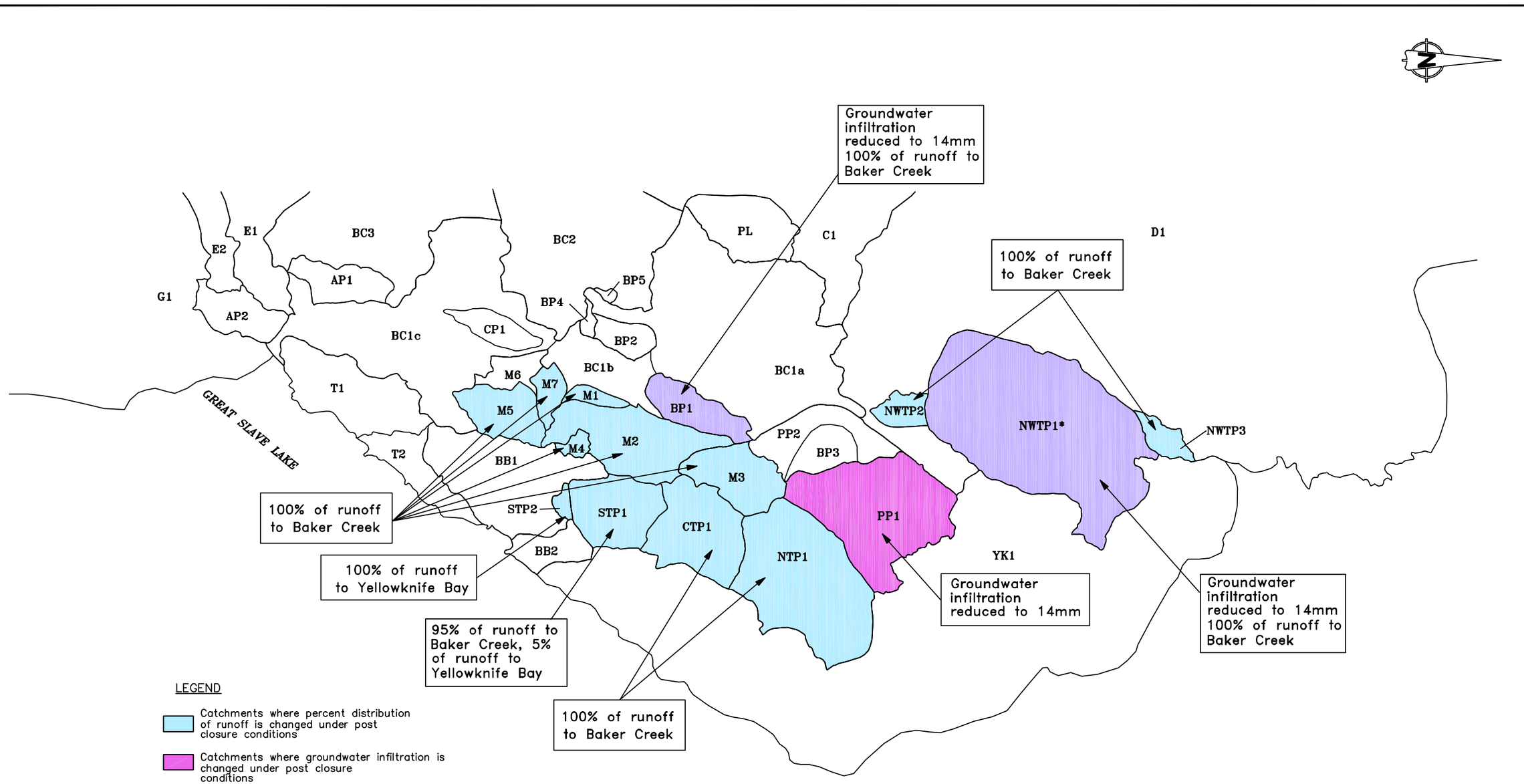
Giant Mine Remediation Plan

Infiltration Rates Current Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1C1001.13	May 2005	KSS	M.7



File Ref: Inac\1c1001.12 Giant Mine 2003-2004\Acad Drawings\350\Color_Giant_surface_Catchments-2004.dwg

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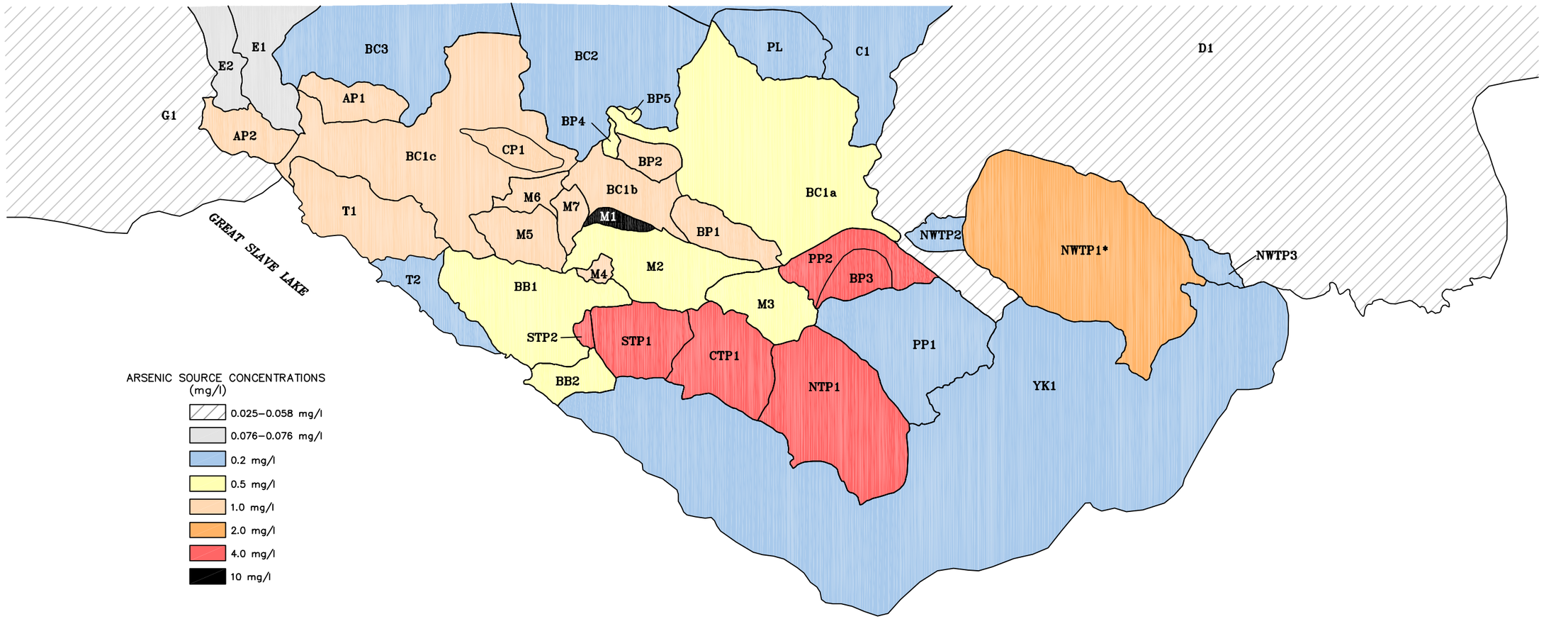
Giant Mine Remediation Plan

Post Closure Runoff and Infiltration Assumptions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.13.B5	May 2005	KSS	M.8



Note: * Vertical seepage at NWTP1 into mine has asenic concentration equal to 7mg/L
Lateral seepage is measured as shown

0 80 160 240 320 400 metres
0 400 800 1200 feet
1:20,000

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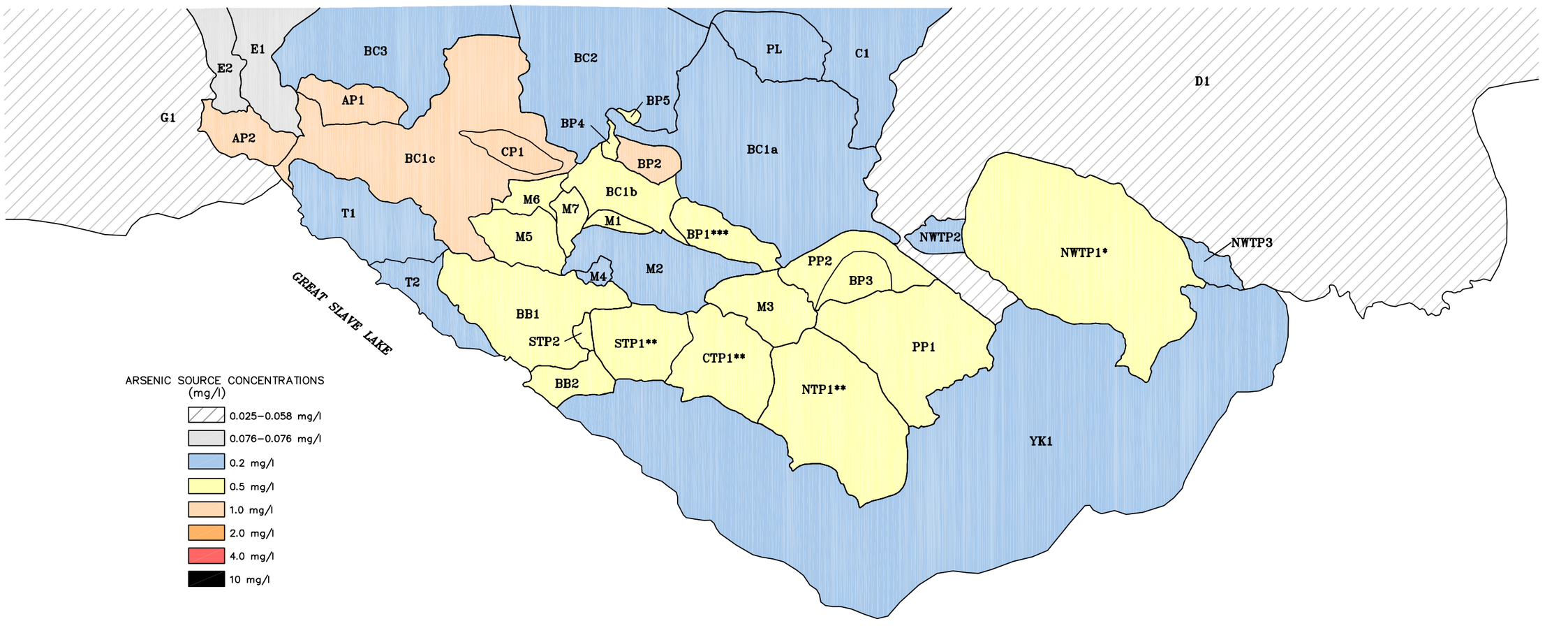
Giant Mine Remediation Plan

Arsenic Concentrations From Surface Sources Current Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.13	May 2005	KSS	M.9

File Ref: Inac\1ci001.12 Giant Mine 2003-2004\Acad Drawings\B50\Color_Giant_surface_Catchments-2004.dwg



Note: * Vertical Seepage at NWTP1 into Mine has Arsenic Concentration Equal to 7mg/L
Lateral Seepage is Measured as Shown

** Vertical Seepage at South, Central and North Tailings Ponds have Arsenic Concentration Equal to 4mg/L, Lateral Seepage is Measured as Shown

*** Vertical Seepage at B1 Pit has Arsenic Concentration Equal to 1mg/L, Lateral Seepage is Measured as Shown

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Giant Mine

Arsenic Concentrations From Surface Sources Future Conditions

PROJECT NO.	DATE	APPROVED	FIGURE
1CI001.12	May 2005	KSS	M.10

File Ref: Inac\1CI001.12 Giant Mine 2003-2004\Acad Drawings\B50\Color_Giant_AS_CONC_FUTURE_COND.dwg

Appendix M1

Surface Estimates – Current Conditions

Scenario: Current Conditions, Regional Mean Annual Runoff (MAR) of 56 mm, Local MAR of 100 mm, Annual Balance

Area	Subcatchment		Area	Surface Yield	Deep GW Yield	Total Annual Surface Flow	% Surface Flow Distribution				Aportioned Surface Volume Flow (m^3/yr)				Infiltration to UG Mine	As	As Load (kg/yr)		
	ID	Description	m^2	m^3/m	m^3/m	m^3	Baker Crk	ETP	YK Bay	UG Mine	Baker Crk	ETP	YK Bay	U/G (direct inflows)	Underground Mine	mg/L	Baker	UG Mine	YK Bay
Baker Creek: Upstream of Giant																			
Inputs																			
	A1	Duckfish Lake (not included in the calculations)	24,324,988	0.056	0.000	1,362,199	0	0	0	0	0	0	0	0	-	x			
	B2	Optional western boundary of Baker Creek (not included in the calculations)	25,269,363	0.056	0.000	1,415,084	0	0	0	0	0	0	0	0	-	x			
	B1	Runoff from large upstream catchment of Baker Creek	122,683,710	0.056	0.000	6,870,288	100	0	0	0	6,870,288	0	0	0	-	0.026	179	0.00	0.00
	C1	Runoff from subcatchment upstream Trapper Creek confluence to B1	3,928,865	0.056	0.000	220,016	100	0	0	0	220,016	0	0	0	-	0.20	44	0.00	0.00
	P1	Inputs from Pocket Lake	132,753	0.056	0.000	7,434	100	0	0	0	7,434	0	0	0	-	0.20	1.5	0.00	0.00
Calculated Net Inputs		Baker Creek: Upstream of Giant									7,097,738	0	0	0	-	0.032	224	0.00	0.00
Measured Inputs		Measured Concentration/Flow/Load above confluence with Trapper Creek (C1+B1+P1)									7,097,738					0.032	227		
		% Difference in measured vs calculated loads															-1%		
Trapper Creek																			
Inputs																			
	D1	Upper Trapper Lake/Gar Lake Catchment	6,943,169	0.056	0.000	388,817	100	0	0	0	388,817	0	0	0	-	0.058	23	0.00	0.00
	NWTPi	Northwest Pond (lateral seepage to Trapper Creek and Mine into NW2)	690,578	0.100	0	69,058	40	50	0	10	27,623	34,529	0	6,906	-	2.0	55	14	0.00
	NWTPii	Nothwest Pond area vertical seepage to Mine	690,578	0	0.417	0	0	0	0	0	0	0	0	0	288,164	7.0	0.00	2017	0.00
	NWTPiii	Discharge from Underground Mine	na	na	na	881,475	0	100	0	0	0	881,475	0	0	na				
	NWTP2	Quarry on the south margin of Northwest Pond	36,766	0.100	0.0075	3,677	0	0	0	100	0	0	0	3,677	276	0.20	0.00	0.79	0.00
	NWTP3	Pumpback seepage collection basin	34,526	0.100	0.0075	3,453	50	50	0	0	1,726	1,726	0	0	259	0.20	0.35	0.052	0.00
Calculated Net Input		Trapper Creek									418,167	917,730	0	10,582	288,699	0.187	78	2032	0.00
Measured Inputs		Loading Total Closing Control Point at Output (d/s of D1discharge into BC1a)									418,167					0.100	42		
		% Difference in measured vs calculated loads															30%		
Effluent Treatment Plant and Downstream Subcatchments																			
Net Discharge to Baker Creek																			
Inputs																			
	PP1i	Settling and Polishing Pond (lateral seepage and runoff)	328,107	0.100	0.000	32,811	100	0	0	0	32,811	0	0	0	-	0.20	6.6	0.00	0.00
	PP1ii	Settling and Polishing Pond (vertical seepage)	328,107	0	0.031	0	0	0	0	0	0	0	0	0	10,253	5.0	0.00	51	0.00
	PP2	Below Polishing Pond (tailings spill, outside of blind B3 Pit)	92,419	0.100	0.055	9,242	100	0	0	0	9,242	0	0	0	5,083	4.0	37	20	0.00
	BP3	B3 Pit and Portal drains to Mine	66,720	0.100	0.055	6,672	0	0	0	100	0	0	0	6,672	3,670	4.0	0.00	41	0.00
	ETP	Effluent Treatment Plant Discharge				750,000	100	0	0	0	750,000	0	0	0	-	0.38	285	0.00	0.00
Calculated Net Input		Effluent Treatment Plant and Downstream Subcatchments									792,053	0	0	6,672	19,006	0.415	329	113	0.00
Measured Inputs		Loading Total Closing Point at Output (Baker Creek at BC1a)									750,000					0.38	285		
		% Difference in measured vs calculated loads															7%		
Baker Creek: Upstream of Mill Area to inlet of Baker Creek Pond																			
Local Inputs																			
	BC1a	Baker Creek upstream of Mill including Baker Creek Pond (10% of area contaminated by tailings)	715,294	0.100	0.031	71,529	100	0	0	0	71,529	0	0	0	22,353	0.50	36	11	0.00
	M3	M3 catchment west of tailings ponds (includes TRP)	130,209	0.100	0.0075	13,021	25	0	0	75	3,255	0	0	9,766	977	0.50	1.6	5.4	0.00
	BP4	Small pit to the south of BP2	9,115	0.100	0.055	912	0	0	0	100	0	0	0	912	501	0.50	0.00	0.71	0.00
	BP5	Small pit to the west of BP2	4,743	0.100	0.055	474	0	0	0	100	0	0	0	474	261	0.50	0.00	0.37	0.00
Calculated Net Input		Baker Creek: Upstream of Mill Area to inlet of Baker Creek Pond									74,785	0	0	11,151	24,092	0.50	37	18	0.00
Upstream Inputs:																			
Upstream Baker Creek											7,097,738	0	0	0	-		224	0.00	0.00
Trapper Creek											418,167	917,730	0	10,582	288,699		78	2032	0.00
WTP and Settling/Polishing Ponds											792,053	0	0	6,672	19,006		329	113	0.00
Cumulative Net Input											8,382,742	917,730	0	28,406	331,797	0.080	668	2162	0.00
Measured Inputs		Loading Total Closing Point at location just upstream of BC1a d/s endpoint									na					na	na		
		% Difference in measured vs calculated loads															na		

Area	Subcatchment		Area	Surface Yield	Deep GW Yield	Total Annual Surface Flow	% Surface Flow Distribution				Aportioned Surface Volume Flow (m^3/yr)				Infiltration to UG Mine	As	As Load (kg/yr)		
	ID	Description	m^2	m^3/m	m^3/m	m^3	Baker Crk	ETP	YK Bay	UG Mine	Baker Crk	ETP	YK Bay	U/G (direct inflows)	Underground Mine	mg/L	Baker	UG Mine	YK Bay
Baker Creek: Mill Area Reach																			
Local Inputs																			
	BP1	B1 Pit	85,485	0.100	0.055	8,549	0	0	0	100	0	0	0	8,549	4,702	1.0	0.00	13	0.00
	BP2	B2 Pit	43,803	0.100	0.055	4,380	0	0	0	100	0	0	0	4,380	2,409	1.0	0.00	6.8	0.00
	M1	M1 Mill and roaster area	19,960	0.100	0.0075	1,996	25	0	0	75	499	0	0	1,497	150	10	5.0	16	0.00
	M2	M2 Upland above Mill	202,976	0.100	0.0075	20,298	25	0	0	75	5,074	0	0	15,223	1,522	0.50	2.5	8.4	0.00
	M4	M4 South of Mill (Parking area)	14,213	0.100	0.0075	1,421	25	0	0	75	355	0	0	1,066	107	1.0	0.36	1.2	0.00
	M7	M7 South of Mill (C-shaft, Shops, Dry and Ore Stockpiles)	34,156	0.100	0.0075	3,416	25	0	0	75	854	0	0	2,562	256	1.0	0.85	2.8	0.00
	BC1b	Baker Creek near Mill Area (~40% of area is contaminated similar to M1)	117,924	0.100	0.055	11,792	100	0	0	0	11,792	0	0	0	6,486	1.0	12	6.5	0.00
Calculated Net Input		Baker Creek: Mill Area Reach	sumed discharge								18,575	0	0	33,277	15,631	1.11	21	55	0.00
Upstream Inputs											8,382,742	917,730	0	28,406	331,797		668	2162	0.00
Cumulative Net Input											8,401,317	917,730	0	61,683	347,428	0.082		2218	0.00
Measured Inputs		Loading Total Closing Point at BC1b d/s endpoint									na					na	na		
		% Difference in measured vs calculated loads															na		
Baker Creek: Downstream of Mill Area																			
Local Inputs																			
	BC2	West Tributary 1 of Baker Creek	537,051	0.100	0.012	53,705	100	0	0	0	53,705	0	0	0	6,579	0.20	11	1.3	0.00
	M6	catchment south and west of C-Dry	41,451	0.100	0.012	4,145	100	0	0	0	4,145	0	0	0	508	1.0	4.1	0.51	0.00
	M5	catchment above and east of C-shaft/dry	93,038	0.100	0.0075	9,304	50	0	0	50	4,652	0	0	4,652	698	1.0	4.7	5.3	0.00
	AP1	A1 Pit	119,948	0.100	0.055	11,995	0	0	0	100	0	0	0	11,995	6,597	1.0	0.00	19	0.00
	AP2	A2 Pit	83,121	0.100	0.055	8,312	0	0	0	100	0	0	0	8,312	4,572	1.0	0.00	13	0.00
	CP1	C1 Pit	50,418	0.100	0.055	5,042	0	0	0	100	0	0	0	5,042	2,773	1.0	0.00	7.8	0.00
	BC3	West Tributary 2 of Baker Creek	513,128	0.100	0.012	51,313	100	0	0	0	51,313	0	0	0	6,286	0.20	10	1.3	0.00
	BC1c	Baker Creek catchment downstream of Mill area to mouth at YK Bay	577,117	0.100	0.036	57,712	100	0	0	0	57,712	0	0	0	20,776	1.0	58	21	0.00
	E1	Tributary of Baker Creek	4,696,410	0.056	0.000	262,999	100	0	0	0	262,999	0	0	0	-	0.079	21	0.00	0.00
	E2	Tributary of Baker Creek	109,667	0.100	0.000	10,967	100	0	0	0	10,967	0	0	0	-	0.076	0.83	0.00	0.00
	G1	Unamed creek that probably discharges into Baker just upstream of outlet	1,396,826	0.056	0.000	78,222	100	0	0	0	78,222	0	0	0	-	0.025	2.0	0.00	0.00
Calculated Net Input		Baker Creek: Downstream of Mill Area	measured discharge								523,714	0	0	30,001	48,788	0.21	111	68	0.00
Upstream Inputs											8,401,317	917,730	-	61,683	347,428		689	2218	0.00
Cumulative Net Input											8,925,032	917,730	0	91,683	396,216	0.090	800	2286	0.00
Measured Input		Closing Point at BC1c d/s endpoint									8,925,032					0.094	839		
		% Difference in measured vs calculated loads															-2%		
Yellowknife (YK) Bay, Great Slave Lake																			
Non-Baker Creek Inputs																			
	T1	Townsite catchment into YK Bay	200,825	0.100	0.000	20,082	0	0	100	0	0	0	20,082	0	-	1.0	0.00	0.00	20
	T2	Area adajecnt to Townsite 1	92,275	0.100	0.000	9,228	0	0	100	0	0	0	9,228	0	-	0.20	0.00	0.00	1.8
	STP1	South Pond seepage	136,049	0.100	0.0075	13,605	0	75	25	0	0	10,204	3,401	0	1,020	4.0	0.00	4.1	14
	STP2	Seepage collection from south pond that is pumped pack to SP1	11,183	0.100	0.000	1,118	0	75	25	0	0	839	280	0	-	4.0	0.00	0.00	1.1
	CTP1	Central Pond seepage	181,041	0.100	0.0075	18,104	0	95	5	0	0	17,199	905	0	1,358	4.0	0.00	5.4	3.6
	NTP1	North Pond seepage	364,714	0.100	0.0075	36,471	0	95	5	0	0	34,648	1,824	0	2,735	4.0	0.00	11	7.3
	BB1	Back Bay catchment 1	286,855	0.100	0.000	28,686	0	0	100	0	0	0	28,686	0	-	0.50	0.00	0.00	14
	BB2	Back Bay catchment 2	60,103	0.100	0.000	6,010	0	0	100	0	0	0	6,010	0	-	0.50	0.00	0.00	3.0
	YK1	Area north of Backbay discharging to Backbay	2,252,783	0.100	0.000	225,278	0	0	100	0	0	0	225,278	0	-	0.20	0.00	0.00	45
Calculated Inputs		Yellowknife (YK) Bay, Great Slave Lake									0	62,889	295,694	0	5,114		0.00	20	110
Upstream Inputs											8,925,032	917,730	0	91,683	396,216		800	2286	0.00
Total Inputs to Baker Creek											8,925,032						800		
Total Inputs to YK Bay													9,220,726						910
Total Surface Inputs to UG Mir															493,013			2307	
		from inside Mine drill envelope (without NW Pond)											6,410		157,049	430			
		from outside Mine drill envelope											64,006		43,847	120			
		NW Pond													292,117	800			

Appendix M2

Surface Estimates – Future Conditions

Scenario: Future Conditions Regional Mean Annual Runoff (MAR) of 56 mm, Local MAR of 100 mm, Annual Balance

Area	Subcatchment ID	Description	Area (m^2)	Surface Yield (m^3/m)	Deep GW Yield (m^3/m)	Total Annual Surface Flow (m^3)	% Surface Flow Distribution: Baker Crk	ETP	YK Bay	UG Mine	Aportioned Surface Volume Flow (m^3/yr): Baker Crk	ETP	YK Bay	U/G (direct inflows)	Infiltration to UG Mine: Underground Mine	As (mg/L)	As Load (kg/yr): Baker	UG Mine	YK Bay
Baker Creek: Upstream of Giant																			
Inputs																			
	A1	Duckfish Lake (not included in the calculations)	24,324,988	0.056	0.000	1,362,199	0	0	0	0	0	0	0	0	-	x			
	B2	Optional western boundary of Baker Creek (not included in the calculations)	25,269,363	0.056	0.000	1,415,084	0	0	0	0	0	0	0	0	-	x			
	B1	Runoff from large upstream catchment of Baker Creek	122,683,710	0.056	0.000	6,870,288	100	0	0	0	6,870,288	0	0	0	-	0.026	178.63	0.00	0.00
	C1	Runoff from subcatchment upstream Trapper Creek confluence to B1	3,928,865	0.056	0.000	220,016	100	0	0	0	220,016	0	0	0	-	0.20	44.00	0.00	0.00
	PI	Inputs from Pocket Lake	132,753	0.056	0.000	7,434	100	0	0	0	7,434	0	0	0	-	0.20	1.49	0.00	0.00
Calculated Net Inputs		Baker Creek: Upstream of Giant									7,097,738	0	0	0	-	0.032	224.12	0.00	0.00
Measured Inputs		Measured Concentration/Flow/Load above confluence with Trapper Creek (C1+B1+P1)									na						na		
		% Difference in measured vs calculated loads															na		
Trapper Creek																			
Inputs																			
	D1	Upper Trapper Lake/Gar Lake Catchment	6,943,169	0.056	0.000	388,817	100	0	0	0	388,817	0	0	0	-	0.058	22.55	0.00	0.00
	NWTPi	Northwest Pond (lateral seepage to Trapper Creek and Mine into NW2)	690,578	0.100	0	69,058	100	0	0	0	69,058	0	0	0	-	0.50	34.53	0.00	0.00
	NWTPii	Nothwest Pond area vertical seepage to Mine	690,578	0	0.0140	0	0	0	0	0	0	0	0	0	9,668	7.0	0.00	67.68	0.00
	NWTPiii	Discharge from Underground Mine	na	na	na														
	NWTP2	Quarry on the south margin of Northwest Pond	36,766	0.100	0.0075	3,677	100	0	0	0	3,677	0	0	0	276	0.20	0.74	0.06	0.00
	NWTP3	Pumpback seepage collection basin	34,526	0.100	0.0075	3,453	100	0	0	0	3,453	0	0	0	259	0.20	0.69	0.05	0.00
Calculated Net Inputs		Trapper Creek									465,004	0	0	0	10,203	0.126	58.51	67.78	0.00
Measured Inputs		Loading Total Closing Control Point at Output (d/s of D1discharge into BC1a)														na	na		
		% Difference in measured vs calculated loads															na		
Effluent Treatment Plant and Downstream Subcatchments																			
Net Discharge to Baker Creek																			
Inputs																			
	PP1i	Settling and Polishing Pond runoff	328,107	0.100	0.000	32,811	100	0	0	0	32,811	0	0	0	-	0.50	16.41	0.00	0.00
	PP1ii	Settling and Polishing Pond infiltration	328,107	0.000	0.014	0	0	0	0	0	0	0	0	0	4,593	5.0	0.00	22.97	0.00
	PP2	Below Polishing Pond (tailings spill, outside of blind B3 Pit)	92,419	0.100	0.055	9,242	100	0	0	0	9,242	0	0	0	5,083	0.50	4.62	2.54	0.00
	BP3	B3 Pit and Portal	66,720	0.100	0.055	6,672	0	0	0	100	0	0	0	6,672	3,670	0.50	0.00	5.17	0.00
	ETP	Effluent Treatment Plant Discharge				365,000	0	0	100	0	0	0	365,000	0	-	0.38	0.00	0.00	139
Calculated Net Inputs		Effluent Treatment Plant and Downstream Subcatchments									42,053	0	365,000	6,672	13,346	0.50	21.03	30.68	139
Measured Inputs		Loading Total Closing Point at Output (Baker Creek at BC1a)														NA	NA		
		% Difference in measured vs calculated loads															NA		
Baker Creek: Upstream of Mill Area to inlet of Baker Creek Pond																			
Local Inputs																			
	BC1a	Baker Creek upstream of Mill including Baker Creek Pond (10% of area contaminated by tailings)	715,294	0.100	0.031	71,529	100	0	0	0	71,529	0	0	0	22,353	0.20	14.31	4.47	0.00
	M3	M3 catchment west of tailings ponds (includes TRP)	130,209	0.100	0.0075	13,021	100	0	0	0	13,021	0	0	0	977	0.50	6.51	0.49	0.00
	BP4	Small pit to the south of BP2	9,115	0.100	0.055	912	0	0	0	100	0	0	0	912	501	0.50	0.00	0.71	0.00
	BP5	Small pit to the west of BP2	4,743	0.100	0.055	474	0	0	0	100	0	0	0	474	261	0.50	0.00	0.37	0.00
Calculated Net Inputs		Baker Creek: Upstream of Mill Area to inlet of Baker Creek Pond										0	0	1,386	24,092	0.246	20.82	6.03	0.00
Upstream Inputs:																			
Upstream Baker Creek											7,097,738	0	0	0	-		224.12	0.00	0.00
Trapper Creek											465,004	0	0	0	10,203		58.51	67.78	0
ETP and Settling/Polishing Ponds											42,053	0	365,000	6,672	13,346		21.03	30.68	138.7
Cumulative Flows and Loads												0	365,000	8,058	47,641	0.042	324.47	104.50	138.7
Measured Inputs		Loading Total Closing Point at location just upstream of BC1a d/s endpoint									na					na	na		
		% Difference in Current measured vs Calculated future loads															na		
Baker Creek: Mill Area Reach																			
Local Inputs																			
	BP1i	B1 Pit runoff	85,485	0.100	0.000	8,549	100	0	0	0	8,549	0	0	0	-	0.50	4.27	0.00	0.00
	BP1ii	B1 Pit infiltration	85,485	0.000	0.014	0	0	0	0	100	0	0	0	0	1,197	1.0	0.00	1.20	0.00
	BP2	B2 Pit	43,803	0.100	0.055	4,380	0	0	0	100	0	0	0	4,380	2,409	1.0	0.00	6.79	0.00
	M1	M1 Mill and roaster area	19,960	0.100	0.0075	1,996	100	0	0	0	1,996	0	0	0	150	0.50	1.00	0.07	0.00
	M2	M2 Upland above Mill	202,976	0.100	0.0075	20,298	100	0	0	0	20,298	0	0	0	1,522	0.20	4.06	0.30	0.00
	M4	M4 South of Mill (Parking area)	14,213	0.100	0.0075	1,421	100	0	0	0	1,421	0	0	0	107	0.20	0.28	0.02	0.00
	M7	M7 South of Mill (C-shaft, Shops, Dry and Ore Stockpiles)	34,156	0.100	0.0075	3,416	100	0	0	0	3,416	0	0	0	256	0.50	1.71	0.13	0.00
	BC1b	Baker Creek near Mill Area (~40% of area is contaminated similar to M1)	117,924	0.100	0.055	11,792	100	0	0	0	11,792	0	0	0	6,486	0.50	5.90	3.24	0.00
Calculated Net Inputs		Baker Creek: Mill Area Reach										0	0	4,380	12,127	0.36	17.22	11.76	0.00

Area	Subcatchment		Area	Surface Yield	Deep GW Yield	Total Annual Surface Flow	% Surface Flow Distribution				Aportioned Surface Volume Flow (m^3/yr)				Infiltration to UG Mine	As	As Load (kg/yr)		
	ID	Description	m^2	m^3/m	m^3/m	m^3	Baker Crk	ETP	YK Bay	UG Mine	Baker Crk	ETP	YK Bay	U/G (direct inflows)	Underground Mine	mg/L	Baker	UG Mine	YK Bay
Upstream Inputs												0	365,000	8,058	47,641		324.47	104.50	138.7
Cumulative Flows and Loads												0	365,000	12,438	59,767	0.044	341.69	116.25	138.7
Measured Inputs		Loading Total Closing Point at BC1b d/s endpoint									na					na	na		
		% Difference in measured vs calculated loads															na		
Baker Creek: Downstream of Mill Area																			
Local Inputs																			
	BC2	West Tributary 1 of Baker Creek	537,051	0.100	0.012	53,705	100	0	0	0	53,705	0	0	0	6,579	0.20	10.74	1.32	0.00
	M6	catchment south and west of C-Dry	41,451	0.100	0.012	4,145	100	0	0	0	4,145	0	0	0	508	0.50	2.07	0.25	0.00
	M5	catchment above and east of C-shaft/dry	93,038	0.100	0.0075	9,304	100	0	0	0	9,304	0	0	0	698	0.50	4.65	0.35	0.00
	AP1	A1 Pit	119,948	0.100	0.055	11,995	0	0	0	100	0	0	0	11,995	6,597	1.0	0.00	18.59	0.00
	AP2	A2 Pit	83,121	0.100	0.055	8,312	0	0	0	100	0	0	0	8,312	4,572	1.0	0.00	12.88	0.00
	CP1i	C1 Pit (lateral runoff and seepage)	50,418	0.100	0	5,042	0	0	0	100	0	0	0	5,042	-	1.0	0.00	5.04	0.00
	CP1ii	C1 Pit (vertical)	50,418	0.000	0.055	0	0	0	0	0	0	0	0	0	2,773	1.0	0.00	2.77	0.00
	BC3	West Tributary 2 of Baker Creek	513,128	0.100	0.012	51,313	100	0	0	0	51,313	0	0	0	6,286	0.20	10.26	1.26	0.00
	BC1c	Baker Creek catchment downstream of Mill area to mouth at YK Bay	577,117	0.100	0.036	57,712	100	0	0	0	57,712	0	0	0	20,776	1.0	57.71	20.78	0.00
	E1	Tributary of Baker Creek	4,696,410	0.056	0.000	262,999	100	0	0	0	262,999	0	0	0	-	0.079	20.78	0.00	0.00
	E2	Tributary of Baker Creek	109,667	0.100	0.000	10,967	100	0	0	0	10,967	0	0	0	-	0.076	0.83	0.00	0.00
	G1	Unamed creek that probably discharges into Baker just upstream of outlet	1,396,826	0.056	0.000	78,222	100	0	0	0	78,222	0	0	0	-	0.025	1.96	0.00	0.00
Calculated Net Inputs		Baker Creek: Downstream of Mill Area										0	0	25,349	48,788	0.206	109.01	63.24	0.00
Upstream Inputs												-	365,000	12,438	59,767		341.69	116.25	138.7
Cumulative Flows and Loads												0	365,000	37,787	108,555	0.055	450.69	179.50	138.70
Measured Input		Closing Point at BC1c d/s endpoint									na					na	na		
		% Difference in measured vs calculated loads															na		
Yellowknife (YK) Bay, Great Slave Lake																			
Non-Baker Creek Inputs																			
	T1	Townsite catchment into YK Bay	200,825	0.100	0.000	20,082	0	0	100	0	0	0	20,082	0	-	0.20	0.00	0.00	4.02
	T2	Area adajecnt to Townsite 1	92,275	0.100	0.000	9,228	0	0	100	0	0	0	9,228	0	-	0.20	0.00	0.00	1.85
	STP1i	South Tailings Pond runoff	136,049	0.100	0.0000	13,605	95	0	5	0	12,925	0	680	0	-	0.50	6.5	0.00	0.34
	STP1ii	South Tailings Pond infiltration	136,049	0.000	0.0075	0	0	0	0	0	0	0	0	0	1,020	4.0	0.00	4.1	0.00
	STP2	Seepage collection from south pond that is pumped pack to SP1	11,183	0.100	0.000	1,118	0	0	100	0	0	0	1,118	0	-	0.50	0.00	0.00	0.56
	CTP1i	Central Tailings Pond runoff	181,041	0.100	0.0000	18,104	100	0	0	0	18,104	0	0	0	-	0.50	9.1	0.00	0.00
	CTP1ii	Central Tailings Pond infiltration	181,041	0.000	0.0075	0	0	0	0	0	0	0	0	0	1,358	4.0	0.00	5.4	0.00
	NTP1i	North Tailings Pond runoff	364,714	0.100	0.0000	36,471	100	0	0	0	36,471	0	0	0	-	0.50	18	0.00	0.00
	NTP1ii	North Tailings Pond infiltration	364,714	0.000	0.0075	0	0	0	0	0	0	0	0	0	2,735	4.0	0.00	11	0.00
	BB1	Back Bay catchment 1	286,855	0.100	0.000	28,686	0	0	100	0	0	0	28,686	0	-	0.50	0.00	0.00	14.34
	BB2	Back Bay catchment 2	60,103	0.100	0.000	6,010	0	0	100	0	0	0	6,010	0	-	0.50	0.00	0.00	3.01
	YK1	Area north of Backbay discharging to Backbay	2,252,783	0.100	0.000	225,278	0	0	100	0	0	0	225,278	0	-	0.20	0.00	0.00	45.06
Calculated Net Inputs		Yellowknife (YK) Bay, Great Slave Lake									67,500	0	291,083	0	5,114		34	20	69
Upstream Inputs											8,265,184	0	365,000	37,787	108,555		451	179	139
Total Inputs to Baker Creek											8,332,684						484		
Total Inputs to YK Bay													8,988,766						692
Total Surface Inputs to UG Mine															151,456				359
		from inside Mine envelope (without NW Pond)													132,430	363			
		from outside Mine envelope													9,082	25			
		NW Pond													9,944	27			

Appendix M3

Underground Estimates

Table M3-1
Current Conditions: Fully Dewatered

DUPUIT FLOW - lateral GW flow (includes recharge)
K = '[q-(R(L/2))] * 2L / [h1^2-h2^2]

	K:	8.5E-09	m/s	deep bedrock
		0.00073	m/day	deep bedrock
Option Dependent Variables	h1=	125	m	height of seepage face in mine
Drawdown "Depth to Water", (m): **610**	h2=	610	m	epth of dewatered section of mine
Constant Head boundary height, h2 (m): 610	distance (L)=	900	m	
Height of seepage wall, h1 (m): **125**	"q" (flow/unit area)	0.197	m^2/d	
	TOTAL LATERAL GROUNDWATER INFLOW:	**1180**	**m^3/d**	

INFILTRATION FROM SURFACE MODEL	Source Type	Infil vol. (m^3/day)
	Total Infiltration through Drill Envelope from Surface Mine, excluding NW Pond	**431**
	Northwest Pond	**800**
	total	**1231**

DISTRIBUTED INFILTRATION THROUGH WORKINGS	Source Type	Footprint Area (m^2)	% of Total Drill Envelope Footprint	Dsitributed Infil vol. (m^3/day)	Vert. Infiltr. Source Concentration (kg/m^3)	Daily Load (kg/day)		
	arsenic dust - funnelled flow from pits	8,059	#N/A	6	4.0	24		
	arsenic dust - infiltration from Baker Creek	8,059	#N/A	6	4.0	24		
	roaster tailing backfill	233,312	13%	52	0.0050	0.26		
	flotation tailings backfill	233,312	13%	52	0.0050	0.26		
	waste rock backfill	838,591	45%	188	0.0015	0.28		
	regional bedrock/mine walls	559,061	30%	126	0.00005	0.0063		
	total:	**1,880,393**		**431**	**total:**	**49**	**kg/day**	**= total infiltration load**

NORTHWEST POND INFLOWS	NW Pond	0	#N/A	**800**	0.007	**5.6**	**kg/day**	**= total NW Pond load**

GROUNDWATER FLOW	Source Type	Cross-sectional Area (m^2)	% of Saturated Area	GW Flow. (m^3/day)	Source Concentration (kg/m^3)	Daily Load (kg/day)		
	dust	0	0.0%	0	6.0	0.0		
	roaster tailing backfill	0	0.0%	0	0.010	0.0		
	flotation tailings backfill	0	0.0%	0	0.0050	0.0		
	waste rock backfill	0	0.0%	0	0.0015	0.0		
	bedrock/tunnels	375,000	100.0%	1,180	0.0015	1.8		
	total:	**375,000**	100.0%	**1,180**		**1.8**	**kg/day**	**= total groundwater load**
		Total Flow (m^3/day) =		**2,411**		**56**	**kg/day**	**= TOTAL LOAD from underground**

Table M3-2
Future Conditions: Dewater to 425 Level (During Freezing Implementation/Verification)

DUPUIT FLOW - lateral GW flow (includes recharge)
K = '[q-(R(L/2))] * 2L / [h1^2-h2^2]

		K:	8.5E-09	m/s	deep bedrock
			0.00073	m/day	deep bedrock
Option Dependent Variables		h1=	512	m	height of seepage face in mine
Drawdown "Depth to Water", (m):	**100**	h2=	610	m	epth of dewatered section of mine
Constant Head boundary height, h2 (m):	610	distance (L)=	900	m	
Height of seepage wall, h1 (m):	**512**	"q" (flow/unit area)	0.096	m^2/d	
		TOTAL LATERAL GROUNDWATER INFLOW:	**576**	**m^3/d**	

INFILTRATION FROM SURFACE MODEL	Source Type	Infil vol. (m^3/day)
	Total Infiltration through Drill Envelope from Surface Mine, excluding NW Pond	**363**
	Northwest Pond	**27**
	total	**390**

DISTRIBUTED INFILTRATION THROUGH WORKINGS	Source Type	Footprint Area (m^2)	% of Total Drill Envelope Footprint	Dsitributed Infil vol. (m^3/day)	Vert. Infiltr. Source Concentration (kg/m3)	Daily Load (kg/day)		
	arsenic dust - funnelled flow from pits	8,059	#N/A	0	4	0.000		
	arsenic dust - infiltration from Baker Creek	8,059	#N/A	0	4	0.000		
	roaster tailing backfill	233,312	13%	45	0.0050	0.23		
	flotation tailings backfill	233,312	13%	45	0.0050	0.23		
	waste rock backfill	838,591	45%	163	0.0015	0.24		
	regional bedrock/mine walls	559,061	30%	109	0.00005	0.0054		
	total:	**1,880,393**		**363**		**0.70**	**kg/day**	**= total infiltration load**

NORTHWEST POND INFLOWS	NW Pond	#N/A	#N/A	**27**	0.0070	**0.19**	**kg/day**	**= total NW Pond load**

GROUNDWATER FLOW	Source Type	Cross-sectional Area (m^2)	% of Saturated Area	GW Flow. (m^3/day)	Source Concentration (kg/m^3)	Daily Load (kg/day)		
	dust	0	0.0%	0	6	0.0		
	roaster tailing backfill	258,597	16.1%	93	0.010	0.93		
	flotation tailings backfill	258,597	16.1%	93	0.0050	0.46		
	waste rock backfill	655,283	40.7%	235	0.0015	0.35		
	bedrock/tunnels	436,855	27.1%	156	0.0015	0.23		
	total:	**1,609,331**	100.0%	**576**		**2.0**	**kg/day**	**= total groundwater load**
		Total Flow (m^3/day) =		**966**		**2.9**	**kg/day**	**= TOTAL LOAD from underground**

Table M3-3
Future Conditions: Maintain Water Level Below Base of Open Pits (Long-term Operations)

DUPUIT FLOW - lateral GW flow (includes recharge)
K = '[q-(R(L/2))] * 2L / [h1^2-h2^2]

		K:	8.5E-09	m/s	deep bedrock
			0.00073	m/day	deep bedrock
Option Dependent Variables		h1=	560	m	- height of seepage face in mine
Drawdown "Depth to Water", (m):	**50**	h2=	610	m	- depth of dewatered section of mine
Constant Head boundary height, h2 (m):	610	distance (L)=	900	m	
Height of seepage wall, h1 (m):	**560**	"q" (flow/unit area)	0.075	m^2/d	
		TOTAL LATERAL GROUNDWATER INFLOW:	**450**	**m^3/d**	

INFILTRATION FROM SURFACE MODEL	Source Type	Infil vol. (m^3/day)
	Total Infiltration through Drill Envelope from Surface Mine, excluding NW Pond	**363**
	Northwest Pond	**27**
	total	**390**

DISTRIBUTED INFILTRATION THROUGH WORKINGS	Source Type	Footprint Area (m^2)	% of Total Drill Envelope Footprint	Dsitributed Infil vol. (m^3/day)	Vert. Infiltr. Source Concentration (kg/m3)	Daily Load (kg/day)		
	arsenic dust - funnelled flow from pits	8,059	#N/A	0	4	0.000		
	arsenic dust - infiltration from Baker Creek	8,059	#N/A	0	4	0.000		
	roaster tailing backfill	233,312	13%	45	0.0050	0.23		
	flotation tailings backfill	233,312	13%	45	0.0050	0.23		
	waste rock backfill	838,591	45%	163	0.0015	0.24		
	regional bedrock/mine walls	559,061	30%	109	0.00005	0.0054		
	total:	**1,880,393**		**363**	**total:**	**0.70**	**kg/day**	**= total infiltration load**

NORTHWEST POND INFLOWS	NW Pond	N/A	N/A	**27**	0.007	**0.19**	**kg/day**	**= total NW Pond load**

GROUNDWATER FLOW	Source Type	Cross-sectional Area (m^2)	% of Saturated Area	GW Flow. (m^3/day)	Source Concentration (kg/m3)	Daily Load (kg/day)		
	dust	0	0.0%	0	6	0.0		
	roaster tailing backfill	258,597	16.1%	72	0.010	0.72		
	flotation tailings backfill	258,597	16.1%	72	0.0050	0.36		
	waste rock backfill	655,283	40.7%	183	0.0015	0.27		
	bedrock/tunnels	436,855	27.1%	122	0.0015	0.18		
	total:	**1,609,331**	100.0%	**450**		**1.5**	**kg/day**	**= total groundwater load**
		Total Flow (m^3/day) =		**840**		**2.4**	**kg/day**	**= TOTAL LOAD from underground**