# Annual Environmental

# and

# Reclamation Report
# 2007

For Submission to:

**Ministry of Energy, Mines and Petroleum Resources**
**and**
**Ministry of Environment**

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# 1.0 INTRODUCTION

Imperial Metals Corporation is the sole owner/operator of the Mount Polley Mine, an open pit copper-gold mine, located approximately 60 km northeast of Williams Lake, B.C. (Figure 1). Access to the mine site from 150 Mile House is north along secondary highway No. 115 for 60 km to Morehead Lake and then south at the Bootjack Lake turn-off for another 12 km on the site access road to the property. The mine is positioned on a ridge dividing the Polley Lake / Hazeltine Creek and Bootjack Lake / Morehead Creek drainages, both of which are situated within the Quesnel River Watershed.

Approval of the Mount Polley Mine Reclamation and Closure Plan by the Ministry of Energy, Mines and Petroleum Resources (previously the Ministry of Energy and Mines) resulted in the issuance of Permit M-200 in July of 1997. In 2007 the mine received amendments to the M-200 permit approving the following:

- The Northeast Zone Dump Extension,
- Copper Oxide Test Heap Leach Pad
- The Boundary Road
- Wight Pit High Wall Rehabilitation.

The permit was last amended on February 19th, 2008, approving the *Tailings Storage Facility* Stage 6 construction.

In May of 1997 the mine received a Ministry of Environment (previously the Ministry of Water, Land and Air Protection) Effluent Permit (PE 11678) issued under the provisions of the provincial *Waste Management Act*. The permit authorized the discharge of concentrator tailings, mill site runoff, mine rock runoff, contaminated soil, open pit water, and septic tank effluent to a tailings impoundment. The most recent amendment to this permit (May 2005) allows for the discharge of effluent from the Main Embankment Seepage Collection Pond, there has been no discharge from this location in either 2006 or 2007. In 2007, a number of studies were commissioned to obtain the information necessary to apply for an additional discharge permit into Hazeltine Creek. These studies are detailed in Section 2.7.2.

The Mount Polley open pit operation is on a phased development schedule, ultimately involving the creation of six and possibly seven pits. The current project infrastructure consists of the mill site, four open pits, three rock disposal sites and a *Tailings Storage Facility*, as well as the main access road, power line, tailings pipeline and sediment and seepage control ponds. Construction activities in 1995 consisted primarily of clearing the mill site. Construction of the entire facility began in 1996 with the mill being commissioned in June 1997. The first full year of mining and milling at Mount Polley took place in 1998. The mine suspended operations in October 2001. The mine re-opened in December 2004, with mill production commencing again in March of 2005.

Each year all data collected under the requirements of permit PE 11678 is submitted in an Annual Environmental Report by April 30th of the year following the reporting period. This includes a report on the construction and performance of the tailings impoundment and dam, reclamation activities, and an evaluation of the impacts of the operation on the receiving environment. For the M-200 permit, an Annual Reclamation Report outlining the results of all geological characterization, material characterization test work, and water quality monitoring is submitted by March 31st of each year. Also provided in this report are details of the reclamation plan and a summary of the disturbance and reclamation activities for the previous years and for five (5) subsequent years. Since the reporting year 2000, these two reports have been combined into one for submission to the Ministry of Energy, Mines and Petroleum Resources and to the Ministry of Environment in order to satisfy the requirements of the respective permits. This reporting format of a combined report for both Ministries has been continued for the 2007-reporting year.

## 1.1. RECLAMATION OBJECTIVES

In accordance with the BC Mines Act and the Health, Safety and Reclamation Code for Mines in British Columbia, the primary objective of the Reclamation Plan is to *"return all mine-disturbed areas to an equivalent level of capability to that which existed prior to mining on an average property basis, unless the owner, agent or manager can provide evidence which demonstrates to the satisfaction of the chief inspector the impracticality of doing so*".

In 1995 and 1996, a comprehensive environmental baseline-monitoring program, that expanded on previous studies (1989/1990), was designed and carried out in order to support mine planning, operations, and reclamation. The program included environmental baseline studies documenting the pre-development land use and conditions of the aquatic and terrestrial ecosystems. This provided the foundation upon which the operational and post–closure monitoring programs are based and reclamation activities are developed, such that the land may be returned to its original capability once mining has ceased. Environmental monitoring is ongoing, fulfilling both the requirements of the M–200 permit by the Ministry of Energy, Mines and Petroleum Resources (MEMPR) and the effluent permit PE 11678 by the Ministry of Environment.

As identified in the reclamation plan, the primary end land uses for the Mount Polley project area are wildlife habitat and commercial forestry. Reclaimed areas will also be capable of supporting secondary end land uses such as hunting, guide-outfitting, trapping and outdoor recreation. Perpetuating, and, if possible, enhancing biodiversity are important considerations when planning for wildlife habitat as an end land use objective. The following goals are implicit in achieving this primary objective:

- Long-term preservation of receiving water quality within and downstream of the receiving environment of the decommissioned operations;
- Long-term stability of engineered structures, including the rock disposal sites, Tailings Storage Facility and open pits, as well as all exposed erodible materials;
- Natural integration of disturbed lands into surrounding landscape and, to the greatest possible extent, restoration of the natural appearance of the area after mining ceases;
- Establishment of a self-sustaining vegetative cover, consistent with the end land uses of wildlife habitat, commercial forestry, and outdoor recreation; and
- Removal and proper decommissioning of all secondary access roads, structures and equipment not required after the mine closes.

To achieve these goals, reclamation planning must be flexible enough to allow for modifications to the mine plan, and to incorporate results from ongoing reclamation research programs into the plan. For instance, in 1998, reclamation research test plots were established on the East 1170 rock disposal site to monitor the effects of soil thickness and various other parameters on plant growth. Plots comprising new treatments were added to the trial in 1999, and some of the plots that were planted in 1998 were repeated in the 1999 plots with the original prescriptions. In 2000, Phase II of the Reclamation Research program was initiated, with additional plots established on re-sloped areas of the 1170 rock disposal site. These research initiatives have been monitored and reported on in last year’s (2006) Annual Reclamation Report.

## 1.2. ENVIRONMENTAL MONITORING

The main objective of the environmental monitoring program is to monitor and track changes to drainage chemistry from disturbed areas and waste material in surface water, seepage and groundwater water. Sampling procedures follow those that are described in the “British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air Emission, Water, Wastewater, Soil, Sediment, and Biological Samples” 2003 edition and the Mount Polley “Quality Assurance/Quality Control Manual”.

Throughout the year, on a regularly scheduled basis, surface water and ground water are sampled and analyzed at locations and time intervals specified in Permit PE 11678. These surface and groundwater monitoring locations are shown in **Figure 2**. In addition, surface water flows and static ground water levels are also measured and recorded on a regular basis at locations specified in permit PE 11678. Static water levels are recorded in conjunction with water sampling of the groundwater monitoring wells.

A new weather station was purchased in 2005, which continuously measures daily precipitation (rainfall during non freezing months only), and temperature. This data is downloaded on a monthly basis. Evaporation rates are measured on site with an evaporation pan (non freezing months only) and are summarized at year-end along with the precipitation and temperature data. Winter, snow pack measurements are taken at the end of each month during the applicable months. This data is used to update the water balance on a monthly basis.

At such time that the mine discharges under the current permit, or under a new discharge permit, a biological monitoring program initiated in accordance with the Metal Mining Effluent Regulations will be developed.

Mount Polley continues to recycle used materials including waste oil, scrap steel, batteries, and beverage containers. In 2007 Mount Polley donated the funds generated by its beverage container recycling program to the Big Brothers and Big Sisters of Williams Lake. As part of promoting our habitat stewardship initiatives, the mine discourages bear interaction through a garbage management program. In 2007 there were no bear encounters or mortalities.

In 2007, Mount Polley received approximately 19,000 tonnes of sulphur product as part of a federal clean up initiative from the Greater Vancouver area. This project allows for environmental clean up activities to take place, it recycles contaminated soil and it recovers copper effectively from a particular ore type, which was historically difficult to do. In addition, Mount Polly accepted approximately 6,500 tonnes of mineral-enriched soil from the Pacific Environmental Centre (PEC). The material is similar to mine waste material found at Mount Polley.

# 2.0 ENVIRONMENTAL PROTECTION & RECLAMATION PROGRAM

## 2.1. RECLAMATION FACILITIES AND STAFF

During operations, the Mount Polley reclamation research program and annual reclamation initiatives are under the direction of the Environmental Superintendent, who reports to the General Manager. The environmental technologist, environmental technician, the survey crew, and the engineering department also contribute to reclamation activities undertaken at Mount Polley. Some programs also draw on the advice of reclamation specialists, including government and industry staff, professional agrologists, registered professional foresters, professional geologists and professional biologists. Some of this work includes: soils inventory, soil classification and mapping, waste characterization, and fish and fish habitat assessments.

In-house reclamation activities conducted by Mount Polley include:

- Drafting and surveying;
- Site preparation, and land contouring;
- Installation of diversion ditches, drainage works, sediment control and settling ponds;
- Placement of stockpiled materials on reclamation sites;
- Seeding of domestic grass-legume cover crops; and
- Monitoring/Reporting.

Mount Polley has much of the heavy equipment necessary to carry out a majority of the reclamation activities, such as bulldozers, backhoes and haulage trucks. It will also rent additional equipment, such as hydro seeders, harrows, plows and diskers as they are needed.

Since operations restarted in December of 2004 minimal reclamation has taken place due to increasing and continuing development. It is anticipated that 10 ha of the *East Rock Disposal Site* will be reclaimed in 2008.

## 2.2. RECLAMATION ACTIVITIES – 2007

### 2.2.1. STABILITY OF WORKS

#### *2.2.1.1. ROCK DISPOSAL SITES*

Examinations of rock disposal sites are made in accordance with section 6.12.1 of the "Health, Safety and Reclamation Code for Mines in British Columbia". A variance was granted by MEM on February 9, 2001. Mount Polley operates in accordance with the terms and reference of this variance. The rock disposal sites that are monitored are the East Rock Disposal Site, the North Rock Disposal Site, Northeast Zone Rock Disposal Site and the Cariboo Pit Rock Disposal Site.

#### *2.2.1.2. TAILINGS STORAGE FACILITY AND ASSOCIATED WORKS*

The last inspection of the Tailings Storage Facility and associated works took place in September of 2007 by Knight Piésold Consulting (KP). KP's findings are documented in a report found in Appendix 1 entitled, "*Tailings Storage Facility Report on 2007 Annual Inspection (Ref. No VA101-01/20-1)*. This report was submitted to the Ministry of Energy, Mines and Petroleum Resources in March of 2008.

### 2.2.2. RE-VEGETATION TREATMENTS & FERTILIZER APPLICATIONS

The total area that has been seeded/planted throughout the mine site in 2007 was minimal, being limited to seeding bermed area's along the tailings haul road to the tailings pond.

### 2.2.3. ROCK DISPOSAL SITE RECLAMATION

No reclamation was conducted on the East, North, Northeast Zone or Cariboo Pit rock disposal sites during 2007.

### 2.2.4. WATERCOURSE RECLAMATION

No further changes to the watercourses at the Mount Polley mine site were made in 2007. All diversion ditches and pipelines continue to operate as designed. The focus in 2007 was to mitigate potential sediment loading from the mine site and to predict long term water quality that would discharge from the site.

### 2.2.5. PIT RECLAMATION

In 2007, no reclamation was conducted on the Cariboo, Bell or Wight pits at Mount Polley. Mining of the Bell and Wight pits will be completed in 2008 allowing for the full development of the Springer Pit. The existing pits will not be reclaimed in 2008 and there is potential to allow the vacant pits to fill with water.

### 2.2.6. TAILINGS STORAGE FACILITY RECLAMATION

No reclamation was conducted at the *Tailings Storage Facility* in 2007; however, in planning for mine site closure, seepage collection pond designs were commissioned to consider the use of long-term passive treatment technology.

### 2.2.7. ROAD RECLAMATION

No road reclamation was conducted during 2007.

### 2.2.8. SECURING OF MINE OPENINGS

Mount Polley Mine consists exclusively of open pits. Therefore, there are no mine openings to secure. In January 2008, an application was filed with MEMPR to amend permit M-200 by bringing some existing logging roads in the area under permit. This amendment would help to restrict access to the mine site and facilitate access planning. The amendment has since been granted.

### 2.2.9. METAL UPTAKE IN VEGETATION

Metal uptake analysis was completed on various plant species growing in the vicinity of the mine. The data will be used in a comparative manner against data that was collected and summarized in the 2006 Annual Report (see Table 2.25 and Figure 3).

### 2.2.10. CHEMICAL, REAGENT OR SPILL WASTE DISPOSAL

Waste oil and grease were generated at Mount Polley during 2007. As a result, Sumas Environmental was scheduled on a routine basis to remove the waste.

### 2.2.11. ACID ROCK DRAINAGE/ METAL LEACHING PROGRAM

The Acid Rock Drainage / Metal Leaching (ARD/ML) Monitoring Program for the Mount Polley Mine continued through 2007. The program characterizes all material types that will be handled during the mine life. Mount Polley's LECO analytical machine allows the mine to best manage mine waste by directing it to suitable storage sites, or to construction usage when required and if deemed suitable. The following sub-sections cover general discussions regarding the present program.

#### *2.2.11.1. Waste Rock*

Bell Pit, Wight Pit, Cariboo South Pit, Southeast Pit and Springer Pit:

On each bench, a sample of cuttings was collected from each blast hole and analyzed for total copper, non-sulphide copper, iron, and gold. Blast hole patterns were on average 7.4m burden by 8.5m spacing. Bench height is typically 12 metres. Areas of ore and waste were identified by indicator kriging and assigning assay values, mill head value, etc. using an inverse distance calculation. The Mine Geologist and Mine Planners then established ore/waste boundaries based on the calculated mill head values. For purposes of ARD-ML monitoring, only waste areas were sampled. Each month, approximately five composite blast hole samples were collected for PAG (potential acid generating), NAG (non-acid generating) or probable NAG material from every blast of more than 20 holes. Test results are listed in Table 2.26: Blast Hole Samples Analyzed for ABA. A summary (by individual pit) of materials classified NAG and PAG, as well as the weight of overburden and waste rock are presented in the table below and discussed in the following paragraphs.

All waste material in the Wight Pit was designated NAG. Approximately 11,900,000 tonnes of NAG rock were used in road, *Tailings Storage Facility* (TSF) and dump construction. 487,370 tonnes of overburden was placed in the till dump.

In the Bell Pit, there is a pyrite rich (up to 5% Py) section on the northeast side of the pit. Previous and current testing substantiates this material as PAG. 736,246 tonnes of PAG material from this area of the pit were placed in the PAG dump (Cariboo Pit). 3,735,245 tonnes of NAG rock were placed in waste dumps and used for road construction. From the Cariboo South Extension, some 90,853 tonnes of rock were designated as NAG and used in road construction and delivered to the waste dumps.

Although the Southeast Pit rock is not strictly by definition, PAG rock, it lacks the components required to qualify as NAG and therefore, in most cases has been designated PAG. 36,797 tonnes of designated PAG rock were deposited into the PAG dump, while 7,352 tonnes of NAG rock were placed in the Wight Pit Rock Dump. Approximately 6,660 tonnes of overburden was obtained from this pit.

A total of 5,479,756 tonnes of NAG rock generated from the Springer Pit was placed in the North Bell Dump, while a further 28,490 tonnes of overburden were placed in the same dump in a separate location

| | | ***2007*** | | | |
|---|---|---|---|---|---|
| | | **NAG** | **PAG** | **OB*** | **Waste** |
| Wight Pit | 1008+ | 196,065 | 0 | 0 | 196,065 |
| | 972 | 221 | 0 | 0 | 221 |
| | 960 | 188,420 | 0 | 0 | 188,420 |
| | 948 | 427,637 | 0 | 0 | 427,637 |
| | 936 | 1,140,903 | 0 | 39,716 | 1,180,619 |
| | 924 | 2,962,909 | 0 | 95,350 | 3,058,259 |
| | 912 | 2,448,940 | 0 | 349,698 | 2,798,638 |
| | 900 | 2,244,409 | 0 | 2,606 | 2,247,015 |
| | 888 | 1,279,674 | 0 | 0 | 1,279,674 |
| | 876 | 768,653 | 0 | 0 | 468,653 |
| | 864 | 233,322 | 0 | 0 | 233,322 |
| **WP Total** | | **11,891,152** | **0** | **487,370** | **12,378,522** |
| **Bell Pit** | 1168 | 100,773 | 0 | 0 | 100,773 |
| | 1156 | 151,156 | 72 | 0 | 151,228 |
| | 1144 | 139,920 | 64,469 | 0 | 204,389 |
| | 1132 | 154,685 | 60,345 | 0 | 215,030 |
| | 1120 | 227,669 | 109,159 | 0 | 336,828 |
| | 1108 | 693,482 | 175,541 | 0 | 869,023 |
| | 1096 | 1,279,506 | 205,445 | 0 | 1,484,951 |
| | 1084 | 818,109 | 121,215 | 0 | 939,324 |
| | 1072 | 169,945 | 0 | 0 | 169,945 |
| **BP Total** | | **3,735,245** | **736,246** | **0** | **4,471,491** |
| **Cariboo (C2)** | 1130 | 90,853 | 0 | 0 | 90,853 |
| **C2 Total** | | **90,853** | **0** | **0** | **90,853** |
| **South East Pit** | 1180 | 7,352 | 36,797 | 6,660 | 50,809 |
| | | 0 | 0 | 0 | 0 |
| **SE Total** | | **7,352** | **36,797** | **6,660** | **50,809** |
| **Springer Pit** | | **0** | **0** | **0** | **0** |
| | 1204 | 273,893 | 0 | 0 | 273,893 |
| | 1192 | 1,703,068 | 0 | 9,670 | 1,712,738 |
| | 1180 | 2,205,560 | 0 | 11,790 | 2,217,350 |
| | 1168 | 1,083,296 | 0 | | 1,083,296 |
| | 1156 | 125,002 | 0 | 7,030 | 132,032 |
| | 1144 | 82,141 | 0 | | 82,141 |
| | 1140 | 6,796 | 0 | | 6,796 |
| **SP Total** | | **5,479,756** | **0** | **28,490** | **5,508,246** |
| **PIT TOTAL** | | **21,106,153** | **773,043** | **522,460** | **22,401656** |

* Overburden

There were 128 pit blast hole samples analyzed for ABA. (Table 2.26). Where the NPR value was equal to or less than 2 the corresponding material from that specific blast would be designated PAG and sent to the PAG dump for both the Bell Pit and Southeast Pit.

Any waste rock with ABA results of less than 2 from the Wight Pit and Springer Pit was designated as NAG and delivered to the nearest NAG dumps. This is because the amount of material was not considered significant compared to the amount of NAG material sent to the respective dumps throughout the year.

ABA sampling determined that approximately 116,563 tonnes of rock from the Wight Pit was PAG. This material was dumped into the Wight Pit Rock Dump along with a further 53,061 tonnes of PAG from the Cariboo South Extension. This amounted to only 1.4% of the total NAG placed in the Rock Dump. The remaining material from the Cariboo South Extension was dumped in the East Bell Dump, which also doubled as the building site for the Test Leach Pad. A total of 29,053 tonnes of PAG rock were delivered to this NAG dump for a total of 3.3% of the dumping.

In 2007, 87,328 tonnes of PAG from the Springer Pit were dumped into the North Bell Dump. This PAG material amounts to 0.9% of the overall NAG dumped (9,215,001 tonnes) into the Bell Dump.

Table 2.26 shows that the mean NPR value of the 128 ABA samples was 6.57 and the range was 0.15 to 59.29. The table below summarizes the NPR results by pit.

| Pit | # of samples | Mean | Min NPR | Max NPR |
|---|---|---|---|---|
| **Bell Pit** | 32 | 9.84 | 0.6 | 59.29 |
| **Cariboo Pit** | 2 | 4.99 | 1.98 | 8.00 |
| **Southeast Pit** | 4 | 0.91 | 0.15 | 1.69 |
| **Springer Pit** | 20 | 8.07 | 2.00 | 17.01 |
| **Wight Pit** | 69 | 5.03 | 1.63 | 15.03 |

ABA samples designated as PAG are shown in the following table. Eight (8) samples collected from the Bell Pit and four (4) samples from the Southeast Pit had a mean NPR value of 1.04 and a Min and Max range of NPR values from 0.15 to 1.69.

| **Blast** | **Total Sulphur** | **AP** | **Total Carbon** | **NP** | **NPR** |
|---|---|---|---|---|---|
| B1072-10 | 0.09 | 2.75 | 0.04 | 3.58 | 1.30 |
| B1096-15 | 0.41 | 12.94 | 0.21 | 17.17 | 1.33 |
| B1096-21 | 0.61 | 18.94 | 0.32 | 26.50 | 1.4 |
| B1096-22 | 0.86 | 26.91 | 0.39 | 32.08 | 1.19 |
| B1096-8 | 0.06 | 1.75 | 0.03 | 2.83 | 1.62 |
| B1108-13 | 1.28 | 40.00 | 0.54 | 45.00 | 1.13 |
| B1120-21 | 2.00 | 62.50 | 0.27 | 22.67 | 0.36 |
| B1144-23 | 1.21 | 37.81 | 0.24 | 19.58 | 0.52 |
| Z1080-01 | 0.57 | 17.94 | 0.07 | 5.75 | 0.32 |
| Z1080-01 | 0.75 | 23.44 | 0.04 | 3.5 | **0.15** |
| Z1080-02 | 0.05 | 1.63 | 0.03 | 2.75 | **1.69** |
| Z1080-02 | 0.14 | 4.28 | 0.08 | 6.25 | 1.46 |
| **Mean Values** | **0.67** | **20.91** | **0.19** | **15.64** | **1.04** |

### *2.2.11.2. Low Grade Stockpile*

At 2007 year end, the low-grade stockpile was estimated to contain 835,054 tonnes of ore grading 0.248% Cu and 0.269 g/t Au. This includes a net reduction in the remainder of the 877,072 tonnes of ore placed before 2005 (re-startup) and in the 625,956 tonnes placed in the stockpile and the 806,043 tonnes taken out of the stockpile in 2007.

### *2.2.11.3. Rock Borrow Pit*

No rock was extracted from the rock borrow in 2007.

### *2.2.11.4. Tailings*

Representative composite tailings samples were collected to represent the tonnage of tailings deposited to the *Tailings Storage Facility*. Samples were collected and analyzed for the 9 of the 12 months. Table 2.27.1 shows a summary of the ABA data for each of these samples. No mineralogical analyses were conducted on tailings material in 2007. From January to December 2007, 6,444,000 tonnes of tailings were deposited into the TSF. The composite tailings sample had an average NPR value of 4.47 and a range of NPR values from 2.57 to 8.50.

#### *2.2.11.5. Soils and Till*

In 2007, a total of 522,460 tonnes of soil / till were stockpiled generally from the Wight pit and Springer pit area. Nine ABA samples were taken for analysis; the average NPR value was approximately 22.92 and had a range of values from 4.93 to 64.44.

#### *2.2.11.6. Field Grab Samples*

Five (5) samples were collected from the *Wight Pit Dump*; samples had a mean NPR value of 3.32 and a range of NPR values from 2.65 to 4.61.

Five (5) samples were collected from the *Bell Pit Dump*; sample had a mean NPR value of 8.84 and a range of NPR values from 6.27 to 14.0.

Twelve (12) samples were collected from *the Tailings C zone*; samples had a mean NPR value of 4.16 and a range of NPR values from 2.32 to 5.92.

Five (5) samples were collected from *the SEZ haul Road to the TSF*; samples had a mean NPR value of 14.14 and a range of NPR values from 3.61 to 16.71.

Three (3) samples were collected from *the Boundary haul Road to the Boundary pit*; samples had a mean NPR value of 10.70 and a range of NPR values from 4.17 to 21.38.

#### *2.2.11.7. Quality Control and Assurance*

Four (4) of the field grab samples plus 1 composite tailings sample referred to in the previous sub-section were also submitted to Cantest for independent ABA analysis as part of Mount Polley's Quality Control and Assurance program. In addition, ICP-MS metal scans were conducted on the solids and 24-hour shake flask tests were run.

Mount Polley analysis results indicated both higher AP (+ 20%) and lower NP/AP ratios (16%) compared to the results reported by the external laboratory (see

Table 2.27.2). In 2008 a complete comparison compiling and comparing sample preparation and analytical procedures used will be undertaken to identify the source(s) of the discrepancies.

### *2.2.11.8. Geological Characterization*

Mount Polley ore bodies are alkalic porphyry copper-gold deposits hosted within Jurassic - Triassic Polley Stock that intrudes the Nicola Group volcanic rocks. The Polley Stock is a northwesterly, elongated body approximately five kilometers long and extends from Bootjack to Polley Lakes in the east west direction. The stock is a multi-phase pluton with composition ranging from diorite -to- monzodiorite -to- monzonite. It is variable altered and brecciated. Felsic (plagioclase phyric) and mafic (augite phyric) dykes occur as late stage intrusive phases. Late brittle faults offset lithologies, alteration, and mineralization.

#### **Lithologies**

Volcanics: These volcanic and volcaniclastic rocks are the oldest on the property, form part of the Nicola Group, and are Upper Triassic in age. They consist mainly of andesitic basalt or augite phyric alkali basalt, and volcanic breccias. Volcanic rocks do not make up a significant component of material from the pits.

Diorite: The diorite occurs mainly in the western section of the Bell Pit and is bluish-grey, fine to medium grained and equigranular to weakly porphyritic. Phenocrysts are plagioclase, minor augite, and occasional magnetite, biotite, calcite, and apatite.

Monzonite: The monzonite unit is greyish white to pinkish grey or greenish grey, medium to coarse-grained, and equigranular to weakly feldspar phyric. Predominate feldspars are orthoclase and albite. Accessory minerals include magnetite, augite, biotite, calcite, apatite, and epidote. This unit is variably flooded with potassic alteration and epidote. This unit is variable brecciated and hosts copper / gold mineralization.

Potassium feldspar phyric dykes: These dykes are pinkish orange to orangish grey. The matrix is fine to medium grained, orangish grey and composed largely of potassium feldspar. The phenocrysts are elongated subhedral to euhedral plagioclase laths up to 10mm long. These dykes are often planar occurring in various orientations and filling fractures of the brecciated monzonite. They vary in width from fractions of a metre to 5 meters wide.

Augite Phyric Dykes: These dykes are distinctive dark green with a fine to medium grained mafic matrix and scattered up to 3mm augite phenocrysts (up to 8% of rock) and occasionally up to 2% euhedral magnetite phenocrysts. Dykes are generally planar in form and tend to fill fractures and faults. They are occasionally exhibit orange potassic alteration.

## Alteration and Mineralization:

Brecciation and hyrothermal alteration variably affected the Polley Stock and the surrounding Nicola Group volcanics. Alteration can be described in terms of a potassic core enveloped by a propylitic zone. In core of the system, intense potassic alteration is accompanied by variable strong albite, magnetite, and actinolite alteration. Propylitic alteration (calcite – chlorite – minor pyrite) occurs near the perimeter of the system.

Mineralization is variable. In the Bell Pit, chalcopyrite is the dominant sulphide. In the northeast corner of this pit, there is a pyrite zone, where up to 5 % pyrite occurs. From an ABA point of view, this material is generally potentially acid generating. Ore waste contacts in the Bell Pit are generally gradational. The west contact is lithologically controlled by a diorite contact. In the Wight Pit, chalcopyrite and bornite are the main sulphides accompanied by locally minor pyrite. The mineralizing solutions were deficient of sulphur. Wight Pit ore is particularly high in silver (compared to Bell Pit ore).

## Structures

Faults recognized to date are late and brittle. Two dominate fault sets have been recognized. One is a north-north-east trending, steeply dipping set. The other is a west northwest trending, also steeply dipping. Both fault sets offset and terminate the ore.

#### *2.2.11.9. Drainage Monitoring Program*

Mount Polley's Effluent Permit PE 11678 with the Ministry of Environment requires that water samples be collected from the Tailings Supernatant Pond (Sample Site E1) and the Main Embankment Seepage collection Pond (Sample Site E4). Composite samples of the foundation drains (Sample Site E5) of the *Tailings Storage Facility* are also collected. Sampling occurs twelve (12) times per year. These samples are analyzed for total metals using ICP scan and for conventional parameters such as nutrients, pH, alkalinity and sulphate. Discussion of sampling results for these and other sample sites are found in Section 2.3.

#### *2.2.11.10. ARD/ML Research - Kinetic Testing*

Kinetic Rate information is a critical part of drainage chemistry prediction that provides a measure of the dynamic performance or "reactivity" of the material being tested. Steve Day of SRK has been retained by Mount Polley Mining Corporation to interpret results of the kinetic-testing program and suggest other recommended testing, if required.

Six humidity cell tests are currently operating at Cantest (formerly Vizon SciTec Inc.). Four tests on samples from the Wight Pit were initiated on July 19, 2004. At the time of writing this report, these tests had provided 170 weeks of data. The tests contain the following drill core samples of waste rock and ore:

HC2 – Plagioclase Phric Monzodiorite ( PPp) 31576
HC3 – Breccia (chloritic) (BXc) 32491
HC4 – BX Breccia ore 31943
HC5 – PPp ore on both side(will probably go to mill ) 32519

Two more tests were initiated on September 26, 2005 for the Southeast Zone. At the time of writing this report 112 weeks of data were available from these tests. The tests contain drill core chips from the following samples:

HC6 – Monzonite SE-05-17 Comp #1
HC7 – Monzonite SE-05-30 Comp

The following is a summary of the analysis report prepared by SRK Consulting. The full report is provided in Appendix 2: Humidity Cell Testing of NE and SE zone. Consistent with previous reports by SRK, results obtained from humidity cell test work to date indicate:

- Neutral pH weathering conditions consistent with the carbonate content of the rock;
- A site specific criterion for PAG rock of about 2.5. The criterion could be better defined if samples containing higher sulphur concentrations were tested;
- Time frames to generate ARD form the Wight Pit waste is in the order of decades but certainly shorter in the Southeast Zone where AP is higher than in the Northeast Zone;
- Relatively low contaminant-leaching rates, with only molybdenum showing release rates that correlate with bulk characteristics. No parameters showed correlations with sulphur content.

## 2.3. SURFACE WATER MONITORING

Surface water sampling and analysis was conducted in accordance with sub-section 3.1 of the Mount Polley Effluent Permit PE 11678. The calibration, sampling, filtering, preservation and shipping procedures used for the monitoring program are outlined in the "Quality Assurance/ Quality Control Manual 2003". The sampling program included monthly sampling at six sites (E1, E4, E5, W4, W8 and W8z), quarterly sampling at six sites (W1, W3a, W5, W7, W12 and W13), bi-annual sampling at one site (W11) and intensive (once a week for 5 weeks) sampling at three sites (W4, W8 and W8z) during spring freshet and fall low flows. Samples were submitted to ALS Environmental for analysis of: physical parameters (turbidity, total suspended solids, total dissolved solids, and hardness); anions and nutrients (alkalinity, sulfate, total nitrogen, nitrate plus nitrite, ammonia and ortho-phosphorus): total metals: and dissolved metals.

### 2.3.1. SITE E1 – TAILINGS SUPERNATANT

Tables 1.1-1 and 1.1-2 summarize the 2007 water quality-sampling results at site E1 (Tailings Supernatant). Some parameters have been graphically represented using data collected between 1997 and 2007. This data is presented as figures 1.1-1 and 1.1-2. Finally, the analytical reports for the 96-hour LC50 toxicity (rainbow trout) tests can be found in Appendix 3 of this report. A few key parameters are discussed in the following paragraphs.

Dissolved Sulphate values reached a high of 346 mg/L in the fall of 2007. Increased Sulphate values are likely a result of mining the Wight Pit and water transfer from the Cariboo Pit to the Tailings Storage Facility. Over the year, the Nitrogen values (as Nitrate plus Nitrite) ranged between 1.41 mg/L in October and 2.54 mg/L earlier in the year in February. Due to the continuous deposition of tailings into the pond, total suspended solids have traditionally been high at this site. In 2007 the TSS ranged between a low of 1.5 mg/L seen in January and May and a high of 19.5 mg/L in August. In 2007, the maximum total and dissolved copper levels were 0.013 mg/L and 0.0039 mg/L respectively. Mean values were 0.0032 mg/L (total) and .00103 mg/L (dissolved) respectively.

### 2.3.2. SITE E4 – MAIN EMBANKMENT SEEPAGE POND

Tables 1.2-1 and 1.2-2 summarize the 2007 water quality-sampling results at site E4. Figures 1.2-1 and 1.2-2 contain the graphical representation of selected parameters from the year 2001 to 2007. Finally, the analytical reports for the 96-hour LC50 toxicity (rainbow trout) tests can be found in Appendix 3 of this report; all toxicity results were non-lethal (i.e. no mortality observed in any test results).

This is the only site from which the mine is permitted a discharge; however, since the mine recommenced operation in 2005, there has been no discharge from this site.

Although there was no discharge from E4 in 2007 the following discussion provides a comparison of the permitted discharge levels of certain parameters and the values obtained in samples taken in 2007.

The discharge limit for non-filterable residue (TSS) is 25 mg/L. All samples taken in 2007 were below this discharge limit, reaching a maximum value of 24 mg/L in April.

The discharge limit for nitrogen (as nitrate plus nitrite) is 10 mg/L for this site. All samples taken in 2007 were below this discharge limit. The maximum value reported was in December with a value of 4.3 mg/L.

The discharge limit for ortho-phosphorus (as Phosphorus) is 0.05 mg/L for this site. Ortho-phosphorus levels in all 2007 samples were below this discharge limit. The maximum concentration was 0.028 mg/L.

The discharge limit for dissolved sulphate is 200 mg/L for this site. Half of the samples taken in 2007 exceeded this limit reaching a maximum of 266 mg/L. in December.

The total copper (T-Cu) discharge limit for this site is 0.020 mg/L. All samples taken in 2007 were below this discharge limit. The maximum concentration was 0.011 mg/L.

The total iron (T-Fe) discharge limit for this site is 1.0 mg/L. All but one of the 2007 samples were below this discharge limit. The highest level (1.43 mg/L) of total iron was recorded in April.

The discharge limit for total selenium (T-Se) at this site is 0.01 mg/L. Three samples taken in 2007 exceeded this discharge limit. The maximum value for total selenium was 0.011 mg/L.

### 2.3.3. SITE E5 – MAIN EMBANKMENT DRAIN COMPOSITE

Tables 1.3-1 and 1.3-2 summarize the 2007 water quality-sampling results at site E5. Figures 1.3-1 and 1.3-2 contain the graphical representation of selected parameters from the year 2000 to 2007.

Dissolved sulphate values ranged from 182 mg/L in February to nearly 314 mg/L in December. Nitrate plus nitrite values ranged from 0.421 mg/L in March to 9.07 mg/L in December. Total and dissolved copper levels reached maximums of 0.015 mg/L and 0.0102 mg/L respectively. Since 2001, molybdenum has increased from 0.002 to 0.156 mg/L in February of 2006. The average total molybdenum level for 2007 was 0.128 mg/L, slightly lower than the 2006 average of 0.133 mg/L.

### 2.3.4. SITE W1 – MOREHEAD CREEK

Tables 1.4-1 and 1.4-2 summarize the 2007 water quality-sampling results at site W1. Figures 1.4-1 and 1.4-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Dissolved sulphate values ranged between a high 4.83 mg/L in February to a low of 1.66 mg/L in August. Similarly, levels of nitrogen (as nitrate plus nitrite) ranged between a high of 0.137 mg/L in February to a low of 0.0025 mg/L in August. Throughout the year total copper values ranged narrowly between 0.00408 mg/L 0.00565 mg/L.

### 2.3.5. SITE W3A – MINE DRAINAGE CREEK AT MOUTH

When the baseline-monitoring program was established for the year 1995, sample site W3 was established directly downstream of the mine site on a creek internally named ‘Mine Drainage Creek’. This site was monitored during the baseline periods of 1995 and 1996, as well as from 1997 through to April 2000 as part of the operational monitoring program. When the mine began operations in 1997, the water from the mine site that normally fed into this creek was intercepted and collected, in order to minimize the water from the operations entering the Bootjack Lake system. As a result, the original sampling location (W3) had a significant decrease in flow volume, so much so that samples could only be collected during spring runoff, and sometimes during fall turnover. Commencing in May 2000, the sampling location was moved further downstream to the mouth of the creek just before it drains into Bootjack Lake. This site is named ‘Mine Drainage Creek at Mouth’ and has the codeW3a. Flow volumes at this location occurred year round resulting in more samples being collected throughout the year as compared to the original site W3. Since May 2000 this has been the new sampling location.

Tables 1.5-1 and 1.5-2 summarize the 2007 water quality-sampling results at site W3a. Figures 1.5 and 1.5-1 contain the graphical representation of selected parameters from 1997 to April 2000 for site W3 and from May 2000 to 2007 for site W3a. A few key parameters are discussed below.

In 2007 sulphate values ranged from 9.7 mg/L in May to 14.3 mg/L in August. Nitrate plus nitrite values ranged from a high of 0.455 mg/L in March to a low of.0.0307 mg/L in May. Total copper increased from 0.0112 mg/L in March to 0.0446 mg/L in August before dropping down again by October to 0.0179 mg/L. The mean baseline value at the original site further upstream was 0.0348 mg/L. , Mean total copper levels of 0.024 mg/L was similar to the baseline mean.

### 2.3.6. SITE W4 – NORTH DUMP CREEK

Tables 1.6-1 and 1.6-2 summarize the 2007 water quality-sampling results for site W4. Figures 1.6-1 and 1.6-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraphs.

Dissolved sulphate values for 2007 ranged between 46.4 mg/L in March to 231 mg/L in September. Exceedance of the AWQC maximum of 100 mg/L first occurred in March and continued through the year. It should be noted that runoff from the North rock disposal site drains into this creek system. Site W4 is presently sampled monthly, as well as for five consecutive weeks during spring runoff and during autumn low flows - a suitably intense sampling schedule for this location.

With the exception of two notable spikes, one in 2002 and one in 2003, nitrogen (as nitrate plus nitrite) levels remained mostly low and flat throughout the monitoring period through 2005. Beginning in 2006 however, an increasing trend has been witnessed (See Figure 1.6-1). In November 2006 the level spiked to 1.98 mg/L. Since March of 2007, samples were analyzed with levels ranging between 3.15 and 10.4 mg/L.

Since 1997 when this site first started being monitored as par of the operational program, total copper levels have remained below the mean baseline of 0.035 mg/L. The maximum value in 2007 was 0.0161 mg/L.

In 2007, total iron ranged between 0.015 mg/L in December to 0.245 mg/L in March. A similarly high value was seen in April. This may be an artifact of sampling during high spring run-off periods. Similar high values have been noted during spring freshet in previous years.

### 2.3.7. SITE W5 – BOOTJACK CREEK ABOVE HAZELTINE CREEK

Tables 1.7-1 and 1.7-2 summarize the 2007 water quality-sampling results for site W5. Figures 1.7-1 and 1.7-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed below.

Dissolved sulphate values for 2007 ranged between 5.83 mg/L in August and 10.60 mg/L in November. Nitrogen (as nitrate and nitrite) levels ranged from a high of 0.672 mg/L in February to a low of 0.0087 mg/L in May. Total copper values have had extremely low variation throughout the monitoring period of 1997 to 2006, with all but one sample falling between the range of 0.001 mg/L and 0.014 mg/L. The value outside this range was seen in 1999 and measured 0.0258 mg/L. In 2007, total copper values continued to show little variability remaining at low levels less than 0.008 mg/L.

### 2.3.8. SITE W7 – UPPER HAZELTINE CREEK

Tables 1.8-1 and 1.8-2 summarize the 2007 water quality-sampling results for site W7. Figures 1.8-1 and 1.8-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed below.

Dissolved sulphate typically ranged between 2 mg/L and 15.6 mg/L throughout the monitoring period of 1997 to 2006. Values in 2007 ranged from 13.1 mg/L in February to 17.5 mg/L in December. Nitrogen (as nitrate plus nitrite) has typically ranged between 0.005 mg/L and 0.25 mg/L, with a peak of 0.414 mg/L (seen in December 1998). Most values are very close to the mean baseline of 0.041 mg/L. In 2007, the values ranged from 0.0025 mg/L in June to 0.175mg/L in November.

Non-filterable residue (TSS) levels have always hovered around or been less than the method detection limit of 3 mg/L, with some peaks around 19 mg/L in 1998 and March 2002. For 2007, one sample had a maximum concentration of 10.5 mg/L, but the average value was 2.24 mg/L.

Total copper values ranged between 0.00137mg/L in August and 0.00431 mg/L in December.

Total iron has risen to as high as 1 mg/L (2000), but typically fluctuates between 0.1 mg/L and 0.5 mg/L. Total iron in samples collected in 2007 ranged from a low of 0.047 mg/L in 2007 to a high of 0.181 mg/L in November. The mean baseline level is 0.12 mg/L.

### 2.3.9. SITE W8 – NORTHEAST EDNEY CREEK TRIBUTARY

Tables 1.9-1 and 1.9-2 summarize the 2007 water quality-sampling results for site W8. Figures 1.9-1 and 1.9-2 contain the graphical representation of selected parameters from 1997 to 2007. This site is downstream of the main embankment seepage pond (E4) - the permitted discharge point; however there was no discharge from E4 in 2007. A few key parameters are discussed below.

In 2007, the maximum sulphate level was seen in March (11.3 mg/L). The average sulphate value for this site in 2007 was 6.41 mg/L.

Nitrogen (as nitrate plus nitrite) levels dropped to a low of 0.0025 mg/L in September and then abruptly hit their peak of 0.379 mg/L the following month. The average level for the year was 0.11 mg/L.

In 2007, the mean total copper value was 0.0022 mg/L. Total iron levels ranged within typical historical norms from a high of 0.477 mg/L in January to a low of 0.041 mg/L in September.

### 2.3.10. SITE W8Z – SOUTHWEST EDNEY CREEK TRIBUTARY

Tables 1.10-1 and 1.10-2 summarize the 2007 water quality-sampling results for site W8z. Figures 10.1-1 and 10.1-2 contain the graphical representation of selected parameters from 1997 to 2007. *It should be noted that this is a control site, as it is not downstream of any Mount Polley mine component.* A few key parameters are discussed in the following paragraph.

In 2007, dissolved sulphate values decreased from the previous year's high of 17.9 mg/L reached in February. The maximum level obtained in 2007 was 3.7 mg/L with an average of 1.46 mg/L. Nitrogen levels (as nitrate plus nitrite) ranged from 0.0025 mg/L in October to 0.92 mg/L in October. Mean total copper (0.005 mg/L) and mean total nitrogen (0.93 mg/L) values hovered within ranges that approximated historic norms for the site and showed relatively low variation.

### 2.3.11. SITE W11 – LOWER EDNEY CREEK U/S OF QUESNEL LAKE

Tables 1.11-1 and 1.11-2 summarize the 2007 water quality-sampling results for site W11. Figures 1.11-1 and 1.11-2 contain the graphical representation of selected parameters from 1997 to 2007. *It should be noted that this site is a far-field site, selected for comparisons to the sites downstream from the mine disturbance. As with the control site W8z, it is not likely to show any effects from the mine operations.* A few key parameters are discussed in the following paragraph.

Dissolved sulphate values have typically been below 12 mg/L and this trend continued in 2007 when the peak value was 6.69 mg/L. Nitrogen (as Nitrate plus nitrite) values have typically remained around the mean baseline of 0.039 mg/L, with a peak of 14.4 mg/L in 1999. In 2007, values were less than the mean baseline, with a high of 0.0663 mg/L. Between 1997 and 2001 total copper values fluctuated considerably, reaching highs of 0.00612 mg/L in 1997 and 0.0058 mg/L in 2001. Since then, levels have continued to fluctuate but at lower levels and with less amplitude. In 2007, total copper levels of 0.00334 and 0.00299 mg/L were detected. In comparison, the mean baseline level is 0.0022 mg/L

### 2.3.12. SITE W12 – 6K CREEK AT ROAD

Tables 1.12-1 and 1.12-2 summarize the 2007 water quality-sampling results for site W12. Figures 1.12-1 and 1.12-2 contain the graphical representation of selected parameters from 1997 and 1999 to 2007. A few key parameters are discussed in the following paragraph.

Over the years, dissolved sulphate values have nearly all been below 8 mg/L, with most samples keeping close to the mean baseline of 3.6 mg/L. Samples from 2007 averaged 4.97 mg/L and did not rise above 9.12 mg/L. In 1999 a historical peak in nitrogen (as nitrate plus nitrite) was detected (0.221 mg/L). Since then, values have remained lower. In 2007, the maximum value detected was 0.0621 mg/L. Total copper values at this site have typically been at or below the mean baseline of 0.011 mg/L. 2007 was no exception, with a detected high of 0.0106 mg/L.

### 2.3.13. SITE W13 – 9.5K CREEK ON BOOTJACK FOREST SERVICE ROAD

Tables 1.13-1 and 1.13-2 summarize the 2007 water quality-sampling results for site W13. Figures 1.13-1 and 1.13-2 contain the graphical representation of selected parameters from 2000 to 2007. *It should be noted that this site was added to the monitoring program to find any effects that may come from the mining of the Springer Pit. This pit is in the early stages of development and has not yet impacted the water quality at W13.* Although this site is required to be sampled quarterly, no sample was taken in the third quarter because there was no flow. A few key parameters are discussed in the following paragraph.

Between 1997 and 2006, dissolved sulphate levels typically ranged from 1.5 mg/L to 2.0 mg/L. In 2006, they spiked to 54.2 mg/L. In 2007, levels of 178 and 158 mg/L were detected in May and October respectively, it should be noted that the flow at this site is very low, averaging less than 1 liter per second. Two of the three samples taken in 2007 evidenced low levels (less than 0.01 mg/L) of nitrogen (as nitrate plus nitrite). In May however, a spike of 2.63 mg/L was detected. This value should be viewed with caution since it represents a 100-fold increase over typical levels. The reason for such a high detected level could be because of stream contamination by cow manure. Finally, total copper values at this site have generally decreased over time, from a high of 0.0458 mg/L in 2000 to a low of 0.0104 mg/L in May of this year.

## 2.4. GROUNDWATER MONITORING

Groundwater sampling and analysis was conducted in accordance with sub-section 3.1 of Effluent Permit PE 11678. The sampling, filtering, preservation and shipping procedures used for the monitoring program are outlined in the “Quality Assurance/ Quality Control Manual 2003”. Field pH, temperature and conductivity were measured at the time of sampling using a WTW Multimeter.

In 1995, groundwater-monitoring wells (series 95) were installed in the vicinity of the open pits and mill site. Two of these wells (95R-4, 95R-5) continue to be monitored. In 1996, in order to monitor aquifers in both surficial deposits and bedrock, the B.C. Ministry of Water, Land and Air Protection requested the establishment of additional monitoring wells downslope from the pit, rock disposal site and Tailings Storage Facility. In conjunction with these ‘downslope’ wells, background wells were established up slope of any potential impacts by mining activities. Nine groundwater-monitoring locations were established in 1996. Six of these sites are multi-level, consisting of “A” (deep) wells and “B” (shallow) wells, while the remaining three sites monitor a single depth. A commitment to install three additional multi-level monitoring locations along the southeast embankment of the *Tailings Storage Facility* was made in 1996. These wells were subsequently installed in 2000. The locations of the monitoring wells are shown in Figure 2.

Objectives of the groundwater-monitoring program include the following (Knight Piésold Ltd., 1996):

- To determine the direction and volume of groundwater flow from the mine site and other disturbed areas to receiving waters.
- To identify the locations of all surficial and deep groundwater aquifers underlying the mine site and their points of discharge to surface water.
- To establish background groundwater quality in aquifers prior to mine development; and
- To calculate seepage and groundwater contamination dilution ratios in surface receiving waters in order to minimize impacts.

Samples were submitted to ALS Environmental for water chemistry analysis, including: physical parameters (turbidity, total suspended solids, total dissolved solids, and hardness); anions and nutrients [alkalinity, sulfate, nitrate, nitrite, and ammonia (N)]; and dissolved metals. Additionally, freatic water levels are recorded prior to water quality-sampling. (Section 2.6.8)

### 2.4.1. 95R-4 (SPRINGER PIT WELL)

95R-4 is located at 10 km on the Bootjack Forest Service Road. Table 2.1 summarizes the results of the water quality data from 2007 for this well. Figures 2.1-1 and 2.1-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Nitrogen (as nitrate plus nitrite) peaked at the end of 2002 at nearly 0.04 mg/L, but has since dropped back to around baseline levels of 0.004 mg/L, (which is the method detection limit of this parameter). The 2007 value was 0.005 mg/L. Dissolved sulphate continues to be below the mean baseline value of 17.4 mg/L, with the 2007 value being 12.3 mg/L. Finally, dissolved metal concentrations remained relatively stable throughout the monitoring period of 1995 thru 2007

### 2.4.2. 95R-5 (LOWER SOUTHEAST ROCK DISPOSAL SITE WELL)

95R-5 is located along Polley Lake Forest Service Road, northwest of the east rock disposal site and immediately east of the northeast zone soil stockpile location. Table 2.2 summarizes the results of the water quality data from 2007 for this well. Figures 2.2-1 and 2.2-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Until July 2005, nitrogen levels (as nitrate plus nitrite) were characteristically below the minimum detection limit of 0.005 mg/L. Since then the levels have been increasing, peaking this year at 3.31 mg/L. Dissolved sulphate levels have also risen since July 2005. In 2007 they peaked at their highest level to date (168mg/L). In comparison, typical historic levels fluctuated around 20 mg/L. Finally, dissolved metal concentrations remained relatively stable throughout the monitoring period of 1995 thru 2006. In order to more closely monitor the nitrate plus nitrite and sulphate values, this site will be sampled twice per year instead of once.

### 2.4.3. GW96-1A (TAILINGS STORAGE FACILITY NORTH WELL – DEEP)

GW96-1a is located downslope of the seepage collection pond of the Perimeter Embankment. Table 2.3 summarizes the results of the water quality data from 2007 for this well. Figures 2.3-1 and 2.3-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite has fluctuated over the monitoring period as high as 0.19 mg/L in 2004. Since then, levels have dropped back down and remained low. Dissolved sulphate values have remained very consistent throughout the monitoring period, fluctuating between 45 mg/L and 60 mg/L except for one sample in 2006, which had a much lower level of 24 mg/L. Dissolved copper levels appear to be fluctuating considerably with relatively high levels being seen in 2001 (0.042 mg/L), 2004 (0.008 mg/L), and again this year (0.00699 mg/L). .

In August of 2006, total copper levels dropped down to 0.00027 mg/L. Finally, all other dissolved metal concentrations remained relatively flat throughout the monitoring period of 1997 thru 2007.

### 2.4.4. GW96-1B (TSF NORTH WELL – SHALLOW)

GW96-1b is located down gradient of the seepage collection pond of the Perimeter Embankment. Table 2.4 summarizes the results of the water quality data from 2007 for this well. Figures 2.4-1 and 2.4-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite has remained at or below the baseline value of 0.041 mg/L for the entire monitoring period, with the exception of three samples - one in 1998 (0.257 mg/L) and two in 1999 (0.088 and 0.048 mg/L). Generally, dissolved sulphate concentrations have been steady ranging around 30 mg/L; however, in August of 2006 sulphate rose to around 65 mg/L. Finally, dissolved metal concentrations rose in 2006, the source of water is likely to originate from the Perimeter Embankment Seepage Pond.

### 2.4.5. GW96-2A (TAILINGS STORAGE FACILITY EAST WELL – DEEP)

GW96-2a is located approximately 900 m southeast of the GW96-1 monitoring wells and is designed to monitor any groundwater effects from the Tailings Storage Facility on Hazeltine Creek. Table 2.5 summarizes the results of the water quality data from 2007 for this well. Figures 2.5-1 and 2.5-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite has somewhat fluctuated during the 1997 to 2007 monitoring period, with a range of only 0.004 mg/L to 0.061 mg/L. 2007 dissolved sulphate levels appear to have been stable at approximately 24 mg/L. Finally, most dissolved metal concentrations remained relatively flat throughout the monitoring period of 1997 thru 2007. The exceptions were Aluminum and Iron, which rose considerably. This trend was also noted in well GW96-1.

### 2.4.6. GW96-2B (TAILINGS STORAGE FACILITY EAST WELL – SHALLOW)

GW96-2b is located approximately 900 m Southeast from the GW96-1 monitoring wells and is designed to monitor any groundwater effects from the Tailings Storage Facility on Hazeltine Creek. Table 2.6 summarizes 2007 water quality-sampling results for this well. Figures 2.6-1 and 2.6-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite levels have predominantly fluctuated with low amplitude around the minimum method detection limit of 0.005 mg/L and this trend continued through 2007. Generally, dissolved sulphate has fluctuated little; however, since 2004, levels have shown a gradual increase with a peak in mid 2007 of 24.7 mg/L. Finally, all other dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2007.

### 2.4.7. GW96-3A (TSF SOUTHEAST WELL – DEEP)

GW96-3a is located down gradient of the seepage collection pond of the Main Embankment. Table 2.7 summarizes the 2007 water quality-sampling results for this well. Figures 2.7-1 and 2.7-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraphs.

Over the monitoring period of 1997 to 2007 field pH has fluctuated significantly between 6.6 and 12.5. This parameter has been graphed with dissolved aluminum, in order to show the relationship between the levels of dissolved aluminum and pH in any given sample.

Nitrate plus nitrite has usually remained below 0.1 mg/L, with only one sample in late 1999 peaking at nearly 0.26 mg/L. Dissolved sulphate has fluctuated significantly over the monitoring period of 1997 to 2007, ranging from 25 mg/L to 322 mg/L. In 2007, the sulphate values were 231 mg/L in May and 33.9 mg/L October.

Dissolved copper appears to have risen somewhat over the monitoring period, moving from 0.001 mg/L to around 0.003 mg/L with a peak 0.0045 mg/L in 2004. All other dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2007. Dissolved copper dropped in 2007 to as low as 0.00032 mg/L.

It should be noted that this well has a very slow recharge rate, and in some cases, it is not possible to purge the well more than once in order to collect a sample in a timely manner. As a result, the results from this well should be viewed with caution and should be evaluated in connection with data from other wells in the vicinity of the *Tailings Storage Facility*. In order to better capture fresh ground water samples from this well, sampling was moved up by one month (May) relative to other groundwater well sampling.

### 2.4.8. GW96-3B (TSF SOUTHEAST WELL – SHALLOW)

GW96-3b is located downslope of the seepage collection pond of the Main Embankment. Table 2.8 summarizes the 2007 water quality-sampling results for this well. Figures 2.8-1 and 2.8-2 contain the graphical representation of selected parameters from samples taken between 1997 and 2007. A few key parameters are discussed in the following paragraph.

With the exception of two spikes, one in late 1999, and another in June 2007, nitrate plus nitrite levels have fluctuated little, remaining at or near the method detection limit of 0.005 mg/L. Dissolved sulphate has remained flat, fluctuating only slightly between 5 mg/L and 8 mg/L. Finally, all dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2007,

### 2.4.9. GW96-4A (TSF SOUTHWEST WELL – DEEP)

GW96-4a is located downslope of the south and main embankments. Table 2.9 summarizes the 2007 water quality-sampling results for this well. Figures 2.9-1 and 2.9-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraphs.

Nitrogen (as nitrate plus nitrite) has remained very stable, at or below the method detection limit of 0.005 mg/L. There was a slight increase in June of 2006 to 0.0118 mg/L. Dissolved sulphate has also remained stable since 1999, keeping near or below 5 mg/L. 2007 values were 2.17 mg/L and 2.16 mg/L.

With only one exception, dissolved copper has remained below 0.0024 mg/L. At the end of 2002 one sample had a value of 0.0054 mg/L, but subsequent samples showed levels returning to the previous range below 0.0024 mg/L. Dissolved copper decreased to below baseline concentrations in 2006 with values less than 0.0015 mg/L and remained there during 2007. All other dissolved metal values, remained relatively stable throughout the monitoring period of 1997 thru 2007.

### 2.4.10. GW96-4B (TSF SOUTHWEST WELL – SHALLOW)

GW96-4b is located downslope of the south and main embankments. Table 2.10 summarizes the 2007 water quality-sampling results for this well. Figures 2.10-1 and 2.10-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraphs.

Nitrate plus nitrite has remained below the mean baseline of 0.013 mg/L, with only two exceptions - one in 1999 when it reached a detected level of 0.031 mg/L and one in 2005 when it reached 0.02 mg/L. Both 2007 values were below the method detection limit of 0.005 mg/L. Dissolved sulphate levels have remained at or below the mean baseline of 2.5 mg/L for the entire monitoring period with the exception of a single spike in 2005 to 8mg/L. The 2007 values were both below the method detection limit.

Dissolved copper had typically remained close to the mean baseline level of 0.0005 mg/L throughout the early monitoring period. However, since late 2001, copper has been fluctuating regularly between a 2002 high of 0.0022 mg/L and a low of 0.00027 mg/L in 2006. In 2007, this trend appears to continue with levels rising to 0.00174 in November. All other dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 through 2007, with the exception of iron, which fluctuated within its normal range.

### 2.4.11. GW96-5A (TAILINGS STORAGE FACILITY CONTROL WELL – DEEP)

GW96-5a is located at the north end and upstream of the *Tailings Storage Facility* and is monitored as a control site. Table 2.11 summarizes the 2007 water quality-sampling results for this well. Figures 2.11-1 and 2.11-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraphs.

Nitrate plus nitrite had a peak of 0.267 mg/L in 1998, but since that time and through 2007, nearly all samples have been below 0.02 mg/L. Dissolved sulphate in 2007 measured below baseline of 15 mg/L. In 2001, a November sample spiked up to 115 mg/L; however, this data point is expected to be a sampling or analytical data error, as it is one order of magnitude larger than the more typical values from this well.

Dissolved copper has typically remained close to (most often below) the mean baseline of 0.004 mg/L throughout the monitoring period. However, one sample in 2002 showed an increase to 0.0071 mg/L. Dissolved copper values for 2007 were both less than 0.002 mg/L. With the exception of a single spike in dissolved aluminum and iron in August 2004, all other dissolved metal concentrations appear to have, remained relatively stable throughout the monitoring period of 1997 thru 2007.

### 2.4.12. GW96-5B (TSF CONTROL WELL – SHALLOW)

GW96-5b is located at the north end and upstream of the *Tailings Storage Facility* and is monitored as a control site. Table 2.12 summarizes the results of the water quality data from 2007 for this well. Figures 2.12-1 and 2.12-2 contain the graphical representation of selected parameters from 1998 to 2001 and for 2007. This well had been damaged in 2001 and no samples could be collected between 2002 and 2005. Although this well was repaired in 2006 and sample collection had resumed, recent (mid 2007) construction of a ditch upslope of the well, has reduced flow into the well considerably. Since construction of the ditch (sometime after the first sample of the year was taken in June), the well has not produced enough water to provide another sample. In 2007 nitrogen (as nitrate plus nitrate) levels were below detection limits. Dissolved sulphate levels were within the typical range of 4 to 8 mg/L recorded prior to 2002. Except for molybdenum, which recently appears to be at higher levels (0.0157 mg/L) relative to those recorded between 1998 and 2002, dissolved metal concentrations appear to be fluctuating within historically typical ranges.

### 2.4.13. GW96-6 (SOUTHEAST ROCK DISPOSAL SITE WELL)

GW96-6 was located downslope of the east rock disposal site. No water samples were collected in 2007 because the well was deactivated in the fall of 2006. Figures 2.13-1 and 2.13-2 contain the graphical representation of selected parameters from 1997 to 2006. As discuss with Ministry of Environment staff in 2007, a replacement well will be installed in 2008.

### 2.4.14. GW96-7 (SOUTHEAST SEDIMENT POND WELL)

GW96-7 is located down gradient of the Mill Site, half way down the tailings access road, near the booster pump station. Table 2.14 presents the 2007 water quality-sampling results for this well. The well is sampled on an annual basis. Figures 2.14-1 and 2.14-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Historically, nitrogen concentrations (as nitrate plus nitrite) have remained relatively stable, fluctuating only mildly between 0.005 mg/L and 0.014 mg/L; however, beginning in 2006, levels began increasing. In 2007 the nitrogen levels increased to 0.34 mg/L, the highest level detected to date at this site. . Dissolved sulphate concentrations have remained constant with levels only fluctuating slightly between 18 and 31 mg/L. All dissolved metal concentrations remained relatively flat throughout the monitoring period of 1997 thru 2007.

### 2.4.15. GW96-8A (BOOTJACK FOREST SERVICE RD. @ 11 K WELL – DEEP)

GW96-8a is located on Bootjack Forest Service Road at 10.75 km. Table 2.15 summarizes the results of the water quality data from 2007 for this well. Further, figures 2.15-1 and 2.15-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

In 2007, nitrate plus nitrite concentrations were below 0.1 mg/L, a continuation of the historical trend with the exception of two samples – one taken in 1998 (0.156 mg/L) and one in 1999 (0.176 mg/L). Dissolved sulphate has remained constant with concentrations narrowly ranging between 8 and 12 mg/L. All dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2007.

### 2.4.16. GW96-8B (BOOTJACK FSR @ 11 K WELL – SHALLOW)

GW96-8b is located on Bootjack Forest Service Road at 10.75 km. Table 2.16 summarizes the 2007 water quality-sampling results for this well. Figures 2.16-1 and 2.16-2 contain the graphical representation of selected parameters from 1997 to 2007. A few key parameters are discussed in the following paragraph.

Until 2003, nitrogen (as nitrate plus nitrite) regularly fluctuated, reaching a high of 0.153 mg/L in 1998 and lows below the minimum detection limit (0.005 mg/L) in 2001, 2002, and 2003. Since then, nitrogen concentration has been gradually trending lower from 0.12 mg/L to this year’s level of 0.0605 mg/L. Dissolved sulphate has narrowed its range somewhat, moving from lows of 2 mg/L and highs of 13 mg/L to a tighter range of 8 mg/L to 11.2 mg/L since early 2003. Finally, all dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2007.

### 2.4.17. GW96-9 (TSF SOUTHEAST PRESSURE WELL)

GW96-9 was located south of the Main Embankment. This well was deactivated in the spring of 2006. No samples were taken in 2007. Figures 2.17-1 and 2.17-2 contain the graphical representation of selected parameters from 1997 to 2005.

This well was established in order to sample a near-surface aquifer. Its deactivation was discussed with Ministry of Environment staff and a decision was made to replace it with either another well (outside of the *Tailings Storage Facility* final toe) or with a surface water sampling station. Beginning in 2008, a surface water sample will be taken twice per year from the ditch originating from the South Dam, which reports to the Main Collection Seepage Pond.

### 2.4.18. GW00-1A (TSF NORTHWEST WELL – DEEP)

GW00-1a is located downstream of the South Embankment at the *Tailings Storage Facility*. Table 2.18 summarizes the results of the water quality data from 2007 for this well. Further, figures 2.18-1 and 2.18-2 contain the graphical representation of selected parameters from 2000 to 2007. A few key parameters are discussed in the following paragraph.

With the exception of one sample taken in 2004 (0.007 mg/L) nitrogen (as nitrate plus nitrite) has consistently remained at or below the method detection limit of 0.005 mg/L. This trend continued into 2007. Dissolved sulphate has decreased from 330 mg/L in 2000 to 187 mg/L in 2005. In 2007, concentrations climbed slightly, reaching 239 mg/L. Finally, all dissolved metal concentrations remained relatively stable throughout the monitoring period of 2000 thru 2007.

### 2.4.19. GW00-1B (TSF NORTHWEST WELL – SHALLOW)

GW00-1b is located downstream of the South Embankment at the Tailings Storage Facility. Table 2.19 summarizes the 2007 water quality-sampling results for this well. Figures 2.19-1 and 2.19-2 contain the graphical representation of selected parameters from 2000 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite has remained below the method detection limit of 0.005 mg/L with the exception of one sample taken in 2005 (0.008mg/L). Dissolved sulphate has remained constant at around 10 mg/L. All dissolved metal concentrations remained relatively flat throughout the monitoring period of 2000 thru 2007.

### 2.4.20. GW00-2A (TAILINGS STORAGE FACILITY WEST WELL – DEEP)

GW00-2a is located downstream of the South Embankment at the *Tailings Storage Facility*. Table 2.20 summarizes the 2007 water quality-sampling results for this well. Figures 2.20-1 and 2.20-2 contain the graphical representation of selected parameters from 2000 to 2007. A few key parameters are discussed in the following paragraph.

On two occasions, once in 2003 and once in 2005, nitrogen (as nitrate plus nitrite) rose to a high of slightly above 0.020 mg/L. In 2006 its value decreased back below the method detection limit (0.005 mg/L) and remained there during 2007. Further, dissolved sulphate has decreased from averages as high as 30 mg/L in 2000 to less than 10 mg/L in 2006 and 2007. Finally, all dissolved metal concentrations remained relatively stable throughout the monitoring period of 2000 through 2007.

### 2.4.21. GW00-2B (TAILINGS STORAGE FACILITY WEST WELL – SHALLOW)

GW00-2b is located downstream of the South Embankment at the Tailings Storage Facility. Table 2.21 summarizes the 2007 water quality-sampling results for this well. Figures 2.21-1 and 2.21-2 contain the graphical representation of selected parameters from 2000 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite concentrations rose from the method detection limit of 0.005 mg/L to a high of 0.019 in 200 then they dropped back down to below the method detection limit in 2005 before rising again to 0.01 in 2007. In 2000, dissolved sulphate concentration peaked at 18 mg/L. It then dropped the following year to below 8mg/L and has remained there since, fluctuating between 2.3 and 7.44 mg/L. All dissolved metal concentrations remained relatively stable throughout the monitoring period of 2000 thru 2007.

### 2.4.22. GW00-3A (TSF SOUTHWEST WELL – DEEP)

GW00-3a is located downstream of the South Embankment at the *Tailings Storage Facility*. Table 2.22 summarizes the 2007 water quality-sampling results for this well. Figures 2.22-1 and 2.22-2 contain the graphical representation of selected parameters from 2000 to 2007. A few key parameters are discussed in the following paragraph.

Except for one sample collected in 2005 (0.017 mg/L), nitrate plus nitrite concentrations have remained at or below the method detection limit of 0.005 mg/L. A high concentration (104 mg/L) of dissolved sulphate was detected in 2001 but since then levels have been considerably lower, fluctuating moderately between 4.2 and 22 mg/L. All dissolved metal concentrations remained relatively stable throughout the monitoring period of 2000 thru 2007.

### 2.4.23. GW00-3B (TSF SOUTHWEST WELL – SHALLOW)

GW00-3b is located downstream of the South Embankment at the *Tailings Storage Facility*. Table 2.23 summarizes the 2007 water quality-sampling results for this well. Figures 2.23-1 and 2.23-2 contain the graphical representation of selected parameters from 2000 to 2007. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite has risen from the method detection limit of 0.005 mg/L in 2000 to a high of 0.012 mg/L in 2003 and 0.019 in 2005. Through 2006 and early 2007 concentrations remained at or below the method detection limit of 0.005 mg/L before rising again in October to 0.0135 mg/L. Dissolved sulphate levels have decreased from a high of 12 mg/L in 2000 to around 6 mg/L in 20076. Finally, all dissolved metal concentrations remained relatively flat throughout the monitoring period of 2000 thru 2006 but in 2007, aluminum and iron levels increased dramatically by more 30 to 40 times respectively. Aluminum concentration was detected to be 0.597 mg/L while iron was detected at 1.41 mg/L.

### 2.4.24. GW05-01 (WIGHT PIT/POLLEY LAKE INTERFACE WELL)

GW05-01 is located between the Wight Pit and Polley Lake; it was established in 2005 to capture groundwater as it moved from Polley Lake towards the Wight Pit. This well is continuously pumped as groundwater is returned to Polley Lake.

Table 2.24 summarizes the results of water quality data from 2006 for this well. Further, figures 2.24-1 and 2.24-2 contain the graphical representation of selected parameters from 2005 and 2006. A few key parameters are discussed in the following paragraph.

Nitrate plus nitrite ranged between the method detection limit of 0.005 mg/L to 0.836 mg/L. Further, dissolved sulphate ranges from 62.7 mg/L to 111 mg/L. Finally, all dissolved metal concentrations remained relatively stable throughout the monitoring period of 2007.

## 2.5. CLIMATOLOGY

Mount Polley's Effluent Permit (PE 11678) requires the collection of detailed meteorology data. The main objective of this data collection program is to provide site-specific precipitation and evaporation data for use in water balance prediction. To meet the permit requirements, Mount Polly operates an automated weather station, which collects, at half hour intervals, temperature (at 3 meter elevation) and precipitation. Evaporation levels are measured on a weekly basis with an evaporation pan. 2007 was a relatively dry year; only 6,12 mm of precipitation fell at the site versus an average amount of 742 mm. Total evaporation for 2007 was 279 mm versus the annual average of 423 mm.

### 2.5.1. TEMPERATURE – MINIMUM, MAXIMUM AND AVERAGE

Figures 4.1 through 4.6 present Mount Polley's 2007 climate (temperature and rainfall) data. Monthly minimum, maximum, and average temperatures as well as daily average temperature are shown. The lowest monthly mean temperature was –12.0 degrees Celsius recorded in December; however, this was based only on 14 days of data collection as the weather station stopped functioning in the second half of the month. The lowest monthly mean temperature recorded over the span of an entire month was –5.31$^{o}$C in January. The maximum monthly mean temperature was 16.99$^{o}$C recorded in July.

### 2.5.2. PRECIPITATION

Mount Polley rainfall data are shown for the months of January to November in Figures 4.1 through 4.5. The figures also present the monthly and daily precipitation values. The month receiving the most rainfall was April when 123mm fell. It is interesting to note that nearly half of this total (57mm) fell in one day. September was the driest month with only 2.6mm of rain falling, mostly at the start of the month.

### 2.5.3. EVAPORATION

Mount Polley's evaporation rates (non-freezing months only) are shown in Figure 4.6. The amount of evaporation for 2007 was 279 mm versus an average of 423 mm. May had the greatest evaporation level at over 67 mm and October had the lowest level at under 15 mm.

### 2.5.4. WATER BALANCE

Table 4 (2 pages) contains the updated water balance spreadsheet for the 2007 period. A review of the water balance is included in the Annual Tailings Inspection report, presented in Appendix 1. An annual water balance spreadsheet for the Mount Polley Mine site was first developed in 2005 in order to facilitate water planning and predict water surplus or deficit volumes after the resumption of the operations in 2005. Each year, the spreadsheet is updated by adding new development areas (including Springer Pit, Wight Pit and the Northeast rock disposal site), updating precipitation estimates, and modifying other aspects of the water balance to match the new mine plan. On December 31st, 2007 the inventory of water stored in the *Tailings Storage Facility* was 2.91M m3.

## 2.6. HYDROLOGY AND HYDROGEOLOGY

In 2007, flow discharges were monitored at seven surface water sites (W1a, W3a, W4, W5, W7, W8 and W12) situated in the vicinity of the Mount Polley mine site (see Figure 2 for site locations). Monthly discharge graphs (Figures 3.1 through 3.7) were generated for each site. Flow levels were determined by recording staff gauge readings and applying a formula (determined in previous years) that gives a stage discharge curve for each monitoring site. Flow measurements were measured with a Swoffer (model 3000) flow meter and compared with the staff gauge readings. Staff gauges were covered in snow and ice from January to April and in November and December. Continuous water level data (using an analog chart recorder established by Water Survey of Canada in 1995) is recorded at Station W7 on Hazeltine Creek from approximately March to November of each year (i.e. during months when the creek channel is unaffected by ice cover).

In addition to these surface water sites, there were 22 groundwater wells that were monitored for static water levels throughout 2007, also in the vicinity of the Mount Polley mine site. Graphs have been generated and are discussed in sub-section 2.6.8.

### 2.6.1. SITE W1A – UPPER MOREHEAD CREEK

Figure 3.1 shows the flow measurement comparisons from 1997 to 2007. In 2007, spring freshet flows were below the average volumes normally seen at this site.

### 2.6.2. SITE W3A – MINE DRAINAGE CREEK AT MOUTH

From 1995 through 1999 water volumes were monitored on this creek at site W3, which is located just downstream from the mine site. Starting in 2001, water volumes were monitored from a new location on this creek, labeled W3a. This location is at the end of the creek, immediately before it empties into Bootjack Lake. Figure 3.2 shows the flow measurement comparisons for monitoring site W3, with data from 1995 and 1997 to 2001 and the flow measurement comparisons for monitoring site W3a between 2001 and 2007.

Since the data from W3a can really only be compared to the data collected from previous years at the same location, water volumes from 2004 will be compared to the only other data from this site, which is from 2001. Peaks in 2007 occurred in May.

### 2.6.3. SITE W4 – NORTH DUMP CREEK

Figure 3.3 shows the flow measurement comparisons from 1995 and from 1997 to 2007. Water volumes during the spring freshet period for 2007 were slightly higher than statistical average.

### 2.6.4. SITE W5 – BOOTJACK CREEK ABOVE HAZELTINE CREEK

Figure 3.4 shows the flow measurement comparisons from 1995 and 1997 to 2007. Water volumes were recorded to be very low in 2007. This location will need to be recalibrated.

### 2.6.5. SITE W7 – UPPER HAZELTINE CREEK

Figure 3.5 shows the flow hydrographs for 1995 and from 1997 to 2007. Hazeltine Creek is a continuous flow monitoring station, with flows being measured when temperatures are above freezing. Indicated flows for 2007 appear to be considerably different from previous years. This difference is a result of more accurate flows being defined in 2007 through a stage-discharge validation exercise conducted by an independent hydrologist from Knight Piésold. This validation was made possible as a result of the installation of a continuous pressure sensor data logger at the site. In 2008, Mount Polley anticipates retrospectively editing the historical flow data from this site to account for a progressive ratings shift, which stems from gradual deterioration of the weir. Mount Polley also anticipates replacing the weir within the next two years.

### 2.6.6. SITE W8 – NORTHEAST EDNEY CREEK TRIBUTARY

Figure 3.6 shows the flow measurement comparisons from 1995 and 1997 to 2007. Water volume and distribution were below average compared to previous years. There appear to be a reduced flow in the fall.

### 2.6.7. SITE W12 – 6K CREEK AT ROAD

Figure 3.7 shows the flow measurement comparisons from 1997 to 2007. Overall, all flows for the year was low which represents the climatic conditions.

### 2.6.8. GROUNDWATER STATIC WATER LEVELS

Figure 3.8 contains the static water levels for the wells 95R-4 and 95R-5, for the period 1996 to 2007.

For well 95R-4, the static water level has been consistently around 11 meters, with only one exception in June 2000, when it was at 0 meters. As for well 95R-5, the static water level has been shifting between 2 meters and 0 meters, with no specific trend.

Figure 3.9 contains the static water levels for wells GW96-1a/1b, GW96-2a/2b, GW96-3a/3b and GW96-4a/4b for the period 1996 to 2007.

For well GW96-1a, the static water level has been mostly between 15 meters and 20 meters, but has dropped as low as 40 meters in spring 2001 and as high as nearly 0 meters in summer 2001. As for well GW96-1b, the static water level has been very consistent at 13 meters, with a movement to nearly 0 meters in the summer of 2001. This peak matches perfectly with those seen in the twin well GW96-1a. In 2006 GW96-1b had a value of 15 meters.

For well GW96-2a, the static water level has been mostly at 30 meters, with only a few exceptions. In the summers of 2001 and 2007, the static water level moved to 30 meters, which is typical. As for well GW96-2b, the static water level has been very consistent at 15 meters, with a movement to nearly 5 meters in the summers of 2001 and 2007. These peaks match perfectly with those seen in the twin well GW96-2a. In 2007 GW96-2b was 16 meters.

For well GW96-3a, the static water level has fluctuated wildly, with a range of 42 meters to nearly 0 meters. In 2007 the water level was at 2 meters. As for well GW96-3b, the static water level has been very consistent at 0 meters, with a movement to nearly 3-5 meters in the summers of 2001 and 2007. These peaks match with similar peaks for wells GW96-1 and GW96-2.

For well GW96-4a, the static water level has ranged from 0 meters down to nearly 4 meters. The most recent readings in 2007 are around 1 meters. As for well GW96-4b, the static water level has matched the static water level pattern of its twin well GW96-4a almost perfectly. The most recent values for 2007 are also around 2 metres.

Figure 3.10 contains the static water levels for wells GW96-5a/5b, GW96-6, GW96-7, GW96-8a/8b and GW96-9 for the period 1996 to 2007.

For well GW96-5a, the static water level has been mostly between 5 meters and 0 meters, but has dropped as low as 13 meters in winter 2001. As for well GW96-5b, the static water level has been very consistent between 3 meters and 0 meters. No data points exist after 2001, as this well was damaged around this time. This well was repaired in 2007 and now has data points which range from 0 meters to 2 meters.

For well GW96-6, the static water level has been nearly always been at 0 meters, but it has dropped as low as 15 meters, as it did in spring 2000.

For well GW96-7, the static water level has been very constant between 5 meters and 2 meters. The most recent values in 2007 were around 2.5 metres.

For wells GW96-8a and GW96-8b, the static water level for both wells has always been 0 meters, and this continued for 2007.

For well GW96-9, the static water level has ranged from 0 meters down to nearly 2.5 meters. The most recent readings in 2006 are around 0.2 meters. Groundwater well GW96-9 was deactivated in the spring of 2006 during the commencement of the *Tailings Storage Facility* stage 5-construction phase, as it was within the final toe design of the dam. This 6.1m deep well was established to capture a near surface aquifer and was supplemental well to wells GW96-3a/b and GW96-4a/b. There will not be any 2007 or future samples for this well.

Figure 3.11 contains the static water levels for wells GW00-1a/1b, GW00-2a/2b and GW00-3a/3b for the period 2000 to 2007.

For well GW00-1a, the static water level has fluctuated between 8.5 meters and 0.5 meters, with the most recent values in 2007 at 0.5 meters. As for well GW00-

1b, the static water level has been much flatter, ranging from 3.0 meters to 0.5 meters. In 2007 the static water level was measured at 7.0meters.

For well GW00-2a, the static water level has remained fairly flat, with a range of about 6 meters to 3 meters. As for well GW00-2b, the static water level has followed its twin well GW00-2a almost perfectly, where the trend is only 0.5 meters lower than the deep well. This well static water level reached 5 meters in of 2007.

For well GW00-3a, the static water level has fluctuated somewhat, with the majority of the samples between 6 meters and 4 meters, but with several samples in 2002 and 2007 as low as 19 meters. As for well GW00-3b, the static water level has been very consistent at within the range of 6 meters to 4 meters.

## 2.7. RECLAMATION RESEARCH – 2007

The objective of the reclamation research program is to develop the methods, materials and protocol for achieving end land use objectives defined in the Mount Polley Reclamation Plan. The primary end land use objectives are wildlife habitat and commercial forestry. Secondary objectives include cattle grazing, hunting, guide-outfitting, trapping and outdoor recreation.

### 2.7.1. TREE GROWTH PLOTS

In 2007, field reclamation research focused on the collection of tree growth plot data from operational research trials established in 1998 on top of rock disposal sites (RDS) located on the uppermost terraces at Mount Polley. Although data was collected in 2007, analysis and summary of the results is not planned until 2008. Continued research on the operational research trials on the 1170 rock disposal site will be maintained, and re-evaluated in 2008 to determine optimum soil thickness creating a suitable medium for tree growth given the primary reclamation objectives of wildlife habitat and commercial forestry.

### 2.7.2. AQUATIC ASSESSMENT HIGHLIGHTS - 2007

Environmental initiatives conducted by the Mount Polley Mine in 2007 included a number of studies that were part of a Technical Assessment in support of an application to allow discharge of wastewater to Hazeltine Creek (under the Waste Discharge Regulation of the British Columbia *Environmental Management Act*). These key initiatives included:

1. Projection of Mount Polley effluent volume;
2. Characterization of Mount Polley effluent quality;
3. Review and compilation of Hazeltine Creek hydrology;
4. Preliminary discharge strategy and characterization of effluent mixing in Hazeltine Creek;
5. Habitat and geomorphological assessment of Hazeltine Creek;
6. Characterization of the use of Hazeltine Creek by fish;
7. Toxicity testing to support the development of site-specific water quality objectives for copper and cadmium in Hazeltine Creek;
8. Toxicity testing of an aquatic moss to assess potential site-specific effects of sulphate;
9. Toxicity testing of effluent using sensitive early life stages of coho salmon (embryo viability) and rainbow trout (embryo-alevin-fry stages);
10. Participation in a consortium supporting the re-development of the national water quality guideline for cadmium;
11. Implementation of a comprehensive baseline aquatic environmental study of Hazeltine Creek; and
12. Continued refinement of a strategy for discharge to Hazeltine Creek.

All of these initiatives, which are discussed in the following subsections (2.7.2.1 to 2.7.2.12), were undertaken to support the identification of the potential impacts associated with the proposed effluent discharge and to serve as the technical information on which to base the development of plans to mitigate (eliminate) potential impacts. A brief overview of each of these key initiatives is provided in the sections that follow, including a description of the initiative and a summary of associated results.

#### *2.7.2.1. Projection of Mount Polley Effluent Volume*

One of the concepts for effluent discharge is that *Tailings Storage Facility* (TSF) seepage water, which is generally of better quality than TSF supernatant, will be the source of effluent to be discharged. This seepage water will likely be polished in a passive constructed (wetland) treatment system prior to discharge. In order to provide some working bounds on effluent quantity, Knight-Piésold recently estimated the supply of seepage water to the seepage collection pond. The total lower and upper bound seepage rates were estimated as 1,500 $m^3$/day and 4,500 $m^3$/day (547,500 $m^3$/year and 1,642,500 $m^3$/year; Knight-Piésold 2007a).

#### *2.7.2.2. Characterization of Mount Polley Effluent Quality*

In order to facilitate the identification of contaminants of potential concern in Mount Polley effluent, the chemical characteristics of the effluent were predicted based on historical chemical characteristics of source waters and of seepage water (the latter being the proposed source of effluent to be discharged). The key assumption in characterizing the chemical characteristics of effluent in this manner was that historical data adequately reflect future conditions (i.e., that there will be no drastic changes in seepage water quality); however, it was recognized that some changes might occur with the mining of new ore bodies having slightly different mineralogy. To the extent possible, such differences were taken into account in the predictions (e.g., data associated with the Wight Pit were considered). The assessment identified ten parameters of potential concern (aluminum, cadmium, copper, iron, molybdenum, selenium, phosphorus, nitrate, sulphate and total suspended solids) based on: geochemistry of Mount Polley ore deposits; concentrations relative to provincial and federal water quality guidelines; current and historical water quality trends; and existing/projected waste and water management practices (Knight-Piésold 2007b). Predicted concentrations of these parameters in raw effluent were:

| Parameter | Conc. (mg/L) | Parameter | Conc. (mg/L) |
|---|---|---|---|
| Aluminum | 0.011 | Selenium | 0.0038 |
| Cadmium | 0.00020 | Phosphorus | 0.038 |
| Copper | 0.0198 | Nitrate | 0.67 - 28.9 |
| Iron | 0.25 | Sulphate | 500 |
| Molybdenum | 0.061 | Total Suspended Solids | 5.8 |

It is notable that the predicted concentrations of aluminum, iron, molybdenum and nitrate are below British Columbia Water Quality Guidelines for the protection of aquatic life (BCMOE 2006a,b) and that the predicted concentrations of aluminum, iron, phosphorus and total suspended solids are below the upper limit of baseline concentrations (i.e., they are not significantly greater than the background in Hazeltine Creek). Therefore, priority parameters upon which to focus the assessment of potential effects of discharge were identified as cadmium, copper, selenium and sulphate.

### *2.7.2.3. Review and Compilation of Hazeltine Creek Hydrology*

In order to facilitate an assessment of effluent discharge into Hazeltine Creek, available data on the hydrology of Hazeltine Creek at Station W7 were recently reviewed and compiled. The review concluded that the weir equations previously used to calculate discharge slightly overestimated discharge (Knight-Piésold 2007c). A new rating curve was developed, ground-truthed with available field data, and used as the basis for plotting the annual hydrograph for Hazeltine Creek at Station W7. These data were subsequently used for development of a preliminary discharge strategy and characterization of effluent mixing in Hazeltine Creek. Recommendations for weir calibration and for generally improving the accuracy of the stage record were made and were implemented in 2007. Such improvements were considered critical if the Mount Polley Mine is to implement a strategy of discharge-proportional-to-flow. Maximum flow in Hazeltine Creek occurs in April or May (the highest monthly average flow occurs in May, at approximately 0.6 $m^3/s$ at Station W7). The highest recorded flow in Hazeltine Creek at Station W7 was 1.95 $m^3/s$ (April 27, 1997) and the 2-year return period 7-day average high flow was 1.77 $m^3/s$ (April/May, 1997).

Minimum flow in Hazeltine Creek typically occurs from August to October (annual average of approximately 0.03 $m^3/s$ at Station W7 in September and October; 1995-2002). The lowest recorded flow in Hazeltine Creek at Station W7 was <0.0001 $m^3/s$ (various years in August to October) and the 2-year return period 7-day average low flow was estimated to be 0.0098 $m^3/s$ (Knight-Piésold 2007c).

### *2.7.2.4. Preliminary Discharge Strategy and Characterization of Effluent Mixing in Hazeltine Creek*

A preliminary assessment of effluent mixing in Hazeltine Creek was conducted based on predicted effluent volumes, predicted effluent characteristics and the hydrology of Hazeltine Creek (Knight-Piésold 2007d). Effluent discharge rates were based on supply rates (seepage), which are somewhat proportional to the hydrology of Hazeltine Creek (but are not strictly proportional due to an apparent lag in the maximum seepage rate relative to the maximum flow rate in Hazeltine Creek). With the construction of a treatment wetland, effluent discharge could likely be controlled to take better advantage of higher dilution available in Hazeltine Creek in the spring. That is, the effluent discharge strategy could be further refined to include holding effluent (or releasing it very slowly) in low flow months and releasing more in high flow months in proportion to the flows through Hazeltine Creek (see Section 2.7.2.12). Despite the need for refinement, the model provided a useful first assessment of the implications of effluent discharge on the water quality of Hazeltine Creek. Using a computer model of mixing (CORMIX GI 4.3T), Knight Piésold (2007d) predicted the percent of Mount Polley effluent in Hazeltine Creek with distance from discharge under three scenarios (a lower bound, a most-probable rate and an upper bound). Under the average condition, the following effluent concentrations were calculated:

| Month | W7 | 2000 m | 4000 m | W11 |
|---|---|---|---|---|
| Jan | 27% | 25% | 24% | 11% |
| Feb | 22% | 20% | 19% | 8% |
| Mar | 15% | 14% | 13% | 5% |
| Apr | 7% | 6% | 6% | 2% |
| May | 8% | 7% | 7% | 3% |
| Jun | 20% | 19% | 18% | 8% |
| Jul | 26% | 24% | 23% | 10% |
| Aug | 43% | 41% | 39% | 20% |
| Sep | 53% | 50% | 48% | 26% |
| Oct | 54% | 51% | 49% | 27% |
| Nov | 35% | 33% | 32% | 15% |
| Dec | 30% | 28% | 26% | 12% |

It is evident that this discharge strategy results in low effluent concentrations in months when Hazeltine Creek flows are high and higher effluent concentrations when Hazeltine Creek flows are low (up to 54% effluent in upper Hazeltine Creek and 27% effluent in lower Hazeltine Creek, respectively). With control over discharge (holding in a discharge pond), the discharge strategy could likely be improved significantly (see Section 2.7.2.12). However, even under this sub-optimal discharge strategy, the model indicated that the only parameters for which elevations above effect-based guidelines or the upper limit of background would be predicted to occur were cadmium, copper and sulphate (Knight-Piésold 2007d). Concentrations of selenium were predicted to occur at a concentration equal to the effect-based guideline only during low flow months (Knight-Piésold 2007d). It is anticipated that optimization of the discharge strategy and effluent polishing could eliminate the potential for selenium to exceed the effect based guidelines in Hazeltine Creek. Thus, this assessment suggested that cadmium, copper and sulphate are the parameters with the greatest potential to exceed effects-based guidelines in Hazeltine Creek due to the discharge of Mount Polley effluent. Maximum concentrations of these parameters (in October) under the average discharge condition were roughly 6.3-times, 6.0-times and 5.4-times their most stringent respective guidelines. These parameters are the focus of initiatives to determine site-specific protective limits that account for the chemical and biological conditions of Hazeltine Creek (see Sections 2.7.2.7 to 2.7.2.10).

### *2.7.2.5. Habitat and Geomorphological Assessment of Hazeltine Creek*

Mount Polley recently commissioned a study to physically characterize Hazeltine Creek from Station W7 downstream to Quesnel Lake (Minnow 2007a; Appendix 4). The characterization included the division of the creek into representative reaches based largely upon gradient and geomorphology. At each reach, detailed documentation of physical habitat features included channel dimensions, stream morphology, channel bed and bank material, bank stability and angle, riparian vegetation (vegetation types, approximate root depth, overhead shading) and in-stream cover. General habitat features, including locations of any groundwater seeps, tributaries etc., supported by photographs, were also documented for each reach. The information collected was used to evaluate channel stability, as summarized using a Bank Erosion Hazard Index (BEHI) and applied using hydrological data collected at the time of the survey and routinely at Station W7. Additional fish habitat characteristics were also recorded at each reach, including quantification of the relative proportion of functional in-stream cover (type and relative amount by wetted channel surface area) and any barriers to upstream fish migration were identified and documented. As part of the fish habitat characterization, the implication of increased flow to fish habitat was considered while conducting the field survey. Key fish habitat features were photographically documented during the field survey.

Preliminary findings of the evaluation were that erosion potential in Hazeltine Creek was low to moderate and that reaches immediately downstream of the proposed point of discharge had the greatest erosion potential under a high flow scenario (Minnow 2007a). High erosion rates would be expected at flows greater than 1.243 $m^3/s$ (i.e., the lowest bank-full flow and the flow above which bank overflow would be expected) and minimal erosion would be expected at flows of 0.116 $m^3/s$ or lower. As summarized above, highest recorded flow in Hazeltine Creek at Station W7 was 1.95 $m^3/s$ (April 27, 1997) and the 2-year return period 7-day average high flow was 1.77 $m^3/s$ (April/May, 1997). Therefore a flow of 1.243 $m^3/s$ was identified as a preliminary maximum permissible flow for

Hazeltine Creek (i.e., a flow rate above which any exceedence would not be due to effluent discharge). Furthermore, the maintenance of a flow of 0.116 $m^3/s$, to the extent possible given water quality concerns, was identified as having the potential to substantially augment the amount of functional habitat available to fish in Hazeltine Creek.

To expand upon this habitat assessment and preliminary evaluation of erosion potential, Mount Polley retained Knight-Piésold to conduct a hydrological/geomorphological assessment aimed at refining the preliminary maximum permissible flow limit. Specifically, the objective of this ongoing task is to identify a maximum total permissible flow rate for Hazeltine Creek immediately downstream of the discharge (i.e., to avoid excess erosion and associated damage to fish habitat). By extension, this will allow the identification of a natural flow rate above which effluent should not be discharged. Both of these limits will be utilized in mitigating potential physical effects of effluent discharge and finalizing an effluent discharge strategy. This evaluation has identified that the preliminary discharge strategy would likely not cause significant effects on fluvial geomorphology (Knight-Piésold 2007e). Specifically, at the increases in discharge considered in the preliminary strategy, bankfull width was predicted to increase by approximately 7%, hydraulic radius by approximately 2%, sediment transport by a maximum of 40%, and substrate size by 6%. These predicted responses are well within one standard deviation of natural (baseline) spatial variability within the creek (Knight-Piésold 2008). These findings will be utilized, in conjunction with additional findings of the ongoing geomorphological assessment, to refine the discharge strategy to minimize any contribution of discharge to channel erosion (Section 12).

#### *2.7.2.6. Characterization of the Use of Hazeltine Creek by Fish*

Although fish community characterization of the waterbodies has been conducted on several occasions both prior to and during operation, all previous studies were focused on areas immediately adjacent to the Mount Polley Mine site. As result, available data on fish communities of lower Hazeltine Creek were limited. In order to address this deficiency, fish occupancy surveys were conducted in the spring and fall of 2007. Intensive backpack electrofishing was also conducted in the late summer of 2007 in conjunction with the integrated baseline aquatic environmental study (Section 2.7.2.6).

The spring survey (May and June 2007) involved trapping (minnow traps and larger folding fish traps) and a systematic observational survey. The spring survey documented the use of lower Hazeltine Creek by coho salmon, rainbow trout, longnose dace, burbot, peamouth chub, redside shiner, bridgelip sucker and largescale sucker (Nowotny 2007; Appendix 5).

The fall survey (October 2007) effort was minimal, employing two large minnow traps for one night. This survey yielded no fish (captured or observed); however, spawning coho were subsequently observed in lower Hazeltine Creek (Holmes, pers. comm. 2007).

In addition to the fish species documented during the assessment conducted in 2007, Chinook salmon, mountain whitefish, and sockeye salmon have previously been documented in Hazeltine Creek (BCMOE Fisheries Information Data Queries 2008). It is notable that sockeye are considered to be present in Hazeltine Creek only in dominant cycle years (every four years including 2001, 2005, 2009, etc.).

#### *2.7.2.7. Toxicity Testing for Site-Specific Water Quality Objectives for Copper and Cadmium*

Copper and cadmium were identified as two metals for which it would be valuable to conduct a site-specific evaluation (see Section 2.7.2.2) and to potentially develop site-specific water quality objectives (SSWQO) for the protection of aquatic life in Hazeltine Creek. An SSWQO is a numerical concentration or narrative statement that is established to protect a designated water use at a specific site. Based on site-specific considerations, particularly of water chemical characteristics that might be expected to limit the bioavailability and toxicity of divalent metals (particularly copper), it was decided to pursue a procedure for the development of an SSWQO called the Water-Effect Ratio Procedure (e.g., BCMELP 1997; CCME 2003). Briefly, the WER Procedure involves side-by-side toxicity testing of laboratory water and site water spiked with the element of concern. It essentially tests the relative bioavailability of the spiked element in site water. If site water contains higher concentrations of any number of ligands that might bind copper (e.g., dissolved organic carbon), or of other elements that might compete with copper for uptake (e.g., hardness which represents the concentrations of calcium and magnesium), copper might be expected to be less bioavailable and therefore less toxic (e.g., Borgmann 1983; Winner 1985; Meador 1991; Welsh et al. 1996). In such a case, generic guidelines would be over-protective because they represent cases of higher bioavailability than exist at the site of interest.

Water-Effect Ratio (WER) testing was implemented by the Mount Polley Mine on two occasions in 2007 (April and August), on both occasions using two toxicity test organisms – rainbow trout and the water flea *Ceriodaphnia dubia*. Test timing was chosen based on season patterns in water quality and associated modeling of the aquatic speciation and toxicity of copper and cadmium (Minnow 2007b).

The water effect ratio testing conducted in April 2007 returned WERs of 30.3 for 48-h *C. dubia* survival, 26.9 for 96-h rainbow trout survival, 5.8 for 7-d *C. dubia* survival and 7.7 for 7-d *C. dubia* reproduction (Nautilus 2007; Appendix 6). It was hypothesized that the lower WERs associated with the 7-d tests were likely due to the required addition of food to these tests. Specifically, that the addition of food (organic matter) would have the probable effect of increasing the organic ligands in both test waters available to bind copper, thereby decreasing the difference in DOC concentrations between tests and decreasing the WER. The August 2007 testing returned WERs of 1.9 for 48-h *C. dubia* survival, 2.3 for 96-h rainbow trout survival, 3.0 for 7-d *C. dubia* survival and 2.4 for 7-d *C. dubia* reproduction (Nautilus 2007; Appendix 6). The reason for the differences in

WERs associated with the two time periods was most likely due to differences in sample hardness and dissolved organic carbon between the two sampling events. It is notable that, in all of the testing conducted to date, the lowest observed toxic concentration was 28 ug/L (48-h *C. dubia* in August 2007). The corresponding concentration of copper to exert a similar effect over 7-days was higher (56 ug/L), which supports the hypothesis that the addition of food reduces the bioavailability of copper. The same relative effect was observed in April 2007.

In the case of cadmium, testing conducted in April 2007 returned WERs that were all near 1 (Nautilus 2007; Appendix 6). This suggested that Hazeltine Creek water did not have a substantial effect on cadmium toxicity (relative to laboratory water) and testing was discontinued.

In 2008, toxicity testing in support of the development of WERs will be conducted at a greater frequency using *C. dubia* in order to better understand seasonal variability in the bioavailability and toxicity of copper in Hazeltine Creek.

### *2.7.2.8. Sulphate Aquatic Moss Testing*

Sulphate was also identified as a potential issue at Mount Polley (Section 2.7.2.2); however, the issue is considered to stem from a scientifically flawed provincial water quality guideline for sulphate (BCMOE 2000). In particular, data used as the basis for guideline development: toxicity of 250 mg/L sulphate to a bass species that does not occur in British Columbia (1973 study); toxicity of 205 mg/L sulphate to an amphipod (1996 study); and toxicity of 100 mg/L sulphate to an aquatic moss (1975 study) are considered questionable. All three of the results upon which the BC guideline is based have been refuted in attempts to repeat them (Davies et al. 2003; Davies and Hall 2007; Davies 2007). Nonetheless, due to the presence of a potentially sensitive aquatic moss (*Fontinalis antipyretica*) in Hazeltine Creek, Mount Polley conducted toxicity testing using the moss.

Toxicity testing of sulphate spiked into Hazeltine Creek water using the aquatic moss *Fontinalis antipyretica* indicated no toxicity up to a concentration of 2400 mg/L (Appendix 7). Both endpoints assessed (growth and chlorophyll content) returned the same result. This is supported by recently published findings, which documented no effect of sulphate on *F. antipyretica* at sulphate concentrations up to 1500 mg/L (Davies 2007).

#### *2.7.2.9. Salmonid Early Life Stage Testing*

The following is a summary of the results presented in a report prepared by Nautilus Environmental for Mount Polley Mine. The report, titled *Toxicity Testing of Effluent from E4 Using Early Life Stages of Salmonids (Oncorhynchus kisutch and Oncorhynchus mykiss*, is attached herewith as Appendix 8).

Salmonids represent a critical biological resource of Hazeltine Creek and include rainbow trout, coho salmon, sockeye salmon and chinook salmon. They are also generally sensitive to aquatic contaminants (e.g., Buhl and Hamilton 1991). Furthermore, early developmental stages of fish (i.e., embryo, larval and early juvenile) can be equally or more sensitive to aquatic contaminants than adults (Environment Canada 1998). In consideration of all these factors, Mount Polley decided to test the potential toxicity of their seepage pond water to early life stages of rainbow trout and coho salmon. Toxicity testing of coho salmon involved testing the embryo stage (11 days) and toxicity testing of rainbow trout involved testing the embryo-alevin-fry stages (66 days). It is notable that the water tested may be of poorer chemical quality than the effluent ultimately discharged from the mine (Mount Polley is considering passive [wetland] treatment of their effluent).

Toxicity testing of seepage pond effluent using coho salmon embryos returned a result of non-toxic. Specifically, the EC50 (effective concentration, 50%) and EC25 were both >100% and the no-observed-effect-concentration and lowest-observed-effect-concentration were 100% and >100%, respectively (Nautilus 2008a;Appendix K). Toxicity testing of seepage pond effluent using rainbow trout through the embryo-alevin-fry stages returned some effects on alevin survival at 50% and 100% effluent. There was no effect at 25% effluent. No effects, either to survival or growth, occurred in the alevin to swim-up fry stage of the test. At this stage, the EC50 (effective concentration, 50%) and EC25 were both >100% and the no-observed-effect-concentration and lowest-observed-effect-concentration were 100% and >100%, respectively (Nautilus 2008a). Therefore, results of the entire test (embryo to fry) returned some effects on alevin survival at 50% and 100% effluent, but no effect at 25% effluent. Average concentrations of key constituents of the effluent at the time of testing were: 310 mg/L hardness, 239 mg/L sulphate, <0.00009 mg/L cadmium, 0.0028 mg/L copper and 0.0082 mg/L selenium.

#### *2.7.2.10. Cadmium Consortium*

The Mount Polley Mine is part of a consortium, established in 2007, that is assisting Environment Canada to expedite a revision of the National (Canadian) water quality guideline for the protection of aquatic life for cadmium. The current national guideline for cadmium is hardness dependent according to the equation $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ and was derived by dividing a lowest recorded toxicity value of 0.17 ug/L (Biesenger and Christensen 1972) by a safety factor of 10. It is notable that the national guideline for cadmium was adopted as the BC working guideline (BCMOE 2006b). Substantial advances made in the understanding of the aquatic toxicity of metals, including cadmium, the general improvement in toxicity methodology, as well as the sheer volume of available data on the aquatic toxicity of cadmium, suggest that taking the lowest available toxicity datum and dividing it by 10 is not a defensible approach to guideline development (it is unnecessarily over-protective). Accordingly, Environment Canada recently drafted a new “Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life”. Mount Polley is financially supporting (in conjunction with several other mines and Canada’s Science Horizons program) the application of the protocol for the development of a new national water quality guideline for cadmium. It is anticipated that the result will be available in 2008 and that some additional time will be required for national ratification.

#### *2.7.2.11. Baseline Aquatic Environmental Study of Hazeltine Creek*

In order to provide better baseline information upon which to base a strategy for discharge and against which to interpret future chemical and biological monitoring data, the Mount Polley Mine undertook a comprehensive baseline aquatic environmental study of Hazeltine Creek in August 2007. The assessment was focused on Hazeltine Creek and the area of Quesnel Lake that receives Hazeltine Creek, but also included Edney Creek and reference areas for both upper and lower Hazeltine Creek. Methodology and endpoints were consistent with requirements for Environmental Effects Monitoring (EEM) under the federal *Fisheries Act*. The study included evaluation of water chemistry, sediment chemistry, the benthic invertebrate community, the fish community, and sentinel fish population(s).

Preparation of an integrated interpretive report is currently underway. It is anticipated that the interpretive report will be completed in April 2008.

#### *2.7.2.12. Refinement of a Strategy for Discharge*

As indicated previously, many of the evaluations conducted by Mount Polley in 2007 were implemented based on a preliminary discharge strategy (Section 2.7.2.4) and generally conservative (worse than expected) estimates of discharge volume and quality. The technical assessments undertaken in 2007 were used to refine the strategy for effluent discharge (i.e., Mount Polley is taking an iterative approach). Fundamental considerations driving the strategy for effluent discharge are the maintenance of water quality that is fully protective of aquatic life and the avoidance of any detrimental physical effect. The current concept for discharge involves the polishing of effluent in a passive treatment system followed by release at a rate proportional to the flow of Hazeltine Creek. Site-Specific Water Quality Objectives for copper and sulphate, in conjunction with maximum permissible flows, are being used to guide the strategy.

### 2.7.3. BIOSOLIDS PROGRAM

In 1999 the Ministry of Environment issued Mount Polley Mining Corporation a permit to import biosolids from the Greater Vancouver Regional District for the purposes of mine site reclamation (Permit PE15968). After initial receipt and stockpiling of the biosolids shipments in 2000, the program was suspended. Biosolids shipments recommenced in 2007.

In 2007, one hundred and seven (107) shipments of biosolids were received from the Lulu Island Waste Treatment Plant beginning in February and ending in November. A total of 1,109.21 dry tonnes were shipped. New (received in 2007), old (received in 2000) and composite (combined new and old) samples were collected and analyzed in September and October 2007. The results of the analyses are presented in Table 2.28.1.

### 2.7.4. GENOMICS SCIENTIFIC RESEARCH PROPOSAL

In the latter part of 2007 Mount Polley partnered with the University of British Columbia on a proposal submission to Genome British Columbia. Genome B.C. is a research organization that invests in and manages large-scale genomics and proteomics research projects and science and technology platforms focused on various areas of strategic importance <u>including the environment</u>. The overall objective of the proposed research is to develop genomics tools that will be used to monitor microbial communities and metabolic processes in passive water treatment systems used in the mining industry. The significance of this work will be to improve the performance of passive treatment systems and to discover organisms, pathways and/or enzymes that can be exploited in innovative future applications for the mining industry. The contributions to new science will include (i) cultivation-independent genomic surveys of ML and ARD treatment systems never before performed and (ii) new information on the interrelationship between nutrient supplies and microbial processes within high metal and/or sulphate environments. As of the writing of this report, the proposal application was still under review.

# 3.0 MINING PROGRAM

A detailed Mine Plan was presented in the Reclamation and Closure Plan submitted to MEM and approved under Permit M-200.

## 3.1. SURFACE DEVELOPMENT TO DATE

### 3.1.1. AREAS OF DISTURBANCE TO END OF 2007

Since mining operations ceased in 2001, there was almost no new disturbance created up to 2004. The only exception is the exploration work in the Northeast Zone that was conducted toward the end of 2003. The disturbed areas map (Figure 4) has been updated from a 2006 fall aerial photograph to include 2007 disturbance areas.

At the end of 2007, the total disturbed area in all categories was 742.44 hectares. Surface areas of the various disturbed reclamation units are outlined in Table 3.2 and are detailed by mine component in Table 3.1.

## 3.2. SURFACE DEVELOPMENT IN 2007

As discussed in the previous section, since mining operations ceased in 2001, almost no new disturbance was created in 2004. In 2007, the following changes are as follow:

In 2007, the waste dumps increased by 22 ha. The tailings ponds had no significant increase in disturbance. The dam was raised from 948 to 951m with a minor increase in its footprint.

Pit areas increased by 28ha, while areas of road disturbance increased by approximately 10 ha.

## 3.3. PROJECTED SURFACE DEVELOPMENT FROM 2007 TO 2011

### 3.3.1. AREAS OF DISTURBANCE

Tables 3.3 and 3.4 illustrate the projection of further disturbance for the next five years and mine life.

### 3.3.2. SALVAGING AND STOCKPILING OF SURFICIAL MATERIALS

Soil salvage is a critical component of reclamation planning, as it will provide the soil material necessary to reclaim the mine site for desired end land uses. In 1997 Mount Polley prepared a Soil Salvage and Stockpile Protocol, SSSP-97, which addressed site-specific criteria relating to soil management.

In 2007, approximately 275,000 m$^3$ of soil were salvaged from the Wight (North East Zone) pit, which contributes to a total of 3,200,000 m$^3$ in storage held at Mount Polley (Table 3.5). This amount over 582 ha (total area disturbed minus pits and stockpiles) yields a nominal 54cm of soil in storage for each hectare disturbed.

### 3.3.3. DRAINAGE CONTROL / PROTECTION OF WATERCOURSES

In 2004, Knight Piésold (Ref. No. 1624/1, 1995) developed an overall water management plan for the Mount Polley Mine Project. Additionally, ongoing environmental studies, commissioned in 2007, include the development of site-specific water quality objectives. Results presented in the 2007 studies were summarized in section 2.7.2.

## 3.4. Test Heap Leach

### List of Chronological Activities

The Test Heap Leach Pad has a high integrity low permeability double liner system constructed over the entire leach pad area. The double liner system for the pad area contains the following components from bottom to top:

- 150 mm Prepared Subgrade (Zone F);
- 500 mm Soil Liner (Zone S);
- 60-mil smooth HDPE Inner and Outer Liners with a Geonet between them;
- 100 mm diameter cpt pipe runs continuously in an East-West direction with a spacing of 6 metres between pipes and covered with a 1000 mm Protective/Drainage Layer;
- The Test Heap Leach Pad also contains a Leak Collection and Recovery System (LCRS).

A 24-hour hydrostatic test was completed to evaluate the integrity of the inner liner. The results of the hydrostatic test indicate that the leakage rate through the inner liner is below a theoretical leakage rate, which has been determined by conservatively assuming that one hole or defect is present per acre of liner area. Results of the successfully completed hydrostatic test were reviewed by Knight Piésold. These results, as well as a description of the test heap leach pad construction program, are detailed in Knight Piesold's report titled, *Test Heap Leach Pad Construction Report (REF. NO. VA101-1/17-1), and provided herewith as Appendix 9a.*

The initial site grading for the Test Heap Leach Pad construction program at Mount Polley Mine commenced in August 2006 and the pad was fully lined with 60-mil HDPE by mid November 2006. The construction program was halted at this time due to winter conditions. Additional items to be completed in the spring at the Test Heap Leach Pad prior to loading the pad include the following:

- Visually inspecting the liner for damage once the pad is free of ice and snow.
- Completing a second hydrostatic test in the sump area to confirm that the inner liner has not been damaged from ice during the winter.
- Installing the drainage system consisting of 100 mm diameter cpt pipe, in the bottom of the leach pad.
- Placing the protective/drainage layer, consisting of plus 6 mm minus 19 mm drain gravel, on top of the drainage system at the bottom of the leach pad.
- Installation of the settlement monuments.

Final crushing and stacking of the test heap and the final tonnes and grade are listed in the following table.

**Crushing and Stacking Results for the Test Heap Leach**

| Description | | Wet Tonnes | Moisture (%) | Dry Tonnes | Sulphur Tonnes | Grade (%) Cu-ToT | Cu-NS | Fe-ToT | Au (gpt) | Tonnes Cu-ToT (t) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Daily - Crushing** | SPRINGER | | | | | | | | | |
| | C2 | | | | | | | | | |
| | | | | | | | | | | |
| **Total - Crushing** | | | | | | | | | | |
| **MTD - Crushing** | SPRINGER | 65,872 | 3.22 | 63,749 | | 0.485 | 0.339 | 6.06 | 0.36 | 309.20 |
| | C2 | | | | | | | | | |
| | | | | | | | | | | |
| **Total - Crushing** | | 65,872 | 3.22 | 63,749 | | 0.485 | 0.339 | 6.06 | 0.36 | 309.20 |
| **YTD- Crushing** | SPRINGER | 204,983 | 3.19 | 198,438 | 3,781 | 0.345 | 0.250 | 5.62 | 0.22 | 683.63 |
| | C2 | | | | | | | | | |
| | | | | | | | | | | |
| **Total - Crushing** | | 204,983 | 3.19 | 198,438 | 3,781 | 0.345 | 0.250 | 5.62 | 0.22 | 683.63 |

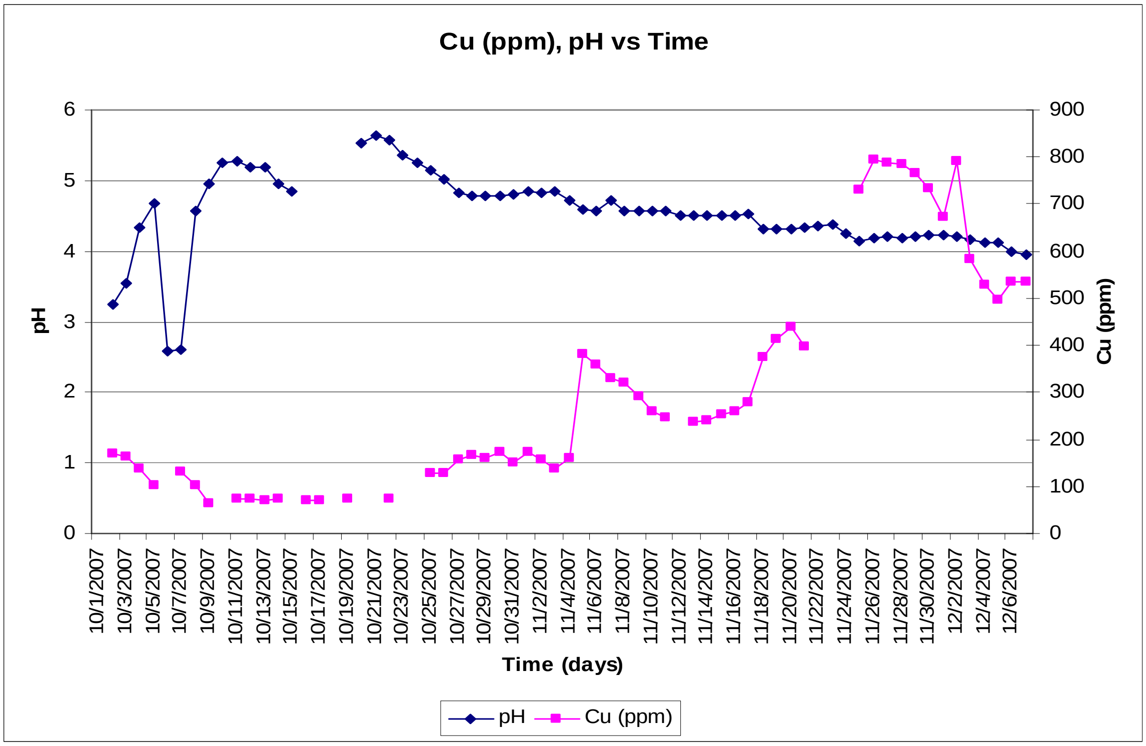
All HOBO meters have been installed for temperature measurements inside the heap. Initial readings reported a 25 degree Celsius measurement in the first quadrant, which was under leach during the month of September 2007.

The Electro- Metals / Electro-Winning plant (EMEW/MCC) was completed during the month of October.

The drip lines were buried at a depth of approximately 300 mm.

Heap leaching commenced on October 9th.

As shown in the following figure, the pH within the leach pad has continually dropped and as of early December had dropped below 4.



The EMEW cells were operated in November but no copper was produced. The solution conductivity was not high enough to allow for the rectifier amps to be greater than 200. The cells were operated again on December 6th and the amperage was 208, which resulted in copper production. The pH was checked entering and exiting the EMEW cells and was found to be 4.0 and 3.1 respectively. The drop in pH across the cells proved that metal was being precipitated and sulphuric acid generated. The operation and precipitation of copper will allow sulphuric acid to be returned to the heap and subsequently leach more copper.

The EMEW circuit operated through December on an intermittent basis as long as a current of greater than 200 amps could be generated. The filter press will be operated with existing cloths and also a sample will be sent to the supplier to determine the best filter cloth to be used.

Table 2 below shows local groundwater results prior to placing oxide material onto the leach pad.

Three (3) samples representing 200,000 tonnes of ore placed onto the leach pad were analyzed. The Neutralizing Potential Ratio results were 2.22, 4.69 and 2.33.

**Groundwater Water Monitoring Well Data…GW05 R5**

| Parameter | Units | Collection Date<br>**21-Jun-07** |
|---|---|---|
| Field pH | pH units | 7.61 |
| Field Temp | degrees C | 6.8 |
| Field Conductivity | uS/cm | 569 |
| Alkalinity Total | mg/l | 193 |
| Sulfate | mg/l | 168 |
| Nitrate + Nitrite | mg/l | 3.31 |
| Ammonia - N | mg/l | 0.0083 |
| Hardness | mg/l | 404 |
| Dissolved Aluminum | mg/l | 0.001 |
| Dissolved Arsenic | mg/l | 0.00054 |
| Dissolved Barium | mg/l | 0.0148 |
| Dissolved Calcium | mg/l | 121 |
| Dissolved Copper | mg/l | 0.00068 |
| Dissolved Iron | mg/l | 0.015 |
| Dissolved Lead | mg/l | 0.00005 |
| Dissolved Magnesium | mg/l | 24.9 |
| Dissolved Manganese | mg/l | 1.41 |
| Dissolved Molybdenum | mg/l | 0.0246 |
| Dissolved Nickel | mg/l | 0.0005 |
| Dissolved Potassium | mg/l | 0.89 |
| Dissolved Selenium | mg/l | 0.001 |
| Dissolved Silicon | mg/l | 7.29 |
| Dissolved Sodium | mg/l | 7.55 |
| Dissolved Strontium | mg/l | 0.342 |
| Dissolved Zinc | mg/l | 0.001 |

# 4.0 FUTURE RECLAMATION PROGRAMS

## 4.1. RECLAMATION RESEARCH FOR 2007

In 2007 reclamation research will involve evaluating the 1170m dump plots, and establishing a plan from the results. Additional Metal update will be done.

# 5.0 RECLAMATION COST UPDATE

A detailed reclamation cost update for the end of 2007 has been completed. The summary tables and detailed categories of disturbance can be found in APPENDIX 10 - RECLAMATION BOND COSTING – 2007.

# 6.0 References:

BCMELP (British Columbia Ministry of Environment, Lands and Parks). 1997. Methods for Deriving Site-Specific Water Quality Objectives in British Columbia and Yukon. Waste Management Branch. November 1997.

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