MPMC00135

**Mount Polley Mining Corporation**
**IMPERIAL METALS CORPORATION**

# 2009 Environmental and Reclamation Report

Submitted 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 drainage from the Bootjack Lake / Morehead Creek drainage, 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 2009, the mine received an amendment to the M-200 permit to mine the Pond Zone open pit.

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 have been no discharges from this location since 2005. In 2007 and 2008, a number of studies were commissioned to obtain the information necessary to apply for an additional discharge permit into Hazeltine Creek .In 2009 Mount Polley submitted an effluent discharge application to the Ministry of Environment. The submission of this application was subsequent to a public meeting in Likely BC.

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, three open pits, three rock disposal sites and a *Tailings Storage Facility*, as well as the main access road, power line, tailings pipeline, drainage collection systems and sediment/ 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. Mine life is currently planned until 2015.

Each year all data collected under the requirements of permit PE 11678 is submitted in an Annual Environmental Report by March 31st 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 2009-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, which 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.

## 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 water and groundwater. 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 samples are collected at locations and time intervals consistent with specifications listed in Permit PE 11678. The samples are then sent to an independent laboratory (ALS Laboratory Group (ALS)) for analysis and reporting. 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.

The Mount Polley weather station continuously measures daily precipitation (rainfall during non freezing months only), and temperature. The weather 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 2009 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 wildlife interaction through a garbage management program. In 2009, there were no bear encounters or mortalities.

In 2009, Mount Polly accepted approximately 6369 tonnes of mineral-enriched soil from two (2) sources. A total of 2491 tonnes of material was imported from the Pacific Environmental Centre (PEC); Then, 3878 tonnes and from a site in Langley. Generally, these materials are similar to mine waste material found at Mount Polley. Monthly composite tailings samples were taken when processing the Langley soil and analytical results were below the lead level found in Table 1, Schedule 4 "Leachate Quality Standards" of the Hazardous Waste Regulation.

# 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, 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
- 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. We 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.

## 2.2. RECLAMATION ACTIVITIES – 2009

Tables 3.1 to 3.5 included in this report provide a summary of; all disturbed areas, reclaimed areas, the five projections of disturbance and reclamation, and the soil stockpile inventories.

### 2.2.1. STABILITY OF WORKS

#### 2.2.1.1. *Rock Disposal Sites*

Examinations of rock disposal sites are made in accordance with section 6.10.1 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. Monitoring occurs at 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 Tailings Storage Facility and associated works was inspected in September of 2009 by Knight Piésold Consulting (KP). KP's findings are documented in a report found in Appendix 1 entitled, Tailings Storage Facility Report on 2009 Annual Inspection (Ref. No VA101-1/27-1).

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

The total area that has been seeded/planted throughout the mine site in 2009 was minimal; being limited to seeding bermed areas along the tailings haul road to the tailings pond, drainage ditches and abandoned borrow areas to reduce downstream siltation.

### 2.2.3. ROCK DISPOSAL SITE RECLAMATION

No reclamation was conducted on the East, North, Northeast Zone or Cariboo Pit rock disposal sites during 2009.

### 2.2.4. WATERCOURSE RECLAMATION

The disturbed area along the Long ditch (installed in 2008) was seeded in 2009 to provide erosion and sediment control. No other changes to the watercourses at the Mount Polley mine site were made in 2009. All diversion ditches and pipelines continue to operate as designed.

### 2.2.5. PIT RECLAMATION

In 2009, no reclamation was conducted on the Cariboo, Bell or Wight pits. The Cariboo pit has been used as a PAG dump and a catchment for Tailings Supernatant. Mining of the Bell pit was completed in 2008 and is being used as a rock dump. An amendment to Permit PE-11678 was received allowing the transfer of Tailings Supernatant to the Cariboo/Bell Pit. From a reclamation standpoint, the transfer of supernatant provides for rapid filling of pits and submergence of pit walls that may otherwise have contributed to metal leaching.

The Wight pit was completed in early mid 2009.

### 2.2.6. TAILINGS STORAGE FACILITY RECLAMATION

No reclamation was conducted at the Tailings Storage Facility in 2009; however, in planning for mine site closure, an experimental anaerobic bioreactor (discussed further in Section 2.8.4) was designed and constructed adjacent to the main embankment seepage collection pond as part of a research initiative investigating the ability of sulfate reducing bacteria to improve effluent water quality. This research program was initiated in 2008 in conjunction with Genome B.C. and the University of British Columbia for consideration as a long-term passive treatment technology option in reclamation.

### 2.2.7. ROAD RECLAMATION

No road reclamation was conducted during 2009.

### 2.2.8. SECURING OF MINE OPENINGS

Mount Polley Mine consists exclusively of open pits. Therefore, there are no mine openings to secure. In 2008, permit M-200 was amended by bringing some existing logging roads in the area under permit. This amendment has helped to restrict access to the mine site and facilitate access planning.

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

In the course of its ongoing operations, Mount Polley utilizes chemicals and reagents that are subject to a waste disposal management plan. Included in this plan are provisions for dealing with the waste products. In 2009 Sumas Environmental Services Ltd. was scheduled on a routine basis to remove and dispose of these waste products in an environmentally safe manner compliant with all relevant waste management legislation.

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

The Acid Rock Drainage / Metal Leaching (ARD/ML) Monitoring Program for the Mount Polley Mine continued through 2009. 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.

#### 2.2.10.1. *Waste Rock*

*Wight Pit, Southeast Pit, Springer Pit, Pond 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. The results are displayed in table 2.25. Blast hole patterns were on average 7.4m burden by 8.5m spacing. Bench height is 12m in the Springer Pit and Wight Pit, while bench height is 10m in the Southeast and Pond Pits. 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 then established ore/waste boundaries based on the calculated mill head values. For purposes of ARD-ML monitoring, ore areas were excluded from ABA analysis, as this material is run through the mill. However, any rock destined for the Low grade leach stockpile, #4 High-Ox stockpile, or #3 Non-Economic stockpile had ABA analysis of the blast holes. For each blast, ABA composites were made from a prescribed number of blast hole samples according to the waste tonnage in the blast. Thus, a bigger waste tonnage would correspond to an increasing number of blast samples that would make up the composite. This makes the ABA data more representative of the entire blast.

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 tables below and discussed in the following paragraphs.

**Waste Material Truck Count by Pit**

| 2009 | Truck Count Tonnage | | | | |
|---|---|---|---|---|---|
| | *NAG* | *PAG* | *LSW* | *OB** | *Total Waste* |
| Wight Pit | 256,041 | 0 | | 0 | 256,041 |
| Pond Zone | 17,026 | 160,606 | 281,147 | 205,629 | 841,907 |
| Springer Pit | 14,697,921 | 1,242,892 | 6,519 | 156,458 | 16,103,790 |
| South East Pit | 0 | 2,263,976 | | 20,318 | 2,290,916 |
| **PIT TOTAL:** | **14,970,988** | **3,667,474** | **287,666** | **382,405** | **19,492,654** |

* Overburden

<u>Wight Pit</u>

The Wight Pit finished ore production in 2009, and subsequently became a dump location for PAG from the Southeast, Springer, and Pond Pits. A total of 260,000 tonnes of NAG were deposited on the Wight Pit Rock Dump before the Wight Pit finished production.

For 2009, all PAG was deposited in the Wight Pit below the 900m elevation mark. (Polley Lake elevation 922m) The PAG was used to buttress the exposed Kidney Zone wall slash, and to construct a ramp down to the 876m elevation at the north end of the pit where underground development is to occur. Previously, the Bell Pit was used as a

PAG dump, but this ceased in November 2008 when the pit became too full and PAG could not be dumped below the long-term groundwater level.

Southeast Pit

All waste from the Southeast Pit was designated PAG and placed in the Wight Pit, with the exception of 20,000 tonnes of till. Approximately 2,263,000 tonnes of Southeast Zone PAG was hauled to the Wight Pit.

Springer Pit

The majority of Springer waste is NAG except for a distinct zone of unoxidized high-pyrite PAG along the south margin of the Pit. This PAG had not been previously modeled until 2009, although the diamond drilling data indicated substantial quantities of pyrite in this area. Approximately 12,060,000 tonnes of Springer NAG were hauled to the Bell Pit dump. Approximately 1,227,000 tonnes of Springer PAG were hauled to the Wight Pit.

Pond Pit

Mining of the Pond Zone Pit commenced in late 2009. ABA test work on Pond Zone drillcore indicated the presence of a large volume of PAG rock on both sides of the northwest-trending orebody. However, the PAG to the west of the ore had low sulphur as well as low neutralizing carbon. This facilitated the permitting and construction of a Sandwich Dump, whereby this Low-Sulphur PAG waste (LSW) could be pancaked with high NPR Springer NAG to create a 1:2 NPR blended stockpile that neutralizes any acid production. To qualify as LSW, the Pond PAG must have sulphur less than 0.3%. In addition, the NAG from Springer must have NPR greater than 6. To date, all ABA analyses of Pond Pit blast holes indicate that the intrusive to the west of the ore is LSW, while the basalt located east of the ore is genuine PAG. Approximately 17,000 tonnes of NAG was also hauled off the top bench of the Pond Pit, where sufficient oxidation had penetrated to oxidize the pyrite in the basalt.

Approximately 179,000 tonnes of PAG were hauled from the Pond Pit to the Wight Pit. Also, 20,000 tonnes of LSW was hauled to the Wight Pit to speed up ramp construction. At year-end, the sandwich dump contains approximately 323,000 tonnes of Pond LSW layered with 308,000 tonnes of Springer NAG.

2.2.10.2. *Tailings Storage Facility*

291,000 tonnes of NAG was hauled to the Tailings Storage Facility for dam construction. Where possible, clean NAG with low alteration and copper mineralization was selected for haulage to the dam and used as downstream shell material.

2009 Waste Material Survey Data by Pit.

| 2009 | SURVEY DATA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Wight Pit** | ***High Ox*** | ***Non-Econ*** | ***Leach*** | ***Total*** | ***Nag*** | ***Pag*** | ***OB*** | ***Total Waste*** |
| 912 | | | | 0 | 102 | | | 102 |
| 900 | | | | 0 | 14,944 | | | 14,944 |
| 888 | | | | 0 | 53,310 | | | 53,310 |
| 876 | | | | 0 | 18,771 | | | 18,771 |
| 864 | | | | 0 | 70,947 | | | 70,947 |
| 852 | | | | 0 | 81,302 | | | 81,302 |
| 840 | | | | 0 | 89,125 | | | 89,125 |
| 828 | | | | 0 | 121,319 | | | 121,319 |
| 816 | | | | 0 | 34,384 | | | 34,384 |
| 804 | | | | 0 | 8,424 | | | 8,424 |
| **WP Total:** | **0** | **0** | **0** | **0** | **492,628** | **0** | **0** | **492,628** |
| **Pond Pit** | ***High Ox*** | ***Non-Econ*** | ***Leach*** | ***Total*** | ***Nag*** | ***Pag*** | ***LSW*** | ***Total Waste*** |
| 1090 | | | | 0 | 7,050 | | | 7,050 |
| 1080 | | | | 0 | 128,975 | | 54,265 | 183,240 |
| 1070 | | | | 0 | 162,235 | 125,044 | 110,141 | 397,420 |
| 1060 | | | | 0 | 61,175 | 48,070 | 72,316 | 181,561 |
| 1050 | | | | 0 | 7 | | | 7 |
| **PZ Total** | **0** | **0** | **0** | **0** | **359,442** | **173,114** | **236,722** | **769,278** |
| **Southeast Pit** | ***High Ox*** | ***Non-Econ*** | ***Leach*** | ***Total*** | ***Nag*** | ***Pag*** | ***OB*** | ***Total Waste*** |
| 1070 | | | | 0 | | 83,390 | | 83,390 |
| 1060 | | | | 0 | | 558,283 | | 558,283 |
| 1050 | | | | 0 | | 798,909 | | 798,909 |
| 1040 | | | | 0 | | 640,418 | | 640,418 |
| 1030 | | | | 0 | | 268,525 | | 268,525 |
| 1020 | | | | 0 | | 653 | | 653 |
| 1010 | | | | 0 | | | | 0 |
| | | | | 0 | | | | 0 |
| **SEZ Total** | **0** | **0** | **0** | **0** | **0** | **2,350,178** | **0** | **2,350,178** |
| **Springer Pit** | ***High Ox*** | ***Non-Econ*** | ***Leach*** | ***Total*** | ***Nag*** | ***Pag*** | ***OB*** | ***Total Waste*** |
| 1192 | | | | 0 | 57,132 | | | 57,132 |
| 1180 | | | | 0 | 470,685 | | | 470,685 |
| 1168 | | | | 0 | 916,152 | | | 916,152 |
| 1156 | | | 16 | 16 | 254,618 | | | 254,618 |
| 1144 | | | 2,070 | 2,070 | 142,928 | | | 142,928 |
| 1132 | | 8,737 | 42,254 | 50,991 | 1,259,440 | | | 1,259,440 |
| 1120 | | 74,468 | 280,333 | 354,801 | 2,811,032 | | | 2,811,032 |
| 1108 | 93,810 | 659,460 | 360,135 | 1,113,405 | 3,325,431 | | | 3,325,431 |
| 1096 | 135,444 | 531,052 | 155,820 | 822,316 | 2,554,296 | 164,016 | | 2,718,312 |
| 1084 | | 403,097 | 193,185 | 596,282 | 1,762,046 | 495,540 | | 2,257,586 |
| 1072 | 32,371 | 214,951 | | 247,322 | 1,104,326 | 281,158 | | 1,385,484 |
| 1060 | | 39,908 | | 39,908 | 304,959 | | | 304,959 |
| 1048 | | | | 0 | 264 | | | 264 |
| 1036 | | | | 0 | | | | 0 |
| 1024 | | | | 0 | | | | 0 |
| 1012 | | | | 0 | | | | 0 |
| 1000 | | | | 0 | | | | 0 |
| **SP Total:** | ***261,625*** | ***1,931,673*** | ***1,033,813*** | ***3,227,111*** | ***14,963,309*** | ***940,714*** | ***0*** | ***15,904,023*** |
| ***PIT TOTAL:*** | ***261,625*** | ***1,931,673*** | ***1,033,813*** | ***3,227,111*** | ***15,815,379*** | ***3,464,006*** | ***236,722*** | ***19,516,107*** |

### 2.2.10.3. *ABA Data*

There were 291 ABA composites analyzed from four active pits in 2009, the majority of which came from Springer. Material stockpiled in the #4 High-Oxide and Leach stockpiles had high NPR, however the material stockpiled in the 3# Non-Economic stockpile had an NPR of 1.59. The lower NPR in the Non-Economic ore is due to a lower oxide ratio and higher pyrite levels. PAG from the Springer had an average NPR of 0.72. PAG from the Southeast Pit had an average NPR of 0.43.

NPR Results by Pit.

| PIT | TYPE | # samples | MIN NPR | MAX NPR | AVE AP | AVE NP | AVE NPR |
|---|---|---|---|---|---|---|---|
| SPR | Hi-Ox | 13 | 0.87 | 26.12 | 2.16 | 12.84 | 5.94 |
| SPR | Leach | 17 | 2.8 | 39.24 | 1.62 | 12.65 | 7.82 |
| SPR | Non-Eco | 40 | 0.24 | 61.39 | 11.27 | 17.91 | 1.59 |
| SPR | NAG | 136 | 2.09 | 239.54 | 2.62 | 21.96 | 8.38 |
| WIGHT | NAG | 3 | 2.97 | 6.62 | 22.80 | 97.25 | 4.27 |
| POND | NAG | 1 | 2.33 | 2.33 | 3.97 | 9.25 | 2.33 |
| POND | LSW | 3 | 0.84 | 1.56 | 3.54 | 3.17 | 1.08 |
| SPR | PAG | 44 | 0.18 | 1.96 | 31.1 | 22.43 | 0.72 |
| SEZ | PAG | 33 | 0.13 | 1.4 | 22.48 | 9.73 | 0.43 |
| POND | PAG | 4 | 0.6 | 2.01 | 12.53 | 10.85 | 0.87 |

PAG samples by Pit.

All results of PAG samples by pit are reported in table 2.27. ABA samples designated as PAG were as follows;

- Springer Pit – 44 Samples with mean NPR of 0.72
- South East Zone – 33 samples with mean NPR of 0.43
- Pond Zone – 4 samples with mean NPR of 0.87. (One sample was noted as being in limestone which considerable changed the mean0

### 2.2.10.4. *Low Grade Stockpile*

At 2009 year end, the low-grade Non-economic ore was estimated to contain 1,900,000tonnes of ore. The mean NPR was measured at 1.59.

### 2.2.10.5. *Rock Borrow Pit*

No rock was extracted from the rock borrow in 2008.

### 2.2.10.6. *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 11 of the 12 months. Table 2.26 shows a summary of the ABA data for each of these samples. From January to December 2009, approximately 7,100,000 tonnes of tailings were deposited into the TSF. The composite tailings sample had an average NPR value of 3.00 and a range of NPR values from 1.10 to 7.90.

### 2.2.10.7. *Soils and Till*

In 2009, a total of 583,654 tonnes of soil / till were stockpiled generally from the Wight pit and Springer pit area. No ABA samples were taken for analysis.

### 2.2.10.8. *Field Grab Samples*

Four (4) samples were collected from the Oxide Stockpile; samples had a mean NPR value of 8.51 and a range of NPR values from 1.96 to 19.26.

One (1) sample was collected from the Springer Waste Sandbox; this sample had a NPR of 37.33

Two (2) samples were collected from the North Bell Dump; these samples NPR values of 2.49 and 23.44.

Three (3) samples were collected from the Fine Ore Stockpile; samples had a mean NPR value of 1.86 and ranged from 0.78 to 2.44.

Eight (8) samples were collected from the Tailings Storage Facility; samples had a mean NPR value of 4.50 and a range of NPR values from 1.05 to 37.33.

### 2.2.10.9. *Quality Control and Assurance*

Ten drill hole rejects were submitted to Acme and ALS for independent ABA analysis as part of Mount Polley's Quality Control and Assurance program. From the analysis Mount Polley's lab consistently reported a higher AP than the external lab.

### 2.2.10.10. *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 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.

### 2.2.10.11. *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.

#### 2.2.10.12. *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 Consulting Engineers and Scientists* has been retained by Mount Polley Mining Corporation to interpret results of the kinetic-testing program and suggest other recommended testing, if required.

The final analysis and report from SRK will be available mid April 2010 at which time Mount Polley will forward the report as Appendix 2 to the Government Agencies.

## 2.3. PERMIT PE-11678 SURFACE AND GROUNDWATER MONITORING

### 2.3.1. DATA QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The purpose of a QA/QC program is to verify the reliability of monitoring data through the implementation of procedures for controlling and monitoring the measurement process. The QA/QC program provides information for the evaluation of the analytical procedures, and for the monitoring of issues pertaining to possible contamination both in the field and in the analytical laboratory. The QA/QC program is conducted at all stages of the sampling program; sample collection, transport, filtration, and analysis. Appendix 3 includes the National Quality Manual Summary provided by ALS.

#### 2.3.1.1. *Data Quality Objectives*

The Laboratory Data Quality Objectives provided to Mount Polley by ALS are also included in Appendix 3.

#### 2.3.1.2. *Replicates and Travel Blanks*

The field quality assurance program at Mount Polley includes one semi-blind replicate for standard parameters, one semi-blind replicate for total metals, one semi-blind for replicate metals and a travel blank that is submitted with each month's sample shipment.

The semi-blind replicates are intended to evaluate the QA/QC surrounding the sampling methods. Replicates are prepared by collecting two full sample suites from one location, labeling one with the correct sampling location name (e.g. E4) and labeling the second sample suite with anonymous name (e.g. ED). When the results are reported back from the analytical laboratory all parameters from the replicate and the actual sample are screened to confirm likeness or potential of sampling error/contamination. The screening process also considers small-scale natural variations in water quality which may occur over the timescale of collection (~10 minutes). In particular, there is considerable potential for variations in water quality over short-time scales during periods of high sediment loads.

Travel blanks, supplied by the analytical laboratory, are exposed to the same conditions and treatments as the water samples collected, and are intended to monitor contamination that may occur in the field.

### 2.3.2. FIELD METHODOLOGY

#### 2.3.2.1. *Sample Collection*

All water sampling was done in accordance with the procedures described in the "British Columbia Field Sampling Manual: 2003 – For Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples" and the Mount Polley "Quality Assurance/Quality Control Manual".

#### 2.3.2.2. *Field Meters*

Field Meters are used to measure; dissolved oxygen, conductivity, pH and flow.

The conductivity and pH meter used for field analysis of surface water and groundwater is a WTW pH/Conductivity 340i meter. Prior to taking measurements, the meter is calibrated regularly using buffer pH of 10.00.

The portable flow monitoring device used by Mount Polley is a Swoffer Model 3000. This unit is maintained by the environmental staff and is sent to the manufacturer for periodic calibrations.

The dissolved oxygen meter used for bi-annual lake profiling is rented from Hoskin Scientific in Vancouver.

### 2.3.3. 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. Field pH, temperature and conductivity were measured concurrent with surface water sampling using a WTW Multimeter and recorded in a field book. 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, W13, and E8 (commencing June 2009)), 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 autumn low flows. Samples were submitted to ALS Laboratory Group 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.

In response to the Ministry of Environments comments on the 2008 Annual Environmental and Reclamation report, surface water quality tables within this include chloride and nitrate values.

#### 2.3.3.1. *Site E1 – Tailings Supernatant*

Tables 1.1-1 and 1.1-2 summarize the 2009 water quality sampling results at the Tailings Storage Facility - site E1 (Tailings Supernatant). Some parameters have been graphically represented using data collected between 1997 and 2009. This data is presented as figures 1.1-1 and 1.1-2. A few key parameters are discussed in the following paragraph.

An increase in sulphate levels was observed in October with analysis results reporting a maximum of 877 mg/L. Increased sulphate levels in 2009 are likely a result of mining the South East Pit, transfer of water from the Cariboo Pit to the Tailings Storage Facility (approx. 1,200,000 m3), and diversion of seepage and run-off water through a newly constructed ditch along the east edge of the mine site. Nitrogen levels (as nitrate plus nitrite) fluctuate throughout the year with a maximum of 4.12 mg/L recorded in December and the annual minimum of 2.97 recorded during freshet. Total Nitrogen levels follow a similar trend with the maximum annual concentration of 5.45 recorded in December and the annual minimum of 3.62 mg/L reported in September. Due to the continuous deposition of tailings into the pond, total suspended solids (TSS) are slightly elevated at this site. In 2009 the average TSS value recorded was 16.9 mg/L, ranging from 1.5 to 114 mg/L (May 2009).

Total and Dissolved Copper remain similar to 2008 with a maximum value of 0.125 mg/L total copper recorded in May.

Increased selenium and molybdenum levels have been observed at E1 since 2004. The mean value for total selenium reported was 0.017 mg/L and the maximum was 0.0224 mg/L. The mean value for total molybdenum was 0.2141 mg/L and the maximum was 0.258.

#### 2.3.3.2. *Site E4 – Main Embankment Seepage Pond*

Tables 1.2-1 and 1.2-2 summarize the 2009 water quality sampling results at site E4. Figures 1.2-1 and 1.2-2 present graphs of selected parameter levels between 2001 and 2009. Toxicity analysis was conducted in February, June, August, and November by Nautilus Environmental. Analytical reports for the 96-hour LC50 toxicity (rainbow trout) tests can be found in Appendix 4 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 have been no discharges the following discussion provides a comparison of the permitted discharge levels of certain parameters and the values obtained in samples taken in 2009.

The discharge limit for total suspended solids (TSS) is 25 mg/L. One sample taken in January 2009 exceeded this limit (133 mg/L) while all other samples remained below.

The elevated TSS levels in January appear to have impacted the results for various metals including copper, iron, molybdenum and selenium.

The discharge limit for nitrate (N) is 10 mg/L for this site. All samples taken in 2009 were below this discharge limit. The maximum level reported was 3.66 mg/L in May.

The discharge limit for ortho-phosphorus (as phosphorus) is 0.05 mg/L for this site. Ortho-phosphorus levels in December 2009 exceeded the limit (0.066 mg/L) while all other samples remained well low with a mean concentration of 0.006 mg/L.

The discharge limit for dissolved sulphate is 200 mg/L for this site. All sample results in 2009 were above this limit. The mean concentration for sulphate was 309 mg/L.

The total copper discharge limit for this site is 0.020 mg/L. With the exception of one sample in January (0.0292 mg/L) all other samples taken in 2009 were below this discharge limit. The annual mean concentration at E4 was 0.0074 mg/L.

The total iron discharge limit for this site is 1.0 mg/L. With the exception of one sample in January (2.36 mg/L) all other 2009 samples were below this discharge limit.

Beginning in 2007 total selenium had fluctuated strongly at this site ranging from a low of 0.0024 mg/L to a maximum of 0.011 mg/L. This trend continued in 2009. The discharge limit for total selenium at this site is 0.01 mg/L. One sample taken in 2009 exceeded this discharge limit (0.011 mg/L).

Although there is no discharge limit for total molybdenum designated for this site it should be noted that a general increasing trend has been observed over the past four years. In 2004, minimum levels of 0.01 mg/L were recorded, reaching a peak in May 2009 (0.191 mg/L) before dropping back down to below 0.116 mg/L.

#### 2.3.3.3. *Site E5 – Main Embankment Drain Composite*

Tables 1.3-1 and 1.3-2 summarize the 2009 water quality sampling results at site E5. Figures 1.3-1 and 1.3-2 present graphs of selected parameter levels from the year 2000 to 2009.

Observed dissolved sulphate levels fluctuated between 275 and 350, a slight increase from 2008.

Nitrogen levels (as nitrate plus nitrite) ranged between 0.54 mg/L in March to 2.69 mg/L in June. Total and dissolved copper levels reached maximums of 0.0122 mg/L and

0.00181 mg/L respectively. Molybdenum steadily increased from 2001 (0.002 mg/L) to 2005 (0.159 mg/L). Since 2005 levels have remained between 0.1 mg/L and 0.17 mg/L. The average total molybdenum level for 2009 was 0.1407 mg/L.

#### 2.3.3.4. *Site W1 – Morehead Creek*

Tables 1.4-1 and 1.4-2 summarize the 2009 water quality sampling results at site W1. Figures 1.4-1 and 1.4-2 present graphs of selected parameter levels from 1997 to 2009. A few key parameters are discussed in the following paragraph.

Dissolved sulphate levels ranged between 3.5 and 17.2 mg/L.

Levels of nitrogen (as nitrate plus nitrite) ranged from below MDL to 0.1 mg/L. Both analytes fluctuated within the range of historical variability for this site.

Total copper values ranged between 0.00269 and 0.0086 mg/L similar to 2008 results. Total selenium levels did not exceed the MDL.

#### 2.3.3.5. *Site W3a – Mine Drainage Creek at Mouth*

When the baseline-monitoring program began in 1995, sample site W3 was established to monitor surface drainage directly downstream of the mine site. The creek was given the name ‘Mine Drainage Creek’. The site was monitored during the baseline periods of 1995 and 1996, and 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 sample site (W3) became unsuitable due to a significant decrease in flow volumes over most of the year. Samples could only be collected during spring runoff and occasionally during fall turnover. Commencing in May 2000, the sampling location was moved further downstream on this same creek to its mouth at Bootjack Lake. This site is named ‘Mine Drainage Creek at Mouth’ and has the codeW3_a. Flow volumes at W3_a were sufficient for year round monitoring. Since May 2000 this has been the new sampling location.

Tables 1.5-1 and 1.5-2 summarize the 2009 water quality sampling results at site W3a. Figures 1.5-1 and 1.5-2 present graphs of selected parameter levels from 1997 to April 2000 for site W3 and from May 2000 to 2009 for site W3a. A few key parameters are discussed below.

In 2009 sulphate values ranged between 7.16 mg/L to 20 mg/L. Nitrogen levels (as nitrate plus nitrite) ranged from a high of 0.185 mg/L to a low of 0.0176 mg/L consistent with 2008 results.

Analysis of total copper reported a mean value of 0.015 mg/L. This is a marked decrease from the baseline mean of 0.0348 mg/L.

#### 2.3.3.6. *Site W4 – North Dump Creek*

Tables 1.6-1 and 1.6-2 summarize the 2009 water quality sampling results for site W4. Figures 1.6-1 and 1.6-2 present graphs of selected parameter levels from 1997 to 2009. A few key parameters are discussed in the following paragraphs.

A large fluctuation of levels was observed in sulphate values in 2009 , from a low of 26.2 mg/L in May to 539 mg/L in August. Levels above the BC Water quality objectives maximum of 100 mg/L occurred in 18 of the 20 samples taken during 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.

Nitrogen (as nitrate plus nitrite) levels have displayed an increasing trend since 2006. (See Figure 1.6-1). This trend continued in 2009 with a mean “nitrate” value of 9.39 mg/L and a maximum value of 20.1 mg/L recorded in August.

Since 1997 when this monitoring site was established as part of the operational program, total copper levels have remained below the mean baseline of 0.035 mg/L. The maximum value in 2008 was 0.0349 mg/L, more than three times the mean value for the year of 0.01 mg/L. Copper levels decreased in 2009 with a mean value of 0.012 recorded.

Total iron continues to fluctuate at this site. The minimum recorded in 2009 was 0.015 and the maximum was 1.91 mg/L during freshet in May.

An increase in total aluminum has been noted at this monitoring location in 2009. A maximum of 1.44 mg/L was recorded in May, well above the mean of 0.11 mg/L recorded since monitoring began in 1995.

Total selenium levels began to increase in 2006, increasing from levels below detection to 0.0045 mg/L in November 2006 to a maximum of 0.0357 in July 2008. 2009 saw a mean total selenium value of 0.0154 mg/L.

Mount Polley recognizes the increasing levels of nitrate, sulphate and selenium at this monitoring location and has taken significant steps to remediate the situation. A coffer dam and pipeline to collect runoff was constructed in September of 2009 to divert flow to either the Wight Pit or the long ditch which flows to the tailings pond.

#### 2.3.3.7. *Site W5 – Bootjack Creek Above Hazeltine Creek*

Tables 1.7-1 and 1.7-2 summarize the 2009 water quality sampling results for site W5. Figures 1.7-1 and 1.7-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed below.

An increase in dissolved sulphate values was observed in 2009 with values ranging from between 8.9 mg/L and 74.4 mg/L.

Nitrogen (as nitrate plus nitrite) levels ranged from a high of 0.834 mg/L to a low of 0.22 mg/L.

Total copper values have had extremely low variation throughout the monitoring period of 1997 to 2009, with all but three samples falling between the range of 0.001 mg/L and 0.014 mg/L. The values outside this range were seen in 1999, 2001 and 2008.

#### 2.3.3.8. *Site W7 – Upper Hazeltine Creek*

Tables 1.8-1 and 1.8-2 summarize the 2009 water quality sampling results for site W7. Figures 1.8-1 and 1.8-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed below.

Dissolved sulphate typically ranged between 2mg/L and 17.5 mg/L throughout the monitoring period of 1997 to 2007. In 2009 values increased slightly, ranging from 23.2 to 26.5 mg/L.

Nitrogen (as nitrate plus nitrite) has historically fluctuated significantly from below the MDL of 0.005 mg/L to 0.25 mg/L. Highs of 0.414 mg/L and 0.441 mg/L were noted in December 1998 and November 2008 respectively. In 2009, the values ranged between 0.08 mg/L and 0.499 mg/L.

Total suspended solids (TSS) have historically been less than, or fluctuated around the MDL of 3 mg/L, with peaks of approximately 19 mg/L in 1998 and March 2002. In 2009, TSS levels remained below the MDL.

In 2009 total copper continued to remain low, ranging from 0.0018 mg/L and 0.0038.

Total iron has reported large fluctuations since monitoring began in 1997 ranging from a high above 1.0 mg/L in 2000 to a low of 0.10 mg/L. 2009 levels followed the general trend with a high 0.4 to a low of 0.03 mg/L reported throughout the year.

#### 2.3.3.9. *Site W8 – Northeast Edney Creek Tributary*

Tables 1.9-1 and 1.9-2 summarize the 2009 water quality sampling results for site W8. Figures 1.9-1 and 1.9-2 present graphs of selected parameters from 1997 to 2009. This site is downstream of the main embankment seepage pond (E4) - the permitted discharge point; however there was no discharge from E4 in 2009. A few key parameters are discussed below.

Generally there were very little changes noted in water quality at this site in 2009. There was an increase in TSS (79 mg/L) measured in December, however this was likely due to disturbance of the creek bed while breaking through the ice. There was a slight increase in the iron levels (1.51 mg/L) recorded in December which may be related to the elevated TSS.

#### 2.3.3.10. *Site W8z – Southwest Edney Creek Tributary*

Tables 1.10-1 and 1.10-2 summarize the 2009 water quality sampling results for site W8z. Figures 10.1-1 and 10.1-2 present graphs of selected parameters from 1997 to 2009. 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 2009 this site was monitored from January to June when flows decreased too far to sample. There were no significant changes in water quality observed at this location.

### 2.3.3.11. *Site W11 – Lower Edney Creek U/S of Quesnel Lake*

Tables 1.11-1 and 1.11-2 summarize the 2009 water quality sampling results for site W11. Figures 1.11-1 and 1.11-2 present graphs of selected parameters from 1997 to 2009. It should be noted that this site is a far-field site, selected for comparisons to the sites downstream from the mine disturbance.

Since the summer of 2000 dissolved sulphate levels have shown a fluctuating trend upwards approximately rising to a maximum of 18.9 mg/L in June 2009.

Historically, nitrogen (as Nitrate plus nitrite) values have typically remained around the mean baseline of 0.039 mg/L, with a peak of 0.144 mg/L in 1999. In 2008, a significant increase to 0.366 mg/L was noted towards the end of the year (November) and in 2009 levels decreased to a mean of 0.065 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 2009 cooper levels recorded were similar to baseline with a mean of 0.0028 mg/L

### 2.3.3.12. *Site W12 – 6K Creek At Road*

Tables 1.12-1 and 1.12-2 summarize the 2009 water quality sampling results for site W12. Figures 1.12-1 and 1.12-2 present graphs of selected parameters from 1997 and 1999 to 2009. A few key parameters are discussed in the following paragraph.

An increase in sulphate values was observed at this location in 2009. A maximum value of 31.4 mg/L was recorded in November. The mean sulphate value for 2009 was 12.9 mg/L.

There were no other significant changes in water quality observed at this monitoring location in 2009.

### 2.3.3.13. *Site W13 – 9.5K Creek On Bootjack Forest Service Road*

Tables 1.13-1 and 1.13-2 summarize the 2009 water quality sampling results for site W13. Figures 1.13-1 and 1.13-2 present graphs of selected parameters from 2000 to 2009. Only two samples were collected from this quarterly monitoring site in 2009. In February and August there was not sufficient flow to sample. 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 2009, levels recorded were 18.3 and 10.5 mg/L. It should be noted that the flow at this site is very low, averaging less than 1 liter per second.

Total copper values at this site have generally decreased over time, from a high of 0.046 mg/L in 2000 to a low of 0.0098 mg/L in May of 2007. In 2009, total copper levels fluctuated slightly between 0.0171 and 0.0181 mg/L.

In 2008 a change in Molybdenum was recorded increasing from a previous maximum of 0.00099 mg/L to a new high of 0.0087 mg/L. In 2009 levels decreased to an average of 0.0017 mg/L.

### 2.3.3.14. *SITE E8 – Cariboo pit supernatent*

Tables 1.14-1 and 1.14-2 summarize the 2009 water quality sampling results for site E8. Figures 1.14-1 and 1.14-2 present graphs of selected parameters for June to November 2009.

Nitrogen (as nitrate plus nitrite) ranged between 8.03 and 9.88 mg/L slightly higher than the readings at E1 (Tailings Impoundment Supernatant)

Sulphate levels ranged between 348 and 565 mg/L slight lower than E1.

## 2.3.4. GROUNDWATER MONITORING

Groundwater sampling and analysis was conducted in accordance with sub-section 3.1 of 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". 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 of the pit, rock disposal site and Tailings Storage Facility (TSF). In conjunction with these 'downslope' wells, background wells were established upslope 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.

Prior to drawing water from each well, freatic water levels are recorded during each purging and sampling event (Section 2.6.8). Samples are drawn and then submitted to ALS Laboratory Group 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.

In response to the Ministry of Environments comments on the 2008 Annual Environmental and Reclamation report, groundwater quality graphs within this include selenium data. As well we have included well depth information in each section.

#### 2.3.4.1. *95R-4 (Springer Pit Well)*

95R-4 is located at the 10 km board on the Bootjack Forest Service Road. This well was drilled to a depth of 123.4 metres. Table 2.1 summarizes the results of the water quality data from 2009 for this well. Figures 2.1-1 to 2.1-3 present graphs of selected parameters from 1997 to 2009. 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 below minimum detection limit (0.005 mg/L)

Dissolved sulphate levels previously fluctuating between 12 and 20 mg/L saw an increase to 45 mg/L in 2009. As well Dissolved Aluminum increased from a maximum of 0.0065 to a maximum 0.337 mg/L.Total alkalinity, dissolved selenium, and dissolved iron saw slight increases in 2009. Analysis results for dissolved copper showed a large increase reporting a result of 0.013 mg/L. As there was only one sample taken of this well in 2009 it is difficult to determine if these results are accurate or possibly an anomaly occurred n the sample.

#### 2.3.4.2. *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. This well was drilled to a depth of 79.2 metres and is now being monitored twice annually in order to follow changes and trends more closely. Table 2.2 summarizes the results of the water quality data from 2009 for this well. Figures 2.2-1 to 2.2-3 present graphs of selected parameters from 1997 to 2009. In reviewing the water quality data from this well it should be noted that the freatic level has significantly dropped (figure 3.8). This drop is likely an outcome of reduced flow resulting from the installation of the Long Ditch in 2008. A few key parameters are discussed in the following paragraph.

Until June 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 in 2007 at 3.31 mg/L and then continuing to decrease to a measure of 0.472 mg/L in 2009. Total Alkalinity (reported as CaCO3 ) values have increased at a steady rate since 1998 from a low of 90.4 to a high of 198 mg/L in 2009. Dissolved sulphate levels have been steadily increasing since August 2004. This trend continued in 2009 with analysis reporting a dissolved sulphate value of 447 mg/L. Dissolved aluminum has generally fluctuated between below detection and 0.008 mg/L. Dissolved aluminum levels in June 2009 returned a level of 0.021 mg/L however levels decreased to 0.001 mg/L in September 2009.

Since June 2004, dissolved copper levels have been rising steadily, reaching their highest levels to date in June of this year (0.00187 mg/L). Historically, dissolved iron levels have fluctuated significantly between a low of 0.027 mg/L and a high of 0.639 mg/L. Since 2005, levels have steadily dropped leveling out at 0.015 mg/L in 2008 and 2009. Other dissolved metal concentrations remained relatively stable throughout the monitoring period of 1995 thru 2009.

#### 2.3.4.3. *GW96-1a (Tailings Storage Facility North Well – Deep)*

GW96-1a is located downslope of the seepage collection pond of the Perimeter Embankment. The total depth of this well is 59.0 metres. Table 2.3 summarizes the results of the water quality data from 2009 for this well. Figures 2.3-1 and 2.3-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed in the following paragraph.

Total Alkalinity as CaCO3 generally fluctuates between 168 mg/L and 335 mg/L with one low of 56.7 in June 2006 and one high of 344 mg/L reported in November 2008. Dissolved sulphate values in this well 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. Between 1997 and 2006, Dissolved aluminum levels fluctuated between 0.006 and 0.1 mg/L. Between 2007 and 2009 levels peaked at 0.404 mg/L (Oct. 2007) and decreased again to 0.076 mg/L in Sept. 2009. Dissolved copper levels have fluctuated considerably with relatively high levels being seen in 2001 (0.042 mg/L), 2004 (0.008 mg/L), and 2007 (0.00699 mg/L), but returning to lower levels in 2008 and 20090.0013 mg/L as a high for 2009). All other dissolved metal concentrations remained relatively consistent throughout the monitoring period of 1997 thru 2009.

#### 2.3.4.4. *GW96-1b (TSF North Well – Shallow)*

GW96-1b is located down slope of the seepage collection pond of the Perimeter Embankment. The total depth of this well is 38.72 metres. Table 2.4 summarizes the results of the water quality data from 2009 for this well. Figures 2.4-1 and 2.4-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed in the following paragraph.

Total alkalinity has remained relatively consistent with a mean of 159 mg/L and a maximum of 286 mg/L in August 2006. Generally, dissolved sulphate concentrations have been steady ranging around 30 mg/L; however, in August of 2006 sulphate concentrations rose to around 65 mg/L. Other dissolved metal concentrations rose in 2006 and then dropped right back down in 2007 remaining similar in 2009.The water in this well likely includes seepage from the Perimeter Embankment Seepage Pond.

#### 2.3.4.5. *GW96-2a (Tailings Storage Facility East Well – Deep)*

Well GW96-2a is located approximately 900 m southeast of the GW96-1 monitoring wells and was commissioned to monitor potential groundwater effects from the Tailings Storage Facility on Hazeltine Creek. The total depth of this well is 54.88 metres. Table 2.5 summarizes the results of the water quality data from 2008 for this well. Figures 2.5-1 and 2.5-2 present graphs of selected parameters from 1997 to 2008. A few key parameters are discussed in the following paragraph.

Total alkalinity levels have remained consistent in this well ranging from 185 to 248 mg/L CaCO3. 2009 dissolved sulphate levels remained stable at approximately 24 mg/L. Most dissolved metal concentrations remained relatively even throughout the monitoring period of 1997 thru 2009. The exceptions were dissolved aluminum and dissolved iron , which peaked briefly in 2007.

### 2.3.4.6. *GW96-2b (Tailings Storage Facility East Well – Shallow)*

GW96-2b is located approximately 900m Southeast from the GW96-1 monitoring wells and was commissioned to monitor potential groundwater effects from the Tailings Storage Facility on Hazeltine Creek. The total depth of this well is 35.67 metres. Table 2.6 summarizes 2009 water quality sampling results for this well. Figures 2.6-1 and 2.6-2 present graphs of selected parameters from 1997 to 2008. A few key parameters are discussed in the following paragraph.

Total alkalinity in this well has remained consistent with a mean value of 252 mg/L CaCO3. Since November 2002, sulphate levels have been steadily rising, reaching their highest levels this year, at 69.3 mg/L. Dissolved molybdenum levels continued to rise in 2009(0.0197) mg/L in 2009 from their historical norms below 0.006 mg/L. All other dissolved metal concentrations remained low in 2009.

### 2.3.4.7. *GW96-3a (TSF Southeast Well – Deep)*

GW96-3a is located down slope of the seepage collection pond of the Main Embankment. The total depth of this well is 52.59 metres. Table 2.7 summarizes the 2009 water quality sampling results for this well. Figures 2.7-1 and 2.7-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed in the following paragraphs.

Over the monitoring period of 1997 to 2009 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. The variability of the field pH does not appear at other monitoring wells, indicating it is a function of this well.

Throughout the monitoring period Total alkalinity, dissolved sulphate, dissolved molybdenum, and dissolved copper, have all fluctuated greatly. This trend continued in 2009. Dissolved iron saw some fluctuations from 1997 to 2005; however levels appear to have balanced out in 2007 to 2009. Dissolved sulphate has fluctuated significantly over the monitoring period of 1997 to 2009, ranging from 25 mg/L to 322 mg/L. In 2009, sulphate was reported as 116 mg/L in October, a significant decrease in levels from 2008 (229 mg/L

A decreasing trend in dissolved copper levels was apparent from 2005 to 2008 however 2009 saw higher levels again peaking at 0.004 mg/L in June.

Please note that figure 2.7-2 shows elevated selenium levels however the detection limit used was 0.005 mg/L. The actual dissolved selenium was below the detection limit.

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 TSF.

### 2.3.4.8. *GW96-3b (TSF Southeast Well – Shallow)*

GW96-3b is located down slope of the seepage collection pond of the Main Embankment. The total depth of this well is 19.97 metres. Table 2.8 summarizes the 2009 water quality sampling results for this well. Figures 2.8-1 and 2.8-2 present graphs of selected parameters from samples taken between 1997 and 2009. A few key parameters are discussed in the following paragraph. This well was only sampled once in 2009.

Total alkalinity, dissolved sulphate, and dissolved aluminum have remained consistent since monitoring began in 1997. Since 2006, dissolved iron has been fluctuating up to ten-fold between a low of 0.015 mg/L and 0.14 mg/L. This trend continued in 2009. All other dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2009.

### 2.3.4.9. *GW96-4a (TSF Southwest Well – Deep)*

GW96-4a is located down slope of the south and main embankments. The total depth of this well is 24.7 metres. Table 2.9 summarizes the 2009 water quality sampling results for this well. Figures 2.9-1 and 2.9-2 present graphs of selected parameters from 1997 to 20098. A few key parameters are discussed in the following paragraphs.

Total Alkalinity, dissolved sulphate and molybdenum have remained stable since 1999.

With only one exception (late 2002), dissolved copper has remained below 0.0024 mg/L. Dissolved aluminum levels spiked briefly in May 2008 to 0.094 mg/L before dropping to historically normal levels in November (0.003 mg/L).

### 2.3.4.10. *GW96-4b (TSF Southwest Well – Shallow)*

GW96-4b is located down slope of the south and main embankments. The total depth of this well is 7.16 metres. Table 2.10 summarizes the 2009 water quality sampling results for this well. Figures 2.10-1 and 2.10-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed in the following paragraphs.

Total alkalinity levels have been increasing slightly since 1999 with a mean value of 223 mg/L CaCO3. With the exception of a brief spike to 8mg/L, dissolved sulphate levels have remained at or below the mean baseline of 2.5 mg/L for the entire monitoring period.

Throughout the early monitoring period (to 2001), dissolved copper had typically remained close to the mean baseline level of 0.0005 mg/L. However, since late 2001, copper has been fluctuating regularly between a 2002 high of 0.0022 mg/L and a low of 0.00018 mg/L in 2008. Dissolved molybdenum levels remained relatively low in 2009 while dissolved iron levels fluctuated markedly, continuing their historical pattern.

### 2.3.4.11. *GW96-5a (Tailings Storage Facility Control Well – Deep)*

GW96-5a is located at the north end and upstream of the TSF and is monitored as a control site. The total depth of this well is 19.82 metres. Table 2.11 summarizes the 2009 water quality sampling results for this well. Figures 2.11-1 and 2.11-2 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed in the following paragraphs.

Total alkalinity has fluctuated from 226 and 368 mg/L CaCO3 with an average of 319 throughout the monitoring period. With the exception of one spike reported in 2001, dissolved sulphate has remained consistent at or below 27 mg/L.

Previously dissolved copper has typically remained close to (most often below) the mean baseline of 0.004 mg/L throughout the monitoring period with the exception of one sample in 2002 (0.0071 mg/L). Dissolved copper values for September 2009 were reported as 0.00926mg/L, well above the base line of 0.004 mg/L.

Analysis of this well reported a spike in dissolved aluminum, iron, and copper in September 2009, all other dissolved metal concentrations appear to have, remained relatively stable throughout the monitoring period of 1997 thru 2009.

### 2.3.4.12. *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. The total depth of this well is 6.71 metres. 2007 construction of a ditch upslope of the well, intercepted flow into this shallow well. Since construction of the ditch, the well has not produced enough water to provide another sample.

### 2.3.4.13. *GW96-6 (Southeast Rock Disposal Site Well)*

GW96-6 was covered by construction of the rock disposal dump in 2006.

### 2.3.4.14. *GW96-7 (Southeast Sediment Pond Well)*

GW96-7 is located down slope of the Mill Site, half way down the tailings access road (near the booster pump station). The total depth of this well is 14.12 metres. Table 2.14 presents the 2009 water quality sampling results for this well. The well is sampled on an annual basis. Figures 2.14-1 to 2.14-3 present graphs of selected parameters from 1997 to 2009. 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. Values in 2009 continued to drop to 0.0025mg/L. Ammonia Nitrogen levels also increased in 2006 from previous average of 0.0053 mg/L. While levels decreased in 2007 and 2008, 2009 saw an increase to 0.047 mg/L. 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 2009.

### 2.3.4.15. *GW96-8a (Bootjack Forest Service Rd. @ 11 K Well – Deep)*

GW96-8a is located on Bootjack Forest Service Road at 10.75 km. The total depth of this well is 39.33 metres. Table 2.15 summarizes the results of the water quality data from 2009 for this well. Figures 2.15-1 to 2.15-3 present graphs of selected parameters from 1997 to 2009. A few key parameters are discussed in the following paragraph.

In 2009, Nitrogen levels (as nitrate plus nitrite) remained low (below 0.1 mg/L), continuing the historical trend. Ammonia Nitrogen recorded a peak in 2004 (0.062 mg/L) and remained higher than previously record levels until June 2009 when it returned to a lower level of 0.005 mg/L. Dissolved sulphate levels have also continued to remain low, recording an average of 11.8 mg/L. All dissolved metal concentrations remained relatively stable throughout the monitoring period of 1997 thru 2009.

### 2.3.4.16. *GW96-8b (Bootjack FSR @ 11 K Well – Shallow)*

GW96-8b is located on Bootjack Forest Service Road at 10.75 km. The total depth of this well is 15.4 metres. Table 2.16 summarizes the 2008 water quality sampling results for this well. Figures 2.16-1 to 2.16-3 present graphs of selected parameters from 1997 to 2009. 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 levels have been gradually trending lower than 0.12 mg/L. 2009 levels were 0.05 mg/L. Ammonia Nitrogen reported a peak in 2007 and has since reduced to previously lower levels. Dissolved sulphate has narrowed its fluctuating 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 July of 2000. Dissolved selenium has fluctuated between detection limit and 0.0022 (Nov. 2007). 2009 saw dissolved selenium levels at 0.0013mg/L. Dissolved copper and molybdenum levels have remained low, fluctuating very little over the entire monitoring period, while aluminum and iron have shown some fluctuations but remain low.

### 2.3.4.17. *GW96-9 (TSF Southeast Pressure Well)*

GW96-9 was located south of the Main Embankment. This well was deactivated in the spring of 2006.

### 2.3.4.18. *GW00-1a (TSF Northwest Well – Deep)*

GW00-1a is located downstream of the South Embankment at the TSF. The total depth of this well is 21.03 metres. Table 2.18 summarizes the results of the water quality data from 2009 for this well. Figures 2.18-1 and 2.18-2 present graphs of selected parameters from 2000 to 2009. A few key parameters are discussed in the following paragraph.

Total alkalinity (CaCO3) has remained consistent throughout the monitoring period reporting a mean value of 126 mg/L. Dissolved sulphate showed an initial decreasing trend from 330 mg/L in 2000 to 187 mg/L in 2005. Since then, it has been rising gradually, reaching 259 mg/L in September of this year. Dissolved iron levels have fluctuated between below detection to 0.094 mg/L. In September 2009 dissolved iron levels were recorded as 0.015 mg/L. While dissolved aluminum levels increased in 2008 (0.018 mg/L) they decreased again in 2009 (0.05 mg/L) . Dissolved copper levels have fluctuated throughout the monitoring period reporting a mean value of 0.0017 mg/L. In 2009 dissolved copper was record as 0.0018 mg/L slightly higher than the mean value. Molybdenum levels have remained flat between 0.016 and 0.024 mg/L.

### 2.3.4.19. *GW00-1b (TSF Northwest Well – Shallow)*

GW00-1b is located downstream of the South Embankment at the TSF. The total depth of this well is 10.58 metres. Table 2.19 summarizes the 2009 water quality sampling results for this well. Figures 2.19-1 and 2.19-2 present graphs of selected parameters from 2000 to 20089. A few key parameters are discussed in the following paragraph.

Total alkalinity in this well has remained consistent throughout the monitoring period. In 2008, this well recorded sharp increases in dissolved sulphate, aluminum, copper, and iron. In 2009 all of these parameters decreased to previous levels with the exception of dissolved sulphate, which continued to climb. Sulphate levels recorded in 2009 were

258 and 307 mg/L. Also dissolved molybdenum increased slightly from a previous maximum of 0.006 mg/L in November 2000 to a new high of 0.0096 mg/L.

Observed dissolved selenium levels have also increased from previous levels. In June 2009 sample results returned a value of 0.0066 mg/L. However, September sampling results showed a decrease to below the detection limit. This well will be monitored closely in attempt to confirm whether the recorded changes are an anomaly or an initial indication that a new contaminant source has developed upslope.

#### 2.3.4.20. *GW00-2a (Tailings Storage Facility West Well – Deep)*

GW00-2a is located downstream of the South Embankment at the TSF. The total depth of this well is 21.55 metres. Table 2.20 summarizes the 2009 water quality sampling results for this well. Figures 2.20-1 and 2.20-2 present graphs of selected parameters from 2000 to 2009. A few key parameters are discussed in the following paragraph.

Total alkalinity in this well has remained consistent throughout the monitoring period. Dissolved sulphate has followed a slight downward trend, with some fluctuations, reaching a low of 6.35 mg/L in September 2009.Although a slight increase in dissolved iron was observed in 2008 these levels appear to be trending back down in 2009 (0.086 mg/L in September). Dissolved aluminum, molybdenum, and copper appear to be consistent from previous years.

#### 2.3.4.21. *GW00-2b (Tailings Storage Facility West Well – Shallow)*

GW00-2b is located downstream of the South Embankment at the TSF. The total depth of this well is 10.64 metres. Table 2.21 summarizes the 2009 water quality sampling results for this well. Figures 2.21-1 and 2.21-2 present graphs of selected parameters from 2000 to 2009. A few key parameters are discussed in the following paragraph.

In 2009 Mount Polley staff were only ale to sample this well in the Spring. There was insufficient water available for collecting a sample in the Fall. Total alkalinity in this well has remained consistent throughout the monitoring period. Dissolved sulphate levels have remained below the baseline level of 18.5 mg/L measured in November 2000 and have fluctuated very little. All dissolved metal concentrations remained relatively stable throughout the monitoring period of 2000 thru 2009.

### 2.3.4.22. *GW00-3a (TSF Southwest Well – Deep)*

GW00-3a is located downstream of the South Embankment at the TSF. The total depth of this well is 24.29 metres. Table 2.22 summarizes the 2009 water quality sampling results for this well. Figures 2.22-1 and 2.22-2 present graphs of selected parameters from 2000 to 2009. A few key parameters are discussed in the following paragraph.

Total alkalinity (CaCO3) has fluctuated widely in this well ranging from 303 in 2001 to 73.5 mg/L in 2007. 2009 saw values of 140 and 220 mg/L. Dissolved sulphate levels were significantly higher than average in September 2009 ( 265 mg/L). This increase was also observed in GW00-1b. Dissolved aluminum, copper, iron, molybdenum, and selenium remained consistent in 2009.

### 2.3.4.23. *GW00-3b (TSF Southwest Well – Shallow)*

GW00-3b is located downstream of the South Embankment at the TSF. The total depth of this well is 13.66 metres. Table 2.23 summarizes the 2009 water quality sampling results for this well. Figures 2.23-1 and 2.23-2 present graphs of selected parameters from 2000 to 2009. A few key parameters are discussed in the following paragraph.

Total alkalinity and dissolved sulphate levels have remained relatively constant in this well. Dissolved aluminum and iron levels reported spikes in the fall of 2007 and 2009, returning to normal levels during the spring sampling period. Dissolved cooper levels increased significantly in September 2009 to 0.011 mg/L.

### 2.3.4.24. *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. The captured groundwater is continuously pumped and returned to Polley Lake. Table 2.24 summarizes the results of water quality data for this well between 2005 and 2009. Figures 2.24-1 and 2.24-2 present graphs of selected parameters during the monitoring period. A few key parameters are discussed in the following paragraph.

Total alkalinity in this well has remained consistent throughout the monitoring period increasing slightly in 2009. Dissolved sulphate levels historically ranging between 39.1 mg/L and 111 mg/L , increased to a high of 162 mg/L in 2008, decreasing to 108 mg/L in 2009. Dissolved aluminum showed a significant spike in 2008; however it appears to have settled back to previously low levels (0.001 mg/L). Dissolved copper levels appear to be fluctuating more since 2008. In 2009 this well reported dissolved copper as 0.0056 mg/L. Dissolved iron, molybdenum and selenium remained consistent in 2009.

### 2.3.5. BIOLOGICAL MONITORING LAKE SAMPLING PROGRAM

Section 3.2 of PE 11678 requires that, prior to discharge of any effluent from the mine, Mount Polley must develop a biological monitoring program in accordance with the Metal Mining effluent Regulations. In preparation for this Mount Polley implemented a pre-discharge aquatic environmental study. In late August 2007, “Minnow Environmental Inc” conducted a study including biophysical conditions, water quality, sediment quality, benthic invertebrate communities, fish communities and sentinel fish populations, at four upper creek areas, two lower creek areas, and at the mouth of Hazeltine Creek at Quesnel Lake (Appendix 4 – Mount Polley Mine Aquatic Environmental Characterization 2007, Minnow Environmental).

Mount Polley has preformed water quality sampling in both Polley and Bootjack Lakes twice annually since 2006, collecting both physical and chemistry data. These data are being compiled by Minnow Environmental Inc and will be provided the Ministry of Environment as appendix 6 to this report in Early May 2010.

In 2009 Mount Polley conducted a fish tissue and water quality study in Bootjack, Polley, Quesnel, Trio, and Frypan Lakes. The results from this study will also be included in appendix 6 (available in mid-2010).

### 2.3.6. 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 records temperature (at 3 meter elevation) and precipitation at half hour intervals. Evaporation is measured using a standard Class A evaporation pan. 2009 was a dry year; recording only 448mm of precipitation. Total evaporation for 2009 was 385mm.

| Month | Total Rainfall (mm) | Average Temp | Max Temp | Min Temp |
|---|---|---|---|---|
| January | | -7.48 | 2.8 | -25. |
| February | | -6.12 | 3.7 | -22. |
| March | | -4.2 | 7.4 | -26. |
| April | 21.4 | 2.51 | 13.3 | -8.3 |
| May | 55.2 | 7.796 | 23.6 | -1.5 |
| June | 42.8 | 13.23 | 25.9 | 2.8 |
| July | 38.2 | 17.65 | 31.1 | 7.0 |
| August | 15 | 15.95 | 31.1 | 5.8 |
| September | 47.4 | 12.2 | 27. | -0.6 |
| October | 58.4 | 1.56 | 12.9 | -8.9 |
| November | 43.6 | 0.76 | 9.4 | -10. |
| December | | -10.5 | 2.4 | -29. |

### 2.3.6.1. *Temperatures*

Figures 4.1 through 4.3 present Mount Polley's 2008 temperature data. Monthly minimum, maximum, and average temperatures as well as daily average temperature are shown. The lowest monthly mean temperature was –10.5 degrees Celsius recorded in December. The maximum monthly mean temperature of 17.65 occurred in July.

### 2.3.6.2. *Precipitation*

2009 was a dry year in the Mount Polley area with a total precipitation value of 488 mm recorded (33% less than 2008). October received the most precipitation at 68.0 mm, significantly more than the 28.4 mm received in October 2008. The driest non-freezing month was February with no snow recorded. Rainfall data for 2009 and cumulative data from 2006 through 2009 are presented as bar graphs in Figures 4.4 through 4.6.

### 2.3.6.3. *Evaporation*

Evaporation data for May to October (non-freezing period) is presented below. Total evaporation for 2009 amounted to 385 mm. July experienced the greatest amount of evaporation at 110 mm.

### 2.3.6.4. *Water Balance*

Table 4 (2 pages) contains the updated water balance spreadsheet for the 2009 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, 2009 the inventory of water stored in the Tailings Storage Facility was 0.940 M m3.

## 2.3.7. HYDROLOGY AND HYDROGEOLOGY

In 2009 hydrological monitoring included calibration of staff gauges and recording of staff gauge measurements (during non-freezing months) at six surface water monitoring sites (W1a, W4, W5, W7, W8 and W12) situated in the vicinity of the Mount Polley mine site (see Figure 2 for site locations). It also included continuous monitoring of water levels at W7, W8, and Edney Creek near its confluence with Hazeltine Creek (Ditch Road bridge crossing) using pressure transducers.

Discharge curves (Figures 3.1 through 3.7) have been generated for each site for each year in which sufficient data was collected to develop the curves. These curves are generated from calculated flow levels based on staff gauge readings and applying a stage-discharge formula developed in previous years for each monitoring station.

2.3.7.1. *Site W1a – Upper Morehead Creek*

Figure 3.1 shows the flow measurement comparisons from 1997 to 2009. A bench mark survey was conducted at W1A on May 25th 2009. It was determined that the staff gauge had moved between 1.2 and 1.3 cm since the previous survey in 2008.

2.3.7.2. *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. No flow data was collected in 2008 or 2009.

2.3.7.3. *Site W4 – North Dump Creek*

Figure 3.3 shows the flow measurement comparisons from 1995 and from 1997 to 2007. In 2008 a new staff gauge was installed and calibrated at this site, but to date there is not enough flow data to develop a discharge curve, and as such no flow data was graphed for 2008 or 2009. The staff gauge was damaged in 2009 again and will be replaced in 2010.

2.3.7.4. *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, as the staff gauge location had become buried in organic debris. The staff gauge at this site was reestablished and calibrated in 2008 and in 2009. Staff gauge readings were recorded in 2008 and 2009, but to date there is not enough flow data to create a discharge curve and as such no flow data was graphed for 2009.

#### 2.3.7.5. *Site W7 – Upper Hazeltine Creek*

Figure 3.5 shows the flow hydrographs for 1995 and from 1997 to 2008. Hazeltine Creek is a continuous flow monitoring station, with flows being measured when temperatures are above freezing. These curves are based on tabulated monthly averages corrected for shifts in the curves, which were developed from the 2008 flow validation study. Staff gauge readings and continuous flow monitoring was conducted in 2009, however the data has not been tabulated at reporting time. A memo with the results will be sent to MOE as soon as it is available.

#### 2.3.7.6. *Site W8 – Northeast Edney Creek Tributary*

Figure 3.6 shows the flow measurement comparisons from 1995 and 1997 to 2009. A benchmark survey was completed on the staff gauge at W8 on June 8th. The staff gauge appears to be in the correct position; however one benchmark seems to have moved.

#### 2.3.7.7. *Site W12 – 6K Creek At Road*

Figure 3.7 shows the flow measurement comparisons from 1997 to 2009. A benchmark survey was conducted at this site on May 12, 2009. It was determined that there had been no recordable movement since last survey in 2008.

#### 2.3.7.8. *Site W11 - Edney creek*

A staff gauge benchmark survey was conducted at this site on May 25, 2009. There was no significant movement recorded.

### 2.3.8. GROUNDWATER STATIC WATER LEVELS

Figure 3.8 presents graphs of static water levels for wells 95R-4 and 95R-5, for the period 1996 to 2009.

Static water levels in 95R-4 have been consistently around 11 meters, with only one exception in June 2000, when it was at 0 meters and one exception in June 2009 when the level was 7.83m. In comparison, SWLs in well 95R-5, have been shifting between 0 meters and 2 meters, with no specific trend. In 2008, however, the static water levels appear to have dropped significantly, to 4.4 m. This trend continued in 2009 with a level of 4.48 and 5m in June and September. Figure 3.9 presents graphs of static water levels for wells GW96-1a/1b, GW96-2a/2b, GW96-3a/3b and GW96-4a/4b for the period 1996 to 2009.

SWLs in well GW96-1a have predominantly fluctuated between 15 meters and 20 meters, but have dropped to as low as 40 meters (Spring 2001) and risen to as high as 2.5 meters in the summer of 2001. By comparison, levels in well GW96-1b have been very consistent at 13 meters, with only 3 occasions where the level rose to near 0 meters (June of 2001, 2004 and 2008). 2009 saw consistent SWL in these wells.

In well GW96-2a, SWLs have typically been observed at approximately 30 meters, with a few exceptions. In 2001, 2003 and 2007, the SWLs rose to 5, 12, and 6 metres respectively, before dropping back to 30 metres by the next sampling session. Over the years, SWLs in well GW96-2b have been very consistent at 15 meters, with brief rises to nearly 5 meters in 2001, 2003 and 2004. In 2009, the static water level in well GW96-2a and 2b remained consistent with previous levels.

In well GW96-3a, the SWLs have greatly, with a range of 42 meters to nearly 0 meters. In 2009 SWL's in this well remained consistent with previous levels. SWLs in well GW96-3b continue to be very consistent remaining at or near 0 meters.

Static water levels in well GW96-4a have ranged between zero and four. Levels in 2009 continue to remain in this range. Static water levels in well GW96-4b have mirrored those of its twin well GW96-4a, fluctuating with a similar pattern at slightly greater depths. This trend has continued in 2009.

Figure 3.10 presents the static water levels for wells GW96-5a/, GW96-7, GW96-8a/8b and for the period 1996 to 2008.

GW96-5a static water levels have predominantly fluctuated between 5 meters and 0 meters, dropping as low as 13 meters in the winter of 2001 and to 5.77 in 2009.

Well GW96-7 static water levels have consistently measured between two and four metres. In 2001 it briefly dropped to 5.25 metres. 2008 levels rose to above ground level (10 cm above ground in PVC housing pipe) and dropped back to 0.45 metres in 2009.

Static water levels in wells GW96-8a and GW96-8b have always been at ground level (0 meters), and this trend continued in 2009.

Figure 3.11 presents graphs of static water levels for wells GW00-1a/1b, GW00-2a/2b and GW00-3a/3b for the period 2000 to 2009.

During each sampling event, static water levels in well GW00-1a have consistently dropped with each of the three purges. This indicates that insufficient time is being allowed for well re-charge. In 2009, recharge time was increased from 24 to 48 hours. The static water levels did drop between purges however the drop did decrease from 2008. In well GW00-1b, static water levels have historically fluctuated between 0.5 and 3 metres. This trend continued into 2009.

Static water levels in wells GW00-2a and 2b have remained relatively flat over the entire monitoring period, with small fluctuations exhibited between 3 and 6 meters. In 2006, well GW00-2b exhibited a brief drop in the SWL to 8.9 metres.

The static water levels in well GW00-3a have fluctuated somewhat, with the majority of the samples between 4 meters and 6 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 remaining within the range of 4 to 6 meters. SWL's in both wells continued to follow this trend in 2009.

## 2.4. RECLAMATION RESEARCH – 2009

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.

### 2.4.1. TREE GROWTH PLOTS

A research report written by R. Meister, *Forestmeister Services,* was included in the 2008 Annual Environmental and Reclamation Report submitted by Mount Polley. There was no research summary reported in 2009.

### 2.4.2. AQUATIC ASSESSMENT HIGHLIGHTS – 2009

Environmental initiatives conducted by the Mount Polley Mine in 2009 included continued studies in support of an application to allow discharge of mine wastewater to Hazeltine Creek (under the Waste Discharge Regulation of the British Columbia Environmental Management Act).

- Continued participation in a consortium supporting the re-development of the national water quality guideline for cadmium; and
- Fish tissue sampling in Polley Lake, Bootjack Lake and Frypan Lake.
- Continued refinement of a strategy for effluent discharge to Hazeltine Creek.

All of these initiatives, which are discussed in the following subsections (2.7.2.1 to 2.7.2.4), were undertaken to support the identification of the potential impacts associated with the proposed effluent discharge and to serve as the technical information upon 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.

### 2.4.3. 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 (see 2007 Annual Report for summary of 2007 analysis and shipment data).

The following is a summary of the biosolids deliveries for 2009;

**Biosolids Source:** Annacis Island Wastewater Treatment Plant Class A cake and Lulu Island Wastewater Treatment Plant Class B cake

**Period of deliveries:** August 5 to November 1, 2009

**Total tonnage:** 7,225 wet tonnes (7,101 wet tonnes Class A + 124 wet tonnes Class B)

**Delivered to:** Main stockpiling area (Site 1A)

**Biosolids quality confirmation:** all biosolids delivered to Mount Polley in 2009 met the requirements of Permit PE 15968 as well as the Organic Matter Recycling Regulation criteria for Class A or Class B biosolids. Analytical results are presented in appendix 7.

### 2.4.4. GENOMICS SCIENTIFIC RESEARCH PROPOSAL

In December 2009, a “100GPM ABR” was constructed and commissioned. The Anaerobic Biological Reactor (“ABR”) forms part of the Passive Water Treatment system on site, and represents the latest in scientific methodology and research. Part of the Genome project formed in 2008 (a partnership between industry and the University of British Columbia), this ABR is a larger prototype as compared to a five (5) gallon per minute (“GPM”) model that has been in operation on site since 2008. The objective of an ABR is to remove metals and sulphate down to reduced concentrations. An intermediary step between the smaller 5GPM prototype and the projected final 1,000GPM model, the 100ABR was seen as an ideal opportunity to build on previous results and gain insight into scaling factors involved in construction. The ABR feed flow is the toe drain of the existing Tailings Storage Facility (“TSF”) along the Main embankment of the Dam, reduced from a 6” header pipe into eleven (11) 2” capped pipe “fingers” with varying exit hole sizes (designed to achieve uniform water flow to the material contained within the ABR).

Material composition of the ABR consists of a layered construction of organics (0.6m of wood chips mixed with cow manure) and hay (0.2m), capped with a rock layer (0.15m) to prevent material up flow. Three (3.0) metres of water freeboard was designed for, with scheduled completion of filling occurring in April, 2010. Water is decanted from the system by means of a culvert feeding existing ditch systems, ultimately flowing into the Main seepage pond. The system is scheduled to be drained in the summer of 2010, at which point, representatives of the research team at the University of British Columbia will take samples to compliment their ongoing research.

# 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 2009

At the end of 2009, the total disturbed area in all categories was 827.10 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.

Figure 3 provides a detailed summary of all disturbance areas overlain on an updated (as of 2009) aerial orthophoto mosaic.

## 3.2. SURFACE DEVELOPMENT IN 2009

In 2009, the waste dumps increased by 22.5 ha, pit areas increased by 22 ha and road disturbance area increased by approximately 30.5 ha. The tailings ponds had no significant increase in disturbance.

## 3.3. PROJECTED SURFACE DEVELOPMENT FROM 2010 TO 2014

### 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 2009, approximately 236,813m3 of soil was salvaged from both the Wight pit and the Springer pit, which contributes to a total of 3,200,000 m3 in storage held at Mount Polley (Table 3.5). This amount over 695 ha (total area disturbed minus pits and stockpiles) yields a nominal 46cm (vertical equivalent) of soil in storage for each hectare disturbed.

### 3.3.3. DRAINAGE CONTROL / PROTECTION OF WATERCOURSES

In 2008, Mount Polley constructed a long ditch (described in section 2.2.4) to mitigate the potential of site drainage from entering the Polley Lake system. Additionally towards the end of the year Mount Polley Environmental staff submitted a permit application to the Ministry of Environment for the transfer of Tailings supernatant to the Cariboo and Bell pits.

## 3.4. TEST HEAP LEACH

The initial site grading and liner installation for the Test Heap Leach Pad commenced in August 2006. Construction and stacking of ore was completed by August 1st 2007. The first full year that the Test Heap Leach Pad was operational was in 2008. In 2009, the leach pad ran for approximately 60% of the time.

The pad consists of four (4) quadrants; 1 and 2 contain a sulphur/oxide ore mix and 3 and 4 only contain oxide ore. The oxide heap leach, which had not been actively operated since mid-December, was re-started on April 28th. Leaching of quadrant #3, along with two headers of four on #1 quadrant, had been leached until March 19th from December.

The electro- winning process has been unable to remove the majority of copper from solution due to the limited ability to process the entire flow. The electrowinning circuit was being disassembled in May and June, and a cementation circuit using a stainless steel tank was used in its place.

The heap leach discharged leachate and cementate product to the mill. A discharge line had been connected from the cementation tank to the mill thickener and was used starting in the third week in July. Cementate was transferred to the mill by agitating and back-flushing the solution in the tank. NaHS was attempted to be injected into the stream, but the back-pressure prevented sufficient addition to precipitate covellite. The thickener feed samples, which was taken while NaHS was added at indicated flow rates of 0.2 and 0.25 L/min, had high copper levels.

In August, preparation of quadrants 3 and 4 to be used for September mill feed was carried out. Bleeding of leachate solution to the mill and rinsing of the ore were major operational features of the month. Quadrants 3 and 4 were rinsed with 3870 m3 of process water. Bleeding of 1592 m3 of leachate solution at the beginning of August and 1430 m3 at the end of July lowered the level so that the process rinse solution would not overflow the heap.

Approximately 60,000 tonnes of material was removed from the heap leach in October 2009. Quadrants 3 and 4 had 30,000 tonnes of material removed that contained good gold grades (0.3 gpt) that could be recovered in the mill. Quadrants 1 and 2 had 30,000 tonnes of material removed that showed 55% recovery of copper. The reason for removing Quadrant 1 and 2 was that some covellite had been precipitated and could be recovered through flotation techniques in the mill.

Approximately 28,000 tonnes of material and 2000 tonnes of Sulphur were replaced onto quadrants 1 and 2. The Sulphur was blended into the base of the heap prior to re-stacking the quadrants with run-of-mine ore.

In March 2009 at small leak occurred in the recirculation line at the leach pad. The spill was stopped, reported to PEP, assessed, and mitigated.

Appendix 8: *2008 Chronological Series of Events at the Research Test Leach – Mount Polley Mine* contains a summary of monthly reports for the Test Heap Leach Pad.

### 3.5. RECLAMATION RESEARCH FOR THE FUTURE

In addition to the projects outlined in section 2.4, future reclamation research will include test pads that were initiated in 2008 to determine if:

- The addition of char to soil increases the retention of soil constituents;
- The addition of char and biosolids increases soil productivity and moisture retention; and
- The placement of a soil cap (cover) over Springer waste rock influences the mobility of chemical constituents during leaching.

## 4.0 RECLAMATION COST UPDATE

A detailed reclamation cost update for the end of 2009 has been completed. The summary tables and detailed categories of disturbance can be found in APPENDIX 9 - RECLAMATION BOND COSTING – 2009.

# 5.0 REFERENCES

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