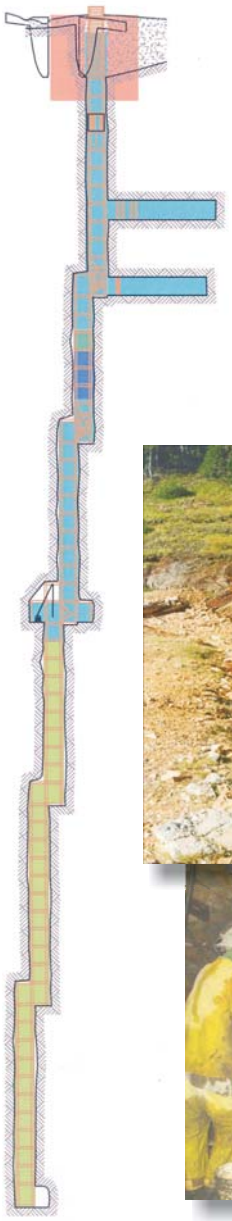
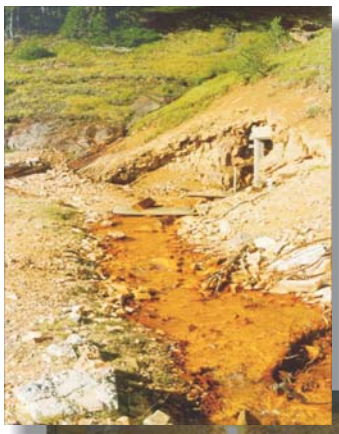
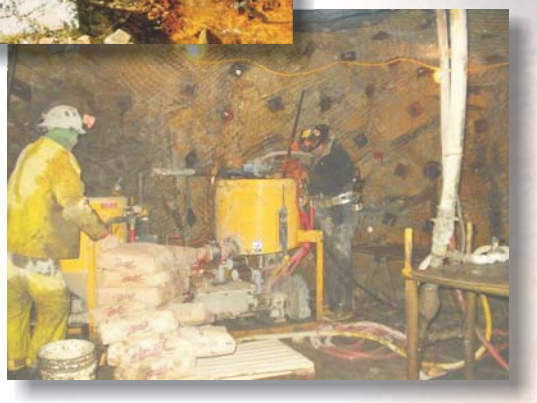
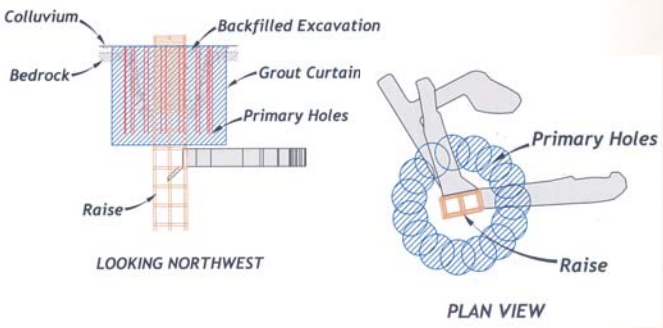
Glengarry Mine Closure Construction Report









New World Mining District Response and Restoration Project

TETRA TECH

USDA

United States Department of Agriculture
Forest Service
Gallatin National Forest

GLENGARRY MINE CLOSURE
CONSTRUCTION REPORT
CONTRACT 50-0398-3-004
2003-2005

PHASE III
NEW WORLD MINING DISTRICT
RESPONSE AND RESTORATION PROJECT

Prepared for:

USDA Forest Service
Gallatin National Forest
Bozeman, Montana

Prepared by:

TETRA TECH
P. O. Box 1413
Bozeman, Montana 59771

MAY 2007

EXECUTIVE SUMMARY

The Glengarry Mine is located in the New World Mining District of south-central Montana near Cooke City. Closure of the Glengarry Mine, under a contract with the USDA Forest Service, Gallatin National Forest, was undertaken to eliminate an acidic, metals-laden discharge to Fisher Creek, a major tributary to the headwaters of the Yellowstone River. With an average historical flow rate of 200 liters per minute (53 gallons per minute) of low pH and copper-, iron-, manganese-, and zinc-laden water, the mine adit contributed more than 30 percent of the total metal load to Fisher Creek. Extensive work was done in 2000 and 2001 to reopen 1,750 feet of underground workings at the Glengarry Mine to evaluate options to control the quantity and quality of the discharge.

In 2002, an engineering design for permanent closure was developed. This design included a combination of grouting specific features, backfilling the Glengarry tunnel and one of the raises (the Como Raise), and placing cement plugs in strategic locations. Construction was completed over a three-year period, with the first phase completed in 2003 with the grouting of the Como Raise collar at the surface and grouting a major fault in the main Glengarry tunnel. Construction work completed in 2004 and 2005 involved pouring a watertight cement plug in the Como Raise at 39 meters (128 feet) below the surface, backfilling the raise, and placing four watertight plugs and three backfilled segments in the main Glengarry tunnel. A portal plug consisting of earthen backfill completed the work at the site. The result of the closure was a 99% reduction in flow and an average reduction in metals loading of 99.9% (as of June 2006). Total cost to complete the closure was about $3.2 million.

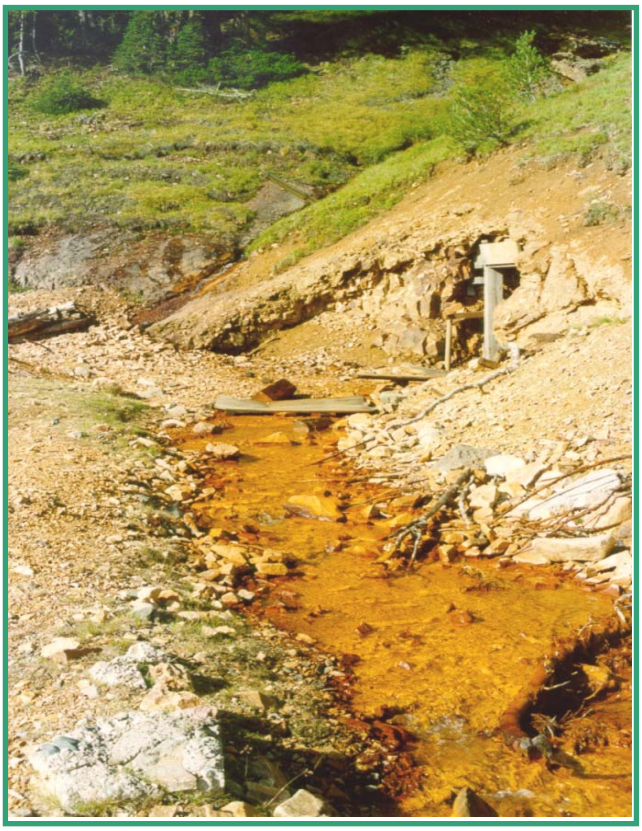


Figure E-1. Acidic Discharge from the Glengarry Mine Adit Prior to Closure

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INTRODUCTION

This Construction Report was prepared for the USDA Forest Service (USDA-FS), Gallatin National Forest to summarize the Glengarry Mine Closure Construction Contract. The Glengarry Mine Closure was part of the Como Basin/Glengarry Adit/Fisher Creek Response Action, the third major response action (Phase III) conducted for the New World Mining District Response and Restoration Project. The New World Mining District Response and Restoration Project is a non-time critical CERCLA removal action with the goal of achieving the highest and best water quality practicably attainable within the District. The two previous major actions conducted under this project were the Selective Source Response Action and the McLaren Pit Response Action.

BACKGROUND

The New World Mining District is located in Park County, Montana, in an area generally north of the small town of Cooke City (**Figure 1**). The primary environmental issues within the District are associated with impacts from historic mining and more recent mineral exploration activities that occurred since prospecting in the area was initiated in about 1869.

The Glengarry Mine Closure was performed according to the preferred alternative selected by the USDA Forest Service in an Engineering Evaluation/Cost Analysis (EE/CA) that was completed for the project (Maxim Technologies, 2002). The EE/CA characterized mining wastes associated with the Como Basin, the Glengarry Mine, and other historic mines located in the Fisher Creek drainage, and then developed and evaluated alternatives to mitigate environmental impacts associated with historic mining.

The analysis presented in the EE/CA determined that outflow from the Glengarry Mine was a major source of contaminated water and metal loading to surface water in the Fisher Creek drainage. Underground investigation of the Glengarry Mine and associated workings involved rehabilitation of 470 meters (1,540 feet) of the 1,006 meters (3,300 feet) of the total workings in the mine and the upper 66 meters (215 feet) of a 150-meter (490-foot) tall raise (the “Como Raise”) from the adit level to a topographic feature called the Como Basin (**Figure 2**). Subsequent underground groundwater investigations identified acidic and metals-laden contaminated water flows into underground workings from four principal sources that combined and flowed through the mine workings, discharging contaminated surface water from the adit portal into upper Fisher Creek.

The objective of the Glengarry Mine closure was to minimize or eliminate contaminated in-flow into the Glengarry workings and the resulting contaminated discharge from the adit portal. The Action Memorandum for the Glengarry Mine closure recommended a number of construction components in order to minimize contaminated discharge from the adit (USDA-FS, 2002).

REPORT ORGANIZATION

This Construction Report includes the general setting and site characteristics of the Glengarry Mine, information on the construction contract and construction activities, a sequential summary discussion of overall project activities, and discussion of major problems encountered, contract changes, and recommendations. Appendix A contains a table of the initial and final contract quantities and costs. Appendix B contains spreadsheets showing measured units of drilling footages and grouting and cement quantities. Digital photographs of contract activities are included within the text of this document; many more construction photographs are available in

project files. Initial and final as-built drawings are contained in the final contract files, although numerous figures included in the text of this report show illustrations of as-built construction elements.

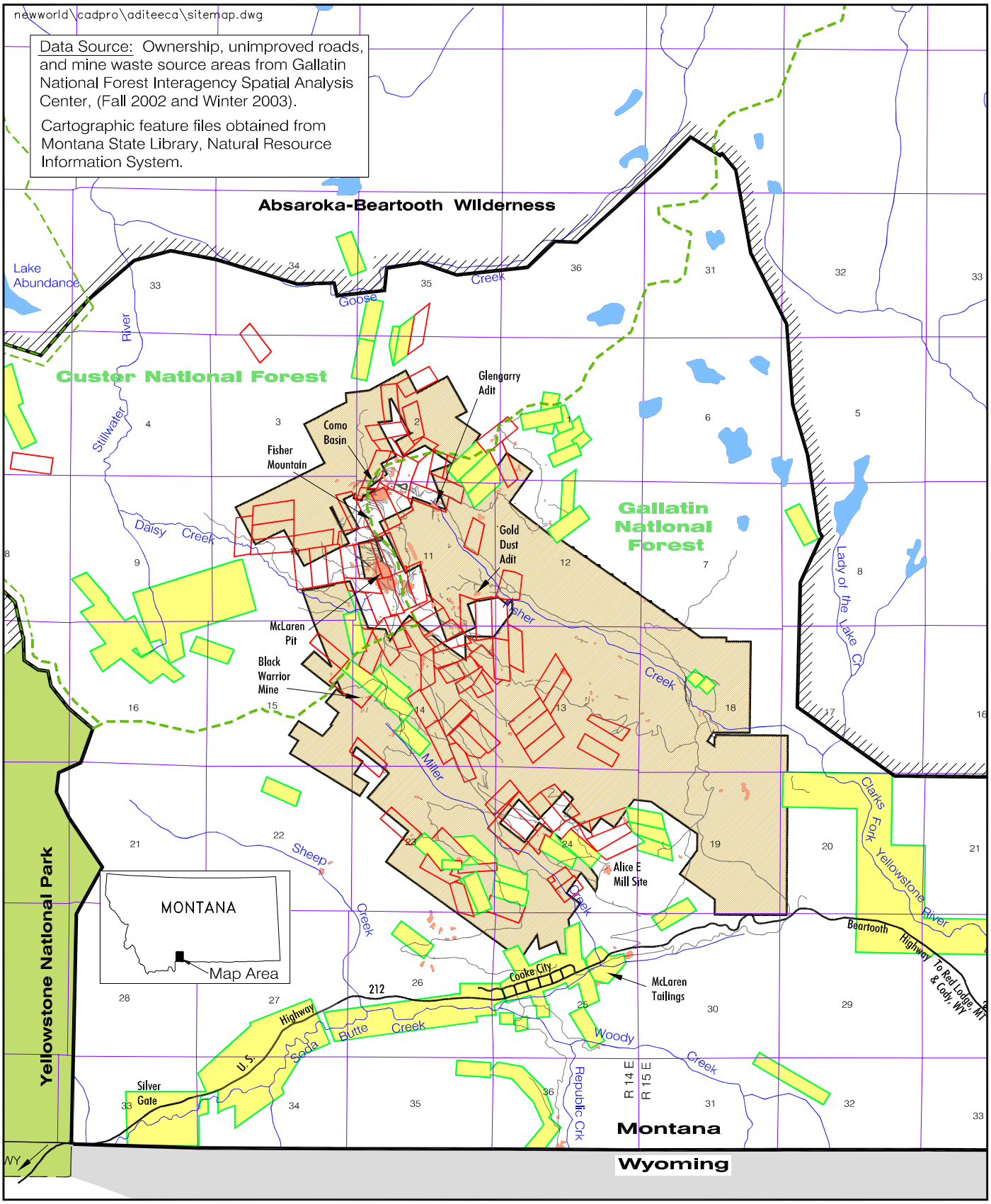
CONTRACT OVERVIEW

Closure of the Glengarry Mine was proposed as a two-year construction and closure project that would allow monitoring the success of the first season of work, and provide an opportunity to make modifications or adjustments to the program before the second field season of work began. The first year's program was to complete work in the Como Raise and in the 1066 fault zone, and the second year's program was to construct adit plugs and backfill selected portions of the workings on the adit level.

The USDA-FS issued a Request for Proposal on January 8, 2003, using negotiated contract procedures where the contract award was based on the best value to the government. Biding closed on February 13, 2003. The technical review team evaluated contractors' proposals in February and March of 2003, and identified the most highly qualified firms. The final contract was awarded to Hayward Baker, Inc. (HBI) of Denver, Colorado, on April 1, 2003, based on a best value determination associated with the bid price of $2,949,623.40. **Table 1** contains a summary of contract information.

TABLE 1
Summary of Contract Information

Contract Name	Glengarry Mine Closure, New World Mine Response and Restoration Project, Phase III
Contract Number	50-0398-3-004
Contract Award Date	April 1, 2003
Contract Signed	April 1, 2003
Final Acceptance	September 2005
Contractor	Hayward Baker, Inc., Denver CO
Subcontractor	Opal, Billings, MT
Original Contract Amount	$2,949,623.40
Final Contract Amount	$3,281,597.41
Original Contract Time	200 calendar days of work estimated in 2 years
Contract Time Used	258 calendar days of work required in 3 years
Engineering Design	Henry Bogert, Mining Engineer, Butte, Montana Tetra Tech, Helena, Montana
USDA-FS Contracting Officer	William M. Pfeifer
Contracting Officer's Representative	Frank C. Ehernberger, USDA Forest Service
On-Scene Coordinator	Mary Beth Marks, USDA Forest Service
Inspectors/Technical Representatives	Allan Kirk, Tetra Tech Henry Bogert, Mining Engineer



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Project Vicinity Map
New World Mining District
Response and Restoration Project
Cooke City Area, Montana
FIGURE 1

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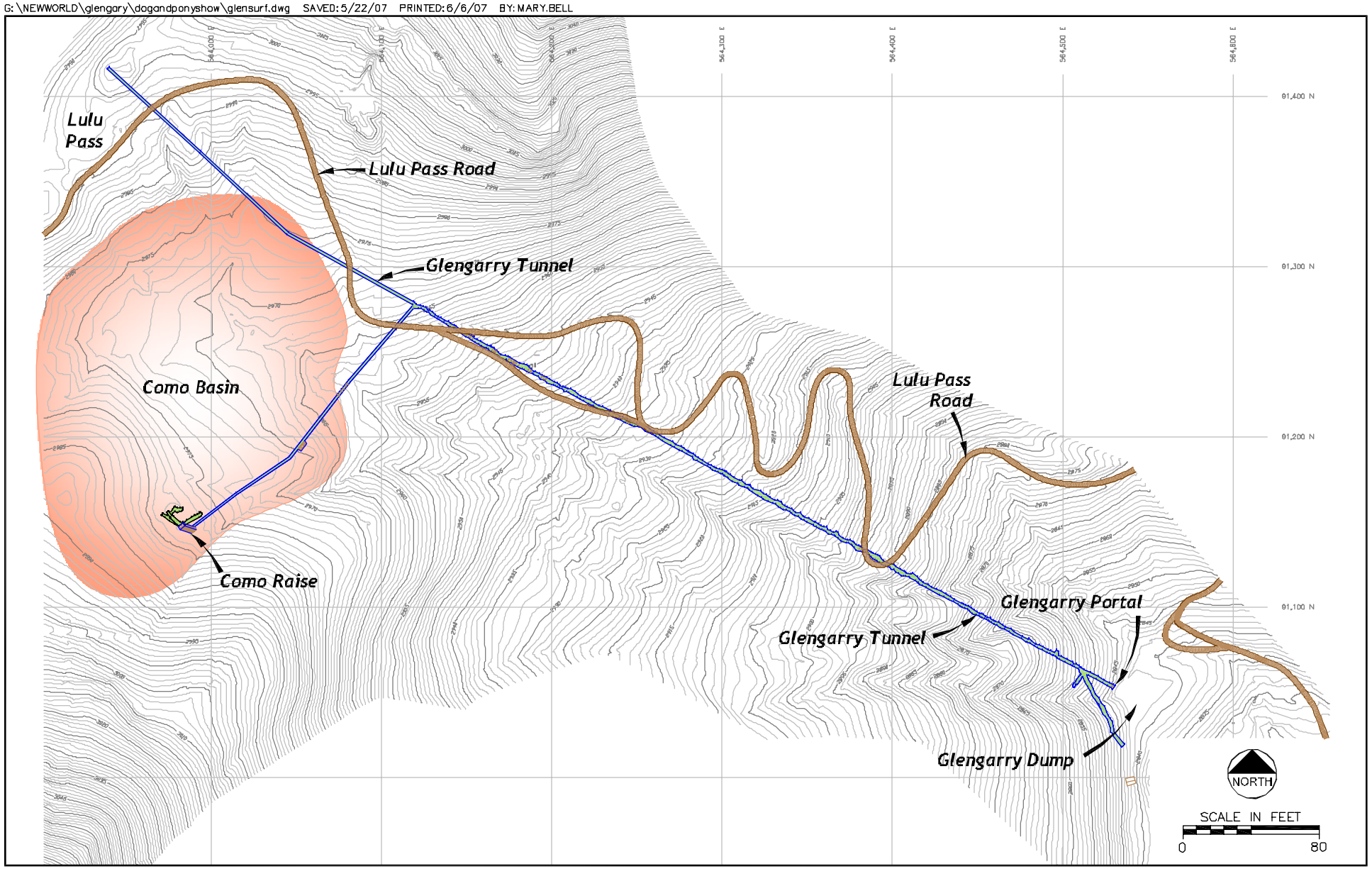

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Topographic Map Showing
Projection of the Glengarry Mine
New World Mining District
Response and Restoration Project
FIGURE 2

Construction and closure activities under Contract 50-0398-3-004 included:

- Site preparation
  - Installing culverts, silt fence, and surface water diversions around the portal pad and raise collar construction areas.
  - Maintaining sediment control structures on and around the Glengarry waste rock dump, including the construction of a secondary sediment control pond (to the east of the dump) and piping water and sediment overflow from the first pond to the second pond.
  - Construction of a muck storage pad at the New World Waste Repository area and transporting muck removed from the mine workings to the storage pad.
  - Stockpiling and ultimate disposal of mine debris, timber, rail, ties, and old air and water lines.
- Grouting the Como Raise collar
- Setting a watertight raise plug and placing cemented backfill in the upper 215 feet of the Como Raise
- Mucking 1,500 feet of the Glengarry Mine workings and rehabilitating the workings to provide access to the underground work area
- Grouting a fault zone located 325 meters (1,066 feet) inward from the portal
- Constructing four (4) watertight adit plugs
- Pumping cemented backfill into two sections between watertight plugs
- Placing non-acid generating rock as backfill in a portion of the adit between selected plugs
- Constructing a portal plug
- Final surface regrading and seeding of the portal area was done under a separate contract.
- Contract Additions
  - McLaren Adit Borehole Plugging
  - Closure of the South Henderson Adits
  - Gold Dust Adit Borehole Plugging
  - Glengarry Adit Portal Plug

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GLENGARRY MINE SETTING AND CHARACTERISTICS

This section presents information about the historic workings and site characterization and investigation results. Reopening work described in this section was conducted under previous contracts.

HISTORICAL WORKINGS OF THE GLENGARRY MINE

The Glengarry Mining Company drove the Glengarry adit beginning in 1925 (Lovering, 1929). The adit was collared at an elevation of about 2841 meters (9,320 feet) near the base of Lulu Pass in the headwaters of Fisher Creek, a tributary of the Yellowstone River (**Figure 2**). The adit was driven about 700 meters (2,300 feet) west-northwest towards Lulu Pass and attempted to intercept mineralization mined at higher elevation in the Spaulding Tunnels near Lulu Pass. No mineralization was found along the adit level heading of the mine (Lovering, 1929).

In the early 1930's the southwest drift of the Glengarry Mine was driven some 183 meters (600 feet) to come in under mineralization identified at the surface in the Como Basin Deposit (**Figure 2**). The Glengarry Mining Company drove two sets of raises from this southwest drift. The first raise was abandoned after a fault zone was encountered about 50 feet (15 meters) above the floor of the drift that produced water at a rate of about 38 to 76 liters per minute (Lpm) (10 to 20 gallons per minute [gpm]) (**Figure 3**). The second raise (the Como Raise) is located at the end of the southwest drift heading and was driven to the surface a distance of about 150 meters (490 feet) into the Como Basin at the foot of the north flank of Fisher Mountain (**Figures 2 and 3**). The top of this raise passes through the Como stratabound massive sulfide replacement deposit that is hosted in the Meagher Limestone Formation. Both sets of raises seasonally generate a considerable amount of water that flows out of the Glengarry adit and into upper Fisher Creek.

PREVIOUS WORK REOPENING THE GLENGARRY MINE

The Glengarry Mine was partially reopened by the Montana Bureau of Mines and Geology for the Montana Department of Natural Resources and Conservation (DNRC) in the mid-1970's to evaluate the mine for possible closure (DNRC, 1977). The USDA-FS reopened the Glengarry Mine in 2000, and the raise to surface in the Como Basin was partially reopened in 2001. Reopening was conducted to provide access in order to assess the conditions of the underground workings, and to identify and characterize the sources of water inflow. Reopening work and a description of conditions found in the raise are briefly discussed below. Further details on the reopening work can be found in Bogert (2001).

Because it was one of the principal sources of metals loading and acid mine drainage in the headwaters of Fisher Creek, the Glengarry Mine was rehabilitated for assessment purposes in September and October of 2000 under response and restoration activities initiated by the USDA-FS. During this first phase of reopening and assessment, accumulated debris and ferricrete mud 0.6- to 1.5-meters (2- to 5-feet) deep were removed from the Glengarry tunnel (in mining terms a "drift") beginning at the portal and extending back to a "Y" intersection 470 meters (1,540 feet) inward from the portal (**Figure 2**). The two branches of the "Y" were made accessible, although debris and ferricrete mud were not removed from the drift beyond the intersection. The Glengarry workings were surveyed, and planimetric and geologic maps were produced.

In the heading extending southwest from the "Y" intersection, two raises are present (**Figures 2 and 3**). At 570 meters (1,875 feet) inward from the portal, a three-compartment, timbered raise extends vertically upward from the adit level. Timber and debris cluttered the bottoms of the raise compartments and approximately 68 Lpm (18 gpm) of water flowed down this first raise. A map dating from the 1930's shows this raise extending upward approximately 15 meters (50 feet) (**Figures 2 and 3**).

At the end of the southwest heading, 655 meters (2,150 feet) inward from the portal, the timbered, two-compartment Como Raise extends vertically upward from the adit level to the surface (**Figures 2 and 3**). At the time of reopening (late fall) approximately 3.8 to 7.6 Lpm (1 to 2 gpm) of water flowed from the bottom of the Como Raise. A substantial air flow came down the raise on warm days. Access into the bottom of the raise was blocked by timber lagging, as well as sand and gravel 1.5-meters (5-feet) deep in the drift. The map dating from the 1930's shows the second raise extending vertically to the surface (as described above).

The following year in June 2001, the Como Raise was reopened from the surface downward to a depth of 66 meters (215 feet) where a small room with two pneumatic hoists was encountered. The rehabilitated portion of the raise crossed downward through about 1 to 2 meters (3 to 6 feet) of colluvium, 3 meters (10 feet) of Park Shale, 24 meters (80 feet) of silicified Meagher Limestone that was replaced by massive sulfide mineralization over the top 4.6 to 6.1 meters (15 to 20 feet), and about 37 meters (120 feet) into the underlying Wolsey Shale (**Figure 3)**.

The Como Raise consists of two, 1.4-meter (4.5-feet), square-set compartments (**Figure 4**) and is offset horizontally in five places. Vertical distance between the peeled log timber sets is about 2 meters (6.5 feet). The north compartment contained ladders, landings and a timber slide; the south compartment was used as an ore pass. The ore pass was partially lined with 5-centimeter (2-inch) lacing in varying states of repair.

During the site assessment in 2001, damaged and rotten timbers in the upper 6.5 meters (21 feet) of the Como Raise were replaced with 15 centimeter (6 inch) cribbing attached at the base to an original bearing set. The excavation around the reconstructed collar cribbing was as much as 7 meters (23 feet) deep on the west side of the raise (**Figure 5**). This excavation was backfilled with clayey overburden material and compacted in 0.3-meter (1-foot) lifts to the reconstructed surface. Below the cribbing, the original square-set raise timbers were found to be in good condition and were left intact.

During raise rehabilitation, old ladders and debris were removed from the north compartment and new ladders and landings were installed down to the pneumatic hoist room level to a depth of 65 meters (215 feet) below the surface. Three separate, short, horizontal working levels were encountered in the Meagher Limestone at 10 meters (35 feet), 23 meters (75 feet), and 30 meters (100 feet) below the surface (**Figure 6**). Each horizontal level and the raise down to 66 meters (215 feet) were surveyed and the geology was mapped. Water inflows were measured and sampled at the collar of the raise and at each horizontal level during July and August 2001. Water was also sampled at the contact of overburden with bedrock (Park Shale) in the exposed wall of the excavation during re-construction of the raise collar. No significant water inflows were encountered below the middle of the Meagher Limestone at about 14 meters (47 feet) below the surface (**Figure 3**).

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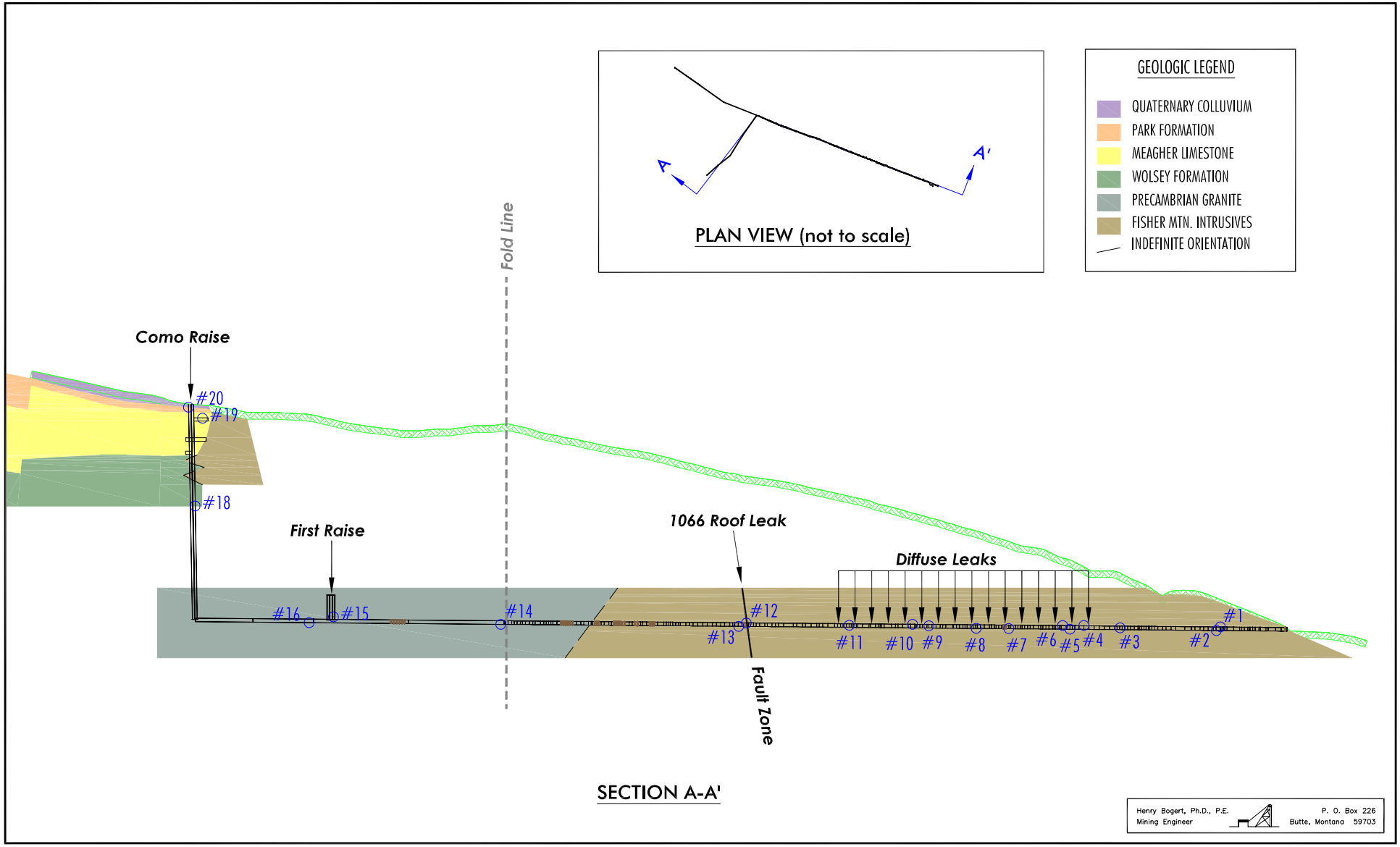

Not To Scale

#12 ○ Sample Locations

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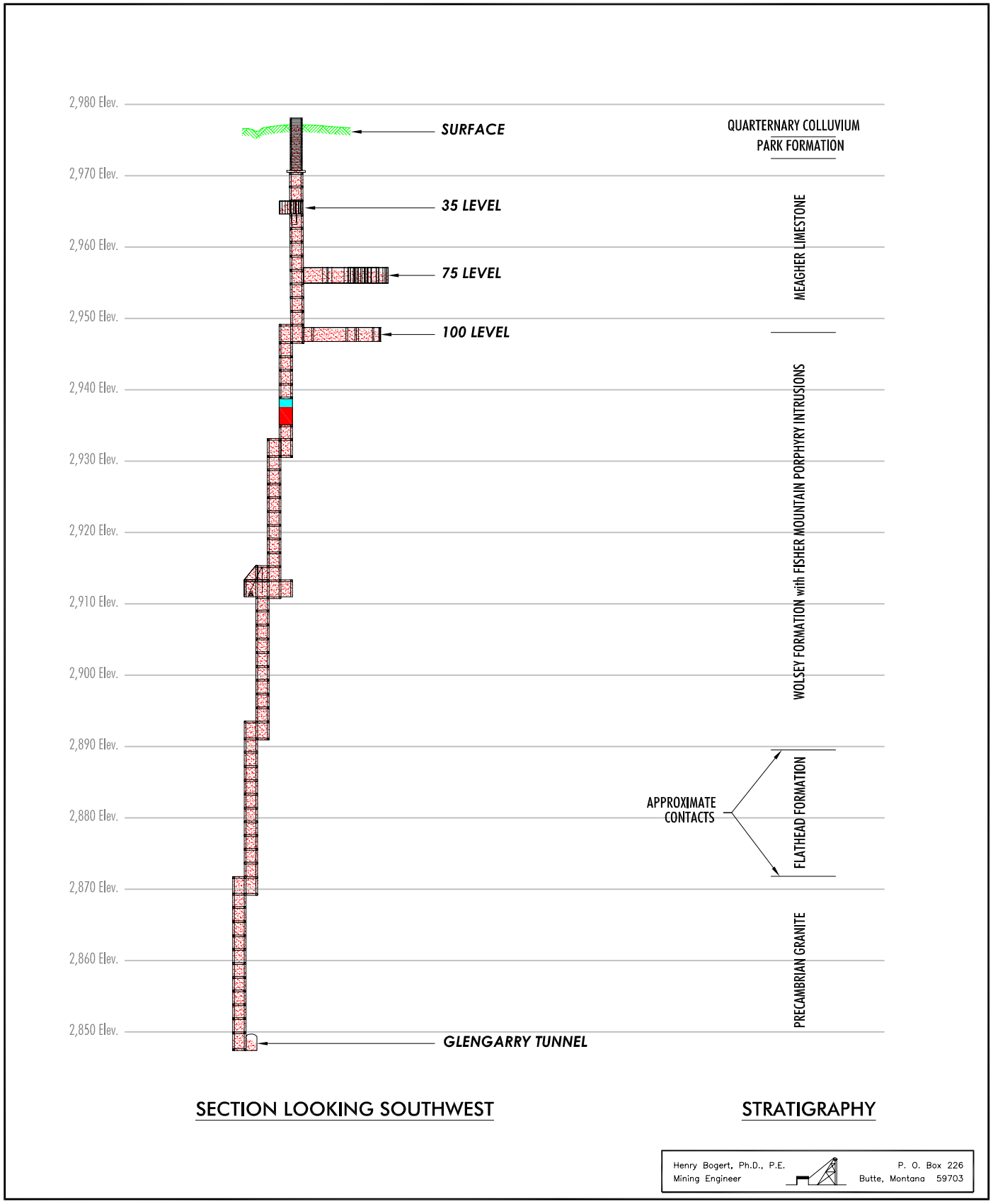
Cross-Section of the Glengarry Mine
Showing Geology and Water Inflow
New World Mining District
Response and Restoration Project
FIGURE 3

Figure 4. Glengarry Mine Two Compartment Como Raise

Figure 5. Como Raise Collar Showing Original Timber-Bearing Set, Raise Collar Cribbing, and Excavation



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Como Raise Profile
New World Mining District
Response and Restoration Project
FIGURE 6

Figure 6 – back page

Later in 2001, debris was removed from below the first raise in the Glengarry drift (**Figure 3**) and temporary ladders were installed up the middle compartment of the first raise. The purpose of this work was to determine whether the top of the raise was open or if it extended beyond the 15 meters (50 feet) shown on the 1930's map. Debris was removed and aluminum ladders were nailed in place extending approximately 8 meters (25 feet) up the center compartment. From there a round timber bulkhead was seen at the same elevation as the other two bulkheads in the adjacent compartments. Removing the bulkheads to determine what was above them or to identify the source of the water inflow was not attempted.

All of the accessible workings were mapped planimetrically for spatial control and then geologically to identify geologic units, structures, mineralization, and points of water inflow. These data, together with the geologic logs of adjacent exploration holes drilled by Crown Butte Mines, were used to develop a model of the geology around the raise. At least two intrusions and two faults within close proximity to the raise were identified and correlated both vertically and laterally.

GLENGARRY ADIT DISCHARGE CHARACTERISTICS

Groundwater quantity and quality has been regularly measured in the discharge from the Glengarry adit since 1989. Over this period, the discharge flow ranged from 57 Lpm (15 gpm) to 848 Lpm (224 gpm) and averaged about 200 Lpm (53 gpm).

Until 2000, when the USDA-FS completed reopening work in the mine, little was known about water quality and quantity entering the Glengarry workings. Historic mine maps indicated a hydrologic connection with the Como Basin, but insufficient data were available to determine an appropriate approach for closure. In the fall of 2000, the hydrogeology of the mine workings was mapped and a series of water flow and chemistry sampling stations were established (**Figure 3**). To understand the hydro-geochemistry of water inflows into the mine, flow was measured and samples were collected from each inflowing source of water. Flow measurements were also made and samples collected from the adit sill (floor) both up and downgradient of each principal inflow.

Figure 3 depicts the following three principal point sources of inflow into the Glengarry Mine:

1) **Como Raise -** The top of the Como Raise (**Figure 3**, station No. 20) contributes 3.8 Lpm to 41 Lpm (1 to 11 gpm) of inflow. During snowmelt, most of the flow was historically derived from surface water passing directly down the raise or from colluvial material exposed at the surface in the Como Basin where water flows along the bedrock/colluvial surface and then into and down the raise. Presumably, at peak snowmelt periods, this is the source of the very high historical flow rates (848 Lpm, 224 gpm) exiting the portal. This seasonal water flow is characterized by a pH of 3.0 standard units (su), 100 to 400 milligrams per liter (mg/L) iron, 5 to 7 mg/L manganese, and 8 to 40 mg/L copper.

2) **Short Raise** - The presumed fault structure above the bulkhead at top of the first short raise about 15 meters (50 feet) above the drift level (**Figure 3**, station No. 15) has a fairly constant flow in the range of 26 to 68 Lpm (7 to 18 gpm) although lower flows occur in the spring prior to snowmelt. The water is characterized by a pH of 3.1 to 3.3 su, 47 to 93 mg/L iron, and below detection to 0.32 mg/L copper. Manganese concentrations range from 5 to 7 mg/L.

3) **1066 Roof Leak -** The 1066 roof leak (**Figure 3**, station No. 12) is associated with a fault 325 meters (1,066 feet) inward from the portal, and has a flow that varies seasonally from 9 to 49 Lpm (2.4 to 13 gpm). This flow is characterized by a pH of 4 to 5 su, 24 to 123 mg/L iron, and 0.0014 to 0.05 mg/L copper. Concentrations of aluminum (4 to 24 mg/L), arsenic (0.016 mg/L), and cadmium (0.0015 to 0.0032 mg/L), in water discharging from this structure are higher than concentrations in water discharging from the two raises.

A fourth, diffuse source, representing a collection of small, fracture-controlled roof leaks (**Figure 3**, station Nos. 1 through 11), are developed in bedrock between the portal and the 1066 roof leak. The diffuse roof leaks are dry in the winter but collectively contribute up to 57 Lpm (15 gpm) during snowmelt. These leaks exhibit a pH of 3 to 6 su, 2 to 10 mg/L iron, and 0.001 to 0.006 mg/L copper.

Comparison of flow volumes on the sill (floor) of the adit between stations shows that the adit loses water along two stretches, near the contact of the Precambrian and intrusive rocks, and in a zone between 122 and 183 meters (400 and 600 feet) inward from the portal (**Figure 3**). The magnitude of loss is small relative to total flow from the adit.

Load analysis shows that the vast majority of metal loading into the adit comes from the two raises and the 1066 roof leak and not the diffuse fractures. Comparison of loading sources between elements shows that the Glengarry receives several orders of magnitude more copper from the top of the Como raise than from all other inflow sources combined. The raises also contribute more manganese load as well. The 1066 roof leak contributes more arsenic, aluminum, and cadmium load than the raises. In addition, the two raises and the 1066 roof leak each contribute at least an order of magnitude more iron load than do the diffuse roof leaks. Comparison of the percent contribution of inflows relative to outflow shows that roughly equal loads of iron, lead, and zinc are released by the raises and the 1066 roof leak, varying depending upon flow. These geochemical results clearly showed that control of discharge from the Como Raise and the 1066 roof leak were most important in reducing the contaminant load that discharges from the adit.

GLENGARRY MINE CLOSURE PROJECT SUMMARY

A summary of the major tasks involved in the Glengarry Mine Closure project is presented below in approximate chronological order of the work as it was completed.

Work conducted in Year 1 (2003) included:

1) Site preparation work at the Glengarry dump and portal sites
2) Constructing a secondary sediment pond (including operation and maintenance)
3) Constructing and operating a muck storage pad at the waste repository
4) Glengarry Mine rehabilitation
5) Cutting underground drill stations and plug sites Nos. 5 and 6
6) Como raise collar grouting
7) McLaren Adit borehole plugging (work added to the contract)
8) Grouting of the 1066 roof leak

Work conducted in Year 2 (2004) included:

1) Providing plug aggregate
2) Operating and maintaining sediment ponds
3) Cutting underground drill stations and plug sites Nos. 1 through 4.
4) Drilling plug station boreholes
5) Installing a monitoring well at the surface with a screened interval in the adit drift (work added to the contract)
6) Como Raise plugging and backfill
7) Watertight plug construction and construction of backfilled sections:
   - Two, 5-meter (16-foot) long watertight, cement plugs (Plugs #4 and #6)
   - One cemented-fill segment between plugs for structural fill (Plug #5)
   - One backfilled segment filled with stockpiled rock from drill station construction (between Plug #4 and Plug Site #3)
8) South Henderson Mountain Adit Closures

Work from Year 2 that was not completed in 2004 was completed in Year 3 (2005) including:

1) Completing the remaining watertight plugs and cement backfill section (Plug Nos. 1 through 3)
2) Constructing a portal plug (work added to the contract)
3) Plugging drill holes in the Gold Dust Adit (work added to the contract)

SITE PREPARATION

The Portal pad area for the Glengarry Mine was constructed on top of the existing waste rock dump. Surface water was diverted in buried culverts, pipes, and ditches through and around the waste rock dump. Water from the adit was collected in a culvert routed through a plastic pipe where it was delivered to the sediment pond during active rehabilitation and construction phases. In the off seasons, water from the adit was diverted back into Fisher Creek. The perimeter of the waste rock dump and construction site was barricaded with an orange safety construction fence and silt fencing was installed along the toe of the waste rock dump.

Sediment Ponds

An existing lined sediment pond was constructed on the Glengarry waste rock dump in 2000 and was used to remove and retain sediment before discharging water from the Glengarry adit to Fisher Creek during mine rehabilitation and underground construction (**Figure 7**). In 2001, about 100 cubic meters (131 cubic yards) of sediment generated during mine rehabilitation and assessment phases was removed from the pond, leaving approximately 300 cubic meters (392 cubic yards) of sediment in the pond. Management of the ponds required adjusting diversion pipe outlets to control flow rates, pond levels, and sediment discharge during peak periods of mucking and construction in the mine. In addition, sodium hydroxide was added in a drip line from a drum to enhance flocculation of very fine-grained material.

Figure 7. Glengarry Mine Waste Rock Dump and Portal Area Showing Surface Facilities

A second sediment pond (**Figure 8**) was constructed in 2003 and operated in conjunction with the primary settling pond to more effectively remove sediment before discharging to Fisher Creek during construction. The pond was designed to hold 300 cubic meters (392 cubic yards) of sediment with enough freeboard to treat water. The pond was fit to surface topography, lined with a non-woven geotextile and a polyvinyl chloride (PVC) liner. PVC baffles were constructed across the pond to lengthen the flow path through the pond and maximize settling of sediment. The site selected for pond excavation developed a wet seepage requiring the construction of an unanticipated underdrain system beneath the pond. The two ponds were connected with a 14-inch PVC discharge pipeline that fed discharge water from the upper primary sediment pond to

the lower pond prior to discharge to Fisher Creek (**Figure 7**). Pond embankment and cut and fill slopes were seeded and covered with erosion matting.

Figure 8. Secondary Sediment Pond at the Glengarry Mine Site

Routine daily water quality sampling was performed during the active construction phases that measured field parameters, flow, temperature, SC, pH, and turbidity. Copper and iron concentrations were measured using Hach field kits. Water quality sampling for turbidity was also conducted. Samples were collected at the secondary pond outlet and at surface water station SW-3, which is located about 300 meters (1,000 feet) downstream.

Muck Storage Pad

Muck containing rock, gravel, sand, silt, and clay material from mine rehabilitation and ongoing underground construction were dewatered on a temporary timber-bermed pad on the waste rock dump until sufficiently dry to haul to a temporary muck storage pad constructed adjacent to the New World Waste Repository (**Figure 9**). The muck storage pad was originally designed to hold 220 cubic meters (288 cubic yards) of material. This was doubled to 440 cubic meters (575 cubic yards) during the construction phase because of an increase in the estimated volume of muck that may be generated. The pad was excavated and cut material was used to construct a berm around the pad. The pad was lined with a PVC bottom liner and a non-woven geotextile top liner. A PVC cover was placed over the pile to keep it dry in between periods of hauling muck to the pad. Construction of the muck storage pad was paid for based on square meter of pad constructed and muck was paid for based on the cubic meter of muck hauled and placed.

Figure 9. Muck Storage Pad at the New World Waste Repository

In all, 351 cubic meters (459 cubic yards) of rock and debris required mucking from the sill of the Glengarry Mine and transported to the muck storage pad. Material from the muck pad was ultimately placed in the waste repository and the muck pad removed under a separate contract.

Underground Site Preparation

The main drift from the Glengarry Mine trends northwest from the portal at a +0.5% slope. The drift was driven approximately 1.5-meters (5-feet) wide and 2.5-meters (7-feet) high. Adit rehabilitation, drill station excavations, and plug site excavations took place within the first 460 meters (1,500 feet) inward of the portal. Rehabilitation included removal of pipe, track, ties, and 23 to 36 centimeters (9 to14 inches) of clay, silt, sand, gravel, rock, and other debris on the sill. Muck was hauled to the muck storage pad and timber and ties were separated from non-combustible debris. Some timber repair and reconstruction was required about 404 meters (1,325 feet) inward from the portal. A short raise located about 8.5 meters (28 feet) inward from the portal and extending 4 meters (13 feet) to the surface was bulkheaded off during construction and filled with cement in closure. Underground work required installation of ventilation and utilities including water lines, compressed air lines, and 480-volt power cables. Water storage, an air compressor, and a portable generator were installed on the waste rock dump to supply utilities. Surface facilities to support underground construction included an equipment room and temporary storage (**Figure 7**).

Four plug site locations and three drill stations were excavated and constructed between the portal and 460 meters (1,500 feet) inward from the portal. Six of the stations (4 plug and 2 drill stations) were of similar construction and were designed for the construction and emplacement of four watertight and two structural plugs. These stations required the drilling of three holes from each station to the surface used for delivery of cemented fill into plugs. Construction of plug and drill stations is described in detail in a subsequent section of this report.

Como Raise Collar Preparation

Site preparation in the Como Raise area required minor road reconstruction, constructing a storage pad and lay-down area, building a bridge segment, and installing perimeter drainage control, and silt and safety fencing. The storage pad was used to store about 2,294 cubic meters (3,000 cubic yards) of aggregate and pallets of cement.

COMO RAISE COLLAR SURFACE GROUTING

Where the Como Raise surfaces in the Como Basin, acidic metals-laden surface water historically flowed down the raise. In 1993, Crown Butte Mines regraded the surface around the raise collar and constructed an HDPE-lined surface water diversion ditch around the upgradient areas of the collar to divert surface water flow away from the raise. However, these changes did not prevent acidic waters from flowing through colluvial soils along the north flank of Fisher Mountain, and, after encountering the bedrock surface, flow to the raise collar and then drop down the raise. The purpose of the Como Raise grouting program was to place an impermeable grout curtain in the colluvial soils and upper portions of the fractured bedrock around the raise collar. The grout curtain was designed to extend downward through colluvium and compacted fill adjacent to the cribbed raise collar, and extend 1 to 10 meters (3.3 to 33 feet) into underlying bedrock (**Figure 10**). The raise collar grout curtain was constructed during August and September of 2003.

The contract's proposed method of installing the grout curtain in shallow unconsolidated materials called for drilling 7.5-centimeter (cm) (3-inch) diameter holes through the colluvium, compacted backfill, and fractured, near-surface bedrock, and then using permeation grouting or jet grouting to construct the shallow portion of the grout curtain. The nature of the clay-rich colluvium and compacted backfill prohibited use of these grouting techniques, which resulted in a considerably different program for construction of the shallow portion of the grout curtain. This program is described below and illustrated in **Figure 11.**

A nominal 0.61-meter (2-feet) wide trench with a 9.1-meter (30-foot) diameter was excavated using a backhoe in colluvial materials around the raise collar. The depth of the trench segments either went to bedrock (1 meter [3 to 4 feet]) on the south and east sides of the raise or as deep as the backhoe could dig and still maintain an open trench (1.8 meters) on the north and west sides of the raise (**Figure 11**). The trench was filled with grout to the surface and the grout was allowed to set for 48 hours. In all, the trench took 16.2 tons of dry weight grout to fill (4,380 gallons or about 585 cubic feet of grout). Filling the trench was done in stages as the grout permeated the adjacent colluvial materials by gravity, requiring the trench to be "topped off" with grout to keep it full. The result was a minimum 0.61-meter (2-feet) wide by 1- to 2-meter (3- to 6-feet) high grout ring-wall surrounding the raise collar (**Figure 12**).

After the grout curtain had set, 39, 0.3-meter (12-inch) diameter auger holes were drilled through the grout wall, colluvium, and compacted fill into the uppermost portion of the underlying bedrock (**Figures 11 and 13**). These holes were drilled only in areas of the wall that had not

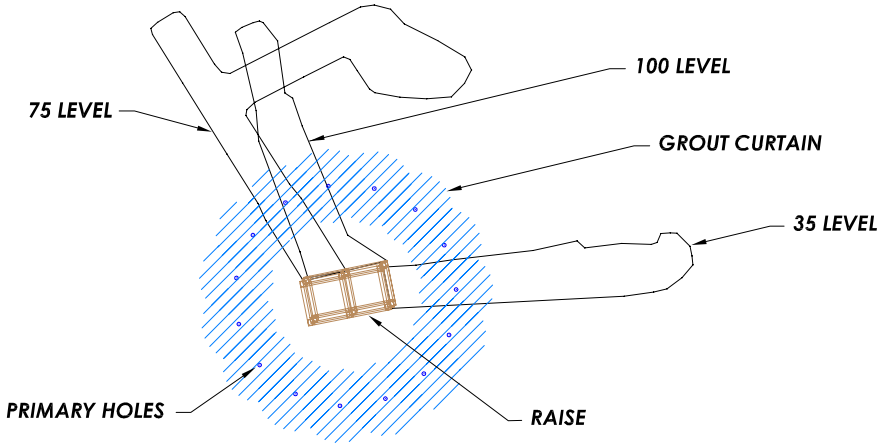
previously been excavated to bedrock (north and west sides of the raise collar; about a third of the ring circumference). Following drilling in an alternating pattern such that auger holes formed a continuous and overlapping series of columns, the holes were filled with grout in stages as grout diffused out into the adjacent unconsolidated materials. The final product comprised a downward extension of the excavated grout wall into the uppermost portion of the underlying bedrock in the ring surrounding the raise collar. The auger drilled portion of the grout wall required 234 meters (767 feet) of drilling (197 meters paid, no pay for drilling cement) and 17.1 dry tons of grout (about 4,500 gallons or 600 cubic feet) to fill the 39 columns.

Once the grout ring-wall was completed, 30, 10-centimeter (4-inch) diameter, 0.9-meter (3-feet) deep rotary holes were drilled on 0.9-meter (3-foot) centers along the centerline of the grout wall and 7.6-cm (3-inch) diameter threaded steel standpipes were cemented in place at the collar of the holes. Fifteen holes on 1.8-meter (6-feet) centers along the ring wall were designated as primary holes and were deepened by drilling of a 7.6-centimeter (3-inch) rotary hole extending 0.3 to 0.45 meter (12 to 18 inches) into the underlying bedrock (**Figures 11 and 14**). These holes were pressure grouted at 15 to 34 pounds per square inch (psi) until refusal (no grout take for 5 minutes). Once completed, secondary holes were drilled and grouted in the same fashion. The purpose of these holes was to concentrate pressure grouting near the bedrock/colluvium interface. In all, 3.31 dry tons of grout (about 800 gallons or 105 cubic feet) were pumped into the primary and secondary holes. Grout takes were highly variable, ranging from 5.4 gallons (0.7 cubic feet) on the east side to as much as 144 gallons (20 cubic feet) on the west side of the raise collar.

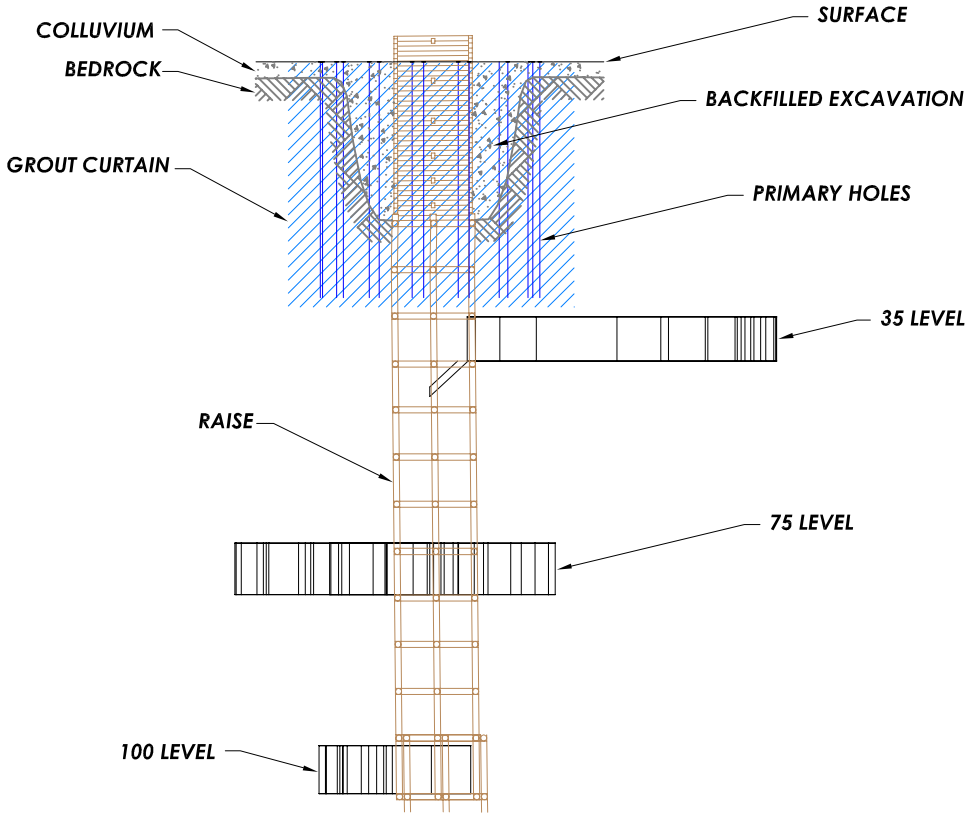
Grouted primary holes were redrilled from surface to a total depth of 10 meters (35 feet), well into the underlying bedrock (3.2 to 9.2 meters depending on the hole location), and pressure grouted. Primary holes were initially grouted with microfine grout (90% passing 5 microns); if grout takes were sufficiently large, grouting was finished with Portland cement grout. Grouting of the 15 primary holes took about 2,700 gallons of grout (about 364 cubic feet) and required 18.35 dry tons. All primary holes were pumped to refusal at 25 to 30 psi. Once all primary holes were grouted, secondary holes were drilled and grouted in the same fashion. Secondary holes were fully grouted with microfine grout. Grouting of the 15 secondary holes required about 460 gallons of grout (about 61.6 cubic feet) or 5.12 dry tons. All secondary holes were grouted to refusal at 30 psi. A total of 363 meters (1,191 feet) of primary and secondary holes was drilled.

Secondary holes were designed to complete the infill grouting of the primary holes. These holes also served as a measure of the effectiveness of primary grouting from holes on 1.8-meter (6-feet) centers. Many of the secondary holes only took as much grout as was required to fill the holes, indicating good grout continuity between primary holes. Most other holes took only a few gallons of grout. Five holes took more than 50 gallons (6 cubic feet) of microfine grout before reaching refusal. Packers were not needed to conduct any of the pressure grouting. No tertiary grout holes were required. The purpose of this grouting was to provide a downward extension of the grout wall as a fracture-filling curtain in the underlying bedrock, further protecting the raise from the migration of near-surface water into the raise.

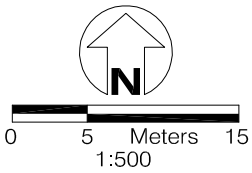
Once grouting was completed, standpipes were cut off at the top of the grout wall. Drilling was paid by the linear meter and grouting was paid by the dry weight of grout delivered to the wall/curtain with a price differential between Portland and microfine grout mixtures. Hook up charges for grout lines were paid once per hole.



PLAN VIEW



LOOKING NORTHWEST



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General Plan and Section of the
Como Raise Collar Grout Curtain
New World Mining District
Response and Restoration Project
FIGURE 10

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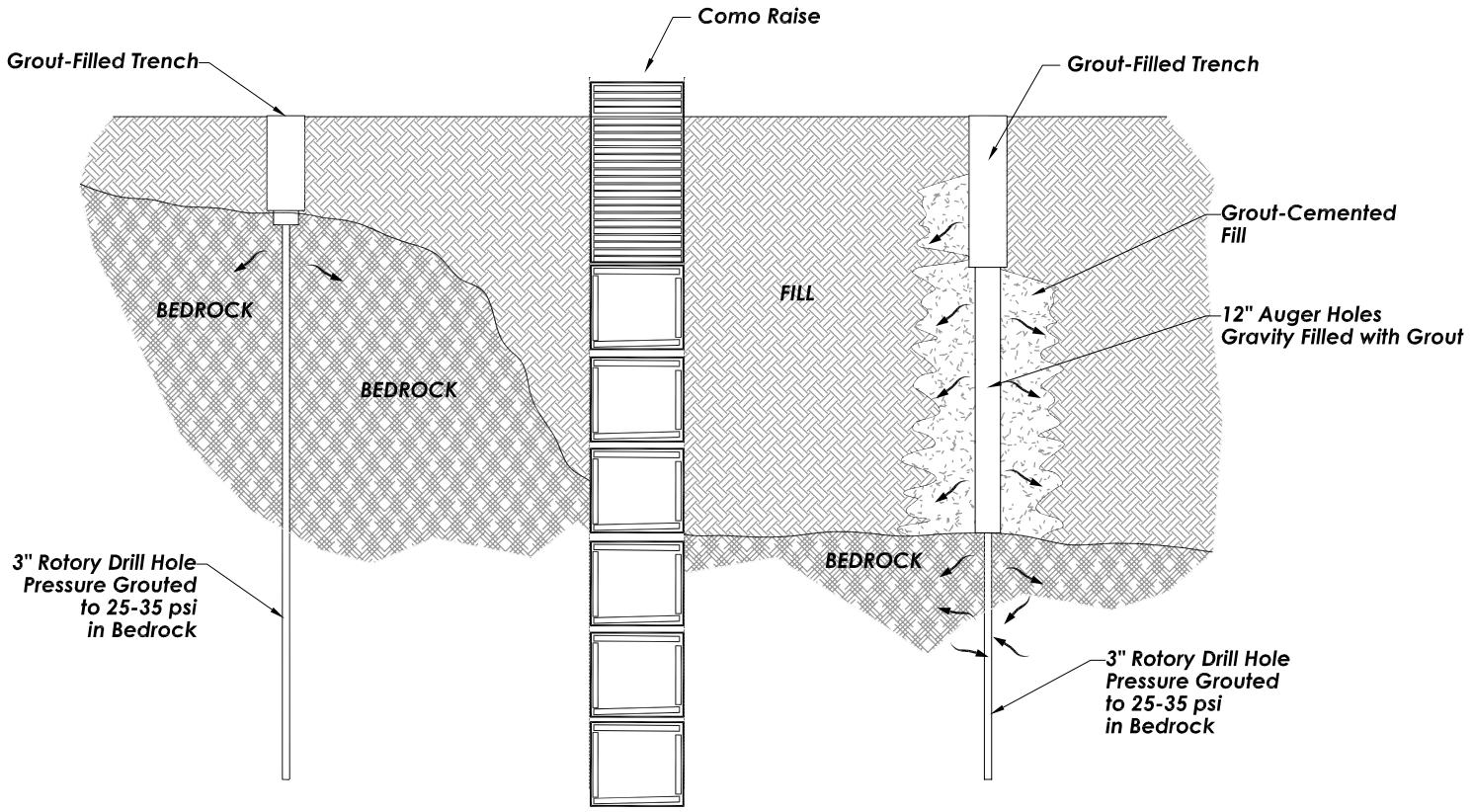

Grout Flow Line

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Detailed Cross-Section of the
Como Raise Collar
Grout Curtain
FIGURE 11

Figure 12. Como Raise Collar Grout Trench

Figure 13. Como Raise Collar Auger Holes for Caisson Wall

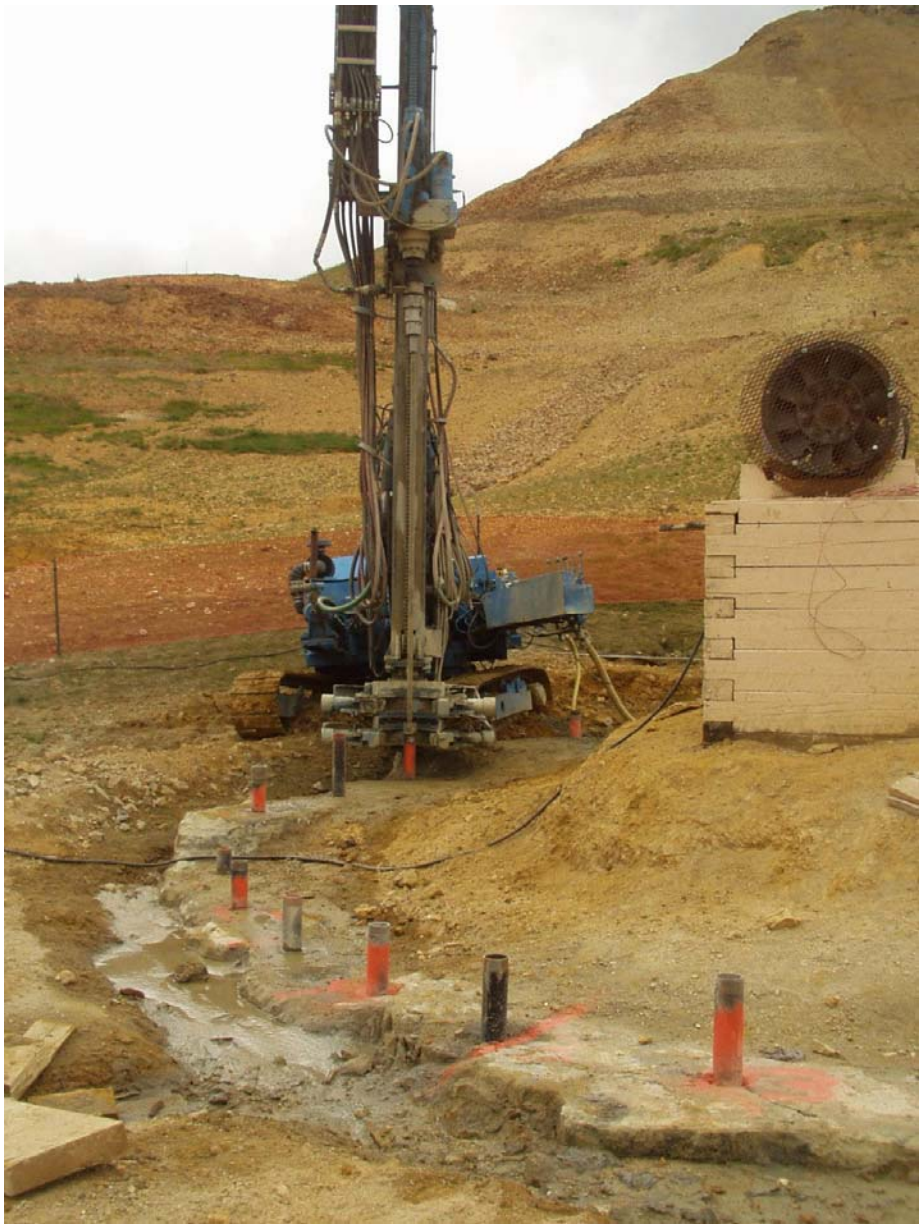


Figure 14. Rotary Drilling Primary (Red) and Secondary Drill Holes into Bedrock

1066 FAULT GROUTING

The zone of rock in the drift making water in the 1066 roof leak area was timbered, lagged and heavily covered with ferricrete stalactites when the workings were opened for assessment in 2000. Historical mapping of the Glengarry by DNRC and Kennecott in the mid-1970s (Kennecott, 1973; DNRC, 1974) had mapped the zone as a Tertiary porphyry dike that cut the adit at a very oblique angle trending N 35 W. The initial design called for drilling this water-bearing structure and placing an impermeable grout curtain around the drift from two drill stations, one either side of the structure. During rehabilitation for plug construction in 2003, rib lagging was removed from the timber sets through the 1066 zone, and the rock was scaled to expose bedrock through zone. The water-bearing interval was observed to be a fault that crossed the adit at about right angles (strike N 20 E, dip 73^{o} east; drift trends N 60 W) rather

than the originally reported obliquely-oriented dike (**Figure 15**). Because of the different type of structure (fault versus dike) and its different orientation, the initial plan for drilling the zone was changed to construct one drill station in the drift about 24 meters (80 feet) toward the portal from the 1066 fault, or about 300 meters (984 feet) inward from the portal. The drill station was cut on both sides of the adit to drill the structure at right angles to the drift.

Figure 15. Glengarry Mine 1066 Fault Zone in Altered Fisher Mountain Intrusive

With the exception of modifying the drill station layout and drilling plan, and grouting a caved zone along the fault by bulkheading off and cementing the back of the adit (described below), grouting of the 1066 fault zone was executed much as originally planned (ie, to construct a grout curtain around the fault; **Figure 16**). Initially, five core holes were drilled from the drill station to cut the fault zone beginning on October 3, 2003. Two holes were drilled from the north side of the station (one up angle and one down angle), and three from the south side of the station (two up angles and one down angle). Each of the holes were drilled to intercept the structure at a point on a circle 9.1 meters (30 feet) in diameter centered on the adit drift. These initial core holes were drilled to intersect the fault and to determine its precise location, orientation, thickness, and rock quality so that the grouting program design could be finalized. Water pressure on these holes was measured by placing a valve and gage on the holes and measuring the hydrostatic head that developed over time. The measured water pressure was about 25 psi, indicating about 17.7 meters (58 feet) of hydrostatic head. The fifth core hole drilled (P4, down hole from the south station) shut off 100% of the flow from the fault zone, indicating that flow along the fault plane was being "piped" or flowed preferentially along a narrow, highly transmissive zone. A total of 161.2 meters (529 feet) of core drilling was completed in the first phase of drilling.

While initial core drilling was being completed, the remainder of the timber sets and lagging from the fault zone were removed. It was discovered that the fault zoned had caved, opening up a hole into the back (the ceiling of the drift) some 4.6 meters (15 feet), and that this caved interval would likely present a problem when trying to pressure grout the fault zone, as too little rock

remained between the drift and the 9.1-meter (30-foot) diameter circle intended for the grout curtain. To solve this problem, the fault zone was retimbered and the back lagged. The ends of the timber sets were bulkheaded off and the open space volume of the fault zone was backfilled with cement using the timber set lagging as forms. Cementing of the fault zone open space took about 14 days as it had to be done in numerous stages and used 22.45 dry tons of grout. Final grouting was completed through standpipes placed in the highest point of the fault zone stoping. Grouting of the bulkhead forced grout out of the down-hole (P4) that shut off water flow in the fault zone.

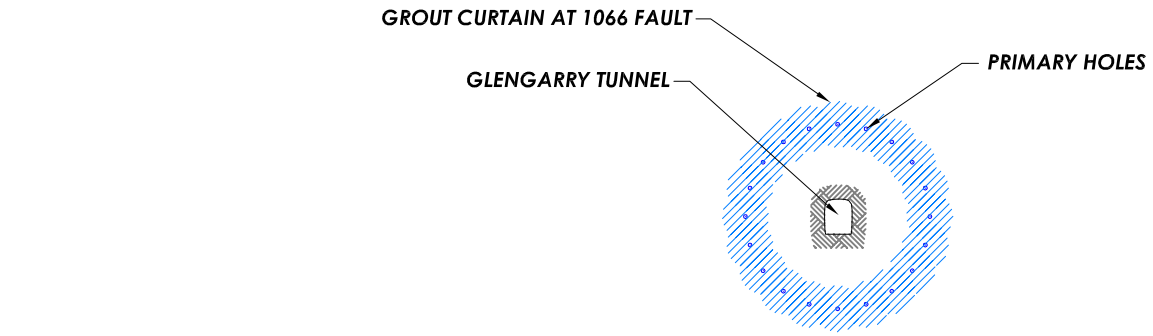
The remainder of the drilling to complete the nine primary and nine secondary holes for placing the grout curtain around the fault zone was completed with rotary drilling. In all, 385.1 meters (1,263.5 feet) of rotary drilling were completed. Primary holes were drilled and grouted first and then secondary holes were drilled and grouted.

Primary and secondary holes were initially grouted with microfine grout in order to force fine grout out into distal fractures and were then finished with Portland cement grout (**Figure 17**). All holes were grouted to refusal (no grout take for 20 minutes at 150 psi). Primary holes took 1,243 gallons of grout (166 cubic feet) using 4.28 dry tons of grout (5 sacks of grout per cubic yard of mix). Secondary holes took 1333 gallons of grout (178 cubic feet) using 2.74 tons of grout. Grout for secondary holes was much less viscous (2.5 to 3 grout sacks per cubic yard of mix). All holes were shut in using pump-through valves after completion of pressure grouting. During grouting of the fault zone, flow at the cemented bulkhead went from 19 Lpm (5 gpm) on October 22 to less than 0.5 gpm on October 28. Grouting of secondary hole S4 on the second to last day of active grouting shut off almost all flow from the bulkhead fracture leaks. Flow at the portal for the same period was reduced from 189 to 103 Lpm (50 to 27.3 gpm).

MCLAREN ADIT BOREHOLE PLUGGING CONTRACT ADDITION

The McLaren Adit (also know as the Winter Tunnel), which is located west of the Como Basin in the Daisy Creek drainage, contained a leaking exploration drill hole that brought surface water into the back of the mine. This exploration drill hole contributed about 78% of the 26 Lpm (7 gpm) flow, 22% of the iron load, and 50% of the manganese load in the discharge flowing from the adit portal. As the grouting equipment used by the contractor was suited for grouting this hole from underground, a change order was requested by the USDA-FS, and the borehole was grouted on Sept 23, 2003.

The grouting process involved connecting a grout line to a packer set in the bottom of the 10.8-centimeter (4.25-inch) diameter hole, which was located about 112 meters (366 feet) inward from the portal and 40 meters (130 feet) below the surface. Grout was mixed and pumped from the adit opening through a high-pressure grout line into the mine and up the drill hole. The exploration borehole took 175 gallons of grout and reached refusal. This quantity of grout is estimated to have filled about 18 meters (60 feet) of the lower portion of the borehole with grout. The packer did not leak during grouting, and the grouted borehole did not leak water or grout upon completion. The hole was checked the following week and the packer and flow-through valve were removed. No leakage from the hole was observed when the packer was removed.



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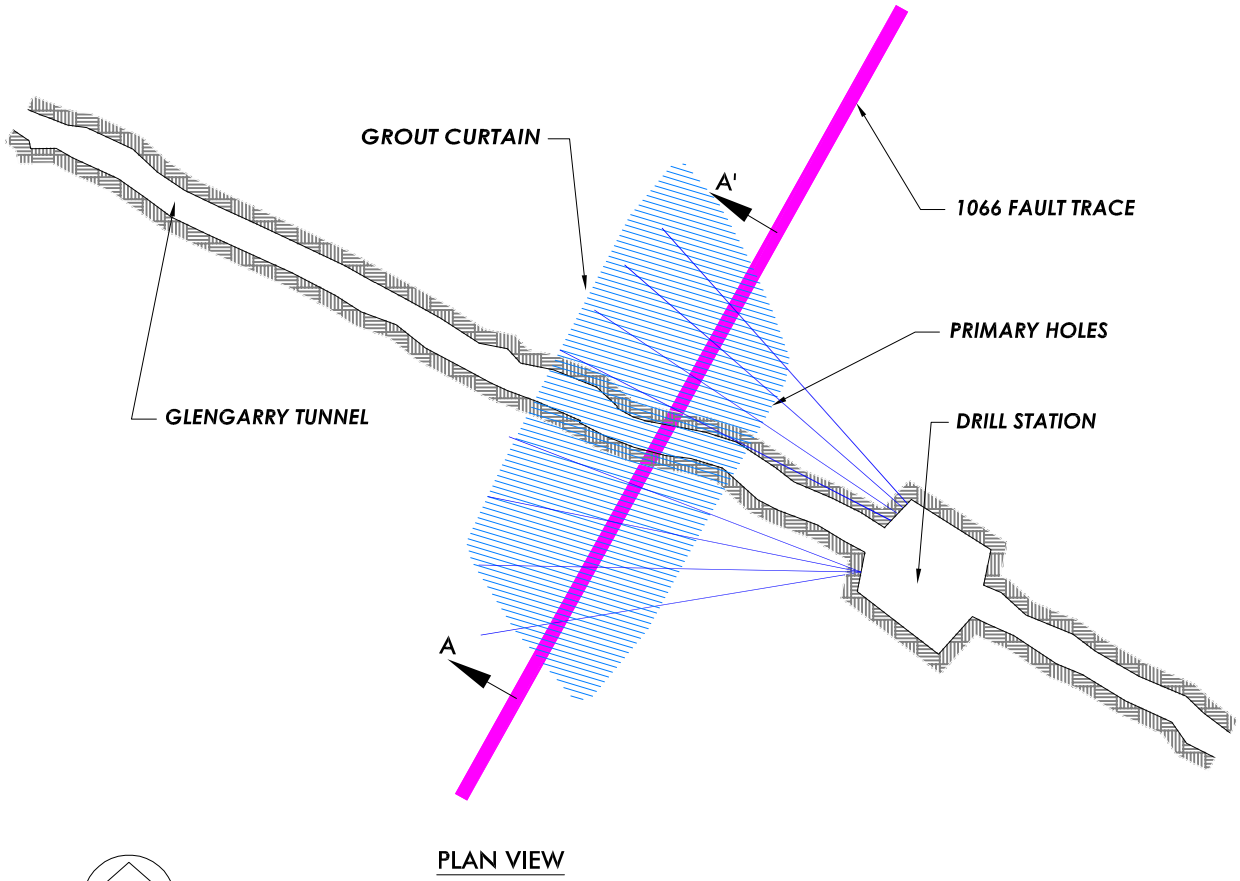
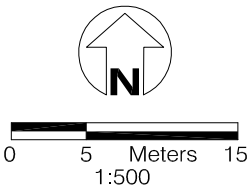


PLAN VIEW



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Plan and Cross-Section Schematic of the
1066 Fault Zone Grout Curtain
New World Mining District
Response and Restoration Project
FIGURE 16

Figure 16 – back page

Figure 17. Grouting the 1066 Fault Zone

COMO RAISE BACKFILL AND WATERTIGHT PLUG PLACEMENT

The purpose of plugging the Como Raise was to eliminate any water discharge down the raise that might enter below the grout curtain constructed at the raise collar. The purpose of backfilling the raise was to provide stability for the plug by backfilling with cemented structural fill to provide a foundation for the plug. Work to backfill the Como Raise was scheduled to be completed in either 2003 or 2004. Work began on the Como Raise in 2004 after rehabilitation work, plug station construction, and plug station drilling in the Glengarry drift was completed at the end of the 2003 construction season (the Como Raise provided natural ventilation to the underground during rehabilitation work).

Cement Backfill

Backfilling of the upper portion of the Como Raise and watertight plug installation was executed largely as anticipated in the original contract. There were two changes to the original plans: a change in the vertical location of the backfill interval and raising the location of the plug site. The vertical location of the base of the backfilled interval was changed from a position at about the 185-foot level in the raise to a position at the 215-foot level (five sets lower), at the raise offset at the floor level of pneumatic host room (**Figure 18**). This was done to accommodate an interval of shot rock lodged between the lagging and the ribs from about 180 feet to the floor of the hoist room. This material would have been difficult and dangerous to remove so the elevation of the base of the backfilled section was lowered. The second change involved raising the location of the watertight plug from the 140 level just above the second raise offset up two timber sets to approximately the 128 level (**Figure 18**). The area in vicinity of the140 foot level, the ore pass was completely filled with rock, lagging, and timber debris. The new location was

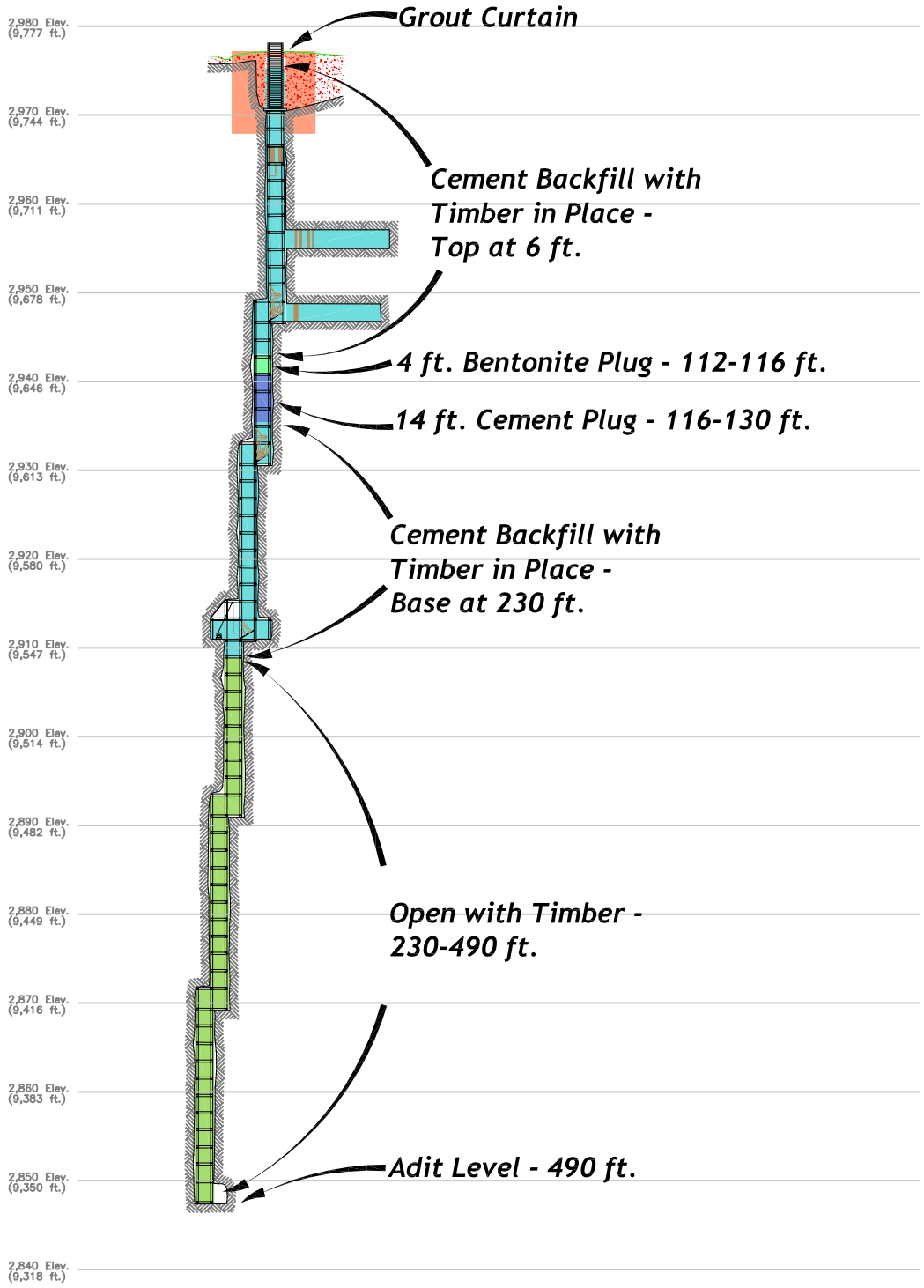
chosen to place the plug in the relatively impermeable Wolsey Shale Formation and below any water producing intervals in the overlying Meagher Limestone. This new location was also selected to avoid offsets in the raise (**Figure 18**) and to site the watertight plug in a portion of the raise with a minimum amount of rock fill debris between the lagging and the ribs, and in an interval in which the lagging was largely broken or rotted away.

Rehabilitation of the Como Raise began on July 20, 2004, with the placement of a pneumatic tugger on the surface. A wire line was connected to the tugger and lowered down the raise to hoist waste materials and to lower construction materials into the raise. Site preparation included the following: timbers caps above and below the plug interval were blocked and rock bolted to the ribs, and the upper cap set braced with I-beams and bullhorn hitches that were rock bolted to the ribs (**Figure 19**). Three timber sets, lacing, and ladders were removed from the watertight plug interval and the waste material dropped down the raise below the pneumatic hoist level offset in the raise. The total interval stripped of timbers for the plug site was about 6 meters (20 feet). The ribs of the plug interval were scaled of loose rock and washed clean prior to initiating backfilling of the raise. A metal rebar ladder was constructed and placed in the raise across the proposed watertight plug interval to permit access to lower portions of the raise for placement of the cement backfill.

To support the cement backfill in the raise, a 15-centimeter (6-inch) steel I-beam bulkhead was constructed in the raise on the floor of pneumatic hoist level offset at a depth of about 65-meters (215-feet) below the surface (August 5, 2004). The I-beams were placed such that they took advantage of the rock support at the offset and the bearing set. The I-beams were covered with three sets of 7.5-centimeter (3-inch) lagging laid in layers oriented at right angles to one another. Burlap was placed in between the layers and the edges between the lagging and the rock ribs of the mine were sealed with burlap and wedges.

Backfill material was comprised of Type I and II Portland cement mixed with an off site commercial 0.925-centimeter (3/8-inch) minus aggregate. About 2,294 cubic meters (3,000 cubic yards) of aggregate were delivered and stockpiled near the Como Raise. New gradations were run on the delivered aggregate. The aggregate was stored under a plastic cover to protect it from acquiring excess moisture. The batch mix design was formulated to produce a cemented backfill material with a 28-day uniaxial compressive strength greater than 1,800 psi (12.5 MPa), a slump greater than 15 centimeters (6 inches), and a permeability < 10^{-8} cm/sec with minimal shrinkage.

Concrete was initially placed on the bulkhead from a continuous, 15 cubic meter (20 cubic yard) per hour batch plant at the surface (**Figure 20**). Cement was pumped from the batch plant via a push-piston pump through a 10.2-centimeters (4-inch) high-pressure flexible hose to a 15-centimeter (6-inch) HDPE tremi pipe for delivery down the raise. The HDPE pipe was cut off in stages as cement levels were advanced up the raise during backfilling. The first lift of cement was pored on August 17 and was about 1-meter (3.3-feet) thick (9.9 cubic yards). This first lift was allowed to set for 24 hours. The second and third lifts (August 18 and 19) were about 3.2-meters (10.5-feet) thick (31.3 and 30.7 cubic yards, respectively) and were also allowed to set up for 24 hours between pours. The raise was backfilled in two successive pours on August 24 and 27 and consisted of 78.8 and 82 cubic yards of placed concrete (**Figure 21**). These two pours brought the level of the backfill to the bottom of the watertight plug site, about 39 meters (128 feet) below the raise collar (**Figure 18**).



CROSS SECTION OF RAISE

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Como Raise Plug and Backfill
New World Mining District
Response and Restoration Project
FIGURE 18

Figure 19. I-beams and Bullhorn Hitches Used to Support Timber Sets in Como Raise Plug Area

Figure 20. Continuous 15 Cubic Meter/Hour Concrete Batch Plant at the Como Raise

Figure 21. Cement Backfill in Timbered Portion of the Como Raise

A batch mix log was kept for total cement, sand, and water for each shift (a batch). The cement pump stroke was calibrated on site for accurate delivery volume. A counter was used on the pump to track the number of stoke-counts so that the total volume delivered over a given period could be calculated. After some initial confusion about the pump stroke capacity, field measurements of actual delivery rate of 0.875 cubic feet/stroke were measured for two consecutive weeks and compared with manufacturer's specifications 0.90 cubic feet/stroke and a previous measurement of 0.83 cubic feet/stroke.

Compressive strength tests were performed at 7, 14, and 28 days on 6X12-inch cylinders by Ingberg-Miller (Cody, Wyoming), a third party independent testing firm. Samples were collected at least twice daily during days of active cement delivery to the raise. Compressive strength values met or exceeded 1,800 psi for all backfilled portions of the raise tested. Cone slump tests were initially conducted every 2 to 3 hours until the optimum mix design was established and then later at a minimum of three times per day or whenever batch mixing and pumping had been suspended for more than an hour.

Watertight Raise Plug

The watertight raise plug was constructed as initially proposed in the contract at the slightly higher elevation in the raise. On August 28, a concrete plug of 43.4 cubic meters (56.8 cubic yards) was placed as a continuous pour in the lower part of the timber-stripped, watertight plug interval over a thickness of about 4.6 vertical meters (15 feet). The watertight plug was allowed to cure for 48 hours. On August 31, about 2.3 meters (7.5 feet) of water had collected on top of

the plug, an indication that the plug effectively prevented water infiltration. Standing water was pumped off the concrete plug and a 1.2-meter (4-foot) thick layer (5 pallets) of ¾-inch bentonite clay pellets was placed on top of the cement plug on August 31. This bentonite clay layer was used to create an additional watertight component to the cement plug. An open-latticed wooden mat was constructed on top of the clay pellets in order to prevent the next batch of cement backfill placed on top of bentonite layer from displacing the bentonite chips (**Figure 22**). On August 31, the first batch of backfill cement (20.2 cubic meters [26.4 cubic yards]) was poured on top of the wooden mat.

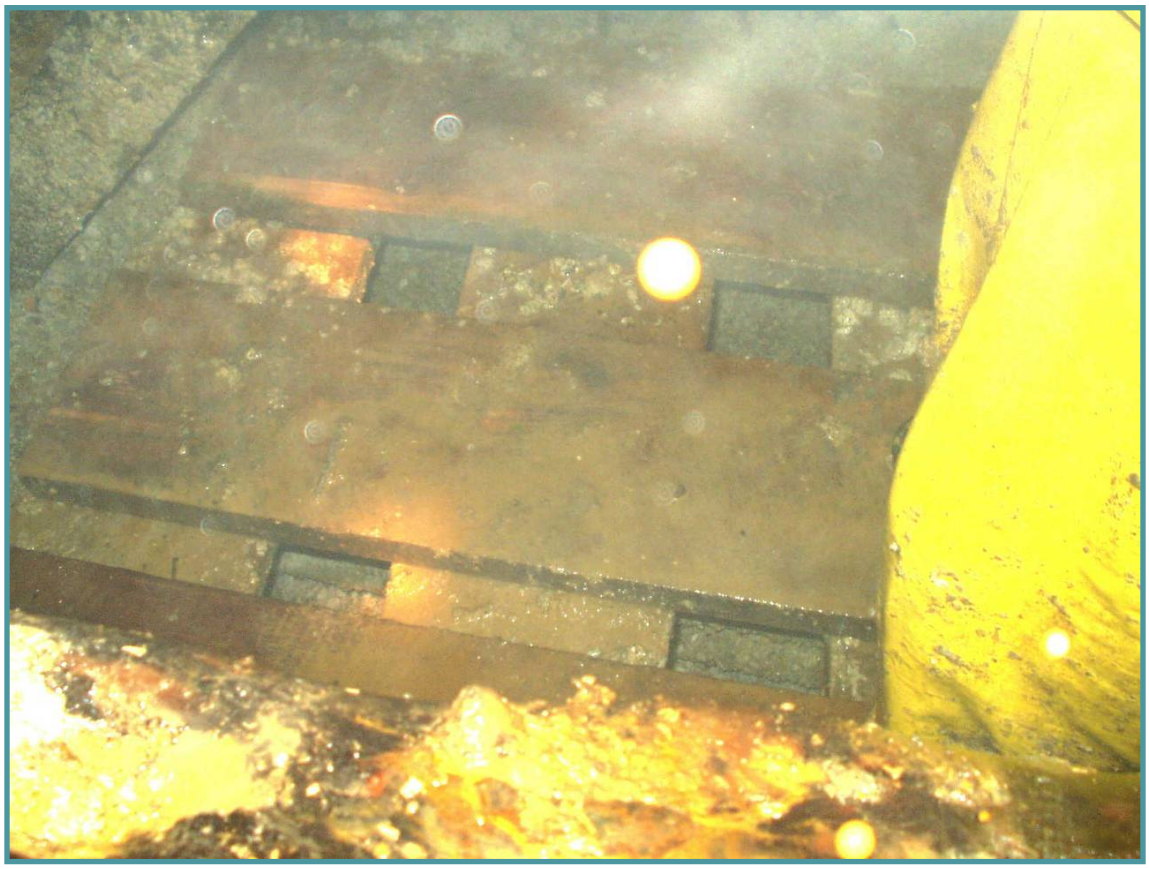

Figure 22. Wooden Lattice Mat Installed Over Bentonite Pellet Clay Layer

The remainder of the raise was backfilled with concrete to within about 3 meters (10 feet) of the top of the raise collar (1.8 meters [6 feet] below the ground surface) in three pours of 89, 112, and 44 cubic meters (117, 146.8, and 57.5 cubic yards) on September 1, 2, and 7. A total of 487.14 cubic meters (637.2 cubic yards) of concrete backfill were place in the Como Raise. On September 10, 2004, the cribbed raise collar was removed to the top of the cement backfill, and the collar area backfilled with fill and graded to drain away from the raise. There was no water flowing or dripping at the bottom of the Como Raise after placement of the plug and backfill.

SOUTH HENDERSON ADIT CLOSURES CONTRACT ADDITION

On August 20, 2004, HBI drilled rock in the brow areas of two open adits in the South Henderson Mountain area and blasted the adit closed using explosive charges. This action effectively closed the adits to human access and eliminated the physical safety hazards presented by the open adits.

ADIT PLUGS

In general, construction of plug stations, drilling of boreholes for grout delivery, construction of bulkheads, and pouring cement for watertight plugs and backfilled portions of the Glengarry drift went largely as planned in the contract. Plugs were placed in the underground workings at strategic locations to block water flow into and through the workings. The underground workings, plug locations, and surface topography are shown on **Figure 23**. The following sections discuss plug and drill station construction, borehole drilling from the plug stations for the delivery of grout, and placement of the adit plugs and backfill segments.

Plug and Drill Stations

Four plug site locations and three drill stations were excavated and constructed between the portal and 460 meters (1,500 feet) inward from the adit portal (**Figure 24**). Six of the stations (4 plug and 2 drill stations) were of similar construction and were designed for the construction and emplacement of four watertight and two structural concrete plugs (**Figure 24**). These stations were used to drill three holes from each station upward to the surface so that cement could be pumped from the surface into the plugs sites (**Figures 23 and 25**). The stations were located at Plug 6 (456 meters; 1,496 feet), Plug 5 (345 meters; 1,132 feet), Plug 4 (312 meters; 1,023 feet), Plug 3 (178 meters; 584 feet), Plug 2 (93 meters; 305 feet), and Plug 1 (29 meters; 95 feet) inward from the portal (**Figure 23**). The other drill station was located 300 meters (984 feet) inward from the portal and was the station from which the 1066 fault was drilled.

The ceiling (back) of drill and plug stations was constructed in an arched configuration to allow the cement plug a place to key into the bedrock above the working height of the drift, as well as to accommodate room for the drill rig to drill holes (including vertical holes) from the drill station to the surface (**Figure 25**). Plug stations were nominally 6.1 meters (20 feet) long and 4.6 to 5.5 meters (15 to 18 feet) high at the peak of the arch. Plug stations were cut to be wider on the inboard and narrower at the outboard end of the plug drill stations (flared toward the interior of the mine). Muck from the drill and plug stations was hauled to a rock storage area on the Glengarry waste rock dump for use as backfill between Plugs 3 and 4. Drill Station #5 and Plug Station #6 were completed between October 8 and October 15, 2003. Plug station #4 was drilled for blasting, but this station and outboard stations could not be blasted or constructed until grouting of the 1066 fault was completed (utility lines were in the blast pattern). Plug and Drill Stations #1 through #4 were constructed between July 2 and July 19, 2004. Plug stations were filled sequentially from Station #6 toward the portal.

Boreholes and Plug Site Preparation

Cemented fill was delivered to the plug sites from the surface, requiring holes be drilled from the apex of the underground stations to the surface **(Figures 23 and 25)**. Drillhole angles were calculated such that the holes surfaced near the Lulu Pass Road to accommodate the placement of a grout plant in a convenient location (**Figure 23**). Three core holes (size BQ) were drilled to the surface at site Nos. 3 through 6, two of which were reamed out to 10 centimeters (4 inches) from the surface using a rotary drill with a pilot bit (**Figure 26**). The 10-centimeter holes were cased with 7.62-centimeter (3 inch) steel casing. The two reamed holes at each station were slated to be used for cement fill delivery (one as primary and the second in the event the primary hole plugged). At Plug Sites #1 and #2 only one un-reamed hole was drilled. The un-reamed BQ core hole at each drill station was designed to be a breather hole, allowing for the displacement of air and water during the complete filling of the arched plug. The BQ holes had only surface casing set.

The contractor for the work, HBI, submitted a value engineering plan that eliminated drilling three holes at Plug Sites #1 and #2 (**Figure 23**), and instead proposed drilling a vent hole at each site and filling the plug sites from a cement plant located at the mine portal. Drilling began in Plug Site #6 on July 7, 2004, and finished at Plug Site #1 on September 23, 2004. A total of 1,065.3 meters (3,495 feet) of BQ core drilling and 680.6 meters (2,232.8 feet) of reaming was executed for this portion of the contract.

Bulkhead Construction

Steel I-beam supported and timbered bulkheads were constructed at each end of the plug stations in preparation of pouring the watertight plugs (**Figure 27**). The plugs were designed to be 5 to 6 meters (16 to 20 feet) long. Perimeter areas of the bulkhead were chocked with burlap held in place by wooden wedges and foam to hold back and form up the concrete.

Placement of Plugs

Four watertight plugs (Nos. 1, 3, 4, and 6) were poured with cement from the surface (**Figures 23 and 24**). Cemented aggregate fill made up of 7.5 sacks of cement to for each 0.76 cubic meter (1 cubic yard) of cement was pumped down one of the reamed boreholes. Slump was maintained for the most part between 8 and 9 inches. The plug station volume was calculated in advance, and only enough concrete was added to the plug to bring the cement level into the top of the arch. Water that accumulated behind the bulkhead as the cement filled the plug station initially flowed through the burlap seals. Cement was allowed to set for 24 to 48 hours, after which cement grout was injected into the top of the plug using a tremme line. The purpose of the grout was to infiltrate bedrock and shrinkage fractures (if any, although none were observed in any stripped bulkheads) under a hydrostatic head of 100 to several hundred feet. Grout mix was approximately a 3.5 sack mix per cubic yard. Grouting was continued until it flowed from one of the holes at the surface. The remaining holes were topped off with grout and the surface casing removed. The No. 6 and No. 3 bulkheads were stripped after 48 hours to observe the seal of the plug. None of the plugs had leaks of more than a drip or two per second upon completion. Plug Nos. 4 to 6 were poured in 2004, with station No. 4 being completed on October 6. Plug Nos. 1 through 3 were poured between July 26 and August 30, 2005.

After completing the pour for Plug #1, the short vent raise located 8.5 meters (28 feet) inward from the portal was backfilled with cement on August 23-24, 2005. This raise had been bulkheaded off at the back of the drift during previous underground rehabilitation work to provide overhead protection. After the bulkhead was made watertight, 6.4 cubic meters of a 5 sack mix of concrete was placed into the vent raise in two separate pours completed from the surface. Cement was brought to within about 0.5 meter of the surface and, after the cement had set, the remaining depression was backfilled with soil to blend with the surrounding topography.

Adit Backfill Sections

Two segments of the workings between Plug Nos. 4 and 6 and Plug Nos. 1 and 3 (**Figure 24**) were filled from Drill Station Nos. 2 and 5 with long, cemented-fill plugs. These long plugs were designed to provide a structural fill for ground support around and between the watertight plugs in the event the workings collapse. Segments were filled by connecting a 3-inch HDPE pipe to the bottom of a 3-inch drill hole casing, running the pipe along the drift, and pouring cement on the sill of the workings between short wooden stop dams. In this manner, the long plugs were filled for most the plug interval to within 30 to 45 centimeters (12 to 18 inches) of the back (**Figure 28**). Plug Nos. 5 and 2 were poured in 2004 and 2005, respectively.

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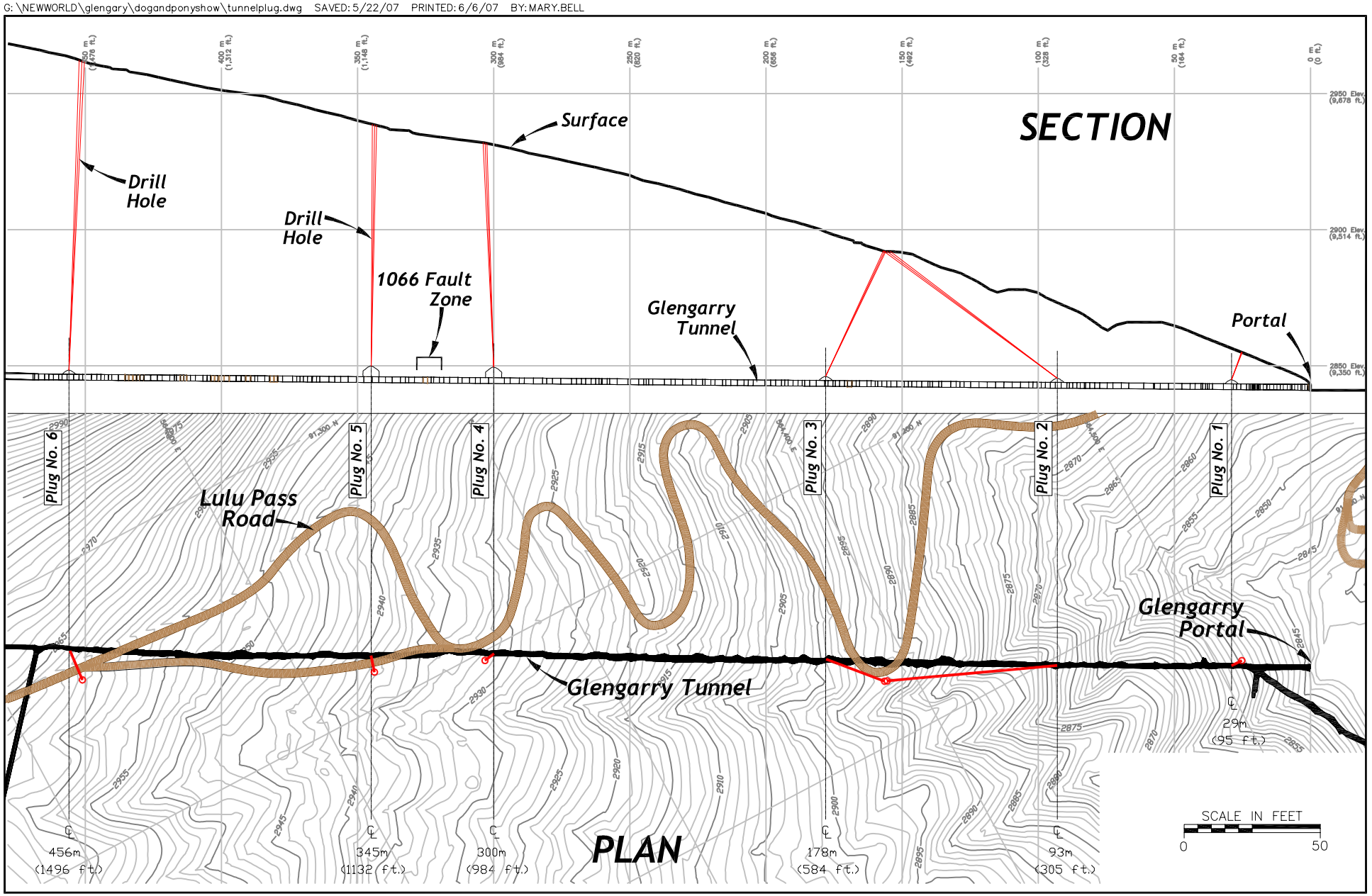

Surface location of drill hole

Subsurface trace of drill hole from drill station

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Plan Map and
Section of Glengarry Adit
New World Mining District
Response and Restoration Project
FIGURE 23

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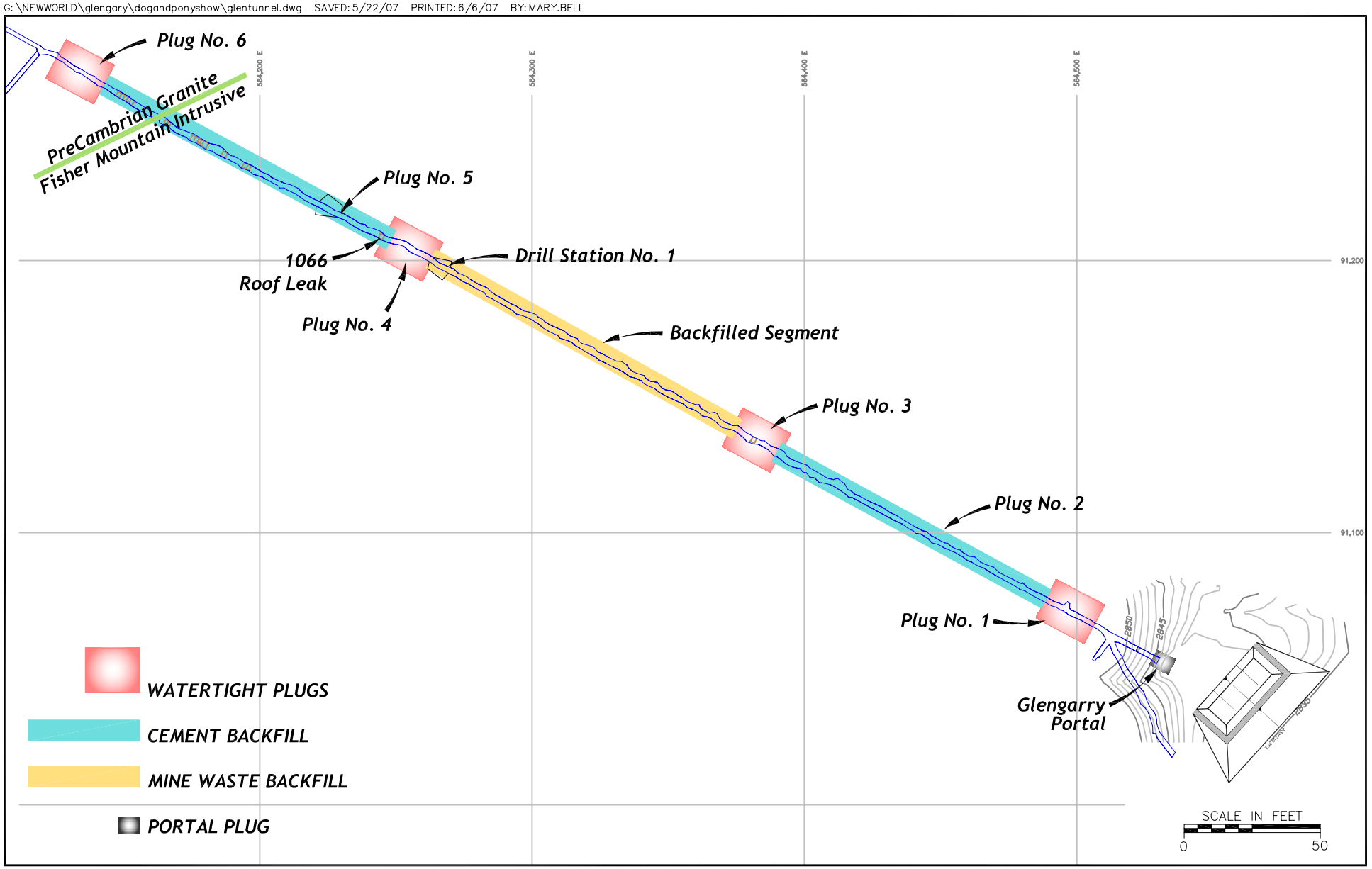

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Plan Map of Adit Plugs
and Backfill Segments
New World Mining District
Response and Restoration Project
FIGURE 24

Figure 25. Watertight Plug Station with Hagby Core Drill Drilling Borehole to Surface

Figure 26. Rotary Drill Reaming of BQ Core Holes

Figure 27. I-beam and Timber Constructed Bulkhead for Plug Station

Figure 28. Cement Backfilled Segment

Figure 29. Waste Rock Backfilled Segment

One 178-meter (584-feet) segment of the workings between Plug Nos. 3 and 4 (**Figure 29**) was filled with rock generated from drill station construction to act as a structural fill. In all, about 900 cubic meters (1,177 cubic yards) of rock was used to fill this interval. This backfilled section was completed between October 6 and 11, 2004.

PORTAL PLUG CONTRACT ADDITION

A portal plug was constructed to allow for final surface revegetation of the portal pad site as additional work (Modification #15) to the contract (**Figure 30**). The sill in the portal area from 3.7 meters (12 feet) outside of the brow to 7 meters (23 feet) inside of the brow was covered with a 30- to 46-centimeter (12- to 18-inch) thick layer of rounded cobbles to act as a drainage layer. The cobbles were covered with 1.3-centimeter (0.5-inch) thick non-woven geotextile fabric and the portal backfilled with leftover cement aggregate (3/8-inch minus) and compacted with a mucker or loader bucket. The toe area of the backfill was wet but no flow was observed from the former adit. In all, 6.9 cubic meters (9 cubic yards) of cobbles and 34 cubic meters (45 cubic yards) of aggregate were used in the Glengarry portal closure.

Over the course of adit plugging activities, a number of sacks of cement became wet or were otherwise damaged. These sacks were store on pallets in the portal pad area. Prior to placing the portal plug, these damaged sacks of cement (about 120 sacks on 3 pallets) were placed in the short return drift located just inside the portal and were subsequently buried behind the portal plug. Adit work was completed on August 30, 2005.

Figure 30. Backfilled Adit Portal Plug

GLENGARRY MINE MONITORING WELL CONTRACT ADDITION

The Environmental Protection Agency, a cooperating partner on the project, was interested in learning about the rate and height that water would fill the open workings in the Glengarry behind Plug #6. To accommodate this interest, installation of a monitoring well was added to the contract (Contract Modification #9, August 4, 2004). The well was drilled from the surface as a 10 centimeter (4 inch) well to a point in the workings near the "Y" intersection, about 460.6 meters (1,511 feet) inward from the portal. Hole drilling depth was 118 meters (386 feet) to the back of the workings, and was completed on August 28, 2004. The well was completed with 5 centimeter (2 inch) schedule 80 PVC casing with a 3 meter (10 feet) stainless steel 40 slot screen set from the sill through the back of the adit. Annular flow-through packers were set at bottom of hole. The annular space of the boring between the casing and the hole wall was filled with 3/8-inch bentonite chips to within 9.1 meters (30 feet) of the surface. The upper 9.1 meters was grouted with cement and a steel wellhead protector was installed.

GOLD DUST ADIT CONTRACT ADDITION

Crown Butte Mines, Inc. (CBMI) had used the Gold Dust Adit for underground exploration drilling in 1993 by drilling numerous coreholes from several drill stations located within the workings. As a number of these exploration holes produced a considerable volume of water, CBMI installed mechanical packers at the end of the drilling program and rock bolted these in place with chains because of the high hydrostatic heads encountered in drilling. Since 1993, two of the packers had deteriorated from rust and had failed; eight of the original exploration bore holes produced water that contributed measurably to flow from the adit. On August 23 and 24, 2004, HBI rehabilitated the portal of the Gold Dust Adit. Rehabilitation consisted of racking and replacing portal timber sets and damaged and missing lagging across the caps of some sets.

On July 25, 2005, HBI undertook underground rehabilitation of the Gold Dust workings by clearing caves along the railroad track that was still useable in the mine, resetting the track gauge, reestablishing ventilation, repairing electrical utilities, and setting underground pumps for grouting. A locomotive, timber car and ventilation fan were mobilized to the site to assist with grouting work (**Figure 31**).

In all, 32 of 33, 5.7-centimeter (2.25-inch) diameter underground coreholes were reopened, packers removed, and the holes grouted to stem flow from the drill holes. Originally, only about 15 holes were scheduled for grouting; however, because of the risk of water flows shifting to adjacent holes once the flows were grouted, it was decided to grout all holes while there was access to the mine and the labor and equipment was there to do the work. All holes were flushed clean prior to grouting (**Figure 32**), and mechanical pump through packers installed in the collars of the holes. Down angle holes were easily grouted without packers. A few up-holes making large volumes of water had to be grouted through packing boxes with a ½-inch plastic grout line used for an internal tremme. A total of 282 sacks (13.25 dry tons) of grout were used in the holes, which should have been enough to fill about 3,075 linear meters (10,087 feet) of hole. Grouting stopped the flow from all underground drill holes and measurably reduced outflow from adit opening.

Figure 31. Gold Dust Adit Rehabilitation

Figure 32. Flushing an Underground Borehole in the Gold Dust Adit

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PROBLEMS ENCOUNTERED AND CHANGES MADE

Hayward Baker, Inc., approached the project aggressively and with enthusiasm considering the amount of equipment that had to be moved in and the amount of surface site preparation that needed to be done before any of the underground closure work could begin. The HBI project manager was well organized, understood the project, and knew what needed to happen. Once site preparation work was completed, the HBI crew moved onto the Glengarry portal pad and Como Basin sites and constructed efficient site setups that served well through the duration of the project. A description of the problems encountered and changes to the contract are described in this section.

PROBLEMS ENCOUNTERED

Site Preparation

Before any underground work could begin, surface facilities such storage and office pads, lay-down areas, stockpile areas, sediment ponds, and muck storage had to be constructed. HBI subcontracted this work to another firm, Opal. The subcontracted firm, its crew, and supervisors were inexperienced in site earthwork and had many difficulties with site construction. There were problems with site drainage that the subcontractor needed to adapt to HBI's proposed operation, but the subcontractor was slow to develop plans for this work, which caused delays and several occurrences of improperly constructed components that had to be redone.

A second sediment pond that was planned for the site had to be moved from the original location due to very wet ground conditions. The alternate site was considerably drier but not completely dry, and this led to delays with construction. The subcontractor's work on the secondary pond was inept and required almost constant supervision from the Contracting Officer's Representative (COR) or Technical Representatives. Several elements were constructed poorly and had to be redone. These included:

- Poorly designed and constructed underdrain (Modification #1 required by pond relocation)
- Uncompacted pond embankments that had to be re-excavated, dried, and reconstructed)
- Pond liner cut incorrectly
- Grade control on the pond berm was incorrect such that the pond would not drain through discharge pipes (the liner had to be pulled back and the embankment raised)
- The wrong pipe fittings were initially ordered for the discharge lines between ponds
- The pond was undersized by 40% (did not excavate deep enough because of wet soils and failed to increase footprint size)

The subcontractor also constructed the muck storage pad located at the New World Waste Repository. The subcontractor encountered difficulties at this site as well, again due to inexperience. The pad had to be re-excavated twice because the contractor did not accurately construct the pad to the required volume. The berms were inadequately constructed (too gentle a slope and too large a footprint) and the pad liner was cut improperly and had to be patched together.

Cement Pumping

A problem with calibration of the stroke volume on the cement pump was identified and corrected during the backfilling of the raise that took considerable time and effort on the part of the COR. The backfilling cement crew was not adequately trained in measuring stroke volumes, performing slump tests, and tracking batch mixes, all of which also took a considerable amount of the COR's time. Finally, an outside third party contractor was hired to perform slump tests, track batch mixes, and collect and break concrete cylinders (no cost to the US Government).

Raise Collar Grouting

Grouting of the raise collar generally went well except for minor problems associated with the trench, which was too wide, and with drilling caissons from surface rather than from a poured grout wall.

Adit Plugs

To the contractor's credit, many tasks involved in placing the plugs had to be modified on a daily basis as various unanticipated situations arose. The contractor showed flexibility and adaptability (as well as a reasonable sense of humor) that made the job go much better than might have been expected while making these changes. During the latter stage of adit plugging in 2004, there was insufficient technical supervision of the mining and grouting crews such that much of the decision responsibilities of how to perform expected tasks had to be assumed by the COR and Technical Representative. In addition, the contractor tried to rush the completion of some tasks that ultimately caused additional problems and overall delays to the schedule. For example, failure to wait 24 hours for cement to cure before placing a second batch of grout into Plug #3 caused a blowout at the bulkhead. Some quality assurance responsibilities shifted to the COR because of a lack of adequate staffing by HBI at this stage of the project.

CONTRACT MODIFICATIONS

Table 2 summarizes contract modifications showing cost (or credits) resulting from the modification and the cumulative changes to overall contract costs. Some of the contract modifications are briefly described below.

- There was a major change in plan regarding the method of grouting of colluvium at the Como raise collar where jet and permeation grouting was abandoned in favor of trenching and drilling of overlapping caissons to bedrock. This required adjusting the contract for variations in actual quantities of drilling and grouting for the raise grouting portion of the contract (part of Modification #3). A new plan was presented by HBI that was approved by the Technical Representative and the COR (Modification #3).
- The muck storage pad was increased in size from a capacity of 220 cubic meters to 440 cubic meters due to a larger expected volume of muck from the adit (Modification #2). Transporting the larger muck volume was added to the contract as part of Modification #3. Modification #7 was for adjustments for final quantities for hauling muck to the muck storage pad (final volume 351 cubic meters).

TABLE 2
Summary of Contract Modifications

Mod No.	Date	Description	Amount	Contract Value
		Original Contract		**$2,949,623.40**
1	7/21/03	Add Item 2.2.1 Secondary Pond subdrain	$6,300.00	$2,955,923.40
2	8/14/03	Sign Install. Increase size of sludge pad	$43,006.20	$2,998,929.60
3	9/10/03	Colluvium grouting AQ and 1050 leak opening, muck quantities	$62,624.45	$3,061.554.05
4	10/03/03	Add 2.5.10 McLaren Adit, 2.4.1B 1066 fault zone shoring, AQ Como rock grouting	$37,079.65	$3,098,633.70
5	9/30/03	Admin Electronic Pay notification	$0.00	$3,098,633.70
6	11/25/03	Add 2.4.2G 1066 Grout, 2.6.1A Re-drilling, AQ 1066 leak grouting	$-193,316.14	$2,905,317.56
7	12/19/03	AQ adjustment of 2.3.2 Haul and Place Muck = 351 cubic meters	$12,670.63	$2,917,988.19
8	7/30/04	Move raise plug and bulkhead	$0.00	$2,917,988.19
9	8/4/04	Add Item 3.1.5 Glengarry Monitoring Well	$45,000.00	$2,962,988.19
10	9/9/04	Add Item 4.1, Gold Dust, & 4.2 S. Henderson Adit closures	$9,261.29	$2,972,249.48
11	9/9/04	Add Item 1.2 Contractor VECP	$-25,341.34	$2,946,908.14
12	9/17/04	Adjust Item 3.1.5 to $35,779.11	$9,220.89	$2,937,687.25
13	10/21/04	AQ adjustments/Equitable Price adjustments	$176,816.33	$3,114,503.58
14	12/28/04	Gold Dust Adit borehole grouting, add time to 9/1/2005, COR	$96,000.60	$3,210,504.18
15	8/15/05	Adjust Item 3.3.2, Add vent raise and portal plug, +3 days	$71,093.23	$3,281,597.41

- The plans for drilling and grouting the 1066 roof leak changed after the timbers were stripped from the leaking zone, as the initially suspected dike turned out to be a fault that was oriented differently than believed from historical accounts. Because of this, one of the two original drill stations planned was deleted, and a larger drill station was constructed to drill the 1066 fault. As this drill station was much larger, the site was no longer suitable as a plug station so a new Plug Station #4 was constructed between the drill station and the 1066 fault. No modification was needed to the contract for this change as the work for the deleted drill station was traded for construction of the larger drill station. Additional work was required to clear timbers and muck from the 1066 zone than originally planned (in original contract as unit costs, part of Modification #3). Because the fault zone had stoped vertically and laterally upward into the back of the mine, a bulkhead was needed to allow completion of a grout curtain around the fault (part of Modification #4).
- Modification #4 was partially for adjustment of actual versus estimated quantities for various components of backfilling and plug installation. In addition to construction and cementing of the bulkhead at the 1066 fault zone, two other components of Modification #4 included an addition to the contract to grout and plug a leaking borehole in the McLaren Adit and adjustments for actual quantities in the Como Raise collar grouting.
- Modification #5 outlined procedures for electronic payment notification.

- Modification #6 included credits back to the US Government for adjustment to the actual quantities involved in drilling and grouting the 1066 fault zone and a credit for re-drilling of cement (previously charged but not a payable item under the contract).
- Two changes were approved to the cement backfilling and plugging of the Como Raise. The base of the backfill was dropped to a lower level in the raise for safety and structural reasons, and the watertight plug interval was raised one timber set in elevation (1.8 meters; 6 feet) for ease of construction and safety reasons. Neither of these changes required a change in the dollar value of the contract; however, Modification #8 was prepared to describe this change.
- Modification #9 included an addition to the contract to install a monitoring well behind Plug #6, as well as the addition to the schedule of values for two new pieces of equipment: 1) a track mounted rotary drill (Klemm 806D), and 2) a second air compressor.
- Modification #10 added two new additional items to the contract: 1) rehabilitation of the Gold Dust Portal, and 2) closure of the South Henderson Mountain Adits.
- Modification #11 resulted from a value engineering change proposal submitted by HBI that recommended cementing plug stations #1 and #2 from the portal and eliminating the need for four BQ drill holes, hole reaming, and drillhole casing.
- Modification #12 was a revision of price for the Glengarry monitoring well based on actual quantities and an extension of the contract completion date by 9 days because of all of the additions to the contract.
- Modification #13 included adjustments to actual quantities for the adit plugging, modified mobilization payment schedule and added 17 days to the project schedule.
- Modification #14 added the Gold Dust Adit borehole grouting as a modification to the contract,
- Modification #15 added the closure of the small vent raise above the Glengarry portal and the placing of a portal plug in the portal as modifications to the contract.

CONTRACT WORK ORDERS

Table 3 lists specific work orders that were issued in support of contract modifications and are part of the overall contract records.

TABLE 3
Summary of Contract Work Orders

Work Order	Date	Description
A	7/15/03	Install fuel tanks; construct turnout; separate debris; change rock storage site
B	7/31/03	Secondary settling pond modifications
C	8/3/03	Soil grouting plan dated 7/31/03
D	8/6/03	Trench excavation
E	7/23/04	Item 4.1 Gold Dust Mine Portal rehabilitation
F	8/19/04	Item 4.2 South Henderson Adit Closures Item 4.3 Glengarry Powder Adit Closure

RECOMMENDATIONS

Overall, this project went much smoother than anticipated. This largely had to do with the contractual competence and experience of the COR (managing modifications, work orders, record keeping, and anticipating problems), the technical competence of both the COR and the Technical Representatives, and their commitment to being physically present during all critical periods of work execution. In addition, the COR and Technical Representatives were capable of making sound, on-the-spot, technical decisions to keep the project moving ahead, and the On-Scene Coordinator provided strong, decisive, and technically sound project guidance and oversight that greatly facilitated overall project management. HBI should also be commended for their technical capabilities, flexibility, and adaptability to change and willingness to work and do what was needed to get the job done in a very cordial and professional fashion. These factors were critical to the overall success of the project.

A few items could have been done differently that may have helped the project move forward more quickly and efficiently.

1. The timber sets at the 1066 roof leak could have been stripped out during the assessment phase of the project, which would have allowed a better understanding of the structure and its orientation and condition prior to design of the closure action. This wasn't done due to concerns about compromising the structural integrity of the drift if the timber sets were removed.

2. Rules regarding set times for phases of cementing and grouting should not have been allowed to vary, thinking it might be more expedient. The two or three times these rules were violated it caused subsequent problems and delays.

3. The contractor should have always had adequate management supervision of the grouting crews on-site during periods of active grouting.

4. The contractor should have provided competent QA/QC staff for monitoring cement characteristic, batch mixes, and pours.

5. The 2004 completion schedule could have been met if the contractor had been slightly more efficient and organized; however, numerous additions to the contract probably made this objective unattainable, and certainly many of the very worthwhile additions may not have been completed at all without the overall delay to the project schedule.

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APPENDIX A

SCHEDULE OF ITEMS

APPENDIX A

Original and Final Schedule of Items

				Awarded Schedule			Revised Schedule		
Bid Item No.	**Description**	**Method of Meas.**	**Pay Unit**	**Orig. Qty.**	**Orig. Unit Price**	**TOTAL**	**Revised Qty.**	**Revised Unit Price**	**TOTAL**
1	**MOBILIZATION**								
1.0	Mobilization	LSQ	ls	1	$525,000.00	$525,000.00	1	$525,000.00	$525,000.00
1.1	Sign Installations	LSQ	ls				1 Mod 2	$775.00	$775.00
1.2	Contractor VECP	LSQ	ls				1 Mod 11	$30,972.74	$30,972.74
2	**2003 WORK**								
2.1	Glengarry Site Work	LSQ	ls	1	$79,866.00	$79,866.00	1	$79,866.00	$79,866.00
2.2	Construct Secondary Sediment Pond	LSQ	ls	1	$78,394.00	$78,394.00	1	$78,394.00	$78,394.00
2.2.1	Secondary Pond Subdrain	LSQ	ls				1 Mod 1	$6,300.00	$6,300.00
2.3	Construct Muck Solids Storage Pad								
2.3.1	Construct Muck Storage Pad	AQ	square meter	220	$191.96	$42,231.20	440 Mod 2	$191.96	$84,462.40
2.3.2	Haul and Place Muck Solids	AQ	cubic meter	150	$408.73	$61,309.50	351 Mod3&7	$408.73	$143,464.23
2.4	Glengarry Tunnel Rehabilitation/Drill Station/Plug Site Excavation								
2.4.1	Glengarry Tunnel Rehabilitation	LSQ	ls	1	$90,000.00	$90,000.00	1	$90,000.00	$90,000.00
2.4.1A	Uncover 1066 Structure	LSQ	ls				1 Mod 3	$1,030.00	$1,030.00
2.4.1B	Bulkheading 1066 Structure	LSQ	ls				1 Mod 4	$19,405.00	$19,405.00
2.4.1C	Grout Backfill 1066 Structure	LSQ	ls				1 Mod 6	$10,140.00	$10,140.00
2.4.2	Underground Plug site Construction	LSQ	ls	1	$80,000.00	$80,000.00	1	$80,000.00	$80,000.00
2.4.3	Underground Drill Station Construction	LSQ	ls	1	$61,226.00	$61,226.00	1	$61,226.00	$61,226.00
2.5	Como Raise Collar Grouting								
2.5.1	Drilling Colluvium and Alluvium	AQ	meter	100	$187.00	$18,700.00	201 Mod 3	$187.00	$37,587.00
2.5.2	Colluvium and Alluvium Hook-up	AQ	each	30	$2,200.00	$66,000.00	22 Mod 3	$2,200.00	$48,400.00

APPENDIX A

Original and Final Schedule of Items

				Awarded Schedule			Revised Schedule		
Bid Item No.	**Description**	**Method of Meas.**	**Pay Unit**	**Orig. Qty.**	**Orig. Unit Price**	**TOTAL**	**Revised Qty.**	**Revised Unit Price**	**TOTAL**
2.5.3	Grouting Colluvium and Alluvium with Portland cement	AQ	tonnes	40	$1,653.45	$66,138.00	34.45 Mod 3	$1,653.45	$56,961.35
2.5.4	Drilling Bedrock	AQ	meter	270	$193.17	$52,155.90	373 Mod 4	$193.17	$72,052.41
2.5.5	Pressure Grouting Standpipes	AQ	each	30	$200.00	$6,0000.00	28 Mod 4	$200.00	$5,600.00
2.5.6	Pressure Grouting Packers	AQ	each	15	$125.00	$1,875.00	0 Mod 4	$125.00	$0.00
2.5.7	Pressure Grouting Hook-up	AQ	each	30	$1,000.00	$30,000.00	42 Mod 4	$1,000.00	$42,000.00
2.5.8	Pressure Grouting with Portland cement	AQ	tonnes	10	$1,929.03	$19,290.30	7.4 Mod 4	$1,929.03	$14,274.82
2.5.9	Pressure Grouting with ultrafine cement	AQ	tonnes	10	$2,687.41	$26,874.10	5.9 Mod 4	$2,687.41	$15,855.72
2.5.10	Winter Adit Grouting	LSQ	ls				1 Mod 4	$4,087.00	$4,087.00
2.6	1066 Roof Leak Grouting								
2.6.1	Drilling BQ core	AQ	meter	800	$186.97	$149,576.00	499.3 Mod 6	$186.97	$93,354.12
2.6.1A	Redrilling Cement	AQ	meter				46.4 Mod 6	$93.49	$4,337.94
2.6.2	Hook-up	AQ	each	40	$200.00	$8,000.00	19 Mod 6	$200.00	$3,800.00
2.6.3	Grouting with Portland cement	AQ	tonnes	65	$496.04	$32,242.60	23.9 Mod 6	$496.04	$11,855.36
2.6.4	Grouting with ultrafine cement	AQ	tonnes	65	$1,984.14	$128,969.10	1 Mod 6	$1,984.14	$1,984.14
2.7	Como Raise Backfilling and Plugging								
2.7.1	Set-up and raise preparation	LSQ	ls	1	$58,000.00	$58,000.00	1	$58,000.00	$58,000.00
2.7.2	Batch and place cemented backfill	AQ	cubic meter	700	$313.91	$219,737.00	498.1 Mod 13	$343.95	$171,321.50
2.7.3	Construct plug	LSQ	ls	1	$64,500.00	$64,500.00	1	$64,500.00	$64,500.00

APPENDIX A

Original and Final Schedule of Items

				Awarded Schedule			Revised Schedule		
Bid Item No.	**Description**	**Method of Meas.**	**Pay Unit**	**Orig. Qty.**	**Orig. Unit Price**	**TOTAL**	**Revised Qty.**	**Revised Unit Price**	**TOTAL**
3	**2004 WORK**								
3.1	Plug site Boreholes								
3.1.1	Drilling BQ hole	AQ	meter	440	$187.01	$82,284.40	382.6 Mod 11&13	$187.01	$71,550.03
3.1.2	Drilling 10 cm (4 inch) or larger hole	AQ	meter	880	$262.46	$230,964.80	682.7 Mod 11&13	$262.46	$179,181.44
3.1.3	Casing BQ hole	AQ	meter	100	$170.60	$17,060.00	115 Mod 13	$170.60	$19,619.00
3.1.3A	Casing BQ Hole Overrun	AQ	meter				234.5 Mod 13	$148.35	$34,788.08
3.1.4	Casing 10 cm (4 inch) or larger hole	AQ	meter	200	$246.06	$49,212.00	230 Mod 13	$246.06	$56,593.80
3.1.4A	Casing 10 cm Hole Overrun	AQ	meter				457.7 Mod 13	$213.97	$97,934.07
3.1.5	Glengarry Monitoring Well	LSQ	ls				1 Mod 9&12	$35,779.11	$35,779.11
3.2	Batching Cemented Fill (paid under item 3.3.2)								
3.3	Cemented Fill Plugging and Backfill								
3.3.1	Plug site preparation	LSQ	ls	1	$75,656.00	$75,656.00	1	$75,656.00	$75,656.00
3.3.2	Placing cemented fill	AQ	cubic meter	1200	$333.53	$400,236.00	1383.32 Mod 15	$333.53	$461,378.72
3.3.3	Portland cement grouting	AQ	tonnes	40	$971.45	$38,858.00	40	$971.45	$38,858.00
3.3.4	Place Glengarry Dump rock	AQ	cubic meter	350	$255.05	$89,267.50	402.5 Mod 13	$255.05	$102,657.63
3.3.4A	Place Glengarry Dump Rock Overrun	AQ	cubic meter				339.9 Mod 13	$221.78	$75,383.02

APPENDIX A

Original and Final Schedule of Items

				Awarded Schedule			Revised Schedule		
Bid Item No.	**Description**	**Method of Meas.**	**Pay Unit**	**Orig. Qty.**	**Orig. Unit Price**	**TOTAL**	**Revised Qty.**	**Revised Unit Price**	**TOTAL**
4	**MISCELLANEOUS ADDED WORK**								
4.1	Gold Dust Mine Portal Rehab	LSQ	ls				1 Mod 10	$7,053.69	$7,053.69
4.2	South Henderson Adit Closures	LSQ	ls				1 Mod 10	$2,207.60	$2,207.60
4.3	Gold Dust Adit Borehole	LSQ	ls				Mod 14	$96,000.60	$96,000.60
4.4	Plug Short Raise	LSQ	ls				Mod 15	$6,943.51	$6,943.51
4.5	Portal Plug with Clean Material	LSQ	ls				Mod 15	$3,007.00	$3,007.00
	TOTAL					$2,949,623.40			$3,281,597.41

DESIGNATED METHOD OF MEASUREMENT

DQ Designed Quantities
LSQ Lump Sum Quantities
AQ Actual Quantities

APPENDIX B

DRILLING AND GROUTING SUMMARY SPREADSHEETS

TABLE B-1
TRENCHED GROUT WALLS
COMO RAISE COLLAR GROUTING

Segment	Day	Legnth (feet)	Width (feet)	Depth (feet)	Calc. (cu ft)	Calc. (gallons)	Calc. (bags)
South	6-Aug	9	1.6	4	57.6	430.8	38.3
Southwest	6-Aug	6	1.6	6	57.6	430.8	38.3
Southeast	6-Aug	9	1.6	4	57.6	430.8	38.3
West	7-Aug	7.5	1.6	6	72	538.6	47.9
East	7-Aug	9	1.6	6	86.4	646.3	57.4
Northeast	8-Aug	9	1.6	6	86.4	646.3	57.4
	12-Aug	35	1.6	3	168	1256.6	111.7
Total Circumference		84.5			585.6	4380.3	389.4
Calc. Circumference		94.248					
HBI Circumference		69				HBI bags	345

TABLE B-2
12 INCH AUGER HOLE DRILLING
COMO RAISE COLLAR GROUTING

Hole #	Cement (feet)	Waste (feet)	Bedrock Top (feet)	TD (feet)	Total Depth Cement (feet)	Total Depth Cement (meters)	Comments
A-0	0.0	7.0	7.0	8.5	8.5	2.59	Allan's Folly
A-1 8/11	7.0	0.0	7.0	7.5	0.5	0.15	
G-1	3.0	13.0	16.0	17.0	14.0	4.27	drilled hole between A-1 and C-1 at steep excavation cut
C-1 8/13	3.0	17.0	20.0	22.0	19.0	5.79	hole G-1 took a lot of grout, make C-1 a primary hole
D-8	2.6	17.9	20.5	22.0	19.4	5.91	wood at 13'
B-1 8/12	2.6	12.4	15.0	16.0	13.4	4.08	took a lot of grout; hole too shallow?
B-1 redrill	18.0	2.5	20.5	22.0	4.0	1.22	redrill of above to proper depth
D-7	2.6	17.4	20.0	22.0	19.4	5.91	
E-1 8/15	2.6	17.4	20.0	22.5	19.9	6.07	
A-2	2.6	18.4	21.0	23.0	20.4	6.22	
C-2	2.6	19.4	22.0	23.0	20.4	6.22	
E-2	2.6	17.4	20.0	22.5	19.9	6.07	1.5 feet massive sulfide
B-2	3.0	20.0	23.0	25.0	22.0	6.71	
D-6	3.0	17.5	20.5	23.5	20.5	6.25	soft minor massive sulfide, lots of grout (5 min)
E-3	3.0	17.0	20.0	22.5	19.5	5.94	hard at 21.5 seems shallow Consider as Primary Hole
A-3	3.0	21.0	24.0	26.0	23.0	7.01	2.5 feet wet massive sulfide + chlorite mud. TD sil. Cm
C-3	2.6	18.4	21.0	26.0	23.4	7.13	3.5 feet wet massive sulfide + chlorite mud. TD sil Cm
D-5	2.6	18.4	21.0	23.5	20.9	6.37	
F-1 8/18	2.6	17.9	20.5	24.0	21.4	6.52	21-23.5 massive sulfide
G-2	1.6	20.9	22.5	24.0	22.4	6.83	massive sulfide 21-22.5
E-4	2.6	18.9	21.5	24.0	21.4	6.52	1.5 feet massive sulfide, TD silicified limestone
A-4	2.6	18.4	21.0	26.0	23.4	7.13	check depths with Todd; hole too shallow?, changed
B-3	2.6	18.4	21.0	26.0	23.4	7.13	4.0 feet wet massive sulfide + chlorite mud, TD sil Cm
E-5	2.6	15.4	18.0	24.0	21.4	6.52	18-20 soft, 21.5-23 massive sulfide
G-3	3.0	18.0	21.0	21.5	18.5	5.64	narrow overlap hole hard drilling
F-2	3.0	16.5	19.5	23.0	20.0	6.10	massive sulfide 20.5-22.5
D-4	3.0	17.5	20.5	23.5	20.5	6.25	6' wood, 6" overlap, lots of grout (5 min)
							consider A-5 as a primary hole
A-5		20.0	20.0	21.0	21.0	6.40	4.0 feet wet massive sulfide + chlorite mud, TD sil Cm
B-4	3.6	17.4	21.0	24.0	20.4	6.22	3.0 feet wet massive sulfide + chlorite mud, TD sil Cm
E-6	3.0	14.0	17.0	27.0	24.0	7.32	26-27 drilled 35 level workings
H-1	3.0			21.0	18.0	5.49	Told drillers to take this hole to 21 feet
D-3	see E-7						adj hole wet not completed today
E-7	4.0	5.0	9.0	18.5	14.5	4.42	massive sulfide 9-18
A-6	4.0	5.0	9.0	14.0	10.0	3.05	Soft bedrock 9-13 feet; TD sil Cm
D-2	3.0	7.0	10.0	13.0	10.0	3.05	Soft bedrock 10-12 feet; TD sil Cm, lots of grout
F-3	3.0	4.5	7.5	9.5	6.5	1.98	
E-4	2.6	5.4	8.0	9.5	6.9	2.10	
D-1 8/14	3.0	6.0	9.0	10.0	7.0	2.13	
A-7	2.6	5.9	8.5	9.0	6.4	1.95	TD sil Cm
Total				767.0	645.2	196.7	no pay for redrilling cement

TABLE B-3
BEDROCK/COLLUVIAL CONTACT OR SHALLOW BEDROCK DRILLING
COMO RAISE COLLAR GROUTING

Hole No.	Depth (feet)	Depth (meters)	Bedrock (feet)	Bedrock (meters)	Pressure (psi)	Grout (gallons)	Grout (bags)	Comments
P1	25.0	7.6	2.0	0.6	22	44.0	3.9	Start flow 22/ End flow 9, Ground refusal outside (blowout)
P2	25.0	7.6	2.0	0.6	25	45.0	4.0	Refusal (for 5 minutes)
P3	17.5	5.3	1.5	0.5	44	5.4	0.5	Refusal (for 5 minutes)
P4	9.0	2.7	1.5	0.5	24	18.8	1.7	Refusal (for 5 minutes)
P5	9.0	2.7	1.5	0.5	15	4.7	0.4	Refusal (for 5 minutes)
P6	8.5	2.6	1.5	0.5	18	6.0	0.5	Refusal (for 5 minutes)
P7	6.5	2.0	1.5	0.5	14	5.0	0.4	Refusal (for 5 minutes)
P8	5.5	1.7	2.0	0.6	14	6.0	0.5	Refusal (for 5 minutes)
P9	5.5	1.7	1.5	0.5	17	7.1	0.6	Refusal (for 5 minutes)
P10	4.6	1.4	1.5	0.5	14	6.0	0.5	Refusal (for 5 minutes)
P11	4.5	1.4	1.5	0.5	18	6.0	0.5	Refusal (for 5 minutes)
P12	7.5	2.3	2.0	0.6	15	18.7	1.7	Ground refusal inside (blowout)
P13	9.0	2.7	2.0	0.6	8	104.7	9.3	Start flow 20/ End flow 17,
P14	23.5	7.2	1.5	0.5	30	144.0	12.8	Start flow 30/ End flow 30,
P15	22.0	6.7	1.5	0.5	23	56.8	5.0	Start flow 23/ End flow 20,
							0.0	
S1	23.0	7.0	1.5	0.5	34	47.8	4.2	Start flow 22/ End flow 22,
S2	19.5	5.9	1.5	0.5	16	54.7	4.9	Start flow 19.6/ End flow 19,
S11	6.5	2.0	2.0	0.6	17	10.0	0.9	Refusal (for 5 minutes)
S12	8.5	2.6	1.5	0.5	17	6.0	0.5	Refusal (for 5 minutes)
S13	18.5	5.6	1.5	0.5	32	87.0	7.7	Start flow 22/ End flow 20,
S14	23.5	7.2	1.5	0.5	32	47.6	4.2	Start flow 25/ End flow 24,
S15	22.5	6.9	1.5	0.5	32	61.0	5.4	Start flow 20/ End flow 20,
TOTAL								
THRU 8/31	304.6	92.8	36.0	11.0		792.3	70.4	
		Chargeable		11.0		Chargeable	70.4	

TABLE B-4
DEEP BEDROCK HOLES DRILLING
COMO RAISE COLLAR GROUTING

Hole No.	Date Drilled	Total Depth (feet)	Total Depth (meters)	Date Grouted	Grout Type	Grout (gallons)	Grout microfine (bags)	Grout Portland (bags)	Final Pressure (psi)	REFUSAL	COMMENTS
P-1	8-Sep	30	9.1	9-Sep	microfine	157.2	20		4	No	
P-1A	10-Sep	30	9.1	11-Sep	portland	321.2		40	30	Yes	0.5:1 portland mix, lg vol and press refusal
S-1	15-Sep	30	9.1	16-Sep	microfine	78.9	18		20	Yes	
P-2	8-Sep	30	9.1	9-Sep	microfine	281.0	40		10	No	
P-2A	10-Sep	30	9.1	11-Sep	portland	12.5		2	30	Yes	0.5:1 portland mix
S-2	10-Sep	30	9.1	16-Sep	microfine	73.2	15		30	Yes	comm with surface
P-3	8-Sep	23	7.0	18-Sep	microfine	8.0	0		10	No	drilled 35 level drift at 21' 10" (1 ft slab back)
S-3				11-Sep	portland	done				Yes	comm with P-4 grouted together
P-4	8-Sep	30	9.1	9-Sep	microfine	140.5	20		10	No	
P-4A	10-Sep	30	9.1	11-Sep	portland	260.7		29	25	Yes	0.5:1 portland mix, lg vol and press refusal
											two leaks to surface 2' BGS at cribbing
											cross comm with S-3, capped -grouted together
S-4	16-Sep	30	9.1	17-Sep	microfine	17.0	3		20	Yes	
P-5	4-Sep	30	9.1	9-Sep	microfine	140.5	20		10	No	
P-5A	10-Sep	30	9.1	11-Sep	portland	32.2		3	30	Yes	0.5:1 portland mix
S-5	16-Sep	30	9.1	17-Sep	microfine	58.6	15		20	Yes	comm with surface
P-6	27-Aug	17	5.2	5-Sep	portland	14.5		8	18	Yes	
P-6A (redrill)	8-Sep	13	4.0	9-Sep	microfine	68.1	10		30	Yes	
S-6	10-Sep	30	9.1	12-Sep	microfine	25.1	5		30	Yes	
P-7	27-Aug	30	9.1	4-Sep	microfine	40.6	3		30	Yes	
S-7	10-Sep	30	9.1	12-Sep	microfine	11.7	2		30	Yes	
P-8	27-Aug	30	9.1	9-Sep	microfine	158.5	22		22	No	
P-8A	16-Sep	30	9.1	17-Sep	microfine	17.0	4		20	Yes	
S-8											not drilled based on refusal and take of adj. Holes
P-9	27-Aug	30	9.1	4-Sep	microfine	17.3	3		10	No	blow-out on inside of grout wall
P-9A	16-Sep	30	9.1	17-Sep	microfine	10.0	2		20	Yes	
S-9	10-Sep	30	9.1	12-Sep	microfine	21.2	4		30	Yes	
P-10	27-Aug	30	9.1	4-Sep	microfine	19.9	6		26	Yes	
S-10	10-Sep	30	9.1	12-Sep	microfine	24.8	5		30	Yes	
P-11	27-Aug	29.5	9.0	4-Sep	microfine	70.2	18		11	Yes	
S-11	10-Sep	30	9.1	12-Sep	microfine	23.6	5		30	Yes	
P-12	27-Aug	30	9.1	4-Sep	portland	17.0		8	18	No	blow-out on inside of grout wall
P-12A	16-Sep	30	9.1	17-Sep	microfine	15.6	3		30	Yes	
S-12	17-Sep	30	9.1	18-Sep	microfine	11.1	2		30	Yes	
P-13	8-Sep	30	9.1	9-Sep	portland	150.6		20	4	No	water communication with P-14 during drilling
P-13A	10-Sep	30	9.1	11-Sep	portland	130.2		25	30	Yes	0.5:1 portland mix
P-13B	15-Sep	30	9.1	16-Sep	microfine	130.0	20		30	Yes	
S-13	17-Sep	30	9.1	18-Sep	microfine	62.5	15		30	Yes	
P-14	8-Sep	30	9.1	9-Sep	portland	97.0		0	4	No	water communication with P-13 during drilling
P-14A	10-Sep	30	9.1	11-Sep	portland	2.7		1	30	Yes	0.5:1 portland mix
P-14B	15-Sep	30	9.1	16-Sep	microfine	48.7	10		30	Yes	comm with P-13
S-14	17-Sep	30	9.1	18-Sep	microfine	40.6	10		20	Yes	comm with surface
P-15	10-Sep	30	9.1	11-Sep	portland	298.7		40	10	No	0.5:1 portland mix
P-15	15-Sep	30	9.1	16-Sep	microfine	63.2	14		10	Yes	comm with surface
S-15	17-Sep	30	9.1	18-Sep	microfine	37.8	10		10	Yes	comm with surface
Total		**1192.5**	**363.5**			**3209.7**	**323.5**	**176.0**			

NOTES: All flow rates were initially adjusted to 6 gallons per minute (gpm) injection as a maximum (controlled by mixing rate)
Refusal holes flow rate drops to < 1 gallon per minute (gpm) for 15 minutes or more commonly to 0 gpm at a constant pressure

TABLE B-5
BULKHEAD GROUTING 1066 FAULT ZONE
GLENGARRY ADIT

Labor			Date Grouted	Grout Mix	Bags Microfine	Bags Portland I/II	Bags Portland III	Comment
Men	Hours	Total Hours						
			10/8/2003		2.5			
3	1	3	10/9/2003	0.85/1		17		
2	5	10	10/11/2003				12	
1	8	8	10/13/2003					Foaming (15 cans)
2	2	4	10/13/2003					Foaming and packing w/ burlap
5	4	20	10/15/2003	0.85/1		63		
			10/15/2003	0.85/1			58	
6	variable	28	10/16/2003	0.85/1		70		10 gallons of sodium silicate
5	variable	31.5	10/17/2003	0.85/1		63		5 gallons of sodium silicate
			10/17/2003					1 box Okum, 3 cans foam
1	1.5	1.5	10/18/2003					
3	5	15	10/20/2003	5:1	4.3	84		
5	5	25	10/21/2003	0.85/1		88		10 gallons of soduim silicate
2	1	2	10/22/2003					Water test, no take in 3
								standpipes @ 25 psi
Sub Total	32.5	148	**Sub Total**	**bags**	**6.75**	**385**	**70**	
				tonnes	**0.135**	**16.394**	**2.981**	

TABLE B-6
1066 FAULT GROUTING
GLENGARRY ADIT

Hole No.	Station	Bearing	Azimuth	Inclination	Est. Distance to Fault (feet)	Actual Distance to Fault (feet)	Approx TD (feet)	Actual TD Core (feet)	Actual TD Rotary (feet)	Completion Date
P1	North	N 50 W	310	3	89		104		104	10/11/2003
P2	North	N 55 W	304	-7	83	78.5-81(96-98)	98	111.3		10/3/2003
P3	North	N 67 W	293	-14	79		94		94	10/10/2003
P4	South	N 63 W	297	-8	77	73.6-75.9	92	88.1		10/7/2003
P5	South	N 71 W	289	3	80		95		94	10/14/2003
P6	South	N 71 W	289	14	88	88-97.4	103	105.2		10/4/2003
P7	South	N 60 W	300	18	93		108		108	10/13/2003
P8	North	N 56 W	304	22(17)	96	92-96 (103-104)	111	112.5		9/27/2003
P9	North	N 52 W	306	13	96	103.5-107	105	111.9		10/1/2003

TABLE B-6
1066 FAULT GROUTING
GLENGARRY ADIT

Hole No.	Station	Bearing	Azimuth	Inclination	Est. Distance to Fault (feet)	Actual Distance to Fault (feet)	Approx TD (feet)	Actual TD Core (feet)	Actual TD Rotary (feet)	Completion Date
S1	North	N 53 W	307	-2	85		100			not drilled
S2	North	N 61 W	299	-12	80		95			not drilled
S3	South	N 58 W	302	-12	77		92		55	10/25/2003
redrill									55	10/28/2003
redrill									38	10/28/2003
S4	South	N 67 W	293	-2	78		93		55	10/24/2003
redrill								cement	55	10/27/2003
redrill								rock	38	
S5	South	N 73 W	267	9	64		79		45	10/23/2003
redrill								cement	45	10/24/2003
redrill								rock	44	10/24/2003
S6	South	N 54 W	295	17	91		106		106	10/21/2003
S7	South	N 60 W	306	18	96		111		111	10/22/2003
S8	North	N 57 W	303	16	97		112		112	10/16/2003
S9	North	N 49 W	311	8	94		105		104.5	10/18/2003

TABLE B-6
1066 FAULT GROUTING
GLENGARRY ADIT

Hole No.	Flow (gpm)	Flow Date	Static Pressure (psi)	Date Grouted	Grout Mix	Gallons (calc)	Bags Microfine	Bags Portland (I/II)	Refusal Pressure (psi)	Comment
P1	1.9	10/11/2003		10/15/2003	5:1	66.0		2.5		
	1.7	10/13/2003			3:1	15.9		1	Yes 150	low grout take
	1.3	10/14/2003								
P2	1.1	10/4/2003								
	0.8	10/8/2003		10/8/2003	3.5:1	50.0	2.5		Yes 120	low grout take
P3	very low	10/11/2003								
	0.1	10/13/2003		10/15/2003	5:1	14.6		0.5	Yes 150	very low grout take
P4	5.0	10/8/2003		10/23/2003	2:1	127.0		12		Stopped all flow to 1066 zone
	7.5	10/9/2003			1.5:1	19.9		12	Yes 150	Bulkhead filling forced grout
	7.9	10/11/2003								to P-4
	8.3	10/21/2003								
	8.8	10/23/2003								
P5				10/23/2003	2:1	148.1		14	Yes 150	Clouded P4 and wash to adit
	2.3	10/14/2003								@ 45 feet in small fault zone
P6	5.0	10/4/2003		10/9/2003	3:1	142.8		9		
	4.6	10/9/2003		10/9/2003	2:1	31.7		3	Yes 150	
P7				10/15/2003	5:1	52.9		2		
	0.2	10/14/2003			3:1	7.9		0.5	Yes 150	low grout take
P8	3.7	10/4/2003	44	10/9/2003	5:1	87.3		3		
	2.2	10/8/2003		10/9/2003	3:1	79.4		5		
	2.2	10/9/2003							Yes 150	
P9	1.6		38	10/8/2003	5:1	145.5	5			
	0.6	10/8/2003		10/8/2003	3:1	158.7	10			
				10/8/2003	2:1	95.2	9		Yes 120	

TABLE B-6
1066 FAULT GROUTING
GLENGARRY ADIT

Hole No.	Flow (gpm)	Flow Date	Static Pressure (psi)	Date Grouted	Grout Mix	Gallons (calc)	Bags Microfine	Bags Portland (I/II)	Refusal Pressure (psi)	Comment
S1										
S2										
S3	3.8	10/25/2003		10/27/2003	5:1	87.3	3		Yes 150	
redrill										
redrill	0.8	10/28/2003	22	10/28/2003	5:1	58.2		2	Yes 200	
S4	3	10/24/2003		10/24/2003	5:1	116.4		4		
					4:1	47.6		3		
					3:1	21.2		2	Yes 150	
redrill				10/27/2003	5:1	211.7	8			
redrill					4:1	84.7	4			
					3:1	95.2		6		
					2:1	42.3		4	Yes 200	shut off most flow at bulkhead
S5	2	10/23/2003		10/23/2003	5:1	218.3		7.5		drilled to 45' & grout short fault
					4:1	15.9		1		
					3:1	15.9		1.5	Yes 125	
redrill				10/27/2003	5:1	29.1	1		Yes 150	
redrill										
S6			24	10/23/2003	5:1	33.0		1.25	Yes 150	
S7	2		12	10/23/2003	5:1	33.0		1.25	Yes 150	
S8				10/17/2003	5:1	87.3		3		
				10/17/2003	4:1	84.7		4	Yes 150	
S9			26	10/20/2003	5:1	50.9	1.75		Yes 150	low grout take

TABLE B-7
CEMENT BACKFILL PLACED
COMO RAISE

Date	Cubic Yards	Cubic Meters	Comments
8/17/2004	9.9	7.57	
8/18/2004	31.3	23.93	
8/19/2004	30.7	23.47	
8/24/2004	78.8	60.25	discrepancy 86.1 (?)
8/27/2004	82.0	62.69	to bottom of plug 86.1 (?)
8/28/2004	56.8	43.43	Water Tight plug
8/31/2004	26.4	20.18	on top of bentonite and wooden mat
9/1/2004	117.0	89.42	
9/2/2004	146.8	112.24	
9/7/2004	57.5	43.96	final pour raise complete
Total	637.2	487.14	

TABLE B-8
DRILL HOLES FROM PLUG STATIONS
GLENGARRY ADIT

Hole #	Azimuth	Inclination	Diameter	Total Depth (feet)	Total Depth (meters)	Reamed (feet)	Cased BQ		Cased 3" (meters)	Grouted	Bags	Pounds	Tons (metric)	Complete	Comments
							(meters)	(hours)							
04-GD-6-1	185	85	BQ	371.3	113.2	371.3	0		113.4	X	?	unknown		X	
04-GD-6-2	86W	86	BQ	372.0	113.4	0	113.4	2	0	X	?	unknown		X	
04-GD-6-3	0	90	BQ	377.2	115.0	377.2	0		114.9	X	?	unknown		X	
04-GD-5-1	196	86	BQ	299.0	91.1	299.0	0		90.7	X	73	6862	3.11	X	casing + TD do not agree
04-GD-5-2	88W	86	BQ	296.2	90.3	0	113.4	6	0	X	incl.			X	
04-GD-5-3	87E	86	BQ	302.2	92.1	299.7	0		92.0	X	incl.			X	reamed different than drilled
04-GD-4-1	149	86	BQ	274.0	83.5	0	84.9		0	X	incl.			X	
04-GD-4-2			BQ	289.5	88.2	275.3	0		85.3	X	incl.			X	casing + TD do not agree
04-GD-4-3			BQ	278.5	84.9	278.0	0		85.3	X	incl.			X	
04-GD-3-1	112	68.5	BQ	169.0	51.5	168.3	0		52.8	X	?	unknown			
04-GD-3-2			BQ	168.5	51.4	164	0		51.2	X	?	unknown			10' of BQ casing only
04-GD-3-3			BQ	169.0	51.5	0	3.0		0	X	?	unknown			I had hole depth of 172
04-GD-2-1	0	90	BQ	91.6	27.9	0	6.1		0	X					
04-GD-1-1	0	90	BQ	37.0	11.3	0	6.1		0	X					
FCGW-100	0	90	4.75	386.0	117.7			4	0	X					
Total				3495.0	1065.3	2232.8	326.9	8.0	685.7						

TABLE B-9
CEMENT PLUG BACKFILL 2004
GLENGARY ADIT

Plug #	Date	Cubic Yards	Cubic Meters	Sacks (Cement)	Tons (metric) Grout	Total Cubic Meters	Comments
	18-Sep	45.4	34.71				bulkhead I-beam moves, stopped will top off
	6-Oct			181.00	7.72	34.7	grouting drill holes 181 sacks = 7.72 tons
6							6.4 cu yds or 4.89 cu m
	27-Sep	109.0	83.34				
	28-Sep	96.0	73.40				
	29-Sep	166.2	127.07				
	30-Sep	208.3	159.26				
5	1-Oct	6.3	4.82			447.9	last pour should have taken much more
	1-Oct	51.0	38.99				
		3.8	2.91			41.90	blowout
	4-Oct			48.00	2.05		from surface with small grout plant (incl. Plug 5 hole top off)
4	5-Oct			26.00	1.11		incl 3 bags microfine
Total tons (m) of grout					10.87		
	6-Oct	175.0	133.80				
	7-Oct	197.0	150.62				mine waste backfill
	8-Oct	136.0	103.98				132m x 1.8m x 2.1 m dimentions
	9-Oct	200.0	152.91				calculated volume to fill = 498.96
	10-Oct	175.0	133.80				
3.5	11-Oct	72.0	55.05				
Total muck placed between plugs 3 and 4 as backfill		955.0	730.1				
3	not done	3.2	2.48				not pumped into plug, into HDPE line that failed.
Grand Total of Cement placed in plugs		689.2	527.0				

TABLE B-10
CEMENT PLUG BACKFILL 2005
GLENGARRY ADIT

Plug #	Date	Stroke Count	Cubic Yards	Cubic Meters	Sacks Cement	Sacks Grout	Metric Tons Grout	Comments
	9/18/2004		45.4	34.71				bulkhead I-beam moves, stopped will top off
	10/6/2004				181.00		7.72	grouting drill holes 181 sacks = 7.72 tons
								6.4 cu yds or 4.89 cu m
6	**Totals**		**45.4**	**34.7**	**181.0**		**7.72**	
	9/27/2004		109.0	83.34				
	9/28/2004		96.0	73.40				
	9/29/2004		166.2	127.07				
	9/30/2004		208.3	159.26				
	10/1/2004		6.3	4.82				last pour should have taken much more
5	**Totals**		**585.8**	**447.9**				
	10/1/2004		51.0	38.99				
			3.8	2.91				blowout
	10/4/2004				48.00		2.05	from surface with small grout plant (incl. Plug 5 hole top off)
	10/5/2004				26.00		1.11	incl 3 bags microfine
4	**Totals**		**54.8**	**41.9**	**74.0**		**3.2**	
	10/6/2004		175.0	133.80				
	10/7/2004		197.0	150.62				mine waste backfill
	10/8/2004		136.0	103.98				132m x 1.8m x 2.1 m dimentions
	10/9/2004		200.0	152.91				calculated volume to fill = 498.96
	10/10/2004		175.0	133.80				
	10/11/2004		72.0	55.05				
3.5	**Totals**		**955.0**	**730.1**				
	2004 (not done)		3.2	2.48				not pumped into plug, into HDPE line that failed.
	7/26/2005	625 (9.65cyds?)	10.2	7.80	195.00			Partial pour started late in day (cu ft/stroke = 0,417)
	7/27/2005	1389?	34.2	26.15	273.00			Pour up into arch (cu ft/stroke 0.667 problem with calibration)
	7/28/2005					75.00	3.20	grouting drill holes 75 sacks = 3.2 tons
								Calculated volume 53 cu yards, HBI says 64.4
3	**Totals**		**47.6**	**36.4**	**468.0**	**75.0**	**3.20**	Stroke count off; Negotiated settlement

TABLE B-10
CEMENT PLUG BACKFILL 2005
GLENGARRY ADIT

Plug #	Date	Stroke Count	Cubic Yards	Cubic Meters	Sacks Cement	Sacks Grout	Metric Tons Grout	Comments
								Calculated volume 150m x 2.5m x 2.5m= 937 cu m
	8/4/2005	3813	123.6	94.50	490			Plus muck bay
	8/5/2005	4002	129.7	99.16	507			0.875 cu ft/stroke, mamufacturer and last job, calibrated below
	8/6/2005	527	17.1	13.07	58			Broken auger sprocket
	8/8/2005	143	4.6	3.52	21			Damaged aggregate/cement belt with large rock
	8/9/2005	2662	86.3	65.98	465			
	8/10/2005	3489	113.1	86.47	517			
	8/11/2005	393	12.7	9.71	60			Pump cylinder loose and detached, damaged sensor
	8/15/2005	4220	136.8	104.59	647			
	8/16/2005	2865	92.8	70.95	395			
	8/17/2005	2991	96.9	74.08	403			Pump stroke calibration test +0.875 cu ft/stroke
	8/18/2005	2556	82.8	63.30	385			Rain today
	8/19/2005	1417	45.9	35.09	140			
	8/22/2005	2153	69.8	53.37	311			112.8 cu yds of aggregate delivered
	8/23/2005	155	5	3.82	20			complete, Overall Average 5.68 bags of cement/cu yd
2	**Totals**		**1017.10**	**777.62**	**4419.00**			
	8/23/2005	65	2.1	1.61	9			Poured surface raise plug
	8/24/2005	190	6.2	4.74	27			
								Average 4.4 bags/cu yd
Surface Raise Plug	**Totals**		**8.3**	**6.35**	**36**			complete, may be labor associated with prep
	8/24/2005	1642	53.2	40.67	393			Calculated volume Bruce = 65.5 cu yds
								Average 7.4 bags/cu yd
	8/26/2005					55	2.34	55 bags of 3 sack mix, 18 batches= 6.0 cu yds
1	**Totals**		**53.20**	**40.67**	**393.00**	**55.00**	**2.34**	
	8/31/2005		6	4.59				Rock placed with mucker, material free
								3 cu yds rock placed with loader hourly
			45	34.40				Aggregate placed with mucker
			51	38.99				Total materials placed with the mucker
								18 cy yds (13.8 cu m) (6 loads)aggregate placed with loader hourly
	Totals		**102**	**77.98**				cu meters placed underground with mucker, material cost incl.
	Pay Items			**39.00**				13.8 cu m of aggregate at cost plus
	Pay Items			**13.80**				loader time, includes operator
Portal Plug	**Pay Items (Hours)**	**1.5**						may be other misc labor charges
PAY ITEM: Total metric tons of grout							**16.41**	
PAY ITEM: Total Cubic Meters of Cement							**1463.5**	
PAY ITEM: Total Cubic Meters of Waste Rock Backfill							**730.1**	