SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN

MARCH 2013 UPDATE - FINAL

Prepared by

Teck Resources Limited

July 15, 2013

Report Distribution

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1.0 INTRODUCTION

The Sä Dena Hes Mine (the Company) is currently owned by a joint venture between Teck Metals Limited ("Teck" - 25% ownership), Teck Resources Limited ("Teck" - 25% ownership) and Pan Pacific Metal Mining Corp (50% ownership, a wholly owned subsidiary of Korea Zinc.) The Joint Venture purchased the Sä Dena Hes lead/zinc property in March 1994. Teck is the operator under the joint venture agreement. Currently Teck is in the process of reorganizing some of its assets and this will eventually result in the joint venture being owned 50% by Korea Zinc and 50% by Teck Resources Limited. Teck will continue to manage the joint venture.

This document contains updates to the Detailed Decommissioning and Reclamation Plan ("DDRP", or the "Plan") for the Sä Dena Hes Mine, Yukon that was originally submitted in February of 2000 and subsequently updated in January 2006, January 2010, and January 2012. This Plan addresses closure issues related to the decommissioning of operations at Sä Dena Hes and reclamation of the site.

The January 2010 amendment to the Water Licence, under "Permanent Closure", Section 78, deems that permanent closure shall commence January 29, 2013. On January 26, 2012 Teck informed the Yukon Government of its intent to comply with the terms of the Water Licence and enter into Permanent Closure and begin to implement the Detailed Decommissioning and Reclamation Plan on January 29, 2013.

In 2012, additional site assessment and studies were conducted to provide additional information to refine the DDRP. In addition, the Liard First Nation (LFN) retained their joint venture consultant Keyeh Nejéh Golder (KNG) to review the January 2012 version of the DDRP to identify gaps and make comments. Golder Associates Ltd. (Golder) undertook the review on behalf of KNG. The March 2013 update of the DDRP incorporates the studies completed to date and addresses comments raised by LFN. This "March 2013 Final" revision incorporates comments received from the Yukon Environment and an update to the 2012 cost estimate is discussed in Section 6.1.

The previous versions of the DDRP included two different scenarios related to closure. The first was if the mine was reclaimed without going back into production and the second considered if

the mine had reopened and completed mining the remaining mineral reserves. As the mine is now deemed to be in Permanent Closure, the second scenario is no longer applicable and closure works associated with it have been removed from this update to the DDRP.

The Sä Dena Hes Operating Corporation has a Type A Water Use Licence (QZ99-045, formerly QZ97-025) issued pursuant to the Yukon Waters Act and Regulations for the mine and milling operations. Teck continues to ensure that all Water Licence obligations are fulfilled on behalf of the Sä Dena Hes Operating Corporation. The Company also has a Yukon Quartz Mining Production Licence QML-0004 issued pursuant to the Yukon Quartz Mining Act and Regulations.

A thorough plan, complete with detailed designs, is presented for all activities that need to be undertaken for an environmentally safe and responsible closure of the Sä Dena Hes Mine. The Plan addresses both the long term physical and chemical stability of the site including reclamation of surface disturbances. A program is presented for site management and monitoring both during implementation of closure and after decommissioning and reclamation measures are completed. The Plan is based on the best information available at the present time however additional environmental investigations will continue through the implementation of the DDRP. If the additional investigations identify any issues not adequately addressed in this Plan, then the Plan will be adapted and any required regulatory approvals for the changes will be obtained prior to the revised Plan being implemented. Decommissioning and reclamation cost estimates are provided and financial security requirements were updated to current amounts.

1.1 CLOSURE PHILOSOPHY

In keeping with its recognized worldwide high standards for environmental and social responsibility, Teck will implement an environmentally sound and technically feasible decommissioning and reclamation plan for the Sä Dena Hes mine. Closure planning and the implementation of the DDRP at a minesite must be undertaken with appropriate environmental care, while respecting local laws, traditional land uses, public interest and ensuring that the company's high environmental standards are achieved. This approach is consistent with Teck's Corporate Code of Sustainable Conduct (see Appendix A). Annually, Teck reports on its Sustainability performance and in 2011 was appointed to the Dow Jones Sustainability World

Index for the second consecutive year, indicating that its sustainability practices rank in the top 10% of companies in the resource industry worldwide. Copies of Teck's Sustainability Reports can be found on Teck's public web site at

www.teck.com/Generic.aspx?PAGE=Teck+Site/Responsibility&portalName=tc

A principal philosophy followed during the development of this Plan was to work towards an eventual closure that requires minimal long term monitoring and maintenance. This involved an assessment of the key mine components that could potentially place the public or the environment at risk following closure. Mitigation measures have been designed to address public safety issues and environmental concerns with post closure monitoring and inspections planned to ensure that this objective is met. Once the effectiveness of the mitigation measures is assured, the management of the site can be safely reduced to a level that is consistent with final closure. Post-closure monitoring has been designed to ensure that performance objectives are closely monitored and inspected during the initial years following implementation of closure measures. It is anticipated that final determination of the effectiveness of closure measures will be the subject of review and concurrence with regulatory agencies, First Nations and the public.

Performance-based criteria were adopted for the Plan where deemed possible. The Water Licence Plan performance criteria for physical structures have been reviewed and criteria selected to conform to the closure philosophy. Licensed effluent discharge standards were used as criteria for waters emanating from the tailings management facility while CCME Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life were used to assess effectiveness of closure measures to local downstream receiving waters. These same performance based criteria will be used to determine the effectiveness of closure measures during post-closure monitoring. It is expected that post-closure monitoring and inspection results will be reviewed to ensure that closure objectives continue to be met well after decommissioning. If these objectives are not met, maintenance or contingency plans will be developed as necessary to address potential areas requiring further remediation.

To ensure that the closure philosophy can be achieved, the following objectives were emphasized during the development of this Plan:

- Protection of public health and safety;

- Implementation of environmental protection measures that minimize adverse environment impacts;
- Ensuring land use commensurate with surrounding lands;
- Post closure monitoring of the site to assess effectiveness of closure measures for the long term

1.2 FIRST NATIONS CONSULTATION

When the Sä Dena Hes Operating Corporation purchased the Sä Dena Hes Mine in 1994, the venture worked with Liard First Nations and formulated a Socio Economic Agreement that was to guide their joint relationship during the operation of the mine. Unfortunately, the mine did not reopen and remained dormant. Upon the decision to permanently close the Sä Dena Hes Mine, Teck sought to update its relationship with the Liard First Nation. The intent of the relationship between the two parties is for both parties to obtain value their relationship as well as the optimization of the economic opportunities within the Nation and locally in the Watson Lake area.

Appendix H of this report has a more detailed review of Teck's consultations with LFN to date and identifies some planned activities going forward. Teck is in the process of preparing a more formal engagement plan that will outline specific engagement activities such as future community meetings at key times through the reclamation process, regular community news letters, and participation of LFN appointed community representatives as part of closure project.

In addition to the ongoing communication and engagement between Teck and the LFN, Teck committed the required funds to enable the LFN to have an environmental consultant of their choice conduct a review of the current Plan to identify potential items/issues that require further study during the 2012 field season and going forward. In the review scope, the environmental consultant was required to engage the LFN by way of hiring LFN members to participate in the review process, and provide updates to the LFN leadership. Results of this review were received in draft form on February 6th, 2013 and Teck has endeavored to address the key comments provided in LFN's review. The Approved review was received by Teck on March 22nd, 2013. A listing of Teck's revisions made in this DDRP as a result of LFN's reviews will be provided in a concordance under separate cover and provided to the LFN, the Ministry of Natural Resources and the Water Board.

In addition to Teck's ongoing engagement and consultation with the LFN, following dialogue with the LFN, and with their agreement, Teck initiated communication with the Ross River First Nation (RRFN). In December 10, 2012, Teck provided a briefing that included the following:

- *Summary (and copy of the newsletter) regarding the LFN community dinner and meeting attended by Teck representatives Oct. 17, 2012 in Watson Lake*
- *A suggested Communications Protocol to guide Teck and the RRDC communication activities*
- *Sä Dena Hes Mine site location map*
- *Contact information for Bruce Donald, Manager, Dormant Properties, Teck Resources Limited*
- *The Sä Dena Hes Mine Project Timeline for 2012 – 2015 for review*
- *The offer to provide a hard copy of the draft Sä Dena Hes Mine Detailed Decommissioning and Reclamation Plan for the Nation's review* and interest.

Going forward, Teck has a desire to ensure the RRFN remains apprised of the Sä Dena Hes DDRP, and is committed to providing future project updates for the interest of the RRFN membership.

Teck's approach to working with the Liard First Nation in 2013 and into the future will be based upon the solid working relationship established and maintained between Teck and the LFN to date.

As part of the ongoing consultation with LFN, including the ecological and human health risk assessment processes, traditional land uses and values will be incorporated into the end land use activities considered.

1.3 SCOPE OF PLAN

The scope of the original Sä Dena Hes Mine Detailed Decommissioning & Reclamation Plan was the subject of a Yukon Territory Water Board public hearing held in Whitehorse on November 19, 1997. Following this public hearing and deliberations by the YTWB,

requirements for the Detailed Decommissioning & Reclamation Plan were set out as outlined in Water Licence QZ97-025, Section 66. The Plan includes the following components*:*

- *"Detailed designs to address long-term physical stability of all closure structures, including designs for upgrading the permanent tailings impoundment structures to withstand natural events with a probability of occurrence similar to their expected service life (1:1000 year to PMF/MCE);*
- *Plans for addressing any short-term or long-term chemical stability or water quality problems;*
- *Plans for mitigating effects of access and surface disturbance;*
- *Plans for post closure monitoring and maintenance;*
- *Consideration of the need for, and as necessary, the establishment of, water balance and water quality models; and*
- *A cost estimate for decommissioning and post closure monitoring and maintenance."*

To achieve these goals, a complete review of all pertinent historical information regarding the Sä Dena Hes operation was undertaken. Table 1-1 Global Information List, presents a complete listing of reports and other information sources that were reviewed in the writing of this Plan. Cominco (a predecessor company now part of Teck) felt that this review was necessary since the original mine ownership had changed and the mine has not been operational since the property was purchased.

The scope of the Sä Dena Hes Mine Decommissioning & Reclamation Plan remains essentially the same as outlined in the 2000 Plan document to include requirements in Section 66 of Water Licence QZ97-025, and subsequently the renewal of this licence, QZ99-045 and the QML-0004 Sections 15 and 16.

Section 83 of the current Water Licence also stipulates that an update to the Decommissioning Plan be submitted by January 28, 2012 which was done. When reviewing Update Document, the following were considered:

1. relevant changes in technology;
2. changes to the Canadian Environmental Quality Guidelines;

3. any relevant additional information that has been acquired through site monitoring or studies; and
4. a review of the estimated costs of decommissioning.

Table 1-1 Global Information List

Report Title / Topic	Author	Date
Reclamation Guidelines for Northern Canada	Land Resources, DIAND	1987
Mt. Hundere Project - Project Overview and Plan for IEE	SRK	Aug-89
Mt. Hundere Joint Venture IN90-002, Volume I - Report, Volume II - Appendices and Interventions	SRK	Jul-90
Mt. Hundere Joint Venture IN90-002, Transcript of Hearing; Additional Exhibits Entered at Hearing (Oct. 10&11/90)	YT Water Board	12-Oct-90
Mt. Hundere Joint Venture IN90-002 - Geotechnical Investigations and final Design for Mill and Tailing Disposal Facilities	SRK	Dec-90
Mt. Hundere Development, Initial Environmental Evaluation of the Mt. Hundere Development on the Watson Lake Area & Yukon (in drawer B210-B240 Vancouver) ** see note*	SRK	*1990*
Screening Report under the Environmental Assessment & Review Process Guidelines Order - Mt. Hundere Development	DIAND	16-Dec-90
EARP Decision Report - Mt. Hundere Development Proposal	DIAND	Jan-91
Water Use Licence IN90-002	YT Water Board	31-Jan-91
Sä Dena Hes Joint Mine (Overview)	Curragh	1991 or 19992
Sä Dena Hes Articles (Northern Miner, etc.)	Various	1991 to 1993
Sä Dena Hes Mine IN90-002 - As Built Construction Report for Reclaim Dam Toe Buttress	James B. Edward	3-Jan-92
Mt. Hundere Joint Venture IN90-002 - *Sä Dena Hes* Mine - As Built Report - North, South & Reclaim Dams & Instrumentation SRK Project 1203	SRK	24-Jan-92
Sä Dena Hes Mine Spill Contingency Plan	Curragh Inc.	Mar-92
1991 Annual Report to the Water Board	Curragh Resources	10-Mar-92
Sä Dena Hes Mine IN90-002 - Inspection of Facilities at the Tailings Impoundment and Reclaim Pond	SRK	20-Jul-92
Mt. Hundere Joint Venture IN90-002 - *Sä Dena Hes* Mine, Inspection Report Reclaim Dam Spillway & Camp Creek Diversion Reconstruction SRK S101104	SRK	19-Nov-92
Sä Dena Hes Mine IN90-002 - South Dam Extension Design Report SRK Project 101204	SRK	25-Nov-92
Water Licence and Temporary Closure Plan	G.B. Acott, Environmental Affairs Curragh Inc.	Dec. 1992
Sä Dena Hes Temporary Closure Plan Report #WH9209	Curragh	Dec-92
Sä Dena Hes Joint Venture Concentrator Operation	Curragh	Jan-93
WGM Due diligence report	Curragh	25-Jan-93
Sä Dena Hes Joint Venture 1992 Annual Report	Ewald Pengal	Feb-93

Report Title / Topic	Author	Date
Environmental Assessment of False Creek Canyon - 1992 Study	P.A. Harder & Associates Ltd.	Mar-93
Assessment of Environmental Liabilities *Sä Dena Hes* Mine near Watson Lake	Norecol, Dames & Moore	12-Oct-93
Application for Temporary Amendment to Water Licence IN90-002, *Sä Dena Hes*	Coopers & Lybrand	19-Nov-93
Sä Dena Hes 1993 Annual Report to the YT Water Board Licence IN90-002	Coopers & Lybrand & Cominco	Feb-94
1994 Annual Inspection of Tailings Management Facility, July 27 & 28, 1994 - *Sä Dena Hes* Mine	SRK	7-Oct-94
Construction Report Remedial Work, *Sä Dena Hes* Mine, Yukon Territory	SRK	Nov-94
Environmental Monitoring at False Canyon Creek 1994	LES & White Mountain	Jan-95
Sä Dena Hes 1994 Annual Report - Yukon Water Licence IN90-002	Cominco	Feb-95
North Creek Dyke, *Sä Dena Hes* Mine, Yukon Territory, C104105	SRK	Feb-95
1995 Annual Inspection - Tailing Management Facility - *Sä Dena Hes*	SRK	Oct-95
Sä Dena Hes Preliminary Decommissioning and Reclamation Plan	Cominco	Nov-95
Sä Dena Hes Preliminary Decommissioning and Reclamation Plan	Cominco	Jan-96
Water Use Licence IN90-002 - Amendment	Water Resources	25-Jan-96
Sä Dena Hes 1995 Annual Report Yukon Water Licence IN90-002	Cominco	Feb-96
Environmental Monitoring at False Canyon Creek 1996	LES	Dec-96
Sä Dena Hes 1996 Annual Report Yukon Water Licence IN90-002	Cominco	Feb-97
Submission in Support of the Amendment of Water Licence IN90-002	Cominco	Aug-97
QZ97-025 Sä Dena Hes Operating Corporation Amendment to IN90-002	YT Water Board	26-Sep-97
Review of Reclamation Cost Estimates	DIAND	Oct-97
1997 Annual Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	15-Oct-97
The Sä Dena Hes Socio-Economic Participation Agreement	Cominco	21-Oct-97

Report Title / Topic	Author	Date
Construction Report South Dam extension Toe Buttress	SRK	Nov-97
Review of Application for Water Licence amendment	Gartner Lee	Nov-97
Sä Dena Hes Amendment	Conservation Society	7-Nov-97
Amendment to IN90-002 (Sä Dena Hes)	YT Water Board	19-Nov-97
QZ97-025 Sä Dena Hes Register Public Hearing Amend to IN90-002	YT Water Board	19-Nov-97
Sä Dena Hes 1997 Annual Report - Yukon Water Licence IN90-002	Cominco	Feb-98
Application for a Type B Licence - Reconstruction of a run-off catchment berm	Access Mining Consultants	Feb. 1998
Water Use Application MS97-091, response to Water resources comments	Cominco	Mar. 1998
Water Licence QZ97-025	Water Board	May 1998
QZ97-025 - Amendment to Water Licence IN90-002	YTG Renewable	Nov. 1998
Site Review of October 18, 1993 Tailings Dams & Diversion Channel – Remedial works, Sä Dena Hes Mine, Yukon Territory	SRK	Oct. 1993
Final Report - Assessment of Environmental Liabilities, Sä Dena Hes Mine, Near Watson Lake, Yukon Territory	Norecol, Dames & Moore	Oct. 1993
Addendum to 1997 Construction Report, South Dam Toe Buttress, Sä Dena Hes, Yukon Territory	SRK	Nov. 1997
Aquamin Case Studies - Sä Dena Hes	Working Group 6 (BC & YT)	N/A
1998 Annual Report	Cominco	Feb. 1999
1998 Annual Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Dec. 1998
Water Licence MS97-091	YT Water Board	May 1998
Sä Dena Hes Water Licence Security	YT Water Board	Mar. 1998
Sä Dena Hes Water Licence Amendments	YT Water Board	Mar. 1998
Reason for Decision - Water Licence QZ97-025 amendment to IN90-002 Sä Dena Hes	YT Water Board	Mar. 1998
Environmental Priorities – Sä Dena Hes	Norecol, Dames & Moore	N/A
Environmental Permits/Licences/ Approvals Needed to Mine in Yukon	DIAND	1999
Environmental Monitoring at False Canyon Creek 1998	LES & Can-Nic-A-Nick	Dec. 1998
1999 Annual Report	Cominco	Feb. 2000

Report Title / Topic	Author	Date
1999 Annual Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Dec. 1999
2000 Annual Report	Cominco	Feb. 2001
2000 Geotechnical Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Feb. 2001
2000 Geochemical Studies, Sä Dena Hes Mine	SRK	Nov. 2000
Environmental Monitoring at False Canyon Creek 2000	LES & Can-Nic-A-Nick	Dec. 2000
Land Reclamation and Revegetation Plan. Preliminary Test Program Summary Report, Sä Dena Hes,	Access Mining Consultants Ltd.	Nov. 2000
2001 Annual Report	Teck Cominco	Feb. 2002
2001 Geotechnical Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Dec. 2001
Results Summary of Phase II Revegetation Test Program -2001, Sä Dena Hes. ,	Access Consulting Group	Feb. 2002
2002 Annual Report	Teck Cominco	Feb. 2003
2002 Geotechnical Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Mar. 2003
2002 Geochemical Projects Sä Dena Hes,	SRK	Mar. 2003
Results Summary of Phase II Revegetation Test Program -2002, Sä Dena Hes. ,	Access Consulting Group	Jan. 2003
2003 Geotechnical Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Dec. 2003
Sä Dena Hes – 2003 Dam Safety Review	Klohn Crippen	Nov. 2003
2003 Annual Report	Teck Cominco	Feb. 2004
Results Summary of Phase II Revegetation Test Program - 2003, Sä Dena Hes. ,	Access Consulting Group	Mar. 2004
Environmental Monitoring at False Canyon Creek 2004	LES & Can-Nic-A-Nick	Nov. 2004
Operating, Maintenance and Surveillance Manual, Tailings Management Facility – December 2004	SRK Consulting	Dec, 2004
2004 Geotechnical Inspection Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK	Feb 2005
2004 Annual Report	Teck Cominco	Mar. 2005
Results Summary of Phase II Revegetation Test Program - 2004, Sä Dena Hes. ,	Access Consulting Group	Mar. 2005
Sä Dena Hes Mine Temporary Closure Site Status Report as of January 2005	Teck Cominco	Jan. 2005
Results Summary of Phase II Revegetation Test Program - 2004, Sä Dena Hes. ,	Access Consulting Group	Mar. 2005
Results Summary of Phase II Revegetation Test Program - 2005, Sä Dena Hes. ,	Access Consulting Group	Jan. 2006
Results Summary of Phase II Revegetation Test Program - 2006, Sä Dena Hes. ,	Access Consulting Group	Jan. 2007
Detailed Decommissioning & Reclamation Plan January 2006 Update	Access Consulting Group, SRK & Teck Cominco	January 2006

Report Title / Topic	Author	Date
Sä Dena Hes Mine 2005 Annual Report, Yukon Water Licence QZ99-045	Teck Cominco	March 2006
Sä Dena Hes Mine 2005 Annual Report, Yukon Production Licence QML-0004	Teck Cominco	April 2006
2005 Geotechnical Inspection, Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK Consulting Engineers and Scientists	March 2006
Sä Dena Hes Mine 2006 Annual Report, Yukon Water Licence QZ99-045	Teck Cominco	March 2007
Sä Dena Hes Mine 2006 Annual Report, Yukon Production Licence QML-0004	Teck Cominco	March 2007
2006 Geotechnical Inspection, Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK Consulting Engineers and Scientists	March 2007
Sä Dena Hes Mine – 1380 Portal	SRK Consulting Engineers and Scientists	March 2007
Sä Dena Hes Mine 2007 Annual Report, Yukon Water Licence QZ99-045	Teck Cominco	March 2008
Sä Dena Hes Mine 2007 Annual Report, Yukon Production Licence QML-0004	Teck Cominco	March 2008
2007 Geotechnical Inspection, Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK Consulting Engineers and Scientists	March 2008
Environmental Monitoring at False Canyon Creek, 2008	Laberge Environmental Services & Can-Nic-Nick Environmental Services	November 2008
Sä Dena Hes Mine 2008 Annual Report, Yukon Water Licence QZ99-045	Teck Cominco	March 2009
Sä Dena Hes Mine 2008 Annual Report, Yukon Production Licence QML-0004	Teck Cominco	March 2009
2008 Geotechnical Inspection, Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK Consulting Engineers and Scientists	March 2009
Sä Dena Hes Mine 2009 Annual Report, Yukon Water Licence QZ99-045	Teck Cominco	March 2010
Sä Dena Hes Mine 2009 Annual Report, Yukon Production Licence QML-0004	Teck Cominco	March 2010
2009 Geotechnical Inspection, Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK Consulting Engineers and Scientists	March 2010
Environmental Monitoring at False Canyon Creek, 2010	Laberge Environmental Services & Can-Nic-Nick Environmental Services	November 2010
Sä Dena Hes Mine 2010 Annual Report, Yukon Water Licence QZ99-045	Teck Metals Ltd.	March 2011
Sä Dena Hes Mine 2010 Annual Report, Yukon Production Licence QML-0004	Teck Metals Ltd.	March 2011
2010 Geotechnical Inspection, Tailings Management Facility, Sä Dena Hes, Yukon Territory	SRK Consulting Engineers and Scientists	March 2011
Summary Report – Site Investigation and Remedial Soil Excavation	Access Consulting	April 18, 2012
Technical Memorandum Reclamation Progress Report	Access Consulting	December 18, 2012
Environmental Monitoring at False Canyon Creek, 2012	Laberge Environmental Services & Can-Nic-Nick Environmental Services	December 2012
Phase I and II Environmental Site Assessment, Sä Dena Hes Mine Yukon Territory	Golder Associates	February 1, 2013
Pre-Demolition Hazardous Building Materials Assessment, Mine Infrastructure and Camp Buildings, Sä Dena Hes Mine Yukon Territory	Golder Associates	February 1, 2013

Report Title / Topic	Author	Date
Pre-Demolition Hazardous Building Materials Assessment, Concentrator Complex and Associated Structures, Sä Dena Hes Mine Yukon Territory	Golder Associates	February 1, 2013
Sä Dena Hes – 1380 Portal Discharge Investigation	SRK Consulting	February, 2013

* Note: The IEE consists of 6 volumes as follows:
Volume I - Project Description
Volume II - Mine Access Road Evaluation
Volume III - Socio-Economic Evaluation
Volume IV - Biophysical Evaluation for the Project Site
Volume V - Appendices
Volume VI - Overview & Summary

Various closure options were assessed to ensure that closure objectives were met for each mine component.

The approach taken to this Plan is to present a brief description of each mine component and the closure issues related to that component. Closure measures are then presented for the mine, tailings management facility, and infrastructure components. A summary of the environmental setting for the project, complete with results from all ongoing licensed monitoring programs are presented in Appendix B ("*Environmental Baseline Update and Technical Basis for Closure Assumptions*"). This approach ensures that the reader is given a picture of the existing facilities at the site and the local environmental conditions without having to review previous historical information. Previous work or reports on the project have been referenced without repeating details so that this document is focused on decommissioning and reclamation.

1.4 CORPORATE BACKGROUND

Teck is a diversified resource company committed to responsible mining and mineral development with business units focused on copper, steelmaking coal, zinc and energy. Teck is also a significant producer of specialty metals such as germanium and indium and actively explores for copper, zinc and gold in the Americas, Asia Pacific, Europe and Africa.

At Teck, the pursuit of sustainability guides our approach to business. We recognize that our success depends on our ability to establish safe environments for our people and collaborative relationships with communities of interest. Teck is headquartered in Vancouver, Canada, and owns or has an interest in 12 operating mines in Canada, the United States, Chile and Peru, as well as one large metallurgical complex in Canada.

Copper:

In 2011, Teck's share of copper production from Antamina in Peru, Quebrada Blanca and Carmen de Andacollo in Chile, Highland Valley copper in British Columbia, and Duck Pond in Newfoundland was 321,000 tonnes of copper.

Coal:

Teck is the largest producer of steelmaking coal in North America and the second-largest exporter of seaborne steelmaking coal in the world. Six operating coal mines are located in Western Canada with five in southeastern B.C. and one in west-central Alberta. In 2011, Teck produced 22.8 million tonnes of coal.

Zinc

Teck's zinc concentrate production primarily comes from the Red Dog mine in Alaska and the Antamina mine in northern Peru. Teck's operations in Trail, B.C. represent one of the world's largest fully integrated zinc and lead smelting and refining complexes. Teck's share of zinc produced was 646,000 tonnes of zinc contained in concentrates and 291,000 tonnes of refined zinc in 2011.

Energy:

Located in the Athabasca region of northeastern Alberta, Teck's energy assets include a 20% interest in the Fort Hills project and a 100% interest in the Frontier project. In addition, we hold interests in various other oil sands leases in the exploration phase.

The Company has significant experience in exploration and mining, particularly in the north, in Canada, Alaska and Greenland. Exploration crews have been working in the north since the 1920's with successful results.

Teck's northern mines past and present include:

- *Con*, Yellowknife, NWT – Con was the first gold mine in the NWT, beginning production in 1937. The mine was sold in 1986 and continued to operate under several different owners until it was permanently closed in 2003.

- *Pine Point*, Pine Point, NWT – This open pit lead-zinc mine operated between 1965 and 1988. It is located near the south shore of Great Slave Lake. Forty-eight deposits containing approximately 64 million tonnes of ore were mined. The Pine Point mine site was decommissioned in accordance with the standards of the day. The Crown agreed to accept the return of the land leases upon completion of the decommissioning and reclamation program with the exception of the tailings impoundment area which Teck continues to lease and manage.

- *Black Angel*, Greenland – The Black Angel lead-zinc underground mine operated between 1973 and 1990, although not under Cominco ownership from 1986 onwards. It was located at 73^{o}N in extremely rugged terrain, approximately 500 kilometres north of the Arctic Circle on Greenland's west coast.

- *Polaris*, NWT – The Polaris zinc-lead underground mine began production in 1981 and ceased production in 2002 producing 1 million tonnes of ore per year. It was the world's most northerly base metal mine, located at 75^{o}N on Little Cornwallis Island approximately 100 kilometres northwest of Resolute, NWT. Post closure reclamation is completed and final demobilization from the site occurred in September 2011. Teck continues to provide on-going site monitoring.

- *Red Dog*, Alaska – The Red Dog zinc-lead open pit mine began producing in 1990 and has a projected mine life of at least another 40 years. It is one of the world's largest zinc mines. The mine is located 145 kilometres north of Kotzebue. Red Dog is a joint venture between Teck and the North Alaska Native Association (NANA) Regional Corporation Inc. Teck is the operator of the mine.

1.5 PROPERTY LOCATION

The Sä Dena Hes property is located close to Yukon's southern boundary with British Columbia, approximately 70 kilometres by road from the Town of Watson Lake. The minesite (see Figure 1-1) is reached via the Robert Campbell Highway, north of Watson Lake. At approximately kilometer 47 of the Robert Campbell Highway, a 25 km access road designed to accommodate the safe and efficient haulage of concentrate extends to the property.

Most of the mineral occurrences are near the treeline ranging in elevation from 1,200 to 1,500 metres above sea level. The plant site is below the mine workings and lies in boreal woodlands. Snowfall in the Watson Lake area is approximately 230 cm/year however the mine site receives heavier snow through the winter (anecdotal). Temperatures vary from an average of –26.3 °C in January, to an average of 14 °C in July. In January mean low temperatures in Watson Lake are -32 C.

The Sä Dena Hes mine comprises the Jewelbox and Burnick underground mines, and two undeveloped mineralized zones – Gribbler Ridge and Attila, and a number of other identified exploration targets within the claims group (see Figure 1-2).

1.6 STATUTORY AND REGULATORY RESPONSIBILITIES

1.6.1. *Regulatory Agencies*

The Sä Dena Hes mine was constructed in 1991 and operated for a 16-month period between August, 1991 and December, 1992 under Water Use Licence IN90-002. The Sä Dena Hes Operating Corporation (SDHOC) purchased the property from Curragh Resources Inc. in March 1994 and the Water Use Licence was subsequently assigned in April 1994. Teck presently manages the property on behalf of the Sä Dena Hes Operating Corporation.

Water Use Licence IN90-002 was amended by the Sä Dena Hes Operating Corporation in August 1997 to address submission of a decommissioning plan for the site. Amended Water Use Licence (QZ97-025) was issued in March 1998 and required the Licensee to submit a Detailed Decommissioning and Reclamation Plan for the site. The licence expiry date remained September 15, 2000.

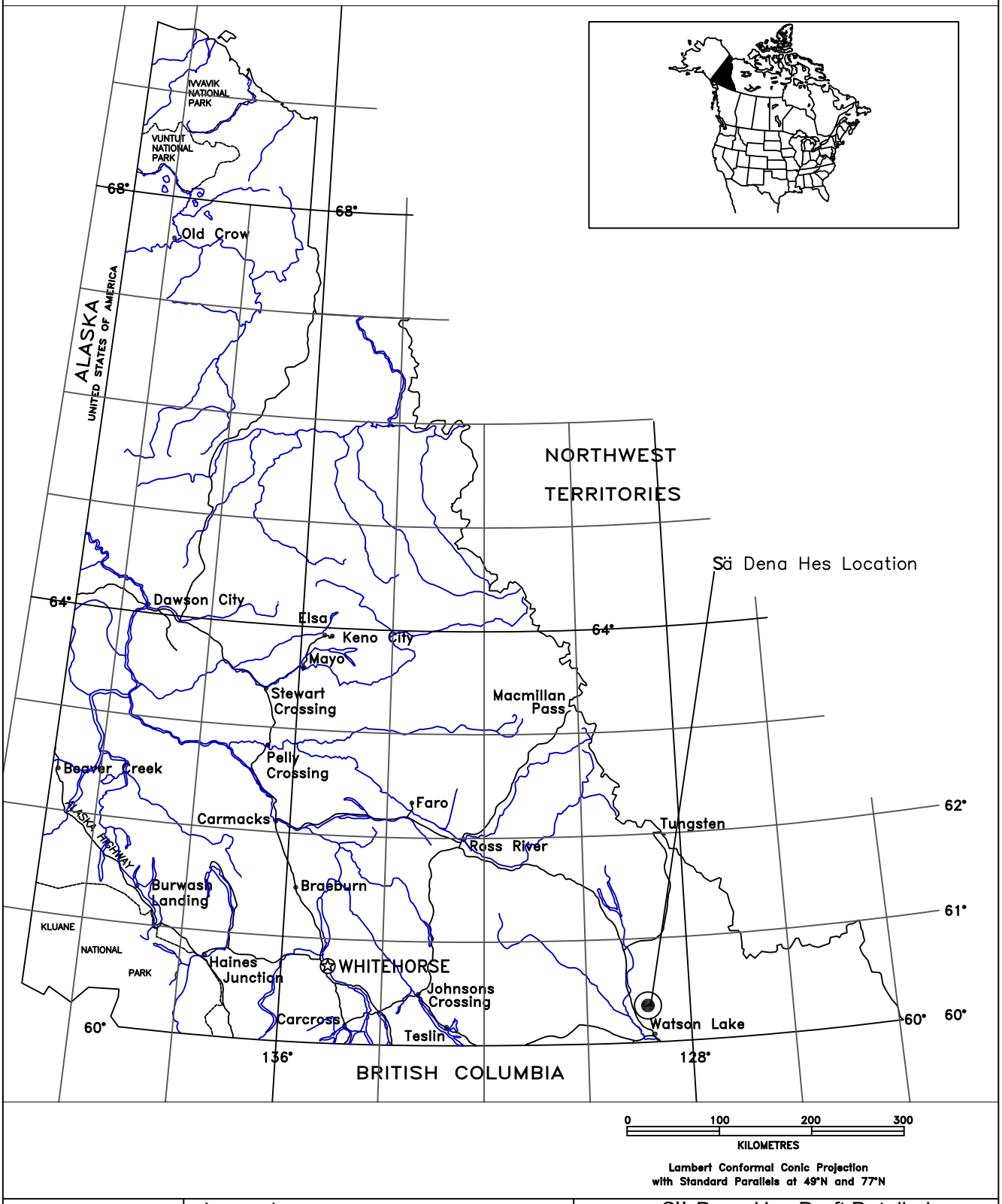
The company submitted a final DDRP in February 2000 after extensive consultation with various interested parties. A Water Use Licence renewal application was also filed (QZ99-045) in February 2000 to renew and extend the existing licence and this application triggered an environmental assessment (EA) pursuant to the *Canadian Environmental Assessment Act* (CEAA). Two further amendment requests (QZ00-047) and (QZ00-048) were made to the Water Board to request an extension to the licence expiry date to ensure completion of the

CEAA review. In addition, the company also submitted an application for a Quartz Mine Production Licence pursuant to the *Yukon Quartz Mining Act* that also required a CEAA review.

An extensive CEAA screening was completed in June 2001 while the property was still under Temporary Closure and included an assessment of the DDRP. The CEAA screening enabled the issuance of both the Water Use Licence (QZ99-045) and Quartz Mine Production Licence (QML-0004) with specific terms and conditions relating to temporary closure and maintenance of the site

The 2001 CEAA screening remains current with respect to the existing property and care and maintenance activities. No new development activities have been undertaken since the screening and all required care and maintenance activities have been implemented by the Company. Required licence studies and monitoring programs have been either completed or continue to be on going as mandated and are submitted on a regular basis to the Water Board and other regulatory authorities. The results of various studies and monitoring programs have been reviewed and an assessment completed regarding the site's effects on the surrounding environment.

Yukon Territory



Teck

ACCESS CONSULTING GROUP

SRK Consulting
Engineers and Scientists

Legend

- Populated Settlements
- ☆ Territorial Capital

Sä Dena Hes Draft Detailed Decommissioning and Reclamation Plan

General Location Map (Map of Yukon)

DRAWN BY: ASH	CHECKED BY:	Fig No. 1-1
January 2010	Scale 1: 6, 000, 000	

500000
510000
520000
6720000
6710000
6700000
6690000
N
MH-20
MH-21
MH-19
MH-16
MH-14
MH-18
MH-15
MH-17
MH-12
MH-13
MH-24
MH-11
Stewart Lake
False Canyon Creek Tributary B
Tributary D
Tributary B
False Canyon Creek
Stewart Creek
Tom Lake
Little Tom Lake
Tom Creek
CLAIM BOUNDARY
SEE DRWG. 3.1
GENERAL ARRANGEMENT PLAN
BURNICK ZONE
MT. HUNDERE
NORTH CREEK DYKE
TAILINGS IMPOUNDMENT
CATCHMENT AREAS
MAIN ZONE
JEWELBOX HILL ZONE
MILL SITE
ACCESS ROAD
ROBERT CAMPBELL HIGHWAY
NORTH CREEK
CAMP CREEK
PORTAL CREEK
3000
3500
4000
4500
5000
2500

NTS: 105 A/06, 105 A/07
105 A/10, 105 A/11

CONTOUR INTERVAL 100 FEET

0 1000 2000 3000 4000 5000 metres
1:100,000

NOTE
BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Teck

ACCESS CONSULTING GROUP

SRK Consulting
Engineers and Scientists

LEGEND
- WATER MONITORING STATION
- FISH MONITORING STATION
- BENTHIC MONITORING STATION

Sä DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAMATION PLAN

SITE LOCATION PLAN

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	PMH	1 – 2	
DATE: January 2010	PROJ. NO. 1CC005.05		

FILE REF.:CATCHMENT.DWG

1.6.2. *Approvals and Licences*

The Company currently holds a Type A Water Licence QZ99-045, and Quartz Mine Production Licence (QML-0004) for quartz mining, both of which were issued in 2003 and expire on December 31, 2015. In 2005 and again in 2010, extensions to the Temporary Closure clauses were obtained for both Licences with the 2010 extension specifying that Temporary Closure ends on January 27, 2013. As of January 28th, 2013, the site is deemed to be in "Permanent Closure" which requires implementation of the site DDRP.

The company is required to comply with the terms and conditions of the Licenses and of the Yukon Waters Act and Regulations. Compliance with licence terms and conditions has been monitored by Yukon Environment, Water Resources Division as well as the Ministry of Mineral Resources.

Various other agencies grant the permits necessary to close a project of this nature. A detailed summary of the approvals and Licenses that may be required for this project and the associated permitting bodies are presented in Table 1-2. As part of implementing the Plan, the Company will ensure that the various other Licenses and/or permits that are required for undertaking are secured and complied with during the decommissioning.

Upon review and acceptance of this update to the DDRP, the plans contained will be implemented beginning in the summer of 2013 and will be substantially complete by December 31, 2015.

Table 1-2 Summary of Current and Potentially Required Permits and Licenses

Authorization and Legislation	Purpose	Responsible Agency
Current Project Authorizations		
Type A Water Use Licence QZ99-045 (Amendment 2 QZ09-093) Expires December 31, 2015 *Yukon Waters Act*	Water use and deposit of a waste associated with mine construction, production and closure/post-closure.	Yukon Water Board (Licencing) YG Energy, Mines and Resources – Mineral Resources (Inspections)
Quartz Mining Licence QML-0004 Expires December 31, 2015 *Quartz Mining Act*	Mine construction, production and closure/post-closure.	YG Energy, Mines and Resources – Mineral Resources
Special Waste Permit (Permit #4201-41-247) Expiry Date: Dec. 31, 2013 *Yukon Environment Act*, Special Waste Regulations	Temporary stockpiling of soils contaminated with metals and/or petroleum hydrocarbons above special waste thresholds.	Environment Yukon, Environmental Programs Branch
Permit To Install A Sewage Disposal System *Public Health & Safety Act,* Sewage Disposal Systems Regulation	Onsite sewage disposal system.	YG Health & Social Services, Environmental Health Branch
Commercial Dump Permit *Yukon Environment Act*, Special Waste Regulations, Air Emissions Regulations, Solid Waste Regulations Expiry Date: Dec. 31, 2014	Construction and operation of a landfill, transfer station or commercial dump.	Environment Yukon, Environmental Programs Branch
Potentially Required Project Authorizations		
Amendment of Type A Water Use Licence QZ99-045 *Yukon Waters Act*	Water use and (potentially) deposit of a waste associated with closure/post-closure.	Yukon Water Board (Licencing) YG Energy, Mines and Resources, Mineral Resources Branch (Inspections)
Amendment of Quartz Mining Licence QML-0004 Certificate of Closure *Quartz Mining Act*	Mine closure/post-closure.	YG Energy, Mines and Resources, Mineral Resources Branch
Fisheries Act Letter of Advice (an *Authorization* is not likely to be required)	Camp Creek realignment; culvert removal; channel stabilization.	Fisheries and Oceans Canada (DFO)

Authorization and Legislation	Purpose	Responsible Agency
Special Waste Permit *Yukon Environment Act*, Special Waste Regulations	Mixing and dilution, generation, handling, collection, storage, release or disposal of special hazardous wastes. Current Permit #4201-41-247 expires December 31, 2013.	Environment Yukon, Environmental Programs Branch
Land Treatment Facility Permit *Yukon Environment Act,* Contaminated Sites Regulation	Operation of a land treatment facility (LTF) for the remediation/treatment of petroleum hydrocarbon contaminated soils.	Environment Yukon, Environmental Programs Branch
Special Waste Relocation Permit *Yukon Environment Act*, Special Waste Regulations	Relocation of contaminated soil. Previous Special Waste Relocation Permit (#4201-45-033) expired on Dec. 31, 2012.	Environment Yukon, Environmental Programs Branch
Application for Operation, Closure, Abandonment, or Renovations to Storage Tanks *Environment Act*, Storage Tank Regulation	Use of storage tanks.	YG Community Services, Protective Services Branch
Explosives Magazine Permit *Explosives Act*	Storage of explosives.	Yukon Worker's Compensation Health and Safety Board, Occupational Health & Safety
Blaster's Permit *Occupational Health and Safety Act*, Occupational Health and Safety Regulations Part 14: Blasting Regulations	Use of explosives.	Yukon Worker's Compensation Health and Safety Board, Occupational Health & Safety
Burning Permit *Territorial Lands Act* *Forest Protection Act*, Forest Protection Regulations	Burning refuse wood.	YG Community Services, Protective Services Branch
Commercial Use Permit *Territorial Lands Act*, Timber Regulation	Timber cutting less than 1000 m^3 per year.	YG Energy, Mines and Resources, Client Services & Inspections
Over-dimensional or Over-weight Vehicle Permits	Oversize trucking.	YG Highways & Public Works, Transportation Services Branch
Certificate and/or Permit for Transport of Dangerous Goods *Transportation of Dangerous Goods Act*	Transport of dangerous goods/waste.	YG Highways & Public Works, Transportation Services Branch

1.7 DOCUMENT ORGANIZATION

Section 1 of this document introduces the philosophy and scope for the Plan as well as Teck's corporate background. Information is provided on the property and its history and includes a discussion of regulatory responsibilities regarding closure.

Section 2 provides a brief overview of the current status of the Sä Dena Hes mine.

Section 3 provides a detailed description of the decommissioning and reclamation plan for the various components including mine workings, tailings management facility, infrastructure and reagents, and site access and haul roads. This section presents a description of each of the project components and outlines potential closures issues. The plan for decommissioning and reclamation activities for each of these areas is then presented.

Section 4 presents the implementation schedule for the Plan, in the format of a Gantt chart.

Section 5 deals with post closure site management plans and activities. This section presents the environmental management measures proposed for the decommissioning and post closure period.

Section 6 provides the January 2012 updated cost estimate for implementing the DDRP.

Section 7 presents a discussion of the licence financial security requirements and arrangements.

Section 8 provides report references.

ACKNOWLEDGEMENTS:

This report benefited from input by the following companies:

Teck – Provided overall direction for the project as well as the corporate policy framework and senior technical review of the proposed closure measures. Staff members from Teck's Dormant Properties office in Kimberley are the primary authors of revisions in this current update with input from a number of consultants. The key authors of the original DDRP were Access Consulting Group and SRK Consultants.

Access Consulting Group – Access were the primary authors of the original report. In subsequent updates, they provided technical and editing support. In 2012 additional support with regard to regulatory processes was provided by Access.

SRK Consultants Ltd. – Responsible for sections on closure measures and original costing (subsequently updated by Teck) for mine workings and the tailings management facility, and the geochemistry, climate, and hydrology components of the environmental baseline update. In 2012 SRK reviewed the site hydrology and geochemistry with additional field work and reporting related to the 1380 Portal discharge.

Laberge Environmental Consultants – Responsible for environmental baseline update for aquatic resources and helped develop the land reclamation closure measures.

Golder Associates Ltd (Golder) – In 2012, Golder conducted a Phase I and II environmental site assessment and hazardous building material assessment of the SDH mine site. The work was conducted on behalf of Keyeh Nejeh Golder Corporation (KNG) which is a joint venture with Golder and the Liard First Nation. The environmental site assessment has identified potential environmental impacts at the site. The results will be used to support the ecological and human health risk assessment which will ultimately guide the overall remediation of the mine site.

Azimuth Consulting Group – Responsible for the section discussing the ecological and human health risk assessment and a risk based approach to establishing remedial plans.

2.0 MINING ACTIVITIES

2.1 MINE HISTORY

The original surface showings were discovered in 1962 by prospectors working for the Francis River Syndicate, and for the next few years geochemical and geophysical surveys were conducted, together with some diamond drilling. Between 1979 and 1982, Cima Resources Ltd. and Canadian Natural Resources Ltd. carried out diamond drill programs totaling almost 3,000 metres in 72 holes, and outlined an estimated 250,000 tonnes of zinc and lead mineralization.

In 1984, Canamax purchased the property and began systematic geological and geochemical prospecting, including airborne geophysical surveys, with follow-up ground geophysics. By the end of 1988, Canamax had completed 23,333 metres of drilling in 193 holes and estimated a zinc-lead-silver mineral inventory of over 5 million tonnes in a number of zones.

In 1989, the Mount Hundere Joint Venture (Curragh Resources Ltd. - 80%, and Hillsborough Resources Ltd. - 20%) purchased the property from Canamax and completed 29,000 metres of diamond drilling in 150 holes in order to upgrade reserves in the Jewelbox Hill and North Hill areas. This program resulted in an assessment of proven plus probable mineable reserves of 3.9 million tonnes at 11.5% Zn, 3.8% Pb, and 53 grams/tonne Ag.

In 1990, Kilborn Ltd. prepared a development plan, the project secured financing from the Bank of Nova Scotia, and the property was put into production in August 1991.

The first zinc and lead concentrate shipment to the port of Skagway, Alaska occurred in September, 1991. Mine production rates and mill processing exceeded design capacity of 1,500 tonnes per day during the production period. The maximum mill throughput was over 1,800 tonnes per day. During the 16 months of production, some 700,000 tonnes of ore were mined and processed. Approximately 120,000 tonnes of zinc concentrates were produced with a grade of 59% Zinc and 54,000 tonnes of lead concentrates at a grade of 77% Lead. The concentrates were trucked in covered containers to Skagway for shipment to European and

Asian smelters. A sharp downturn in metal prices forced the mine to shut down in December 1992, at which time the property was put on a care and maintenance basis.

Curragh Resources sought and received Court protection under the *Corporations and Creditors Arrangement Act* in 1993. On September 20, 1993, Coopers & Lybrand Ltd. was appointed by the court as Receiver and Manager of the Sä Dena Hes property. In March 1994, the current owners purchased the property through the Receiver according to a Court Order. The property has been kept on care and maintenance except for a brief period in the winter of 1998 when SDHOC began preparations for reopening. A downturn in metal prices forced a re-evaluation, and subsequent suspension of work.

2.2 CURRENT STATUS

A decision has been made by the owners to begin Permanent Closure activities commencing in 2013. The site continues under the care of a full time, onsite caretaker. The caretaker provides security for the site, conducts daily checks of the mill and the general area, daily checks of the Tailings Management Facility, as well as conducting monthly and quarterly environmental sampling. Details of the current state of all facilities are provided in later sections of this report.

Geotechnical inspections of the tailings management facility, as required by Water Licence QZ99-045, are conducted on an annual basis. This ensures that any potential geotechnical problems are identified early to enable remedial measures to be undertaken if required. The Company has implemented all recommendations that have resulted from these inspections.

2.3 CURRENT ENVIRONMENTAL STUDIES

Environmental compliance monitoring, internal monitoring of earthworks and independent geotechnical inspections are presently ongoing at the property and are further discussed in Section 5.3. In preparation for Permanent Closure, environmental site assessment (ESA) activities were initiated in 2011 and 2012 to characterize the environmental conditions of the site. The results are being used to develop measures to minimize potential environmental impacts for closure of the mine. The results of the ESA are included in Golder Associates Ltd. (Golder) report entitled *Phase I and II Environmental Site Assessment (ESA), Sä Dena Hes*

Mine, Yukon Territory, dated February 1, 2013 (Golder 2013a). The detailed results are further discussed in Section 3.6 and the report is attached in Appendix J.

Additional assessment will be conducted in 2013 to further define and delineate the extent of contamination in all areas of environmental concern. A background soil concentrations assessment will also be conducted to aid in the delineation of metals contaminated soils. The additional assessment will be used to support the ecological risk assessment (ERA) and human health risk assessment (HHRA) which will ultimately guide the overall remediation of the mine site. The details to the risk assessment approach are further discussed in Section 3.6.5.

3.0 DETAILED DECOMMISSIONING & RECLAMATION PLAN

3.1 OVERVIEW

This section presents a detailed discussion of the planned decommissioning and reclamation measures for the various facilities located on the Sä Dena Hes property.

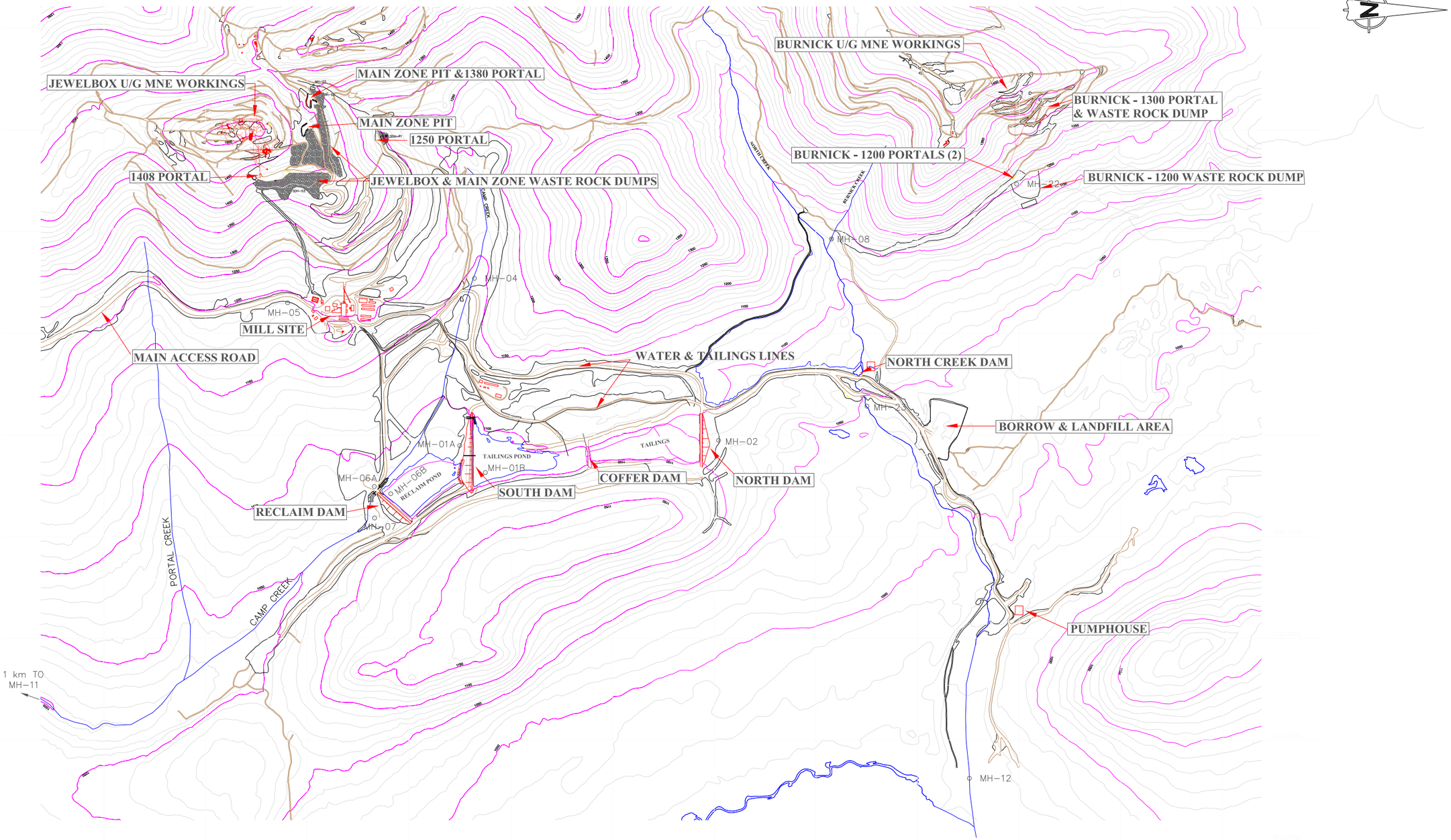
The approach to each subsection is to present a description of each area so readers are familiar with the existing facility and do not have to refer back to previous reports or information. Next, specific closure issues are discussed as they relate to each closure activity.

Finally, planned closure measures are presented. Each section is supported with detailed figures and tables as required. Where needed, references are made to previous reports or supporting documentation. Figure 3-1 provides a general arrangement plan for current conditions at the site. Figure 3-2 presents a summary of the various closure measures for features on the general arrangement plan.

3.2 MINE WORKINGS

This section discusses the mine features that require action upon closure of the operation. This section does not address surface facilities such as buildings, electrical services, air/water services, fuels storage tanks and access roads. These components will be discussed in other sections of this report. Reclamation issues related to these features are discussed in Section 3.7.

Potential water chemistry issues are discussed at length as part of the geochemistry discussions in Section 4 of Appendix B. A summary of site water quality is further discussed in Section 3.6.3.



Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

CONTOUR INTERVAL=10m

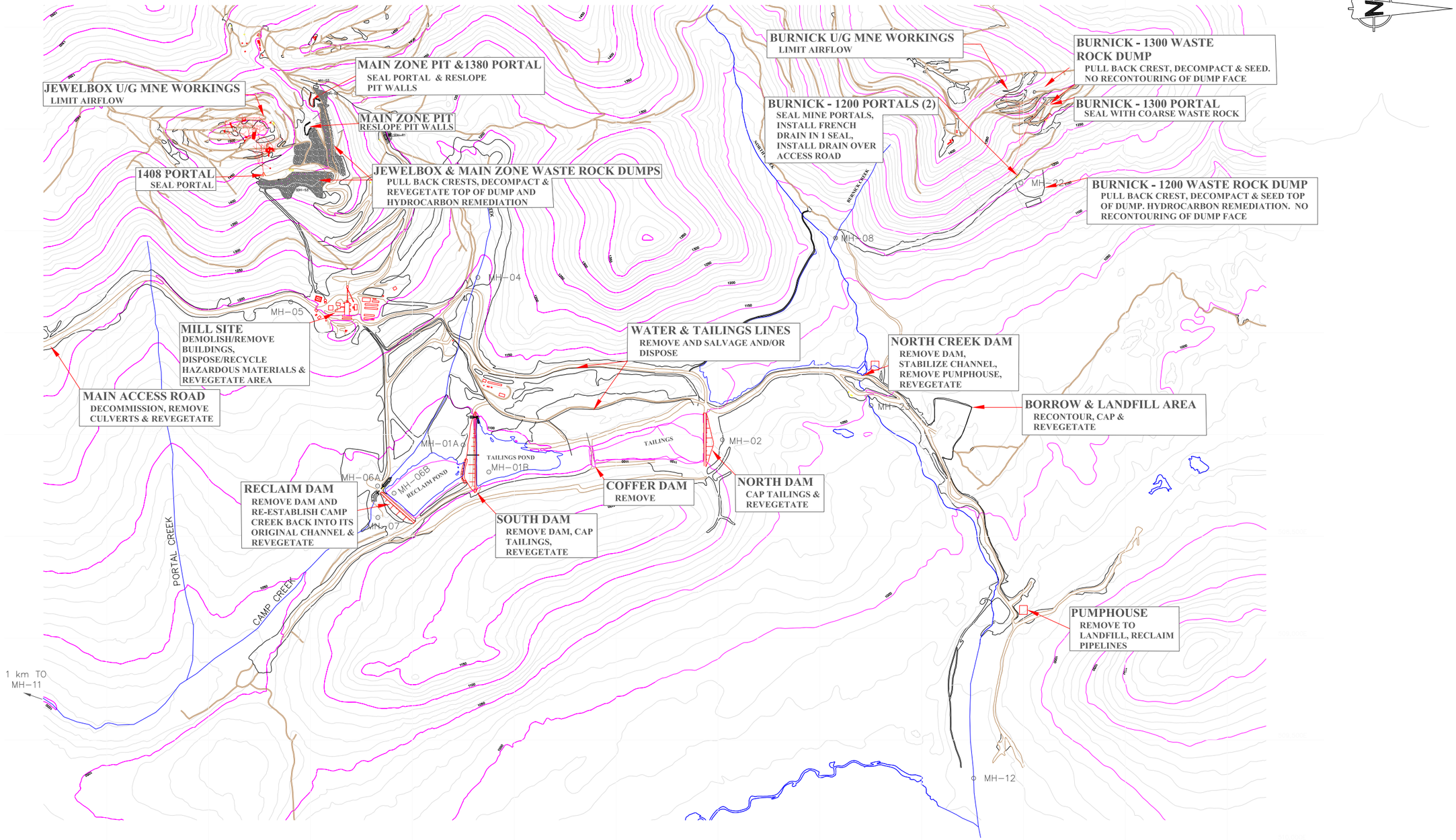
NOTE

BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Sä DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAMATION PLAN

GENERAL ARRANGEMENT PLAN CURRENT CONDITIONS

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
BJD	BJD	3-1	1
Revised: February 1, 2013	PROJ. NO.		



Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

CONTOUR INTERVAL=10m

NOTE

BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Sä DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAMATION PLAN

GENERAL ARRANGEMENT PLAN CLOSURE MEASURES

DRAWN BY: BJD	CHECKED BY: BJD	FIGURE NO. 3-2	REV. 1
Revised: February 1, 2013	PROJ. NO.		

3.2.1. *Jewelbox Ore Body*

The Jewelbox ore body is located near the top of Jewelbox Hill (Figure 3-1) immediately west of the mill complex. Curragh Resources started development of this ore body in 1990 and produced ore using several different underground mining methods. These methods included room and pillar, mechanized cut and fill, and longhole stoping.

Jewelbox has a number of features that will require work upon closure. They include the 1408 Portal, the 1250 Portal, two ventilation raises, a small open pit and the associated waste rock dumps. These features along with a plan view of the extent of the underground workings are shown in Figure 3-3.

3.2.1.1. Jewelbox Underground Mine Workings

(i) Description

The majority of mining activity when the mine was operational came from the Jewelbox ore zone deposit. Except for two minor surface pits, the ore production came from underground mechanized mining methods. Mining methods anticipated included room and pillar, cut and fill, and longhole stoping. Access to the ore reserves was through the 1408 Portal and down the main access ramp which was a decline.

(ii) Closure Issues

Dimensions of the mined stopes and their depths below ground surface are key factors which will determine whether any of mine workings pose a significant risk of causing surface subsidence. If subsidence of the ground surface were to occur, it could cause a safety risk to people or wildlife using the area.

(iii) Closure Measures

Based on available information on depths below surface and the relatively small stope sizes mined, the potential for subsidence in the long term future is presently not considered a concern. However, as part of the closure measures, a geotechnical assessment of the mine

workings will be undertaken in sufficient detail to provide assurance that subsidence is not a long term concern. If subsidence were to be identified as a concern, the only practical mitigation would be to monitor the ground surface and in the event that a public safety concern were identified, the risk would need to be further assessed and potentially additional mitigation measures considered.

3.2.1.2. Jewelbox 1408 Portal

(i) Description

The 1408 portal is located immediately above the mill site, as shown on Figures 3-1 and 3-3. A haul road from the mill provides access to the main ramp of the underground workings at the Jewelbox zone. The portal is roughly 4.5 m by 4.5 m and is set back into the hillside about 8 m. This portal is one of only 3 openings that intersect the underground mine workings at the Jewelbox ore zone.

Dispose of Core in Jewelbox Mineworkings.
Remove Racks and Buildings

Main Zone Area Sediment Basin
Remove to Mineworkings, Revegetate

Pull Back Crest of Waste Rock Dump
Below Pit and Regrade Safety
Berms. No resloping

JEWELBOX HILL ZONE
UNDERGROUND WORKINGS

MH–03

MAIN ZONE PIT
AND 1380 PORTAL

SDH–S2

Ventilation Raise - Cap with
Engineered Concrete Seal

SDH–S1

Flatten Pit Walls
Seal 1380 Portal
With Coarse Rock

Recontour Waste
Rock Piles

JEWELBOX PIT

Flatten Pit Walls

Pull Back Crest
of Road Cut and
Remove Safety Berms.

Pull back crest
of Waste Rock Pile

SDH–R

1250 PORTAL

Backfill Portal
with waste rock

Sediment Pond - Backfill
With Adjacent Waste
Rock

Seal Portal with Coarse Rock

Pull back crest of Waste
Rock Dumps and Remove
Safety Berm. No resloping

1408 Sediment Pond - Place in Mine
Workings (Ventilation Raise)

SDH–S3

Main Haul Roads
Recountour, Scarify and
Revegetate

Ventilation Raise - Cap with
Engineered Concrete Seal

Hyrdocarbon
Remediation
Required

1408
PORTAL

Pull Back Crest of Waste Rock
to 2:1 (H:V)

CAMP CREEK

1500
1450
1400
1350
1300
1250
1200

Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

0 50 100 150 200 250 metres

1: 5,000

CONTOUR INTERVAL=10m

NOTE

BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN
ADJUSTED FROM NAD 1927

Sä DENA HES DRAFT DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

JEWELBOX HILL AND MAIN ZONE
CLOSURE MEASURES

DRAWN BY: BJD	CHECKED BY: BJD	FIGURE NO. 3-3	REV. 2
Revised: February 1, 2013	PROJ. NO.		

(ii) Closure Issues

There are three potential closure issues.

The first and primary concern is to risk of access into the mine by either the public or by wildlife.

The second potential concern is on-going discharge of water from the mine workings. At the last underground inspection in the mine in 2005, the water level in the mine workings was at the 1344 metre elevation and was slowly increasing. Prior to the dewatering of the workings by Cominco in December 1998, the water level had been recorded at the 1350 metre elevation after the mine had been closed for approximately four years. The source(s) of the water is from fractures in the rock below the 1350 metre elevation. As ground conditions underground have not been maintained while the mine has been closed, it is no longer safe to access the mine workings. Consequently there is no current information as to the elevation of water within the mine. The rate of inflow into the mine was very low and originated from the lower levels of the mine. As the water levels increase, the hydraulic head of the water within the mine will result in the rate of inflow of water decreasing and it is expected that the water level within the workings will stabilize at some point. There is not enough information to determine at what elevation that will be. As the main portal at 1408 is approximately 58 metres above the last measured water level, it is unlikely that the water within the mine will reach the portal entrance; but it cannot be categorically ruled out without further information.

The final concern is the uncontrolled release of water from the mine workings from ice plugs forming within the mine workings. A fuller discussion of ice plugs is provided in Section 3.2.3.2.

(iii) Closure Measures

The 1408 Portal will be sealed off using coarse site waste rock to at least 5m into the portal beyond the entrance. Within the tunnel, the waste rock fill will be placed as close to the top of the tunnel as possible to help stabilize the collar of the portal. At surface the waste rock will be sloped from above the top of the portal to the base of the portal at a stable slope and will be contoured to tie into the surrounding terrain for aesthetic purposes. The seals will include two minimum 4 inch diameter pipes (high density polyethylene pipe or equivalent so they don't corrode). The purpose of the pipes is to prevent air from pressurizing within the mine and to

provide a conduit for mine water drainage if required. The pipes will be installed at slightly different elevations and one of the two pipes is a backup in case the other becomes plugged. The ground at portal entrance will be sloped away from the portal to ensure precipitation can drain away to prevent ponding of water up against the seal. Similar methods will be used at the other mine portals that access underground workings.

Prior to construction, drawings will be submitted to the applicable regulatory agencies (including the Mines Inspectorate) for review and approval as required in the existing permits. As-built reports documenting the construction details of the seals will be completed and submitted as part of regulatory reporting.

As discussed previously, the potential for mine water discharging from the portal while not expected in the long term cannot be fully discounted. The portal area will be periodically inspected after decommissioning activities have been completed. If water is detected discharging from this area, environmental testing of the water would be necessary to identify if there are any concerns, and based on the results further investigations or actions may be required.

As water in the mine is lower than the main portal at the 1408 Level, there is no concern regarding potential ice plugs forming. Additionally, the proposed portal seals will limit airflow which would eliminate any potential for an ice plug to form.

3.2.1.3. Jewelbox Ventilation Raises

(i) Description

The mine workings at Jewelbox are ventilated by two ventilation raises that extend up from the underground workings to ‘daylight’ on the hillside above the 1408 Portal. One of the ventilation raises is located near the summit of Jewelbox Hill, while the other is located immediately up slope from the1408 Portal.

(ii) Closure Issues

Both raises must be permanently sealed to prevent access into the mine by the public and by wildlife. Additionally, the airflow through the mine must be controlled to prevent the potential for ice plugs.

(iii) Closure Measures

Both ventilation raises will be sealed using an engineered concrete seal in a manner that is in accordance with Mine Safety Regulations. The seals will provide the physical barrier to eliminate the potential for the public or wildlife to access the mine through ventilation raises. In addition, the seals will prevent water and significant airflow from entering the mine workings (the seals will contain a small pipe to allow some airflow through the seal) through these openings. The seal design will be submitted for regulatory approval prior to construction as required in the site's licences. A certified as built report, complete with drawings will be done to document the details of the seals constructed.

3.2.1.4. Jewelbox - 1250 Portal

(i) Description

The 1250 Portal is located on the north side of Jewelbox Hill, in the Camp Creek catchment as shown on Figures 3-1 and 3-3. Original mine plans called for production to come from this portal, but subsequent diamond drilling and increased knowledge of orebody geometry forced a relocation of the production portal to the current 1408 Portal. The beginnings of a tunnel created by this portal extend only 3 metres (approximately) into the hillside. The tunnel has not exposed any ore and has no water flowing from it. The associated sediment pond near the portal contains only benign material.

(ii) Closure Issues

The loose rock at the entrance to this short tunnel could be a safety hazard to the public. A small quantity of waste rock produced from starting this short tunnel requires contouring. There are no other issues related to this minor item.

(iii) Closure Measures

The opening will be capped with waste rock borrowed locally and the cap will be shaped to form a 2:1 (H:V) slope to ensure stability. The minor amount of waste rock at the portal entrance will be re-graded and revegetated.

3.2.1.5. Jewelbox Pit

(i) Description

The Jewelbox Pit is located between the Jewelbox 1408 Portal and the Main Zone 1380 Portal as shown on Figure 3-3. The pit bottom is at an elevation of 1400m and rises steeply to 1430m. Seepage through the fractures in the rock at the pit bottom is restricted and results in fluctuating ponded water levels in the bottom of the pit. Weathering of the rock face in the pit walls result in rock gradually loosening and falling into the pit.

(ii) Closure Issues

The loose rock and steep slope of the pit walls are a safety concern. During the spring freshet water collects in the bottom of this pit and gradually drains through fractures in the ground and waste rock. Actual routing of the water is difficult to determine.

(iii) Closure Measures

The pit walls will be stabilized by re-sloping, hauling in waste rock from adjacent dumps, or if required by blasting or importing additional fill material. Re-sloping will partially fill the pit. Fill at the base of the pit will consist of coarse waste rock so that it will function like a French drain to ensure that water continues to have a route to discharge out of the pit.

3.2.1.6. Jewelbox Waste Rock Dumps

(i) Description

The waste dumps associated with the development of Jewelbox and Main Zone ore bodies make up the bulk of the waste rock at the Sä Dena Hes minesite. Waste rock from the Jewelbox underground workings was placed immediately below the 1408 Portal as shown on Figure 3-3 and covers an area of 2.6 hectares. In the upper section of this dump (1.3 ha), the material was placed in two to three lifts with berms providing an overall slope of about 2:1 (H:V). However, the lower sections were end-dumped on relatively steep slopes leaving slopes at the angle of repose (1.3:1). Since the shutdown of the mine in 1992, there has been no evidence of any instability of the dump. No tension cracks, toe bulges or subsidence have been noted. These dumps have been inspected annually during closure by a geotechnical engineer.

Waste rock mined from the Jewelbox Pit is located on a ridge immediately east of the pit as shown in Figure 3-3. The dump was built in two phases and covers an area of approximately 1.9ha. The ultimate crest is at El. 1442m and the side slopes of the dump are generally 2:1 (H:V).

Waste rock was also deposited on relatively steep ground immediately below the upper Jewelbox Pit waste rock dump as shown on Figure 3-3. The face of this dump is about 1.3:1 (H:V) and the crest has been over-steepened. The dump covers an area of about 0.4 ha.

Waste rock from the Jewelbox Pit can also be found above and below the access road to the Main Zone Pit. This material sits on relatively steep ground with the dump faces at slopes of 1.3:1 and covers an area of about 0.9 ha. Safety berms are located along the crest of the access road and stand about 1 metre high.

(ii) Closure Issues

There are three primary issues with waste rock dumps for long term closure:

- Physical stability
- Vegetation
- Metals concentrations in surface materials

Long term physical stability is potentially an issue for waste rock dumps at the site as they are located on steep side slopes of the mountains where the mine workings are located.

All of the mine related disturbances adjacent to the Jewelbox and Main Zone ore zones are in the alpine zone (above the tree line), and as such, vegetation is relatively sparse and any disturbance to vegetation takes a long time to recover. Additionally, the composition of waste rock dumps does not provide good soil conditions to facilitate revegetation.

Metals associated with the sulphide ore body in the waste rock dump above Contaminated Site Regulation (CSR) concentrations have been identified by the preliminary environmental site assessment conducted in 2012. Additional sampling will be done in 2013 to better characterize this area. Based on these results, a review of potential exposure of people and wildlife to these metals needs to be evaluated.

(iii) Closure Measures

The crest of the waste dump below the 1408 Portal will be pulled back and rounded for aesthetic purposes and to improve stability. In June 2013, a geotechnical review of the long term stability of the waste rock dump will be conducted. The review will assess the potential for failure, the potential consequences of a failure, and provide any recommended remedial actions and/or long term monitoring.

The waste rock in the Jewelbox Pit dump on the ridge between the Pit and 1408 Portal will be recontoured as much as practical to provide a slope no steeper than about 2:1(H:V).

Revegetation efforts will focus on the relatively flat surface of the waste rock dumps. Surface will be de-compacted and seeded. In some areas, importing finer materials may be required. Refer to Section 3.7 where revegetation plans are discussed in more detail.

All safety berms along the access roads will be removed either with an excavator or by dozer and drainage patterns re-established.

In the summer of 2013 additional sampling of waste rock dump areas will be undertaken to support the ecological and human health risk assessments. If metals concentrations are determined to pose an unacceptable risk to humans or to wildlife based on the results of the ERA and HHRA studies, then remedial plans for those areas will be adapted to ensure there are no unacceptable exposure risks. More detailed discussion of the ERA and HHRA process is discussed in Section 3.6.5.

3.2.2. *Main Zone Ore Body*

The Main Zone is located on the south flank of the Camp Creek catchment. It is on Jewelbox Hill just north of the Jewelbox ore zone. Locations of these mine features are shown in Figures 3-1 and 3-3. The Main Zone workings consist of a small open pit, an adit (1380 Portal) and waste rock dumps. There are no significant underground workings associated with this ore zone.

3.2.2.1. Main Zone - Open Pit

(i) Description

The Main Zone Pit is the lower of the two open pits located on the south flank of the Camp Creek catchment. The pit is a side hill excavation with the pit floor at El. 1370m rising to an elevation of about 1400m with relatively steep slopes.

(ii) Closure Issues

Raveling of the pit highwall is occurring and is a dynamic process due to weathering of the rock. This presents a safety hazard for any people that may be present.

(iii) Closure Measures

The pit walls will be stabilized by re-sloping by dozer where possible, hauling in waste rock from adjacent waste rock dumps or by drilling and blasting if necessary to reduce the wall slope. The re-sloped rock material will be used to backfill the pit. The coarser rock fragments will be directed to the base of the fill to allow free drainage from the pit.

3.2.2.2. Main Zone – 1380 Portal

(i) Description

The 1380 Portal is located within the Main Zone area as shown on Figure 3-3. The portal is approximately 4.5 m by 4.5 m in section and is collared in limestone and skarn. This portal does not connect with any other underground workings. The mining of this relatively short tunnel (adit) was apparently stopped due to very poor ground conditions. Water drains from this portal throughout the snow free period. It likely flows for at least part of the winter but it is not safe to access this area during winter due to avalanche hazards in the area. The water source within the tunnel is from a fault. The groundwater flows out of the fault and onto the adit floor where it comes into contact with weathered mineral rich skarn. The water contacting the weathered scarn results in neutral mine drainage containing total zinc concentrations greater than 30mg/L. The neutral mine drainage then discharges from the portal and flows down slope through the adjacent waste rock dump and into the Camp Creek catchment. For a short period (roughly 3 weeks) each spring during snow melt, some of this water exits to the toe of the waste rock dump as surface water and flows into the invert of the gully joining a surface water flow. The surface water flow in the gulley is primarily from melting snow and exists only during freshet. Currently the zinc concentration in the portal discharge is being attenuated by contact with the waste rock in the dump and overburden. Additional attenuation occurs as the portal drainage water mixes with the alkaline surface water in the gully. For the majority of the year, the portal discharge water does not reach the gully as surface water; rather it drains into the ground. During freshet the surface water in the gully flows downslope until about 500m before Camp Creek where it goes into the ground.

(ii) Closure Issues

Physical closure issues related to this site include stability of the opening and prevention of inadvertent access by the public or by wildlife.

This tunnel (an adit) does not connect to any other mine workings so the portal is the only opening to surface. There is no active airflow through the workings and consequently, there is no significant risk of ice plugs forming within the tunnel.

The water discharge from this portal has elevated zinc levels that are currently being attenuated but the attenuation may in the long-term be exhausted. Refer to Section 3.6.3 for a detailed discussion of the fate of the portal discharge water.

(iii) Closure Measures

The 1380 Portal will be sealed off using coarse site waste rock to at least 5m into the portal beyond the entrance. Material to seal the portal will come from the resloping adjacent slopes. Within the tunnel, the waste rock fill will be placed as close to the top of the tunnel as possible to help stabilize the collar of the portal. At surface the waste rock will be sloped from above the top of the portal to the base of the portal at a stable slope and that is contoured to tie into the surrounding terrain for aesthetic purposes. At the base of the seal, a French drain will provide a drainage channel from the mine workings. As a contingency, the seals will include two minimum 4 inch diameter pipes (high density polyethylene pipe or equivalent so they don't corrode). The purpose of the pipes is to provide a backup conduit for mine water drainage if required. The pipes will be installed at slightly different elevations and so that the upper pipe will can drain if the lower pipe were to plug. The ground at the base of the portal entrance is naturally sloped away from the portal entrance so any precipitation will drain away from the seal.

Prior to construction, construction drawings will be submitted to the applicable regulatory agencies (including the Mines Inspectorate) for review and approval as required in the existing permits. As-built reports documenting the construction of the seals will be completed and submitted as part of required regulatory reporting.

The fate of the portal discharge water is further discussed in Section 3.6.3. Monitoring of the discharge water and receiving water will be included within the mine's post closure monitoring plan as discussed in Section 5.3. As such, the portal seal will be designed to prevent access by the public or wildlife but will allow the continual discharge of water from the portal.

3.2.2.3. Main Zone – Waste Dump

(i) Description

Waste rock from the Main Zone Pit was end-dumped on hillside slopes below the pit floor and into the adjacent gully (Figure 3-3). The slope of the dump is about 1.3:1 and consists of very coarse, broken rock. The dump covers an area of about 0.3 ha. The waste rock is composed primarily of limestone with some mineralized skarn. Some of the skarn has weathered resulting in the release of coarse sphalerite and galena-rich sand. In the spring, water was seen flowing through the dump presumably originating from the Main Zone Pit or the Jewelbox Pit.

Phyllite waste rock was also end-dumped on the hillside of the gulley adjacent to the 1250 Portal. This dump is relatively small (< 0.2 ha) with a slope of about 1.3:1 and contains no mineralized material.

(ii) Closure Issues

There are three primary issues with waste rock dumps for long term closure:

- Physical stability
- Vegetation
- Metals concentrations in surface materials

Long term physical stability is potentially an issue for waste rock dumps at the site as they are located on steep side slopes of the mountains where the mine workings are located.

All the mine related disturbances adjacent to the Main Zone ore zone are in the alpine zone (above the tree line), and as such, vegetation is relatively sparse and any disturbance to vegetation takes a long time to recover. Additionally, the composition of waste rock dumps does not provide good soil conditions to facilitate revegetation.

Metals associated with the sulphide ore body in the waste rock dump have been identified by the preliminary environmental site assessment conducted in 2012. Based on these results, a review of potential exposure of people and wildlife to these metals needs to be evaluated.

(iii) Closure Measures

The crest of the waste dump below the 1380 Portal will be pulled back and rounded for aesthetic purposes and to improve stability.

In June 2013, a geotechnical review of the long term stability of the waste rock dump will be conducted. The review will assess the potential for failure, the potential consequences of a failure, and specify any recommended remedial actions and/or propose any recommended long term monitoring.

Revegetation efforts will focus on the relatively flat surface of the waste rock dumps. Surface will be de-compacted and seeded. In some areas, importing of finer materials may be required. Refer to Section 3.7 where revegetation plans are discussed in more detail.

In the summer of 2013 additional sampling of waste rock dump area will be undertaken to support ecological and human health risk assessments. If metals concentrations pose an unacceptable risk to humans or wildlife based on the results of the ERA and HHRA studies, then remedial plans for those areas will be adapted to reduce the risks to ensure there are no unacceptable exposure risks. More detailed discussion of the ERA and HHRA process is discussed in Section 3.6.5.

3.2.3. *Burnick Ore Body*

The Burnick ore body is located on the North Hill which is approximately 4 km north of the mill site as shown in Figure 3-2. There are 3 portals and a waste dump related to this area of the mine. Very little development has been done to date but future mining was planned.

3.2.3.1. Burnick Underground Mine Workings

(i) Description

The majority of mining activity when the mine was operational came from the Jewelbox ore zone deposit. Mining activities at Burnick were primarily development in preparation for production

and as a result, there are very limited underground mine workings at this location. There were no open pits developed at this location.

(ii) Closure Issues

Although underground mining activity was very limited, if any of these development tunnels were too close to surface, there could be risk of causing some settling of the ground surface (i.e. surface "subsidence"). If subsidence of the ground surface occurred, it potentially could cause a safety risk to people or wildlife using the area.

(iii) Closure Measures

Due to the steeply side slopes of the mountain, workings developed into the mountain, quickly increase in distance from the ground surface. This combined with the lack of large stopes provides a high degree of confidence that there is no significant risk of surface subsidence. However, mine maps will be reviewed by a geotechnical engineer to verify that there areas no surface subsidence risks. If any significant risk were to be identified, the on-going monitoring of the ground surface would part of the long term monitoring program. As with Jewelbox ore zone, if any subsidence were to be identified, it would need to be further assessed and additional mitigation measures considered.

3.2.3.2. Burnick Zone – 1200 Portals

(i) Description.

At the 1200 Level of Burnick, there are two portals separated by several metres. They are shown on Figure 3-4. One of the portals is the main access to the Burnick ore body and the second portal is equipped with a propane heater and a ventilation fan for the ventilation air. Water from the mine workings drains through the ventilation portal. The flow rate of this water used to range from approximately 800 L/min during spring to 15 L/min during winter low flows. The source of most of this water appears to originate from fractures and drill holes located near the entrance of the 1300 Portal and from melting ice in the warmer months. The water flows down slope from this portal within the mine workings, exiting the mine from the 1200 Level. The

higher spring flows have previously been contributed to by melting ice located near the 1200 Level portal entrance, however temporary sealing of the portals in 2009 have already virtually eliminated the ice buildup.

The water discharging from the portal flows into a culvert beneath the portal pad which directs it over the edge of the existing waste rock dump. As there has only been preliminary development completed at Burnick the underground workings are not extensive. A plan view of the present workings at Burnick is shown in Figure 3-4.

(ii) Closure Issues

The two portals at the 1200 Level must be permanently sealed to prevent public and wildlife from accessing the mine workings. The portals will be sealed in a manner that allows a flow of approximately 800 L/min of water to discharge through the seal to prevent any water from building up behind the seal which could create a safety hazard. Water from the portals must be directed down the face of the hill slope in a manner that does not result in erosion or instability of the slope face. Previous geochemical studies conducted by SRK as required in the Water Licence confirmed that there are no unacceptable environmental issues associated with these discharges.

In the Yukon, there have been instances of ice plugs forming in open portals of mines after closure. The ice plugs have resulted in water being stored behind the plugs and being released in an uncontrolled fashion when the ice plugs break. Ice forming in the tunnels is caused by cold air flowing through the tunnels freezing water that is in the mine workings during the severely cold winter months.

When SDMOC took over management of the SDH mine, inspections revealed that the Burnick workings had ice building up within the main access tunnels near the entrance to the two 1200 Level portals. It was confirmed that the buildup of ice was the result of cold air moving through the mine. Initially, Cominco attempted to stop the air flow with fabric seals but that proved ineffective because of the need for continual maintenance. In 2009, temporary waste rock seals were installed at both the upper and one of the lower portals to minimize air flow. Inspection at the lower portal is still possible through the ventilation access portal and subsequent inspections over the past two years have shown that the ice is significantly reduced. Upon permanent

closure of the mine, the seals will continue to prevent any significant air flows within the mine which will eliminate the potential for ice plugs to form.

BURNICK ORE ZONE

1450

1300

1250

1350

1400

1200

1150

1100

1050

1300 PORTAL

Seal Portal with Coarse Rock, Cleanup Wood & Other Misc. Debris, Pull back Crest of Dump, Re-vegetate Top of Small Waste Rock Dump

Core Racks - Dispose of in Jewelbox Mineworkings, Dispose of Wood Structures

BURNICK SHOP

Remove Building, Hydrocarbon Contaminated Soils Remediation, Scarify, Revegetate

MH-22

BURNICK WASTE ROCK DUMP

Outline of Burnick Waste Dump
Pull Back Crest, Decompact & Revegetate Top.
No Resloping of Dump Face

1200 PORTALS

Seal Two Portals with Coarse Rock, Install French Drain and Pipes for Drainage. Remove Exisiting Culvert and Construct Rock Drain Across Access Road

Access Road - Recontour, Scarify & Revegetate

North Hill Sediment Basin
Requires Assessment to Determine Reclamation Requirement

BURNICK CREEK

MH-08

Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

0 50 100 150 200 250 metres

1:5,000

CONTOUR INTERVAL=10m

NOTE

BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Sä DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAMATION PLAN

BURNICK ZONE
CLOSURE MEASURES

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
BJD	BJD	3-4	1
Revised: February 1, 2013	PROJ. NO.		

(iii) Closures measures

Both of the Burnick 1200 Portals will be sealed off using coarse waste rock to at least 5m into the portal beyond the entrance. Within the tunnel, the waste rock fill will be placed as close to the top of the tunnel as possible to help stabilize the collar of the portals. At surface the waste rock will be sloped from above the top of the portals to the base of the portals at a stable slope. This material will be contoured to tie into the surrounding terrain for aesthetic purposes. At the base of the seal in the ventilation portal, a French drain will be constructed with sufficient capacity to handle the potential water flows from the mine. Each seal will include two 4 inch (minimum) diameter pipes (high density polyethylene pipe or equivalent so they don't corrode). The purpose of the pipes is to prevent air from pressurizing within the mine and to provide a conduit for mine water drainage if required (i.e. if the French drain were to plug up). The pipes will be installed at slightly different elevations and one of the two pipes is a backup in case the other becomes plugged. The ground at the base of the portal entrance will be sloped away from the portal to ensure precipitation drains away to prevent ponding of water up against the seal. The existing culvert crossing under the access road will be removed and replaced by a rock drain. The rock drain will extend from the French drain in the ventilation portal seal across the access road and discharge water onto the face of the waste rock dump (where it is currently discharging) so that there is no erosion on the face of the slope.

Prior to construction, design drawings will be submitted to the applicable regulatory agencies (including the Mines Inspectorate) for review and approval as required in the existing permits. As-built reports documenting the construction of the seals will be completed and submitted as part of regulatory reporting.

3.2.3.3. Burnick Zone – 1300 Portal and Waste Rock Dump

(i) Description

The 1300 Portal is accessible via an old exploration road (approximately 7 km) that is currently accessible only by quad or a tracked excavator. Sections of the road are too steep for 4 wheel drive trucks. This portal is at the highest elevation in the mine so that there is no potential for drainage out of the mine workings here.

In 2009 this portal was sealed with adjacent waste rock materials using an excavator. This was done to seal the mine to stop air flow within these workings and to prevent access into the mine workings by people and wildlife. An excavator was used to reach inside the portal as far as possible (in excess of 5m) to place the waste rock materials and then waste rock was placed on the exterior of the portal from above the top of the portal sloping down to the base of the portal.

The associated waste rock dump is very small as not much development mining work was done in this area. The waste rock dump is not discussed separately.

(ii) Closure Issues

There are five primary issues with portal and waste rock dump at this location for long term closure:

- Preventing access by people and wildlife into the mine workings,
- Limiting airflows into the mine workings to control ice buildup above the 1200 Portals,
- Physical stability of the small waste rock dump,
- Disturbances to vegetation, and
- The potential concentrations of metals in waste rock dump surface materials

As with all mine openings, there needs to be a secure seal to prevent people and wildlife from entering the mine due to safety concerns.

As previously discussed with regard to the 1200 Portal area, prevention of ice plugs due to cold air flowing through the wet mine workings in the winter months is important.

Long term physical stability of the small waste rock dump needs to be reviewed as it is located on the steep side slope of the mountain.

All mine related disturbances in this area are in the alpine zone (above the tree line), and as such, vegetation is relatively sparse and any disturbance to vegetation takes a long time to recover. Additionally, the composition of waste rock dumps does not provide good soil conditions to facilitate revegetation.

There is potential for metals associated with the sulphide ore body to be on the surface of the small waste rock dump. Characterization sampling in 2013 is required to determine surface metals concentrations in this area.

(iii) Closure Measures

Given its length and route through high alpine, it is important to minimize disturbance to the access route to the 1300 Portal area. As the facilities and disturbances at this location are minimal, only minimal traffic into this site is expected to be necessary as to implement closure efforts.

The portal will be sealed off using coarse waste rock to at least 5m into the portal beyond the entrance. Material to seal the portal will be sourced from areas immediately adjacent to the portal. Within the tunnel, waste rock fill will be placed as tight to the top of the tunnel as possible to help stabilize the collar of the portal. At surface the waste rock will be sloped from above the top of the portal to the base of the portal (at a stable slope angle), and that the cover over the seal is contoured to tie into the surrounding terrain for aesthetic purposes. The seal will include two minimum 2 inch diameter pipes (high density polyethylene pipe or equivalent so they don't corrode). The purpose of the pipes is to allow minor airflow into the mine workings. The second pipe is to serve as a backup in case one pipe was to plug. The ground at the base of the portal entrance naturally slopes away from the portal entrance so any precipitation will drain away from the seal.

Due to access restrictions to this area, it is not practical to provide accurate drawings of the portal area prior to sealing. However, the methodology will be the same as reviewed by regulator for other openings and as-build drawings and photographs will document that work was completed consistent with approved methods for the other similar portals. These reports will be submitted as part of required regulatory reporting.

The 1200 Portal entrances to the mine workings are the areas where there is potential for ice dams forming backing water up into the mine workings. As discussed previously, providing a secure seal over the 1300 Portal is required to help minimize airflow and preventing ice from building within the mine workings.

In June 2013, a geotechnical review of the long term stability of the waste rock dump will be conducted. The review will assess the potential for failure, the potential consequences of a failure, and specify any recommended remedial actions, and propose any recommended long term monitoring that may be required.

Revegetation efforts will focus on the relatively small flat surface of the waste rock dump. Surface will be de-compacted and seeded. Refer to Section 3.7 where revegetation plans are discussed in more detail.

In the summer of 2013 additional sampling of waste rock dump areas will be undertaken to support ecological and human health risk assessments. If metals concentrations pose an unacceptable risk to humans or wildlife based on the results of the ERA and HHRA studies, then, remedial plans for those waste dump areas will be adapted to ensure there are no unacceptable risk levels. More detailed discussion of the ERA and HHRA process is discussed in Section 3.6.5.

3.2.3.4. Burnick Zone – 1200 Level Waste Dump

(i) Description

The waste rock dump at the 1200 Level from the underground workings at the Burnick Zone covers an area of about 1.4 ha and is located on a steep side hill immediately below the portal. The dump not been used since the mine ceased operations in 1992.

(ii) Closure Issues

There are three primary issues with the waste rock dump for long term closure:

- Physical stability
- Vegetation
- Metals concentrations in surface materials

Prior to 2000, several tension cracks were identified along the crest of the dump. The top of the dump has subsequently been re-graded to reduce the load near the crest. The dump has been

subsequently monitored annually as part of the geotechnical inspection with no further settlement or slumping being observed. However, the long term stability of this dump must be reviewed.

The presence of the waste rock dump has displaced the vegetation in the area and due to the rocky nature of the material combined with the compaction of the relatively flat surface at the top of the dump, does not provide good soil conditions to facilitate revegetation.

Some metals associated with the sulphide ore body are expected to be contained within in the waste rock dump at this location but has not been assessed at this time.

(iii) Closure Measures

At closure, the crest of the Burnick dump will be further pulled back to further reduce loading on the crest to improve stability. The 1200 Portal drainage channel, as discussed in Section 3.2.3.1 above, would be constructed at the south end of the dump. In 2007, flows from the portal resulted in toe materials becoming supersaturated leading to a washout downslope of the toe. This was due to excess water discharging from the portal due to melting ice that had built up over the winter months. The portal seals planned will eliminate this issue going forward. Drainage on the dump face was restored to the proper channel and no further erosion has occurred and the washout area is naturally revegetating.

In June 2013, a geotechnical review of the long term stability of the waste rock dump will be conducted. The review will assess the potential for failure, the potential consequences of a failure, and specify any recommended remedial actions, and if required, recommend long term monitoring.

Revegetation efforts will focus on the relatively flat surface of the waste rock dump. Surface will be de-compacted and seeded. In some areas, importing finer materials may be required if it is too rocky. Refer to Section 3.7 where revegetation plans are discussed in more detail.

In the summer of 2013 sampling of the waste rock dump will be undertaken to support ecological and human health risk assessments. If metals concentrations are determined to pose an unacceptable risk to humans or wildlife, then remedial plans for those areas will be

adapted to ensure there are no unacceptable exposure risks. More detailed discussion of the ERA and HHRA process is discussed in Section 3.6.5.

3.3 TAILINGS MANAGEMENT FACILITY

3.3.1. *General*

The following section presents a description of the existing TMF, followed by a discussion of the closure measures (see Figure 3-5).

3.3.2. *Description*

The TMF consists of three earth structures, which are referred to as the North Dam, the South Dam and the Reclaim Dam as shown on Figure 3-5. The North and South Dams, which impound the tailings, were constructed between July 1990 and October 1991. The starter dams for both structures were built to a height of about 13 metres. A small, two metre high cofferdam was also constructed halfway between the two dams to control flow of water and tailings from the north end of the impoundment.

In addition to the North and South Dams, a Reclaim Dam was built to retain supernatant water decanted from the tailings pond for reuse in the mill. The Reclaim Dam is about 15 metres high at the maximum section. The mine plan involved recycling of the reclaimed water to the mill with a controlled discharge into Camp Creek from April to October each year. During operations water is decanted from the tailings pond to the Reclaim Pond through a concrete decant tower located adjacent to the upstream crest of the South Dam as shown Figure 3-5. Details of the decant tower are shown on Figure 3-5.

Water is discharged from the Reclaim pond to Camp Creek during the licensed allowable discharge period, April through to October.

During operations, when the pond water level becomes too high, water was decanted from the Tailings pond to the Reclaim pond through a concrete decant tower located adjacent to the upstream crest of the South Dam. The decant tower drained the water through the dam in a

0.5m dia. corrugated steel pipe ("CSP") culvert into the Reclaim Pond. During temporary closure the decant system is not being used. Instead a siphon arrangement is used to control water levels retained by the South Dam Pond. Prior to the onset of winter, the water level in the tailings pond is drawn down as far as practical to provide extra storage during the spring runoff.

An emergency spillway, consisting of two 900 mm dia. CSP culverts, is located at the west abutment of the South Dam as shown on Figure 3-5. The spillway has the capacity to discharge flow from a 200-year flood event into the Reclaim pond. An emergency spillway is also located on the west flank of the Reclaim pond which would discharge into the Camp Creek Diversion.

In the 2003 Dam Safety Review, the consequence category of the South Dam was revised and as a result the design flood was verified that the dam would meet the 1000-year event under operations, care and maintenance as well as at closure. A detailed discussion on the revised flood hydrology for the site, including the referenced Figures 3-12 to 3-16, is provided in Section 3.1.5 of Appendix B – Flood Estimates.

An extract of this discussion is provided as follows:

To examine the effects of storage on flood magnitude it was necessary to use a rainfall/runoff model that simulates the full flood hydrograph and that provides flood routing capabilities. The model selected for this purpose was developed by the U.S. Corps of Engineers and is known as HEC-HMS.

Figure 3-12 [Appendix B] *shows the results of applying the HEC-HMS model to the Tailings Management Facility (TMF). The instantaneous peak of the incoming flood hydrograph was estimated to be 5.4 m^3/s. The combined outflow through the two culverts would peak at 1.6 m^3/s, or 30% of the incoming flood peak. During passage of the flood, a volume of 53,000 m^3 of water would be temporarily stored within the TMF. The water level in the TMF would peak at an elevation of 1094.9 m, which is roughly at the crown level of the two culverts.*

The reclaim pipeline (≅ 300 mm dia.) is located along the west side of the access road to the mill as shown on Figure 3-5. A short section of the pipe near the reclaim pumphouse is buried. The tailings pipeline (≅ 250mm dia. HDPE) lies, above ground, along the side of the road as shown on Figure 3-5.

Camp Creek is currently diverted into a channel along the west side of the Reclaim Pond and discharges through a twin culvert spillway (two 1.2m dia CSP's) into a riprap lined channel. The channel is designed to accommodate the 200-year flood event. Although there is no requirement to upgrade the design flood from the current 200-year event for these culverts, the impact of the 1000-year flood on the culverts was reviewed. A detailed discussion of the hydrological assessment is provided in Section 3.1.5 of Appendix B - Flood Estimates. An extract is provided below.

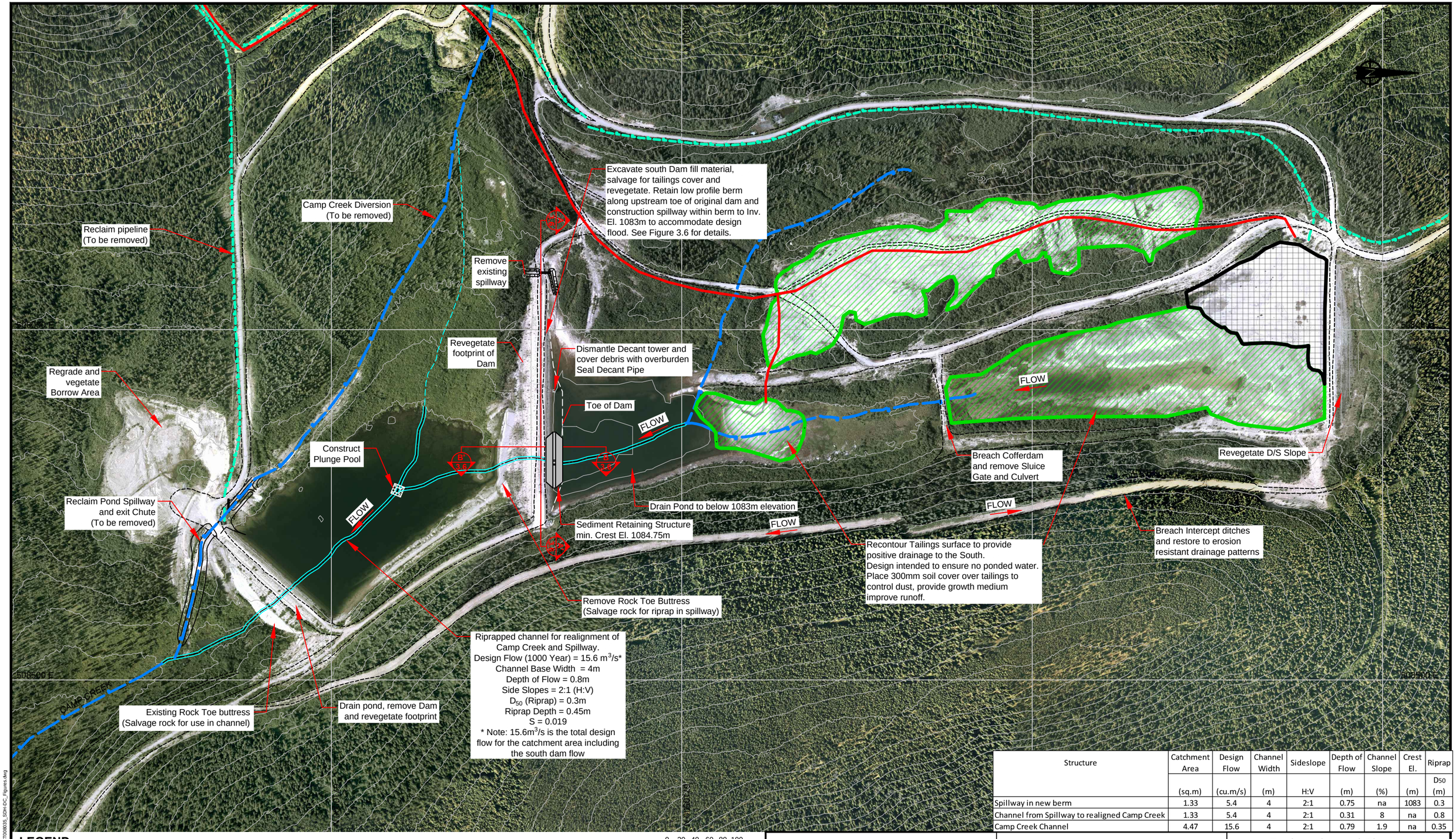
Figure 3-13 [Appendix B] *shows the simulated flood hydrology for the two culverts at the road crossing of the Camp Creek Diversion*. *The instantaneous peak of the hydrograph generated by the Camp Creek catchment would be 12.7 m^3/s, including outflows from the TMF. The combined outflow through the two culverts at the road crossing would be an estimated 6.0 m^3/s, or roughly half the peak of the incoming flood. In passing this flood, some 66,000 m^3 of water would be temporarily stored in the Reclaim Pond. Another 36,000 m^3 would be stored in the TMF. The water level would rise to 1081.1 m behind the Reclaim Dam, leaving a freeboard of about 0.9 m below the dam's crest.*

In March of 1992, the previous operators, Curragh Resources, built a rockfill buttress along the toe of the Reclaim dam to provide extra protection against sloughing and erosion of the toe. Annual inspections of this buttress show that it is performing as designed.

In September 1992, work commenced on a 2-metre raise in the elevation of the South Dam with the intention of bringing it up to El. 1098m. Work on the extension was shutdown on October 14, 1992 because of the construction difficulties experienced due to sub-zero temperatures. In 2008 it was identified that a short section of the crest of the dam was below the design elevation. Work completed in 2010 added approximately 1.0 meter to the crest elevation in the low spot under the supervision of a Geotechnical Engineer.

In 1997 work was initiated on a toe buttress at the South Dam in advance of the planned reopening of the mine in 1998. Although the decision to re-open the mine was postponed, the buttress was completed in the fall of 1998.

Interceptor ditches are located above the TMF on the east side of the catchment. These ditches direct runoff away from the TMF both to the north and the south. Drainage ditches associated with the access roads on the west side of the TMF direct runoff away from the TMF on the west side. In 2010 work was completed on the brushing and cleaning out of these ditches in order to maintain the design capacities.



Structure	Catchment Area (sq.m)	Design Flow (cu.m/s)	Channel Width (m)	Sideslope H:V	Depth of Flow (m)	Channel Slope (%)	Crest El. (m)	Riprap D50 (m)
Spillway in new berm	1.33	5.4	4	2:1	0.75	na	1083	0.3
Channel from Spillway to realigned Camp Creek	1.33	5.4	4	2:1	0.31	8	na	0.8
Camp Creek Channel	4.47	15.6	4	2:1	0.79	1.9	na	0.35

LEGEND

- Covered Tailings
- Cover and Revegetate
- Sediment Retaining Structure
- Major Contours
- Edge of Road
- Water Pipe
- Realigned Flow Channel
- Tailings Line
- Creek
- Original Creek Channel

0 20 40 60 80 100
Scale in Metres

NOTE

Topographic contour data and aerial photos were obtained from McElhanney and are based on August 15, 2012 LiDAR survey. Coordinate system is UTM NAD 83CSRS zone 9V.

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SRK JOB NO.: 1CT008.035
FILE NAME: 1CT008035_SDH-DC_Figures.dwg

Teck

Sä Dena Hes Project

Reclamation and Closure

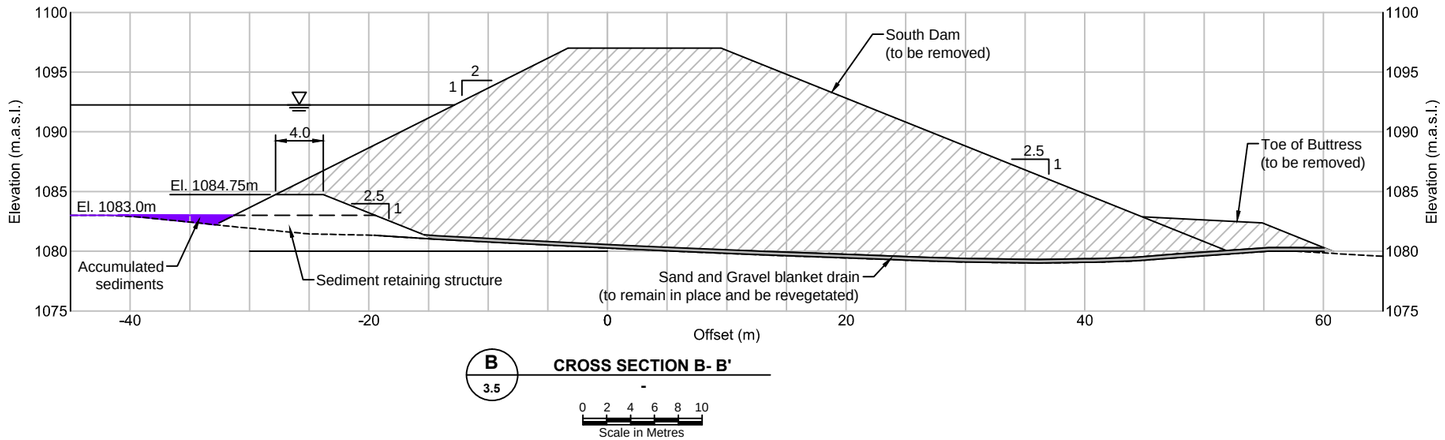
TMF Decommissioning

DATE: Jan. 31, 2013
APPROVED: PH
FIGURE: 3.5

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LEGEND

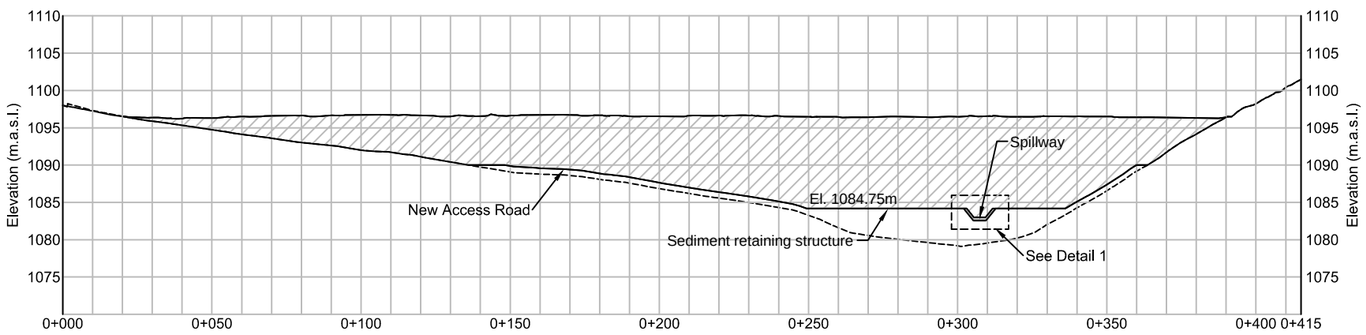
- Existing Ground
- Pre-existing Ground
- Bathymetry
- Remove
- Riprap



B / 3.5 **CROSS SECTION B- B'**

-

0 2 4 6 8 10
Scale in Metres

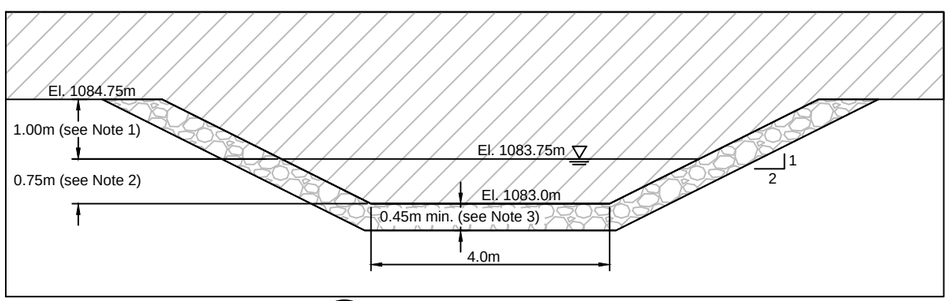


A / 3.5 **Profile A - A'**

2.5x Vertical Exaggeration

Horizontal: 0 10 20 30 40 50
Scale in Metres

Vertical: 0 4 8 12 16 20
Scale in Metres



1 / - **Detail 1**

Spillway

0 0,5 1 1,5 2 2,5
Scale in Metres

NOTES

1. Assume 1m freeboard.
2. Depth of flow based on design flow of 5.4m ^{3}/s (1000 year event).
3. Riprap depth is 1.5 times D_{50}.

srk consulting	Teck	Reclamation and Closure
SRK JOB NO.: 1CT008.035	Sä Dena Hes Project	TMF Decommissioning Sections and Detail
FILE NAME: 1CT008035_SDH-DC_Figures.dwg		DATE: Jan. 31, 2013 / APPROVED: PH / FIGURE: 3.6

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3.3.3. *Closure Issues*

The long-term physical stability of the tailings embankments and the chemical stability of the tailings are the key items that have been addressed in this closure plan. The key physical stability issues are related to the design flood and seismic events. The only chemical stability issue is related to the zinc loading from the tailings. Further discussion of water quality can be found in Section 3.6.3.

(i) Physical Stability Issues

As the Reclaim Dam will be removed after closure, the physical stability of this structure is not addressed in the Plan. While the South Dam will also be decommissioned, the physical stability of the current configuration of the South Dam is discussed.

The stability analyses of the north tailings embankment, which is presented in Section 10 of Appendix B, concluded that the dam has an adequate factor of safety under both static and seismic loading.

The Plan calls for the draining of the water behind the South Dam, the removal of the majority of the dam and the placement of a minimum 0.3m thick soil cover over the tailings. In order to provide a measure to reduce the risk of any post closure release of the covered tailings, a small berm would be left from the remnants of the South Dam along the existing alignment of the upstream toe of the dam. A spillway would be constructed at the low point of the berm with an invert elevation of 1083m and a freeboard of 1m. The spillway would be designed to accommodate the 1000-year peak flow of 5.4 m^3/sec.

The selection of the 1000 year design event for the spillway in the berm is based on the guidelines presented in Table 8 of the “Mine Reclamation in the Northwest Territories and The Yukon”, Indian and Northern Affairs Canada (INAC), 1992 and the Canadian Dam Association Dam Safety Guideline (2007). In the unlikely event of a spillway failure, limited tailings and embankment material would be released and transported downstream into False Canyon Creek. The tailings are not acid generating, however once the flood levels have subsided, there is potential for a moderate increase in metal concentrations such as zinc in the stream due to

oxidation of sphalerite in the exposed tailings. There would be no loss of life expected, no damage to buildings or agricultural land, and no loss to roads.

With the present spillway design, it is expected that minimal maintenance would be required following a 1000 year event. In the event of a 1000 year flood event, an inspection of the site would be conducted to determine if any maintenance work is required.

(ii) Chemical Stability

Based on SRK's loading assessment, the tailings loading is 1 or 2% of the total load to False Canyon Creek. As such, it is concluded that the zinc load from the tailings is not having a significant impact on the receiving water quality, and consequently no additional engineered measures to control leaching are required for closure. Further discussion of water quality is discussed in Section 3.6.3.

3.3.4. *Closure Measures*

General closure measures for the Tailings Management Facility are presented in Figure 3-5.

3.3.4.1. Tailings Embankments

At closure, the remaining ponded water above the South Dam will be siphoned into the Reclaim Pond. Final draining will be by pumping down to a level that will enable the dam decommissioning work to proceed. As the water levels in the Reclaim and South Dam ponds were kept low the last few years, the discharge volume to completely drain the ponds is expected to be within permit levels allowing this activity to be completed in 2013. Discharge rates from the Reclaim Pond are regulated under the Water Licence, so monitoring of discharge rates will be done to ensure compliance with the Licence.

As the stability analyses concluded that the North Dam has adequate factors of safety against failure under both static and seismic conditions, no specific action to stabilize the dam is required. The downstream slope of the North Dam will not be revegetated (and tree and shrub growth will continue to be managed) and the crest of the dam will be contoured to slope down to tie in flush with the cap on the tailings surface.

3.3.4.2. Dust Control

To prevent ponding of water on the surface of the tailings, the latter will be recontoured to provide positive drainage towards the south end of the impoundment. A nominal 300 mm cover of till material will be placed over the contoured tailings to control dust and provide a growth medium for revegetation. Where required (i.e. where there is significant moisture), mine waste rock will be placed on the tailings to provide a suitable sub-base so that heavy equipment are able to work on the tailings surface without becoming stuck. The capping material will consist of locally available till (including dam fill material from the South and Reclaim Dams) with sufficient fines for seeding and planting.

As the southern extent of the existing tailings deposit is currently covered with water, the proximity of the tailings to the upstream toe of the dam and the depth of the tailings is unknown. However, an estimate of the extent of the tailings was made and is shown on Figure 3-5.

3.3.4.3. Interceptor Ditches

The interceptor ditches on the east hillside above the TMF will be breached and regraded to restore original drainage patterns.

3.3.4.4. Tailings Pond Decant Tower

The decant tower will be dismantled to ground level and the resulting debris buried on site. All exposed rebar will be cut off. The decant pipe will be completely removed once the South Dam is decommissioned.

3.3.4.5. Tailings Pipelines

The high density polyethylene (HDPE) tailings pipelines will be salvaged or disposed of, and all drop boxes will be removed.

3.3.4.6. South Dam

As discussed in Section 3.3.3, the South Dam will be removed and a low profile berm will be left in place to provide a barrier to any tailings migration. A spillway would be constructed within the berm to accommodate the peak flow of the 1000-year event as shown on Figures 3.5 and 3.6. Details of the hydrology and flood estimate for this event are presented in Section 3.1 of Appendix B. The design flow was estimated to be 5.4 m^3/s. Sections of the proposed spillway are shown in Figure 3-6.

The spillway crest and sideslopes will be riprapped with suitably sized material. Below the spillway, a riprapped channel will convey the flow to the restored Camp Creek as shown on Figure 3-5. The channel would be designed for the same event as the spillway in the berm but the riprap sizing would be adjusted for the steeper slope. Details of the channel geometry are presented in the table on Figure 3-5. There is limited source of rip rap available on the mine site. However a source of rock has been identified from a sidehill exposure located at km 17 on the main access road to the mine site and is within SDHOC mineral claims. Testing of the rock to confirm that it is suitable will be done in Summer 2013 and a quarry development plan will be submitted to the Yukon Energy, Mines and Resources, for approval as required in the QML.

3.3.4.7. Reclaim Pond

(i) Reclaim Dam

The water ponded behind the dam will be siphoned down as far as practical and the remainder then pumped down to allow the dam to be removed. During the final pumping process sediment control measures may be required. As discussed above, discharge of the water to Camp Creek will be planned to ensure compliance with licence requirements. Three sediment samples were collected from accessible areas in 2012. Cadmium and selenium concentrations exceeded the applicable CSR standard (Golder, 2012a). Once the water is removed, additional sediment samples will be collected and analyzed for metals. If significant elevated metal concentrations are discovered, then the drained reclaim pond area will either be capped, or the sediments removed and hauled to the main tailings pond area for capping and reclamation. A riprapped

channel will be constructed from the outlet of the spillway in the berm at the toe of the former South Dam to a plunge pool at the confluence with the restored Camp Creek. A similar riprapped channel will also be required to convey the flow in Camp Creek through the area previously occupied by the Reclaim Dam and would be designed for the 1000-year flood peak flow of 15.6m^3/sec. Details of the channel are provided in the table in Figure 3-5. This channel would be riprapped for a distance of about 70 metres beyond the former Reclaim Dam centerline.

(ii) Camp Creek Diversion

At closure the Camp Creek diversion will be redirected back into its original channel and the diversion contoured to provide natural drainage patterns. Camp Creek will be restored to its original alignment within a riprapped channel designed to accommodate the 1000-year event. Details of the channel are presented on Figure 3-5.

(iii) Reclaim Lines

The existing HDPE reclaim lines on surface will be removed (and where practical, salvaged) and all culverts used to convey the line to the mill will be removed. The pumphouse will be removed, and the buried sections of the reclaim line and the discharge pipe to the existing Camp Creek spillway channel will be left in place.

3.4 INFRASTRUCTURE: BUILDINGS, STRUCTURES AND SERVICES

The approach to the decommissioning of the constructed infrastructure is to completely remove all materials with the exception of concrete foundations, which will be demolished to ground level and buried *in situ*. This will be accomplished by contracting the work to a company experienced in demolition. It is expected that there will be a salvage value for much of the materials (particularly structural steel and other crushing, grinding and processing equipment from the mill). However, salvage values have not been used to offset closure costs. Any non-hazardous materials that are not economic to be salvaged will be placed in an on-site landfill.

In all cases, concrete foundations and other concrete structures will be broken up to ground level and buried under approximately half a metre of till material.

The reader is referred to Figure 3-7, for the location of the infrastructure components that are dealt with in this section.

Closure issues related to infrastructure include public health and safety, site stabilization, aesthetics, and restoration of disturbed lands. Hazardous building materials have been identified and will require special handling and disposal during building demolition and salvage. The results are further discussed in Section 3.5.

The approach to closure for the infrastructure components of Sä Dena Hes is to first salvage any buildings or equipment that may be used at other mining operations that are within an economic hauling distance, and then assess the remaining facilities and equipment for disposal through demolition and salvage contracts. It is impossible at this time to accurately predict freight haulage costs, and supply and demand economics for salvage at the time of potential demolition. If it is not economical to remove material from the site, it will be disposed of in a permitted industrial landfill. Any hazardous building materials will be removed from site and either recycled or taken to an approved disposal facility.

Freshwater Line to Jewelbox
COARSE ORE STOCKPILE
CRUSHER HOUSE
HAUL ROAD
Hydrocarbon Contaminated Soils
Stored Awaiting Remediation
N
FUEL STORAGE TANKS
Gasoline
Diesel
WATER TANK
Process & Fire Water
RECLAIM CONVEYOR
CONVEYOR
CONCRETE SLAB
Former Mobile Equipment Service Garage
COARSE
ORE BIN
Containment Area
MAIN ACCESS ROAD TO MINE
WATER DISTRIBUTION
PUMP HOUSE
REAGENT
BINS
KITCHEN
WATER STORAGE
BUNK TRAILER
MAINTENANCE
SHOP
PROPERTY ACCESS GATE
BUNK TRAILER
OFFICE
COMPLEX
CONCENTRATOR
COMPLEX
MCC
POWER
HOUSE
BUNK TRAILER
WAREHOUSE
DRY AND
LAB
MCC
AMBULANCE GARAGE
Radiator
Banks
BUNK TRAILER
SEPTIC
TANKS
TRUCK LOAD OUT
OUTSIDE CONCRETE
STORAGE SLAB
BUNK TRAILER
COLD STORAGE
STEEL BALL
STORAGE
Hydrocarbon Contaminated Soils
Stored Awaiting Remediation
TAILINGS LINE
CORE RACKS
WASTE OIL TANK
RECLAIM WATER LINE
5,000L CAPACITY WASTE OIL STORAGE

Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

0 50 100 150 200 250 metres

1:5,000

CONTOUR INTERVAL=10m

NOTE

BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN
ADJUSTED FROM NAD 1927

Sä DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAMATION PLAN

CONCENTRATOR PROCESS AREA CURRENT CONDITIONS

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
BJD	BJD	3-7	1
Revised: February 1, 2013	PROJ. NO.		

Table 3-1 provides a brief dimensional description of the various infrastructure components, and Figure 3-7 depicts the general arrangement of the central office, accommodation and mill site buildings and services. Over the past several years a number of buildings and structures have been removed as they have deteriorated as a result of age and subsequent winter snow damage. These include all facilities previously located at the Jewelbox site, the shop at the Golden Hills site and the First Aid trailer located at the main gate. All waste generated from these demolitions have been disposed of in a permitted landfill site. Figure 3-8 depicts the generalized closure measures for this area.

Other infrastructure and facilities associated with outlying mine components are listed in Table 3-1, and are depicted on the drawing particular to each component (Figures 3-3 and 3-4).

An on-site permitted landfill facility will be constructed for the disposal of non-putrescible industrial waste that has no salvage value generated during closure activities. The reader is referred to Section 3.5.6 for a discussion of this facility.

3.4.1. *Concentrator Buildings*

The ore Concentrator ("mill") is comprised of the mill building itself, the crusher house, conveyors, and truck load out facility. All buildings are steel frame construction on concrete slab flooring. A list of equipment currently located in the mill is found in Table 3-2.

The mill building itself houses what is expected to be the most attractive components from a sale or salvage perspective; in particular, the ball and sag mills and structural steel, as well as other scaffolding and processing equipment.

Buildings and equipment that are not sold or salvaged will be demolished and the debris will be hauled for burial in a permitted landfill site. The concrete foundations will be demolished to ground level, and the rubble will be buried on site and covered with till material.

Table 3-1 Infrastructure Description

Component	Description (see Figure 3-7 for layout)
	(Note all concrete slabs 0.20 m thick)
Concentrator Buildings	
Concentrator Complex	Area of 1761 m^2, 352 m^3 concrete slab
Crusher House	8 m x 12 m, Metal Building, 91 m^3 concrete slab
MCC	6 m x 11 m metal building, 14 m^3 concrete slab
MCC	6 m x 13 m, 16 m^3 concrete slab
Reagent Bins	2 m x 5 m , 2 m^3 concrete slab
Coarse Ore Bin	9 m x 8 m , 14 m^3 concrete slab
Power House	13 m x 27 m, Metal Building, 77 m^3 concrete slab
Service Garage	13 m x 15 m, Metal Clad Building, 41 m^3 concrete slab
Accommodation Buildings	
Bunk Trailer x 10	7 m x 33 m, Metal Trailer
Bunk Trailer x 10	8 m x 64 m, Metal Trailers
Bunk Trailer x 10	8 m x 50 m, Metal Trailers
Kitchen Trailers x4	19 m x 39 m, Metal Trailer
Office Trailers Complex	22 m x 23 m, 98 m^3 concrete slab
Miscellaneous Buildings/ Structures	
Ambulance Garage	13 m x 10 m, Metal Building
Water Distribution + Pump House	Area= 182 m^2, Metal Clad Building
Warehouse	10 m x 8 m, Metal Clad Building
Cold Storage Warehouse	10 m x 16 m, Metal building
Burnick 1200 Portal Shop	40 x 20 m metal clad building, earth floor, concrete footing
Burnick 1200 Portal Fuel Tank	
Miscellaneous Core Racks, Gribbler Ridge	Wooden structures
Water Storage	17 m x 3 m, storage tank
Radiator Banks	5 m x 8 m, 8 m^3 concrete slab
Storage Slab	6 m x 47 m, 57 m^3 concrete slab
Warehouse and Dry Lab	Area of 760 m^2, 152 m^3 concrete slab
Ball Storage	3 m x 5 m, 3 m^3 concrete slab
Diesel – 5,000 l; Gasoline – 2,000 l	Area of 729 m^2, 56 m^3 concrete slab
Decant Tower	50 m^3 reinforced concrete structure
North Creek Dyke	
1480 Portal Electrical Transformer	Power poles, chain link fence
Water Intake Pumphouse/Shop	2 m x 3 m wooden sheds (x3); 1.2 m^3 concrete pad

Table 3-2 Mill Equipment List

EQUIPMENT	MANUFACTURER	QUANT.	SIZE	REMARKS
Grizzly		1	760mm x 760mm	
Rock Breaker	Teledyne	1	30 kW	Hydraulic
Reciprocating Feeder	Universal engineering	1	1525mm x 4267mm	
Jaw Crusher	Allis Chalmers	1	1220mm x 1067mm	Used
Ore Conveyor	Trans-Continental	1	900mm	500 t/p
Belt Magnet	J.F. Comer	1	3 H.P.	
Reclaim Conveyor	Trans-Continental	1	900mm	250 t/h
Reclaim Vibrating Feeder	AISCO	1	1067mm x 2240mm, 5 H.P.	
Ore Bin	GEM Steel	1	200t	
SAG Vibrating Feeder	AISCO	1	1067mm x 2240mm, 5 H.P.	
SAG Feed Conveyor	Trans-Continental	1	900mm	100 t/h
SAG Mill	MPSI	1	5500mm DIA. x 2134mm, 970 H.P., Variable speed.	
Liner Handler	McLellan Industries	1		
SAG Discharge Pumps	G.I.W.	2	150mm x 100mm, 60 H.P.	
Vibrating Screens	Simplicity	1	1525mm W x 3600mm L, 10 Mesh, 25 H.P.	
Ball Mill	Allis Chalmers	1	3050mm DIA. x 3680mm, 900 H.P.	Used
B.M. Disch. Pumps	I.T.T.	2	250mm x 200mm, 60 H.P.	
B.M. Cyclones	Technequip/Krebs	2	D20B	
Lead Unit Flotation Cells	Outokumpu	4	5.1m^3, 25 H.P./Cell	
Lead Unit Cell Blower	Roots	1	297m^3/hr, 24.8 kPa	
Flotation Cells, Lead Rgh and zinc Rgh	Denver	2 sets, 15/set	5.7m^3, 25 H.P./Cell	Used
Lead and Zinc CLNR Flotation Cells	Denver	2 sets, 14/set	1.4m^3, 7.5 H.P./Cell	
Lead Regrind Mill	Taylor	1	1830mm x 2140mm, 150 H.P.	
Lead Rgr Cyclones	Techniquip/Krebs	3	D6B	
High Rate Thickener	Outokumpu/ Supaflo	2	4600mm DIA.	
Lamella Clarifier	Lamella	2	570mm x 55°	
Slurry Storage Tank	GEM Steel	3	5500mm DIA. x 14000mm	
Pressure Filters	Filtra Systems	2	Lead-28m^2, Zinc-32m^2	100 psi
Concentrate Bin	GEM Steel	2	3500mm DIA. x	

EQUIPMENT	MANUFACTURER	QUANT.	SIZE	REMARKS
			9000mm	
Minifab Flocculant Mixer	Allied Colloids	1	$1m^3$	Flocculant Mixing
Lime Grinding Mill	SALA	1	900mm DIA. x 1525, 10 H.P.	
Fresh Water Tank	GEM Steel	1	200,000 USG	
Flotation Air Blower	Spencer	1	21240 Im^3/hr, 14.5 kPa	Used
Air Compressor	Ingersol Rand	2	2550m^3/hr, 750 kPa, 350 H.P.	
Air Dryer	Xebic	1	170 Im^3/hr, 758 kPag	
Pressure Filter air Receiver Tank	Ingersol Rand	1	1830mm DIA. x 4000mm	
Courrier 30 OSA	Outokumpu	1	10 streams, Lead Zinc, Iron, % solids	
DCS	Fisher Controls	1		
PLC	Allen Bradley	1		
Truck Scale	Canadian Weigh Scale	1	100 t	Computerized loading system
Diesel Generator	Midwest	2	2 MW	
Diesel Generator	Midwest	2	1 MW	

Note: Unless otherwise stated, dimensions are in millimeters

Freshwater Line to Jewelbox

COARSE ORE STOCKPILE

CRUSHER HOUSE

HAUL ROAD

Fuel Storage Tanks will be emptied (products used on site or recycled), tanks cleaned & cut up. Metal will be either recycled or disposed of in site permitted landfill. Containment liner cleaned and placed in site landfill.

After all buildings and materials have been removed from the cleared areas of the Concentrator and adjacent areas, the site will be recontoured and revegetated. Areas where concrete slabs remain at ground level will have a minimum 0.5m cap placed over them and areas where there are metals contamination will be either excavated or capped as recommended in the Site's ERA/HHRA studies

Hydrocarbon Contaminated Soils
Stored Awaiting Remediation

WATER TANK
Process & Fire Water

FUEL STORAGE TANKS

Gasoline

Diesel

CONCRETE SLAB
Former Mobile Equipment Service Garage

Hydrocarbon contaminated soils to be remediated in an on site permitted landfarm or transported to an off site permitted disposal site.

Containment Area

COARSE ORE BIN

CONVEYOR

RECLAIM CONVEYOR

MAIN ACCESS ROAD TO MINE

WATER DISTRIBUTION PUMP HOUSE

REAGENT BINS

KITCHEN

WATER STORAGE

BUNK TRAILER

MAINTENANCE SHOP

PROPERTY ACCESS GATE

CONCENTRATOR COMPLEX

MCC

MCC

POWER HOUSE

OFFICE COMPLEX

BUNK TRAILER

BUNK TRAILER

WAREHOUSE
DRY AND LAB

AMBULANCE GARAGE

Radiator Banks

SEPTIC TANKS

TRUCK LOAD OUT

OUTSIDE CONCRETE STORAGE SLAB

BUNK TRAILER

BUNK TRAILER

COLD STORAGE

STEEL BALL STORAGE

Hazardous materials survey of the Concentrator buildings completed. Hazardous materials from Concentrator buildings and elsewhere onsite will be appropriately packaged, manifested, and transported off site for recycling and/or disposal at licensed facilities

Hydrocarbon Contaminated Soils
Stored Awaiting Remediation

Hydrocarbon contaminated soils to be remediated in an onsite permitted landfarm or removed to an off site permitted disposal site.

TAILINGS LINE

CORE RACKS

WASTE OIL TANK

Waste Oil Tank will be cleaned, cut up and be recycled or disposed of in on-site permitted landfill. Containment liner will be cleaned and disposed of in permitted on-site landfill.

RECLAIM WATER LINE

5,000L CAPACITY WASTE OIL STORAGE

Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

0 50 100 150 200 250 metres

1: 5,000

CONTOUR INTERVAL=10m

NOTE

BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Sä DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAMATION PLAN

CONCENTRATOR PROCESS AREA CLOSURE MEASURES

DRAWN BY: BJD	CHECKED BY: BJD	FIGURE NO. 3-8	REV. 1
Revised: February 1, 2013	PROJ. NO.		

3.4.2. *Power House and Power Lines*

The power house contains four diesel generators which supply power for the mining operation. It is expected that these generators will have an appreciable salvage value. The power is distributed via approximately 6 km of three phase overhead power lines. There is also approximately 600 metres of 60 mm dia. “TEC” cable leading from Jewelbox 1440 portal to the Main Zone pit. The distribution lines will be re-spooled for salvage or placed in the landfill. The power poles (approx. 120) will be removed and either sold for salvage if in good condition, or burned according to Yukon Regulations.

It is not known if the power poles that were installed by the previous operator were treated with a preservative such as creosote. Samples of the poles will be taken in 2013 and if the sample results identify that they are a hazardous waste, then the contaminated portion of the poles will be disposed of in conformity with the Special Waste Regulations of the Yukon Environment Act.

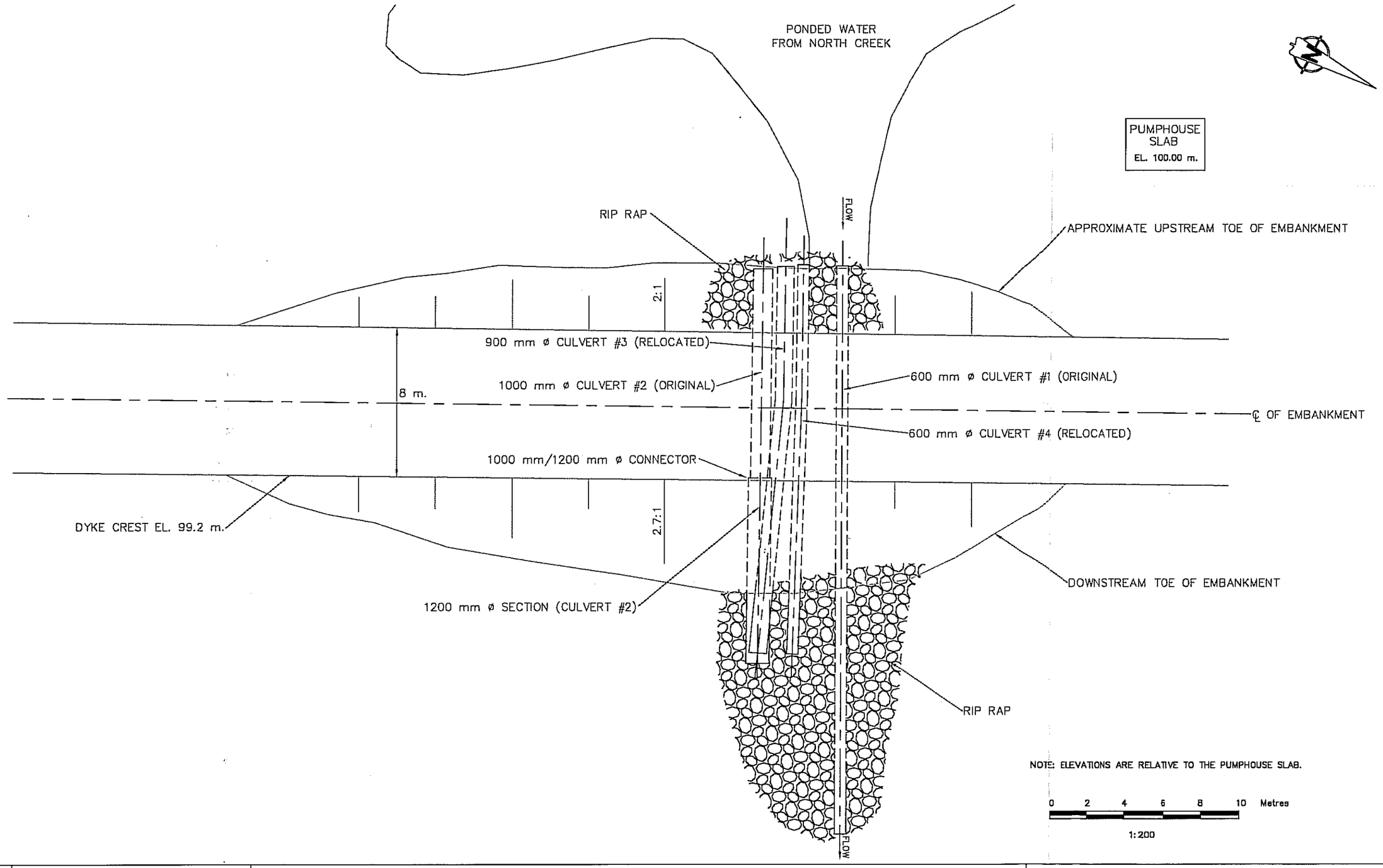
3.4.3. *Water Supply*

The water supply system consists of a series of three electrical 100 hp water pumps housed in 2.5 m x 2 m wooden shacks. These pumphouses are located in the lower North Creek drainage (Figure 3-1). The pumps will be removed for salvage/disposal, the shacks removed, and the wells will be properly decommissioned. The approximately 2 km of water line (300 mm dia.) will be removed for salvage or disposal. The entire disturbed area around the pumphouses at False Canyon Creek was previously reclaimed (see Section 3.7 *Land Reclamation and Revegetation* for a discussion of this activity) by the original site owner.

3.4.4. *North Creek Dyke*

(i) Description

The North Creek dyke is located about 1 km north of the existing tailings impoundment, as shown in Figure 3-1. The dyke was constructed in the summer of 1991 by Golden Hill Ventures (GHV). The dyke was constructed to provide a reservoir from which water was pumped to the northern end of the tailings impoundment in preparation for the start-up of the mill.



NOTE: ELEVATIONS ARE RELATIVE TO THE PUMPHOUSE SLAB.

0 2 4 6 8 10 Metres

1:200

Teck

ACCESS CONSULTING GROUP

SRK Consulting
Engineers and Scientists

SA DENA HES DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

PLAN OF NORTH CREEK DYKE

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	PMH	3-9	
DATE: MARCH 12/13	PROJ. NO. 1CC005.05		

The dyke has a maximum height above original ground of about 5 m and is about 50 m in length. Fill used to construct the dyke is a silty sandy till and it is estimated that about 2000 m^3 of this material was placed.

A 600 mm dia. pipe at the base of the dyke allows flow in the North Creek to pass through the dyke. Three other culverts varying in size from 600 to 1000mm in dia. provide capacity to pass the 200-year event. A plan of the dyke showing the current location of the culverts and layout of the dyke is shown on Figure 3-7.

(ii) Closure Measures

At closure the dyke and culverts will be removed, the area re-contoured and the drainage channel armoured to ensure it is stable.

3.4.5. *Accommodation/Camp Buildings*

The campsite accommodation was provided by approximately 30 sleeping/wash Atco trailers and 6 kitchen/recreation Atco trailers. These trailers are no longer functional and current plans are to demolish them. All piping and cable connections cut at ground level. Any hazardous wastes within the trailers will be managed in accordance with applicable hazardous waste regulations.

3.4.6. *Miscellaneous Buildings & Structures*

The office complex consists of six ATCO trailer units set up on wood block footings and joined under a common roof. Useable office furniture and equipment has been removed to secure storage in Watson Lake and where appropriate, will be offered to local service organizations or shipped to other Company facilities where economically feasible. All Company records have been removed to Teck's office in Kimberley, BC for safe storage. Because of the deteriorated state of this structure, current plans are to demolish it. The trailers will be demolished, and will be burned and/or buried in a permitted landfill site on site and the ground surface regraded, recontoured, and revegetated.

At the Jewelbox 1480 Portal, there was a 13 m x 40 m metal shop building with earthen floor and concrete footings. The building collapsed under snow load in 2007 and has been demolished and refuse buried nearby in an approved landfill site. In 2011 the remainder of the structures at the site have been either demolished or removed from the property. All demolished material has been disposed of in a permitted landfill. Fuel tanks have been hauled away for salvage. Fuel berms will be assessed for hydrocarbon contamination and will be re-contoured, the liner removed and hauled to refuse landfill. The power transformer and power line will be removed for salvage; power poles destroyed or hauled out for salvage depending on conditions; chain link fencing enclosure demolished and landfilled on site. An assessment of hydrocarbon contamination has been conducted in accordance with Special Waste Permit 41-247 issued by Yukon Environment. The results are further discussed in Section 3.6.

At the Burnick 1200 Portal, there is a 13 m x 40 m metal shop with an earthen floor and concrete footings. Current plans are to remove this building in 2013. The concrete foundations will be removed to ground level. Soil hydrocarbon contamination was assessed in 2011 and will be removed for treatment and/or be left on site and risk assessed, and the site decompacted and revegetated.

- At the Burnick 1300 Portal, there is a 2 m x 4 m safety shack which will be demolished and the debris removed to the landfill for burial. The site is to be regraded.

- There are some wood shacks, core racks and core remaining from previous exploration at the property. The cores will be removed from the wood core racks. Plastics and other hazardous wastes will be removed from the wood shacks. All the wood core racks, shelters and buildings will be burnt. The core will be buried on site by a small excavator. All non-wood materials will then be cleaned up and taken to an appropriate permitted landfill. Complete any grading/cleanup of the site. Select core samples have already been donated for archiving.

3.5 HAZARDOUS BUILDING MATERIALS, INDUSTRIAL REAGENTS AND WASTES

A majority of the industrial reagents and wastes were removed from the property in 2011. In 2012 Golder conducted a detailed inventory of the hazardous building materials and substances, however full characterization of these materials will be the responsibility of the

selected demolition and waste contractor. The hazardous building materials and chemical substances identified include process residues, reagents, laboratory chemicals, other chemicals, petroleum products, solvents and paints, lead-based paint, asbestos, mercury containing equipment (fluorescent light tubes), radioactive materials, and crystalline silica. Details of the hazardous materials surveys can be found in Golders' reports (Golder 2013b,c).

Prior to demolition, a qualified hazardous material contractor will be retained to remove and dispose off-site all the hazardous materials in accordance to the Federal TDG Act and Regulations and Yukon SWR. Any materials classified as industrial waste and non-hazardous will be disposed of at the on-site permitted landfill. The exception being mine ore process residues which are further discussed in Section 3.5.1.

3.5.1. *Process Residues*

As the site is a metal mine, it contains numerous areas and facilities that contain various forms of lead and zinc minerals. These minerals are in significant concentrations in the ore, some waste rock, tailings, and concentrates. Various quantities of these mineralized materials are found throughout the process facilities including the crusher, conveyor galleries, mill building and load-out area. The analysis of the mineralized materials includes; antimony, arsenic, cadmium, molybdenum, lead, selenium, silver, and zinc and are classified as industrial wastes on site. Based on the Toxicity Characteristics Leachate Procedure (TCLP) concentrations would warrant classification as Special (leachable) Waste, if these materials were removed from the site.

One potential option for disposal is to transfer the materials to the on-site Tailings Pond as the tailings has also been characterized as containing leachable lead. However, the characteristics need to be further reviewed to ensure that this will not pose any environmental risk in the tailings. If the tailings pond is not considered suitable, then the materials would be placed back within the mine workings at Jewelbox where there is no discharge of water from the mine.

3.5.2. *Hazardous Building Materials*

Asbestos-containing and suspect asbestos-containing materials were identified in a number of locations throughout the various buildings. These materials will be handled as per the Yukon

Solid Waste Regulations, and either properly disposed of in the on-site landfill (under permit) or transported off site.

Lead-paint was also identified in the various buildings. Prior to demolition, additional samples are required to be tested for the lead leachability potential. The results will determine if the levels are classified as a Hazardous Waste, which will determine the proper disposal requirements.

Other materials including equipment containing mercury will be disposed of in accordance to the Yukon SWR.

3.5.3. *Chemicals*

The process facilities and warehouse areas contain a number of different chemicals. These materials may include, but are not limited to: reagents, solvents, paints, cleansers, and battery acid. They will be removed from the mine site and disposed of through a licensed hazardous waste disposal firm. In such an event, the disposal will only take place following consultation with and approval from the appropriate regulatory authorities.

Waste vehicle batteries have been segregated, with periodic shipments to a licensed battery disposal facility. This procedure will continue through the end of mine closure activities.

The mine has an inactive sewage system designed to service a 160 person camp that would consume approximately 40 gal/person/day of water. The current system was installed in 1997 and is comprised of three sewage tanks and a pump-out chamber which then drains to the soil absorption area (septic field) (see Figure 3-8).

The three septic tanks will be pumped out, de-sludged, with sludge hauled offsite to an approved sanitary facility. The pump out chamber would also be removed. The remaining infrastructure (i.e. piping and related materials, including the septic field) would remain buried.

3.5.4. *Fuels and Lubricants*

Currently there are two above ground storage tanks (diesel, gasoline) on site which are currently used by the caretaker. During the closure activities, Teck will decommission these tanks and have temporary double wall fuel tanks brought to site for contractor use. Fuels and lubricants will be required during the three year period for implementation of the closure measures after mine shutdown (as discussed in Section 5.0). Any inventory remaining on site once all activity has ceased will be removed from the site by one of three methods:

- returned to the original supplier for credit wherever possible;
- sold to a third party user; or
- transported to an authorized disposal agency to be recycled or destroyed.

The bulk diesel fuel storage tanks will be emptied of their contents in accordance with one of the above mentioned procedures. The tanks will then be drained and where feasible removed from the site and sold for their salvage value. For tanks too large to be removed, the tanks will be cleaned out with any sludge being treated or removed in accordance with procedures approved by the Yukon regulatory authorities. The cleaned out tanks will then be dismantled and either be salvaged or disposed of as scrap metal and buried in the site landfill area.

All rental propane tanks have been removed by the propane supplier. Associated fuel delivery lines at any portals and at the camp will be removed and disposed of in a manner similar to that of the gasoline and diesel fuels.

Other hydrocarbon products used at the mine site are primarily hydraulic fluids, lubricating oils, greases, antifreeze and solvents and were identified by Golder in their site assessment report (Golder, 2013b,c). All products will be recycled or disposed of through a licensed waste disposal firm.

3.5.5. *Scrap Metal*

Scrap equipment has been stored in various lay down areas (known as "bone yards") located on site and along the access road. This is primarily scrapped equipment that was stored so that it could be utilized on the mine site as a source of spare parts or good recyclable scrap material. Salvageable material from these sites will be sold as scrap and removed from the site. Material that has no scrap value will be disposed of in a permitted landfill on site. Prior to disposal in the

landfill all of this material will be examined to ensure that all hazardous materials have been removed. Non-ore related hazardous materials removed will be shipped off site to a licensed waste disposal site.

3.5.6. *Site Landfills*

The 2000 report proposed the use of the existing landfill for the disposal of non-putrescible wastes that have no salvage value, such as lumber and scrap steel. Schedule A – Solid Waste Management of Sä Dena Hes Operating Corporation's Production Licence QML-0004 requires such a facility to be an "approved engineered landfill area." The company will dispose of materials in accordance with the current Waste Management permit for the disposal of solid waste generated by commercial activities which expires December 31, 2014. The landfill will be managed in accordance with the Production Licence requirements and Yukon Solid Waste Regulations.

Specifically, the engineered landfill facility will:

- be approved by an inspector prior to any waste disposal;
- be compacted and covered with rock or overburden on a regular basis;
- be maintained to minimize attraction of wildlife and water infiltration; and
- be compacted and capped with a liner or a minimum of one meter of low-permeability overburden or soils (sloped and revegetated) to retard the infiltration of water on the completion of landfill activities.

In 2008, in response to the structural failure of the Jewelbox shop, the Company applied for and received approval through Yukon Environmental Programs for a Solid Waste permit #81-020 to landfill the refuse from the shop on site near the Jewelbox portal. This work was completed in late 2009. An amendment to this permit was made in 2010 to locally landfill the refuse of the Golden Hills shop and will include any additional construction materials requiring disposal during closure.

If none of the mill buildings and equipment can be sold or salvaged, and the buildings on site had to be landfilled, the total estimated material quantities have been estimated to be approximately 3500 m^3 bulk disposal volume.

3.6 SITE REMEDIATION AND RISK ASSESSMENT

In preparation of permanent closure of the mine site, environmental site assessment (ESA) activities were initiated in 2011 and 2012 by Access Consulting Group and Golder Associates Ltd. (Golder). Golder conducted the work on behalf of Keyeh Nejeh Golder Corporation (KNG) which is a joint venture with Golder and the Liard First Nation. The site assessments included a preliminary investigation identifying areas of potential environmental concern by reviewing the areas of operation, activities in those areas, and the potential contaminants of concern. The field activities conducted included assessing the quality of the soil, sediment, and/or surface water quality at the mine site to conclude the presence or absence of contamination. Ultimately the results will be used to develop mitigative measures to minimize potential environmental impacts for closure of the mine. The results of the ESA are included in Golder's report entitled *Phase I and II Environmental Site Assessment (ESA), Sä Dena Hes Mine, Yukon Territory,* dated February 1, 2013 (Golder, 2012a). The report is attached in Appendix J.

The results of the environmental site assessments will be used to support the human health and ecological risk assessments which will determine if there are any potential unacceptable risks. If any potential unacceptable risks are identified through the risk assessment process, then mitigative measures will be completed. Risk assessment processes will include consulting local First Nations about potential long term site uses to adequately assess potential exposures. The risk assessment approach is further discussed in Section 3.6.5.

Petroleum hydrocarbon and metals concentrations exceeding the Contaminated Sites Regulation (CSR) Industrial Land (IL) and/or Park Land (PL) use standards were identified in the vicinity of maintenance shops and fuel storage tanks, and metals associated with the mine primary activity areas (i.e., sediment ponds, tailings facilities, waste rock piles) and processing areas (i.e., mill area). The ESA includes assessment of hydrocarbon contamination conducted in accordance with Special Waste Permit 41-247 issued by Yukon Environment. The spatial extent of the hydrocarbon and metal impacts has not been fully delineated and will be completed in 2013. A summary of the results are further discussed below. The CSR Industrial land (IL) use standards were applied to areas of the mine site in which Teck will continue hold surface land leases.

3.6.1. *Petroleum Hydrocarbons in Soil*

Areas identified to have petroleum hydrocarbon impacted soils include the Jewel box, Golden Hill Shop, Burnick Shop, and the drum storage area. Soils in these areas were determined to contain hydrocarbon concentrations exceeding the CSR IL standards and Special Waste standards. Leachable lead has also been identified in three of the four areas which classify the soil as special waste. The exception being that the Burnick Shop contains concentrations only exceeding the IL standards and does not contain Special Waste concentrations. The diesel and gasoline fuel tank containment area currently used by the caretaker will be assessed upon decommissioning in 2014.

Soil excavation activities have been initiated in all four areas and approximately 470 m^3 of soils are currently stockpiled within the adjacent areas. In 2012, 130 m^3 of special waste contaminated soils was transported to Tervita's Northern Rockies Landfill in Fort Nelson, BC. Based on current assessment results an additional 700 m^3 of soils require further excavation. However, some areas have not been fully assessed; and as such additional soils are expected.

Teck is currently evaluating options to address the hydrocarbon contaminated soils (ex-situ and in-situ). A final remediation plan for the excavated hydrocarbon contaminated soils has not been completed. One method is to remove the contaminated soils from the mine site for disposal at a licensed Hazardous Waste disposal firm. The closest Special Waste facility is in Fort Nelson, BC. The second method of disposal will be to have the soils landfarmed where bioremediation will work to remediate the hydrocarbon contaminated soils. The residual metals impacted soils could be deposited at the site with similar metals concentrations (i.e., waste rock dumps, tailings pond). The third method is to evaluate the results within the ecological and human health risk assessment and determine the remediation strategy based on the risks identified. In either event, the disposal will only take place following consultation with and approval from appropriate regulatory authorities. As per the Special Waste Permit 41-247 amended on February 5, 2013 a final disposal plan will be submitted to the Environment Protection Branch by April 30, 2013.

3.6.2. *Metals in Soil*

Metals impacted soils are expected within many areas of the mine site. The ESA targeted all areas of disturbance and identified metals impacted soils (primarily lead and zinc) in areas

including the Jewelbox, Mill Site (including Golden Hill Shop), Burnick Portal, various sediment ponds, waste rock piles and tailings pond (including reclaim pond). Additional metals exceeding the applicable CSR soil standards include arsenic, cadmium, copper, molybdenum, and selenium. Leachable levels of cadmium, lead, selenium and/or zinc were identified at the Jewelbox area, Burnick Portal, mill site, and tailings pond area.

The full spatial extent of the metals soil contamination has not been completely defined. The project's environmental consultant has been assigned to conduct additional soil delineation, development of a hydrogeological investigation program and define a remedial action plan this summer (2013). Ultimately the results will be used to support an ecological and human health risk assessment and the remediation of the mine site. The approach to risk assessment is further discussed in Section 3.6.5.

3.6.3. *Site Water Quality*

A site water quality review including a loading assessment is discussed at length as part of the geochemistry discussions in Section 4 of Appendix B. Note that the loading assessment was conducted originally in 2005. As such, with the additional monitoring dataset available up to 2012, an update of the loading assessment is planned in 2013 to confirm that the results of the 2005 water quality evaluation. Current compliance monitoring includes monthly and quarterly sampling at several receiving water stations and is further discussed in Section 5.3.

The water chemistry review included in Section 4 of Appendix B focused on zinc as the primary contaminant of concern and sulphate as an indicator of mine-related impacts that are not significantly affected by attenuation processes in surface waters. Based on the water chemistry review, the potential site water chemistry issues are associated with the 1380 Portal water discharge and the tailings pond.

Additionally, the Golder ESA report (Golder, 2013a) completed a review and analysis of select surface water discharge points on the mine site from 2011 and 2012. The stations included MH-02 (North Dam seepage), MH-04 (Camp Creek), MH-07 (Reclaim Dam seepage), MH-08 (Burnick Creek), MH-22 (Burnick Portal seepage), and MH-25 (1380 Portal). The samples were compared to the CSR water quality standards for protection of aquatic life and identified cadmium to exceed the CSR standard at all six locations; cobalt, selenium, and zinc to exceed

the CSR standards at one or more monitoring location; and lead exceeded at the Main Zone 1380 Portal. Based on the leachability test results for soils, there is also a potential for metals to have impacts on the groundwater near the Jewelbox Hill, Burnick (1200 Portal), mill site, and tailings pond.

With respect to the Burnick portal, the SRK water quality review and soil column attenuation tests confirmed that the down gradient soils have the potential to significantly attenuate zinc concentrations at the levels observed in the discharge for much longer than 200 years. As such the Burnick Portal water discharge is not considered an environmental concern. Attenuation of metals in soils from the flow path between the Burnick underground and waste dumps is not expected to contribute significantly to downstream zinc concentration, if attenuation is lost at some point in time.

The water quality issues associated with the 1380 Portal, Tailings pond, and groundwater are further discussed in the sections below.

3.6.3.1. 1380 Portal

The fate and transport of water from the 1380 Portal is included within Section 4 of Appendix B and includes additional work that was conducted in 2005 and 2007. In 2012, Teck retained SRK to conduct a tracer study to identify the fate of the portal discharge water as groundwater. The findings are included in SRK's 2013 letter report "1380 Portal Discharge Investigation". This report is included in Appendix G.

The 1380 Portal has been identified as having high levels for lead, cadmium and zinc. The lead, zinc and cadmium concentrations have been reported to be higher than 0.2 mg/L, 30 mg/L and 0.4 mg/L, respectively. The discharge from the portal infiltrates into the adjacent waste rock dump and eventually into the Camp Creek catchment. Some of this water exits to the toe of the waste rock dump as a surface flow and for a short period (roughly 3 weeks) each spring during snow melt, it joins a surface water flows in the invert of the gully. The surface water flow in the gulley is primarily from melting snow and exists only during freshet. Currently the zinc concentration in the portal discharge is being attenuated by contact with the waste rock in the dump and overburden. Additional attenuation occurs as the portal drainage water mixes with the alkaline surface water in the gully. The portal discharge water also mixes with other

groundwater along this flow path. Sulphate loading is also observed to be greater in Camp Creek than the loading from the 1380 Portal, meaning sulphate is added to Camp Creek from sources other than the 1380 Portal. The current monitoring in Camp Creek at MH-04 shows that there are no impacts from the 1380 Portal.

The primary risk is that the strong attenuation of zinc in soils within the gully flow eventually disappears. Based on the current prediction and assuming loss of zinc attenuation capacity of the soils, zinc concentrations in Camp Creek would remain below MMER standards and by MH11 could almost meet the CCME criterion (SRK 2007). This will be reviewed as part of an updated loading assessment to be conducted in 2013.

The 2012 tracer study was conducted to determine a) if the flow in the gully did not report to Camp Creek and the sulphate load in Camp Creek is from some other source or b) if the flow in the gully reports to Camp Creek, but zinc is attenuated and sulphate loading is from unimpacted groundwater discharge to Camp Creek. The tracer test was conducted over 4 weeks, at which time the tracer was not detected within Camp Creek. Based on a range of groundwater travel times, it is estimated that the tracer could take between 36 days and 10 years to arrive at the downstream monitoring location within Camp Creek.

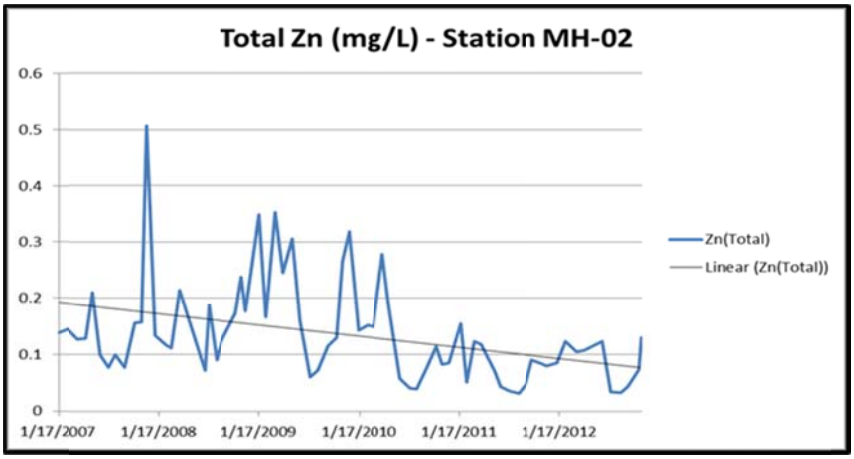
Based on the recent study, the fate and transport of the 1380 Portal water remains unclear. To better refine the groundwater travel times, in 2013 monitoring wells will be installed in between Camp Creek and the 1380 Portal. The monitoring wells will also verify estimates of the sulphate concentration in groundwater from the loading assessment. The wells would also be used as sentinel wells to monitor the migration of zinc and cadmium from the 1380 Portal.

Beyond closure in 2015, an adaptive management approach will be undertaken for addressing the potential breakthrough of zinc or cadmium from the 1380 Portal discharge. Breakthrough would occur after the attenuation capacity of the subsurface material is consumed. Monitoring wells and surface water locations would be monitored annually during base flow conditions. The data would be analyzed to assess zinc and cadmium concentration trends. A sustained upward trend in concentrations would trigger an assessment of mitigation alternatives. An adaptive management plan would set action levels and mitigation for exceedances of an action level.

3.6.3.2. Tailings

Based on SRK's loading assessment, the tailings loading at MH-02 is 1 or 2% of the total load to False Canyon Creek. As such, it is concluded that the zinc load from the tailings is not having a significant impact on the receiving water quality at MH–11 or MH–16, and consequently no additional engineered measures to control leaching are required for closure. Furthermore, since temporary shutdown of the mine in 1992, effluent water quality levels have been in compliance with the Water Licence. Confirmation that tailings seepage does not impact water quality will be evaluated in the planned 2013 updated loading analysis.

A short term increase in total zinc levels at MH-02 in 2009 was noted in the 2010 update, however further data collected to the end of 2011 and 2012 continues to show a decreasing trend. The following graph shows that zinc concentrations appear to increase over periods of low flows i.e., winter, however there is a definite downward trend still continuing. Significant higher total suspended solids readings associated with the elevated zinc levels suggest that the high readings are likely the result of sampling errors.



Beyond closure in 2015, post closure monitoring will continue as discussed in Section 5.3. Concentration trends will be monitored and a sustained upward trend in concentrations would trigger an assessment of mitigation alternatives.

3.6.4. *Groundwater*

Based on the leachable soil results, there is a potential for metals to have impacts on the groundwater near the Jewelbox Hill, Burnick (1200 Portal), mill site, and tailings pond (Golder,

2012a). The development of a hydrogeological assessment plan and implementation will be conducted in 2013.

3.6.5. *Conceptual Approach to Post-Closure Risk Assessment/Management*

The Yukon Mine Site Closure and Reclamation policy (Energy, Mines and Resources 2006) formally recognizes that "risk management may be utilized in the development of the reclamation and closure plan by the mine operator. This approach should take into consideration ecological, human health, socioeconomic considerations and engineering factors and be designed to enable the mine operator and Yukon government agencies to fully understand the likelihood and consequence of failure in order to assess reclamation and closure options and to ensure that risks associated with implementing the mine DDRP are addressed to the satisfaction of the Yukon government."

Yukon Environment (2010) recognizes that the presence of a contaminant at a site does not necessarily constitute a risk. As per this fact sheet: "In order for a risk to exist, three things need to be present:

- contaminants - that can cause toxic or adverse biological effects;
- receptors – any person, animal, or plant that may be vulnerable to the effects of the contaminant; and
- exposure pathways - by which receptors may be exposed to the contaminants."

A risk assessment evaluates the interaction between these three basic components at a specific site and determines the resulting risk to receptors.

Once contamination is identified at a site, risk assessment (human health and ecological) can be used to determine whether, and to what extent, remediation or other risk management efforts are warranted to mitigate current or future risks. There is a considerable amount of guidance on how to conduct both human and ecological risk assessment; although there are some differences in practice, assessment of risks to human health and ecological systems can be conducted in parallel since they reply on similar principles.

According to Protocol 12 (Yukon Contaminated Sites Regulation; Yukon Environment 2011): "The goal of a risk assessment is to determine whether the contaminants present at a site pose an unacceptable risk to the humans, plants and animals that may be exposed to those

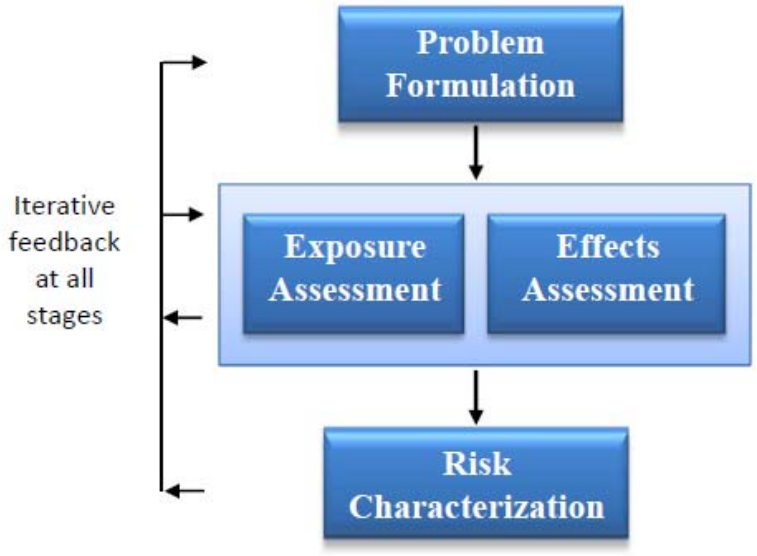
contaminants. If unacceptable risks are found, it may be possible to mitigate the risk to an acceptable level through risk management measures". Removing or capping/containing the contaminants, eliminating exposure pathways (e.g., prevention of access by wildlife to adit water), or installing engineering solutions are examples of how risk can be reduced to acceptable levels, depending on the nature of the site and its contaminants.

As described in Environment Canada (2012) and reflected in Yukon Environment guidance (2011, 2012), risk assessment is often tiered, with screening tools applied at an early stage to determine if further work is needed or to prioritize future investigations. For example, a screening-level risk assessment might use conservative, simplifying assumptions to assess risks. If risks are acceptable using conservative simplifications, then there is probably no need for further work. On the other hand, if potential effects are identified, a more detailed and accurate risk assessment may be warranted, prior to making risk management decisions.

3.6.5.1. General Approach to Risk Assessment to Support Mine Closure

To support closure of Sä Dena Hes mine, the most up-to-date Canadian (Health Canada, various years; Environment Canada, 2012) and BC guidance will be used in the absence of detailed risk assessment guidance for the Yukon Territory. Figure 3-10 below shows a generic risk assessment framework for ecological risk assessment which is over-simplified but consistent with frameworks for human health risk assessment.

Figure 3-10. Generic framework for ecological risk assessment (simplified). Taken from Environment Canada (2012), but similar in principle to frameworks for human health risk assessment.



One of the most important and first steps in risk assessment is “Problem Formulation” (Figure 3-10), which defines the problem to be addressed (in this case, potential issues associated with contamination at a site) and how they will be addressed in the scope for the risk assessment. Prior to undertaking a risk assessment, it is particularly important to liaise with the people who will use the site in the future, to ensure that the land and water are protected appropriately for that use (e.g., consuming country foods like wildlife, fish and berries). With respect to ecological risk (Environment Canada 2012) for each group animals & plants, it is likely that one or more “lines of evidence” (LOEs) will be used in the risk assessment. Each LOE must combine information on:

- Exposure: the extent to which receptors are in contact with contaminants via various pathways; and
- Effects: the nature of effects observed or expected at the site

Importantly for Sä Dena Hes, Figure 3-10 shows that risk assessment involves seeking and using feedback from involved parties throughout the process. During the mine closure process, Teck will be liaising with regulators, First Nations and stakeholders to ensure that the results of the risk assessment are fit-for-purpose. The use of risk assessment in mine closure planning and implementation must ensure that the site is acceptable for human use under future conditions and that potential risks posed to ecological receptors are balanced with the potential benefits of encouraging natural recovery.

Consequently, the ecological risk assessment process may recognize non-pristine habitat quality of particular mine site areas (e.g., waste rock dumps, open pits) and assign them less conservative protection goals (e.g., protection to 'Industrial Land' standards). In areas with high value habitat, more conservative goals may apply to support their integration with the landscape. In such instances, 'Parkland' or similar protective standards may be more appropriate.

When used in a phased manner, risk assessment pulls together information from various sources such as technical studies, knowledge gleaned from local communities, desired end-use goals for the land and traditional knowledge (e.g., from community members in local First Nations). The proposed approach to risk assessment for the Sä Dena Hes mine will involve the local community, particularly the LFN, as described below in Section 3.6.5.2. At this point in the process several specific scenarios will be evaluated to include the following:

- What risks are posed by different mine site areas under current conditions? Is remediation to address contamination necessary?
- What residual risks are posed assuming post-closure conditions as presented in the Plan (i.e., assuming that some mine site areas have been remediated)?
- Use risk assessment to evaluate how different remediation options applied at specific areas (e.g., capping of specific APECs to evaluate implications for risk) may affect risk predictions.

In summary, the scope of the risk assessment has not yet been completely defined and will be developed based on input from regulators, First Nations and other stakeholders, as well as results of 2013 and 2014 site investigations, and Teck's reclamation and closure plans."

For the Sä Dena Hes mine closure, more detail on the stages and anticipated schedule to assess both ecological and human health risks is provided in Table 3-3.

Table 3-3: Proposed stages of risk assessment work for Sä Dena Hes mine closure planning.

Stages	Anticipated Schedule	Proposed Conceptual Approach to Post-Closure Risk Assessment
SITE INVESTIGATION	Summer 2012: Preliminary site investigation Summer 2012: Initial data collection for risk assessment planning Summer 2013: Detailed site investigation	Use information about mine operations to identify areas of the site with potential for mine-related contamination (these are referred to as "Areas of Potential Concern"). Typically, for operations such as Sä Dena Hes, contamination is caused by: (1) fuel storage causing hydrocarbon contamination in localized areas, (2) ore extraction causing exposure of metal-bearing rock at the earth surface (e.g., mine openings, waste rock piles), (3) ore processing causing spread of dust containing metals, potentially affecting soil quality and (4) deposit of mine tailings and any subsequent releases to water. For the Sä Dena Hes mine site, site investigations are underway (preliminary work in 2012 with additional investigations to be done in 2013) to identify mine-related contamination and it is expected that these areas will be the focus of risk assessment. As noted above, several discrete areas of the site, including but not limited to the Mill Site area, tailings ponds, adits and fuel storage areas will be remediated (e.g., soil removed, capped, disposed of in engineered landfill, etc.). These areas may be excluded from consideration by the ecological and human health risk assessments.

Stages	Anticipated Schedule	Proposed Conceptual Approach to Post-Closure Risk Assessment
PROBLEM FORMULATION	March-May 2013	Problem formulation is the first step in risk assessment. It is a scoping and planning stage that is iterative – as more information becomes available about a site, the document can be revised. For Sä Dena Hes, information collected in 2012 will be used to support problem formulation. Problem formulation defines the nature of the problem to be addressed, identifies key issues, and lays out how the risk assessment should be designed. Specifically, problem formulation will include: • Description of risk management goals, land use(s)s and remedial objectives • Description of risk assessment scenarios (e.g., current condition, remediation options (post-closure) • Description of anticipated regulatory processes • Description of process to liaise with Liard First Nation (see Section 3.6.5.2) to ensure their specific site uses are considered • Screening site data for contaminants of potential concern • Identifying human use of the area, as well as use by birds and wildlife including federally and provincially listed species (i.e., those considered rare and endangered) that may be using the site. • Description of all “exposure pathways” (how contamination from mine sources may reach the environment), such as : a. Adit water to ground/surface water b. Groundwater to surface water c. Groundwater to drinking water (to the extent this occurs) d. Mine tailings to groundwater/surface waters e. Water/soil to vegetation and animals f. Human consumption of country foods • Development of a “conceptual site model” by integrating all of the above components. The conceptual model may also need to be dovetailed with discussions about potential mine closure options. • Establish the lines of evidence for the ecological risk assessment as well as how that evidence will be weighted in the risk assessment. • As described in Section 3.6.5.2, it is expected that in consultation with First Nations who utilize the mine site area, will contribute to the problem formulation so the design of the risk assessment will address concerns from the Liard First Nation (LFN).

Stages	Anticipated Schedule	Proposed Conceptual Approach to Post-Closure Risk Assessment
2013 Sampling & Analysis Plan	April-May 2013	The problem formulation (described above) is the blueprint for risk assessment itself. Based on the problem formulation, a "Sampling and analysis plan" will be prepared, which is essentially a workplan for the field and analytical work needed to support risk assessment. This plan will identify the scope and magnitude of sampling and analysis of environmental media such as water, sediment, soil, vegetation, insects and mammals, if warranted.
2013 Field Work	June-October 2013	To support both site investigation and risk assessment, more on-site data and information will need to be collected. This work is expected to include environmental sampling and habitat and wildlife work, but the scope will depend on the steps above. Field work would involve LFN community members.
Preliminary Risk Assessment	October-April 2014	Based on designed, engineered remediation solutions (e.g., capping of tailings pond) and based on the problem formulation and data collected in 2013, a preliminary post-closure risk assessment will be prepared. Depending on a combination of mine closure activities (concurrent) and the findings of the risk assessment, any unacceptable risks will be identified, along with an approach to address those risks (through remediation and/or through collecting more information).
2014 Field Work	June-October 2014	Typically, for such mine sites, a second field season is needed to (1) address any outstanding gaps in site investigation and risk assessment and (2) reduce uncertainty in key risk estimates. Field work would involve LFN community members.
Final Risk Assessment	Spring 2015	Based on an updated problem formulation and data collected in 2014, the final post-closure risk assessment will be prepared. This document will be used to develop a post-reclamation risk monitoring plan.

3.6.5.2. Conceptual Approach to Ecological and Human Health Risk Assessment Engagement with Liard First Nation

The Sä Dena Hes mine lies within the Traditional Territory of the Liard First Nation (LFN). In accordance with the Yukon Mine Site Closure and Reclamation policy (2006), Teck understands that 'the Yukon government will consult with the mine operator, affected First Nations, local communities, and interested stakeholders prior to issuing a Certificate of Closure. It is

anticipated that the proposed approach will be discussed with LFN leadership at meetings in Watson Lake in April 2013.

In order for the LFN leadership and community to remain informed on mine closure, an engagement strategy is being planned. In conjunction with Teck's broader engagement strategy, the following will be proposed a basis for the engagement strategy for environmental assessment and planning and will be adapted and detailed after discussions with LFN:

1. Request that LFN leadership identify a person within their community to be the lead contact in regard to the ecological and human health risk assessment process. This person would preferably have some environmental sciences training. This person would assist in organizing or identifying other community members that can provide traditional knowledge of mine area in regard to LFN member land use, wildlife use, and country foods utilized from the area. The contact person would work with the ERA/HHRA risk assessors in developing sampling plans, participating in the field studies, and reviewing resulting reports.

2. Participate in Community Meetings to:
    a. Ensure that information on the mine closure process is disseminated broadly to the LFN community
    b. Hear first-hand about any environmental concerns of the community with respect to the Sä Dena Hes mine and its closure

3. Involve community members with risk assessment work at the mine site. Every field program will have a minimum of one LFN community member to provide guidance on LFN customs on the land and to assist in conducting field work. Health and Safety training will be provided to the LFN community member regarding site-specific hazards and the work being undertaken.

3.7 LAND RECLAMATION & REVEGETATION

The primary objectives of the land reclamation and revegetation activities at the Sä Dena Hes minesite are to provide short and long term erosion control, to ensure a final land use compatible with the surrounding lands, and to leave the area as a self-sustaining ecosystem.

Thus the overall goal is to conduct Ecological Restoration of the complete site. Ecological restoration is the process of assisting the recovery of an ecosystem that has been altered. The intent is to initiate and accelerate the recovery of this boreal environment with respect to all the components of its general ecosystem: species composition (flora and fauna) and functionality (productivity, energy flow and nutrient cycling). The revegetation program will include establishing an early seral plant community that will meet short term objectives of controlling erosion and initiate the reestablishment of ecological function. The initial plant community will allow the establishment of additional native plant species over time and will result in the development of a plant community with similar ecological function as to what existed prior to disturbance.

This section describes the current areas slated for reclamation, and the closure issues and measures proposed. Previous reclamation activities that have occurred on the property are observed as part of annual site inspections by Teck personnel. The extent of natural revegetation on previously disturbed areas is also observed. These observations have been instrumental in developing the final overall reclamation and revegetation strategy for the site. Reclamation options for various types of disturbed lands were developed and are discussed below. Figure 3-11 provides a summary of the reclamation and revegetation plan for the Sä Dena Hes property.

Previous Revegetation Initiatives

The only intentional revegetation to date occurred in 1992 when the disturbed land around the freshwater pumphouse and its access route was revegetated by the former mine owners. It is understood that the area was cleared of debris, decompacted and seeded with a fertilizer mixture (R. Flanigan, pers. com.); however, no records are available on this reclamation work.

The site was inspected in July 1999 and it was observed that a robust growth of graminoids and legumes covered the area. The most prevalent graminoids here now are creeping red fescue (*Festuca rubra*), reed fescue (*Festuca arundinaceae*), polar grass (*Agrostis latifolia*), small-flowered wood-rush (*Luzula parviflora*) and sedges (*Carex* spp). Legumes include alsike clover (*Trifolium hybridum*). Other colonizing plant species in this area are little-tree willow (*Salix arbusculoides*) and annual hawk's-beard (*Crepis tectorum*).

Natural Revegetation

Natural revegetation of numerous sites at Sä Dena Hes has been occurring since the mine closed and includes disturbed lands adjacent to the tailings management facility; old borrow sources, exploration trails, mine roads and along the main access road. Natural revegetation of a site is the preferred method since the local seed sources and rhizomes are from plants already adapted to the various characteristics of that site. This will be encouraged at Sä Dena Hes wherever possible.

The SDH footprint lies within the Liard Basin ecoregion. This ecoregion is characterized by low hills surrounded by mountains with a white spruce (Picea glauca) dominated boreal forest, and subalpine fir (Abies lasiocarpa) in the subalpine regions. Wetlands are common particularly in the lowlands and stream margins. The moderate precipitation (400 mm to 600 mm annually) coupled with relatively long and warm summers results in vigorous vegetation growth (Smith et al, 2006).

Although a recent extensive survey has not been conducted to document the complete extent of natural revegetation, the following observations have been noted:

- The primary colonizing plant species now found around the minesite are willows, alder, various poplar species and graminoids. The most prevalent willows are little-tree willow (*Salix arbusculoides*), Alaska willow (*Salix alaxensis*), blue-green willow (*Salix glauca*), diamond-leaf willow (*Salix planifolia*) and Barclay's willow (*Salix barclayi*). Arctic willow (*Salix arctica*) occurs above treeline in the Jewelbox adit area. The colonizing graminoid species in the mine area include small-flowered wood-rush (*Luzula parviflora*), spike tristeum (*Tristeum spicatum*), and blue grass (*Poa* spp.). Other herbaceous pioneering species include annual hawk's-beard (*Crepis tectorum*) and arrowleaf senecio (*Senecio triangularis*). Alfalfa (*Medicago savita*), orchard grass (*Dactylis glomerata*), timothy (*Phleum pratense*) and smooth brome (*Bromus inermis*) also occur and have presumably been introduced.

- The extent of recolonization at each location is dependent on local conditions, including soil conditions (type, moisture content and compaction) and aspect. Generally,

revegetation is occurring more extensively next to areas that have not been disturbed in recent years. Most of the exploration trails are in the process of becoming completely recolonized with native species. There is also significant evidence of native shrub recolonization of all disturbed areas in particular access roads and corridors as well as increasing invasion occurring throughout the Tailings pond area.


Mill/Camp Area
N
Teck
Sa Dena Hes
Proposed
Revegetation Treatments
Legend
Seeded - Natives
Planted-1500/ha,&Seeded
Planted-2500/ha
Reslope
Cap
Decompact/Scarify
No Treatment
Scale =1:11,000
Meters
0
550
1,100
2,200

Figure 3-11

Revegetation Options

The establishment of an initial ground cover of graminoids has historically been viewed as a desirable initial objective on most disturbed areas to stabilize slopes and control soil erosion and the subsequent loss of important soil fines. Reclamation and revegetation efforts on site will ensure that this objective is achieved; however, the re-establishment of near natural vegetative communities and native species is the primary objective. Based on recent reclamation research and on site observations, it is apparent that there is an abundance of natural seed and reproductive plant material sources available from local undisturbed ground and that these naturally occurring sources will be a significant component of the reclamation program.

The natural vegetation found on undisturbed sites around the mine generally indicates the underlying soil properties, including texture, drainage, pH, and the level of available nutrients. Revegetation prescriptions are being formulated for the Sä Dena Hes minesite using knowledge of the naturally occurring vegetation and soil conditions and end land use criteria. Additional soil sampling on disturbed sites is being carried out in order to determine areas of localized nutrient deficiencies or mineral anomalies.

Evidence indicates that revegetation by the seeding of sod-forming grass species will inhibit the invasion of the area's natural colonizing species by competing for space, light, nutrients, sunlight and moisture (Craig, et al., 1998.). Seed mixtures will be designed for site specific areas based on the results of research, local conditions and prescription requirements.

The nutrient uptake by northern native seed varieties on nutrient deficient soil is usually more effective than nutrient uptake by agronomic species. Native species will form the majority of plant species utilized in the revegetation program while recognizing that there may be some use of agronomics in site specific applications, in particular any areas identified as having a high erosion potential near water courses.

Currently there is periodic use by wildlife, mainly moose throughout the mine site. As part of the ongoing vegetation test plot program, the Company continues to test various plant species for metals uptake to assess if there are any potential concerns of ingestion of the plants by grazing and/or browsing animals.

In order to establish a successful revegetation program, the Company will conduct the following:

a) Locate available soil/till materials around the site - Soil was stripped from the tailings pond area as part of the initial site preparation process. Unfortunately there are no records existing as to the location of this material; however suspected locations will be investigated. The current Plan is to utilize till material from the deconstruction of the two dams as capping material wherever required on the site. This material was initially stripped from onsite borrow pits which are currently being invaded by native shrubs and trees. This indicates that the till material is suitable for revegetation plans. Plans are to place a minimum 300 mm soil/till cover over the tailings facility and other areas identified by the surveys as having elevated metals content to improve the growing conditions.

b) The nutrients in the available soils - Initial testing indicates nutrient deficiencies in the surrounding soils. Fertilizer formulations utilized in the reclamation program will be based on soils sample analysis. The use of nitrogen fixing species i.e. Alder, native trees and native grasses that have lower nutrient requirements than agronomic species will help ensure long term success.

c) Seeding blends - While it is known what seed mixes have been used at the site previously and what species of plants have been naturally revegetating the site, further assessments will confirm the appropriate seed blends. The intent is to utilize appropriate native species throughout the reclamation program at the site; however there may be situations where agronomic species may be more suitable. Unfortunately native species often take several years to become fully established and in highly erodible situations they may not be the ideal choice, particularly if sediment control is an issue. In these cases various options will be evaluated including the use of nurse crops (i.e., Fall Rye) and the use of nonaggressive agronomics that would eventually permit the ingress of natives.

d) Metals uptake by plants - Different plant varieties and species, tailings characteristics, cover designs and other environmental conditions are all factors influencing uptake of metals by plants. Metal analysis of both twigs and leaves was carried out in 2011 and again in 2012. Samples were taken from plantings and native invaders on tailings, on capped till and also from undisturbed areas adjacent to the tailings ponds. Results to date indicate that uptake of metals in alder is much lower than in willow. As would be expected, metal uptake was greater in plants growing directly on the tailings as opposed to the plants growing on the capped portion of the tailings. Capping of all areas covered by tailings will reduce metals uptake by vegetation and the selection of a higher component of alder will help reduce

browsing impacts. However further review will be completed as part of the Ecological Risk Assessment.

Revegetation research plots were established on a number of sites in 2001 and assessments were carried out annually terminating in the 2007 season. Each summary report has been included in the annual production reports submitted to regulators. Because there was minimal change occurring in the plots between years, the decision was made in 2008 to step out the assessment period from annual to every 5 years. This will allow for a better assessment of changes. Information gleaned from the annual assessments to date will aid in the final selection of appropriate seed mixes for the different areas.

Soil testing of the plots confirms that the soils of this region are generally near neutral (pH ranging from 6.2 to 7.9) and are low in all nutrients. Fertilizer amendments will be required during the initial seeding and planting program.

In the larger, more open disturbed areas at the mine site (tailings ponds, borrow areas, mill and camp site area), where natural seed sources are less available, the seeding/planting of indigenous shrub and tree species (primarily willows, alder, poplar and white spruce) is also proposed to encourage the later seral stages of plant succession on these sites.

3.7.1. *Linear Disturbance - Roads and Trails*

3.7.1.1. Exploration Trails

The exploration trails outside of the immediate mine site have not actively been used for several decades. These trails are in the process of being invaded by native species and will not require further treatments. Additional stabilization may be required in a few locations to correct identified erosion concerns. These exploration trails include approximately 6.0 ha of boreal and 1.5 ha of alpine area (see Table 3-4).

Table 3-4 Summary of Spatial Disturbance for Sä Dena Hes Property

Component		Approach	Approximate Area of Disturbance (ha.)
Exploration Trails	Boreal	Natural Revegetation	6.0
	Alpine	Natural Revegetation	1.5
Access Road (including pullouts and borrows)		Decompact, recontour, pull culverts, active revegetation	65.0
Site Mine Roads		Decompact, recontour, pull culverts, active revegetation	20.7
Non-Linear Disturbances	Tailings Management Facility	Till Cover, Scarify and Revegetate	14.2
	Reclaim Pond	Till Cover and Revegetate	5.8
	Borrow Pits & Refuse Areas	Scarify and Revegetate	13.7
	Mill & Camp	Scarify, Recontour and Revegetate	5.6
	Jewel Box Portal Area	Pull back crest of Dumps, Decompact & Revegetate	8.2
	Burnick Portal Area	Pull back crest of Dumps, Decompact & Revegetate	1.8
		Total Area in Hectares:	**142.5**

3.7.1.2. Main Access Road

The 22 km main access road to the property was constructed in 1990. Figure 1-2 illustrates the overall routing for this road. This road was constructed to facilitate industrial traffic to and from the minesite. The road was constructed by cut and fill methods with a road width of 8 m and associated ditch drainage and culvert installations.

At the present time the plan is to reclaim the road after it is no longer required for access to the site. The road is over 20 km long with many stream crossings and culverts, some of which must be deiced prior to spring breakup each year. The Company will continue to maintain the road until it is established that the reclamation/revegetation program has been successful and that the physical structures at the site are stable. It is assume that this will be 7 to 10 years after completion of the reclamation work before there is sufficient confidence that the road is no longer required. Long term monitoring for dam stability (the North Dam will remain in perpetuity) and water sampling will be conducted via helicopter after the access road has been removed. While the Company would be willing to consider a responsible party taking over the care and maintenance for the road, the Yukon Territorial Government has previously indicated that it would not be willing to do so. Discussions regarding the potential closure will occur with LFN prior to finalizing the plan to remove it.

Closure measures related to road decommissioning include developing a final timeframe for road closure, stabilization of slopes and prevention of erosion, and stabilization of all stream crossings.

Decommissioning of this road will include recontouring including safety berm removal, decompaction, and removal of all stream culverts. All necessary permits required for working near a water course will be obtained from the appropriate Regulatory Agencies prior to commencement of this work. On steeper slopes, erosion control structures may be required to ensure stability until revegetation cover is established. As near to original drainage patterns as practical will be reestablished.

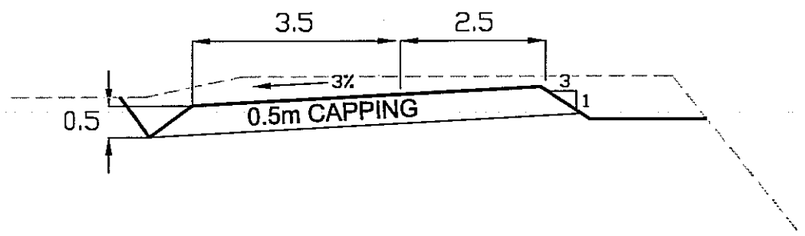
All culverts will be removed upon final closure of the road. Figure 3-13 shows the location of the culvert crossings along the access road, with a listing of culvert sizes. For culvert removal the road bed would be cut down to the culvert invert and the original stream bed elevation with side slopes brought back original grades or to a minimum of 2:1. Till material removed during culvert

removal will either be spread in the immediate vicinity or hauled to the nearest borrow area and spread. Of key importance is the removal of culverts at stream crossings which are fish bearing. The detailed final designs for each removal will be supplied with the appropriate approval application. However, the intention is to restore the stream channel to the original grade, width and channel configuration so that historic flows are accommodated as they were prior to road construction. Stream banks will be stabilized and slopes revegetated. A typical section outlining closure measures at stream crossings appears in Figure 3-14.

The intent of the reclamation program is to encourage natural succession to occur after first preparing the road surface by scarifying and decompacting the road surface. Decompaction is a fundamental step in preparing the site prior to any revegetation work as this allows aeration, water infiltration and root penetration. It also prepares the site for natural invasion by significantly increasing the number of micro sites for seed and moisture retention. Visual assessments of existing roads and trails in the area confirms that natural invasion by woody species is rapid even on areas that to date have not had any site preparation. For the purposes of budgeting, the DDRP assumes that the access road will be seeded.

TYPICAL SECTION
SINGLE LANE WITHOUT BERM

Sta. 0+000 to 2+413



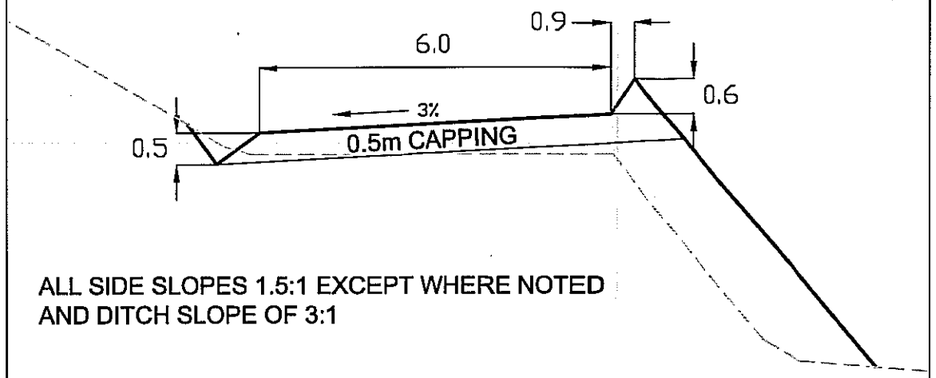
ALL SIDE SLOPES 1.5:1 EXCEPT WHERE NOTED
AND DITCH SLOPE OF 3:1

H= 1:200 V= 1:100

HAUL ROAD - TYPICAL

TYPICAL SECTION
SINGLE LANE WITH BERM

Sta. 0+000 to 1+400

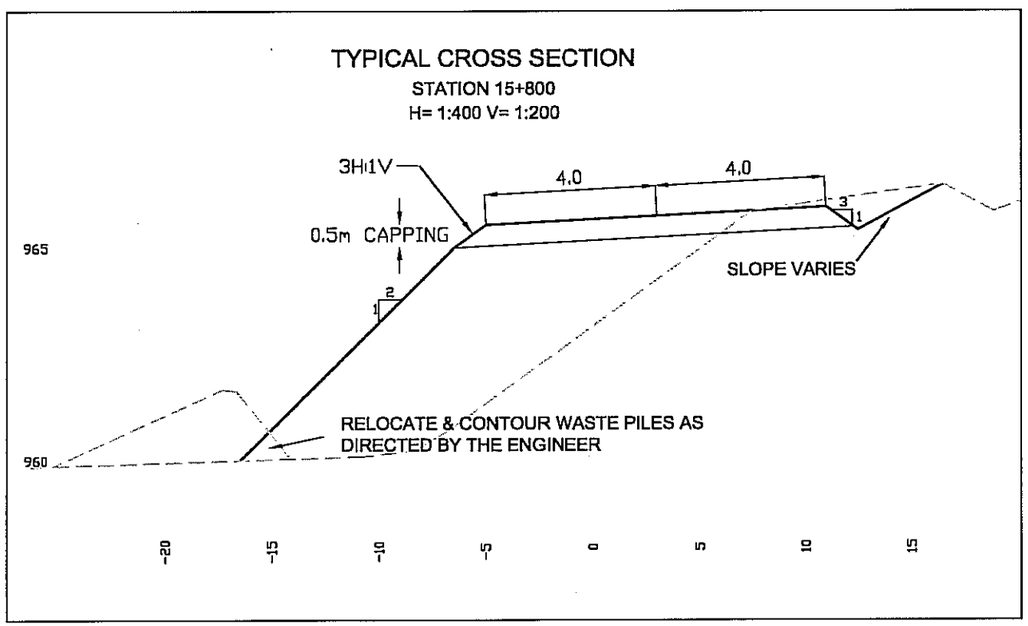


ALL SIDE SLOPES 1.5:1 EXCEPT WHERE NOTED
AND DITCH SLOPE OF 3:1

H= 1:200 V= 1:100

HAUL ROAD - TYPICAL

TYPICAL CROSS SECTION
STATION 15+800
H= 1:400 V= 1:200



ACCESS ROAD - TYPICAL

Teck

ACCESS CONSULTING GROUP

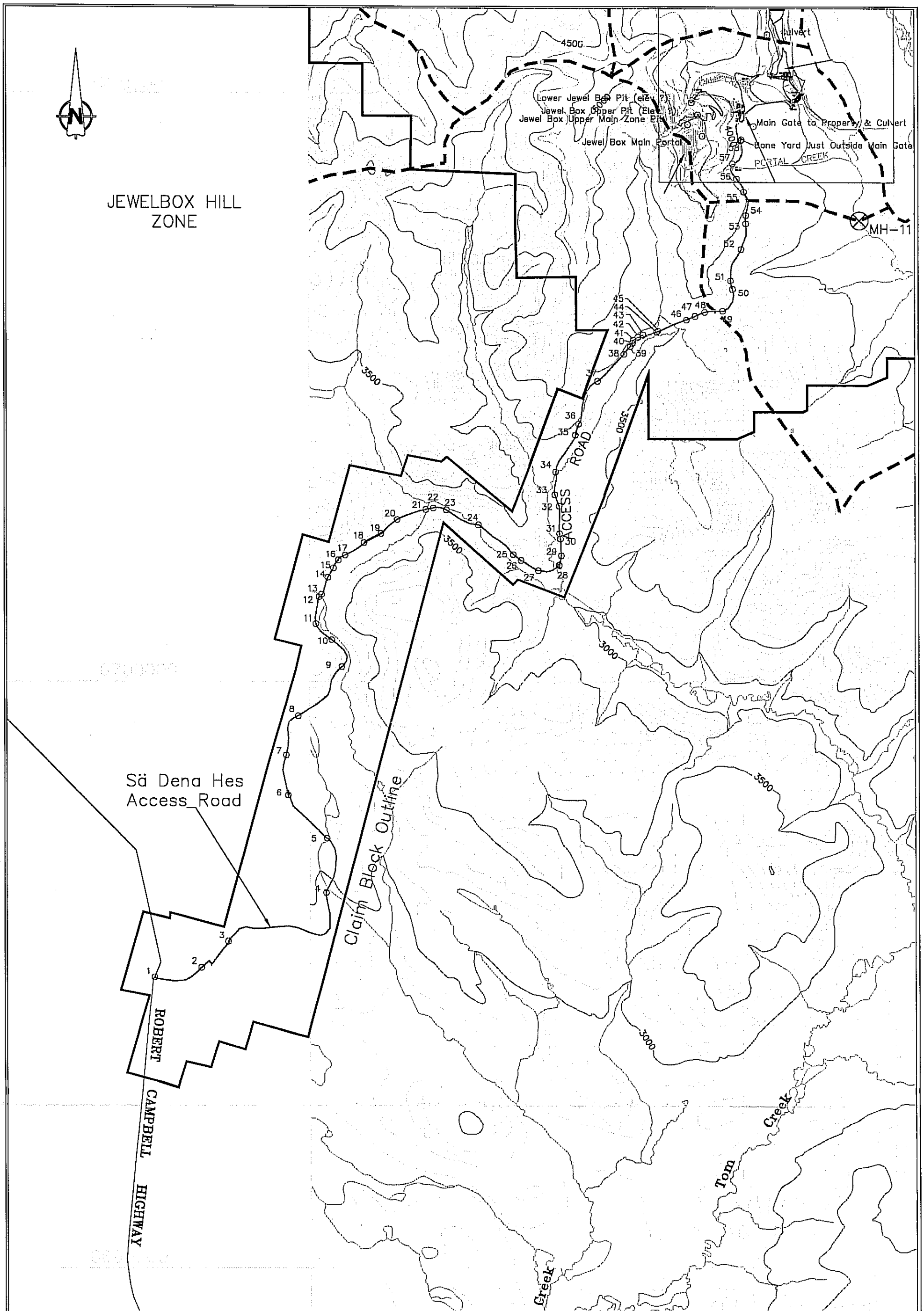
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Sä Dena Hes Detailed
Decommissioning and Reclamation Plan

Typical Road Sections

DRAWN BY: ASH	CHECKED BY: RLM
DATE: MARCH 2013	

Fig No. 3-12



NTS: 105 A/06, 105 A/07
105 A/10, 105 A/11

CONTOUR INTERVAL 100 FEET

0 600 1200 1800 2400 3000

1: 60, 000

NOTE
BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

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LEGEND

○ Culvert Location

Sä DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

Access Road Culvert Locations

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	PMH	3-13	
DATE: MARCH 2013	PROJ. NO. 1CC005.05		

The road surface (approximately 65 hectares) will be revegetated with native graminoids and legumes at an application rate low enough not to hinder native shrub and tree invasion but still control erosion. Stream crossings will be treated appropriately so as not to allow sedimentation of the waterway. The seed mixes used for revegetating this road will include native species similar to the successful road right of way seeding along the Robert Campbell Highway conducted by YG in recent years (Table 3-5). When deemed to be required to reduce erosion, non-native agronomic species, such as Fall rye, will also be seeded on the access road to act as a nurse crop for the native plants. Fall rye provides fast, vigorous growth and provides shelter for the developing native species and also adds much needed organic matter to the soil. The application rate of Fall Rye will be no greater than 25kg/ha.

Table 3-5 Yukon Highways Right of Way Seed mix

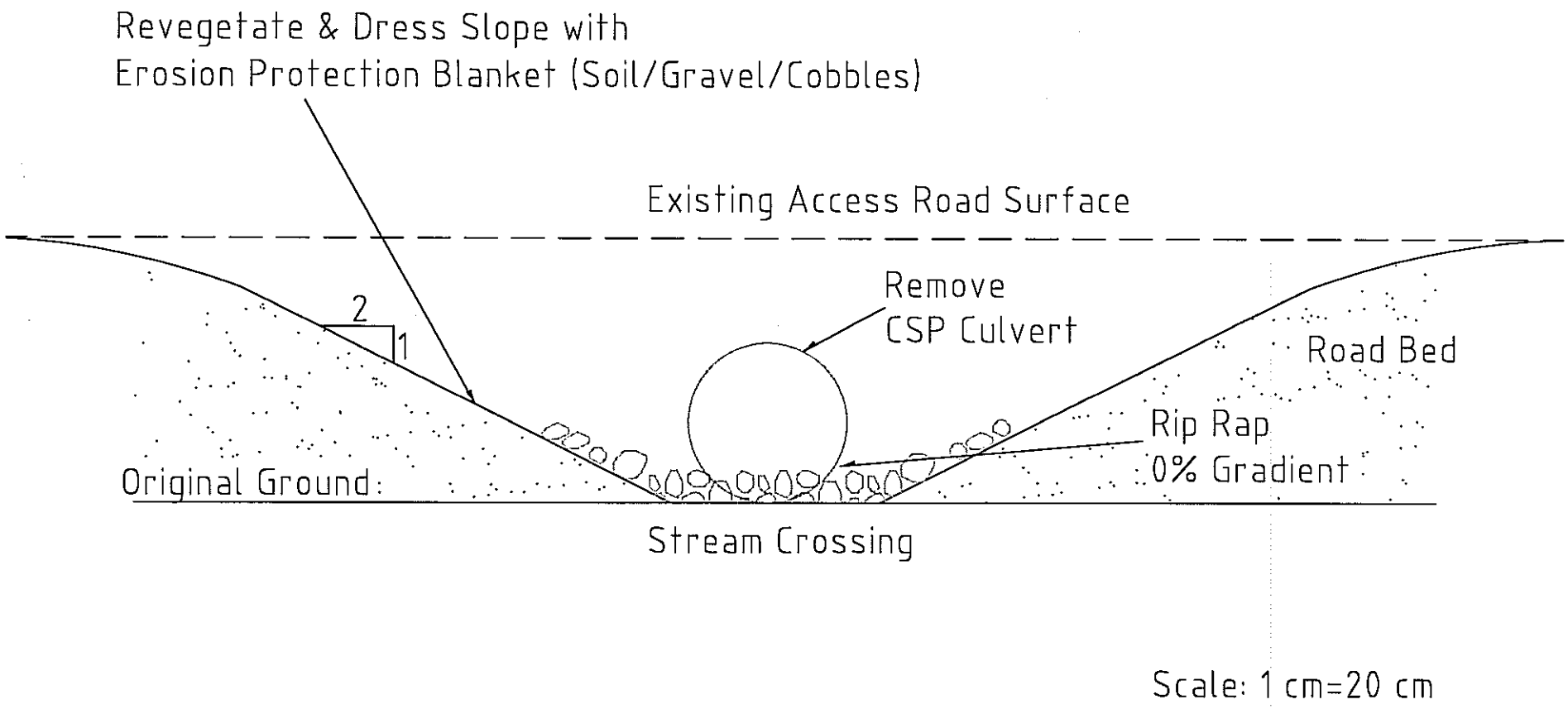
Common name	Scientific Name	% Weight	% Composition
Violet wheatgrass	Agropyron violaceum	47	14
Northern fescue	Festuca saximontana	24	18
Sheep fescue	Festuca ovina	18	31
Glaucous bluegrass	Poa glauca	11	37

A seed test plot was established at Km 22 of the access road in 2001. Violet wheatgrass was documented as the most successful seeded species over the six years of annual assessments. Spike trisetum was a volunteer grass species on the seeded and control plots as well as on the adjacent areas to the plots.

From the revegetation trials conducted throughout the site since 2001, a commercial fertilizer similar to 18-18-18 at rate of approximately 120 kg/ha may be applied during the initial seeding only. An increased rate tended to inhibit the growth of the native species which are adapted to nutrient poor soils. The final fertilizer formulation and application rate will be based on actual soil analysis data which will also indicate what important micro nutrients are required.

Seed rates will be relatively low to allow gradual encroachment of native forbs, shrubs, trees and grasses from the adjacent undisturbed lands. Currently white spruce, willows, poplar and alder are naturally re colonizing the right of way.

After completion of reclamation and the monitoring period, the access road will be blocked by installing large boulders near the highway entrance. The entrance will be recontoured to make it less apparent from the Robert Campbell Highway. Shrubs, such as willows, aspens and poplars, will be planted near the entrance to further reduce the visibility of the entrance to the deactivated road.



Scale: 1 cm=20 cm

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Typical Access Road Culvert Removal

DRAWN BY: ASH	CHECKED BY: RLM	Fig No. 3-14
March 12 2013		

3.7.1.3. Service and Haul Roads within the Minesite

A network of service and haul roads exist on the property (Figure 3-1). These roads provided access to the mine workings, tailings management facilities, and site infrastructure. Figure 3-12 (Typical Section Haul Road) provides a typical section through a haul road, with and without safety berms.

Closure objectives for the site access roads include slope and drainage stabilization, erosion prevention and revegetation.

Figure 3-15 depicts the typical treatment of haul road and service road closure measures.

All of the service and haul roads within the minesite will eventually be decommissioned. All culverts and berms will be removed and the roadbeds will be recontoured to restore original drainage patterns and to provide stability and long term erosion control. On the steeper slopes, where required, erosion control structures will be utilized at suitable intervals to reduce erosion potential. These site access roads cover an area of approximately 20.7 ha (Table 3-4).

The road surfaces will be decompacted and revegetated. Based on current observations it is expected that natural invasion with local species will occur fairly rapidly. To assist in this process, seeding with a light application of native graminoids and legumes will occur. The seed mix for these areas will be similar as for the Main Access Road. Steeper areas susceptible to erosion will have increased application rates of sod forming species to offer control.

Higher Elevation Sites

Many of these service roads are located within the subalpine fir vegetation community. These areas, including subalpine sites such as the haul roads leading to the Jewelbox and Burnick, will use a site specific seed mix that accounts for the higher elevation. One of the test plots for the revegetation trials was set up on the haul road at Jewelbox Hill in 2001. Six years of assessment showed that annually, Alpine Bluegrass was the dominant species in these plots. Alpine Bluegrass, a native perennial bunchgrass, is a good colonizer but spreads by seeds rather than rhizomes and thus is not a very strong competitor. It prefers rocky soils and habitats and grows on dry slopes, and in alpine and subalpine environments. It tolerates low nutrients and drought.

Spike Trisetum has naturally colonized the control plot and has invaded the seeded plots at the Jewel Box site. It is a short perennial bunchgrass and a good colonizer with vigorous seedlings. It is tolerant to drought, low nutrients, permafrost and high elevations and is adapted to cold summers and short growing seasons. For all of the above reasons, Spike Trisetum will form part of the seed mix. Bear root and/or lupine, both of which were found voluntarily growing in the control plot will be the legume(s) within the mix.

Subalpine fir has invaded both the control and seeded plots. Due to the narrow nature of the disturbance to be reclaimed and the voluntary growth of Subalpine fir in and around the site, seedlings of this tree will not be part of the revegetation program at the higher elevation sites.

A potential seed mix is shown in the following table.

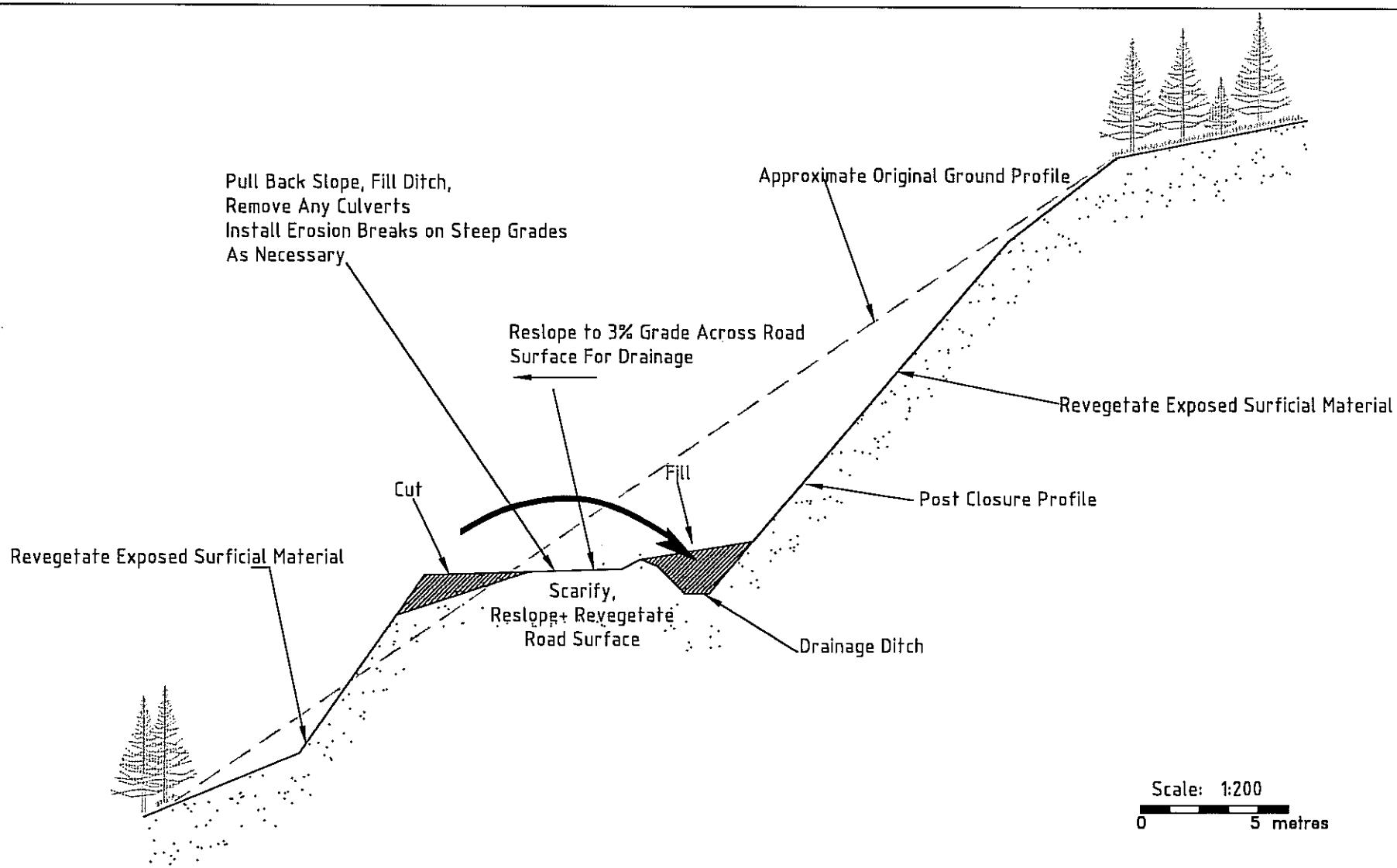
Common Name	Scientific Name	Weight %	Composition %
Alpine Bluegrass	*Poa alpina*	3.7	40
Spike Trisetum	*Trisetum spicatum*	1.3	40
Arctic lupine	*Lupinus arcticus*	41	5
Bear root	*Hedysarum alpinum*	54	15

Due to the documentation of voluntary colonization of the linear disturbed areas, the seed rate will remain low (Approximately 25 kg/ha) to encourage and enable encroachment of native revegetation.

3.7.2. *Non-Linear Disturbances (Mill Site, Accommodations Camp, Tailings Management Facility, and Mine Workings)*

Non-linear disturbances include the areas around the mill and camp, tailings management facility, mine workings including open pits and waste rock dumps, and the refuse landfill site and borrow pit areas. They require special treatment in this revegetation plan because they are not as conducive to natural revegetation as are roads, etc., because of the increased distance from seed sources. The TMF and reclaim pond covers an area of approximately 20 ha, and the remaining non-linear disturbances include an area of approximately 29.3 ha (Table 3-4).

A complete description of the facilities associated with these non-linear disturbances is presented in previous sections. Closure objectives include slope and drainage stabilization, erosion control, and revegetation.



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Sand & Gravel

Existing Vegetation

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Typical Haul Road Closure Cross-section

DRAWN BY: ASH	CHECKED BY: RLM	Fig 3-15
March 12 2013		

3.7.2.1. Mill Site and Accommodations Camp Area

Once all structures are removed these areas will be prepared by decompaction and recontouring where necessary. Foundations from the mill will be either removed above grade or when near steep ground slopes, filled to be able to contour into the surrounding ground features and covered with a minimum of 0.5 meters of till material. A low rate of seed application (similar seed mix as for the main access road) will be applied to increase the biodiversity plus provide a seed source to enhance the revegetation of the areas that are some distance from the seed sources in the adjacent undisturbed areas.

In addition, plugs of seedlings (shrubs and trees) will be planted to increase and enhance the rate of return to a natural forest ecosystem. Unlike the methodology to be used on the TMF (see section 3.7.2.2), the planting density will be lower (approximately 1500 stems/ha) as the intent is not to create a dense forest.

Species collected near a disturbance tend to be more biologically suited for revegetating the site than those collected far away. Seed collections for the growth of the seedlings will begin in the 2013 season from selected areas at SDH. Willow and Poplar seeds will be collected from the appropriate catkins in late May/early June, 2014. Seed cones from white spruce will be collected (if available) in August 2013. Seeds will also be collected from alder in late August to early September. All collected seed will be grown at a nursery in Langley, BC. The plugs will be shipped to SDH for spring planting in 2015. Each plug will be planted with 2 fertilizer biopacs to ensure they have sufficient nutrients to become established. Seedlings will be planted in a general random pattern to more accurately reflect natural growing conditions. The overall density will be approximately 1000 to 1500 stems/ha to provide initial growth of a diverse plant community as well as to allow for natural encroachment.

Willow will have the highest planting concentration followed by alder and white spruce and the following distribution is suggested for the 1500 stems/ha scenario:

Common Name	Scientific Name	Rate of Application
Willow/Poplar	*Salix & Populus sp.*	800 plants/ha
Alder	*Alnus crispa*	400 plants/ha
White Spruce	*Picea glauca*	300 plants/ha

Alder is an aggressive colonizer at the SDH site and is a nitrogen fixer. To allow other plants to establish in these non-linear sites, the planting intensity will be reduced. By including white spruce, the restored site won't be completely dominated by deciduous plants (those that colonize more readily), but will support a community more like the adjacent forest, providing additional habitat for local wildlife species.

3.7.2.2. Tailings Management Facility

The tailings will be covered with a nominal 300 mm soil/till cover from the overburden originally stripped from the pond area and from the till materials generated from the decommissioning of the earthen dams. Teck's experience at its other operations indicates that a 200 mm soil cover is adequate for plant growth. However, based on experience gained at the former Sullivan Mine in Kimberley, B.C., it is felt that it would be more practical from a constructability perspective to place a nominally 300 mm thick cover. The soil will eliminate tailings dusting concerns and provide a suitable growth medium for revegetation. The current plan is to decommission both the South Dam and the Reclaim Dam in 2013 thus allowing the ponds to drain and lower the water table in the tails. Capping of the tailings will commence in late 2014 followed by final revegetation of the tailings area commencing in 2015.

Starting in 2001 a number of test plots were established on the tailings impoundment area in order to determine the optimum soil treatments and seed mixtures. These test plots included applications of till material, fertilizers, as well as different seed mixes. A control plot with no treatment was used to measure the success of the test plots and to monitor any natural revegetation that occurs. Annual assessments of these plots were carried out until 2007 when it was decided that annual changes were so low that changes were insignificant.

In 2009 an alder planting trial was established on the tailings pond. This was initiated following observations that native alder and willow/popular species were volunteering throughout areas on and adjacent to the Tailings Pond. Seed from local plants was collected in the fall of 2008 and sent to a nursery for growing. A total of 1200 plants were planted on the pond in August of 2009. Planting sites varied from on approximately 300 mm of till material to directly on tailings right up to the water edge. Despite the late planting, following three full growing seasons, plant survival remains over 95%. An assessment in 2012 showed that all plants (on the capped areas) were healthy, showed no sign of stress and had significant growth. In 2011 and 2012, leaves and twigs were recovered from alder and willow growing on both the Tailings Facility as

well as from undisturbed areas adjacent to the ponds and sent to the lab for metal uptake analysis.

Results to date indicate that uptake of metals in alder is much lower than in willow. As would be expected, metal uptake was greater in plants growing directly on the tailings as opposed to the plants growing on the capped portion of the tailings. During the first two seasons of growth there was little difference between the vigor of plants growing on till versus those growing directly on the tailings. However, observations conducted in 2012 showed that the plants growing on the till exhibit significantly increased vigor (plant height approximately 2 feet) and those growing directly on the tailings showed definite signs of stress. The following photos show the results of three years of growth.



Alder test plots – 2010



Alder test plots – 2011



Alder test plots – 2012

Following capping of the entire tailings management facility, the surface will be planted with alder and willow seedlings at the following rate:

Common Name	**Scientific Name**	**Stocking Rate (#/ha)**
Willow/Poplar	*Salix/Populus ssp*	500
Alder	*Alnus crispa*	2000

Alder grows prolifically in this region, is less palatable to moose than willows, and uptakes metals to a lesser degree than willow and poplar, making this shrub species an excellent revegetation candidate for the tailings area. Local seed will be collected in late summer/early fall 2013 and sent to NATS nursery in Langley, BC for growing. The seeds will be germinated and the plugs of seedlings will be shipped to the site in readiness for planting during the spring of 2015.

The goal here is to produce a very thick cover of alder with a minor component of willow/poplar. Seedlings will be planted at a rate of 2500 stems/ha.

3.7.2.3. Reclaim Pond

After the reclaim pond has been drained and the original drainage channel of Camp Creek has been restored, the sediments will be characterized for metals content and if found to pose an unacceptable ecological risk they will covered with till and revegetated. The area required for cover and revegetation is approximately 5.8 ha. Either the existing sediments (if determined to be acceptable) or till material from the dam deconstruction (a nominal cover of 300 mm) will be used as the growth medium. Analyses of soil samples taken from the south end of the overburden stock pile (the end closest to the reclaim pond) show that this overburden is deficient in available phosphorous (3.2 mg/kg phosphate) and available potassium (40 mg/kg potassium), but has marginally adequate available nitrogen (41 mg/kg nitrate) and available sulfur (150 mg/kg sulfate). The revegetation prescription used for the reclaim pond will be similar to that recommended for the TMF (see Section 3.7.2.2). If following draining, the Pond does not require further capping, the planting prescription will be modified to include a higher percentage of willow and poplar, since metals uptake will not be an issue.

3.7.2.4. Pits and Waste Dumps

As pits and waste dumps are primarily in the alpine zones where there was little original vegetation, they will not be actively revegetated. The exception is the Burnick 1200 waste rock dump which is located below tree line in the Boreal Zone. The resloped portion of the waste rock area will be revegetated with the same prescription as recommended for the mill area (see Section 3.7.2.1) excluding seedlings.

3.7.2.5. Sediment Ponds

There are four sediment ponds corresponding to the Jewelbox 1408, Main Zone Pit, Burnick 1200 Portal, and the Jewelbox 1250 Portal (see Figures 3-3 and 3-4). They are all approximately 4 m x 3 m, constructed of unlined locally available materials, except the Jewelbox 1408 portal sediment pond which is lined. They were used to provide retention time to mitigate suspended solids levels in the water draining from the mine workings. While confirmatory soil testing has not been conducted, it is expected that three of the sediment ponds (all but

Jewelbox 1250, which saw virtually no production), may contain elevated metals levels. The metal contaminated soils will be either capped with a minimum 1m thick till cap or excavated deposited in the open ventilation shaft at Jewelbox mine workings, and the sites will be regraded and revegetated. The Jewelbox 1250 sediment structure is very small and was constructed out of the natural stream channel. The water will be redirected back into the natural channel and the pond regarded and revegetated.

3.7.2.6. Landfill Sites and Borrow Pits

The site presently has one main landfill area and a number of smaller mining related disturbed sites. A number of borrow areas also exist on the property both related to mining activities and the access road construction. The location of these mine site disturbances is shown in Figure 3-11: Reclamation & Revegetation Plan.

Closure issues associated with these areas are similar with other disturbed lands discussed previously. All landfill, refuse and borrow pit areas will be graded to prevent ponding of water and permit positive drainage, decompacted (if required) and revegetated with a suitable seed and fertilizer mix such as those previously recommended. Capping of the landfill will comply with associated landfill permit requirements.

3.7.3. *Follow-up Monitoring*

Assessments of the revegetation program will be conducted in midsummer for a minimum of five years. As the final reclamation objective is to establish a self-sustaining ecosystem on the site, the main focus of the monitoring will be to ensure that the prescriptions applied to the disturbed sites on the mine are successful. Metals uptake by the new plant community will be assessed at the same time to determine any changes in the plant community.

During the assessments, assessments will be made on seedling survival, especially on the TMF. The previous success of alder growth on the capped tailings indicates that it is likely that there will be little need to make any adjustments in this area.

General observations will be made on the growth of the seeded species and those naturally invading throughout the site. Wildlife use will also be noted.

3.7.4. *Reclamation Schedule*

2013

- Continue assessment of metals uptake in plants on site
- Commence decommissioning of minor site roads no longer required
- Alder catkins will be collected for shipping to nursery for cleaning and sowing
- Resloping of Burnick dump if available

2014

- Additional assessment of metals uptake in vegetation
- Spring seed collection for poplar and willow
- The NATS nursery will sow and grow the required seedlings.
- Site preparation and seeding of designated roads and borrow pits

2015

- Site preparation activities on the Tailings Pond and Reclaim Pond prior to planting
- Seeding and planting of Mill/Camp site
- Site preparation and seeding of designated roads and trails that are no longer required

2016+

- Assessments of site reclamation activities to identify potential areas that require remedial work.

3.8 ADAPTIVE MANAGEMENT PLANNING

The closure measures in the previous sections have been developed and proposed based on the relevant current information collected at the site, and the best interpretations of these data with respect to the conditions on the site as the site reclamation work is scheduled to begin in 2013.

As most of the work proposed in this Plan is relatively straight forward, there are limited areas where changes to the approved Plan are likely. Adaptive management planning (AMP) is a recognized and effective way to ensure that changing conditions during closure are not subject to static reclamation initiatives, and that closure programs can be adapted to these conditions to achieve desired performance. The Company is committed to AMP in the context of closure of some of the higher risk features on the site. The Company sees the application of AMP for the following mine component/conditions:

- **Tailings Storage Facility**
  - The most likely difficulty in reclaiming the tailings facility area will be due to the low load bearing capacity of saturated tailings. This could result in a thicker layer of till or a till/rock combinations being required to be place on the tailings in order to support equipment placing the till cover on the tailings. An option may be to place the till cover in the winter months when the tailings surface is frozen. Due to significant snow cover and low temperatures adversely affecting working conditions, this would increase the costs and would only be used as a measure of last resort.
  - Uptake of some metals into the vegetative cover will occur. What is not currently certain are the long term concentrations of heavy metals in the vegetation. Periodic post-reclamation monitoring of metals concentrations (until determined they are stable) combined with wildlife habitat assessments will be undertaken to assure that no unacceptable risks occur to wildlife using the site. If the assessments indicate unacceptable risk levels, additional mitigative actions will be taken to mitigate the risks to acceptable levels.

- **1380 Portal Discharge**
  - The primary risk is that SRK's prediction that zinc loading discharging from the portal ultimately has an unacceptable effect on the water quality in Camp Creek. While this is

not being predicted, monitoring wells proposed to be installed in 2013 will provide a mechanism to forecast the potential for this. The additional assessment will assist in developing an adaptive management plan if any unacceptable conditions are expected in the future.

- **Contaminated Soils** –
  - The landfarming treatment process for treatment of hydrocarbon contamination is not effective for the removal of metal contamination, and the nature of the site and the confirmed geochemical signature of area surficial soils make it likely that some of the materials treated will have metal contamination that would designate it as special waste. This has been confirmed by recent testing of contaminated soils around the site. This material, once successfully treated for hydrocarbons, could be placed in the tailings facility and reclaimed in keeping with the implemented measures at that location, as similar metals are stored within this facility. This approach has been approved in principle by Environment Yukon at the site. Alternately, the materials could be deposited into the Jewelbox Mine workings. This adaptive management plan will refine these measures based on remediation success and discussion and agreement with the Environment Yukon. A less attractive option from a cost perspective is the complete removal of the hydrocarbon/metals contaminated material from the site and transported to an approved hazardous waste disposal site that will handle both the hydrocarbon and the metals. This would only be considered if the final quantities of metals/hydrocarbon contaminated soils is small due to the high transportation costs to the nearest suitable hazardous waste landfill site. The preferred option may be to evaluate the hydrocarbon contaminated areas under the ecological and human health risk assessment and determine what level of remediation is required to reduce any unacceptable risks, if any (e.g., cap the surface soils or monitor the groundwater quality). Leaving the soils in-situ could reduce the cost and movement of metal contaminated soils from one source area to another which may not completely reduce the risk of the existing conditions (i.e., metals contamination remains).

These and other adaptive management plans will be developed if and when the needs arise. Where adaptive management plans need to be implemented, they will be modelled on accepted AMP features, such as:

- performance monitoring programs, threshold levels for data from the monitoring programs and associated triggers for action items, and
- response actions for expanding or refining the monitoring initiatives, implementing extended closure measures, and/or
- conduct further studies to develop mitigation measures for conditions that are divergent from those expected.

4.0 IMPLEMENTATION SCHEDULE

With the implementation of Permanent Closure of the site starting in 2013, additional engineering and environmental assessments have been conducted in 2012 to facilitate the detailed project planning.

It is anticipated that three years will be required to substantially complete all significant aspects of the DDRP. Detailed planning and weather conditions may result in some adjustments of the conceptual implementation schedule presented in Table 4-2. At the time of preparing this DDRP, the project management team developing the detailed execution plan has not yet reviewed these details. The work would be conducted seasonally during the snow-free period (June to September). If detailed planning shows that some winter activities are economic they will be considered in order to shorten the schedule. During the first year of Permanent Closure (2013), the substantial site decommissioning works would be initiated.

It is our belief that the process and other facilities on site may have sufficient market value such that they can be salvaged rather than demolished. If the complete mill can be sold, ideally it would be removed in 2013. If not then complete removal will occur in 2014.

In 2013 the focus of work will be building removal (if sold) and major earthworks, such as dewatering the reclaim and tailings pond, decommissioning the Reclaim and South dams, channel construction, recontouring and portal closure works. A program of post closure monitoring and inspection will be carried out during the implementation of closure measures. While the details of the post reclamation monitoring program are discussed in Section 5.0, they will be subject to the terms of a new if required beyond the current one which expires on December 31, 2015.

Liard First Nation's environmental consultant has reviewed an earlier draft of this Plan and their comments have been considered in this updated Plan. Additionally through community meetings (next one is in April 2013) as well as engagement of our environmental consultants with community members and using LFN's community members in the field assessment work will all assist in ensuring that LFN's concerns are given full consideration in the reclamation work being planned and executed.

The general schedule for closure of the mine is summarized in Table 4-1. A more detailed schedule for closure measure implementation is presented in Table 4-2 in Gantt chart format.

The Gantt chart displays closure issues that follow directly with the discussion in the body of the text. The associated section numbers are shown where appropriate.

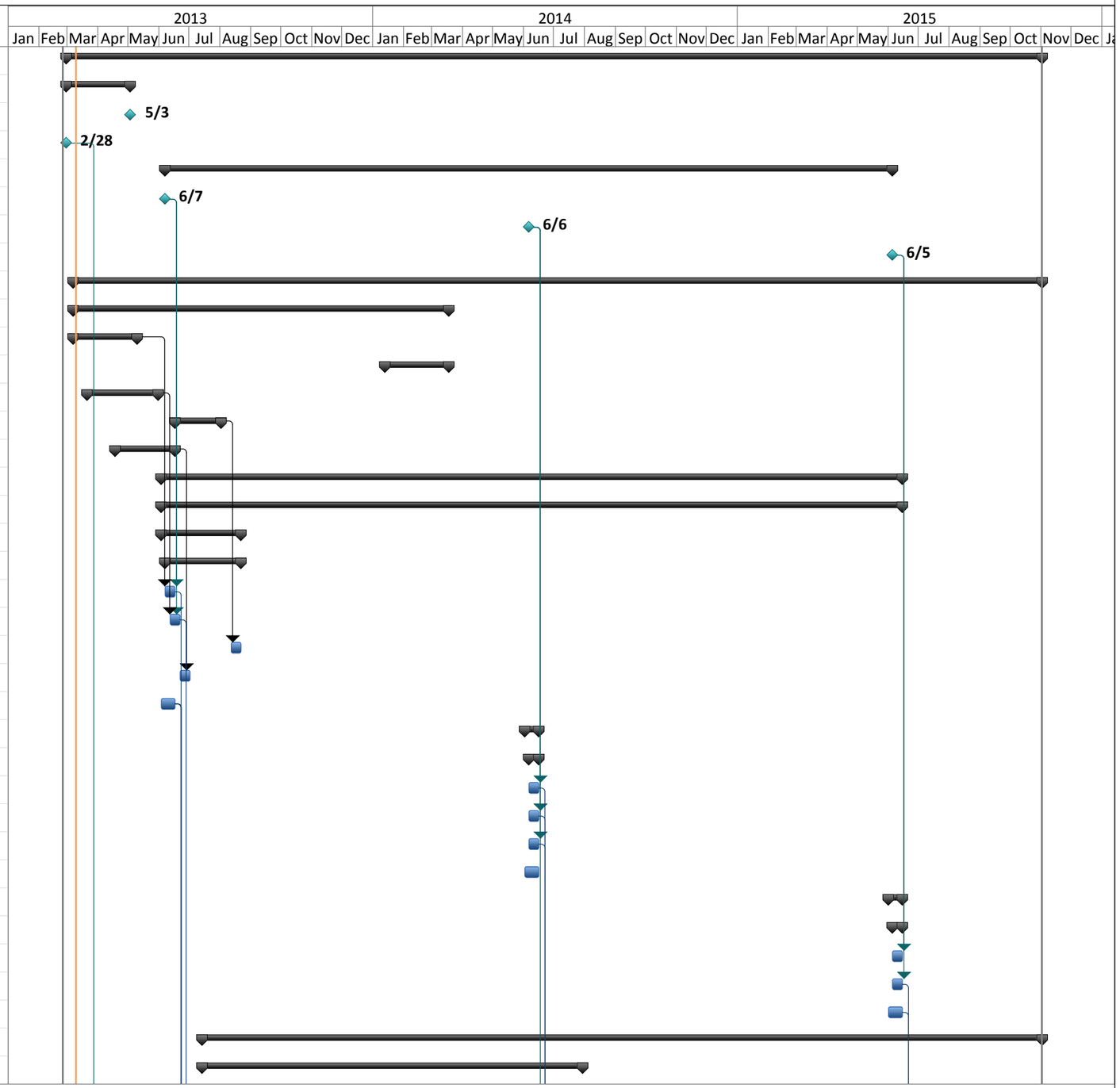
Table 4-1 General Closure Schedule for the Sä Dena Hes Mine

Phase of Operation	Key Triggering Event or Timeline	General Reclamation Activity
Current Conditions	Continued through ongoing care and maintenance	- Continued environmental monitoring programs - monitoring of vegetation test plots - site caretaker on site
Closure Implementation	3-year period is required to implement the various site closure measures. Work to be done seasonally (June-September)	Dismantling of site infrastructure and implementation of the tailings management facility closure measures will commence in year 1. Work will then begin on the reclamation of the open pits, waste rock storage areas and haul roads not required and that have not been previously reclaimed. Reclamation and revegetation of disturbed lands will occur throughout the 3-year period but primarily in year 3.
Main Access Road Closure	Main property access road will remain open during closure implementation and for a period following post reclamation. Decision to permanently close the main access road will be reconfirmed following consultation with regulatory agencies and Liard First Nation.	The current Plan is that the Main Access Road will be blocked, recontoured and sloped, decompacted, culverts removed and revegetated about 7 - 10 years after mine reclamation has been completed.
Post Reclamation Monitoring	Post closure environmental monitoring will continue during closure implementation. Once environmental monitoring results are reviewed and performance of reclamation objectives demonstrated a final certificate of closure will be sought.	Environmental monitoring and inspection frequency will reduce with time, assuming sampling results are satisfactory. Data review to determine that reclamation objectives have been achieved. Post reclamation monitoring will be done following expiry of the current Water Licence.

Table 4-2: Closure Measures Implementation Plan

SA DENA HES

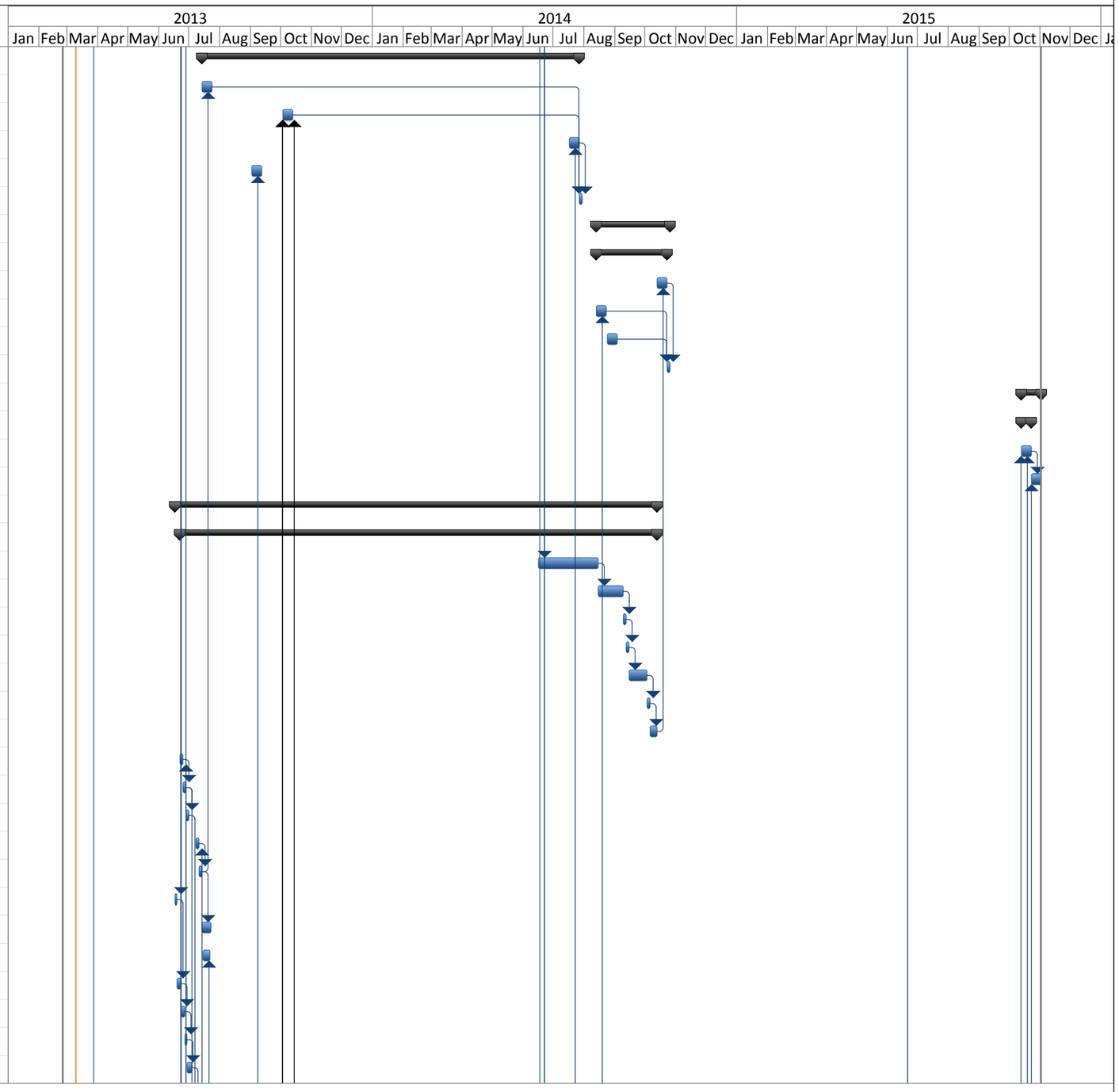
ID	Te	Task Name	Duration	Start	Finish
1		**Sa Dena Hes Min Closure**	**825 days**	**Feb 28 '13**	**Nov 1 '15**
2		**Permits & Approvals**	**46 days**	**Feb 28 '13**	**May 3 '13**
3		MER Approval	0 days	May 3 '13	May 3 '13
4		Notice of Award PM & CM Contract	0 days	Feb 28 '13	Feb 28 '13
5		**Road Bands**	**604 days**	**Jun 7 '13**	**Jun 5 '15**
6		2013	0 days	Jun 7 '13	Jun 7 '13
7		2014	0 days	Jun 6 '14	Jun 6 '14
8		2015	0 days	Jun 5 '15	Jun 5 '15
9		**PM Company**	**820 days**	**Mar 7 '13**	**Nov 1 '15**
10		**Construction Tender Documents**	**310 days**	**Mar 7 '13**	**Mar 17 '14**
11		**Demolition I**	**46 days**	**Mar 7 '13**	**May 9 '13**
18		**Demolition II**	**46 days**	**Jan 13 '14**	**Mar 17 '14**
25		**Earthworks I**	**51 days**	**Mar 21 '13**	**May 30 '13**
32		**Earthworks II**	**46 days**	**Jun 17 '13**	**Aug 1 '13**
39		**Earthworks III**	**46 days**	**Apr 18 '13**	**Jun 16 '13**
46		**Mobilization & Demobilization**	**618 days**	**Jun 3 '13**	**Jun 14 '15**
47		**Mobilization**	**618 days**	**Jun 3 '13**	**Jun 14 '15**
48		**2013**	**80 days**	**Jun 3 '13**	**Aug 21 '13**
49		**Contractors**	**76 days**	**Jun 7 '13**	**Aug 21 '13**
50		Demolition I	10 days	Jun 7 '13	Jun 16 '13
51		Earthworks I	10 days	Jun 12 '13	Jun 21 '13
52		Earthworks II	10 days	Aug 12 '13	Aug 21 '13
53		Earthworks III	10 days	Jun 22 '13	Jul 1 '13
54		PM/CM Team	14 days	Jun 3 '13	Jun 16 '13
55		**2014**	**14 days**	**Jun 2 '14**	**Jun 15 '14**
56		**Contractors**	**10 days**	**Jun 6 '14**	**Jun 15 '14**
57		Demolition II	10 days	Jun 6 '14	Jun 15 '14
58		Earthworks II	10 days	Jun 6 '14	Jun 15 '14
59		Earthworks III	10 days	Jun 6 '14	Jun 15 '14
60		PM/CM Team	14 days	Jun 2 '14	Jun 15 '14
61		**2015**	**14 days**	**Jun 1 '15**	**Jun 14 '15**
62		**Contractors**	**10 days**	**Jun 5 '15**	**Jun 14 '15**
63		Earthworks II	10 days	Jun 5 '15	Jun 14 '15
64		Earthworks III	10 days	Jun 5 '15	Jun 14 '15
65		PM/CM Team	14 days	Jun 1 '15	Jun 14 '15
66		**Demobilization**	**717 days**	**Jul 14 '13**	**Nov 1 '15**
67		**2013**	**319 days**	**Jul 14 '13**	**Jul 29 '14**



PM/CM | Demolition II | Earthworks II | Trees & Shrubs | Misc. Contracts
Demolition I | Earthworks I | Earthworks III | Specialty Contracts

SA DENA HES

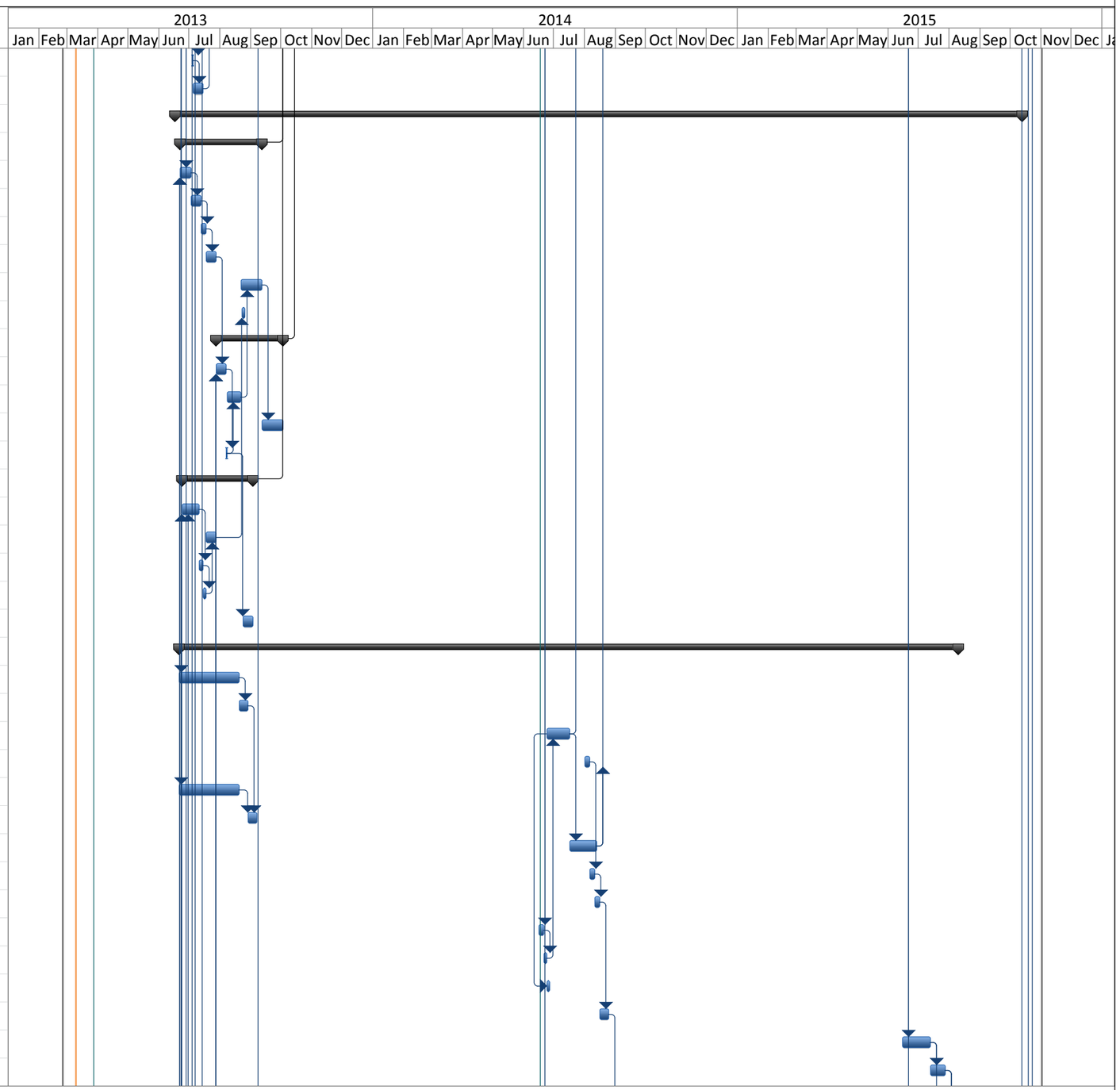
ID	Te	Task Name	Duration	Start	Finish
68		**Contractors**	**316 days**	**Jul 14 '13**	**Jul 26 '14**
69		Demolition I	10 days	Jul 14 '13	Jul 23 '13
70		Earthworks I	10 days	Oct 3 '13	Oct 12 '13
71		Earthworks II	10 days	Jul 17 '14	Jul 26 '14
72		Earthworks III	10 days	Sep 2 '13	Sep 11 '13
73		PM/CM Team	3 days	Jul 27 '14	Jul 29 '14
74		**2014**	**74 days**	**Aug 13 '14**	**Oct 25 '14**
75		**Contractors**	**71 days**	**Aug 13 '14**	**Oct 22 '14**
76		Demolition II	10 days	Oct 13 '14	Oct 22 '14
77		Earthworks II	10 days	Aug 13 '14	Aug 22 '14
78		Earthworks III	10 days	Aug 24 '14	Sep 2 '14
79		PM/CM Team	3 days	Oct 23 '14	Oct 25 '14
80		**2015**	**20 days**	**Oct 13 '15**	**Nov 1 '15**
81		**Contractors**	**10 days**	**Oct 13 '15**	**Oct 22 '15**
82		Earthworks III - 2015	10 days	Oct 13 '15	Oct 22 '15
83		PM/CM Team	10 days	Oct 23 '15	Nov 1 '15
84		**Demolition & Disposal**	**421 days**	**Jun 17 '13**	**Oct 12 '14**
85		**Mill Area**	**416 days**	**Jun 22 '13**	**Oct 12 '14**
86		Hazardous Material Removal	60 days	Jun 16 '14	Aug 14 '14
87		Concentrator Complex	25 days	Aug 15 '14	Sep 8 '14
88		Coarse Ore Bin	3 days	Sep 9 '14	Sep 11 '14
89		Reagents Bins	3 days	Sep 12 '14	Sep 14 '14
90		Crushing & Grinding	18 days	Sep 15 '14	Oct 2 '14
91		Interbuilding Conveyors	3 days	Oct 3 '14	Oct 5 '14
92		Power House	7 days	Oct 6 '14	Oct 12 '14
93		Office Trailers	3 days	Jun 22 '13	Jun 24 '13
94		Diesel, Gasoline & Oil Storage	3 days	Jun 25 '13	Jun 27 '13
95		Accommodation, Camp Trailers & Kitchen	3 days	Jun 28 '13	Jun 30 '13
96		Warehouse, Dry, Lab and Ambulance Garage	3 days	Jul 8 '13	Jul 10 '13
97		Mill Site Facilities & Services	3 days	Jul 11 '13	Jul 13 '13
98		Jewelbox Zone	2 days	Jun 17 '13	Jun 18 '13
99		Burnick Zone	9 days	Jul 14 '13	Jul 22 '13
100		Tailings Mgt. Facility	7 days	Jul 15 '13	Jul 21 '13
101		Trapper's Camp	4 days	Jun 19 '13	Jun 22 '13
102		Gribbler Ridge Exploration Camp	4 days	Jun 23 '13	Jun 26 '13
103		Upper North Creek	2 days	Jun 27 '13	Jun 28 '13
104		Lower North Creek	5 days	Jun 29 '13	Jul 3 '13



PM/CM
Demolition I
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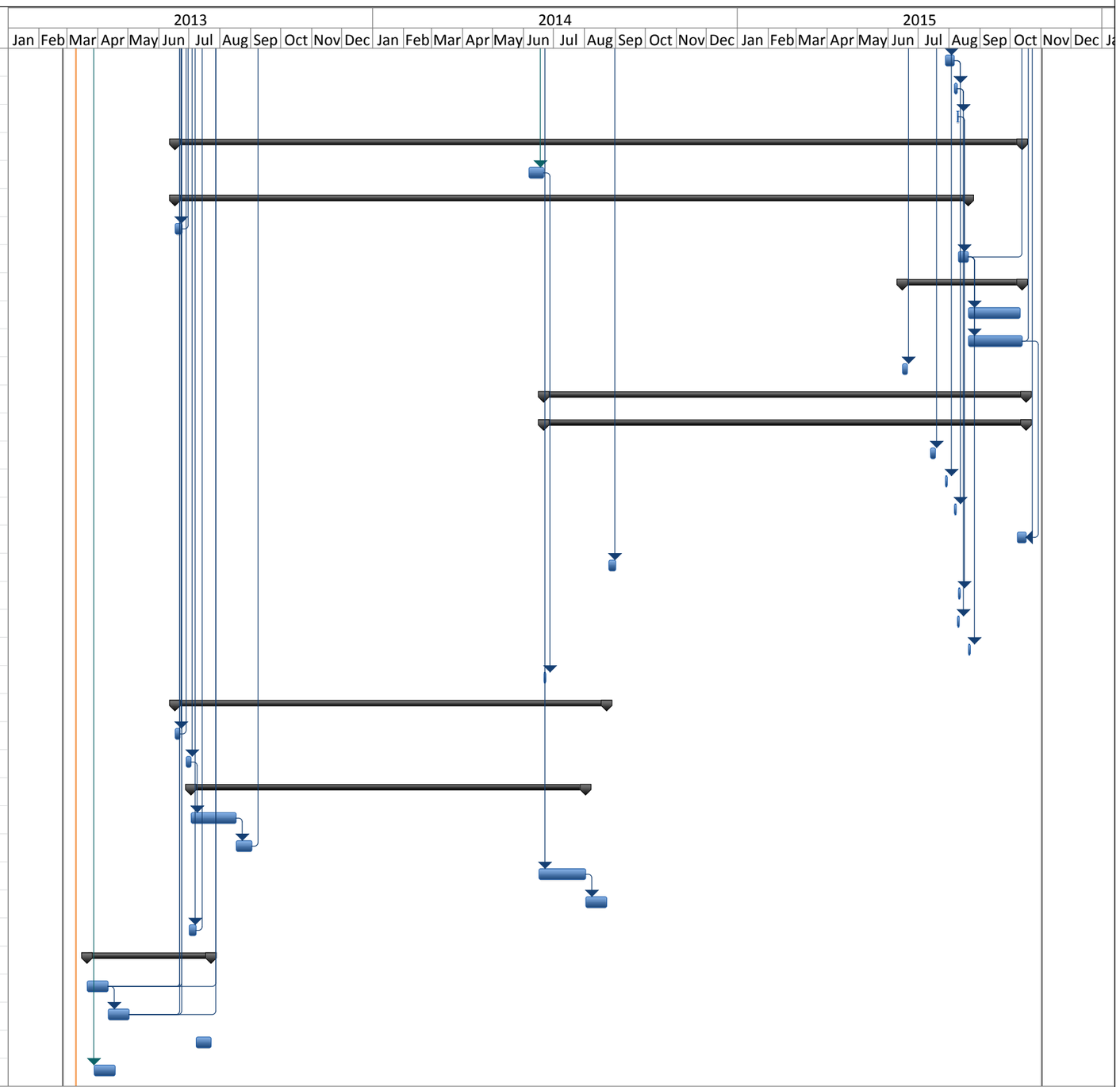
ID	Te	Task Name	Duration	Start	Finish
105		Camp Creek Diversion	1 day	Jul 4 '13	Jul 4 '13
106		Power Poles/Lines & Railway Ties	10 days	Jul 5 '13	Jul 14 '13
107		**Earthworks**	**724 days**	**Jun 17 '13**	**Oct 12 '15**
108		**Jewelbox Zone**	**82 days**	**Jun 22 '13**	**Sep 11 '13**
109		1408 Portal	11 days	Jun 22 '13	Jul 2 '13
110		Ventilation Raises	10 days	Jul 3 '13	Jul 12 '13
111		1250 Portal	5 days	Jul 13 '13	Jul 17 '13
112		Jewelbox Pit	10 days	Jul 18 '13	Jul 27 '13
113		Jewelbox Waste Dumps	21 days	Aug 22 '13	Sep 11 '13
114		Capping & Sloping of Portal	3 days	Aug 23 '13	Aug 25 '13
115		**Main Zone**	**67 days**	**Jul 28 '13**	**Oct 2 '13**
116		1380 Portal	10 days	Jul 28 '13	Aug 6 '13
117		Main Zone Pit	14 days	Aug 8 '13	Aug 21 '13
118		Main Zone Waste Dump	21 days	Sep 12 '13	Oct 2 '13
119		Sediment Ponds	1 day	Aug 7 '13	Aug 7 '13
120		**Burnick Zone**	**71 days**	**Jun 24 '13**	**Sep 2 '13**
121		1200 Portal	17 days	Jun 24 '13	Jul 10 '13
122		1300 Portal	10 days	Jul 18 '13	Jul 27 '13
123		Burnick Waste Dump	4 days	Jul 11 '13	Jul 14 '13
124		North Hill Settlement Basin	3 days	Jul 15 '13	Jul 17 '13
125		Capping & Sloping of Portals	10 days	Aug 24 '13	Sep 2 '13
126		**Tailings Mgt. Facility & Capping**	**656 days**	**Jun 21 '13**	**Aug 9 '15**
127		Drain Tailings	60 days	Jun 21 '13	Aug 19 '13
128		Breach South Dam	9 days	Aug 20 '13	Aug 28 '13
129		Remove South Dam	23 days	Jun 24 '14	Jul 16 '14
130		Recontour South Dam Area	5 days	Aug 1 '14	Aug 5 '14
131		Drain Reclaim Dam	60 days	Jun 21 '13	Aug 19 '13
132		Breach Reclaim Dam	9 days	Aug 29 '13	Sep 6 '13
133		Remove Reclaim Dam	27 days	Jul 17 '14	Aug 12 '14
134		Recontour Reclaim Dam Area	5 days	Aug 6 '14	Aug 10 '14
135		Cofferdam	5 days	Aug 11 '14	Aug 15 '14
136		North Dam	5 days	Jun 16 '14	Jun 20 '14
137		Interceptor Ditches	3 days	Jun 21 '14	Jun 23 '14
138		Tailings Decant Tower	3 days	Jun 24 '14	Jun 26 '14
139		Camp Creek Diversion	9 days	Aug 16 '14	Aug 24 '14
140		Mill Area	28 days	Jun 15 '15	Jul 12 '15
141		Jewelbox Zone	15 days	Jul 13 '15	Jul 27 '15



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ID	Te	Task Name	Duration	Start	Finish
142		Burnick Zone	9 days	Jul 28 '15	Aug 5 '15
143		Landfarm	3 days	Aug 6 '15	Aug 8 '15
144		North Creek Areas	1 day	Aug 9 '15	Aug 9 '15
145		**Pits & Refuse Area**	**724 days**	**Jun 17 '13**	**Oct 12 '15**
146		Rip Rap Pit	15 days	Jun 6 '14	Jun 20 '14
147		**Refuse Area**	**670 days**	**Jun 17 '13**	**Aug 19 '15**
148		2013	7 days	Jun 17 '13	Jun 23 '13
149		2015	10 days	Aug 10 '15	Aug 19 '15
150		**Misc. Areas**	**120 days**	**Jun 15 '15**	**Oct 12 '15**
151		North Creek Dyke	52 days	Aug 20 '15	Oct 10 '15
152		Roads & Trails	54 days	Aug 20 '15	Oct 12 '15
153		Weather Station	5 days	Jun 15 '15	Jun 19 '15
154		**Revegetation & Final Reclamation**	**421 days**	**Jun 21 '14**	**Oct 16 '15**
155		**Seeds & Fertilizers**	**421 days**	**Jun 21 '14**	**Oct 16 '15**
156		Mill Area	5 days	Jul 13 '15	Jul 17 '15
157		Jewelbox Zone	2 days	Jul 28 '15	Jul 29 '15
158		Burnick Zone	2 days	Aug 6 '15	Aug 7 '15
159		Roads & Trails	9 days	Oct 8 '15	Oct 16 '15
160		Tailings Mgt. Facility	7 days	Aug 25 '14	Aug 31 '14
161		North Creek Areas	2 days	Aug 10 '15	Aug 11 '15
162		Landfarm	2 days	Aug 9 '15	Aug 10 '15
163		Refuse Area	2 days	Aug 20 '15	Aug 21 '15
164		Rip Rap Pit	2 days	Jun 21 '14	Jun 22 '14
165		**Contaminated & Hazardous Material**	**370 days**	**Jun 17 '13**	**Aug 22 '14**
166		Chemical Disposal (Site Work)	5 days	Jun 17 '13	Jun 21 '13
167		Fuels & Lubricants	5 days	Jun 28 '13	Jul 2 '13
168		**Hydrocarbons Products**	**333 days**	**Jul 3 '13**	**Aug 1 '14**
169		Test Pitting	45 days	Jul 3 '13	Aug 16 '13
170		Landfarm	16 days	Aug 17 '13	Sep 1 '13
171		Processing of Hydrocarbons	47 days	Jun 16 '14	Aug 1 '14
172		Hydrogeological Drilling	21 days	Aug 2 '14	Aug 22 '14
173		Lead/Zinc Disposal	7 days	Jul 1 '13	Jul 7 '13
174		**Engineering Services**	**102 days**	**Mar 21 '13**	**Jul 22 '13**
175		Portal & Ventilation Seals	15 days	Mar 21 '13	Apr 10 '13
176		Portal Drainage	15 days	Apr 11 '13	May 1 '13
177		Camp Creek Diversion	15 days	Jul 8 '13	Jul 22 '13
178		Refuse Area	15 days	Mar 28 '13	Apr 17 '13



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5.0 SITE MANAGEMENT DURING DECOMMISIONING AND RECLAMATION ACTIVITIES

During the active decommissioning phase which will take 3 years, the number of personnel required will vary depending on site activities, however as the major decommissioning and reclamation tasks are completed the number of site personnel required will decline.

Of primary importance to Teck, is that the work is conducted and reflects our expectation that all people working on the site will conduct their work in a manner that everyone goes home safe and healthy every day from the job site. All work must also be conducted in compliance with all environmental and other applicable regulations.

It is recognized that final engineering designs and control procedures for water related geotechnical structures must be sealed by a Professional Engineer licensed to practice in the Yukon and must be submitted to the Water Board for their review and approval prior to implementing work on these structures.

Teck has a close working relationship with Liard First Nation and are committed to provide opportunities for contracting and employment as part of the decommissioning and reclamation activities and for the environmental monitoring of the site. At the same time, Teck expects that other residents in the area of Watson Lake will find ample opportunity to provide labour, contracting, and supply services to the project.

5.1 SITE ORGANIZATION, ACCESS & SECURITY, AND LAND TENURE

Teck will contract the onsite management of the project to a company that has experience in providing professional project management services. The contracted management team will provide onsite management services, as well as home office technical support and administrative functions. The contact management team will establish office facilities on site to support their daily presence on the project site. Teck's Dormant Properties staff who are currently familiar with the site and have been involved with the development of this DDRP will continue to take an oversight role throughout the duration of the project.

At present, a caretaker remains on site year round to provide site security, site maintenance, monitoring, and inspection requirements. It is anticipated that this will continue in modified form through until decommissioning and reclamation is completed in the fall of 2015. While site management and contractors will be on site during work days, it is not anticipated that any of those personnel will be housed on site. Work crews are also expected to be absent through most of the winter periods. Consequently, the caretaker will continue to have a role until decommissioning and reclamation activities are completed on the property.

Access to the site will be limited to those people preapproved to be onsite and controlled by the presence of a security person stationed at an access gate.

It is expected that the peak employment will be during 2013 and 2014 with site activities reduced during the summer of 2015. Peak employment in 2013 and 2014 is expected to be in the order of 20 to 30 people on site for periods of time. The work will generally be seasonal to avoid periods of snowfall which would reduce efficiencies with planned civil works. It is assumed the work season will generally be from late May to early October but will be adjusted based on conditions at the site in any particular year. It is possible that some indoor preparation work related to decommissioning of the mill facilities could be conducted regardless of the season.

The SDHOC will retain the site's surface lease and some mineral rights for the site for the foreseeable future. Despite the reclamation activities, reclamation structures including portal seals and tailings impoundment structures are believed to remain the responsibility of the SDHOC. As an example, the North Dam will remain a dam and as a result require monitoring and perhaps, occasional maintenance into the future. As a result, control of land use in these areas and the ability of access this land base is important so that the SDHOC has the ability to control and manage these works.

5.2 SUPERVISION AND DOCUMENTATION OF WORK

All decommissioning and reclamation works will be properly supervised to ensure that works are constructed according to their design and that this work is properly carried out and documented. The site project manager or the construction supervisor will oversee all closure works. Daily

inspection procedures will be completed to document work progress, deficiencies and completion. Existing plans for spill response or other site internal procedures for fuel handling, waste disposal, fire control and suppression, health and safety and environmental management systems will be followed.

For the tailings management facility, construction plans for all earthen works will be prepared and submitted to the Yukon Territory Water Board for review and approval prior to construction. These plans would be submitted in a timely manner to facilitate agency review and Board approval prior to implementation. A competent engineer following standard quality control and assurance procedures would also inspect and document this construction work. As built plans and drawings will be completed and the results of the closure work completed on the tailings management facility and any other designed or engineered structures.

Mine records and other historical site related records, files and plans were removed from site in 2010 and are being stored in the Teck's office in Kimberley, BC. Plans are to store all key records and plans electronically to ensure that they are not lost. Where plans or drawings are required for mine safety reasons, these plans would also be submitted to government mine safety offices.

5.3 COMPLIANCE MONITORING AND REPORTING

Environmental compliance monitoring, internal monitoring of earthworks and independent geotechnical inspections are presently ongoing at the property. The environmental monitoring at the Sä Dena Hes mine employs a number of types of scheduled periodic inspections to ensure that the facility is meeting environmental performance objectives and complying with appropriate regulatory standards. These inspections entail:

- Scheduled inspections of the tailings management facility and mine components to monitor environmental performance;
- Scheduled water quality sampling and flow measurements of effluent streams and local receiving water streams;
- Scheduled receiving water programs for benthic invertebrates, stream sediments and fish to monitor downstream environmental quality;

- Scheduled piezometric monitoring of water levels in wells and the decant structure at the tailings management facility;
- Annual summer inspections by a qualified geotechnical engineer of tailings management facility, diversion channel and waste rock storage areas for structural stability; and,
- Scheduled environmental tours of the property by Teck staff to look for environmental hazards and site stability.

At present, the site caretaker undertakes the scheduled environmental monitoring and inspection programs with the exception of the annual geotechnical inspection and the benthic invertebrates, stream sediment and fish monitoring programs, which are conducted by qualified professionals. All results from the licensed compliance monitoring programs are reported to the Yukon Territory Water Board.

During the closure phase environmental compliance monitoring and inspections will continue utilizing site based personnel. A summary of the present environmental compliance and inspection program as outlined in Water Use Licence QZ97-025 is shown in Table 5-1, with monitoring station locations described in Table 5-2. Figures 1-2 and 3-1 provide the station locations for the environmental monitoring programs. The amount of environmental monitoring and inspection (frequency and quantity) will comply with current Water Licence requirements until closures measures have been completed at the end of 2015 which coincides with expiry of the Water Licence. As this monitoring is outlined in the Water Licence it is not repeated in detail in this Plan. An Environmental Monitoring Plan for site closure activities, and an Erosion and Sediment Control Plan for when the dams are being decommissioned will also be adopted and implemented during the reclamation project to ensure minimal erosion and sediment release occurs during reclamation. This is particularly important while doing the final draining of the south tailings and reclaim ponds, and when the deconstruction of the dams and cover construction activities take place. The plan will include physical controls (i.e., such as silt curtains) and an environmental monitoring plan consisting of water chemistry and daily turbidity measurements when work around water is occurring.

Details of the decommissioning and reclamation activities occurring each year will be reported in detail in the annual Quartz Mining Licence report. The Water Licence requires reporting on a

semiannual basis during permanent closure (March 30th and November 30th). Reporting will include a summary of activities for each of the areas where the DDRP describes closure measures and will include as-built drawings for all engineered structures.

As further discussed as part of Section 6.2 Reclamation Security, a comprehensive post reclamation long term monitoring program will be developed at the end of the DDRP program. It will include proposed monitoring locations, monitoring parameters, and frequency of sampling which is expected to vary (i.e., reduce) over time. During implementation of the DDRP, some of the existing permitted monitoring locations will be reclaimed making them obsolete. Additionally, new monitoring stations will be created (e.g., new groundwater monitoring wells) that may need to become part of the longer term site monitoring program. With these changes the long term monitoring program will be developed to reflect the changing site conditions and to collect the data needed to ensure that the site meets the end land use objectives including site environmental monitoring, geotechnical monitoring, and physical site monitoring requirements (e.g., site stability and erosion). It is anticipated that the long term monitoring frequency and scope will be reduced over time as satisfactory closure performance is confirmed. Table 5-3 provides an outline a preliminary scope of a monitoring plan for post 2015 to identify the scale and frequency of monitoring anticipated. It is recognized that the long term monitoring plan will be the primary objective of new licensing and so its development should reflect evolving site conditions as a result of site reclamation activities and input and reviews by government regulators and from the LFN community.

Table 5-1 Licenced Surveillance Program during Temporary Cessation of Operations

		Stations																			
		MH-1	MH-2	MH-3	MH-4*	MH-5	MH-6a	MH-6b**	MH-7	MH-8	MH-9	MH-10	MH-11	MH-13	MH-14	MH-16	MH-18	MH-19	MH-20	MH-22	MH-24	MH-25
	Water Quality Monitoring																					
WATER QUALITY PARAMETER	pH (Field)	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Flow Rate	Q	M	M	Q	M	M	Q	M	M	M	M	M/C***	Q	Q	Q	--	--	--	M	--	M
	Temperature	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Conductivity	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Alkalinity	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	pH(Lab)	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Tot. Sus. Solids	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Dissolved Solids	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	ICP Scan - Total	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Ammonia - Total	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Sulphate	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Hardness	Q	M	M	Q	M	M	Q	M	M	M	M	M	Q	Q	Q	--	--	--	M	--	M
	Cyanide - Total	Q	M	--	--	--	M	Q	M	--	--	--	M	Q	Q	Q	--	--	--	--	--	--
	Bioassay - LC50	--	--	--	--	--	Q	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MONITORING PROGRAMS	**Environmental Monitoring**																					
	Benthic Invertebrates	--	--	--	--	--	--	--	--	--	--	--	--	2Y	2Y	--	2Y	2Y	--	--	2Y	--
	Stream Sediments	--	--	--	--	--	--	--	--	--	--	--	--	2Y	2Y	--	2Y	2Y	--	--	2Y	--
	Fish Monitoring	--	--	--	--	--	--	--	--	--	--	--	--	2Y	--	--	2Y	--	2Y	--	2Y	--
	Physical Monitoring																					
	Internal Monitoring (Earthworks)	Monthly internal inspection of all earthworks on site																				
	Annual Geotechnical Inspection	Annual Geotechnical Inspection of all earthworks																				
	Piezometers Monitoring	Monthly piezometric readings from wells located in tailings management facility																				
	Settlement Marker Monitoring	Annual readings taken during geotechnical inspection																				
	Seepage Monitoring	Monthly seepage readings from seepage weirs located in tailings management facility																				

LEGEND: **Q = Quarterly** **M = Monthly** **2Y = every second year during September** **C = Continuous**

NOTES:
-- Monitoring for this parameter at this station is not required as per water use licence schedule
***** To be monitored as an alternative site to MH-3 only when there is no discharge from the Camp Creek Sediment Pond.
****** To be monitored as an alternative site to MH-6a only when there is no discharge from the reclaim pond.
******* Monitor a minimum of monthly or continuous flow recording year round.

Table 5-2 Licenced Surveillance Network - Water Quality Monitoring Site

MH-1:	Tailings Pond Outflow – discharge from the tailings pond, through the decant tower, to the reclaim pond or if no discharge, the pond water.
MH-2:	Tailings North Dam Seepage – seepage water collected immediately below the downstream face of the north tailings dam.
MH-3:	Camp Creek Pond Outflow – discharge from a sedimentation pond located in upper Camp Creek which drains the Jewelbox Hill 1250 Portal and Main Zone Waste Dump. Note that there has not been any discharge at this location since cease in operations.
MH-4:	Lower Camp Creek – on Camp Creek located immediately above the West Interceptor Ditch sample.
MH-5:	Portal Creek – a small intermittent stream which drains the East face of Jewelbox Hill, immediately below the 1408 portal, to False Canyon Creek; releases discharge from the portal sedimentation pond and water from the Jewelbox Waste Dump.
MH-6a:	Reclaim Pond Outflow – discharge from the reclaim pond through the overflow spillway.
MH-6b:	Reclaim Pond – To be monitored as an alternative to MH-6a only when there is no discharge from the reclaim pond.
MH-7:	Reclaim Pond Seepage – water accumulating within the seepage collection system located immediately below the downstream face of the reclaim dam.
MH-8:	Burnick Creek – a small intermittent drainage south of the Burnick pit and portal sites which will consolidate drainage within a sediment pond from those sites as well as Burnick pit access road runoff; the drainage contributes to the upper end of Tributary E, east fork, of False Canyon Creek.
MH-9:	Burnick West Pond Outflow – discharge from a small sediment pond, which collects drainage from the west and north faces of the Burnick Dump and drains to the upper end of Tributary E, west fork, of False Canyon Creek. Note that there has not been any discharge at this location since cease in operations.
MH-10:	Burnick East Pond Outflow – discharge from a small sediment pond, which collects drainage from the east face of the Burnick Dump, to a branch of Tributary E, west fork, of False Canyon Creek. Note that there has not been any discharge at this location since cease in operations.
MH-11:	Upper False Canyon Creek located one kilometre downstream of the tailing management facility.
MH-12:	Tributary E, east fork – of False Canyon Creek, approximately 2 kilometres downstream of the north tailings dam.
MH-13:	The main channel of False Canyon Creek, approximately 10 kilometres downstream of the reclaim pond.
MH-14:	The main channel of False Canyon Creek, approximately 20 kilometres downstream of the reclaim pond just upstream of the confluence with Tributary E.
MH-15:	Tributary E, west fork, upstream of the confluence with Tributary E, east fork, approximately six kilometres downstream of the North Hill development.
MH-16:	The main channel of False Canyon Creek, downstream of the confluence of Tributary D, approximately 22 kilometres downstream of the reclaim pond.
MH-18:	Lower reaches of Tributary E, approximately one kilometre above the confluence with False Canyon Creek.
MH-19:	The main channel of False Canyon Creek, approximately four kilometres downstream of the Tributary D confluence.
MH-20:	The main channel of False Canyon Creek, approximately 13 kilometres upstream of the mouth and immediately above the Tributary B confluence.
MH-22:	Burnick portal discharge, the end of pipe discharge point into the North Hill Settlement Basin.
MH-23:	North Creek immediately downstream of the impoundment.
MH-24:	The east tributary that joins False Canyon Creek just downstream of MH-13.
MH-25:	The Main Zone 1380 Portal discharge.

Table 5-3 Environmental Monitoring and Inspection Program - Post Closure

		Post Closure Monitoring Year									
	Calendar Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**>2025**
	Elapsed Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**>10**
MONITORING PROGRAMS	**Environmental/Ecological Monitoring**										
	Benthic Invertebrates, Stream Sediments, Fish Monitoring, Surface Water Quality (False Creek Canyon)	2Y	--	2Y	--	2Y	--	2Y	--	2Y	--
	Surface Water Quality	2/Y	2/Y	2/Y	A	A	A	P	P	P	P
	Groundwater	A	A	A	A	A	P	P	P	P	P
	Ecological Risk Assessment Monitoring Terrestrial - wildlife, plants, insects	--	--	--	--	5Y	--	--	--	--	5Y
	Physical Monitoring										
	Portal Seals	A	A	A	A	A	A	A	A	A	A
	Subsidense	A	A	A	A	A	A	A	A	A	A
	Road Erosion	A	A	A	A	A	A	A	A	A	A
	Cover Integrity on Tailings	A	A	A	A	A	A	A	A	A	A
	Re-vegetation	A	A	A	A	A	P	P	P	P	P
	Geotechnical Monitoring										
	Annual Geotechnical Inspection including piezometer monitoring	A	A	A	A	A	A	A	A	A	A
	Waste Dump Stability	A	A	A	A	A	A	A	A	A	A
	Dam Safety Review	--	--	--	--	5Y	--	--	--	--	5Y

LEGEND:

2/Y - Twice a year; A = Annually; 2Y = every second year during September; 5Y = every five years; P = Periodic Inspection

Notes Specific locations, parameters, and frequency to be determined

6.0 CLOSURE COSTS & RECLAMATION SECURITY

6.1 CLOSURE COSTS

The January 2012 estimated costs to implement the Detailed Decommissioning and Reclamation Plan represent a significant upgrading relative to the cost estimate Included in previous updates to the Plan. These are presented in Tables 6-1 through to 6-7. Table 6-1 presents the summary of cost estimates for various mine components including mine workings, tailings management facility, infrastructure, land reclamation and revegetation, and post closure monitoring and maintenance. However, based on the results of the 2012 field work, further technical studies combined with consultants preparing formal "construction" level cost estimates, the cost estimates have increased substantially.

As the work outlined in this DDRP will be implemented in the near future, there are concerns with releasing detailed cost estimate calculations as there is a significant possibility influencing commercial aspects of this work as tendering/contracting of this work begins. As a result, the details of the updated cost estimate have been provided to the Ministry of EMR under separate cover for their confidential review.

To provide an understanding of the scope of work and level of consideration previously developed to implement the 2012 update to the DDRP, these costs have been included for reference.

- Table 6-1 provides a summary of all cost estimates;
- Table 6-2 sets out unit rates used in the calculations;
- Table 6-3 provides closure cost estimates for the existing mine workings
- Table 6-4 presents cost estimates for the tailings management facility
- Table 6-5 provides cost estimates for Demolition and Reclamation
- Table 6-6 provides cost estimates for Land Reclamation & Revegetation
- Table 6-7 outlines costs associated with the site management during closure implementation and presents post closure costs for compliance monitoring and maintenance for 8 years of post-closure monitoring.

All of the individual mine component cost estimate tables provide the detailed breakdown of the costs to implement each of the main elements of the works as described in the Detailed Decommissioning & Reclamation Plan.

6.2 RECLAMATION SECURITY

Based on the 2012 DDRP cost estimate for decommissioning and reclamation of $15,912,000 the owners of the joint venture submitted this amount in reclamation security to the Government of the Yukon. Further technical assessments based on the revised work scopes included in this March 2013 Update (Final) of the DDRP, were used in developing updated cost estimates. The 2013 revised cost estimates have increased substantially from the January 2012 estimates. The decommissioning and reclamation costs for 2013 to 2015 are estimated to be $25,200,000. With the implementation of the DDRP beginning this summer, EMR will determine the process to assess progress on reducing this estimated liability and the process to determine adjustment to the reclamation security. This is consistent with the Yukon Mine Site and Reclamation Closure Policy Financial and Technical Guideline #F-07 Practice states that "the security held will remain commensurate with the outstanding reclamation and closure liability". The same policy includes Guideline #F-10 that the Yukon government may enter into an administrative agreement with the mine owner to adjust security. This administrative agreement may include the development of a security schedule that will be adjusted as reclamation work is implemented.

It is proposed that the Ministry of Mineral Resources consider an agreement with the SDHOC to review and adjust security based on the following basis:

- Annually near the end of each year's reclamation activities (i.e. late September), that the Yukon government conduct a site inspection to verify what reclamation activities have been accomplished during the year.
- That in the annual Quartz Production Licence reporting (due each March 31st), Teck provide documentation of the work completed and make a proposal for the amount of reclamation security to be released based on the cost estimate contained within this DDRP.
- The Yukon government will review Teck's request based on the documentation provided and the Yukon government's own site inspection assessment of the work completed, and based on the outstanding site liabilities make a preliminary determination of the amount of security to be released or increased.

- Teck then be given up to 60 days to review and comment on the Yukon government's assessment of residual liabilities. The Yukon government will give fair consideration to these comments and within 30 days of receiving Teck's comments, finalize the security requirements. The parties will then be required to adjust the outstanding security to match the requirements within 60 days.
- The Yukon government will not reduce the reclamation security to less than 15% of the original reclamation security until:
    - Teck has submitted a detailed long term post-reclamation monitoring plan complete with associated cost estimates for review by the Yukon Government, and
    - The Yukon government has reviewed the submission (and obtained comments from the appropriate interested parties); and attempted to resolve any differences in the monitoring plan and costs with Teck, and
    - The Yukon government will then approve both the long term monitoring plan to be implemented and the associated costs, then
    - The Yukon government would then specify the security requirements for the post-reclamation site monitoring and management program using an assessment of net present values of the required security.
- The proposed post-reclamation long term monitoring plan shall be submitted by Teck, no later than June 30th, 2016. This will allow time for the DDRP to have been fully implemented which will provide a better understanding of post-reclamation conditions required to develop the monitoring plan.
- Subsequent to the Yukon government approving the monitoring plan, from time to time (but no more frequently than annually), Teck or the Yukon government may propose revisions to the monitoring plan for consideration (including associated adjustments to the reclamation security provisions).

Table 6-1 Estimated Decommissioning Costs, Summary Table

January 2012 Update

Table	Description	Cost
6-3	Mine Workings	$537,000
6-4	Tailings Management Facility	$3,122,000
6-5	Infrastructure	$1,861,000
6-6	Land Reclamation and Revegetation	$3,138,000
6-7	Post Closure Site Management (Including Monitoring & Maintenance)	$4,602,000
	Sub-total	**$13,260,000**
	Contingency Allowance @ 20%	$2,652,000
	SDH Decommissioning, Reclamation & Monitoring Cost Total	**$15,912,000**

Table 6-2 Unit Costs

EQUIPMENT RATES		
Bulldozer-small (Cat D6)	$200	per hr
Bulldozer-large (D9H)	$400	per hr
D250E Haul Truck	$250	per hr
235 Excavator	$240	per hr
235 Excavator w Hammer	$300	per hr
16H grader	$325	per hr
Loader-large (Cat 988B)	$300	per hr
Loader-small (Cat 950)	$225	per hr
Drill Rig (Estimated)	$240	per hr
Compactor (Walk behind)	$125	per day
Tractor Trailer (lowbed)	$185	per hr
30 ton Crane	$200	per hr
Hiab Flatdeck truck	$150	per hr
Pickup Truck	$4,500	per month

PERSONNEL RATES		
Blaster	$100	per hr
General Labourer	$60	per hr
Trades Labourer	$70	per hr
Site Supervisor	$150	per hr
Design Engineer	$130	per hr
Environmental Scientist	$95	per hr
Project Manager	$20,000	per month
Camp Labourer	$6,000	per month
Site Caretaker	$6,100	per month
Environmental Monitor	$10,000	per month
Analytical Costs	$750	Unit cost

REVEGETATION RATES		
Revegetation Seed Mix	$13	per kg
Fertilizer	$1	per kg
Seed/Fertilizer Application	$8,000	per ha

CONTRACTOR UNIT RATES & CAMP COST		
Excavation of Soil	$35	cu.m
Supply and place Geotextile	$10	sq m
Load, haul and place soil cover	$15	cu.m
Haul & Place rock cover	$15	cu.m
Drill, Blast and Screen Rip Rap	$65	cu.m
Load, Haul and Place Soil/Rip Rap	$20	cu.m
Erosion barriers	$8	sq m
Camp Cost	$125	per day per person
Power and Heat	$5,500	per month
Sundry equipment maintenance	$5,000	yearly
General Administrative expenses	$10,000	per month

Table 6-3 Estimated Decommissioning Costs – Mine Workings

Item No.	Work Item Description	Equipment/ Labour	Units	Quantity	Unit Cost	Cost	Total Cost
1.0	**MINE WORKINGS**						
1.1	**JEWELBOX ZONE**						
1.1.1	**Jewelbox Zone - 1408 Portal (4.5m x 4.5m)**						
	Permanent Portal Seal - Based estimate on using Tires but alternate methods may be used	235 Excavator	hrs	20	$240	$4,800	
	Supply of used large truck tires	Misc.	ea	30	$100	$3,000	
	Place waste rock cap over tires	235 Excavator	hrs	10	$240	$2,400	
		D250E Haul Truck	hrs	10	$250	$2,500	
	Supply broken rock for drain at base of plug and discharge channel riprap	235 Excavator	hrs	10	$240	$2,400	
		D250E Haul Truck	hrs	20	$250	$5,000	
	Construct rock drain at base of plug	235 Excavator	hrs	5	$240	$1,200	
	Supply till to seal discharge channel	235 Excavator	hrs	4	$240	$960	
		D250E Haul Truck	hrs	4	$250	$1,000	
	Construct lined open channel for discharge from portal	235 Excavator	hrs	15	$240	$3,600	
	Load, haul & place sand for liner bedding	Load, haul and place soil cover	cu m	100	$15	$1,500	
		Compactor (Walk behind)	days	1	$125	$125	
	Supply & install liner material	Misc.	l.s.		$5,000	$5,000	
	Misc. Supplies & Shipping	Misc.	l.s.			$5,000	
	Labour to assist with placing tires & cap	General Labourer	hrs	40	$60	$2,400	
	Supervision to design & install tires & cap	Site Supervisor	hrs	40	$150	$6,000	
	Sub-Total						**$46,885**
1.1.2	**Jewelbox Zone - 1250 Portal**						
	Place waste rock cap in opening	235 Excavator	hrs	10	$240	$2,400	
		D250E Haul Truck	hrs	20	$250	$5,000	
	Supervision of work	Site Supervisor	hrs.	10	$150	$1,500	
	Sub-Total						**$8,900**
1.1.3	**Jewelbox Zone - Ventilation Raises**						
	Construct Concrete cap over upper vent openings (both upper & lower)	235 Excavator	hrs	40	$240	$9,600	
		General Labourer	hrs	40	$60	$2,400	
		Misc.	l.s.		$30,000	$30,000	
	Contour Slope around opening	235 Excavator	hrs	10	$240	$2,400	
		Site Supervisor	hrs	40	$150	$6,000	
	Design and Site Supervision of Cap	Design Engineer	hrs	75	$130	$9,750	
	Sub-Total						**$60,150**
1.1.4	**Jewelbox Zone - Open Pit**						
	Drill and blast highwall	Drill Rig (Estimated)	hrs	40	$240	$9,600	
		Blaster	hrs	40	$100	$4,000	
		General Labourer	hrs	40	$60	$2,400	
		Misc.	l.s.		$2,500	$2,500	
		Bulldozer-large (D9H)	hrs	20	$400	$8,000	
		235 Excavator	hrs	40	$240	$9,600	
		Drill Rig (Estimated)	hrs	40	$240	$9,600	
		Blaster	hrs	40	$100	$4,000	
		General Labourer	hrs	40	$60	$2,400	
		Bulldozer-large (D9H)	hrs	10	$400	$4,000	
		D250E Haul Truck	hrs	10	$250	$2,500	
		Site Supervisor	hrs	80	$150	$12,000	
	Sub-Total						**$70,600**
1.1.5	**Jewelbox Zone - Waste Dumps**						
	Reslope Upper Zone of Dump below Portal (1.3ha)	Bulldozer-large (D9H)	hrs	30	$400	$12,000	
	Reslope Jewelbox pit waste on ridge (1.9 ha)	Bulldozer-large (D9H)	hrs	**30**	$400	$12,000	
	Pull Back crest of waste dump and road cut below access road to Main Pit (0.5ha)	235 Excavator	hrs	30	$240	$7,200	
	Reslope Jewelbox pit waste dump above road (0.8ha)	Bulldozer-large (D9H)	hrs	30	$400	$12,000	
	Supervision	Site Supervisor	hrs	55	$150	$8,250	
	Sub-Total						**$51,450**
1.2	**MAIN ZONE**						
1.2.1	**Main Zone - 1380 Portal (see also Main Zone Pit) (4.5m X 4.5m)**						
	Plug 1380 Portal with concrete plug	Misc.	l.s.			$50,000	
	Sub-Total						**$50,000**
1.2.2	**Main Zone - Open Pit**						
	Drill and blast highwall and cover Portal 1380	Drill Rig (Estimated)	hrs	40	$240	$9,600	
		Blaster	hrs	40	$100	$4,000	
		General Labourer	hrs	40	$60	$2,400	
		Supplies			$2,500	$2,500	
		Bulldozer-large (D9H)	hrs	40	$400	$16,000	
	Sub-Total						**$34,500**
1.2.3	**Main Zone - Waste Dump**						
	Pull Back crest of waste dump below pit (0.3ha)	235 Excavator	hrs	40	$240	$9,600	
	Pull Back crest of waste dump below 1250 portal	235 Excavator	hrs	25	$240	$6,000	
	Supervision	Site Supervisor	hrs	40	$150	$6,000	
	Sub-Total						**$21,600**
1.3	**BURNICK ZONE**						
1.3.1	**Burnick Zone - 1200 Portal**						
	Permanent Portal Seal - Based estimate on using Tires but alternate methods may be used	235 Excavator	hrs	30	$240	$7,200	
	Supply of used large truck tires	Misc.	ea	45	$100	$4,500	
	Supply & Place waste rock cap over tires	235 Excavator	hrs	20	$240	$4,800	
		D250E Haul Truck	hrs	40	$250	$10,000	
	Supply broken rock for drain at base of plug and discharge channel riprap	235 Excavator	hrs	20	$240	$4,800	
		D250E Haul Truck	hrs	40	$250	$10,000	
	Construct rock drain at base of portal plugs	235 Excavator	hrs	10	$240	$2,400	
	Supply till to line discharge channel	235 Excavator	hrs	10	$240	$2,400	
		D250E Haul Truck	hrs	20	$250	$5,000	
	Construct lined open channel for discharge from portal	235 Excavator	hrs	20	$240	$4,800	
	Load, haul & place sand for liner bedding	Load, haul and place soil cover	cu m	100	$15	$1,500	
		Compactor (Walk behind)	days	1	$125	$125	
	Supply & install liner material	Misc.	l.s.		$5,000	$5,000	
	Misc. Supplies	Misc.	l.s.			$4,500	
	Labour to assist with placing tires & cap	General Labourer	hrs	80	$60	$4,800	
	Design of rock drain and channel	Design Engineer	hrs	40	$130	$5,200	
	Supervision installation of tire plug & rock drain	Site Supervisor	hrs	50	$150	$7,500	
	Sub-Total						**$84,525**
1.3.2	**Burnick Zone - 1300 Portal**						
	Portal Size the same as 1200 Portal so use Burnick Zone - 1200 Portal Costs					$84,525	
	Adjustment for to balance with agreed cost review						
	Sub-Total						**$84,525**
1.3.3	**Burnick Zone - Waste Dump**						
	Reslope Dump below Portal (1.4ha)	Bulldozer-large (D9H)	hrs	50	$400	$20,000	
	Supervision	Site Supervisor	hrs	25	$150	$3,750	
	Sub-Total						**$23,750**
Total Estimated Cost in Reclaiming Mine Workings							**$537,000**

Table 6-4 Estimated Decommissioning Costs – Tailings Management Facilities

Item No.	Work Item Description	Equipment/ Labour	Units	Quantity	Unit Cost	Cost	Total Costs
2.0	**TAILINGS MANAGEMENT FACILITY - CURRENT CONDITIONS**						
2.1	**South Dam**						
2.1.1	Pump down Pond	Pump & minor pre-treatment	cu.m	220,000	$0.25	$55,000	
2.1.2	Remove Existing Spillway	235 Excavator	hrs	10	$240	$2,400	
		D250E Haul Truck	hrs	20	$250	$5,000	
2.1.3	Breach Dam	Excavation of Soil	cu.m	16,300	$35	$570,500	
2.1.4	Construct Spillway and Exit Channel						
	Excavate Channel	Excavation of Soil	cu.m	4,125	$35	$144,375	
	Geotextile Spillway and Channel	Supply and place Geotextile	sq.m	4,250	$10	$42,500	
	Rip Rap Spillway and Channel	Drill, Blast and Screen Rip Rap	cu.m	2,625	$65	$170,625	
		Load, Haul and Place Soil/Rip Rap	cu.m	2,625	$20	$52,500	
	Design Spillway & Channel	Design Engineer	hrs	50	$130	$6,500	
	Site Supervision Spillway and channel	Site Supervisor	hrs	60	$150	$9,000	
	Sub-Total						**$1,058,400**
2.2	**Decant Tower**						
2.2.1	Dismantle Decant Tower and Bury debris	235 Excavator w Hammer	hrs	20	$300	$6,000	
		235 Excavator	hrs	30	$240	$7,200	
		General Labourer	hrs	30	$60	$1,800	
2.2.2	Specifications/Design Plug for Decant Pipe	Design Engineer	hrs	24	$130	$3,120	
2.2.3	Plug Decant Pipe	General Labourer	hrs	80	$60	$4,800	
		Materials	l.s.			$5,500	
2.2.4	Supervision	Site Supervisor	hrs	60	$150	$9,000	
	Sub-Total						**$37,420**
2.3	**Tailings Surface**						
2.3.1	Recontour tailings surface (11ha)	Bulldozer-large (D9H)	hrs	200	$400	$80,000	
2.3.2	Remove Cofferdam and bury culvert	Bulldozer-large (D9H)	hrs	16	$400	$6,400	
2.3.3	Supervision	Site Supervisor	hrs	50	$150	$7,500	
	Sub-Total						**$93,900**
2.4	**Reclaim Dam**						
2.4.1	Pump down pond	Pumping (all-inclusive)	cu.m	340,000	$0.25	$85,000	
2.4.2	Remove Existing Spillway and exit channel. Regrade	235 Excavator	hrs	80	$240	$19,200	
		Bulldozer-large (D9H)	hrs	80	$400	$32,000	
		D250E Haul Truck	hrs	80	$250	$20,000	
2.4.2	Breach Dam	Excavation of Soil	cu.m	21,800	$35	$763,000	
2.4.3	Construct Spillway and Exit Channel						
	Geotextile Spillway and Channel	Supply and place Geotextile	sq.m	1,700	$10	$17,000	
	Rip Rap Spillway and Channel	Drill, Blast and Screen Rip Rap	cu.m	1,050	$65	$68,250	
		Load, Haul and Place Soil/Rip Rap	cu.m	1,050	$20	$21,000	
	Design Spillway & Channel	Design Engineer	hrs	50	$130	$6,500	
	Site Supervision Spillway and channel	Site Supervisor	hrs	160	$150	$24,000	
	Sub-Total						**$1,055,950**
2.5	**Camp Creek Diversion and Restoration**						
2.5.1	Breach existing diversion, remove culverts, regrade	235 Excavator	hrs	80	$240	$19,200	
		Bulldozer-large (D9H)	hrs	80	$400	$32,000	
		D250E Haul Truck	hrs	80	$250	$20,000	
2.5.2	Realign Camp Creek and riprap						
	Excavate Channel	Excavation of Soil	cu.m	9,250	$35	$323,750	
	Supply and place Geotextile	Supply and place Geotextile	sq.m	6,290	$10	$62,900	
	Supple and place Rip Rap	Drill, Blast and Screen Rip Rap	cu.m	3,885	$65	$252,525	
		Load, Haul and Place Soil/Rip Rap	cu.m	3,885	$20	$77,700	
	Design of Channel Realignment	Design Engineer	hrs	40	$130	$5,200	
	Site Supervision of channel realignment	Site Supervisor	hrs	160	$150	$24,000	
	Sub-Total						**$817,275**
2.6	**Interceptor Ditches**						
2.6.1	Breach ditches and recontour	Bulldozer-large (D9H)	hrs	30	$400	$12,000	
	Sub-Total						**$12,000**
2.7	**Tailings pipeline (1.9km)**						
2.7.1	Remove Pipeline	235 Excavator	hrs	50	$240	$12,000	
		D250E Haul Truck	hrs	50	$250	$12,500	
		General Labourer	hrs	100	$60	$6,000	
		Site Supervisor	hrs	20	$150	$3,000	
	Sub-Total						**$33,500**
2.8	**Reclaim pipeline (0.8km)**						
2.8.1	Remove Pipeline	235 Excavator	hrs	20	$240	$4,800	
		D250E Haul Truck	hrs	20	$250	$5,000	
		General Labourer	hrs	40	$60	$2,400	
		Site Supervisor	hrs	10	$150	$1,500	
	Sub-Total						**$13,700**
Total Estimated Cost in Reclaiming TMF							**$3,122,000**

Table 6-5 Estimated Decommissioning Costs – Demolition and Reclamation

Item No.	Work Item Description	Equipment/ Labour	Units	Quantity	Unit Cost	Cost	Total Cost
3.0	**INFRASTRUCTURE: BUILDINGS, STRUCTURES AND SERVICES**						
3.1	**Concentrator Buildings (incl. Whse, crusher building, load out)**						
	Remove salvageable equipment	General Labourer	hrs	704	$60	$42,240	
		Trades Labourer	hrs	880	$70	$61,600	
	Dismantle Building - Manpower	General Labourer	hrs	1200	$60	$72,000	
	Dismantle Building - Manpower	Trades Labourer	hrs	720	$70	$50,400	
	Dismantle Building - Equipment	235 Excavator	hrs	120	$240	$28,800	
	Dismantle Building - Equipment	30 ton Crane	hrs	120	$200	$24,000	
	Concrete Demolition	235 Excavator	hrs	80	$240	$19,200	
		235 Excavator w Hammer	hrs	80	$300	$24,000	
	Reslope, contour & bury	Bulldozer-large (D9H)	hrs	48	$400	$19,200	
	Misc. Supplies & Tools	Misc.	l.s.			$11,000	
	Scrap haul to landfill	235 Excavator	hrs	160	$240	$38,400	
		D250E Haul Truck	hrs	240	$250	$60,000	
	Subtotal:						**$450,840**
3.2	**Power House and Power Lines**						
	Remove salvageable equipment	General Labourer	hrs	240	$60	$14,400	
		Trades Labourer	hrs	240	$70	$16,800	
	Salvage and remove powerline and poles		l.s.			$27,500	
	Dismantle Building - Manpower	Trades Labourer	hrs	160	$70	$11,200	
	Dismantle Building - Equipment	235 Excavator	hrs	80	$240	$19,200	
	Concrete Demolition	235 Excavator	hrs	40	$240	$9,600	
		235 Excavator w Hammer	hrs	40	$300	$12,000	
	Reslope, contour & bury	Bulldozer-large (D9H)	hrs	24	$400	$9,600	
	Misc. Supplies & Tools	Misc.	l.s.			$1,650	
	Scrap haul to landfill	235 Excavator	hrs	30	$240	$7,200	
		D250E Haul Truck	hrs	40	$250	$10,000	
	Subtotal:						**$139,150**
3.3	**Water Supply**						
	Remove salvageable equipment - pipeline/pumps	General Labourer	hrs	48	$60	$2,880	
		Trades Labourer	hrs	98	$70	$6,860	
	Remove pipeline	D250E Haul Truck	hrs	100	$250	$25,000	
		235 Excavator	hrs	100	$240	$24,000	
		General Labourer	hrs	200	$60	$12,000	
	Dismantle Building - Manpower	General Labourer	hrs	20	$60	$1,200	
	Dismantle Building - Equipment	235 Excavator	hrs	16	$240	$3,840	
	Misc. Supplies & Tools	Misc.	l.s.			$550	
	Reslope, contour & bury	Bulldozer-large (D9H)	hrs	16	$400	$6,400	
	Subtotal:						**$82,730**
3.4	**North Creek Dyke**						
	Excavation of Soil	Unit cost basis	cu.m	1600	$35	$56,000	
	Remove culverts	Misc.	l.s.			$4,400	
	Drill, Blast and Screen Rip Rap	Unit cost basis	cu.m	20	$65	$1,300	
	Load, Haul and Place Soil/Rip Rap	Unit cost basis	cu.m	20	$20	$400	
	Subtotal:						**$62,100**
3.5	**Service Garage**						
	Dismantle Building - Manpower	General Labourer	hrs	48	$60	$2,880	
		Trades Labourer	hrs	24	$70	$1,680	
	Dismantle Building - Equipment	235 Excavator	hrs	10	$240	$2,400	
	Concrete Demolition	235 Excavator w Hammer	hrs	10	$300	$3,000	
	Reslope, contour & bury	Bulldozer-large (D9H)	hrs	8	$400	$3,200	
	Misc. Supplies & Tools	Misc.	l.s.			$550	
	Scrap haul to landfill	235 Excavator	hrs	6	$240	$1,440	
		D250E Haul Truck	hrs	8	$250	$2,000	
	Subtotal:						**$17,150**
3.6	**Accommodation/Camp Trailers Buildings/Office**						
	Remove salvageable equipment	General Labourer	hrs	140	$60	$8,400	
		Trades Labourer	hrs	48	$70	$3,360	
	Dismantle Buildings - Manpower	General Labourer	hrs	380	$60	$22,800	
		Trades Labourer	hrs	32	$70	$2,240	
	Dismantle Building - Equipment	235 Excavator	hrs	20	$240	$4,800	
	Remove septic tanks & clean line	General Labourer	hrs	24	$60	$1,440	
	Reslope, contour & bury	Bulldozer-large (D9H)	hrs	48	$400	$19,200	
	Misc. Supplies & Tools	Misc.	l.s.			$825	
	Scrap haul to landfill	235 Excavator	hrs	12	$240	$2,880	
		D250E Haul Truck	hrs	20	$250	$5,000	
	Subtotal:						**$70,945**
3.7	**Explosive Magazine**						
	Remove from site	Misc.	l.s.			$2,500	
	Subtotal:						**$2,500**
3.8	**Miscellaneous Buildings & Structures**						
	Remove salvageable equipment - Manpower	General Labourer	hrs	280	$60	$16,800	
		Trades Labourer	hrs	280	$70	$19,600	
	Remove salvageable equipment - Equipment	Hiab Flatdeck truck	hrs	280	$150	$42,000	
		Loader-small (Cat 950)	hrs	280	$225	$63,000	
	Dismantle Building - Manpower	General Labourer	hrs	280	$60	$16,800	
		Trades Labourer	hrs	140	$70	$9,800	
	Dismantle Building - Equipment	235 Excavator	hrs	40	$240	$9,600	
	Concrete Demolition	235 Excavator w Hammer	hrs	40	$300	$12,000	
	Reslope, contour & bury	Bulldozer-large (D9H)	hrs	80	$400	$32,000	
	Misc. Supplies & Tools	Misc.	l.s.			$2,750	
	Scrap haul to landfill	235 Excavator	hrs	30	$240	$7,200	
		D250E Haul Truck	hrs	40	$250	$10,000	
	Subtotal:						**$241,550**
3.9	**Industrial Reagents, Fuels & Waste**						
	Industrial Reagents	Misc.	l.s.			$16,500	
	Fuels	Misc.	l.s.			$11,000	
	Wastes	Misc.	l.s.			$11,000	
	Subtotal:						**$38,500**
3.10	**Spill Clean**						
	Concentrator haul out	lump sum	l.s.			$82,500	
	Other Building/Site spill clean up	lump sum	l.s.			$82,500	
	Hydrocarbon Contaminated Soils clean up	lump sum	l.s.			$385,000	
	Subtotal:						**$550,000**
3.11	**Demolition Overheads**						
	Supervision	Site Supervisor	hrs	1000	$150	$150,000	
	Mob/Demob	Misc.	l.s.			$0	
	Office/Admin Costs	Misc.	l.s.			$5,500	
	Subtotal:						**$155,500**
3.12	**Landfill**						
	Design/build new landfill facility	Misc.	l.s.			$50,000	
	Subtotal:						**$50,000**
Total Estimated Cost in Infrastructure: Buildings, Structures and Services							**$1,861,000**

Table 6-6 Estimated Decommissioning Costs – Land Reclamation & Revegetation

Item No.		Equipment/ Labour	Units	Quantity	Unit Cost	Cost	Total Cost
4.0	**LAND RECLAMATION & REVEGETATION**						
4.1	**Roads and Trails**						
4.1.1	**Exploration Trails**						
	stabilize slopes - erosion barriers	Erosion barriers	per linear m	4000	$8	$32,000	
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	10	$8,000	$80,000	
	Subtotal:						**$112,000**
4.1.2	**Main Access Road**						
	road barrier	Misc.	l.s.			$3,300	
	culvert excavation	235 Excavator	hrs	500	$240	$120,000	
	culvert removal	D250E Haul Truck	hrs	500	$250	$125,000	
	scarify	16H grader	hrs	200	$325	$65,000	
	recontour slopes	Bulldozer-large (D9H)	hrs	200	$400	$80,000	
	stabilize slopes - erosion barriers	Erosion barriers	per linear m	5000	$8	$40,000	
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	65	$8,000	$520,000	
	Subtotal:						**$953,300**
4.1.3	**Service and Haul Roads within the Minesite**						
	road barrier	Misc.	l.s.			$3,300	
	culvert excavation	235 Excavator	hrs	200	$240	$48,000	
	culvert removal	D250E Haul Truck	hrs	200	$250	$50,000	
	scarify	16H grader	hrs	48	$325	$15,600	
	recontour slopes	Bulldozer-large (D9H)	hrs	60	$400	$24,000	
	stabilize slopes - erosion barriers	Erosion barriers	per linear m	3500	$8	$28,000	
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	16	$8,000	$128,000	
	Subtotal:						**$296,900**
4.2	**Non-Linear Developments**						
4.2.1	**Tailings Management Facility**						
	Cover installation - rock fill for base in wet areas (**33%** of 11.8 ha, 1 m depth)	Haul & Place rock cover	cu.m	38,940	$15	$584,100	
	Cover installation - haul soil and place (300 mm depth over entire area)	Load, haul and place soil cover	cu.m	35400	$15	$531,000	
	Grading of surface	Bulldozer-large (D9H)	hrs	100	$400	$40,000	
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	11.8	$8,000	$94,400	
	Subtotal:						**$1,249,500**
4.2.2	**Reclaim Pond**						
	pond clean up	Misc.	l.s.			$11,000	
	Cover installation - rock fill for base in wet areas (25% of 4 ha, 1 m depth)	Haul & Place rock cover	cu.m	10000	$15	$150,000	
	Cover installation - haul soil and place (300mm cover on rock cover area)	Load, haul and place soil cover	cu.m	3000	$15	$45,000	
	Grading of surface	Bulldozer-large (D9H)	hrs	40	$400	$16,000	
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	4	$8,000	$32,000	
	Subtotal:						**$254,000**
4.2.3	**Waste Dumps**						
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	6	$8,000	$48,000	
	Subtotal:						**$48,000**
4.2.4	**Sediment Ponds**						
	Jewel Box sediment pond - recontour and slope	235 Excavator	hrs	12	$240	$2,880	
	Main Zone sediment pond - recontour and slope	235 Excavator	hrs	6	$240	$1,440	
	Sediment Pond solids haul	D250E Haul Truck	hrs	20	$250	$5,000	
	Burnick sediment pond - recontour and slope	235 Excavator	hrs	10	$240	$2,400	
	Revegetation- use a per ha. cost that includes application	Seed/Fertilizer Application	ha	1	$8,000	$8,000	
	Subtotal:						**$19,720**
4.2.5	Disturbed Sites (incl. Mill), Landfill Areas and Borrow Pits						
	LTF-prepare detailed closure plan		l.s.			$2,000	
	Characterize final soil hydrocarbon concentrations		l.s.			$3,000	
	Re-grade & compact LTF area (0.5 ha)	Bulldozer-large (D9H)	hrs	5	$400	$2,000	
	Re-grade & compact landfill areas (2 ha)	Bulldozer-large (D9H)	hrs	50	$400	$20,000	
	Cover installation-haul soil & place (250mm cover over compacted landfill & LTF areas)	Load, haul and place soil cover	cu.m	6250	$15	$93,750	
	Compact cover over landfill areas	Bulldozer-large (D9H)	hrs	50	$400	$20,000	
	Revegetation of all misc disturbed sites - use per ha cost including application	Seed/Fertilizer Application	ha	8	$8,000	$64,000	
	Subtotal:						**$204,750**
Total Estimated Cost in Land Reclamation and Revegetation							**$3,138,000**

Table 6-7 Estimated Decommissioning Costs For Current Site Status – Post Closure Management

Item No.	Work Item Description	Equipment/ Labour	Units	Quantity	Unit Cost	Cost	Total Cost
5.0	**POST CLOSURE SITE MANAGEMENT**						
5.1	**Organization, Site Access & Security, Overhead Costs**						
	Pre-Closure Planning/Organizing	Project Manager	monthly	4	$20,000	$80,000	
	Overall Off-stie Project Manager Incld. Travel	Project Manager	monthly	28	$20,000	$560,000	
	On-Site Management Team (Site Superintendent, Safety, Environmental, Survey/Drafting, Clerk)	Turn Key Cost	monthly	15	$170,000	$2,550,000	
	On-Site Offices, Lunch Rooms, Wash Rooms (Mob/Demob/Rental)	Rental	monthly	36	$7,600	$270,000	
	Safety Supplies	Materials	l.s.	1	$75,000	$75,000	
	Main Access Road Maintenance	Misc.	per year	3	$55,000	$165,000	
	Allowance for other Undefined Site Costs		l.s.	1	$150,000	$150,000	
	Misc. Office/Supply/Misc. Costs	Misc.	per year	3	$10,000	$30,000	
	Subtotal:						**$3,880,000**
5.2	**Supporting Studies**						
	Water Quality Modelling for Selected Closure Plan	Misc.	l.s.	1		$10,000	
	Preparation of required AMPs	Misc.	l.s.	1		$20,000	
	Subtotal:						**$30,000**
5.3	**Supervision and Documentation of Work**						
	Site environmental monitoring, reporting, documentation (5 yrs of p-c)	Environmental Monitor	quarterly	20	$10,000	$200,000	
	Document Reviews/Storage	Misc.	l.s.	1		$10,000	
	Final as built plan	Design Engineer	hrs	160	$130	$20,800	
	Subtotal:						**$230,800**
5.3	**Compliance Monitoring and Reporting**						
	Water Quality Monitoring - During Closure implementation (3yrs) - analytical	Misc.	l.s.			$64,900	
	Water Quality Monitoring - During Closure implementation (3 yrs)- Heli	Misc.	l.s.			$18,480	
	Water Quality Monitoring - Post Closure - Analytical/Collection	Misc.	l.s.			$76,560	
	Water Quality Monitoring - Post Closure - Heli/Travel	Misc.	l.s.			$77,880	
	Geotechnical Inspection - During Closure implementation (3 yrs)	Misc.	years	3	$13,200	$39,600	
	Geotechnical Inspection - Post closure	Misc.	years	5	$13,200	$66,000	
	Biological Monitoring - Professional fees - Closure implementation	Misc.	per event	1	$11,000	$11,000	
	Biological Monitoring - Helicopter & Lab Analysis - implementation	Misc.	per event	1	$6,050	$6,050	
	Biological Monitoring - Professional fees - Post closure	Misc.	per event	3	$11,000	$33,000	
	Biological Monitoring - Helicopter & Lab Analysis - Post closure	Misc.	per event	3	$6,050	$18,150	
	Subtotal:						**$411,620**
5.4	**Post Closure Maintenance**						
	Misc. Maintenance work related to the site after closure	Misc.	per year	5	$10,000	$ 50,000	
	Subtotal:						**$50,000**
Total Estimated Post Closure Site Management							**$4,602,000**

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SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN

MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX A – TECK RESOURCES LIMITED CODE OF SUSTAINABLE CONDUCT

Teck Resources Limited

Code of Sustainable Conduct

To implement our Charter of Corporate Responsibility, we will:

1. Obey the law and conduct business in accordance with our Code of Ethics;
2. Ensure that no discriminatory conduct is permitted in the workplace. Decisions on job selection, advancements and promotions will be unbiased, based on merit and ability, and in keeping with commitments to local communities;
3. Foster open and respectful dialogue with all communities of interest;
4. Respect the rights and recognize the aspirations of people affected by our activities;
5. Support local communities and their sustainability through measures such as development programs, locally sourcing goods and services and employing local people;
6. Continually improve safety, health and environmental policies, management systems and controls and ensure they are fully integrated into each of our activities;
7. Promote a culture of safety and recognize safety as a core value;
8. Continually reinforce company-wide efforts to achieve zero safety or health incidents;
9. Ensure programs that address workplace hazards are applied to monitor and protect worker safety and health;
10. Conduct operations in a sound environmental manner, seeking to continually improve performance;
11. Integrate biodiversity conservation considerations through all stages of business and production activities;
12. Design and operate for closure;
13. Promote the efficient use of energy and material resources in all aspects of our business;
14. Practise product stewardship and promote research to enhance the benefits of our products to society;
15. Conduct regular audits to ensure compliance with this Code.

Donald R. Lindsay
President and CEO

July 2009

Teck

SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN
MARCH 2013 UPDATE

Teck

TECK Metals Ltd.

APPENDIX B

ENVIRONMENTAL BASELINE UPDATE AND TECHNICAL BASIS FOR CLOSURE ASSUMPTIONS

Prepared by:





Laberge Environmental Services

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INTRODUCTION

This report, prepared in support of the Detailed Decommissioning & Reclamation Plan, presents a summary of the environmental conditions at the Sä Dena Hes mine site. Data from the initial environmental baseline surveys, and results from ongoing environmental monitoring programs, have been incorporated to provide an update on the current environmental conditions.

Key findings or pertinent information is summarized with references made to the individual reports where the data was originally presented. The reader is referred to those reports for a complete discussion.

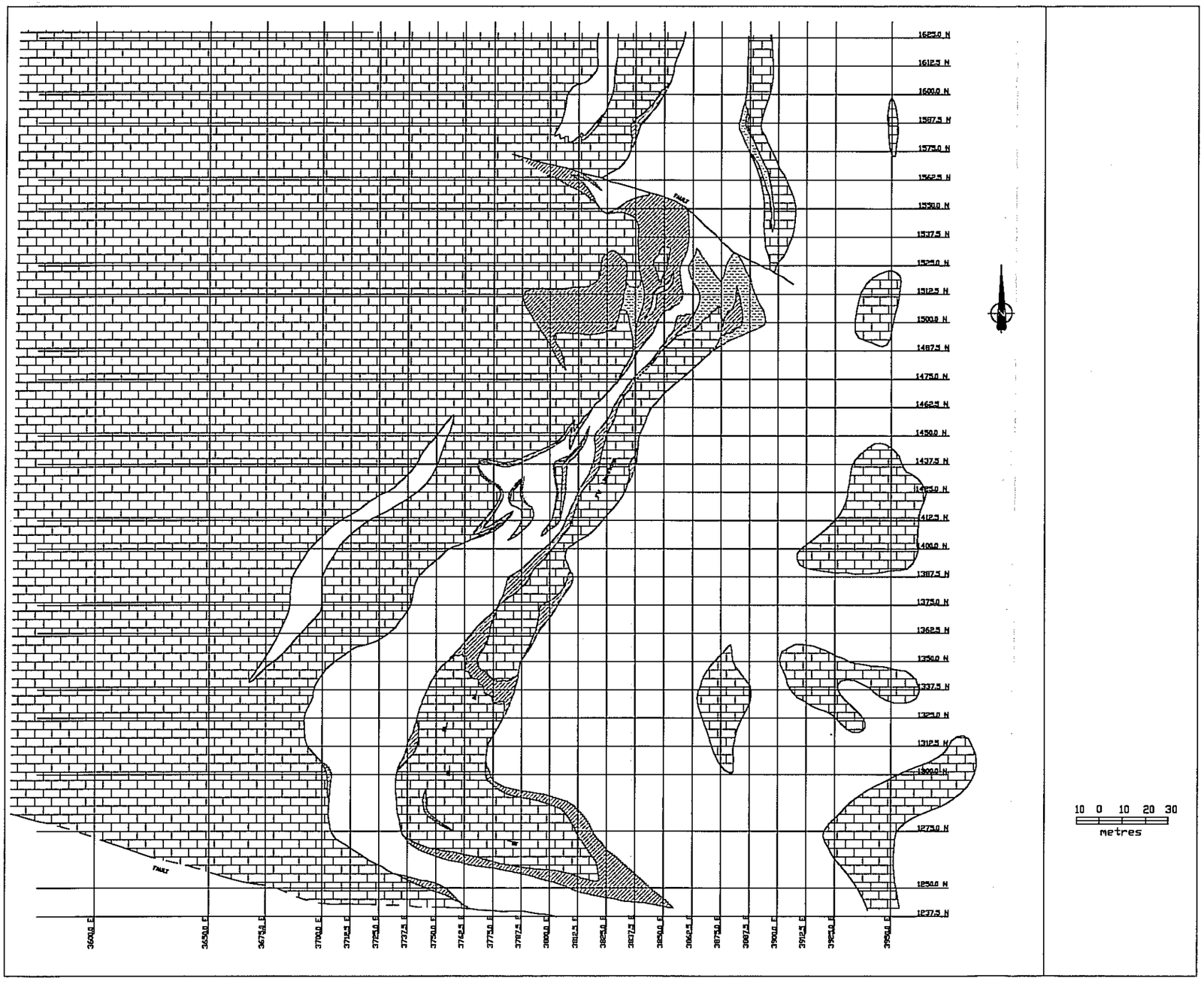
1.0 GEOLOGY AND ORE RESERVES

The following discussion is generally from the Sä Dena Hes Reopening Study, November 1995.

1.1 GEOLOGY

The Sä Dena Hes Property is underlain chiefly by lower Palaeozoic metasedimentary rocks, including both calcareous and non-calcareous pelitic phyllite and limestone. (Refer to Figure 1-1 and Figure 1-2", for a depiction of the typical geometry of the ore deposits and the associated rock types). Limestone comprises about five percent of the stratigraphic sequence and consists of discontinuous units which are up to 100 metres thick, and which typically pinch and swell over short distances. The thicker limestone units can be traced along strike for hundreds of metres. There is evidence locally that the limestone grades laterally into calcareous phyllite.

Intrusive igneous rocks on the property include three suites: mafic to intermediate, intermediate, and quartz porphyry. These intrusives are of limited size, and their age has been estimated at 50 million years. Although larger igneous bodies are not found on the property, it has been speculated that the area is underlain by a granitic pluton of the mid-Cretaceous Selwyn Plutonic Suite.



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Legend

ROCK TYPES

- Marble / limestone
- Phyllite
- Lowgrade Skarn (< 8% Pb+Zn)
- Highgrade Skarn (>= 8% Pb+Zn)
- Oxide Skarn

Structural Symbols

- overturned syncline axis
- overturned anticline axis
- anticline axis
- syncline axis
- dip and strike of bedding

Cross and Long Section Lines

Geology corresponds to 1380.0 m elevation

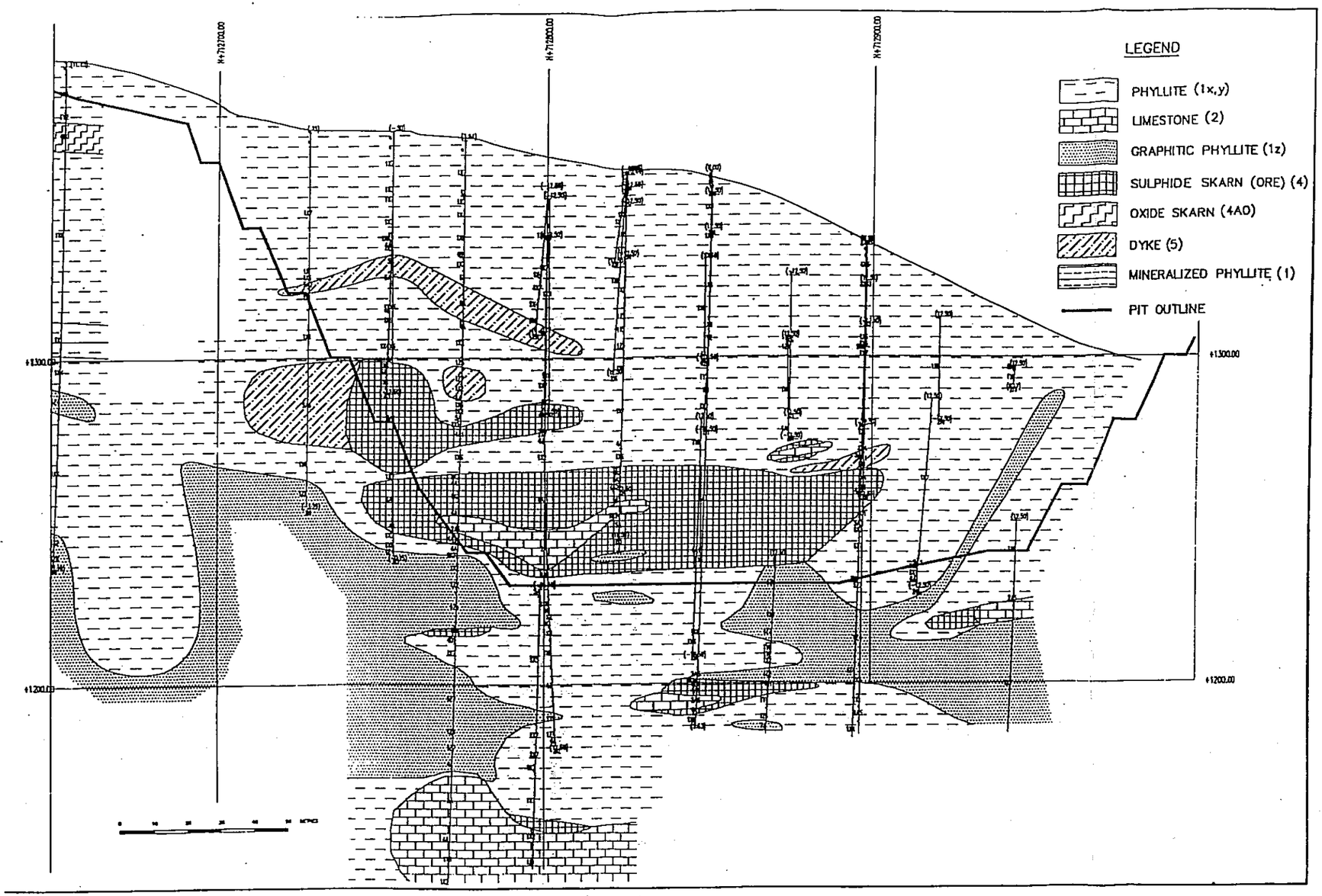
SÄ DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

Typical Geology - Jewelbox Deposit

DRAWN BY: ASH*	CHECKED BY: RLM
DATE: 29/07/99	SCALE 1 : 2,000

Fig No. 1-1

* Taken From a Drawing by L. Pigage



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STEFFEN ROBERTSON AND KIRSTEN
Consulting Engineers

Sä Dena Hes Mine
Detailed Decommissioning and Reclamation Plan

Typical Geological Section- Burnick Deposit

DRAWN BY: ASH	CHECKED BY:
DATE: 05/08/99	

Fig No. 1-2

The sedimentary strata are complexly folded and metamorphosed muscovite-chlorite phyllites of the greenschist facies. Several sets of steeply dipping faults occur on the property which post-date the folding. Most of these faults are thought to have normal displacement; however, some may be strike-slip. On Jewelbox Hill, a shallow-dipping shear zone follows the upper contact of the main limestone/marble body. A prominent conjugate fracture set trending approximately 100 degrees and dipping steeply north and south is considered to be an important control of mineralization.

Mineralization on the property is hosted by skarns which are commonly developed along the contact of limestone or phyllite with marble. Most of the important skarns are formed from a limestone protolith; however, there are good examples of skarn development from phyllite and locally from intrusive rocks. The grades of the latter skarns are generally on the low side.

Sulphide mineralization consists mainly of medium to coarse grained sphalerite and galena which are heavily disseminated in skarn layers. Iron sulphide is present in only minor quantities, or is absent altogether. Close to the peripheries of areas of lead-bearing skarn, there is local development of magnetite skarns. These peripheral skarns occasionally contain pyrrhotite and pyrite, and traces of chalcopyrite in some areas.

The mineralized horizons are commonly heavily oxidized to soft incompetent masses of clay, quartz, smithsonite, anglesite and cerussite to a depth of 130 metres, and some oxides have been encountered at depths of 300 metres and more. Locally, smithsonite has been mobilized from the oxidized skarns and deposited in nearby open fractures.

In some areas the phyllites are modestly to intensely hornfelsed, a feature that is broadly associated with skarn mineralization. Hornfelsing is more readily apparent in the calcareous phyllites than in non-calcareous types; consequently, the contact marking the outer limits of the hornfels suggests that the highly altered phyllites may be closely associated with faults or fractures which form conduits for mineralizing (and hornfelsing) fluids.

1.1.1 Alteration

Prominent alteration zones, up to 2 km long and 1 km wide, occur in four locations: Jewelbox Hill, Gribbler Ridge, North Hill and Porcupine Hill. From current information, the alteration pattern

appears to be similar in all four areas. The phyllite is altered to hornfels over a large vertical distance, at least 300 metres. Limestone beds are converted to marble in most cases (the Burnick area is the main exception), and more locally to an actinolite, diopside or garnet skarn. The skarn zones are up to 30 metres thick and have lateral dimensions up to several hundred metres. They usually occur at limestone-phyllite contacts; for example, at the upper and lower contacts of thick limestone units, along phyllite beds within the thicker limestone beds, or in association with thin limestone beds within the phyllites. Zinc-lead-silver (Zn, Pb, Ag) mineralization is directly associated with the skarn zones.

1.1.2 Mineralization

The sulphide mineralization is fairly similar throughout the Sä Dena Hes property, although mineral proportions vary from place to place. It consists of medium to coarse grained sphalerite and galena more or less evenly distributed in skarn layers. There is very little iron sulphide present (Section 4.2). Variable but minor amounts of quartz and calcite are commonly present as blebs. The Pb:Zn ratio is generally in the order to 1:2 to 1:3. The Burnick Zone at North Hill is an exception with a 1:30 ratio.

Silver values are associated with the galena and no separate silver bearing minerals have been identified. The ratio of Ag to Pb is variable.

Parts of some of the mineralized zones show varying degrees of oxidation. At an early stage, smithsonite develops gram sphalerite, and iron and manganese oxides from the skarn silicates. In extreme cases, the sphalerite and calc-silicates are completely converted to smithsonite and iron oxides, and the galena to cerussite. Although most of the oxidized mineralization appears to occur in-site, there are a few cases where downward migration has apparently occurred, resulting in smithsonite healed cracks in unaltered limestone in the footwall of oxidized skarn mineralization.

A few drill holes have intersected steeply dipping faults with a different type of mineralization, consisting of drusy quartz, chalcedony, fluorite and calcite, over widths of up to 10 metres. Fluorite is occasionally present in the skarn Pb-Zn mineralization, but is minor.

1.1.3 Geological Reserves

In most cases, individual zones of mineralization can be correlated with stratigraphy with a high degree of certainty. Normally, the mineralized skarn layers occur at either the borders of relatively thick, easily identified limestone units or form bands that parallel the contacts of the main limestone bands.

In parts of the Jewelbox and Burnick Zones, where there are structural complexities, the correlation is less certain, but the implications regarding tonnage possibilities are probably not too serious because alternative interpretations provide a similar tonnage in blocks of mineable size.

Based on visual estimates, close to 20% of the Jewelbox mineralization has been oxidized to a significant degree, but the oxidation appears to be mostly restricted to well defined areas (mainly the East Zone). Although minor oxidation is present in the Main Zone and the parts of the JB-1 Zone that are close to surface, no problem is anticipated in mining essentially unoxidized material on a selective basis. The oxidized material is not included in the mineable reserves.

1.1.4 Mineral Reserves

As reported in the Teck Cominco. 2007 Annual Report, mineral reserves are as follows:

Indicated Resource - 2,190,000 tonnes @ 10.4% Zn
2.6% Pb
45 G/T Ag

As no additional reserve estimation work has been done since, there are the most current figures for the reserves.

1.2 PHYSIOGRAPHY

The following is a summary from the Mt. Hundere Development Initial Environmental Evaluation, by SRK Consultants Ltd., April 1990.

"*The mountainous area around Mount Hundere is part of the Hyland Plateau physiographic unit. To the west, the Hyland Plateau gives way to the Liard Plain, a broad southeasterly trending intermontane basin which contains the Liard and Frances Rivers (Bostock, 1970).*

Surface drainage flows both north and south from the Mount Hundere area. A number of valley streams, of which Tom Creek is the largest, drain southward to the Frances River. North of Hundere ridge, most creeks flow northward to join False Canyon Creek which eventually flows to the Frances River, northwest of the study area.

A broadly rolling, till plain, forms the dominant glacial landform traversed by the Robert Campbell Highway in the Liard Plain. Isolated pockets of fluvial and glaciofluvial sands and gravels, glaciolacustrine silts and shallow organic materials mantle the subdued till in places. Surface till on the Liard Plain is variable in colour, moderately stony and has a silty sandy matrix (Klassen, 1987).

The plateau area features broad valleys and rounded ridge crests, Relief is 450 to 600 m within the claim block; Mount Hundere is the highest point at 1576 m. Late Wisconsin ice covered all of the area during glacial maxima. It likely flowed southward to join the southeasterly flowing piedmont glacier in the Liard Plain. As glaciation commenced and the ice sheet retreated and downwasted, glaciers remained in the valleys while ridge crests and upper slopes were ice-free. Till deposits in the valley bottoms and on lower slopes are the result of direct glacial deposition. Tills with a silty sandy matrix reflect the regional glaciation; in the upper valleys a coarser, looser till may be found which reflects deposition from an ablating valley glacier.

Large volumes of meltwater emanated from the retreating ice. Loose, surficial deposits were eroded from slopes, transported by meltwater streams and deposited as glaciofluvial terraces, outwash plains and ice-contact kames and eskers. These granular sediments infilled much of the valley lowlands. In places they are associated with silt deposits laid down in glacial lakes formed by temporary ponding of meltwater.

In post-glacial time, deposition and erosion continued. Colluvial deposits are gravity-transported materials common to sloping ground. Angular bedrock fragments with interstitial sand and silt are ubiquitous on ridge crests and upper and mid-slope positions. Fluvial sediments and organic materials accumulated on floodplains, fans and adjacent valley lowlands. Fluvial erosion, lateral and vertical cutting through existing surface materials, is an on-going but generally imperceptible process; it is usually most dynamic in steeper-gradient channels and where unstable bank materials exist. Landsliding and snow avalanching are rapid mass movement processes which are modifying some areas of sloping terrain. Periglacial processes (driven by the freeze-thaw cycle) are slowly modifying alpine and subalpine slopes."

2.0 CLIMATE

2.1 CLIMATOLOGICAL SETTING

The Sä Dena Hes property is located in the upper basin of the Liard River, some 40 km north of Watson Lake. The climate is dictated by a number of factors, mainly altitude, latitude and distance to mountain barriers. The property is in the rain shadow of the Coast and St. Elias Mountains. These two mountain ranges form an effective barrier against Pacific influences and allow a continental climate to exist over most of the Yukon. The Cassiar Mountains cause a secondary rain shadow effect.

2.2 CLIMATOLOGICAL DATA SOURCES

The climate of the mine site was first characterized in 1990 during the permitting stage of the mine development. Updates were prepared in 1999 and 2005 in support of the DDRP. In preparing these climate assessments, the sources of data were primarily regional climate stations and snow courses. In 2002, Access Mining Consultants established a weather station at the mill site to monitor rainfall intensity, air temperature and humidity. The weather station's rainfall data collected to 2005 were used in the last update of the climate analysis. Approximately ten years of data are now available from the site weather station, and review of this data, together with more recent regional data, is planned for 2013.

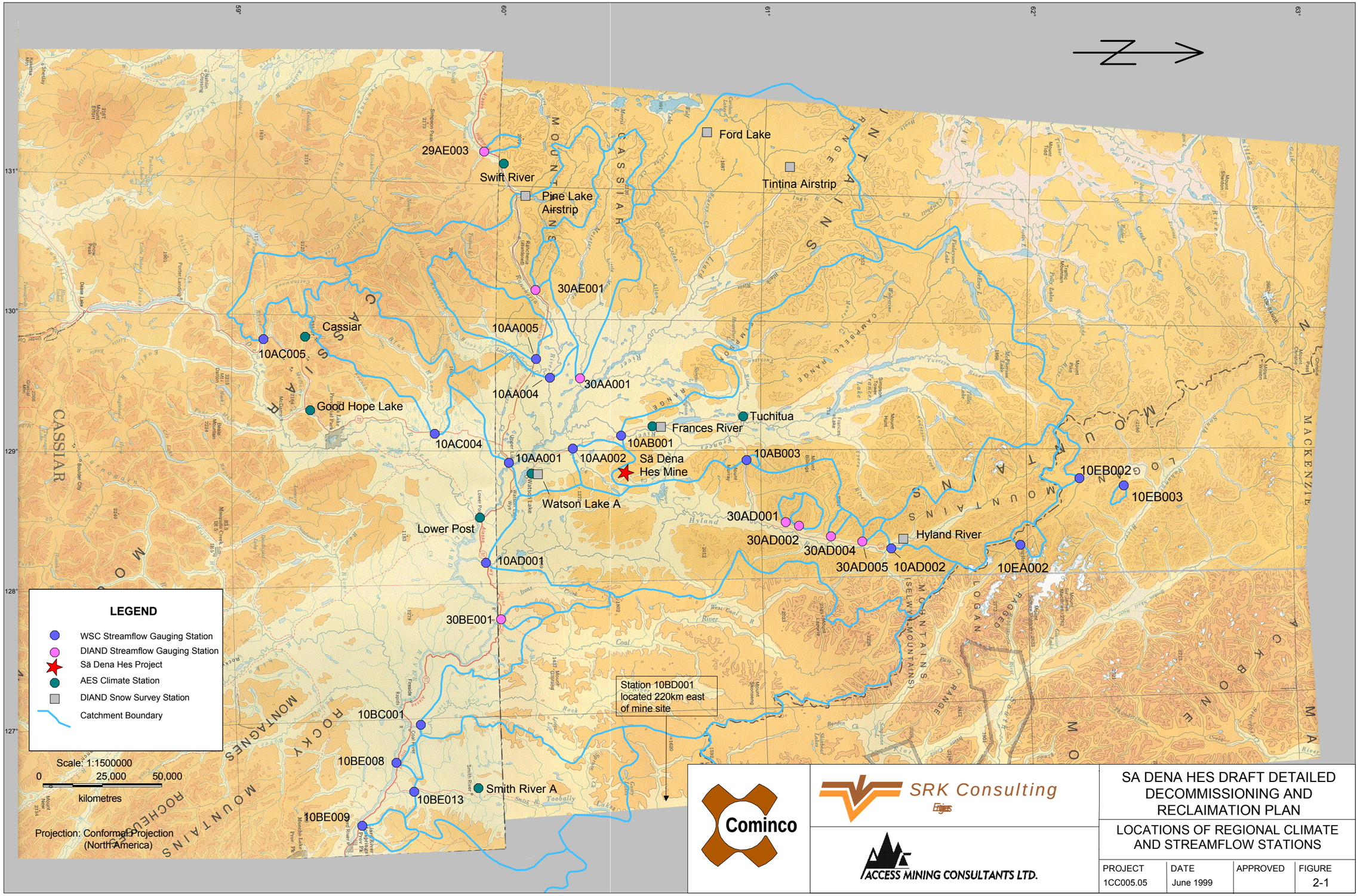
As indicated above, the climate of the mine site was largely inferred from the data of regional climate stations. The primary information was provided by nine climate stations operated by the Meteorological Service of Canada (formerly Atmospheric Environment Service).Supplementary data were obtained from six snow survey records collected by Environment Yukon (formerly operated by the Department of Indian Affairs and Northern Development). Details of these regional stations are provided in Table 2-1. The table also identifies the types of climatological parameters each station provided for the study. The locations of the regional stations except for the single evaporation station, which is located several hundred kilometres from the mine site, are shown on Figure 2-1.

Table 2-1 Details of Regional Climate Stations

Station Name	Latitude		Longitude		Elevation (m)	Authority *	Information Applicable to Study
	Deg	Min	Deg	Min			
Cassiar	59	17	129	50	1077	AES	Precipitation/Temperature
Frances River	60	35	129	11	732	AES	Precipitation
Francis River	60	35	129	11	730	DIAND	Snowpack
Good Hope Lake	59	18	129	17	770	AES	Precipitation/Temperature
Hyland River	61	31	128	16	855	DIAND	Snowpack
Lower Post	59	56	128	30	583	AES	Precipitation
Pine Lake Airstrip	60	6	130	56	995	DIAND	Snowpack
Smith River A	59	54	126	26	673	AES	Precipitation
Swift River	60	0	131	11	891	AES	Precipitation/Temperature
Tintina Airstrip	61	5	131	15	1067	DIAND	Snowpack
Tuchitua	60	56	129	15	724	AES	Precipitation
Watson Lake A	60	7	128	49	689	AES	Precipitation/Temperature
Watson Lake A	60	7	128	50	685	DIAND	Snowpack
Whitehorse A	60	43	135	4	703	AES	Evaporation
Ford Lake	60	47	131	28	1110	DIAND	Snowpack

Note: * AES: Environment Canada, Atmospheric Environment Service

DIAND: Department of Indian Affairs and Northern Development



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SA DENA HES DRAFT DETAILED DECOMMISSIONING AND RECLAIMATION PLAN

LOCATIONS OF REGIONAL CLIMATE AND STREAMFLOW STATIONS

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	June 1999		2-1

2.3 PRECIPITATION CORRECTION FOR NORTHWEST TERRITORIES AND YUKON

When the climate of the mine was re-assessed in 1999 for the closure plan, the data for the regional stations were available up to about 1997. The company reviewed the data in 2005 and updated the plan where applicable.

Figure 2-2 shows the annual series for three measurements of precipitation at the Watson Lake Airport. The top plot on this figure shows the annual maximum daily precipitation from 1939 to 2004. The middle plot presents the annual total precipitation for the same period. Finally, the bottom plot presents the water content of the snowpack on April 1 of each year from 1965 to 2005.

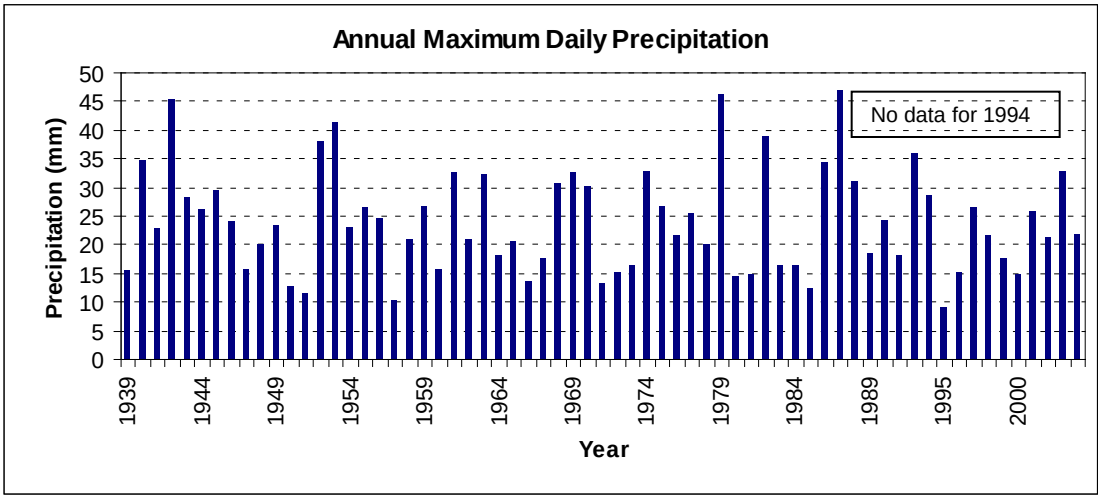
The density of recording stations in the Northwest Territories ("NWT") and Yukon is sparse compared to the rest of Canada, and the measurement of precipitation is subject to a number of measurement errors (Metcalfe, 1999). Most stations still use non-recording or manual methods of measuring precipitation in the form of rainfall and snowfall. The most significant measurement errors are:

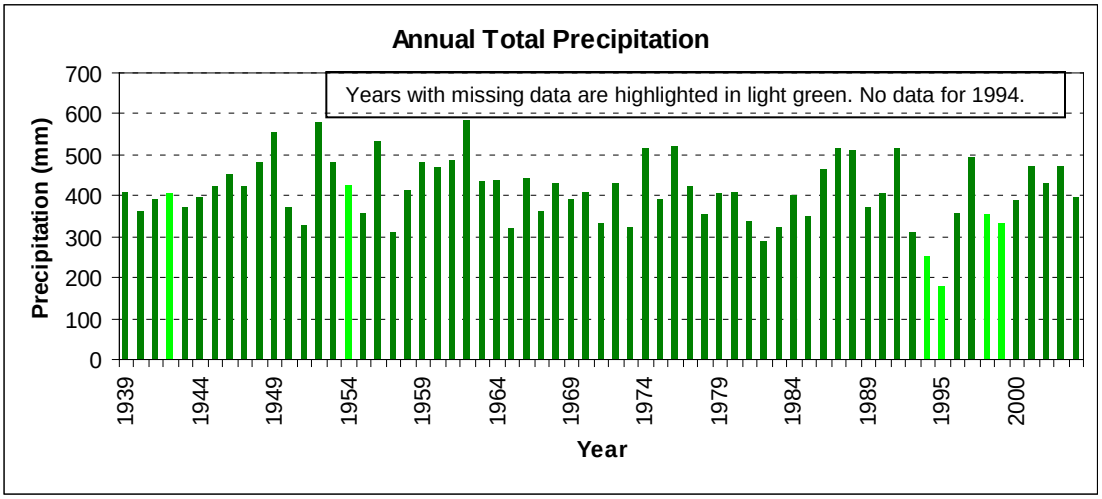
- the standard Type-B rain gauge has been shown to interact with the wind, deflecting a portion of the rainfall away and underestimating the precipitation;
- the standard Nipher snow gauge is used at many of these stations, and these demonstrate a systematic error, underestimating snowfall;
- snowfall is also manually recorded using a ruler at the remaining stations and the depth of snow is converted into a "water equivalent" using an assumed density of 100 kg/m^3. Studies have shown that the average densities of snow in these regions can actually be as much as 20% less than this assumed density, leading to another source of error in the snowfall record; and,
- wind has been shown to be a major cause of error in precipitation gauge measurements.

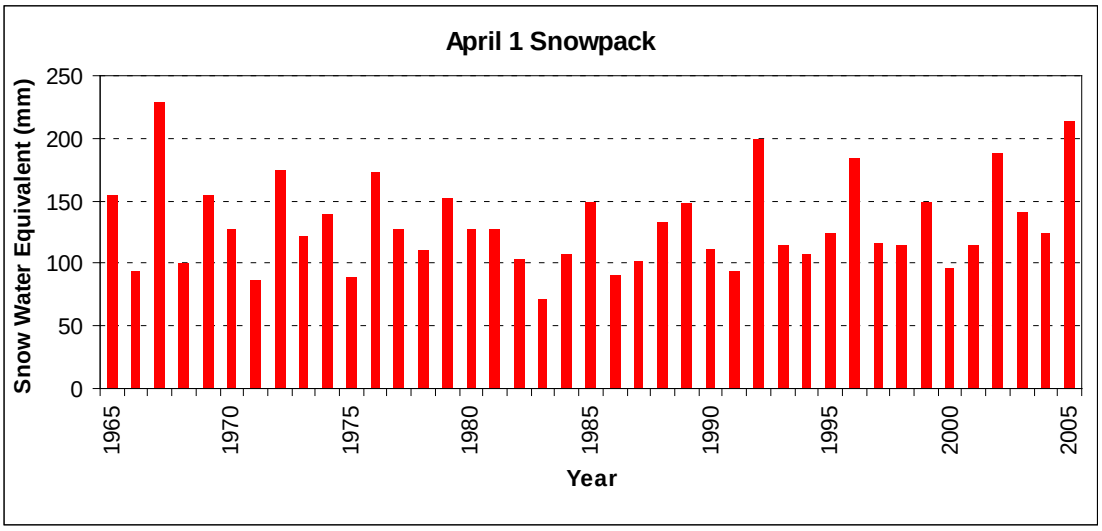
On balance, the measurements combine to cause an underestimation of precipitation at first-order stations equipped with a Nipher snow gauge. The Meteorological Service of Canada (MSC) has embarked on a program to correct the precipitation archive for such stations. The only first-order

station in close proximity to Sa Dena Hes is Watson Lake Airport. The bottom graph on Figure 2-3 shows a comparison of the archived and corrected precipitation record for the Watson Lake Airport. The graph shows the total monthly precipitation, normalized to a percentage of the mean annual precipitation ("MAP"). This demonstrates that the correction process has not significantly changed the shape of the monthly precipitation distribution and therefore precipitation normals provide an adequate basis for characterizing the snowfall and rainfall distributions for the minesite.

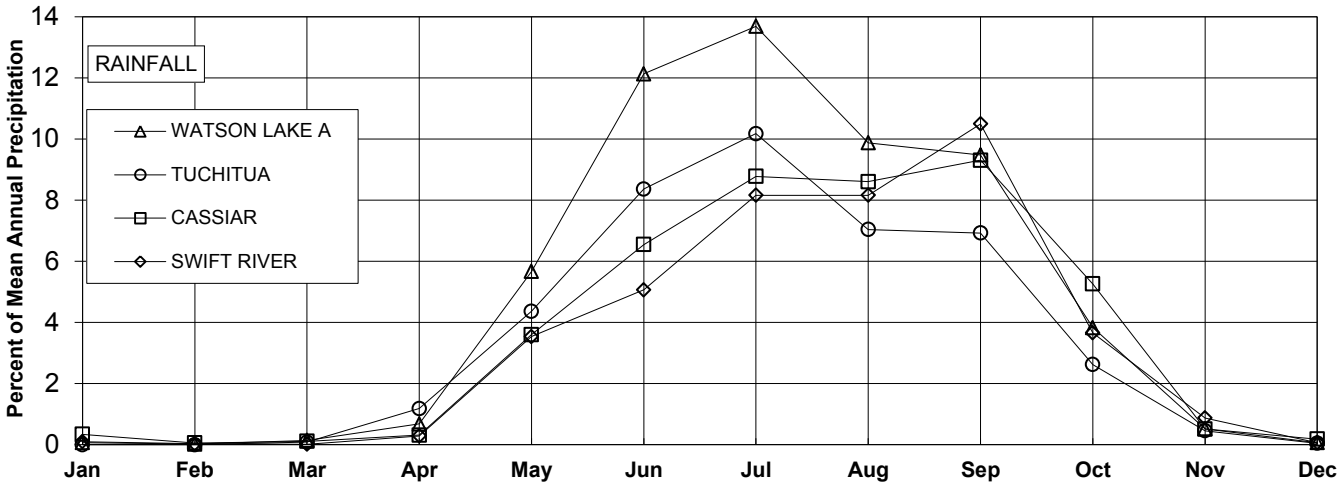
Therefore, the corrected MAP for Watson Lake of 490mm will be used in the analysis. The previous archived value from the 1961 – 1990 normals was 413 mm. For all other stations, the archived MAP value will be used. The correction of the archived records for these other stations is the focus of on-going research at the MSC.

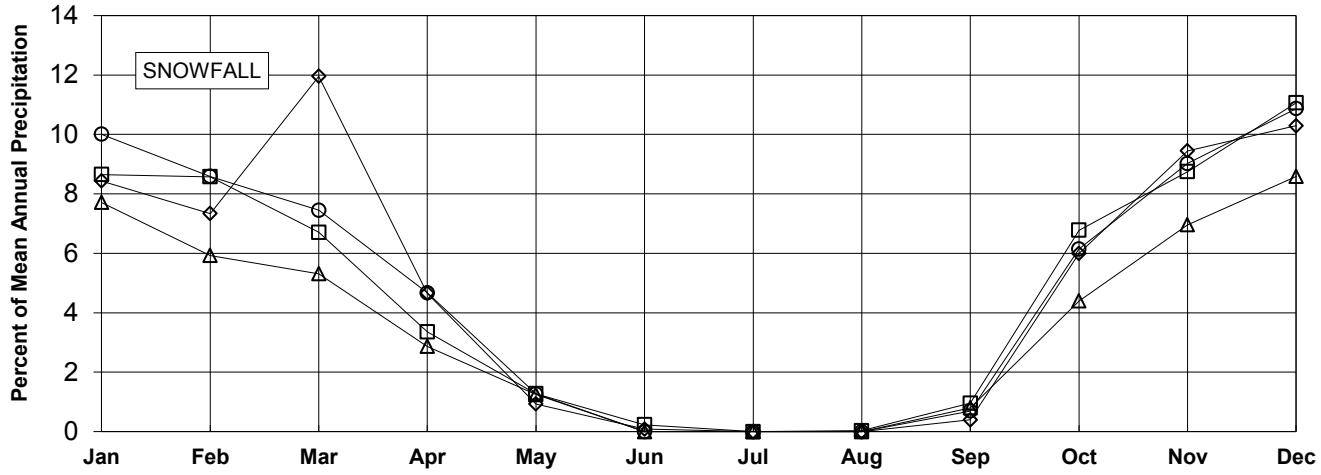




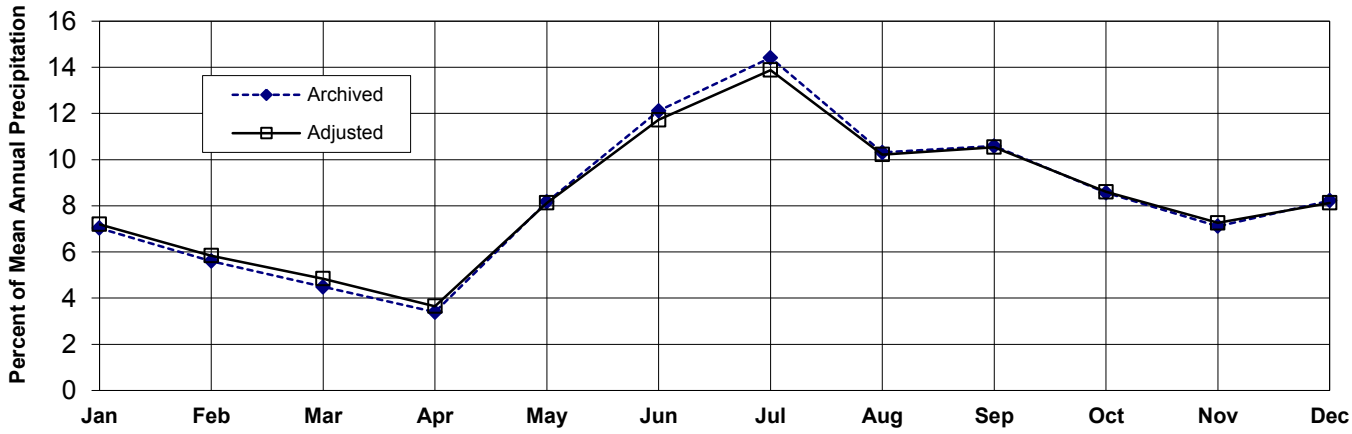


SRK Consulting Engineers and Scientists VANCOUVER	teckcominco	**Annual Precipitation Data for Watson Lake Airport**
Job No: 1CT008.004 Filename: Annual Extreme Daily Precipitation_Fig.xls	Sä Dena Hes Detailed Decommissioning and Reclamation Plan	Date: / Approved: / Figure: **2-2**





Comparison of Archived and Corrected Precipitation Records for Watson Lake A. - (1953-1993)



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SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

MEAN MONTHLY PRECIPITATION DISTRIBUTIONS AT REGIONAL CLIMATE

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		**2-3**

2.4 PRECIPITATION ESTIMATE

Elevation is the principal control on the distribution of precipitation in the region. Figure 2-4 illustrates this control and is a plot of MAP versus elevation as derived from the data of regional MSC stations. A best-fit linear regression of these data showed that the average precipitation gradient in the region is about 48 mm per 100 m of ascent. Using Watson Lake Airport as a base (elevation 689 m and MAP 490 mm) and applying the observed regional precipitation gradient, the mean annual precipitation (MAP) at the tailings impoundment is estimated to be 690 mm. This is about 1.67 times as much precipitation as measured at the Watson Lake Airport. Because of local variations in topography which affect precipitation, the actual mean precipitation at the tailings impoundment may differ by as much as 100 mm from the value calculated.

Rainfall data collected at the mine site were used as a partial validation of the mine site MAP. The tipping bucket was operated in the summers of 2002 and 2005. No data were collected in the intervening years due to an instrumentation malfunction. A summary of the data collected by the tipping bucket is presented in Table 2-2, together with the coincidental data measured at the Watson Lake Airport. These data indicate that the mine receives about 1.14 to 1.19 times more precipitation than Watson Lake during the summer months, which is far less than the 1.67 times expected when the annual totals at the two sites are compared. Rainfall data continues to be collected at site but data collected since 2005 has not been incorporated in the climate characterization.

The small difference between the summer precipitation at the minesite and Watson Lake Airport was not unexpected because orographic effects tend to be less important during warmer weather. To get an indication of the orographic effects in the winter, a comparison was made of snowpack levels between high and low elevation snow courses. Table 2-3 shows the average water contents of the March 1 and April 1 snowpacks at the Pine Lake Airstrip and the Watson Lake Airport. The former station is located at a similar elevation as the minesite and probably provides a reasonable approximation of the snowpack conditions at the minesite. Figure 2-5 provides evidence to suggest that a regional snow course can be used to accurately approximate conditions at the minesite. This figure shows that there are two other snow courses in the region with similar elevations as the minesite, and both experience comparable, but less,

snowpacks than the Pine Lake Airstrip. The snowpack at the Pine Lake Airstrip is some 1.6 to 1.7 times larger than what develops at the Watson Lake Airport.

Taken together, the information provided in Tables 2-2 and 2-3 suggest that the adopted estimate of MAP for the minesite may be conservative (i.e., overestimate the true MAP). On an annual basis, the ratio between the minesite and Watson Lake MAPs would be expected to lie intermediate to the multiplier for the summer months (1.14 to 1.19) and the one for the winter months (1.6 to 1.7). Such an intermediate value would be less than the multiplier that has been adopted (i.e., 1.67). To retain some conservatism, no change is proposed to the adopted MAP value for the minesite.

Table 2-2 Coincidental Precipitation at Minesite and Watson Lake

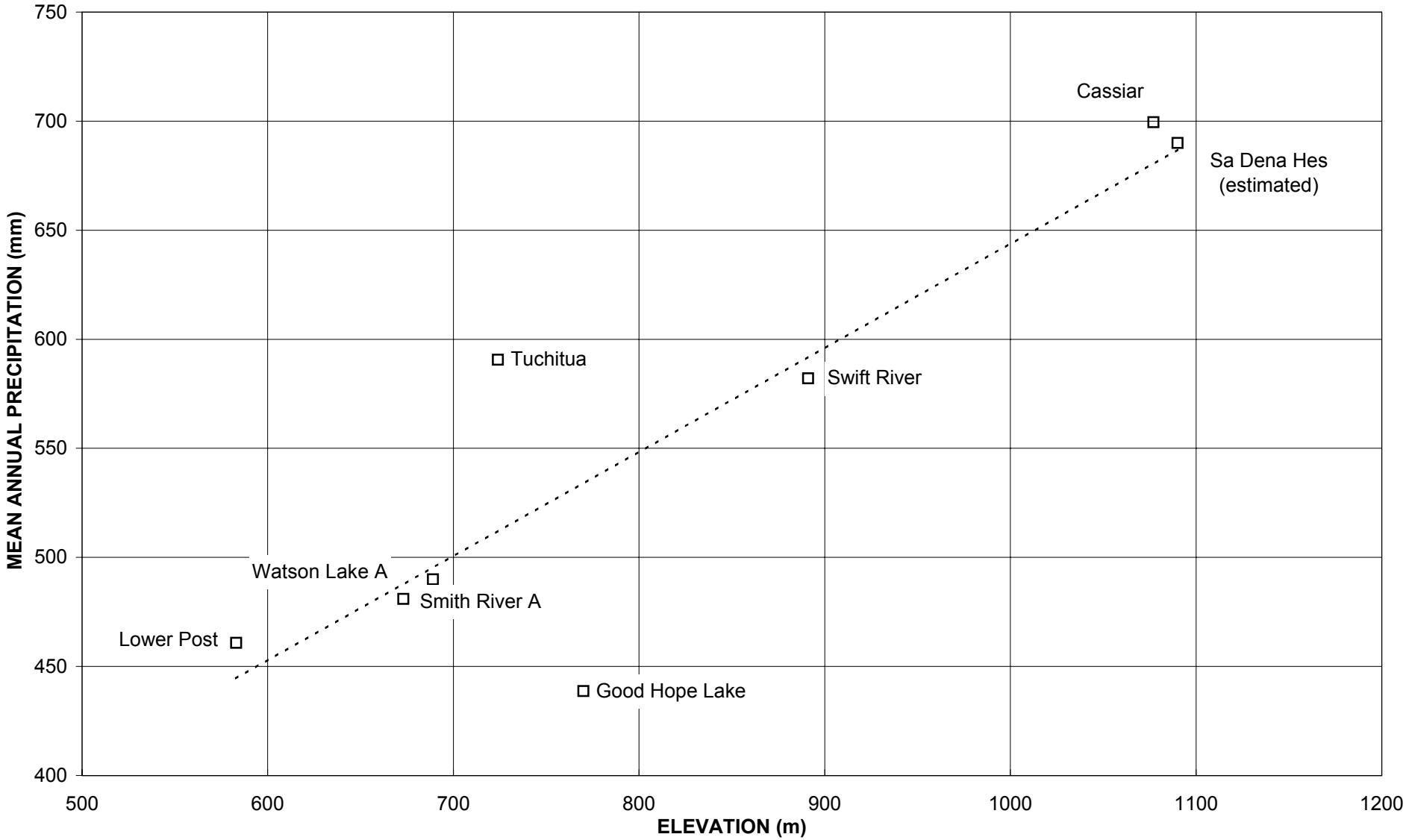
Period of Overlap	Total Precipitation over Period of Overlap (MM)		Ratio: Minesite to Watson Lake Precipitation
	Minesite	Watson Lake	
June 20 to 30, 2002	3.6	7.5	0.48
July 2002	110.8	119.7	0.93
August 1 to 28, 2002	118.8	77.4	1.53
June 20 to August 28, 2002	**233.2**	**204.6**	**1.14**
May 16 to 31, 2005	50.4	57.5	0.88
June 2005	74	61.8	1.2
July 2005	66	61.8	1.07
August 2005	37.6	31.2	1.21
September 2005	53.4	38.4	1.39
October 1 to 24, 2005	24.6	n/a	n/a
May 17 to September 30, 2005	**254.3**	**213.5**	**1.19**

Table 2-3 Comparison of Average Snowpacks at Pine Lake Airstrip and Watson Lake

Date of Measurement	Average Snow Water Equivalent (mm)		Ratio: Pine Lake to Watson Lake Snowpack
	Pine Lake Airstrip	Watson Lake Airport	
March 1	198	125	1.58
April 1	224	131	1.72

Note: Averages are for period 1976 to 2005

The seasonal precipitation distribution at the tailings impoundment was approximated using normalized monthly average distributions of regional MSC stations. The two upper graphs in Figure 2-3 graphically present the monthly rainfall and snowfall distributions for two high altitudes (Cassiar and Swift River) and two low altitude (Tuchitua and Watson Lake A) MSC stations. The rainfall and snowfall (as water equivalent) distributions are expressed as percentages of the MAP. The high altitude stations exhibit fairly different distribution patterns than the low altitude stations. It is assumed that the difference is primarily a result of an elevation dependency; however, it may also be related to spatial variations. The two low altitude stations are located along the valley floors of the Frances and Liard Rivers in fairly close proximity to the mine site whereas the two high altitude stations are sited further to the west within the Cassiar Mountains. The normalized distributions for the two high altitude stations coincide remarkably well despite the fact that the stations have an elevation difference of about 170 m. The one difference is the anomalously high, and probably erroneous, average snowfall at Swift River during March. Based on the similarities between the distributions at the two high altitude stations, the Cassiar distribution was adopted, without any adjustments, to represent the precipitation pattern at the tailings impoundment. This distribution was used to reflect the fact that a higher proportion of precipitation falls as snow at elevations as high as the proposed tailings impoundment than at the valley floor. It should be noted that the snowfall at Cassiar is converted to a water equivalent by applying a factor of 0.1.



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SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

REGIONAL RELATIONSHIP BETWEEN MEAN ANNUAL PRECIPITATION AND ELEVATION

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		2 - 4

The estimated average monthly snowfall and rainfall amounts for the tailings impoundment are shown in Table 2-4 together with other estimated climatic parameters for the tailings impoundment. The mean annual precipitation can be expected to comprise about 300 mm rainfall and 390 mm snowfall as water equivalent. Precipitation is common throughout the year with the driest month typically being April, and the wettest being October.

Table 2-4 Estimated Mean Monthly Climatic Parameters for Tailings Impoundment Site

Parameter	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Rainfall (mm)	2.4	0.4	0.8	2.2	24.9	45.2	60.6	59.4	64.2	36.3	3.6	1.3	301
Snowfall (cm)	60	59	46	23	9	2	0	0	7	47	60	76	389
Total Precipitation (mm)	62	60	47	25	34	47	61	60	71	83	64	78	690
Daily Maximum Temp (°C)	-20.2	-12.3	-5.3	1.3	8.1	14.2	17.1	14.5	8.4	-0.4	-13.1	-18.0	-0.5
Daily Minimum Temp (°C)	-31.3	-28.2	-22.6	-13.2	-3.2	1.7	5.3	3.7	-2.3	-10.1	-24.4	-27.9	-12.7
Daily Mean Temp (°C)	-25.7	-20.3	-14.0	-6.0	2.5	7.9	11.2	9.1	3.0	-5.3	-18.7	-22.9	-6.6
Evaporation (mm)	0	0	0	0	53	105	130	99	43	0	0	0	430

The Cassiar climatological record can also provide an indication of the extreme daily precipitation events at the mine site. The greatest 24-hour rainfall measured at this station over its 26-year history was 48 mm while the greatest 24-hour snowfall was 53 cm. The average number of days with measurable precipitation at Cassiar was 155.

The extremes in annual precipitation at the tailings impoundment were estimated assuming they exhibit a similar variability as observed at Cassiar. The coefficient of variation (standard deviation divided by mean) was used to quantify the amount of variability and has a value of 0.14 for this MSC station. Table 2-5 shows the extreme precipitation values as projected using a normal distribution.

Table 2-5 Estimated Precipitation Extremes: Tailings Impoundment

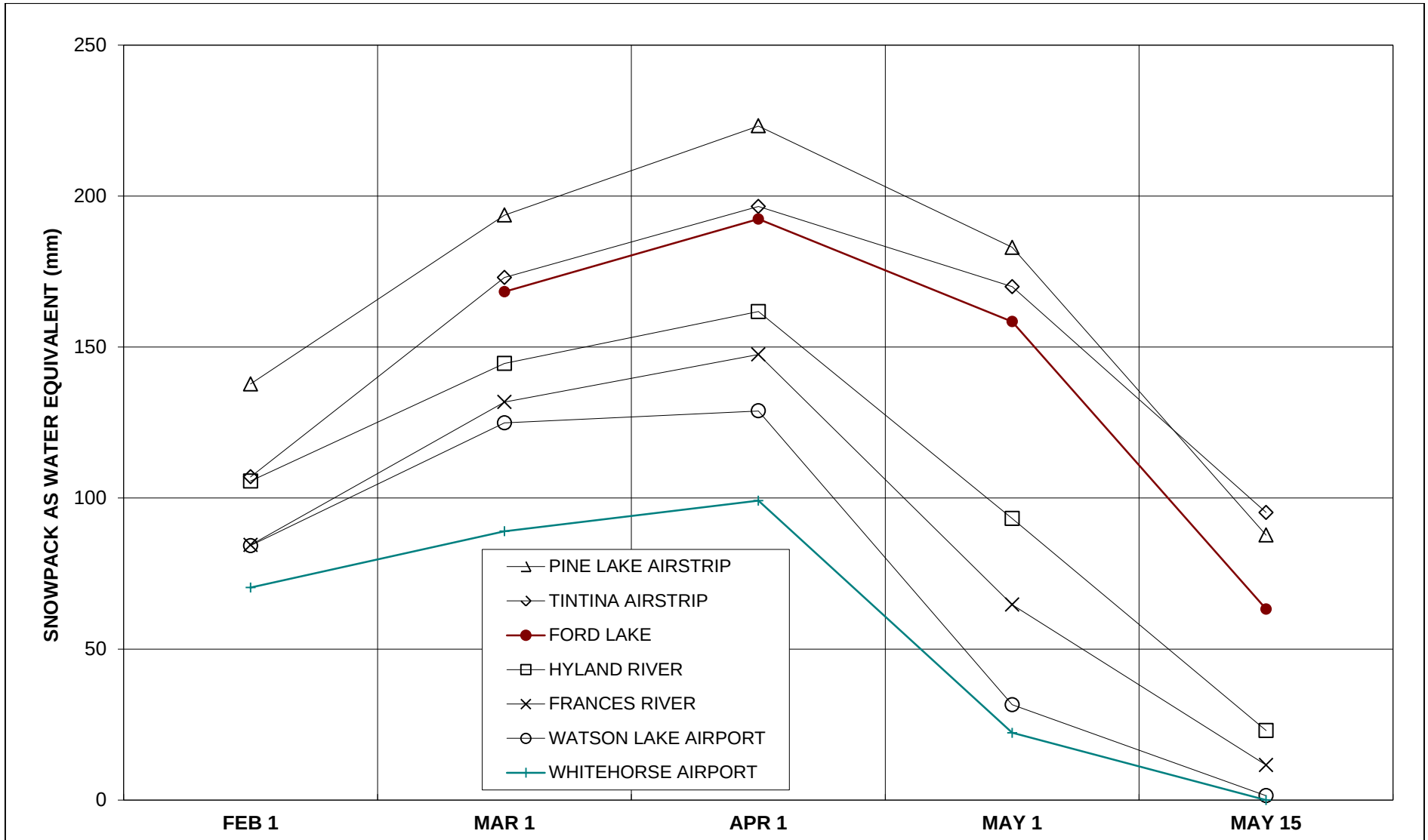
Return Period	Total Annual Precipitation (mm)
100-yr High	920
20-yr High	850
Mean Annual	690
20-yr Low	540
100-yr Low	470

2.5 SNOWPACK ESTIMATE

Environment Yukon operates a relatively dense network of snow survey stations in the region of the Sä Dena Hes minesite. Figure 2-5 is a graphical presentation of the average snowpack statistics for the five closest long-term (i.e., greater than 10 years) stations for various dates during the winter and spring. Inspection of these data reveals the expected general trend of increasing snowpack with increasing elevation. The three highest elevation stations, Pine Lake Airstrip (elev. 995 m), Tintina Airstrip (elev. 1067 m) and Ford Lake (elev. 1110 m) have similar elevations as the Sä Dena Hes minesite and are, therefore, judged to be indicative of the snowpack conditions likely experienced at the tailings impoundment. The accumulation of snow at the tailings impoundment site will typically begin in October and snowmelt will usually be complete by early June. At maximum snowpack in April, the density of the snowpack is about 240 kg/m^3.

2.6 TEMPERATURE ESTIMATE

A regional analysis was used to characterize the temperature regime at the tailings impoundment site. Examination of the spatial temperature differences between the MSC stations, especially those on the valley floors, revealed that the mean annual temperature followed a decreasing trend in both the northward and eastward direction in the region. This observation was taken into account in extrapolating regional temperature data to the mine site. The temperature data collected at the mill site weather station will be used in 2013 to validate the temperature estimates based on regional data.



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SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

MEAN MONTHLY SNOWPACK AT REGIONAL SNOW SURVEY STATIONS

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		**2-5**

The first step in performing the analysis was to evaluate a typical vertical temperature gradient between a valley station and a high altitude station. The stations at Cassiar and Good Hope Lake were judged to be appropriate for this purpose, as they are located fairly close to each other in horizontal distance.

The temperature gradient between this pair of stations, on an annual average basis, was calculated at -0.0084°C/m. A significant variation around this number is, however, observed on a month to month basis. The second step involved using these monthly temperature gradients in conjunction with the climate record of the Watson Lake Airport to extrapolate the regional temperature data to the tailings impoundment site. The Watson Lake Airport, being the closest MSC station to the mine site that measures temperature, was selected as the base for the extrapolation to implicitly account for the observed northward and eastward regional trends in temperature. The elevation difference between Cassiar and Good Hope Lake is similar to that between the tailings impoundment and the Watson Lake Airport (307 m versus 401 m). Therefore, the analysis involved multiplying the incremental temperature differences between the Cassiar and Good Hope Lake stations by the factor 1.3 (401/307) and then adding the resulting numbers to the 1961 – 1990 temperature normals for the Watson Lake Airport. The resulting estimated monthly temperature distribution at the tailings impoundment is listed in Table 2-4. The mean annual temperature at the mine site is predicted to be -6.6°C, which compares to a value of -3.1°C at the Watson Lake Airport.

A rough indication of the temperature extremes at the mine site can be made by referencing the long-term (52 year) and reliable climatological record at the Watson Lake Airport. The extreme minimum temperature experienced at this station was -59°C; the extreme maximum temperature was 34°C.

2.7 EVAPORATION ESTIMATE

The network of evaporation stations is sparse in the Yukon and northern British Columbia. The closest evaporation pan is located at the Whitehorse Airport MSC station, some 340 km west of the mine site. This station experiences higher air temperatures than does the mine site and as a result probably experiences higher evaporation rates.

In order to account for this temperature dependency, the evaporation rate at the tailings impoundment was approximated using the Thornthwaite Method (Gray, 1973), an empirical formula that uses average monthly air temperature and latitude to calculate potential evapotranspiration. The temperature regime derived in Section 2.6 provided the input data for the Thornthwaite Method. The calculated monthly average evaporation values are listed in Table 2-4. Using this empirical method, the annual lake evaporation rate was estimated to be 430 mm.

The accuracy of the Thornthwaite Method was tested by applying it to the same conditions as experienced at the Whitehorse Airport. This empirical relationship predicted an evaporation rate for the period May to September that was only 2% less than the value derived from pan measurements.

3.0 WATER RESOURCES

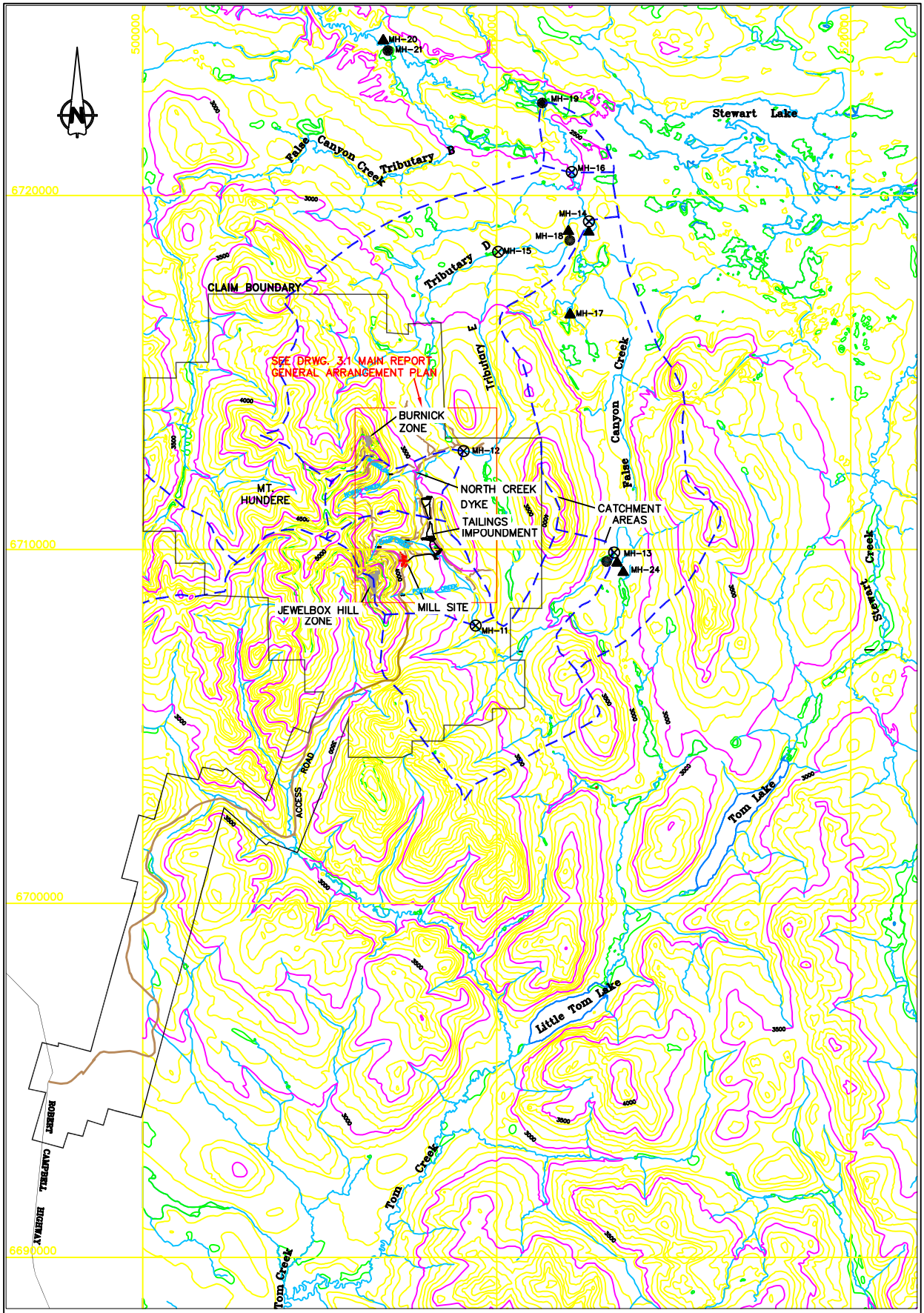
3.1 SURFACE WATER HYDROLOGY

3.1.1 Hydrological Setting

The Sä Dena Hes mine is located in the drainage basin of False Canyon Creek, a left bank tributary of the Frances River. False Canyon Creek has a total catchment area of 492 km^2 and discharges some 55 km above the Frances River and Liard River confluence. Access to the mine development is from the south across the drainage basin of Tom Creek, a left bank tributary of the Liard River.

Figure 2-1 shows the location of the mine in relation to the major rivers and lakes of the region.

The open pits, underground workings and waste rock dumps associated with the Jewelbox ore zones are located near the drainage divide between Tom and False Canyon Creeks. All drainage from the Jewelbox development is directed to Camp Creek, a steep-gradient tributary of False Canyon Creek that drains the eastern flank of Mount Hundere. The mill site is also located in the catchment of Camp Creek. The Burnick development is entirely confined in the headwaters of another False Canyon Creek tributary, which has been designated Tributary D. The tailings impoundment is constructed in a saddle that lies along the drainage divide between Camp Creek and Tributary E. Figure 3-1 shows the locations of the major mine elements relative to the catchments of False Canyon and Tom Creeks. Figure 3-2 is a larger scale map showing the drainage basin for the Tailings Management Facility.



NTS: 105 A/06, 105 A/07
105 A/10, 105 A/11

CONTOUR INTERVAL 100 FEET

0 1000 2000 3000 4000 5000 metres
1:100,000

NOTE
BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

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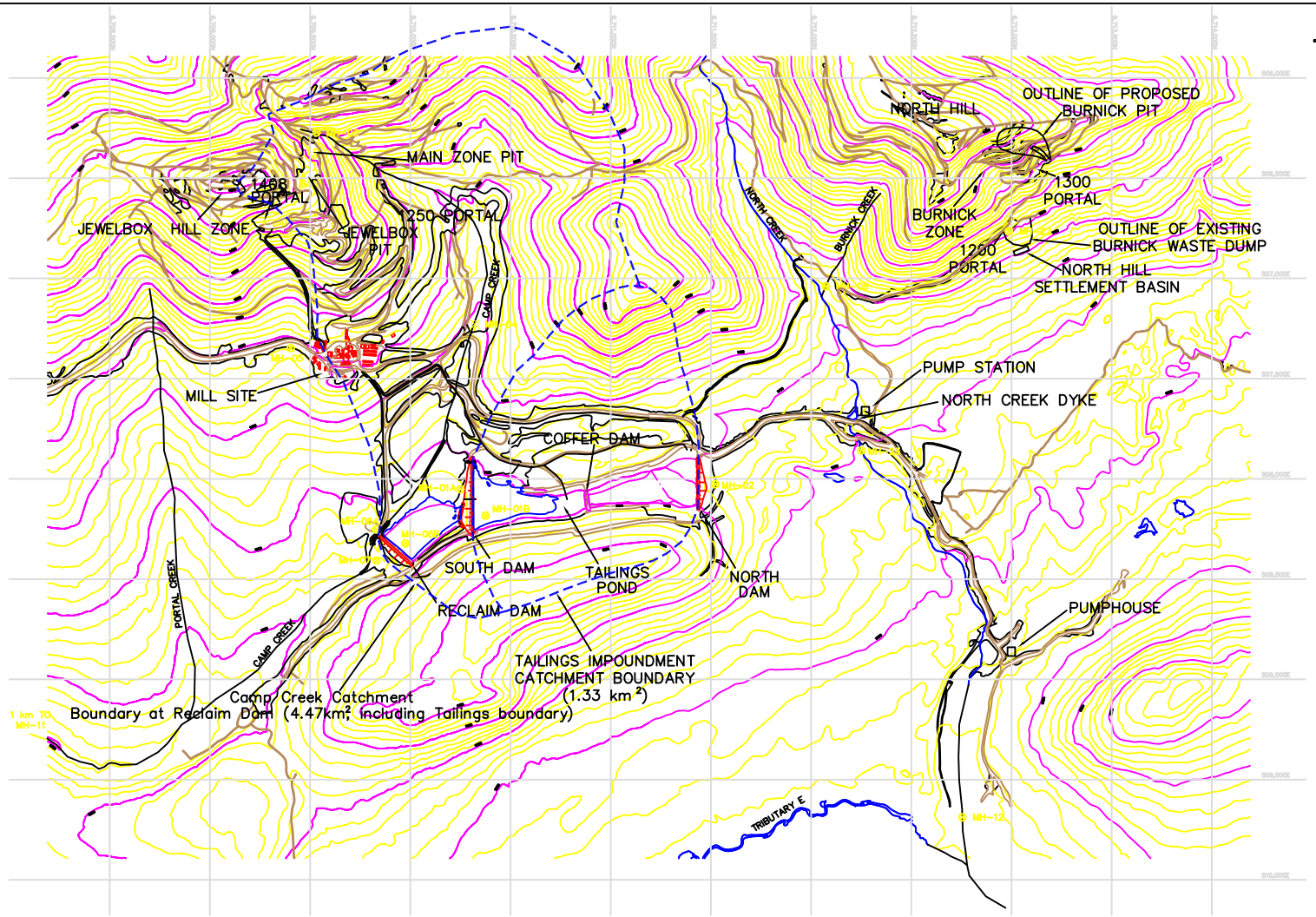
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LEGEND
- WATER MONITORING STATION
- FISH MONITORING STATION
- BENTHIC MONITORING STATION

SÄ DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

LOCATION PLAN

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	PMH	3-1	
DATE: JULY 29,1999	PROJ. NO. 1CC005.05		



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LEGEND

⊗ WATER MONITORING STATION

0 200 400 600 800 1000 metres

1:20,000

CONTOUR INTERVAL=10m

NOTE
BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Sä DENA HES DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

CAMP CREEK AND TMF
CATCHMENT BOUNDARIES

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	PMH	3-2	
DATE: JULY 29,1999	PROJ. NO. 1CC005.05		

3.1.2 Available Data

As was done for the climate analysis, the hydrology of the minesite was first characterized in 1990 as part of the mine's permitting studies. The hydrology was then updated in 1999 and 2005 to support preparation of the DDRP. The hydrology was estimated using a mix of site-specific and regional data. At the point of updating the hydrology in 1999, no automated streamflow gauging stations had been operated at the minesite. The site-specific data largely comprised spot measurements made by a current meter.

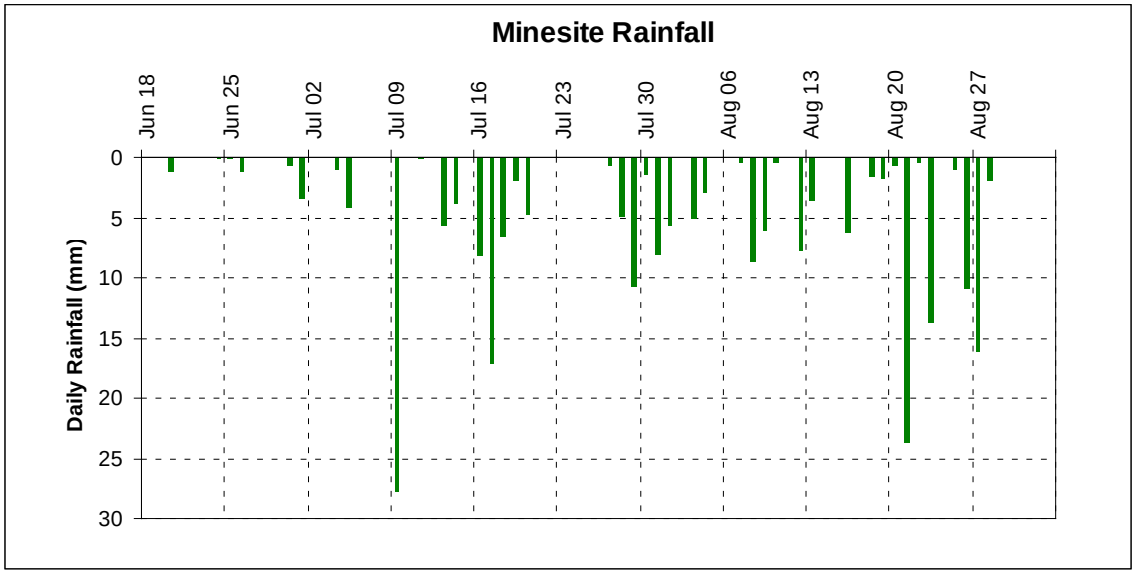
In 2002, Access Mining Consultants established an automated water level recorder in the Camp Creek Diversion upstream of the spillway from the Reclaim Pond. At the time of the latest update to the hydrology assessment (2005), this streamflow gauging station had been operated for four open water seasons. A total of 12 direct flow measurements had been made at the station with a current meter. Operation of this station has continued and the streamflow data collected since 2005 will be incorporated into an updated hydrological assessment for the mine, slated for 2013.

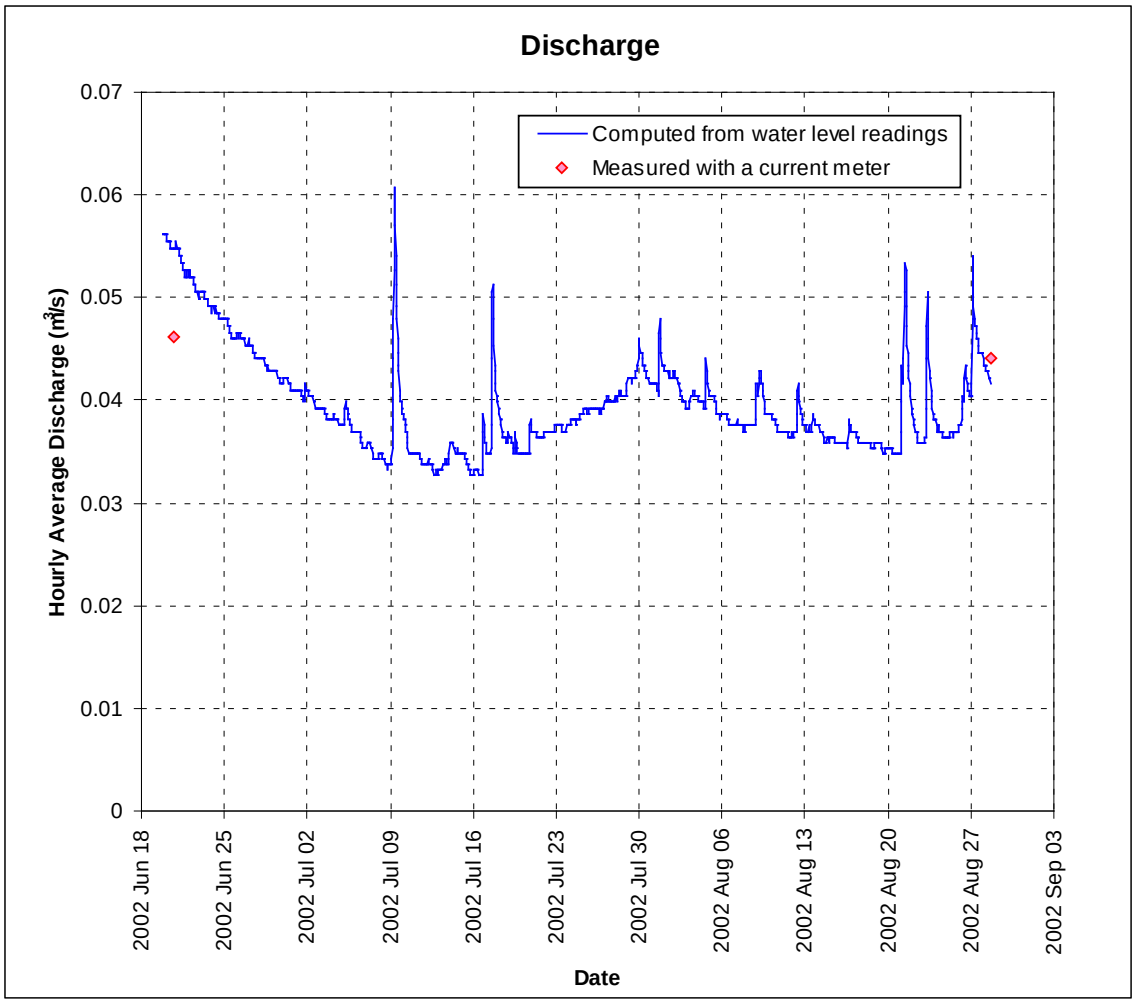
The flows collected at the Camp Creek Diversion from 2002 to 2005 are presented in Figures 3-3 to 3-5. The corresponding daily rainfall records collected at the mill site, where available, are also shown on these figures.

The flow hydrographs for Camp Creek have one distinctive feature: they are subdued. This suggests that the groundwater contribution to streamflow is large. Large rainfalls (e.g., see July 9, 2002 event on Figure 3-3) appear to cause only minor increases in flow in Camp Creek. The groundwater-dominated nature of the hydrology may, at least partly, be a result of the limestone geology within the stream's catchment.

The annual peak was probably missed in the first two years of record and may have also been missed in 2004. However, it is very likely that the 2005 peak was measured, as evidenced by the streamflow record of a regional streamflow gauging station (Big Creek). This regional station experienced its annual peak just days after the peak was observed in Camp Creek (see Figure 3-5).

The 2005 peak flow for Camp Creek is shown on Figure 3-5 to be about 0.5 m^3/s. However, it is strongly suspected that the true discharge was less than this value. On the day preceding the occurrence of the peak, the stream was largely covered by ice and snow. This cover may have partially still been in existence at the time of the flow peak, resulting in a higher stream level for a given flow rate than would occur if the channel was completely free of ice and snow. The shape of the water level record exhibits abrupt increases and decreases in stream depth just prior to and following the apparent peak in discharge, which suggests the stream channel may have been temporarily dammed by ice and snow. Further discussion of the Camp Creek flow data is given in Section 3.1.5.





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Camp Creek Flow Record and Minesite Rainfall Record - 2002

Job No: 1CT008.004

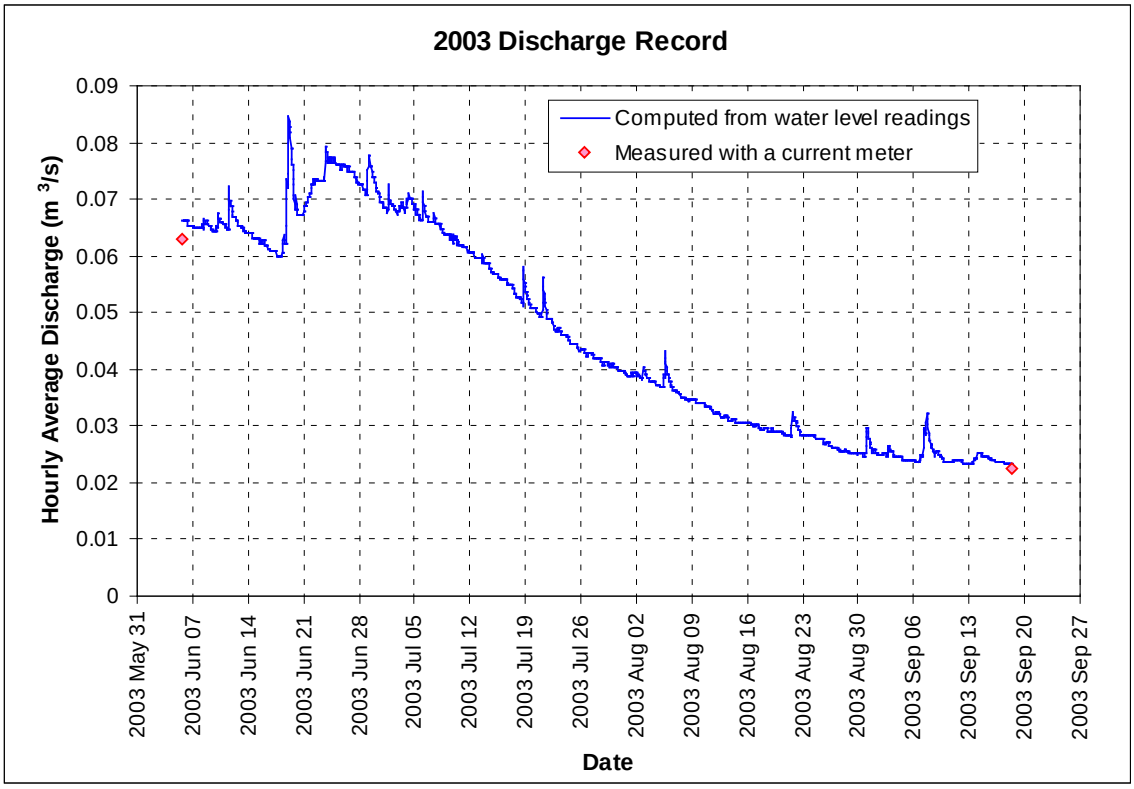
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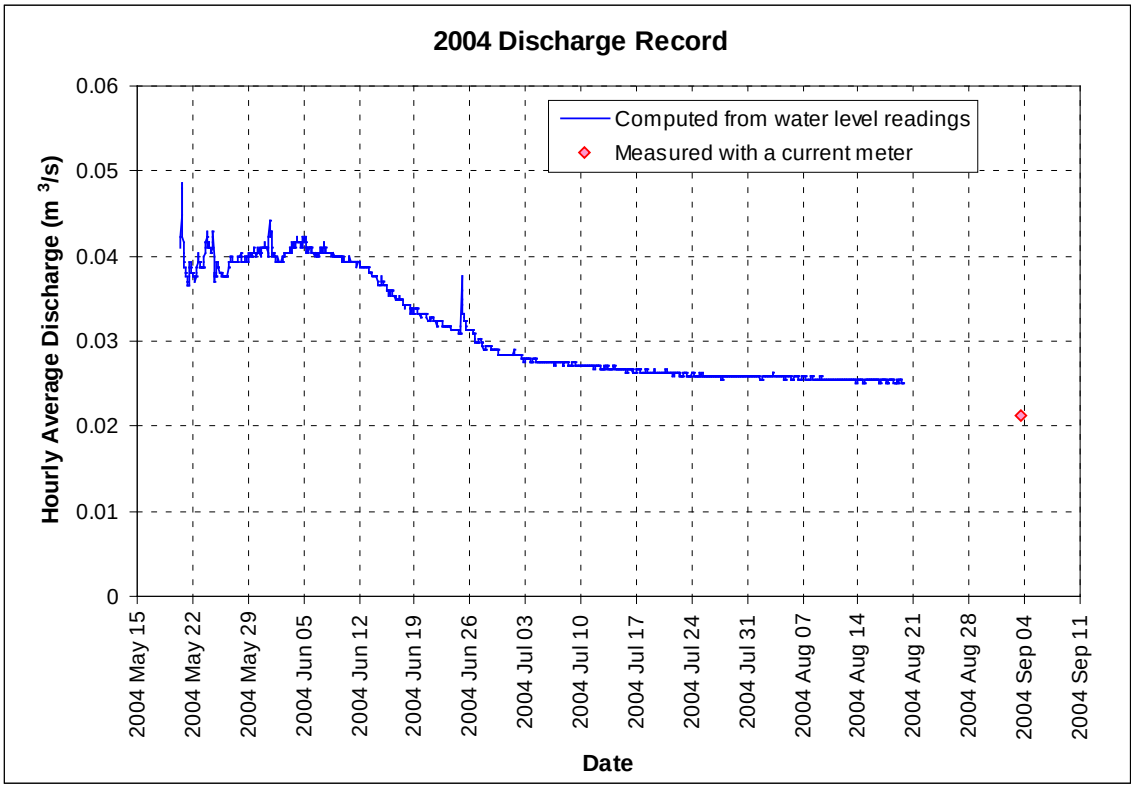
Sä Dena Hes Detailed Decommissioning and Reclamation Plan

Date: Dec. 2005

Approved:

Figure: 3-3





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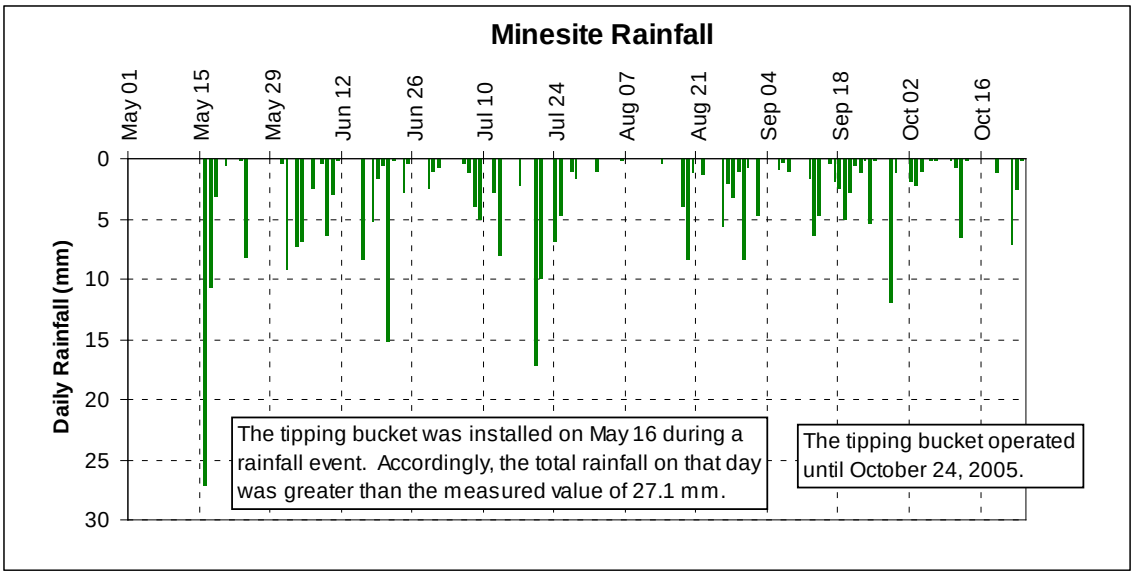
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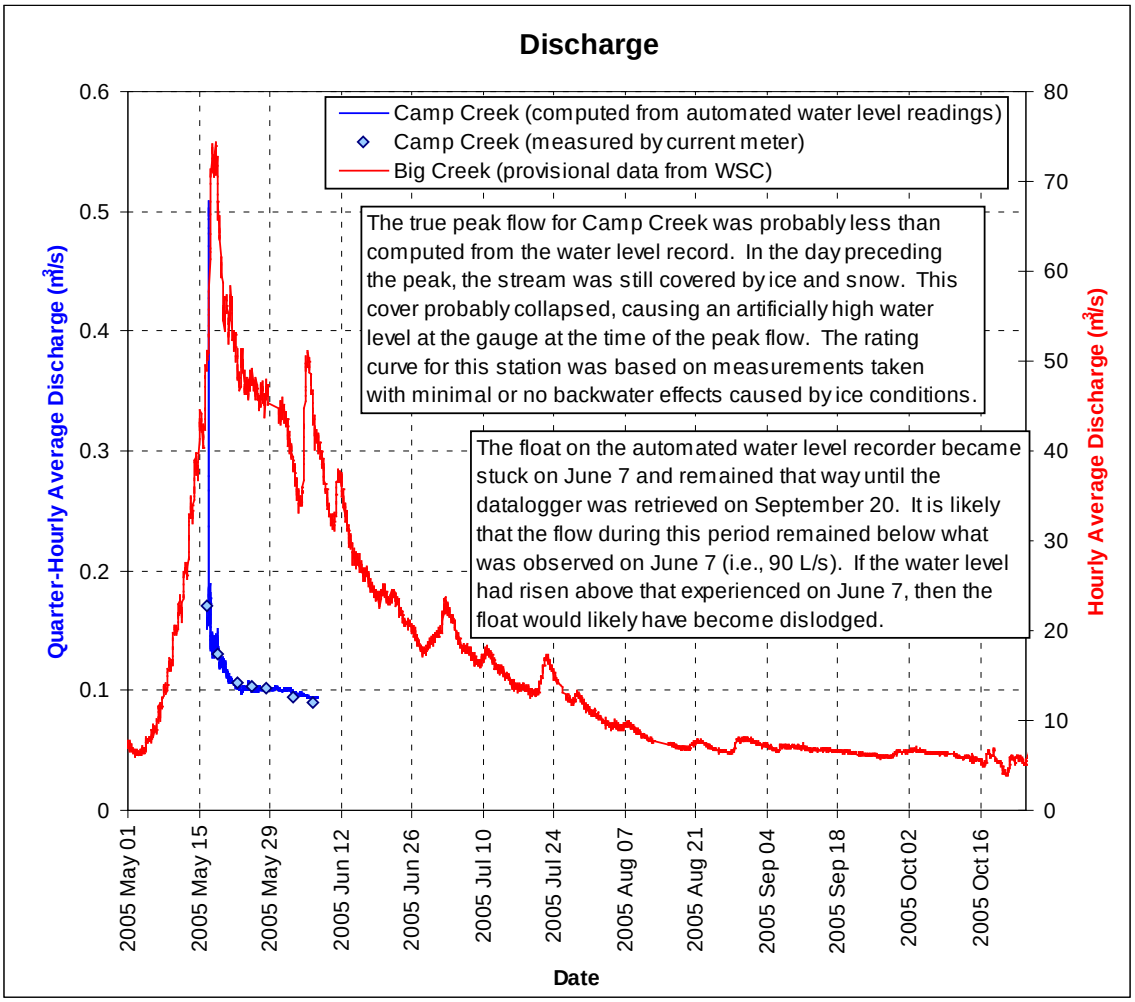
Hourly Flow Record for Camp Creek – 2003 and 2004

Job No: 1CT008.004
Filename: Figure 3_hr flow Record Camp Cr_20051214.ppt

Sä Dena Hes Detailed Decommissioning and Reclamation Plan

Date: Dec. 2005
Approved:
Figure: **3-4**





SRK Consulting Engineers and Scientists VANCOUVER	teckcominco	**Camp Creek Flow Record and Minesite Rainfall Record - 2005**
Job No: 1CT008.004 Filename: Figure 4_Camp Cr Flow Record-05_20051214.ppt	Sä Dena Hes Detailed Decommissioning and Reclamation Plan	Date: Dec. 2005 | Approved: | Figure: **3-5**

3.1.3 Average Flow Estimates

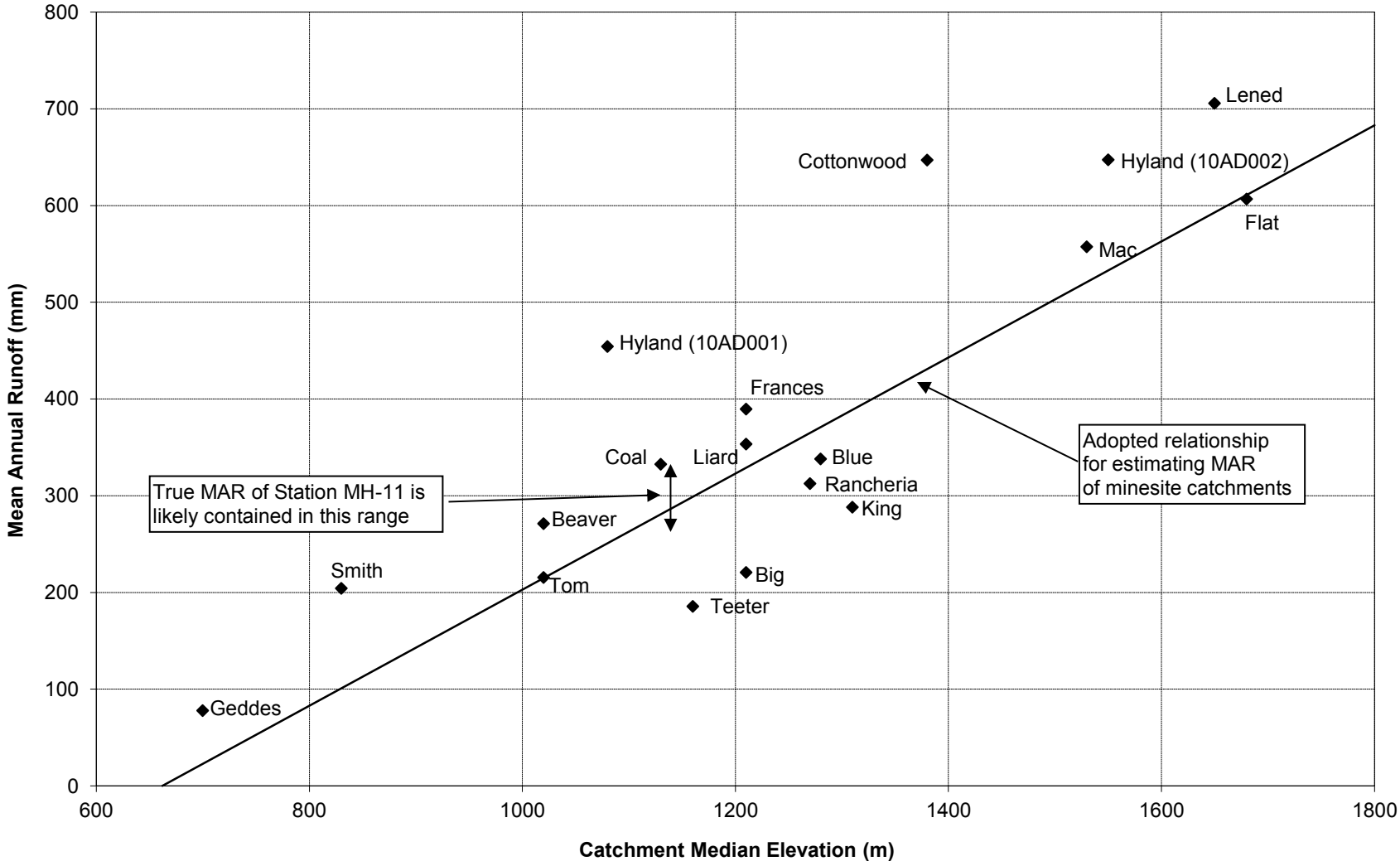
As indicated in Section 2.4, elevation generally accounts for a large proportion of the variation in mean annual precipitation within a mountainous region. It follows, therefore, that mean annual runoff (MAR) would also be a function of elevation. Figure 3-6 shows how this observation was exploited to estimate the average flows of the minesite streams. The vertical axis of this figure displays values of MAR expressed as equivalent depths of water. The horizontal axis shows values of median elevation, which is the variable adopted to quantify the elevation characteristics of the regional and minesite catchments. The 18 pairs of MAR and median elevation values assembled in Table 3-2 for the WSC stations were plotted on this figure. These data demonstrate a reasonably strong relationship between the two variables.

The data plotted on Figure 3-6 were used to develop a relationship that was believed to represent the conditions at the minesite. Two steps were undertaken to develop the relationship. Firstly, a linear regression was fitted to all 18 data points. This defined a straight line with a slope of 0.60 mm per m. Secondly, the intercept of this straight line was adjusted to force the line through the data point for Tom Creek. This adjustment was based on the premise that, of all the WSC catchments, the one for Tom Creek is probably the most representative of the conditions within the False Canyon Creek catchment. These two catchments share a significant portion of their respective drainage divides and also possess similar elevational characteristics.

Expressed as an equation, the adopted relationship between mean annual runoff (MAR in mm) and catchment median elevation (E in m) is:

$$MAR = 0.60\ E - 397$$

The above relationship was derived exclusively from the regional data. The site-specific data collected at Station MH-11 were reserved for validation purposes. The streamflow record for this station comprises a series of spot flow measurements made over a 10-year period.



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SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

REGIONAL RELATIONSHIP BETWEEN MEAN ANNUAL RUNOFF AND CATCHMENT MEDIAN

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		**3-6**

To provide a greater degree of confidence in the estimate, the observed flows at Station MH-11 were correlated with the coincidental flows of neighbouring WSC Stations. Three stations were selected for this purpose, Station 10AA005 on Big Creek, Station 10AA004 on Rancheria River and Station 10AA002 on Tom Creek. Figure 3-7 is a graphical presentation of the correlations. These correlations were performed on log-log graphs in recognition of the differences between the flow regimes of small and large catchments. Station MH-11 commands a much smaller catchment than the three WSC Stations and, accordingly, is expected to experience a more erratic flow regime (i.e., the ratio between the highest and lowest flow for Station MH-11 should be greater than the corresponding ratios for the other three stations).

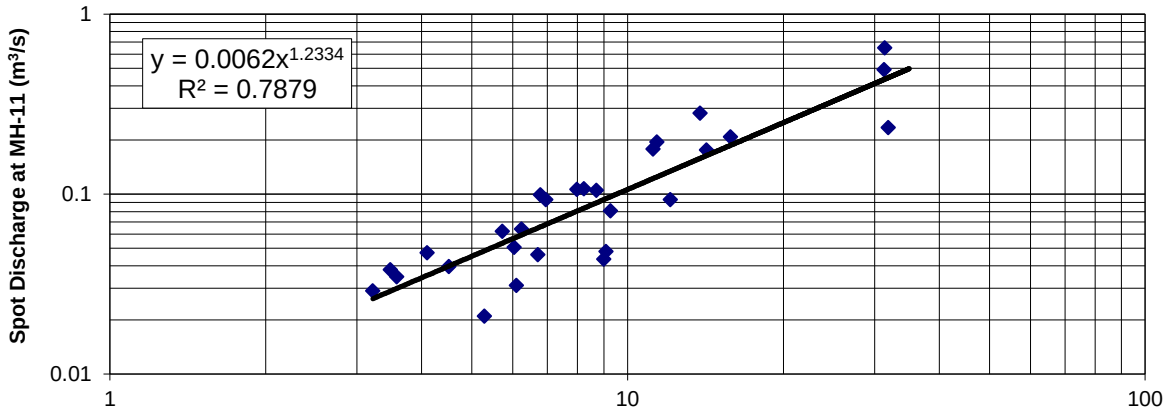
The correlations were used to make estimates of the MAR at Station MH-11. Table 3-1 summarizes the results. These correlations provided estimates that fall in a fairly narrow range from 266 mm to 330 mm. To validate the adopted relationship between MAR and elevation, this range was plotted on Figure 3-6. As can be seen, the adopted relationship passes through the range believed to contain the true MAR of Station MH-11. This suggests that the relationship is reasonably accurate, at least for catchments with similar median elevations as Station MH-11 (1140 m).

The above discussion centred on finding a means of determining the average annual runoff volume at an ungauged site. The remainder of this section presents a technique for distributing this annual volume amongst the twelve months of the year. To implement this technique, an examination was made of the average monthly hydrographs observed at the regional gauging stations. The top plot on Figure 3-8 graphically presents the distributions for five regional stations. The average monthly flows for these distributions have been expressed as percentages of MAR to facilitate comparisons amongst the distributions. Of all the 18 WSC stations selected for the hydrology study, the five selected ones were judged to be the most representative of the minesite catchments, largely on the basis of a similarity in catchment median elevation.

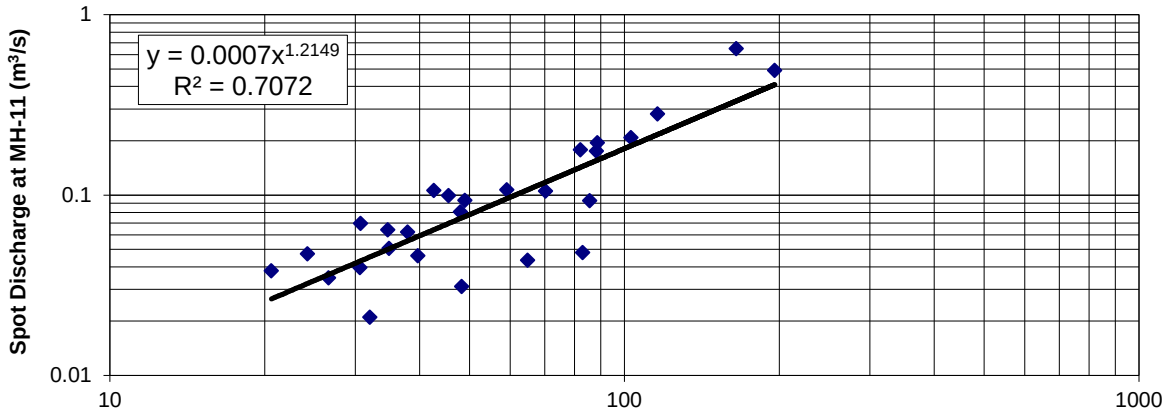
Table 3-1 Estimated Streamflow Characteristics at Station MH-11

Location	Streamflow Characteristic				
	Mean Annual Runoff [a]		7-Day Low Flow for the following Return Periods:		
	As a Flow (m^3/s)	As a Depth (mm)	2-Year (m^3/s)	10-Year (m^3/s)	50-Year (m^3/s)
Big Creek at WSC Station 10AA005	6.93	221	1.97	1.31	0.97
Station MH-11 (estimated using regression between MH-11 and 10AA005)	0.075	266	0.014	0.009	0.006
Rancheria River at Station 10AA004	50.5	312	10.1	5.21	2.79
Station MH-11 (estimated using regression between MH-11 and 10AA004)	0.087	308	0.011	0.005	0.002
Tom Creek at WSC Station 10AA002	2.97	215	0.374	0.182	0.104
Station MH-11 (estimated using regression between MH-11 and 10AA002)	0.093	330	0.015	0.008	0.005
Average estimate for Station MH-11	**0.085**	**301**	**0.013**	**0.007**	**0.004**

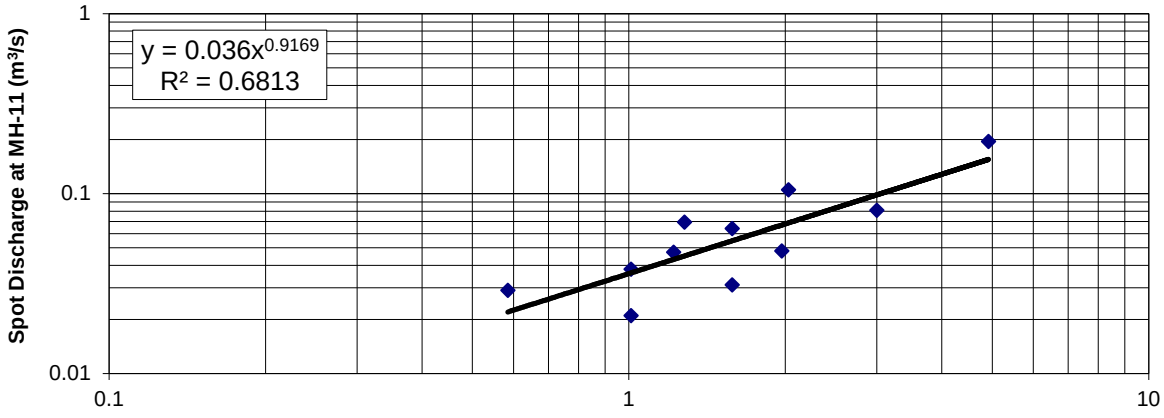
Note: a) Based on the complete daily record of the WSC Station, a daily streamflow record was synthesized for Station MH-11. This was done by applying the regression equation to every observed daily flow value in the record of the WSC station. The MAR of Station MH-11 was then taken to equal the average of the synthesized record.



Daily Average Discharge at WSC Station10AA005 on Big Creek (m³/s)



Daily Average Discharge at WSC Station 10AA004 on Rancheria River (m³/s)

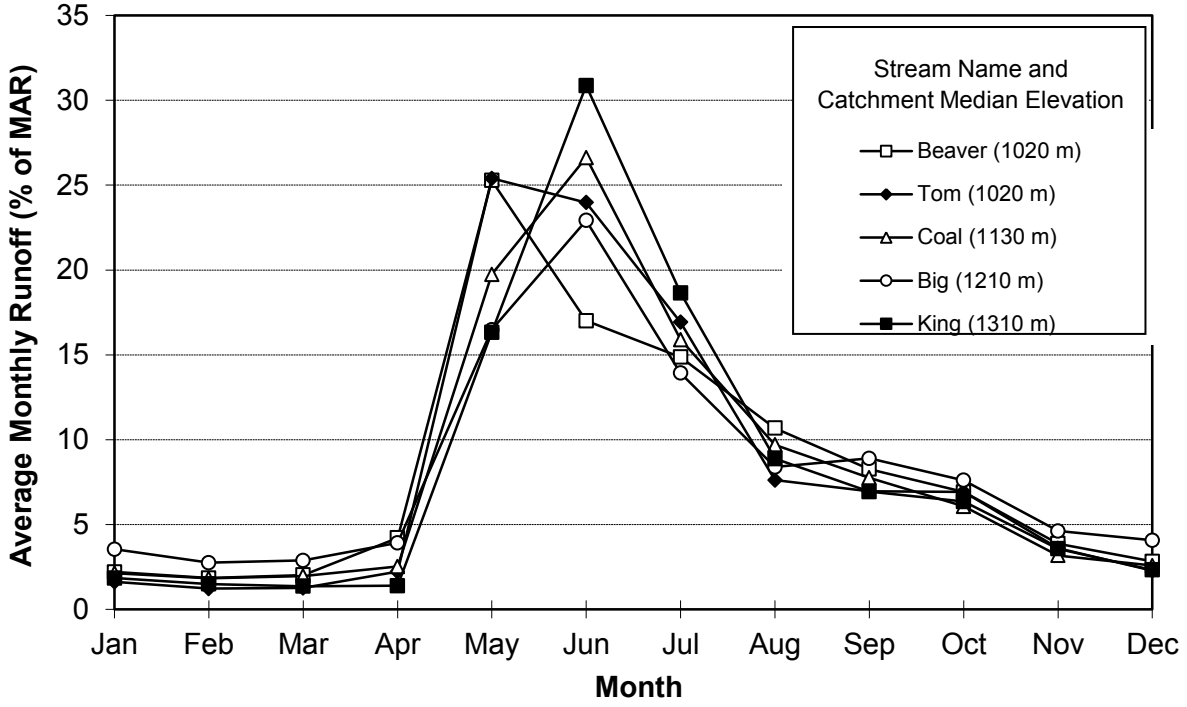


Daily Average Discharge at WSC Station 10AA002 on Tom Creek (m³/s)

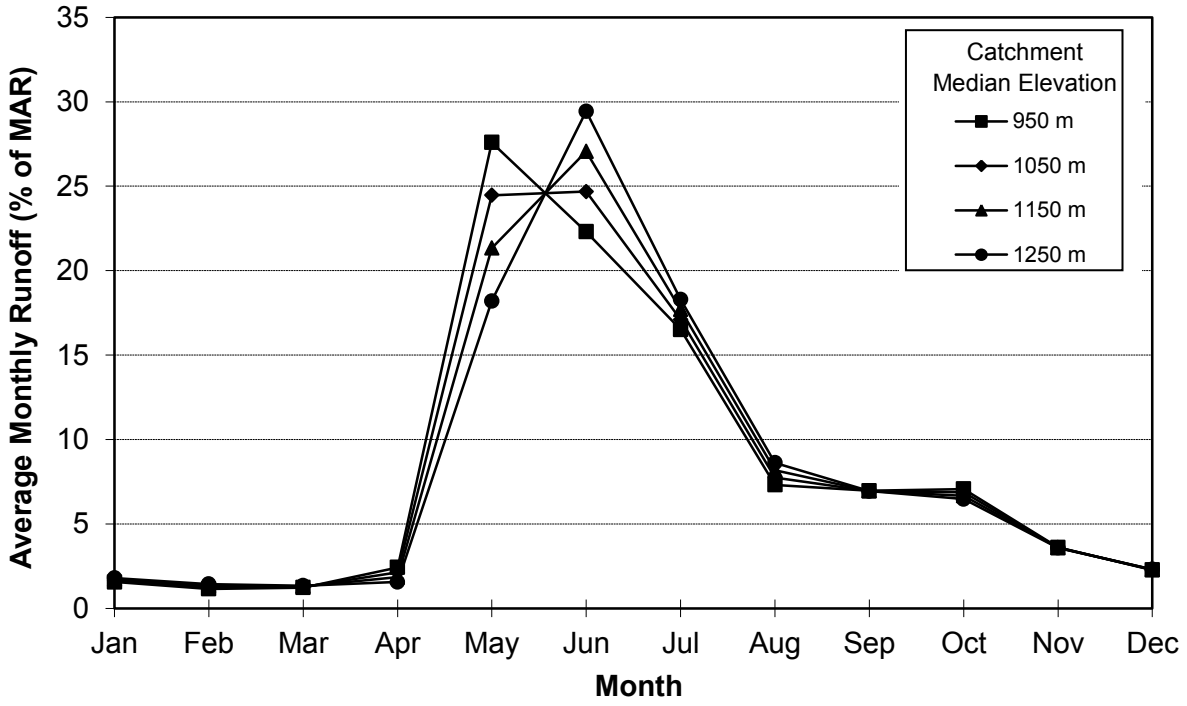
Cominco	SRK Consulting Engineers and Scientists ACCESS MINING CONSULTANTS LTD.	**SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN** CORRELATION BETWEEN SITE AND REGIONAL STREAMFLOW DATA

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		**3-7**

Observed Streamflow Distributions at Regional WSC Stations



Estimated Streamflow Distributions for Minesite Streams



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PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		3-8

The distributions for the five selected stations are characterized by high spring flows during snowmelt and low winter flows during prolonged freezing conditions. All five distributions are remarkably similar over the period August to April, especially considering they represent runoff from significantly different catchment areas ranging from 13.7 km^2 to 9190 km^2. The major difference that exists amongst the five distributions is the proportion of runoff that occurs during the months of May, June and July. Examination of these distributions and the characteristics of their associated catchments revealed that median elevation is a reasonably good predictor of the shape of the average monthly hydrograph. As expected, low-elevation catchments generally experience earlier peaks than high-elevation catchments. The median elevations for the catchments of the five stations are shown in the legend of the top plot.

The observed relationship between hydrograph shape and catchment median elevation was used to estimate the shape of the average monthly hydrograph at ungauged locations around the minesite. The bottom plot on Figure 3-8 shows how this was implemented. The normalized distributions for Tom Creek and King Creek were used to establish the hydrograph shape at median elevations of 1020 m and 1310 m, respectively. Interpolation between the shapes of these two hydrographs was used to estimate the distribution for intermediate median elevations. Figure 3-8 shows the estimated shapes of the hydrographs for four distinct elevations.

3.1.4 Low Flow Estimates

Low flows in southeastern Yukon occur in the winter months due to the prolonged freezing conditions. This is a consistent phenomenon, as evidenced by the WSC streamflow records assembled for this study. For 16 of the 18 records, the annual minimum daily flow was observed to always occur in the period November to early May. Even for the other two records, low flows outside this period were infrequent. For the Cottonwood River, the annual minimum was outside the winter period on only one occasion over a total of 35 years of record. In the case of Geddes Creek, the annual minimum was outside the winter period a total of four times in a 17-year record.
The magnitude of low flows at the minesite was estimated using Regional Analysis. To apply this technique, three steps were undertaken. Firstly, the annual series of 7-day low flows was extracted from each of the 18 WSC streamflow records assembled for this hydrology study. For the purpose of selecting the annual low-flow values, the year was defined as the period June 1 to

May 31. Use of a calendar year was rejected for this purpose to avoid missing any low-flow periods that might span the period from late December to early January. It is interesting to note that the annual low flows for durations of 1, 3, 10 and 30 consecutive days have values very close to the 7-day low flow. This is a consequence of the low flows occurring in the winter rather than the late summer. The winter flows originate from storage releases (lake and groundwater) and, accordingly, vary only slightly over lengthy periods of time.

The second step involved fitting a theoretical frequency distribution (Log-Pearson Type III) to each annual series to estimate the magnitude of extreme low flow events. This step and the previous one were performed using a suite of computer programs developed by the U.S. Geological Survey (Jones and Fahl, 1994) for processing hydrological data (viz., IOWDM2.4, SWSTAT3.2 and ANNIE2.5). Table 3-2 summarizes the results obtained from these programs. Estimates of the 7-day low flow are presented for return periods of 2, 5, 10, 20, 50 and 100 years. Because the 18 WSC stations measure the flow from a wide range of catchment areas, some method was sought to normalize the low flow values so that comparisons amongst the stations could readily be made. The method adopted was to express the values as percentages of the mean annual runoff. For example, the table indicates that the 7-day, 50-year low flow for the Blue River station is 6.3% of MAR. This corresponds to a flow rate of 1.1 m^3/s (i.e., 6.3% of 18.2 m^3/s).

The third and final step entailed finding a way of transposing the low flow values in Table 3-2 to the minesite. To accomplish this, an examination was made of the relationship between low flow and the physical characteristics of the catchments that generated the flow. Two such characteristics were investigated: catchment median elevation and catchment area. Correlation with the former characteristic was poor but catchment area was discovered to help explain at least some of the variation in the low-flow characteristics of the WSC stations. A relationship with catchment area is plausible because channel storage and floodplain area tend to increase as drainage area increases. Increases in these two features of a catchment provide a larger unit storage of water from which to sustain the baseflow.

Table 3-2 Estimated Low Flow Magnitudes at Regional Streamflow Gauging Stations

Streamflow Gauging Station		Catchment Area (km^2)	Mean Annual Runoff (m^3/s)	Annual Minimum 7-Day Discharge as a Percentage of Mean Annual Runoff					
ID No.	Name			2-Year	5-Year	10-Year	20-Year	50-Year	100-Year
10BD001	Beaver River below Whitefish River	7280	62.5	22.3	18.4	16.2	14.3	12.3	10.9
10AA005	Big Creek at km 1084.8 Alaska Highway	991	6.93	28.4	22.1	19.0	16.5	14.0	12.4
10AC004	Blue River near the mouth	1700	18.2	19.3	14.0	11.0	8.7	6.3	5.0
10BC001	Coal River at the mouth	9190	96.8	20.7	18.0	16.7	15.7	14.6	13.9
10AC005	Cottonwood River above Bass Creek	888	18.2	12.5	9.2	7.1	5.4	3.8	2.9
10EA002	Flat River at Cantung Camp	128	2.46	11.4	9.2	8.2	7.4	6.5	6.0
10AB001	Frances River near Watson Lake	12800	158	13.6	11.8	10.9	10.3	9.5	9.1
10BE008	Geddes Creek at the mouth	77.8	0.192	42.7	32.3	27.6	24.0	20.8	18.8
10AD002	Hyland River at km 108.5 Nahanni Range Road	2150	44.1	9.2	8.0	7.4	6.9	6.4	6.0
10AD001	Hyland River near Lower Post	9450	136	13.5	10.9	9.5	8.4	7.1	6.3
10AB003	King Creek at km 20.9 Nahanni Range Road	13.7	0.125	12.0	0.0	0.0	0.0	0.0	0.0
10EB003	Lened Creek above Little Nahanni River	34.3	0.767	8.2	6.1	5.2	4.6	3.8	3.4
10AA001	Liard River at Upper Crossing	33400	374	17.3	15.0	13.9	13.1	12.1	11.6
10EB002	Mac Creek near the mouth	188	3.32	3.4	1.8	1.2	0.8	0.5	0.3
10AA004	Rancheria River near the mouth	5100	50.5	20.0	13.6	10.3	7.9	5.5	4.2
10BE013	Smith River above Smith Falls	3740	24.2	53.4	45.5	42.0	39.3	36.6	34.9
10BE009	Teeter Creek near the mouth	211	1.24	44.9	33.2	27.3	22.6	17.7	14.9
10AA002	Tom Creek at km 34.9 Robert Campbell Highway	435	2.97	12.7	8.1	6.2	4.8	3.5	2.9

Figure 3-9 is a graphical presentation of the analysis involved in the third step. This figure shows three plots, one each for the 2-year, 10-year and 50-year events. The vertical axis of each plot shows values of 7-day low flow expressed as a percentage of MAR. The horizontal axis presents the independent variable, or catchment area. At first glance, the data on these plots appear to exhibit considerable scatter. However, the situation improves when the data points for Geddes Creek, Smith River and Teeter Creek are removed from further consideration (denoted by open diamonds on the plots). The catchments of these streams are probably substantially underlain by carbonate bedrock that promotes the development of substantial groundwater storage. This storage results in an attenuated hydrograph shape with very high baseflows.

Even with the removal of these three "high-yield" catchments, a significant amount of scatter still remained. Given this scatter, the decision was made to develop a prediction equation that would provide conservative estimates of low flow for the minesite streams. To do this, the remaining 15 WSC stations were separated into two groups. The first group comprised the stations that, in effect, formed a lower-bound envelope on all the data. This group was designated the "low-yield catchments" (solid squares on the plots of Figure 3-9). The second group was named the "moderate-yield catchments" and covered the stations lying just above the first group (open squares on the plots). To provide a convenient means of estimating the low flows at ungauged locations, a set of logarithmic regressions were fitted to the data from the first group.

These logarithmic regressions appear as straight lines on the three plots of Figure 3-9. In equation form, these lines are expressed as:

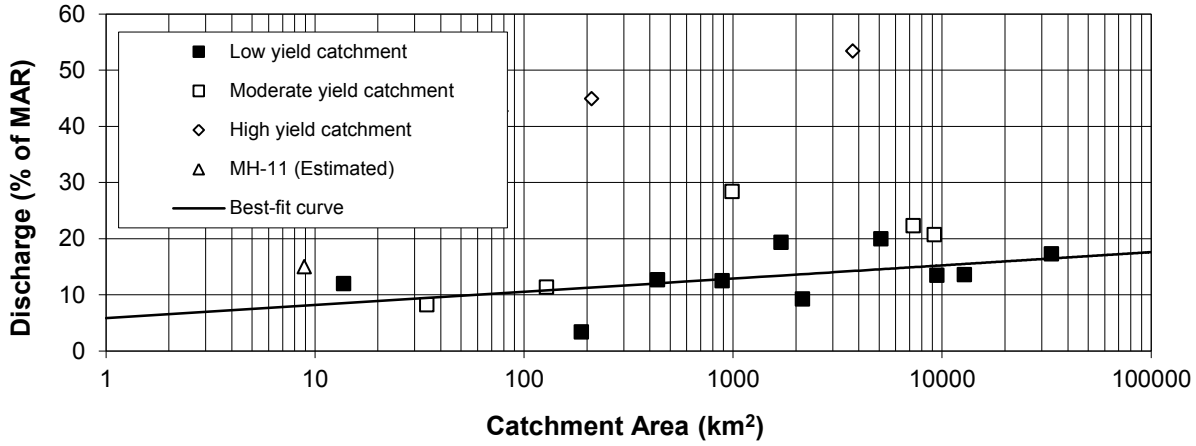
$$Q_{7,2} = Q_{MAR} (0.0235 \log A + 0.0583)$$

$$Q_{7,10} = Q_{MAR} (0.0413 \log A - 0.0541)$$

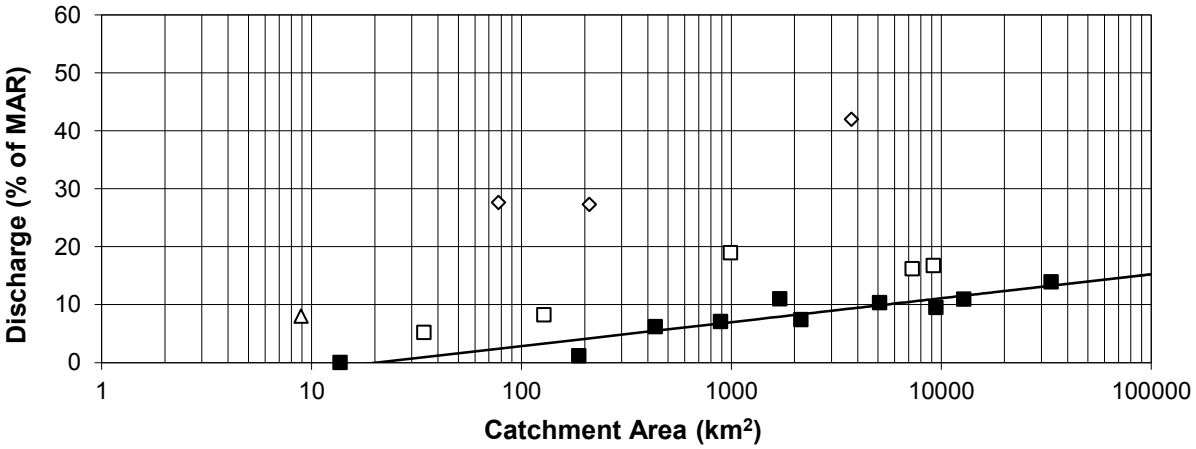
$$Q_{7,50} = Q_{MAR} (0.0351 \log A - 0.0571)$$

where: $Q_{7,2}$ = annual minimum 7-day flow with 2-year return period (m^3/s);
$Q_{7,10}$ = annual minimum 7-day flow with 10-year return period (m^3/s);
$Q_{7,50}$ = annual minimum 7-day flow with 50-year return period (m^3/s);
Q_{MAR} = mean annual runoff (m^3/s); and,
A = catchment area (km^2).

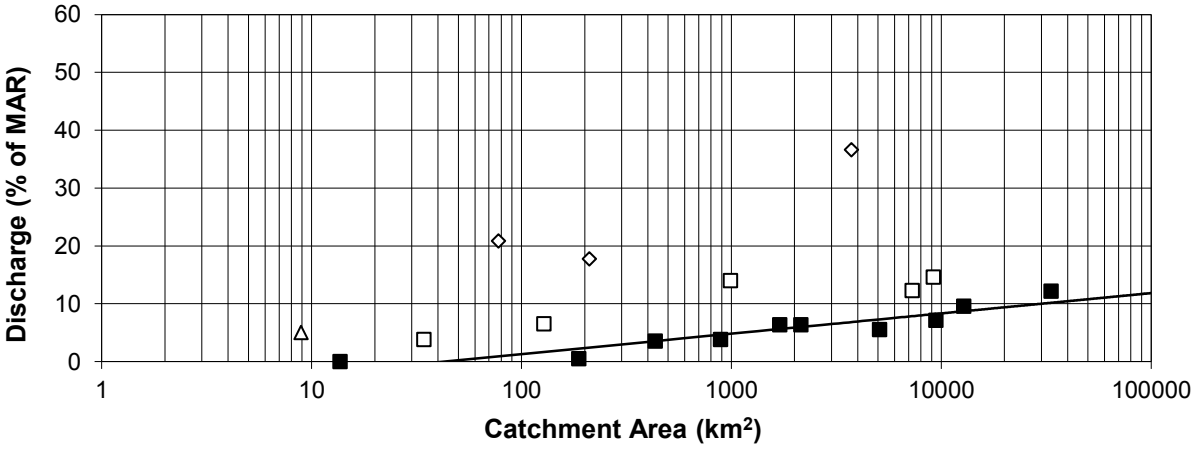
7-Day Low Flow with 2-Year Return Period



7-Day Low Flow with 10-Year Return Period



7-Day Low Flow with 50-Year Return Period



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PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		3-9

These equations suggest that the flow in small catchments (i.e., with areas less than about 10 to 50 km^2) may completely freeze-up at a return period of 10 years.

As was done for average flows, the stream flow record of Station MH-11 was used as a check on the low-flow analysis. Extreme low flow events for this station were estimated using the correlations developed in Section 3.1.3. The mechanics of computing the low flow events are set out in Table 3-1. The estimated 7-day low flows at Station MH-11 for return periods of 2, 10 and 50 years have been plotted on the graphs of Figure 3-9. As can be observed, the MH-11 values suggest that the "moderate-yield" catchments, rather than the "low-yield" catchments, may better represent the Upper False Canyon Creek. However, this observation must be viewed with caution because none of the flow measurements at MH-11 were conducted in the period January to April, or the period most likely to contain the annual minimum flow. Until such measurements become available, the equations based on the "low-yield" catchments should be used to estimate the low-flow characteristics of the minesite streams. Based on the preliminary comparison made with the MH-11 data, these equations will likely provide conservative (i.e., low) estimates for the Upper False Canyon Creek. This is not necessarily the case for locations further downstream in False Canyon Creek. It is noteworthy that the data point for Tom Creek falls within the group of "low-yield" catchments.

3.1.5 Flood Estimates

A Dam Safety Review was conducted in 2003. A key finding was that failure of the tailings dams does not pose a significant risk to the public health and safety after closure. Also, the environmental impact would be limited. For these reasons, the required design flood for closure was deemed to be the 1000-year event, or the same event specified as a requirement in the water licence. This section describes the analysis undertaken to estimate the 1000-year flood magnitudes at key locations around the mine development. For comparison purposes, this section also provides estimates of the mean annual flood(MAF) and the 200-year return period flood. Three techniques were used to estimate the mine's flood regime, namely the Rational Method, Regional Analysis and application of a hydrological model.

3.1.5.1 Rational Method

For small catchments in the Yukon, most of the annual floods are caused by snowmelt, as evidenced by the high frequency of annual flood peaks occurring in the months of May and June. Despite this observation, the most extreme floods on small catchments can be generated by another mechanism, namely intense rainstorms. In recognition of the importance of this second mechanism, the Rational Method was adopted to assess the design floods for the minesite streams. The Rational Method is essentially a modeling technique that simulates the magnitude of floods caused by intense rainstorms.

The Rational Method entails applying the following formula:

$$Q = CIA/3.6$$

Where: Q is the peak instantaneous discharge of the flood (m^3/s);
C is a runoff coefficient (dimensionless);
I is the average rainfall intensity which causes the flood (mm/h); and
A is the catchment area (km^2).

The runoff coefficient specifies the proportion of the rainfall that quickly runs off the catchment to form the flood hydrograph. The remainder of the rainfall is retained on the catchment for subsequent evaporation or slow release to the catchment's streams. The value of the runoff coefficient varies from storm to storm depending on the initial moisture content of the soils and the extent of frozen soils within the catchment. For rural catchments, such as those at the minesite, standard practice is to assume a low runoff coefficient for frequent floods and a high coefficient for rare events. Accordingly, values of 0.3, 0.9, and 0.95 were adopted to represent the "wetness" of the study catchments during, respectively, the mean annual flood, the 200-year flood, and the 1000-year flood. A value of C equal to 0.95 implies a very wet catchment in which practically all of the rainfall is converted to flood runoff.

In order to apply the Rational Method, it was necessary to estimate a characteristic of each study catchment known as the "time of concentration". This is a measure of the response time of the catchment. It may be interpreted as the time it takes for the most remote portion of the catchment to contribute to the flow at the outlet of the catchment. The time of concentration was estimated

using empirical relationships that depend on the physical characteristics of the catchment (Leopold, 1991 and McCuen, 1982).

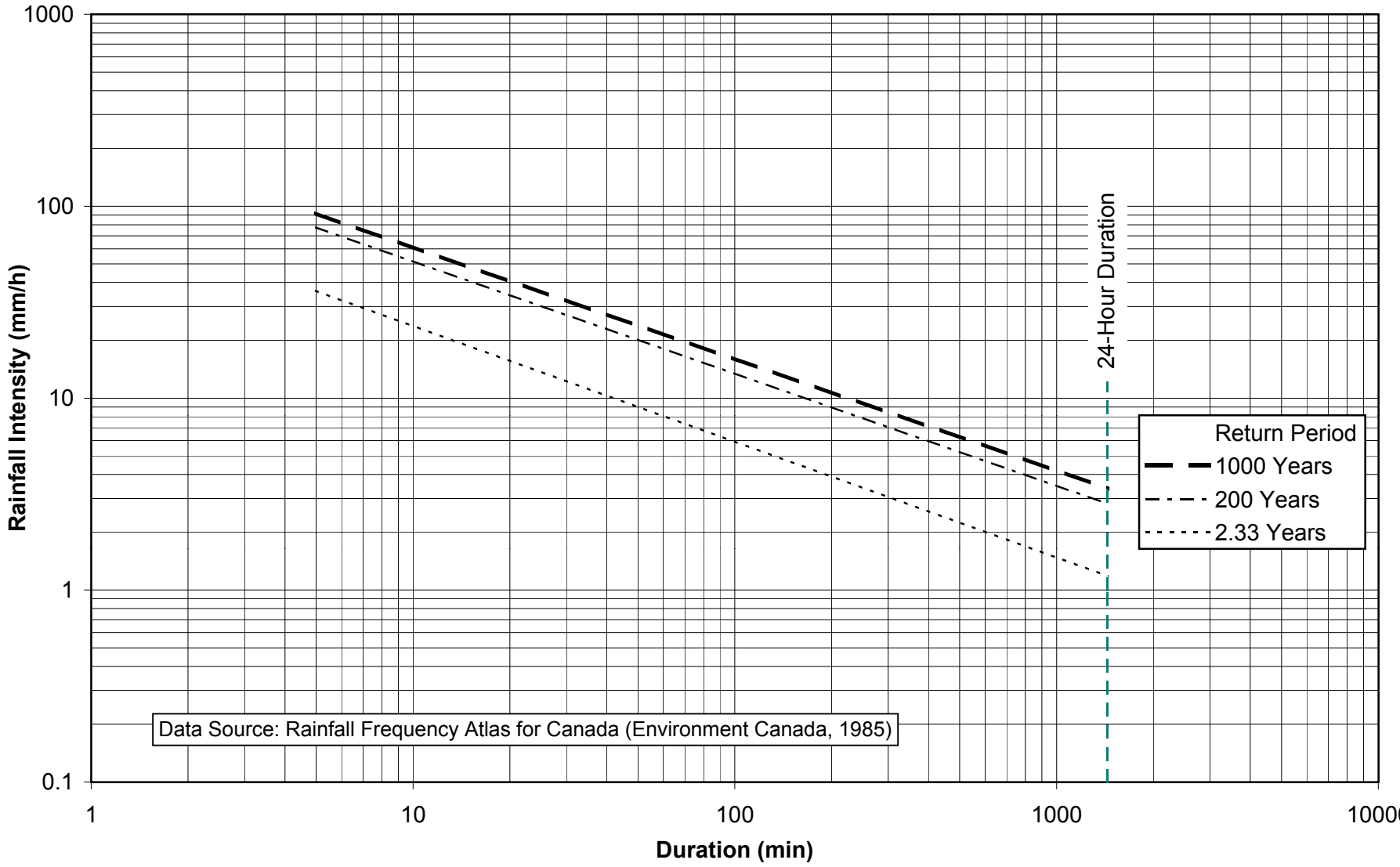
Information on design storm rainfalls likely to be experienced at the minesite was obtained from the "Rainfall Frequency Atlas for Canada" (Hogg and Carr, 1985). The data extracted from this publication are presented in Figure 3-10 in the form of an intensity-duration-frequency relationship. The curves on this figure represent the characteristics of rainfall storms with return periods of 2.33 (i.e., mean annual), 200 and 1000 years.

The calculation of flood peaks using the Rational Method is set out in Table 3-3. Note that the basic premise of the Rational Method is the largest flood will occur when the selected rainfall intensity has a duration exactly equal to the time of concentration. Furthermore, the computed flood peak is assumed to have the same frequency of occurrence as the causative rainfall intensity.

Table 3-3 Flood Peak Estimates Using the Rational Method

Item	Tailings Dam Catchment
Drainage area (A) - km^2	1.33
Lag time (T_L) – h	1.00
Time of concentration (T_c) - h	1.66
Time of concentration (T_c) - min	100
Rational coefficient (C)	
Mean annual maximum	0.3
200-year maximum	0.9
1000-year maximum	0.95
Rainfall intensity (I) - mm/h (for duration = T_c)	
Mean annual maximum	5.94
200-year maximum	13.4
1000-year maximum	16.0
Flood peak (Q) - m^3/s (Q = CIA/3.6)	
Mean annual maximum	0.7
200-year maximum	4.5
1000-year maximum	5.6

Notes: 1. $T_L = 0.89\ A^{0.395}$
2. $T_c = 1.67\ T_L$



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ESTIMATED RAINFALL INTERSITY-DURATION-FREQUENCY CURVES FOR MINE SITE

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		3-10

3.1.5.2 Regional Analysis

The region encompassing the minesite is served by a reasonably dense network of streamflow gauging stations. The data collected at these regional stations were used to estimate the flood hydrology of the minesite streams by a variation on the technique used to estimate the average and low flows. Application of this approach involved four steps, as outlined below.

The first step entailed data gathering. A total of 25 regional streamflow gauging stations were selected to provide the necessary data for the Regional Analysis. Table 3-6 provides details of these stations. The WSC operated 18 of the selected stations while Environment Yukon was responsible for the remainder. From the streamflow record of each of the 25 stations, an annual series of flood peaks was extracted. The length of these annual series ranged from 2 to 41 years.

The second step involved a statistical analysis of the assembled data. For each station, the average of its annual series of flood peaks was calculated to provide an estimate of the mean annual flood. The annual series was then fitted to a theoretical frequency distribution (Generalized Extreme Value) to provide an estimate of the flood events. Table 3-4 presents the estimated mean annual, 200-year and the 1000-year floods for the regional streamflow gauging stations.

The third step involved transposing the above-mentioned flood estimates to the minesite. This was done by exploiting a well-known observation that flood discharge is correlated with catchment area. The most useful way of examining this correlation was to prepare a logarithmic plot of "unit" discharge versus catchment area. Unit discharge means the flood peak is expressed as a flow rate per unit area (i.e., the absolute flood value is divided by the contributing catchment area).

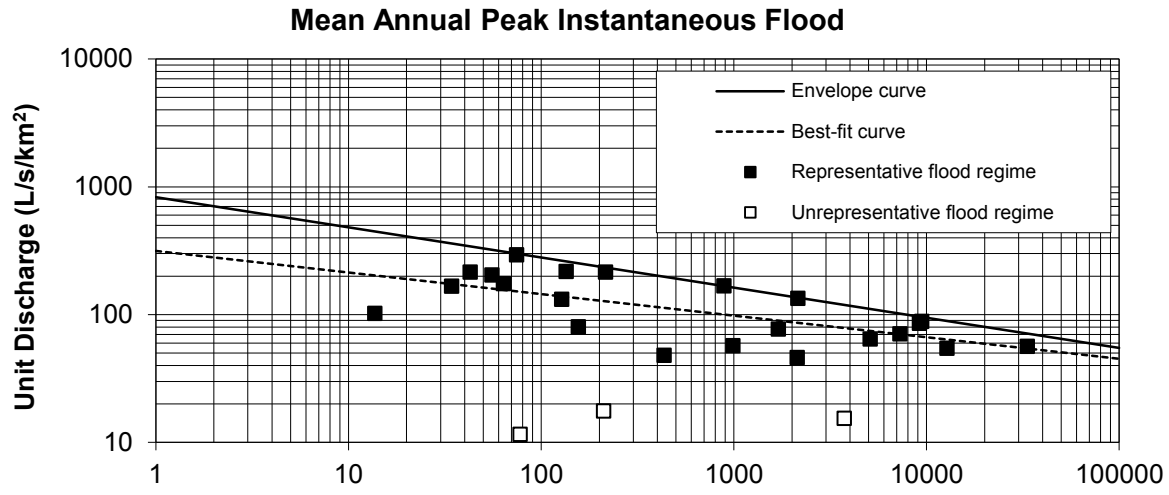
Figure 3-11 presents the plots used to examine the relationship between unit discharge and catchment area for the mean annual, the 200-year and the 1000-year floods. Examination of these plots reveals that the data exhibits the expected inverse trend between unit flood discharge and catchment area (i.e., the unit flood discharge increases as catchment area decreases).

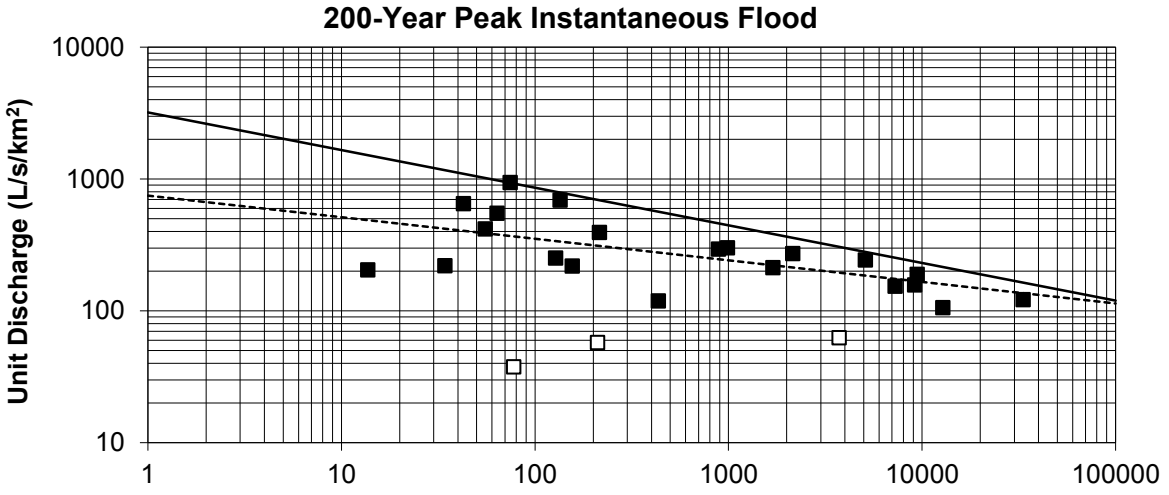
Table 3-4 Estimated Flood Magnitudes at Regional Streamflow Gauging Stations

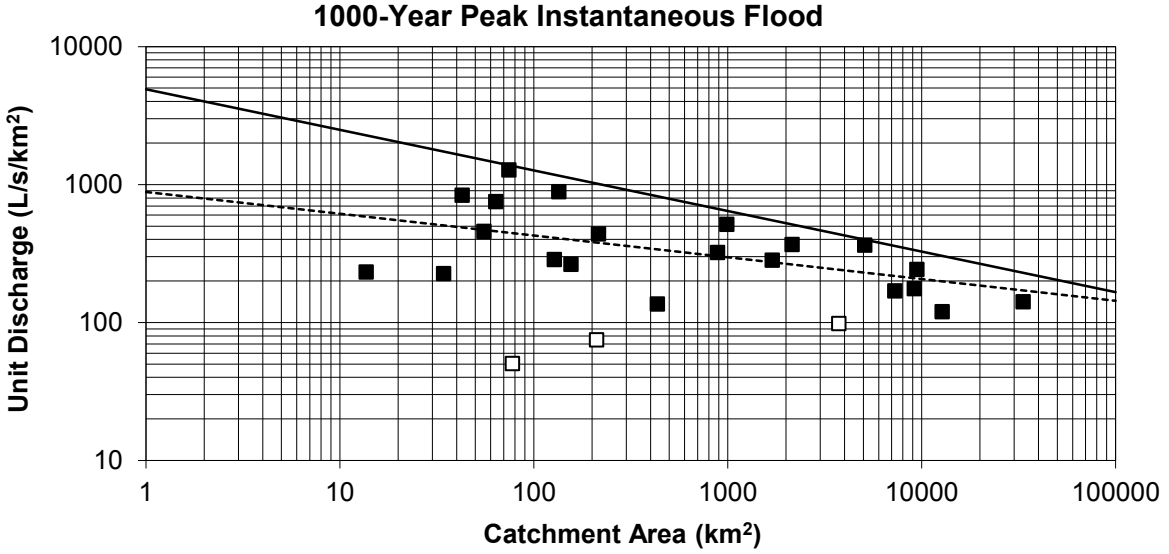
Streamflow Gauging Station [a]		Sample Size (No. of years)	Catchment Area (km^2)	Estimated Maximum Instantaneous Discharge (m^3/s)			Estimated Maximum Instantaneous Unit Discharge ($L/s/km^2$)		
ID No.	Name			Mean Annual Flood	200-Year Flood	1000-Year Event	Mean Annual Flood	200-Year Flood	1000-Year Event
10BD001	Beaver River below Whitefish River	16	7280	514	1120	1230	71	154	169
10AA005/30AE002	Big Creek at km 1084.8 Alaska Highway [b]	20	991	56.5	298	510	57	301	515
10AC004	Blue River near the mouth	33	1700	131	361	480	77	212	282
10BC001	Coal River at the mouth	32	9190	784	1442	1610	85	157	175
10AC005	Cottonwood River above Bass Creek	35	888	149	261	285	168	294	321
10EA002/10EA004	Flat River at Cantung Camp [c]	19	128	16.8	32.1	36.6	131	251	286
30AD005	Flood Creek at km 100.3 Nahanni Range Road	5	42.8	9.2	27.8	35.7	215	650	833
10AB001	Frances River near Watson Lake	36	12800	697	1350	1530	54	105	120
10BE008	Geddes Creek at the mouth	16	77.8	0.90	2.92	3.91	12	38	50
10AD002	Hyland River at km 108.5 Nahanni Range Road	17	2150	288	585	790	134	272	367
10AD001	Hyland River near Lower Post	41	9450	834	1780	2280	88	188	241
30AD001	Jackpine Creek at km 62.2 Nahanni Range Road	5	74.6	21.8	70	95	292	938	1273
10AB003	King Creek at km 20.9 Nahanni Range Road	12	13.7	1.4	2.8	3.2	102	204	232
10EB003	Lened Creek above Little Nahanni River	10	34.3	5.7	7.55	7.73	166	220	225
10AA001	Liard River at Upper Crossing	39	33400	1884	4060	4720	56	122	141
10EB002	Mac Creek near the mouth	15	216	46.4	85	94	215	394	437
30AA001	Meister River above Liard River	2	2135	98.4	-	-	46	-	-
29AE003	Partridge Creek at km 1184.9 Alaska Highway	16	63.7	11.1	35	48	174	549	752
10AA004	Rancheria River near the mouth	13	5100	328	1240	1850	64	243	363

Streamflow Gauging Station [a]		Sample Size (No. of years)	Catchment Area (km^2)	Estimated Maximum Instantaneous Discharge (m^3/s)			Estimated Maximum Instantaneous Unit Discharge ($L/s/km^2$)		
ID No.	Name			Mean Annual Flood	200-Year Flood	1000-Year Event	Mean Annual Flood	200-Year Flood	1000-Year Event
10BE013	Smith River above Smith Falls	12	3740	57.6	234	367	15	63	98
30AD004	South Moose Creek at km 84.8 Nahanni Range Road	5	55.5	11.3	23.2	25.4	204	418	457
30AE001	Spencer Creek at km 1118.6 Alaska Highway	5	156	12.5	34.1	41.2	80	219	264
30AD002	Spruce Creek at km 66.4 Nahanni Range Road	5	135	29.3	93	119	217	689	885
10BE009	Teeter Creek near the mouth	17	211	3.7	12.1	15.7	18	57	75
10AA002	Tom Creek at km 34.9 Robert Campbell Highway	18	435	20.9	51.8	58.9	48	119	135

Notes: a) DIAND recently established a gauging station on Contact Creek (30BE001), located some 60 km east of Watson Lake. The period of record for this station was too short to include in the present analysis. This station commands a small catchment and, accordingly, will be a valuable resource in the future for characterizing the flood hydrology of small basins.
b) This station was originally operated by DIAND from 1978 to 1988 (30AE002). The WSC assumed responsibility for this station in 1989 and gave it a new identification number (10AA005). This station was active in 1998.
c) The WSC has operated two stations on Flat Creek in the vicinity of the Cantung Mine. The first station (10EA002) was operated from 1973 to 1988 and commanded a catchment area of 128 km^2. The second station (10EA004) was located 3 km downstream of the first, was operated from 1988 to 1992, and controlled a total area of 160 km^2. Owing to the closeness in their catchment areas, the flood data for the two stations were combined to create a single record spanning 19 years. The flood values at 10EA004 were scaled by a factor of $(128/160)^{0.75}$ to make them representative of the conditions at 10EA002.







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PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		**3-11**

Two different approaches are commonly used to quantify the correlation between flood discharge and catchment area. One is to fit a power regression to the data and the other is to draw an upper-bound curve which envelops all of the data. Both approaches were used in this study. The respective curves are shown on the plots of Figure 3-8. It is interesting to note that the three upper-bound curves possess a slope close to -0.25 on the logarithmic plot. This same slope is common to flood envelope curves for other parts of the Yukon and for British Columbia.The fourth and final step entailed using the curves on Figure 3-8 is to provide flood estimates for ungauged points on the minesite. For any ungauged point, this was done by planimetering the catchment area controlled by the point of interest. The best fit curves in the plots on Figure 3-11 were used to determine a unit discharge for the given catchment area. The product of unit discharge and catchment area was then calculated to provide the required flood estimates.

3.1.5.3 Hydrological Model

The two flood techniques presented above are aimed at estimating the instantaneous peaks of flood events. This section introduces a flood estimation technique that examines the full flood hydrograph, not just its peak. The third technique was introduced in 2005 as a direct result of the 2003 Dam Safety Review. Following recommendations in that report, Teck initiated a study to determine whether the TMF and the Reclaim Dam have the capacity to deal with the 1000-year flood during the temporary closure status. As the tailings impoundment South Dam emergency spillway was designed for the 1 in 200 year flood, a study was conducted to determine if the current spillway at the TMF (comprising two 900 mm culverts) and the road crossing of the Camp Creek Diversion (comprising two 1200 mm culverts) could accommodate the 1000-year flood. In performing the study, it was recognized that storages within the TMF and the Reclaim Pond would probably have to be relied upon to temporarily store a portion of the incoming flood waters so that the capacities of the culverts would not be exceeded during passage of the extreme flood event. The results of this study are presented below and are still considered valid.

To examine the effects of storage on flood magnitude it was necessary to turn to a rainfall/runoff model that simulates the full flood hydrograph and that provides flood routing capabilities. The model selected for this purpose was developed by the U.S. Corps of Engineers and is known as HEC-HMS.

Figure 3-12 shows the results of applying the HEC-HMS model to the TMF. Key assumptions of the modeling are:

- The 1000-year flood would be generated by an intense thunderstorm (1000-year, 24-hour total rainfall = 81 mm) falling on a ripe snowpack that, in the days preceding the storm, was melting at a high rate (20 mm/d);
- The spillway would be comprised of the existing two 900 mm culverts;
- All interceptor ditches around the TMF would fail, allowing the full catchment runoff to enter the impoundment; and

- The culverts would be flowing prior to the arrival of the storm, so that storage below the invert level of the culverts would not be available to store a portion of the incoming flood hydrograph.

The rainfall intensities associated with the 1000-year storm for durations of 5 minutes to 24 hours were estimated from the intensity-duration-frequency (IDF) curve presented in Section 3.1.5.1 (see Figure 3-10). The record of annual maximum daily precipitation at the Watson Lake Airport climate station was used as a check on the estimated 24-hour rainfall total for the 1000-year event. A theoretical frequency distribution was fitted to the 66 values of annual maximum daily precipitation observed at the climate station. The resulting estimate of 1000-year daily precipitation was close to the value derived from the IDF curve.

The instantaneous peak of the incoming flood hydrograph was estimated to be 5.4 m^3/s. The combined outflow through the two culverts would peak at 1.6 m^3/s, or 30% of the incoming flood peak. During passage of the flood, a volume of 53,000 m^3 of water would be temporarily stored within the TMF. The water level in the TMF would peak at an elevation of 1094.9 m, which is roughly at the crown level of the two culverts.

Figure 3-13 shows the simulated flood hydrology for the two culverts at the road crossing of the Camp Creek Diversion. Key assumptions of the modeling are:

- The 1000-year flood would be generated by the same conditions outlined above for the TMF;
- The interceptor ditches around the TMF would function in such a way as to maximize the peak flow of water to the Camp Creek Diversion (i.e., the West Interceptor Ditch would survive but one of the East Interceptor Ditches would develop a breach and empty into the Reclaim Pond); and
- The TMF spillway and the Reclaim Pond spillway would both be flowing prior to the arrival of the storm so that storage below the crests of these spillways would not be available to store a portion of the incoming floodwaters.

The instantaneous peak of the hydrograph generated by the Camp Creek catchment would be 12.7 m^3/s, including outflows from the TMF. The combined outflow through the two culverts at the road crossing would be an estimated 6.0 m^3/s, or roughly half the peak of the incoming flood. In passing this flood, some 66,000 m^3 of water would be temporarily stored in the Reclaim Pond.

Another 36,000 m^3 would be stored in the TMF. The water level would rise to 1081.1 m behind the Reclaim Dam, leaving a freeboard of about 0.9 m below the dam's crest.

In addition to examining the flood hydrology of the mine during the temporary closure status, HEC-HMS was used to provide additional estimates of flood magnitude for the permanent closure status. Figure 3-14 shows the estimated 1000-year flood that would have to be conveyed by the permanent spillway for the TMF. The situation is identical to the conditions modeled in Figure 3-12 except it was assumed that no storage attenuation would occur within the TMF. Thus, the peak of the outflow hydrograph is identical to the peak of the inflow hydrograph, or 5.4 m^3/s.

Figure 3-15 shows the estimated 1000-year flood for the proposed breach in the Reclaim Dam. Without the benefit of storage within either the Reclaim Pond or the TMF, the flood peaks at an estimated 15.6 m^3/s.

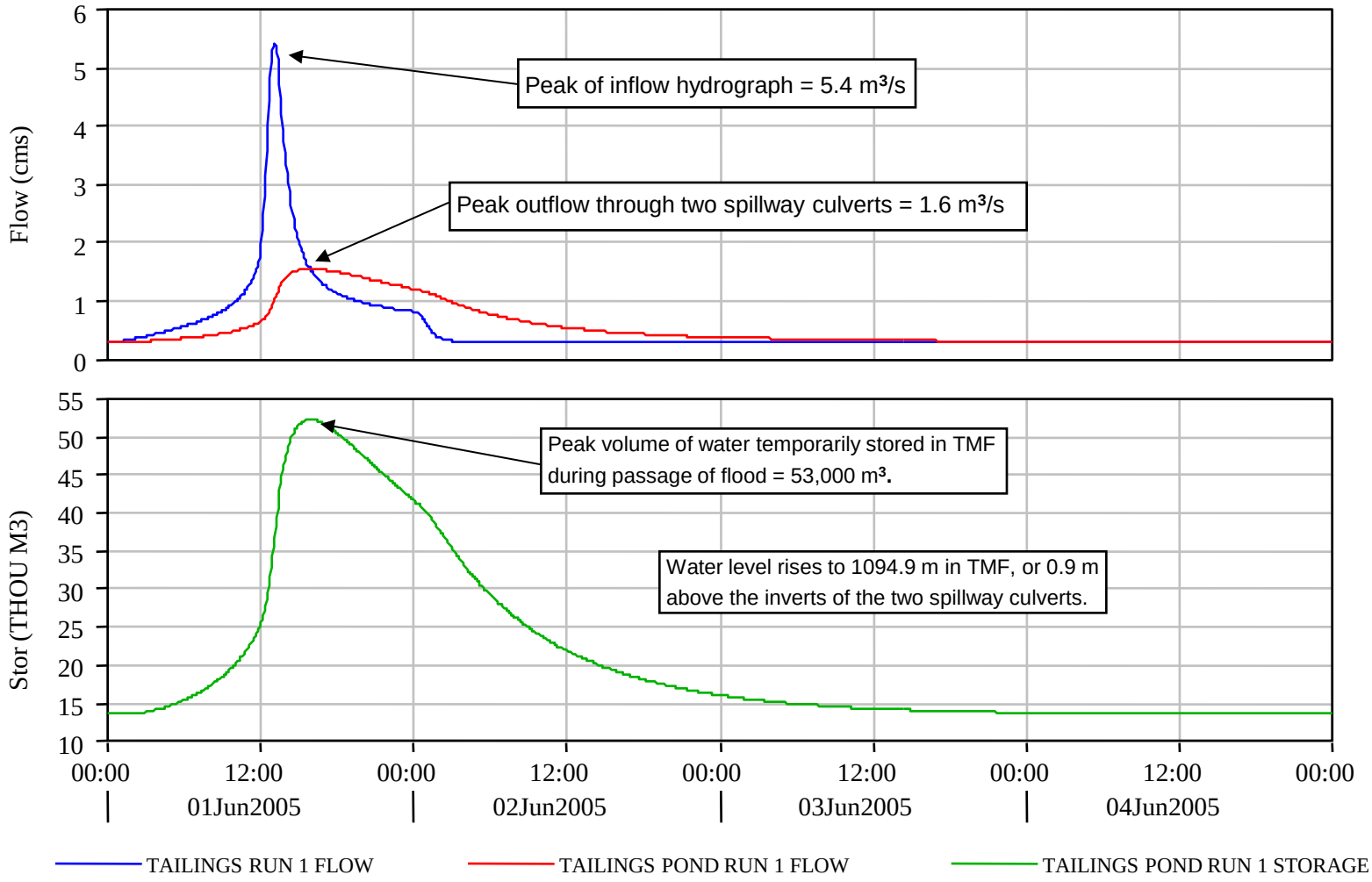
The simulated flood peaks in Figures 3-12 to 3-15 were checked for reasonableness by comparing them against maximum observed floods in the Yukon. Figure 3-16 presents the maximum observed floods at all government-operated streamflow gauging stations within the territory (87 operated by the Water Survey of Canada and 97 by Environment Yukon.) To facilitate comparison of the flood values from the widely different drainage areas, the flood magnitudes have been normalized (i.e., the absolute flood value has been divided by the contributing drainage area). Examination of Figure 3-16 reveals that none of the floods in the Yukon have attained a unit discharge greater than 1.0 $m^3/s/km^2$.

The estimated 1000-year floods for the mine, for both temporary and permanent closure scenarios, all plot above the maximum observed floods in the Yukon. Even the attenuated peaks through the TMF culverts and the Camp Creek culverts are large relative to the floods that have thus far been measured in the territory.

It should be noted that model parameters were selected for HEC-HMS that would generate hydrograph shapes typical of steep, forested catchments. This probably results in an overestimation of the true 1000-year flood peaks that could be generated within the Camp Creek catchment. The flow monitoring station at the minesite has revealed that groundwater contributions to the streamflows of Camp Creek are large. Thus, the 1000-year flood hydrographs

for this stream may be substantially more subdued than simulated by the HEC-HMS model. Further monitoring of the flows in Camp Creek may provide enough evidence to allow the estimated flood peaks to eventually be reduced.

In summary, using the conservative 1000-year flood event, the recent hydrological evaluation confirms that both the current facilities as well as the permanent closure designs proposed in the 2000 DDRP are adequate and do not require upgrading. The closure design currently proposed is a revised version of one of those proposed in the 2000 DDRP (refer to Section 10-3), and as the revisions will not significantly alter the design criteria relevant to the hydrological evaluation, based on the climate and flow data available up to 2005, the permanent closure design is adequate and does not require upgrading.



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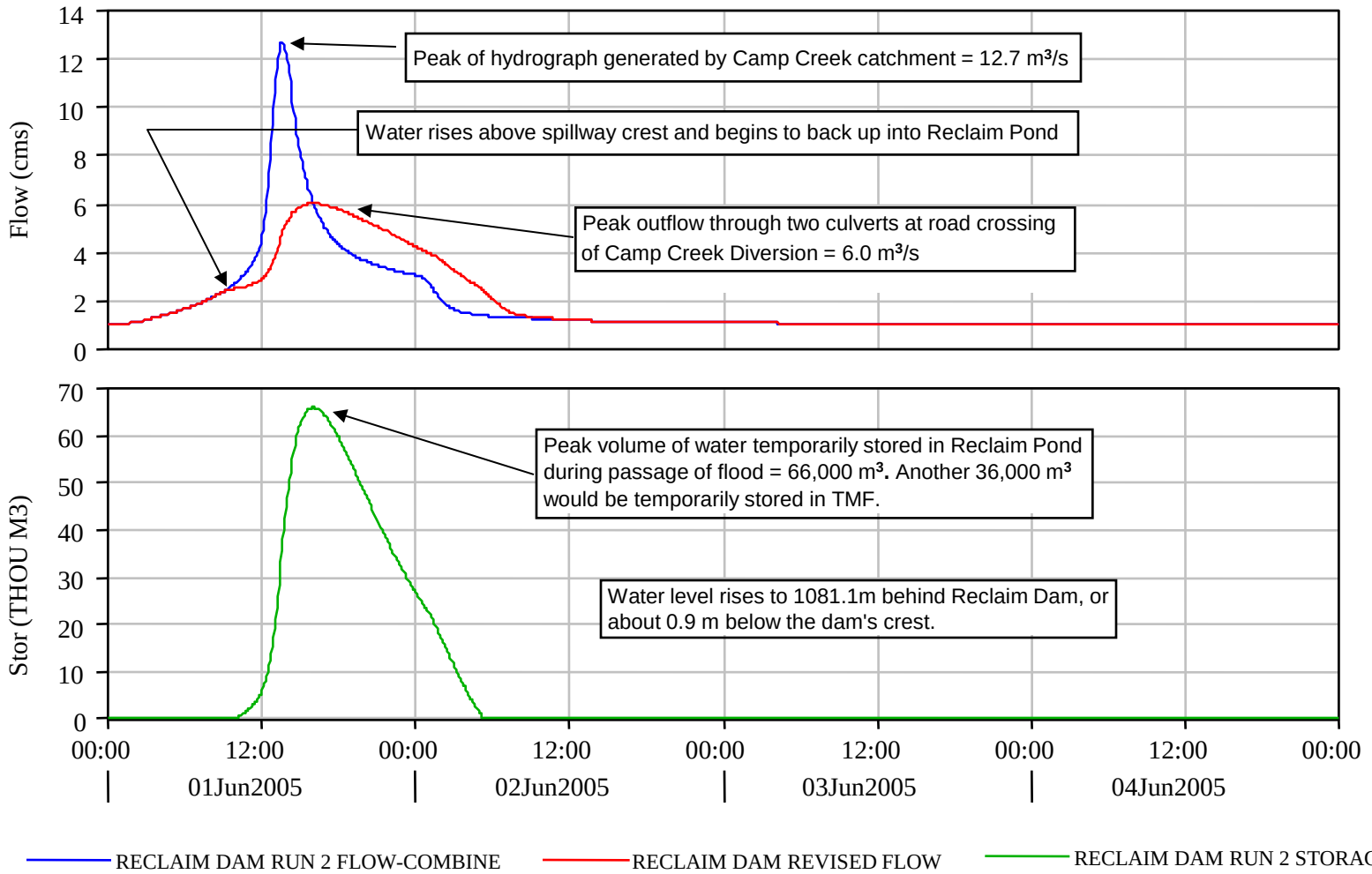
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Simulated 1000-Year Flood in Tailings Management Facility-Temporary Closure Status

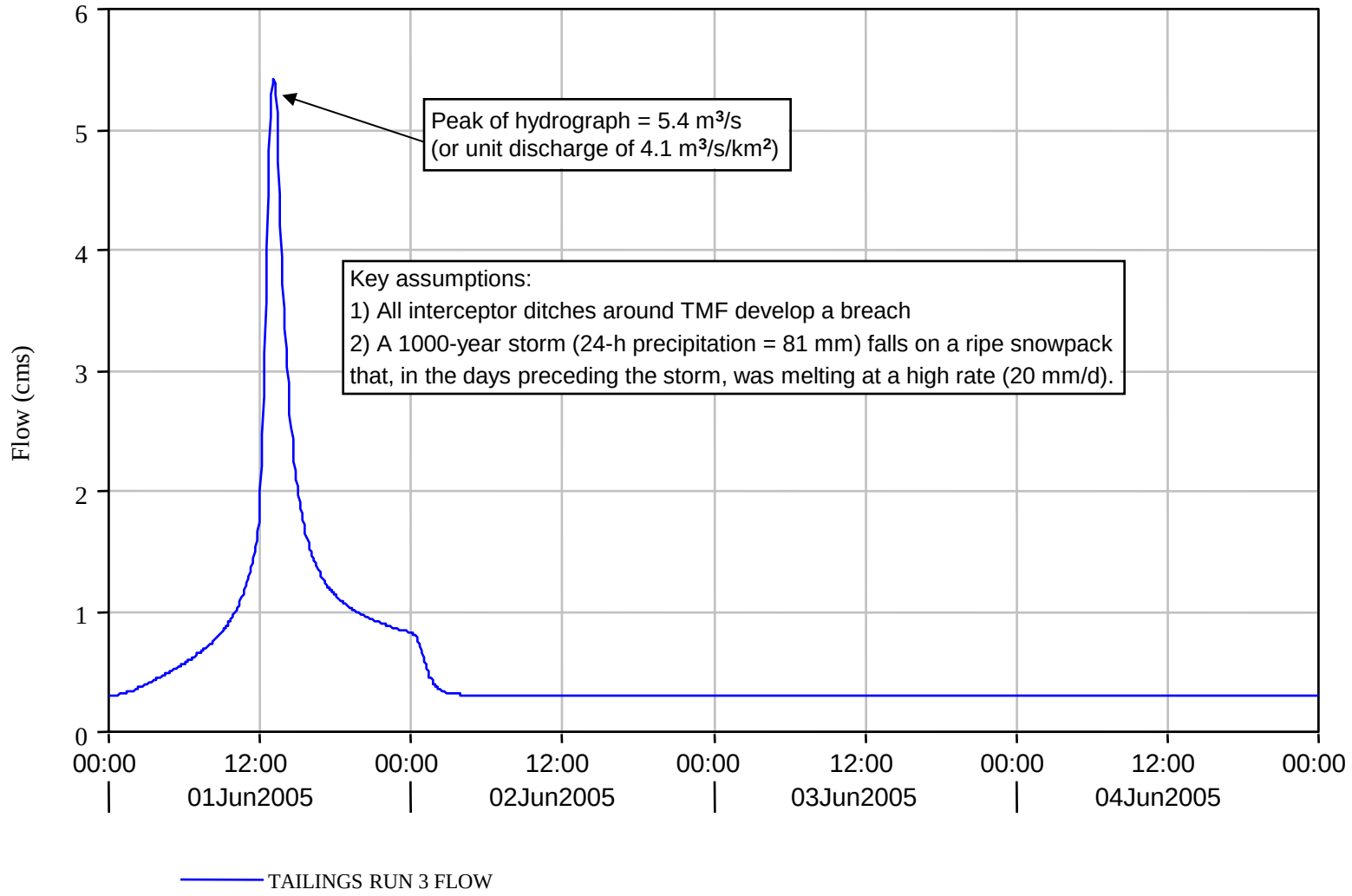
Job No:	1CT008.004
Filename:	Figure 5_Sim 1000yr_Tailings_20051214.ppt

Sä Dena Hes Detailed
Decommissioning and Reclamation Plan

Date:	Approved:	Figure:
Dec. 2005		**3-12**



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Job No: 1CT008.004 Filename: Figure 6_Sim 1000yr_Camp Cr_20051214.ppt	Sä Dena Hes Detailed Decommissioning and Reclamation Plan	Date: Dec. 2005 | Approved: | Figure: **3-13**



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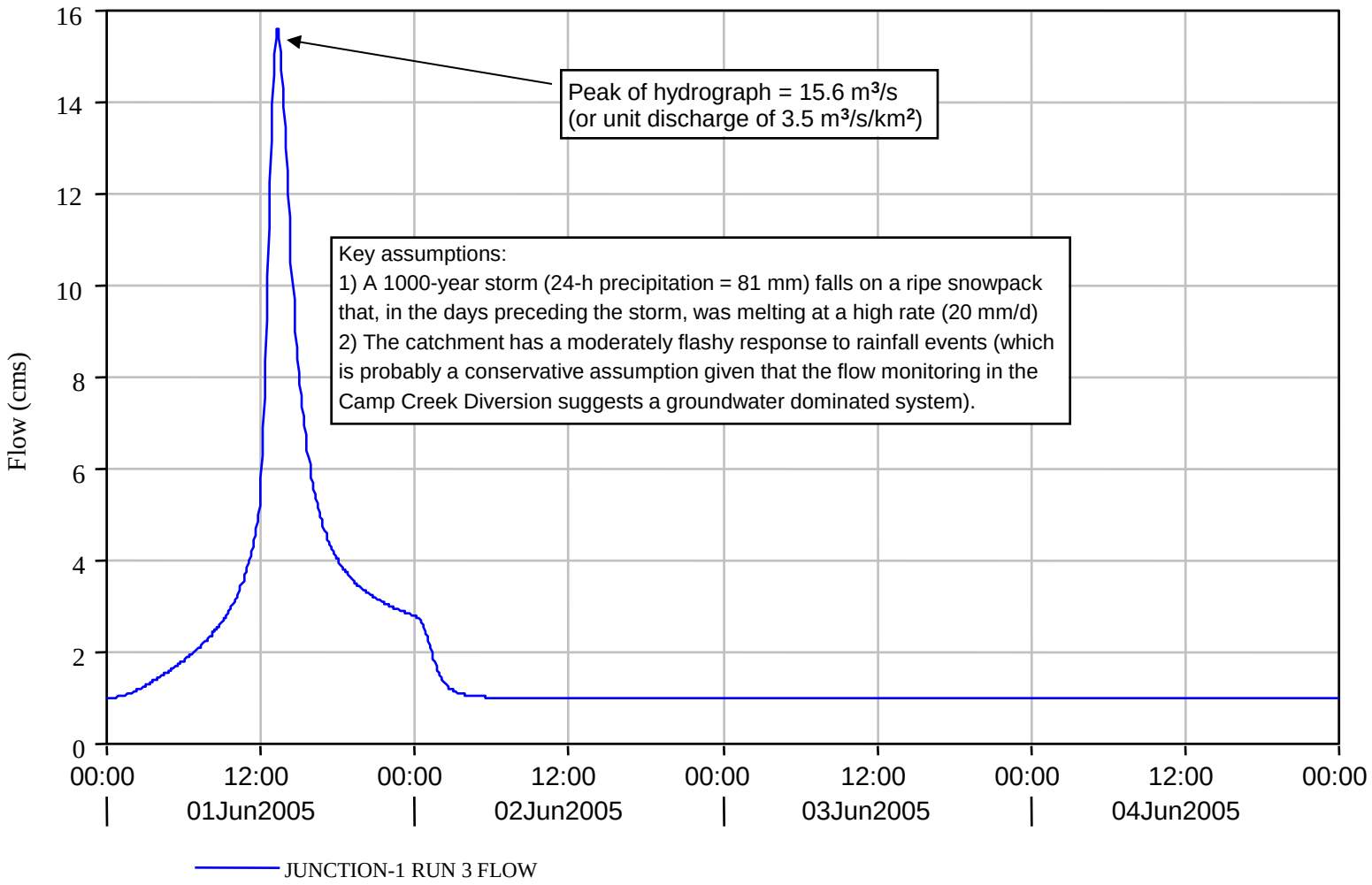
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Simulated 1000-Year Flood at Spillway of Tailings Management Facility - Permanent Closure Status

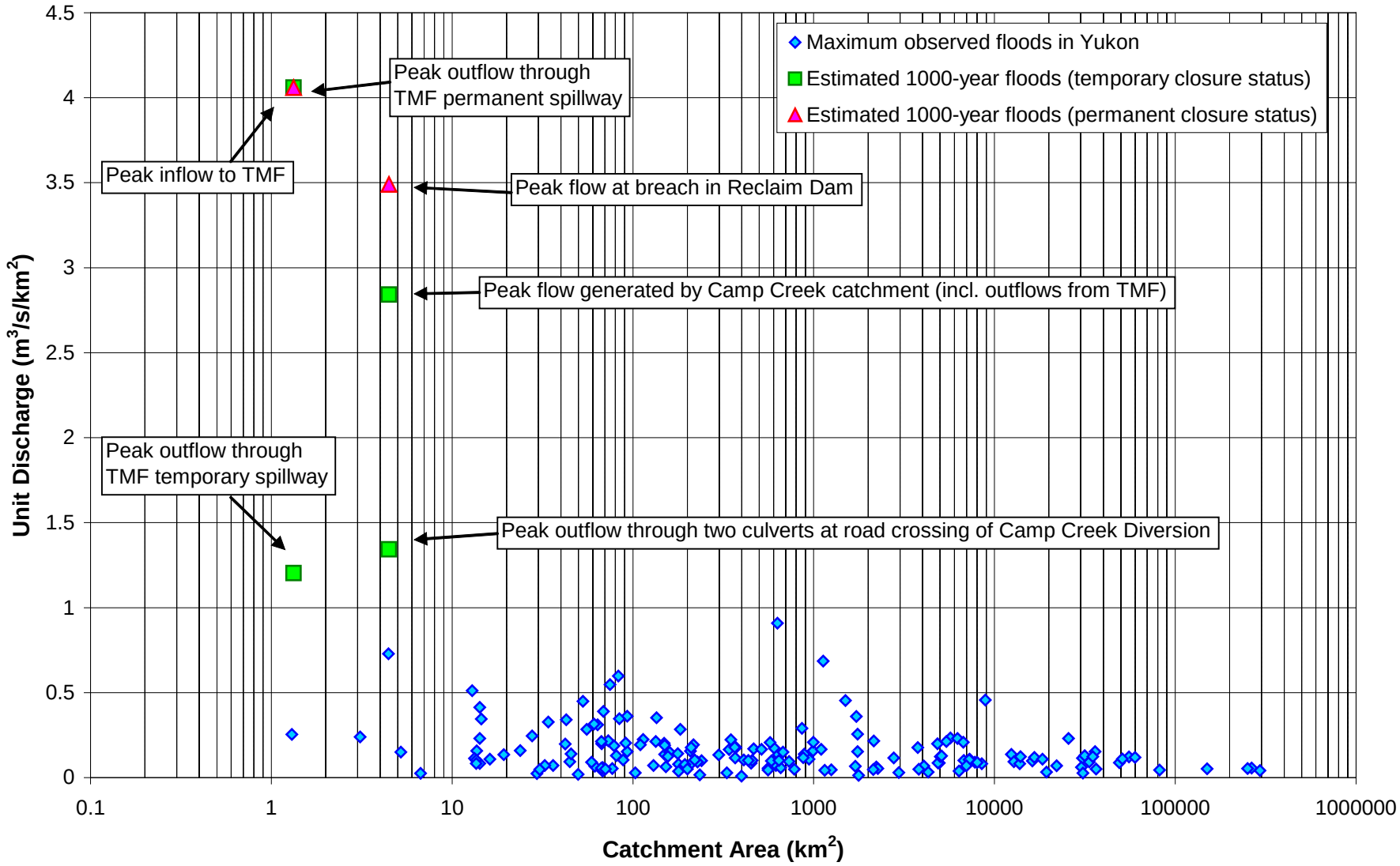
Job No:	1CT008.004
Filename:	Figure 7_Sim 1000yr_Spillway_20051214.ppt

Sä Dena Hes Detailed
Decommissioning and Reclamation Plan

Date:	Approved:	Figure:
Dec. 2005		3-14



SRK Consulting Engineers and Scientists VANCOUVER	teckcominco	**Simulated 1000-Year Flood at Breach in Reclaim Dam - Permanent Closure Status**	
Job No: 1CT008.004 Filename: Figure 8_Sim 1000yr_Breach_20051214.ppt	Sä Dena Hes Detailed Decommissioning and Reclamation Plan	Date: Dec. 2005	Approved: / Figure: **3-15**



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Comparison of Estimated 1000-Year Floods with Maximum Observed Floods in Yukon

Job No: 1CT008.004
Filename: Figure 9_Comparison 1000yr_20051214.ppt

Sä Dena Hes Detailed
Decommissioning and Reclamation Plan

Date: Dec. 2005
Approved:
Figure: **3-16**

3.2 TAILINGS MANAGEMENT FACILITY - SEEPAGE ESTIMATES

3.2.1 Introduction

This section presents a discussion on existing and projected seepage rates from the tailings at the Sä Dena Hes Mine tailings impoundment. This analysis and discussion was originally prepared and reviewed in 2000. In November 2000, SRK submitted to DIAND a review of their seepage estimates from the 2000 DDRP document. They concluded in this memo that:

"On the basis of the above analyses, there is an acceptable margin between the seepage estimate and the threshold levels established using the mass-loading model. We therefore reiterate our opinion that further work to better understand the seepage flows would not be productive."

This discussion has therefore not been revised and is presented in this section.

Direct seepage flows from the toes of the North and South dams, which contain the tailings, have not been consistently measured. However visual estimates of the seepage have been recorded since 1993. In order to better understand the quantities of seepage flow through the dams, available data and simple calculations were used to refine these estimates. These "semi-quantitative" estimates provided a basis for projecting future seepage for the two closure scenarios presented in this closure plan.

Section 3.2.2 discusses the "semi-quantitative" approach used to determine current seepage estimates. Section 3.2.3 discusses the potential for future seepage, for the current closure scenario.

3.2.2 Seepage under Current Conditions

3.2.2.1 South Dam

Visual observations made at the toe of the South Dam indicated a seepage rate along a 115 m zone at the low point in the dam of approximately 60 L/min. To refine this seepage rate, an estimation of seepage was calculated based on changes in pond water level and evaporation

(water balance method). The estimates for seepage losses from the South Dam for existing conditions are based on this water balance method, developed using average annual meteorological data. Seepage loss estimates are relatively insensitive to net evaporation values because of the volume of water in the pond. For example, if evaporation drops to 0 mm, the seepage loss number rises to 238 L/min from 218 L/min. As shown in this example, it is the difference between the values of evaporation and precipitation that are important, not the absolute values for each.

Currently, there is not enough data to estimate groundwater inflow and outflow at the TMF. Therefore, seepage loss estimates do not include the effect of groundwater infiltration/exfiltration.

The method is described below.

The water level in the tailings pond has been monitored since 1993. A record of these levels is shown in Figure 3-17.

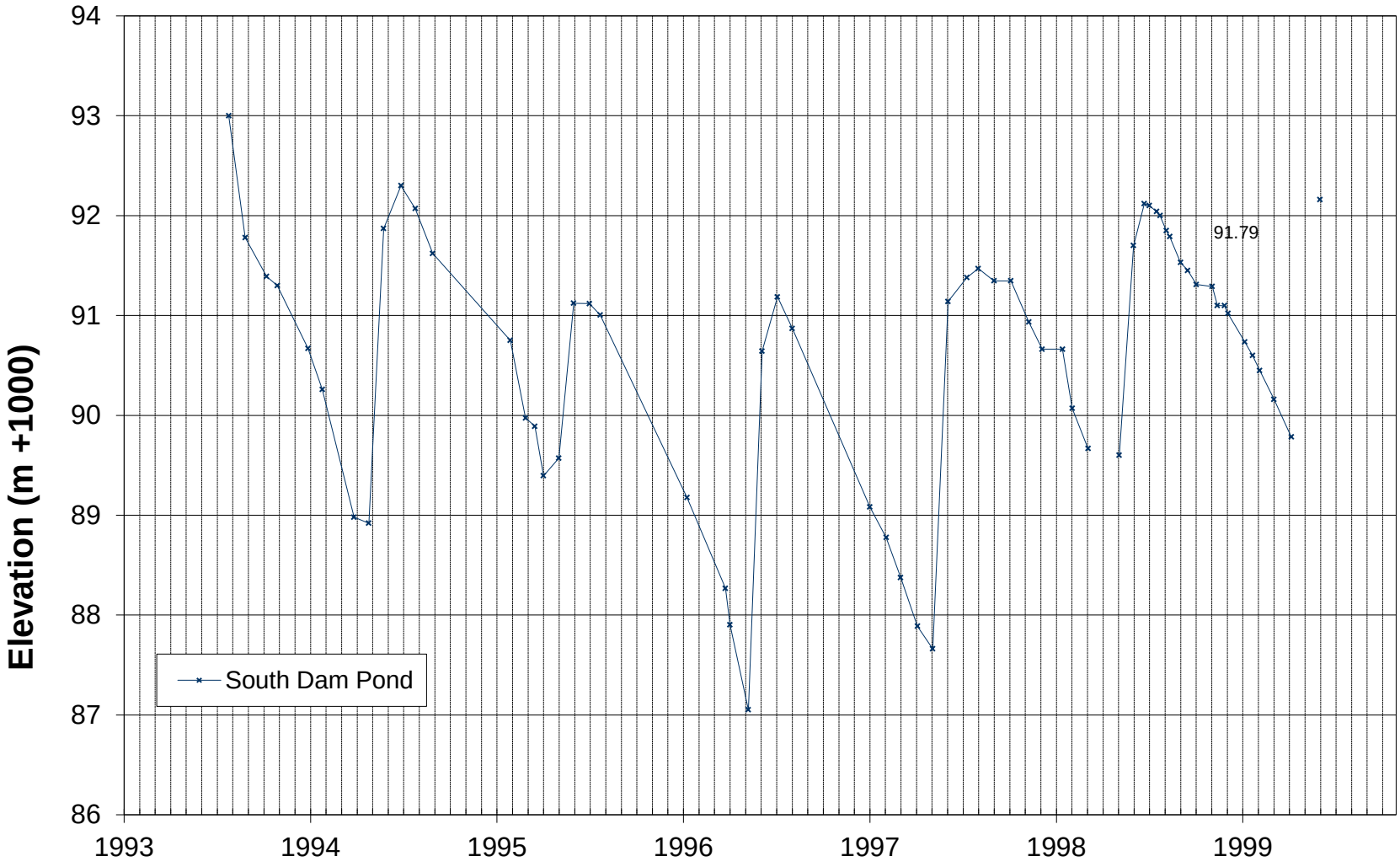
The graph shows a regular seasonal fluctuation in the pond level. The highest levels generally occur in late June or early July, corresponding to the end of the spring snowmelt. These levels steadily decrease to a minimum level in April or May of the following year. There are three possible mechanisms that could cause a drop in the pond level:

1. removal of pond water from the decant tower;
2. net evaporation (precipitation minus pan evaporation) from the ponds surfaces; and,
3. seepage through the dam.

The decant tower was sealed sometime during 1996, therefore the drop in pond levels over the winters of 1997/98 and 1998/1999, and possibly the winter of 1996/1997, would have been due solely to losses from net evaporation and seepage. Table 3-5 shows the estimated losses due to seepage for these three periods based on average evaporation and precipitation values. Since the highest value of 218 L/Min corresponding to the winter of 1996/1997 disregards potential flow that may have occurred from the decant tower, it has been removed from consideration. The average estimated seepage flow through the toe of the south dam for the two succeeding years is 180 L/Min.

Table 3-5 Seepage Estimates Through Toe of South Dam Based on Water Balance

Start Recession			End Recession			Avg Evap over Year	Avg Precip over Year	Change in Dam Volume/Time		Net Evaporative Flux (Evap - PPT)		Seepage
Date	Pond Volume	Pond Area	Date	Pond Volume	Pond Area							
	(Mm^3)	(m^2)		(Mm^3)	(m^2)	(mm/yr)	(mm/yr)	(Mm^3/day)	(L/Min)	(m^3/yr)	(L/Min)	(L/Min)
07/04/96	130.1	31212.2	05/04/97	39.1	14756.2	450.0	690.0	0.30	207.79	-5516.21	-10.50	218.29
08/01/97	139.8	32756.1	05/04/98	82.2	23187.1	450.0	690.0	0.21	145.06	-6713.19	-12.77	157.83
07/02/98	162.8	36297.1	04/06/99	87.1	24066.2	450.0	690.0	0.27	189.00	-7243.59	-13.78	202.78



SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

Figure: 3-17

SA DENA HES - SOUTH DAM
VARIATION IN POND LEVELS

3.2.2.2 North Dam

Visual observations at the North Dam indicated seepage along an 80 metre zone of the downstream toe. This flow combines with seepage from the surrounding hillside to the west as well as seepage from the east side of the valley to constitute the total flow measured at the downstream pipe weir (MH-02). Visual observations made during the site inspections estimated that approximately 60% of the flow at the pipe weir came from the west side of the valley (tailings pond and surrounding hillside).

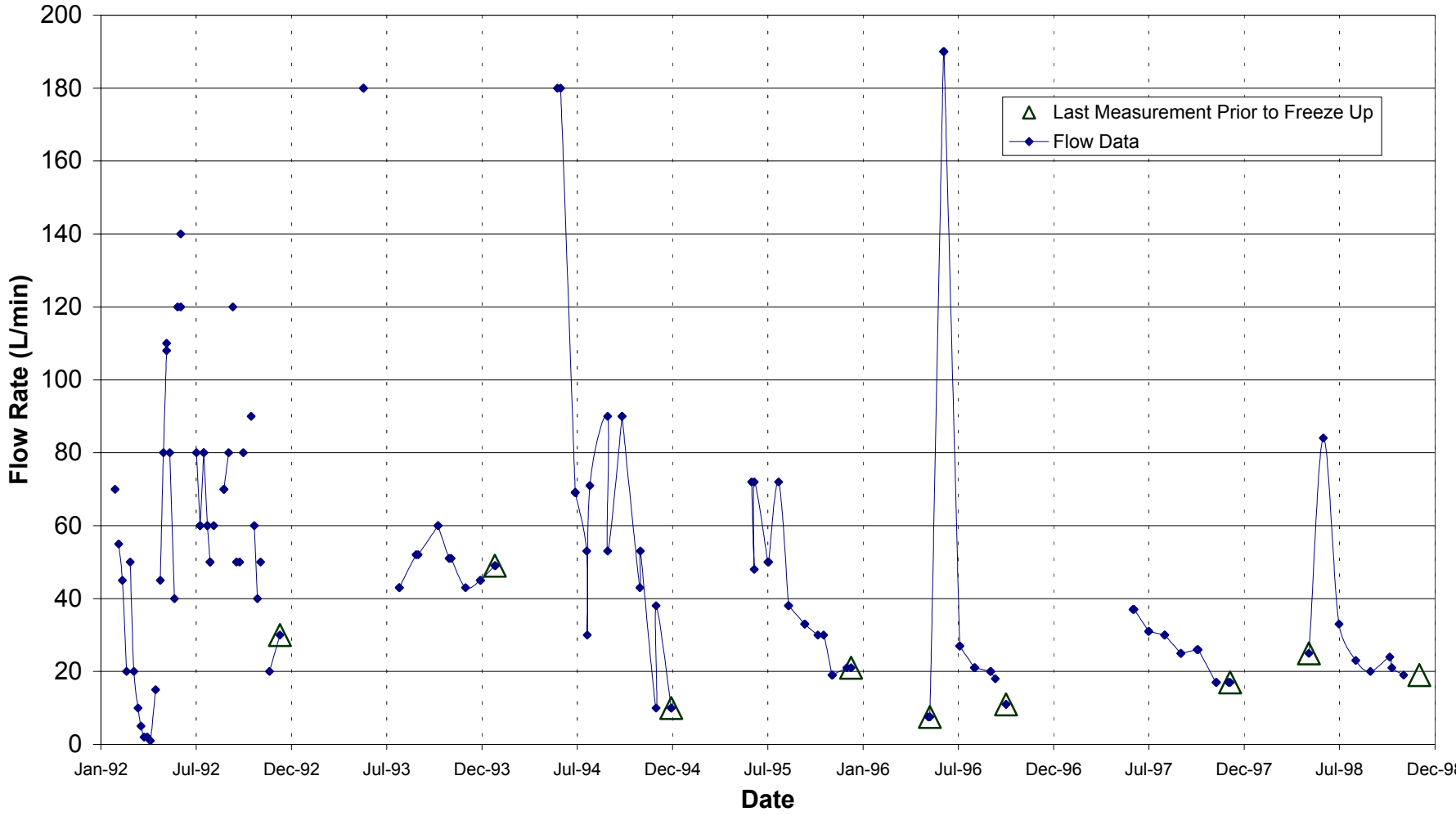
Standing water on the North Dam tailings forms discrete pools of which the occurrence and extent vary seasonally. Therefore a back-calculation of seepage flows could not be performed using a water balance method, as was carried out for the South Dam. Instead, an analysis of the seasonal flow measured at MH-02 was used to estimate seepage from the toe of the North Dam.

The flow measured at MH-02 is comprised of three components:

1. flow from the surrounding hillside to the west;
2. flow from the east side of the valley; and,
3. seepage directly from the toe of the North Dam.

Figure 3-18 shows flows measured at MH-02. The figure shows that the highest flows occur in late May/early June corresponding to the spring snowmelt event. The flows taper off more or less exponentially, reaching an approximate steady-state by early autumn. Generally, the last measurement of flow at the weir prior to the winter freeze showed the lowest flow.

Assuming that the contribution to flow from the surrounding hillside to the west and the east side of the valley is negligible at the end of the season, then the low flow measured at MH-02 is more or less representative of the flow directly from the toe of North Dam. The lowest flows for each season are marked by hollow triangles on the graph, and are fairly consistent from year to year. The average of these low flows is 20 L/Min.



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SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

North Dam (MH-02) Flow Readings

PROJECT	DATE	APPROVED	FIGURE
1CC005.05	AUG. 1999		3-18

3.2.3 Tailings Seepage After Closure

The two closure scenarios under consideration from 2000 through to 2012 were:

Scenario 1 Close mine as is, drain pond at south end, breach South Dam and cover tailings; and

Scenario 2 Re-open mine, raise the level of both the North and South Dams to 1102 m and 1100 m respectively and deposit tailings into impoundment over a 4 year period.

The scenarios have since been further evaluated and decision made to proceed with a revised version of Scenario 1.

Figure 3-19 shows the conceptual pathways for flow through and out of the tailings for this closure options.

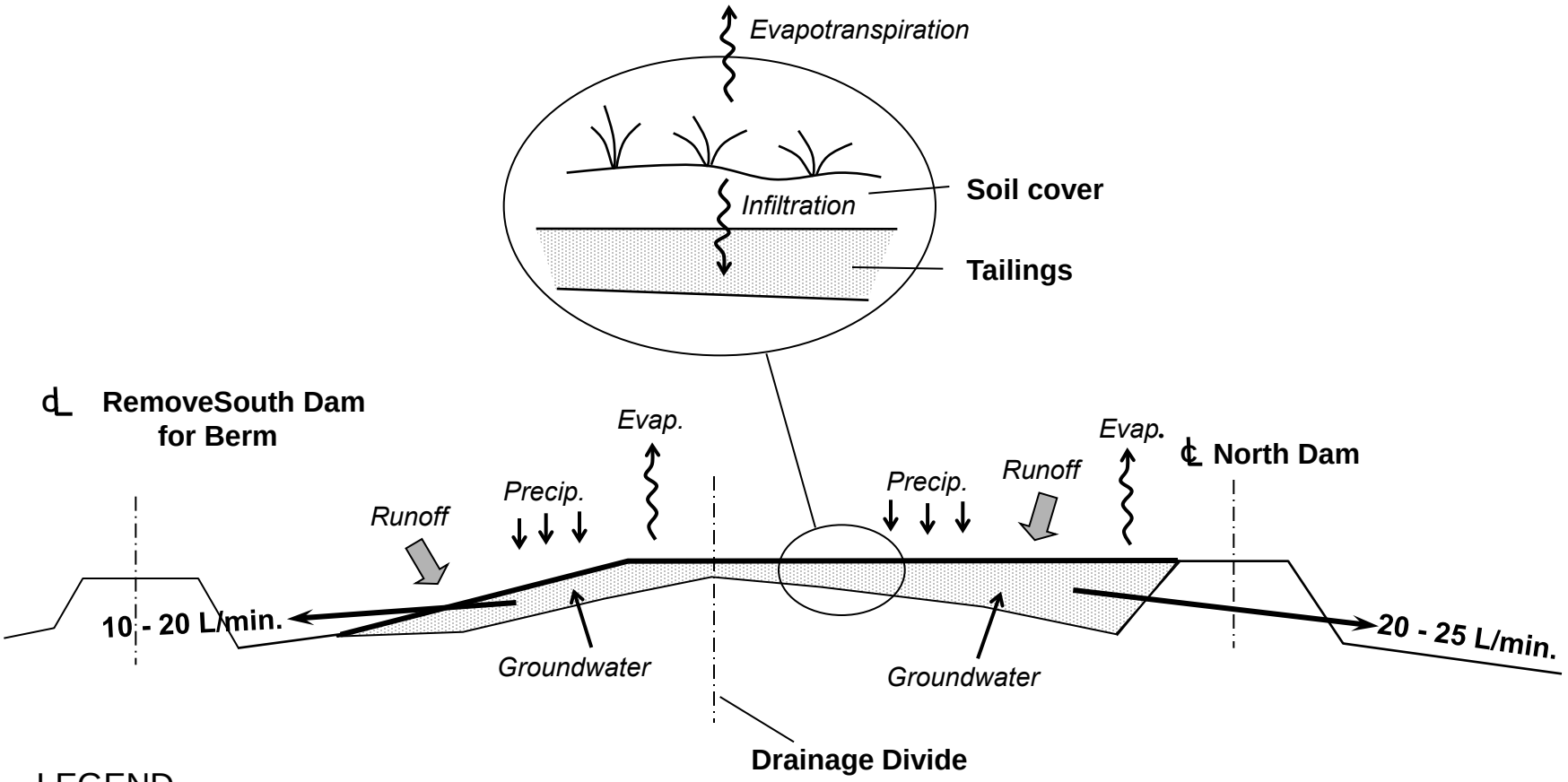
(i) Closure Scenario (see Figure 3-19*)*

This closure options involves removingthe South Dam and applying a soil cover to the existing tailings area.

As shown in Figure 3-19, flow into the tailings will come from groundwater recharge and infiltration through the cover. However, it is also thought that the vegetation cover will reduce the flow.

Tailings at the North end of the impoundment will likely remain saturated after application of the cover, and therefore piezometric levels and hydraulic gradients within the tailings will likely not change. Since seepage through a permeable material is directly related to the hydraulic gradient across that material, the seepage rates through the North Dam will likely not change either and will therefore remain around 20 L/min.

For the South Dam, the current pond of water will be drained and the cover applied for the exposed tailings. Since the tailings are likely to remain saturated, a hydraulic gradient will be established resulting in seepage from the lowest point of the tailings area.



LEGEND

Seepage Flux through Tailings

Closure Scenario

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SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

Conceptual Movement of Water through Tailings – Closure Scenario

PROJECT:	DATE:	APPROVED:	FIGURE::
1CC005.05	Aug. 1999		3-19

Given the smaller area and volume of tailings present at the south end, the seepage rate after application of a cover will likely be lower than that of the existing south end. Although the volume and areal extent of tailings at the South end are not known, they are thought to be approximately half that of the North Dam. Therefore a steady seepage rate, in the range of 10 to 20 L/min, is expected from the tailings at the south end after closure.

3.3 WATER QUALITY

In a report titled *Water Quality and Loading Re-Assessment* issued by SRK in January of 2005, updated water quality monitoring results were reviewed to determine whether significant changes in water chemistry had occurred and how these might affect overall loadings from the site. This assessment will be further updated using the most recent water quality data later in 2013.

Based on previous experience, the review was focused on the following parameters:

- sulfate;
- total suspended solids (TSS); and
- total zinc.

Monitoring results indicated that by 2005, some changes in water chemistry had occurred since the original loading calculation presented in the February 2000 DDRP. The overall conclusions of the loading calculation, however, remain unchanged. In addition, there had been no changes to the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life with respect to monitored surface water parameters in the surveillance network since 2006.

Significant water quality data has been collected under various monitoring programs at the site, and these are presented in comprehensive tables in Appendix C of the 2013 DDRP Update. From the data tables, selected graphs of sulphate and zinc concentrations have been developed for reference and are included in Appendix D of the 2013 DDRP Update.

4.0 GEOCHEMISTRY

The geochemistry section of this report was originally written by S. Day of SRK Consulting for the 2000 DDRP. S. Day also prepared the updates to Section 4.0 that were included in the 2006 DDRP. S. Day did not provide input into this current 2013 update to the DDRP. Comments related to data obtained after the 2006 update of the DDRP have been written by B. Donald of Teck and are restricted to comments regarding data trends and not the geochemical interpretations underlying the trends. The updating of data sets and reevaluation of mass loadings is planned for 2013.

4.1 METHODS

The site was visited on June 17 and 18, 1999. Areas of the site inspected included:

- Jewelbox Zone – 1408 portal and waste rock dump; underground mine workings; Jewelbox Pit; 1250 portal; and waste rock dump. The Jewelbox Zone underground workings were entered at the 1408 portal and descended to the elevation that the mine had flooded to.
- Main Zone – 1380 portal, Main Zone Pit and waste rock dumps.
- Burnick Zone – 1200 portal and waste rock dump; mine workings, sealed 1300 portal (from inside mine). The Burnick Zone workings were entered at the 1200 portal and the entire workings inspected up to the 1300 portal.
- Tailings Impoundment.

Each area was described and photographed. Any significant seeps or discharges not currently included in the monitoring program were sampled. Runoff obviously originating from snow melt was not sampled. Water samples were filtered (syringe 0.45 µm filter), preserved (nitric acid) and refrigerated in the field. All samples were from seeps and discharges, therefore, unfiltered samples were not collected. Some samples of rock and tailings were collected.

Water samples were analyzed for pH, electrical conductivity, total suspended solids, alkalinity, sulphate and metals. Rock and tailings samples were submitted for acid-base accounting, total

metal analysis and determination of soluble metals using a 24-hour 20:1 deionized-water shake flask test.

4.2 BACKGROUND ROCK GEOCHEMICAL INFORMATION

Rock sampling and testing for the IEE indicated that sulphur content of the rock was variable but the abundance of carbonate in the ore and host rocks offset the acid generation potential. Some ore grade materials with greater than 5% sulphur were identified as potentially acid generating. However, the sulphur may have occurred dominantly as sphalerite and galena which can be sources of dissolved zinc and lead but not acidity. Deionized water shake flask tests on the samples indicated leachable sulphate and zinc in several rock types including ore and oxidized ore. Humidity cells which were conducted for 20 weeks in 1990 indicated ongoing leaching of zinc from ore-type materials.

4.3 RESULTS

4.3.1 Underground Mine Workings

4.3.1.1 Burnick 1200 Portal

Drainage from the 1200 Portal at the Burnick Zone discharges onto the Burnick Waste Rock Dump and infiltrates the waste rock. The mine water was consistently slightly alkaline (avg. pH = 8.13) and contained zinc concentrations that averaged 0.416 mg/L. Based on inspection of the slopes below the discharge, SRK (as reported in "2002 Geochemical Projects – Sa Dena Hes" by SRK) was not able to find emergent seepage corresponding to the mine water. There was no evidence that the zinc load in the drainage was detectable in Camp Creek and SRK concluded that zinc was being attenuated by contact with soil.

To evaluate this hypothesis, SRK performed soil column attenuation tests using mine drainage water as the feed. The soil samples were glacial till type materials from near the portal and alluvium composed of carbonaceous phyllite and granite from further downslope. The glacial till would not transmit water so the test was performed in duplicate with the alluvium. The test demonstrated that zinc concentrations decreased from 0.184 mg/L to 0.001 mg/L when in contact

with the soils. Using the results of the testwork, it was concluded that downgradient soils have the potential to significantly attenuate zinc concentrations at the levels observed in the discharge for much longer than 200 years.

The studies confirmed that zinc is passively treated to levels below freshwater aquatic life standards by contact with downgradient soils and that zinc removal will effectively occur in perpetuity. A discussion of zinc loadings from this source is presented in Section 4.4.2. While there is more current water quality data available for the Burnick discharge. The data available to 2010, was reviewed at that time, and the data reviewed were not materially different from the previous datasets, so Section 4.4.2 was not been revised for the 2010 update of the DDRP report. The available data will again be reviewed as part of studies planned for later this year (2013).

4.3.1.2 Main Zone – 1380 Portal

The 1380 portal in the Main Zone Pit is collared in limestone and skarn. The adit was apparently stopped due to very poor ground conditions. Water was observed to be draining through the broken rock, exiting the portal and disappearing into the ground a short distance outside the portal. The flow rate during the June 1999 site visit was estimated as a few litres per second. The drainage was first sampled in 1999 (Table 4-1) during preparation of the closure plan and found to contain 41 mg/L zinc (dissolved). The water was pH-neutral (pH 6.9) and contained 183 mg/L sulphate. Other significant components were Cd (0.4 mg/L) and Pb (0.3 mg/L).

The flow from the portal was originally believed to be intermittent (2000 DDRP). In 2000, the drainage was monitored to determine the variation in flow and chemistry for two months. It is now known that this portal discharges from at least freshet throughout summer and until winter. While flow decreased following freshet, zinc concentrations were sustained. The zinc load associated with this flow was not detectable in Camp Creek at any time during the summer. The area is not safe to monitor during winter due to high snow loads in this area and the potential for avalanches on the steep bare slopes so no winter data is collected. The adit does not connect to any other mine workings however, water flowing from faults in the rock race within the adit provide a conduit for ground water to exit onto the floor of the adit and come in contact with weathered skarn materials, and then the flow exits the portal of the adit. The discharge has elevated metals and the elevated zinc, cadmium and lead concentrations are expected to persist due to the continued

weathering of exposed sphalerite-rich skarn in the workings. The presence of abundant limestone associated with the 1380 portal indicates that the drainage will not be acidic.

Sampling of rock in the portal area showed that zinc is leached from oxidizing exposures and talus containing sphalerite. The source water is probably shallow groundwater but it does not appear to be fed by ponding of water in the small upslope Jewel Box Pit.

SRK concluded that zinc in the drainage is being strongly attenuated by contact with soils between the portal and down gradient springs feeding Camp Creek. To evaluate this hypothesis performed an attenuation test using portal drainage and samples of marble talus. The tests showed very strong attenuation of zinc from 44.9 mg/L to <0.001 mg/L. Cadmium was attenuated to <0.0001 mg/L. Based on measurement of precipitated zinc concentrations in the test, SRK concluded that the attenuation capacity of the soils down gradient of the portal could be exhausted in several years leading to break through of zinc loadings at the Camp Creek springs. Subsequent to this statement, Teck has inspected the surface water flow in the headwaters of Camp Creek and verified that the surface waters go to ground approximately 500 m before arriving at Camp Creek. Using conservative assumptions of no attenuation of zinc loading (i.e. the full loading of zinc is added into Camp Creek), SRK Consultants prepared a technical letter report titled “Sa Dena Hes Mine – 1380 Portal (March 12, 2007) that is attached in Appendix E. This report concludes:

> “Using the conceptual model, and assuming that flow from the gully does report to Camp Creek, it was predicted that in the event of total loss of zinc attenuation capacity of the soils, zinc concentrations in Camp Creek would remain well below MMER standards and by MH11 (the logical “Final Discharge Point”) could almost meet the CCME criterion.”

While there is more current data, water quality data for this site was not updated for the 2010 DDRP update as the changes were not material for the purposes of these discussions. In 2012, work to characterize drainage from this portal was completed including water quality analysis. While lead concentrations (0.04 mg/L) at the portal were an order of magnitude lower than in 1999, other key parameters did not differ substantially from the 1999 water quality, and therefore the changes were again not material for the purposes of these discussions. The available data will again be compiled and reviewed as part of studies planned for later this year (2013).

Table 4-1 Results of Seep Sampling – June 1999

Sample Location		Main Pit Portal (1380)	Main Pit Waste Dump	Jewelbox Underground Pool	Jewelbox Dump Seep	Jewelbox Dump Seep
Sample ID		SDH-S1	SDH-S2		SDH-S3	SDH-S4
Physical Tests	Units	99 06 17	99 06 17	99 06 17	99 06 18	99 06 18
Cond.		421	364	370	200	447
pH		6.9	7.28	7.58	7.29	7.24
TSS.	mg/L	87	115	12	69	325
Diss. Anion.						
Alkalinity-Total	mg/L	23	43	65	33	39
SO_4	mg/L	183	137	82	50	161
Dissolved Metals						
Al	mg/L	<0.005	<0.005	<0.005	0.008	0.014
Sb	mg/L	0.0004	0.0003	0.0027	0.0008	0.0011
As	mg/L	<0.0001	<0.0001	0.0009	0.0015	0.0004
Ba	mg/L	0.012	0.017	0.014	0.019	0.036
Be	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Bi	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Bi	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cd	mg/L	0.363	0.0989	0.0154	0.0027	0.0074
Ca	mg/L	49	57.3	54.7	28.6	74.8
Cr	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Co	mg/L	0.011	0.002	0.003	<0.001	0.002
Cu	mg/L	0.002	<0.001	<0.001	0.002	<0.001
Pb	mg/L	0.345	0.097	0.04	0.06	0.052
Li	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Mg	mg/L	1.55	1.76	3.81	1.78	3.39
Mn	mg/L	0.351	0.045	0.247	0.101	0.329
Mo	mg/L	<0.001	0.001	0.003	0.002	0.002
Ni	mg/L	<0.001	<0.001	0.009	<0.001	0.002
K	mg/L	0.75	0.7	1.61	1.63	1.83
Se	mg/L	0.003	0.003	0.02	0.002	0.008
Ag	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	mg/L	0.059	0.066	0.143	0.058	0.124
Tl	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
U	mg/L	0.00004	0.00019	0.00578	0.00006	0.00053
V	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zn	mg/L	40.6	10.8	0.87	0.22	0.842

4.3.1.3 Jewelbox Hill Zone

From the 1408 portal, a declined ramp provides access to the workings below the elevation of the portal. Since the mine was closed in 1992, the lower portion of the mine has been gradually flooding. At the time of the June 1998 inspection, very little water was observed to be flowing underground. The inspection was done in the spring when one would expect the most water to be present. Based on the observations, it is assumed that the flooding of the mine is the result of groundwater. As the mine fills, the head will increase which will reduce the flow and possibly stop the flow. The maximum water elevation recorded was at the 1350 m elevation in 1998. The portal to the mine is at 1408 m. When preparations were made to reopen the mine in 1999, the mine water was pumped down to the 1344 m elevation. In July 2002, the water level was observed to be at the 1349 m elevation (suggesting an increase in water levels of approximately 2 m per year), and in July 2004 when inspected, the level had not changed. Due to the dormant nature of the mine workings, the mine is no longer safe to enter without doing significant scaling and rock bolting and so no further update sampling is planned until the mine reopens. At the time of inspections, the mine pool was sampled and the results are attached below as Table 4-2.

Table 4-2 Jewel Box Mine Water Pool Analysis

	Units	Fall 1997	Jun 1999	July 2002	Oct 2004
Sample		**Totals**	**Dissolved**	**Dissolved**	**Totals**
pH	pH	8.6	7.58	7.9	
EC	µS/cm		370	388	
Alk	mg/L		65	65	
SO_4	mg/L	104	82	84	99.3
Cd	mg/L		0.0154	0.017	0.019
Ca	mg/L		54.7	66.8	48.7
Mg	mg/L		3.81	4.93	3.33
Mn	mg/L		0.247	0.117	0.025
Zn	mg/L	0.69	0.87	1.75	2.18

In 1999, the pool of water in the mine had a pH of 7.6, EC of 370 µS/cm, sulphate of 82 mg/L, and dissolved zinc of 0.87 mg/L (Table 4-2). This compares well to pH of 8.6, sulphate of 104 mg/L and total zinc of 0.69 mg/L (Table 4-3) measured by Cominco during de-watering of the workings in late 1997. As de-watering proceeded in 1998 zinc concentrations decreased to 0.3 mg/L (Table 4-3).

It is expected that the chemistry of the pool will change as the water continues to rise (as evidenced by the chemistry changes from the 2002 and 2004 sampling events). Dissolution of weathering products from walls will influence the mine pool chemistry but the lack of significant build-up of soluble salts indicates that this will not be a significant effect.

4.3.1.4 Jewelbox Hill Zone – 1250 Portal

At some times, the portal is not the only source of surface flows. At one annual inspection the portal was observed by SRK and found not to be the source of nearby flowing surface water. Surface water flow in the area originated from the nearby natural slopes. Field measured zinc concentrations were 0.04 mg/L. Therefore, SRK concluded the drainage from slopes was not a significant source of zinc loading to Camp Creek.

SRK recommended no further assessment.

4.3.1.5 Jewel Box Hill Zone – Underground Mine Pool

After mining of the Jewel Box underground mine ceased in the early 1990s, the working began to flood. The concern has been raised that the workings could eventually discharge water containing unacceptable levels of zinc. Investigations have evaluated the likelihood of discharge and the zinc concentrations.

The elevation of the lowest portal is 1408 m. In 1997, the flood level was 1350 m (compared to 1340 m in 1992). Teck Cominco completely drained the workings in 1997 in preparation for re-activation of the mine; however, the mine was allowed to re-flood and rose to 1344 m at the time of the June 1999 inspection. When SRK and Teck Cominco accessed the workings in July 2002, the water level was 1349 m. Based on these observations, SRK concluded that the initial flooding rate exceeded 2 m per year but then decreased to 1.6 m per year. In 2004 the water level was

checked again by Teck and was unchanged from 2002. The flooding rate indicates that it is unlikely that a discharge would be observed at the 1408 Portal.

Zinc concentrations in the mine pool were increasing slightly and were 2.18 mg/L in 2004, 1.75 mg/L in 2002 and 0.7 mg/L in 1997. The increase was attributed to the effects of weathering and leaching of residual sphalerite ore. SRK predicted that zinc concentrations might increase further and eventually stabilize and decrease, as the workings become a flow through component of the groundwater system.

Table 4-3 Jewelbox Zone De-watering - Monitoring Results

Report Date	Sample Date	Time	Sample #	pH	TSS	Zn/T	Pb/T	Pb/D	Zn/D	Ammonia Nitrogen	Sulphate
	25-Nov-97	14:25	UMW@SUMP15&16(?)	8.6	7	0.69	0.1			0.458	
	27-Nov-97	16:32	UMW SUMP 027&28	8.2	7	0.65	0.09				
	4-Dec-97	19:42	UMW@SUMP 054&55&56	8.5	13	0.58	0.12	0.04	0.34		
	7-Dec-97	14:35	UMW@SUMP 064(was mislabelled)	8.6	16	0.51	0.07	0.02	0.24	0.936	104
	11-Dec-97	19:45	UMW@SUMP 072	8.4	<4	0.54	0.1				
	15-Dec-97	6:40	UMW@SUMP 073								
24-Dec-97	15-Dec-97	6:40	UMW@SUMP073	8.5	6	0.49	0.08				92.6
20-Jan-98	15-Jan-98		UMW@SUMP 076	8.56	4	0.432	0.121				
26-Jan-98	22-Jan-98		UMN@SUMP 081	9.11	5	0.392	0.066				
2-Feb-98	29-Jan-98		UMW@SUMP092	9.29	5	0.339					
9-Feb-98	7-Feb-98		UMW@SUMP097	9.34	3	0.341					
17-Feb-98	12-Feb-98		UMW@SUMP100	9.28	3	0.314					
23-Feb-98	19-Feb-98		UMW@SUMP103	8.99	9	0.298					

4.3.2 Pit Walls

Rock exposures in the two small Main Zone and Jewelbox pits are small. The Main Zone Pit has exposures of limestone, phyllite and skarn. The Jewelbox Pit has exposures of limestone and phyllite. The reactive surface area represented by these exposures is much smaller than the associated waste rock.

4.3.3 Waste Rock

4.3.3.1 Burnick Zone

Waste rock was dumped along the slope outside the 1200 portals. On-surface, the waste rock consists primarily of mixed weakly mineralized calcareous and non-calcareous phyllite. This rock was reported to be non-acid generating in the IEE. Visual observation confirmed this finding. A pile (<200 m^3) of oxidized ore-type skarn material was located on top of the dump near the portals. This material consists generally of sphalerite with calcite and actinolite, and minor pyrite. The material was non-acidic. A sample of similar rock from the Jewelbox Zone (SDH-R2) contained 2.5% Zn and 1.27% sulphur (Table 4-4). The molar quantities of Zn and S are very similar indicating that zinc sulphide is the dominant sulphur-containing mineral and that the rock will not be acidic. A deionized water leach test on the sample indicated low zinc concentrations (0.009 mg/L) but elevated sulphate (45 mg/L) (Table 4-5).

No toe seeps were visible during the June 1999 site inspection.

The Burnick Zone waste rock dumps are expected to be chemically stable. The skarn material is currently oxidizing but is not expected to generate acid, and therefore will continue to oxidize at current rates.

Table 4-4 ABA and Metal Analysis Results for Rock and Tailings

	Description	Paste pH	CO2 Inorg.	CaCO3 Equiv.[1]	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	MPA[2]	NP[3]	NNP[4]	Fizz Rating	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb
Sample ID			**(Wt.%)**		**(Wt.%)**	**(Wt.%)**	**(Wt.%)**					**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Main Zone 1250 Dump																										
1CC005.05 SD001	SDH-R1	7.6	0.35	7.9	0.31	0.22	0.09	2.8	13.8	11.0	none	190	1612	1294	4.3	95	9	395	4.11	177	43	2	14	121	8.1	20
Jewel Box Zone 1408 Dump Ore																										
1CC005.05 SD004	SDH-R2	7.9	1.58	35.9	1.27	0.04	1.23	38.4	77.5	39.1	moderate	34	36176	25026	18.1	41	18	3910	4.74	< 2	< 8	< 2	< 2	16	161.7	15
South Tailings																										
1CC005.05 SD008	SDH-T1	8.6	10.63	241.3	0.13	<0.01	0.13	4.1	241.3	237.2	moderate	47	4146	3071	4.6	9	4	1857	1.8	17	< 8	< 2	< 2	120	17.7	4
1CC005.05 SD009	SDH-T2	8.6	9.08	206.1	0.20	<0.01	0.20	6.3	208.8	202.6	moderate	20	2892	4129	3.3	8	5	1598	1.6	19	< 8	< 2	2	97	23	3
1CC005.05 SD0010	SDH-T3	8.4	10.91	247.7	0.55	<0.01	0.55	17.2	251.3	234.1	moderate	27	5016	11341	4.3	11	7	1554	1.47	17	< 8	< 2	< 2	119	67.9	4
North Tailings																										
1CC005.05 SD0013	SDH-T4	8.0	7.60	172.5	0.11	0.05	0.06	1.9	181.3	179.4	moderate	70	7607	8241	5.6	21	8	3040	2.83	27	< 8	< 2	2	99	48.2	6
1CC005.05 SD0012	SDH-T5	8.5	10.28	233.4	0.12	0.02	0.10	3.1	233.8	230.7	moderate	45	4769	4208	4.9	51	7	1807	2.02	60	< 8	< 2	2	130	22.4	4
1CC005.05 SD0011	SDH-T6	8.4	10.91	247.7	0.16	<0.01	0.16	5.0	247.5	242.5	moderate	41	4960	7137	3.7	29	7	1713	1.79	41	< 8	< 2	2	117	36.4	4

[1] (Kg CaCO3/Tonne)
[2] Maximum Potential Acidity
[3] Neutralization Potential
[4] Net Neutralization Potential

Table 4-5 Deionized Water (20:1) Leach Extraction Results for Rock and Tailings

Sample	Description	Ag ppb	Al ppm	As ppb	Cd ppb	Cu ppb	Fe ppm	Mo ppb	Pb ppb	Se ppb	Zn ppb	Final pH	SO4 mg/L
1CC005.05 SD001 -2MM	SDH-R1	< 5	< .1	< 30	< 2	6	0.02	16	< 10	< 20	< 5	8.0	19
1CC005.05 SD004 -2MM	SDH-R2	< 5	< .1	< 30	2	2	0.03	< 5	< 10	< 20	9	8.4	45
1CC005.05 SD008	SDH-T1	< 5	< .1	< 30	< 2	4	0.08	13	25	27	13	9.0	3
1CC005.05 SD009	SDH-T2	< 5	< .1	< 30	< 2	3	0.06	11	14	< 20	13	9.1	3
1CC005.05 SD0010	SDH-T3	< 5	< .1	< 30	< 2	5	0.05	9	19	26	13	9.0	3
1CC005.05 SD0011	SDH-T6	< 5	< .1	< 30	< 2	3	0.1	19	22	< 20	39	9.0	2
1CC005.05 SD0011 Dup.	SDH-T6	< 5	< .1	< 30	< 2	4	0.2	23	53	< 20	85	9.0	2
1CC005.05 SD0012	SDH-T5	< 5	< .1	< 30	< 2	4	0.05	31	< 10	< 20	12	9.0	13
1CC005.05 SD0013	SDH-T4	< 5	< .1	< 30	2	5	0.02	18	11	< 20	13	8.5	52
BLANK		< 5	< .1	< 30	< 2	3	0.01	< 5	< 10	< 20	< 5	5.6	<1

4.3.4 Tailings

Tailings are exposed in both the north and south tailings area. The north tailings beach is aerially greater than the south tailings beach. Tailings in both areas are olive-brown with some coarse and fine layering. Partly saturated tailings are grey. The tailings are uniformly calcareous. Salt crusts were not observed on the tailings.

Total sulphur content of six surface samples varied from 0.1 to 0.6% and neutralization potentials were 180 to 250 kg $CaCO_3$/t (Table 4-4). Carbonate content indicated similar levels of neutralization potential. Zinc concentrations varied from 0.4 to 1.1%, and lead from 0.2 to 0.7%. The near molar equivalence of sulphur with lead and zinc content indicates that the residual sulphide content is principally sphalerite and galena with very little iron sulphide. The tailings are therefore not potentially acid generating.

Deionized water leachates of tailings contained low sulphate (2 to 52 mg/L), zinc (0.01 to 0.09 mg/L) and lead (<0.01 to 0.05 mg/L) concentrations. These results indicate oxidation of sphalerite and galena is occurring in the near surface tailings (Table 4-5).

Monitoring of seepage from the North Dam (MH-2) which originates from the tailings in the north end of the impoundment indicates that sulphate, cadmium, and zinc concentrations began increasing in 1992. In 1997, zinc concentrations stabilized (Appendix D of DDRP, Figure D-5). Since 1999 zinc concentrations have decreased through to 2004, then increased back to similar levels in 1999, and then decreased again since 2010. During winters, with high snow loads, sampling is difficult ant it is apparent that samples are being contaminated with sediments. Frequently, TSS results are abnormally high during winter when they should be low (i.e. no erosion would be occurring). Zinc values, including only winter samples when TSS was less than 10 mg/L and all spring and summer results (as these are not believed to be related to sampling problems),while there is a lot of scatter, appear to show slightly decreasingzinc concentrations.

The increase in zinc concentrations up to 1999 may possibly be attributed to oxidation of near surface tailings. It has also been suggested that the increase may be due to leaching of wind-blown tailings. In 2000, a clean up of tailings on the face of the dam and covering of adjacent tailings with a thin layer of gravel was done and has been successful in substantially eliminating the dusting issue.

The increase in sulphate concentrations (Appendix D of DDRP, Figure D-5), but decrease in zinc concentrations, possibly indicates that a solubility control has been reached for zinc but not for sulfate. The cadmium concentrations and alkalinity of the water are consistent with solubility control by cadmium carbonate, which indicates that cadmium concentrations will not increase. Zinc may also be constrained by zinc carbonate in the tailings surface.

In a report titled “2002 Geochemical Projects, Sa Dena Hes Mine” by SRK Consultants dated March 2003, S. Day concluded:

- Elevated zinc concentrations comparable to those obtained at MH-7 are common in pore water in the tailings beach, and confirmed the conceptual model developed by SRK (2003)
- The composition of seepage at MH-2 appears to be dominated (90%) by natural groundwater originating from valley sides.
- Zinc concentrations’ at MH-2 are decreasing but a higher than expected based on conservative element mixing rations. Zinc may partly originate from leaching of wind blown tailings on the dam face.

It should be noted that the South Dam currently impounds much less tailings than the North Dam. Most tailings were deposited near the coffer dam. When these are drained, as per the closure scenario, the exposed area will be much less than the current exposure at the North Dam, and therefore, less zinc expected.

The monitoring suggests that zinc load is not likely to increase substantially and zinc concentrations will stabilize. Also, subsequent analysis of loading sources, as discussed in Section 4, indicate that this is not a significant source in the False Canyon Creek basin. Substantial increases in the load from this source can occur without a noticeable impact on False Canyon Creek.

4.3.5 Conclusions

The mineralization at Sä Dena Hes is characterized by zinc and lead sulphides with low concentrations of iron sulphides in association with abundant carbonates. Therefore, acid generation will not occur. Zinc, cadmium and lead leaching are controlled by the oxidation of sphalerite (Zn, Cd) and galena under pH-neutral atmospheric conditions. Breakdown of sphalerite is apparent throughout the site. Acceleration of sphalerite oxidation is not expected in the absence of a mechanism to lower pH. Zinc and cadmium leaching will continue but is not expected to accelerate. Most sources will continue to leach zinc and cadmium at the current rates. This is demonstrated by the stable zinc and sulphate concentrations at MH-4 which receives drainage from the Main Zone (Appendix D of DDRP, Figure D-1)

4.4 WATER QUALITY PREDICTION

4.4.1 Methods

Mass loadings in the False Canyon Creek (FCC) basin were calculated to assess the degree to which flows (measured and calculated) combined with measured concentrations account for the various sources of chemical load in the basin.

In general, the load observed in FCC at a location downstream of the mine can be described as:

Total Load = Background
+ Discharge from the Burnick Portal
+ Runoff and groundwater from the Burnick Zone waste rock dumps
+ Runoff and groundwater from the Main Zone Pits
+ Runoff and groundwater from the Main Zone Pits waste rock dumps
+ Runoff and groundwater from the Jewelbox Zone waste rock dumps
+ Runoff and groundwater from the north tailings
+ Runoff and groundwater from the south tailings

The data discussed in the following section is unchanged from the 2000 DDRP. The loading to FCC was assessed using the following methods:

1. Monthly statistics were calculated for water quality for several monitoring stations. The statistics included number of samples, mean, median, maximum and minimum. The above sources of loadings have not been monitored separately but influence various downstream monitoring locations.

   MH-22 captures the Burnick Portal. MH-2 is the seepage from the North end of the tailings impoundment. MH-12 reflects the effect of the Burnick Portal, the Burnick Zone dumps and the North Dam on the East Fork of Tributary E. A substantial background component is included. MH-4 represents the effect of the Main and Jewelbox Zone Pits, waste rock dumps and background from North Hill. MH-5 is located by the gate house at the mill site and receives intermittent surface water flow from the Jewelbox Hill Zone waste rock dumps. MH-7 is seepage from the south end of the TMF. MH-11 represents the total of these sources with background from the same catchment area. MH-13 is the same basin with additional background effect.

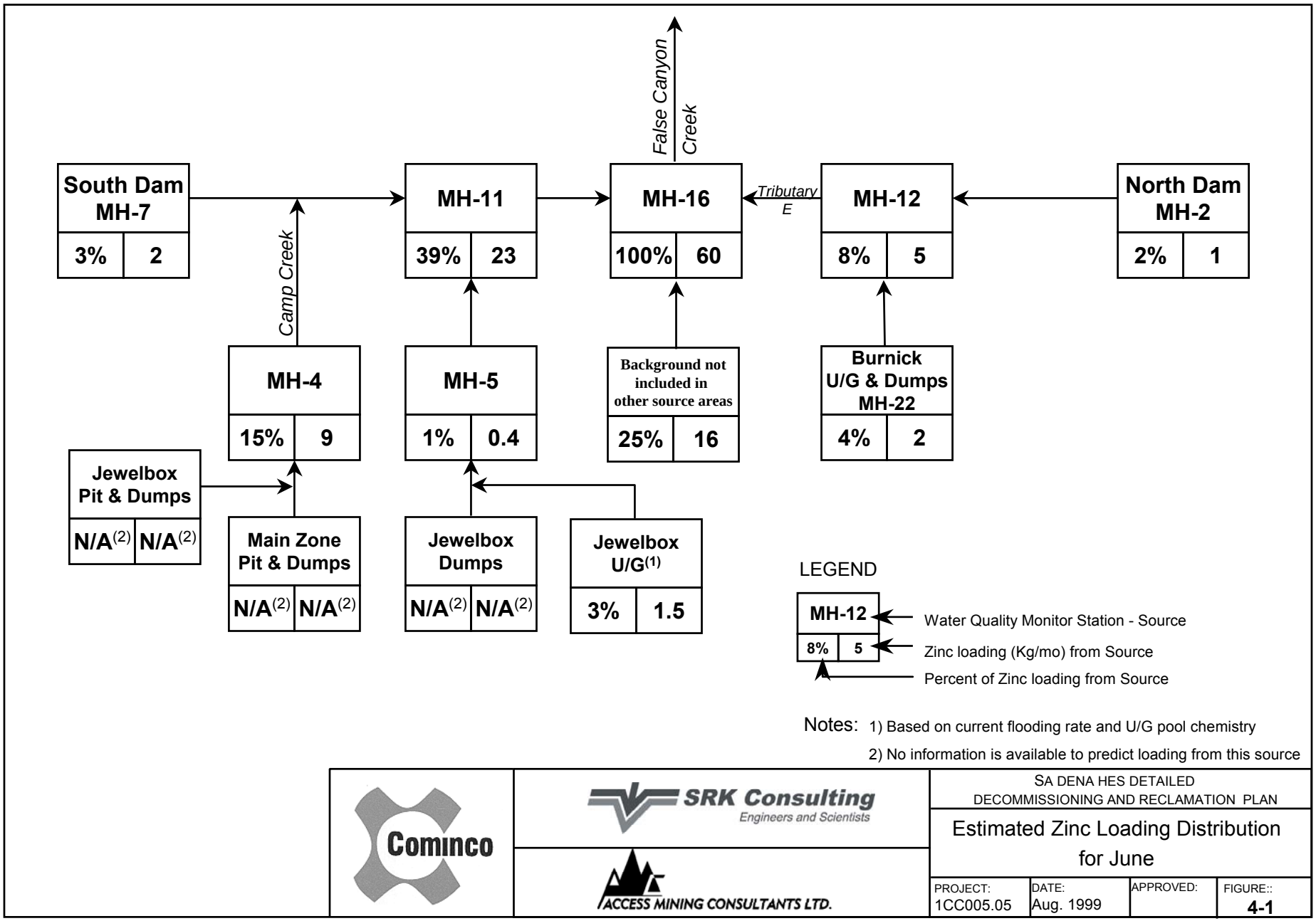
   MH-16 was selected as a downstream monitoring location reflecting the effect of both Tributary E and FCC.

   Median concentrations for selected months formed the basis for the subsequent loading analysis (Table 4-6). The months were January (winter low flow), June (freshet), August (summer low flow), and October (fall and early winter). Where data was not available, other months in the same quarter were substituted.

   Flows for loading calculations were estimated from field measurements (seeps and portal discharge) and regional mean annual runoff analysis (creeks).

   Median loads for routinely analyzed parameters (sulphate, hardness, ammonia, nitrate, barium, cadmium, iron, manganese, lead and zinc) at each location were calculated in kg/month (Table 4-7).

The proportion of load at each point as a proportion of the load in the basin (MH-16) was calculated to evaluate the contribution of each source to the total load in FCC (Table 4-8). This is graphically shown in Figure 4-1.



Notes: 1) Based on current flooding rate and U/G pool chemistry

2) No information is available to predict loading from this source

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SA DENA HES DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

Estimated Zinc Loading Distribution for June

PROJECT:	DATE:	APPROVED:	FIGURE::
1CC005.05	Aug. 1999		4-1

Background concentrations for sampling locations influenced by non-mined areas were calculated by subtracting the loads and flows attributable to all upstream locations (Table 4-9). For example, the background concentration for the MH-12 catchment was calculated from:

$$\frac{M_{MH12} - (M_{MH2} + M_{MH22})}{Q_{MH12} - (Q_{MH2} + Q_{MH22})}$$

Where: Ms are the mass loadings and Qs are the associated flows.

These concentrations also assist with identifying sources of unaccounted for load at the monitoring locations. If the calculated background concentration is higher than the expected background, the unaccounted for load may include the effect of an unmonitored source.

Table 4-6 Summary of Concentrations in False Creek (FCC)

		Tributary E				False Canyon Creek							FCC
		North Dam	Burnick Portal	D/S		Jewelbox Pits and Dumps	Jewelbox Portal	1408 Dump	South Dam Seepage	D/S	D/S		Main
Parameter	Units	MH-2	MH-22	MH-12		MH-4		MH-5	MH-7	MH-11	MH-13		MH-16
January													
Flow	m3/mo	2187	3393	30525		14850	#N/A	#N/A	10736	42759	137835		413117
pH		8	8	8		8	#N/A	#N/A	8	8	8		8
Conductivity	us/cm	1070.00	353	360		314	#N/A	#N/A	531	473	435		395
Susp Solids	mg/L	6.00	2	2		6	#N/A	#N/A	2.25	3	6		2
Alkalinity (CaCO3)	mg/L	425.00	118	184		154.5	#N/A	#N/A	240	210	214		213
Sulphate	mg/L	188.00	47.4	9.4		12.45	#N/A	#N/A	66.6	40.45	16		8.9
Hardness (Total)	mg/L	526.00	168	194		173.5	#N/A	#N/A	309	256	234		220
Ammonia (Nitrogen)	mg/L	0.17	0.038	0.0025		0.0055	#N/A	#N/A	0.182	0.019	0.016		0.007
Nitrate (Nitrogen)	mg/L	0.05	0.43	0		1.14	#N/A	#N/A	0.5	0.425	0		0
Barium (Total)	mg/L	0.15	0.0201	0.103		0.0275	#N/A	#N/A	0.07975	0.092	0.166		0.173
Barium (Dissolved)	mg/L	0.00	0.019	0		0.0295	#N/A	#N/A	0.1	0.1325	0		0
Cadmium (Total)	mg/L	0.00	0.0009	0.00005		0.0002	#N/A	#N/A	0.0005	0.000225	0.00005		0.00005
Cadmium (Dissolved)	mg/L	0.00	0.0005	0		0.0002	#N/A	#N/A	0.0007	0.00015	0		0
Iron (Total	mg/L	0.57	0.06	0.238		0.0385	#N/A	#N/A	0.075	0.142	0.33		0.14
Iron (Dissolved)	mg/L	0.00	0.003	0		0.006	#N/A	#N/A	0.001	0.031	0		0
Manganese (Total)	mg/L	3.64	0.028	0.024		0.007	#N/A	#N/A	0.299	0.077	0.02635		0.0107
Lead (Total)	mg/L	0.00	0.004	0.0015		0.00325	#N/A	#N/A	0.0245	0.006	0.0015		0.0015
Lead (Dissolved)	mg/L	0.00	0.002	0		0.002	#N/A	#N/A	0.0185	0.0035	0		0
Zinc (Total)	mg/L	0.21	0.31	0.005		0.0126	#N/A	#N/A	0.1705	0.047	0.02		0.005
June													
Flow	m3/mo	3750	10914	488501		248570	#N/A	17856	10736	667269	2093002		5993369
pH		8.1	8.05	7.9		8.05	#N/A	7.9	8.1	8.1	8.1		8.4
Conductivity	us/cm	1030	250	257		274.5	#N/A	384	531	324	220		354
Susp Solids	mg/L	2	9	2		38.5	#N/A	2	2.25	6.5	13		2
Alkalinity (CaCO3)	mg/L	366	86.4	130		135	#N/A	101	240	160	109		183
Sulphate	mg/L	249	38.15	7.1		12.25	#N/A	63.4	66.6	17.2	26.8		11.9
Hardness (Total)	mg/L	539	130	141		154.5	#N/A	191	309	182	125		208
Ammonia (Nitrogen)	mg/L	0.162	0.134	0.005		0.0225	#N/A	0.006	0.182	0.00425	0.05		0.034
Nitrate (Nitrogen)	mg/L	0.03	0.37	0.06		0.6	#N/A	#N/A	0.5	0.705	0.185		0.04
Barium (Total)	mg/L	0.152	0.01735	0.075		0.03695	#N/A	0.011	0.07975	0.0625	0.08		0.14
Barium (Dissolved)	mg/L	0	0.015	0.066		0.019	#N/A	#N/A	0.1	0.044	0.0935		0.138
Cadmium (Total)	mg/L	0.0013	0.0008	0.0002		0.000275	#N/A	0.0002	0.0005	0.000275	0.00015		0.0042
Cadmium (Dissolved)	mg/L	0	0.0005	0.00005		0.0002	#N/A	#N/A	0.0007	0.000125	0.0001		0.00005
Iron (Total	mg/L	0.46	0.32	0.62		0.856	#N/A	0.025	0.075	0.305	0.42		0.12
Iron (Dissolved)	mg/L	0	0.0015	0.016		0.00825	#N/A	#N/A	0.001	0.04	0.0295		0.026
Manganese (Total)	mg/L	3.16	0.0515	0.012		0.028	#N/A	0.0010	0.299	0.046	0.045		0
Lead (Total)	mg/L	0.005	0.0065	0.003		0.008	#N/A	0.002	0.0245	0.01	0.007		0.004
Lead (Dissolved)	mg/L	0	0.001	0.0005		0.002	#N/A	#N/A	0.0185	0.0085	0.012		0.004
Zinc (Total)	mg/L	0.24	0.195	0.01		0.037	#N/A	0.0200	0.1705	0.035	0.031		0.01
August													
Flow	m3/mo	893	3437	145727		71502	#N/A	#N/A	4464	203186	651751		1937863
pH		8	8.2	8.1		8.2	#N/A	#N/A	8.2	8.3	8.45		8.2
Conductivity	us/cm	991	292	316		309	#N/A	#N/A	523	397	0		396.5
Susp Solids	mg/L	4	2	2		2.5	#N/A	#N/A	2	2	2		2
Alkalinity (CaCO3)	mg/L	395	103	168		147	#N/A	#N/A	243	196	190.5		206.5
Sulphate	mg/L	221	39.7	7.25		16.55	#N/A	#N/A	38.7	19.1	11.8		9.25
Hardness (Total)	mg/L	525	157	192.5		169	#N/A	#N/A	290	225	205		215
Ammonia (Nitrogen)	mg/L	0.046	0.005	0.00375		0.0025	#N/A	#N/A	0.153	0.0025	0.013		0.00375
Nitrate (Nitrogen)	mg/L	0.01	0.38	0		0.83	#N/A	#N/A	0.12	0.32	0		0.07
Barium (Total)	mg/L	0.155	0.018	0.085		0.02655	#N/A	#N/A	0.086	0.075	0.1355		0.1515
Barium (Dissolved)	mg/L	0	0.019	0		0.027	#N/A	#N/A	0.079	0.079	0.125		0.075
Cadmium (Total)	mg/L	0.0008	0.00085	0.000075		0.0002	#N/A	#N/A	0.0007	0.0002	0.000625		0.00015
Cadmium (Dissolved)	mg/L	0	0.0003	0		0.0002	#N/A	#N/A	0.0002	0.0002	0.00025		0.00005
Iron (Total	mg/L	0.9	0.025	0.224		0.025	#N/A	#N/A	0.025	0.13	0.1805		0.15
Iron (Dissolved)	mg/L	0	0.004	0		0.01	#N/A	#N/A	0.032	0.032	0.043		0.057
Manganese (Total)	mg/L	2.94	0.0165	0.0164		0.007	#N/A	#N/A	0.3195	0.055	0.013		0.01
Lead (Total)	mg/L	0.01	0.0015	0.0015		0.0045	#N/A	#N/A	0.01	0.005	0.0085		0.0015
Lead (Dissolved)	mg/L	0	0.002	0		0.004	#N/A	#N/A	0.007	0.007	0.0005		0.0005
Zinc (Total)	mg/L	0.2	0.25	0.005		0.01	#N/A	#N/A	0.16	0.02	0.0045		0.0075
October													
Flow	m3/mo	937	1049	114935		51151	#N/A	#N/A	3928	168422	568190		1825002
pH		8	8.095	8.1		8.3	#N/A	#N/A	8.2	8.3	8.2		8.2
Conductivity	us/cm	1020	299	316		307	#N/A	#N/A	503	397	392		396.5
Susp Solids	mg/L	2	2	2		2	#N/A	#N/A	2	4	2		2
Alkalinity (CaCO3)	mg/L	383	103.5	165		149	#N/A	#N/A	236	194	190.5		206.5
Sulphate	mg/L	235	45.6	8.5		20.5	#N/A	#N/A	37.5	21.8	11.1		9.25
Hardness (Total)	mg/L	536	157	180		174	#N/A	#N/A	284.5	221.5	207		215
Ammonia (Nitrogen)	mg/L	0.023	0.00375	0.0025		0.0025	#N/A	#N/A	0.208	0.0025	0.0175		0.00375
Nitrate (Nitrogen)	mg/L	0.7975	0.86	0.18		1.57	#N/A	#N/A	0.12	0.3	0.26		0.07
Barium (Total)	mg/L	0.15	0.0175	0.075		0.026	#N/A	#N/A	0.086	0.074	0.123		0.1515
Barium (Dissolved)	mg/L	0	0.017	0.072		0.025	#N/A	#N/A	0.101	0.072	0.111		0.075
Cadmium (Total)	mg/L	0.0008	0.0011	0.00005		0.0002	#N/A	#N/A	0.0008	0.0002	0.00015		0.00015
Cadmium (Dissolved)	mg/L	0	0.0013	0		0.0003	#N/A	#N/A	0.0009	0.00005	0.0001		0.00005
Iron (Total	mg/L	0.89	0.025	0.21		0.025	#N/A	#N/A	0.025	0.13	0.26		0.15
Iron (Dissolved)	mg/L	0	0.0015	0.052		0.008	#N/A	#N/A	0.012	0.03	0.031		0.057
Manganese (Total)	mg/L	3.22	0.011	0.01645		0.0085	#N/A	#N/A	0.366	0.06665	0.0184		0.01
Lead (Total)	mg/L	0.0015	0.002	0.0015		0.004	#N/A	#N/A	0.008	0.004	0.003		0.0015
Lead (Dissolved)	mg/L	0	0.003	0		0.003	#N/A	#N/A	0.01	0.003	0.002		0.0005
Zinc (Total)	mg/L	0.28	0.3235	0.005		0.02	#N/A	#N/A	0.22	0.03	0.005		0.0075

Table 4-7 - Summary of Load Proportions in False Creek Basin at MH-16

		Tributary E				False Canyon Creek							FCC
		North Dam	Burnick Portal	D/S		Jewelbox Pits and Dumps	Jewelbox Portal	1408 Dump	South Dam Seepage	D/S	D/S		Main
Parameter	Units	MH-2	MH-22	MH-12		MH-4		MH-5	MH-7	MH-11	MH-13		MH-16
January													
Flow	m3/mo	2187	3393	30525		14850	#N/A	#N/A	10736	42759	137835		413117
January - Loads													
Sulphate	kg/mo	411	161	287		185	#N/A	#N/A	715	1730	2205		3677
Hardness (Total)	kg/mo	1151	570	5922		2577	#N/A	#N/A	3317	10946	32254		90886
Ammonia (Nitrogen)	kg/mo	0.38	0.13	0.08		0.08	#N/A	#N/A	1.95	0.81	2.21		2.89
Barium (Total)	kg/mo	0.32	0.07	3.14		0.41	#N/A	#N/A	0.86	3.93	22.88		71.47
Cadmium (Total)	kg/mo	0.002	0.003	0.002		0.003	#N/A	#N/A	0.005	0.010	0.007		0.021
Iron (Total	kg/mo	1.25	0.20	7.27		0.57	#N/A	#N/A	0.81	6.07	45.49		57.84
Manganese (Total)	kg/mo	7.96	0.09	0.73		0.10	#N/A	#N/A	3.21	3.29	3.63		4.42
Lead (Total)	kg/mo	0.00	0.01	0.05		0.05	#N/A	#N/A	0.26	0.26	0.21		0.62
Lead (Dissolved)	kg/mo	0.00	0.01	0.00		0.03	#N/A	#N/A	0.20	0.15	0.00		0.00
Zinc (Total)	kg/mo	0.46	1.05	0.15		0.19	#N/A	#N/A	1.83	2.01	2.76		2.07
June													
Flow	m3/mo	3750	10914	488501		248570	#N/A	17856	10736	667269	2093002		5993369
June - Loads													
Sulphate	kg/mo	934	416	3468		3045	#N/A	1132	715	11477	56092		71321
Hardness (Total)	kg/mo	2021	1419	68879		38404	#N/A	3410	3317	121443	261625		1246621
Ammonia (Nitrogen)	kg/mo	0.61	1.46	2.44		5.59	#N/A	0.11	1.95	2.84	104.65		203.77
Nitrate (Nitrogen)	kg/mo	0.11	4.04	29.31		149.14	#N/A	#N/A	5.37	470.42	387.21		239.73
Barium (Total)	kg/mo	0.57	0.19	36.64		9.18	#N/A	0.20	0.86	41.70	167.44		839.07
Barium (Dissolved)	kg/mo	0.00	0.16	32.24		4.72	#N/A	#N/A	1.07	29.36	195.70		827.08
Cadmium (Total)	kg/mo	0.005	0.009	0.098		0.068	#N/A	0.004	0.005	0.183	0.314		25.172
Iron (Total	kg/mo	1.72	3.49	302.87		212.78	#N/A	0.45	0.81	203.52	879.06		719.20
Iron (Dissolved)	kg/mo	0.00	0.02	7.82		2.05	#N/A	#N/A	0.01	26.69	61.74		155.83
Lead (Total)	kg/mo	0.02	0.07	1.47		1.99	#N/A	0.03	0.26	6.67	14.65		23.97
Lead (Dissolved)	kg/mo	0.00	0.01	0.24		0.50	#N/A	#N/A	0.20	5.67	25.12		23.97
Zinc (Total)	kg/mo	0.90	2.13	4.89		9.20	#N/A	0.36	1.83	23.35	64.88		59.93
August													
Flow	m3/mo	893	3437	145727		71502	#N/A	#N/A	4464	203186	651751		1937863
August - Loads													
Sulphate	kg/mo	197	136	1057		1183	#N/A	#N/A	173	3881	7691		17925
Hardness (Total)	kg/mo	469	540	28052		12084	#N/A	#N/A	1295	45717	133609		416641
Ammonia (Nitrogen)	kg/mo	0.04	0.02	0.55		0.18	#N/A	#N/A	0.68	0.51	8.47		7.27
Nitrate (Nitrogen)	kg/mo	0.01	1.31	0.00		59.35	#N/A	#N/A	0.54	65.02	0.00		135.65
Barium (Total)	kg/mo	0.14	0.06	12.39		1.90	#N/A	#N/A	0.38	15.24	88.31		293.59
Barium (Dissolved)	kg/mo	0.00	0.07	0.00		1.93	#N/A	#N/A	0.35	16.05	81.47		145.34
Cadmium (Total)	kg/mo	0.001	0.003	0.011		0.014	#N/A	#N/A	0.003	0.041	0.407		0.291
Iron (Total	kg/mo	0.80	0.09	32.64		1.79	#N/A	#N/A	0.11	26.41	117.64		290.68
Iron (Dissolved)	kg/mo	0.00	0.01	0.00		0.72	#N/A	#N/A	0.14	6.50	28.03		110.46
Manganese (Total)	kg/mo	2.62	0.06	2.39		0.50	#N/A	#N/A	1.43	11.18	8.47		19.38
Lead (Total)	kg/mo	0.01	0.01	0.22		0.32	#N/A	#N/A	0.04	1.02	5.54		2.91
Lead (Dissolved)	kg/mo	0.00	0.01	0.00		0.29	#N/A	#N/A	0.03	1.42	0.33		0.97
Zinc (Total)	kg/mo	0.18	0.86	0.73		0.72	#N/A	#N/A	0.71	4.06	2.93		14.53
October													
Flow	m3/mo	937	1049	114935		51151	#N/A	#N/A	3928	168422	568190		1825002
October - Loads													
Sulphate	kg/mo	220	48	977		1049	#N/A	#N/A	147	3672	6307		16881
Hardness (Total)	kg/mo	502	165	20688		8900	#N/A	#N/A	1118	37305	117615		392375
Ammonia (Nitrogen)	kg/mo	0.02	0.00	0.29		0.13	#N/A	#N/A	0.82	0.42	9.94		6.84
Nitrate (Nitrogen)	kg/mo	0.75	0.90	20.69		80.31	#N/A	#N/A	0.47	50.53	147.73		127.75
Barium (Total)	kg/mo	0.14	0.02	8.62		1.33	#N/A	#N/A	0.34	12.46	69.89		276.49
Barium (Dissolved)	kg/mo	0.00	0.02	8.28		1.28	#N/A	#N/A	0.40	12.13	63.07		136.88
Cadmium (Total)	kg/mo	0.001	0.001	0.006		0.010	#N/A	#N/A	0.003	0.034	0.085		0.274
Iron (Total	kg/mo	0.83	0.03	24.14		1.28	#N/A	#N/A	0.10	21.89	147.73		273.75
Iron (Dissolved)	kg/mo	0.00	0.00	5.98		0.41	#N/A	#N/A	0.05	5.05	17.61		104.03
Manganese (Total)	kg/mo	3.02	0.01	1.89		0.43	#N/A	#N/A	1.44	11.23	10.45		18.25
Lead (Total)	kg/mo	0.00	0.00	0.17		0.20	#N/A	#N/A	0.03	0.67	1.70		2.74
Lead (Dissolved)	kg/mo	0.00	0.00	0.00		0.15	#N/A	#N/A	0.04	0.51	1.14		0.91
Zinc (Total)	kg/mo	0.26	0.34	0.57		1.02	#N/A	#N/A	0.86	5.05	2.84		13.69

Table 4-8 - Summary of Inferred Background Concentrations in False Canyon Creek Basin

		Tributary E				False Canyon Creek							FCC
		North Dam	Burnick Portal	Downstream		Jewel Box Pits and Dumps	Jewel Box Portal	1408 Dump	South Dam Seepage	D/S	D/S		Main
Parameter	Units	MH-2	MH-22	MH-12		MH-4		MH-5	MH-7	MH-11	MH-13		MH-16
January - Load Proportions of MH-16													
Sulphate	%	11%	4%	8%		5%	#N/A	#N/A	19%	47%	60%		100%
Hardness (Total)	%	1%	1%	7%		3%	#N/A	#N/A	4%	12%	35%		100%
Ammonia (Nitrogen)	%	13%	4%	3%		3%	#N/A	#N/A	68%	28%	76%		100%
Barium (Total)	%	0%	0%	4%		1%	#N/A	#N/A	1%	6%	32%		100%
Cadmium (Total)	%	7%	15%	7%		14%	#N/A	#N/A	26%	47%	33%		100%
Iron (Total	%	2%	0%	13%		1%	#N/A	#N/A	1%	10%	79%		100%
Manganese (Total)	%	180%	2%	17%		2%	#N/A	#N/A	73%	74%	82%		100%
Zinc (Total)	%	22%	51%	7%		9%	#N/A	#N/A	89%	97%	133%		100%
June - Load Proportions of MH-16													
Sulphate	%	1%	1%	5%		4%	#N/A	2%	1%	16%	79%		100%
Hardness (Total)	%	0%	0%	6%		3%	#N/A	0%	0%	10%	21%		100%
Ammonia (Nitrogen)	%	0%	1%	1%		3%	#N/A	0%	1%	1%	51%		100%
Nitrate (Nitrogen)	%	0%	2%	12%		62%	#N/A	#N/A	2%	196%	162%		100%
Barium (Total)	%	0%	0%	4%		1%	#N/A	0%	0%	5%	20%		100%
Barium (Dissolved)	%	0%	0%	4%		1%	#N/A	#N/A	0%	4%	24%		100%
Cadmium (Total)	%	0%	0%	0%		0%	#N/A	0%	0%	1%	1%		100%
Cadmium (Dissolved)	%	0%	2%	8%		17%	#N/A	#N/A	3%	28%	70%		100%
Iron (Total	%	0%	0%	42%		30%	#N/A	0%	0%	28%	122%		100%
Iron (Dissolved)	%	0%	0%	5%		1%	#N/A	#N/A	0%	17%	40%		100%
Lead (Total)	%	0%	0%	6%		8%	#N/A	0%	1%	28%	61%		100%
Lead (Dissolved)	%	0%	0%	1%		2%	#N/A	#N/A	1%	24%	105%		100%
Zinc (Total)	%	2%	4%	8%		15%	#N/A	1%	3%	39%	108%		100%
August - Load Proportions of MH-16													
Sulphate	%	1%	1%	6%		7%	#N/A	#N/A	1%	22%	43%		100%
Hardness (Total)	%	0%	0%	7%		3%	#N/A	#N/A	0%	11%	32%		100%
Ammonia (Nitrogen)	%	1%	0%	8%		2%	#N/A	#N/A	9%	7%	117%		100%
Nitrate (Nitrogen)	%	0%	1%	0%		44%	#N/A	#N/A	0%	48%	0%		100%
Barium (Total)	%	0%	0%	4%		1%	#N/A	#N/A	0%	5%	30%		100%
Barium (Dissolved)	%	0%	0%	0%		1%	#N/A	#N/A	0%	11%	56%		100%
Cadmium (Total)	%	0%	1%	4%		5%	#N/A	#N/A	1%	14%	140%		100%
Cadmium (Dissolved)	%	0%	1%	0%		15%	#N/A	#N/A	1%	42%	168%		100%
Iron (Total	%	0%	0%	11%		1%	#N/A	#N/A	0%	9%	40%		100%
Iron (Dissolved)	%	0%	0%	0%		1%	#N/A	#N/A	0%	6%	25%		100%
Manganese (Total)	%	14%	0%	12%		3%	#N/A	#N/A	7%	58%	44%		100%
Lead (Total)	%	0%	0%	8%		11%	#N/A	#N/A	2%	35%	191%		100%
Lead (Dissolved)	%	0%	1%	0%		30%	#N/A	#N/A	3%	147%	34%		100%
Zinc (Total)	%	1%	6%	5%		5%	#N/A	#N/A	5%	28%	20%		100%
October - Load Proportions of MH-16													
Sulphate	%	1%	0%	6%		6%	#N/A	#N/A	1%	22%	37%		100%
Hardness (Total)	%	0%	0%	5%		2%	#N/A	#N/A	0%	10%	30%		100%
Ammonia (Nitrogen)	%	0%	0%	4%		2%	#N/A	#N/A	12%	6%	145%		100%
Nitrate (Nitrogen)	%	1%	1%	16%		63%	#N/A	#N/A	0%	40%	116%		100%
Barium (Total)	%	0%	0%	3%		0%	#N/A	#N/A	0%	5%	25%		100%
Barium (Dissolved)	%	0%	0%	6%		1%	#N/A	#N/A	0%	9%	46%		100%
Cadmium (Total)	%	0%	0%	2%		4%	#N/A	#N/A	1%	12%	31%		100%
Cadmium (Dissolved)	%	0%	1%	0%		17%	#N/A	#N/A	4%	9%	62%		100%
Iron (Total	%	0%	0%	9%		0%	#N/A	#N/A	0%	8%	54%		100%
Iron (Dissolved)	%	0%	0%	6%		0%	#N/A	#N/A	0%	5%	17%		100%
Manganese (Total)	%	17%	0%	10%		2%	#N/A	#N/A	8%	62%	57%		100%
Lead (Total)	%	0%	0%	6%		7%	#N/A	#N/A	1%	25%	62%		100%
Lead (Dissolved)	%	0%	0%	0%		17%	#N/A	#N/A	4%	55%	125%		100%
Zinc (Total)	%	2%	2%	4%		7%	#N/A	#N/A	6%	37%	21%		100%

Table 4-9 – Summary of Inferred Background Concentrations in False Canyon Creek Basin

		Trib. E. East Fork		Jewel Box Pits and	FCC	FCC		FCC
Parameter	Units	MH-12		MH-4	MH-11	MH-13		MH-16
January								
Sulphate	mg/L	-11		185	35	5		5
Hardness (Total)	mg/L	168		2577	230	224		215
Ammonia (Nitrogen)	mg/L	-0.017		0.08	0.080	0.015		0.002
Barium (Total)	mg/L	0.111		0.41	0.049	0.199		0.186
Cadmium (Total)	mg/L	0.000		0.003	0.000	0.000		0.000
Iron (Total	mg/L	0.233		0.57	0.054	0.415		0.021
Manganese (Total)	mg/L	-0.294		0.10	0.130	0.004		0.000
Lead (Total)	mg/L	0.001		0.05	0.012	-0.001		0.002
Lead (Dissolved)	mg/L	0.000		0.03	0.009	-0.002		0.000
Zinc (Total)	mg/L	-0.054		0.19	0.079	0.008		-0.003
June								
Sulphate	mg/L	4.470		3045	15	31.293		3.447
Hardness (Total)	mg/L	138.104		38404	161	98.323		268.509
Ammonia (Nitrogen)	mg/L	0.001		5.59	0.029	0.071		0.028
Nitrate (Nitrogen)	mg/L	0.053		149.14	0.596	-0.058		-0.052
Barium (Total)	mg/L	0.076		9.18	0.039	0.088		0.186
Barium (Dissolved)	mg/L	0.068		4.72	0.022	0.117		0.176
Cadmium (Total)	mg/L	0.000		0.068	0.000	0.000		0.007
Iron (Total	mg/L	0.628		212.78	0.824	0.474		-0.136
Iron (Dissolved)	mg/L	0.016		2.05	0.008	0.025		0.025
Lead (Total)	mg/L	0.003		1.99	0.009	0.006		0.002
Lead (Dissolved)	mg/L	0.000		0.50	0.003	0.014		0.000
Zinc (Total)	mg/L	0.004		9.20	0.043	0.029		-0.003
August								
Sulphate	mg/L	5.112		1183	17.852	8.493		8.048
Hardness (Total)	mg/L	191.264		12084	176.110	195.941		223.590
Ammonia (Nitrogen)	mg/L	0.003		0.18	0.011	0.018		-0.002
Nitrate (Nitrogen)	mg/L	-0.009		59.35	0.788	-0.145		0.119
Barium (Total)	mg/L	0.086		1.90	0.030	0.163		0.169
Barium (Dissolved)	mg/L	0.000		1.93	0.030	0.146		0.056
Cadmium (Total)	mg/L	0.000		0.014	0.000	0.001		0.000
Iron (Total	mg/L	0.225		1.79	0.025	0.203		0.123
Iron (Dissolved)	mg/L	0.000		0.72	0.011	0.048		0.072
Manganese (Total)	mg/L	-0.002		0.50	0.025	-0.006		0.007
Lead (Total)	mg/L	0.001		0.32	0.005	0.010		-0.003
Lead (Dissolved)	mg/L	0.000		0.29	0.004	-0.002		0.001
Zinc (Total)	mg/L	-0.002		0.72	0.019	-0.003		0.010
October								
Sulphate	mg/L	6.276		1049	21.712	6.592		8.405
Hardness (Total)	mg/L	177.259		8900	181.881	200.891		222.504
Ammonia (Nitrogen)	mg/L	0.002		0.13	0.017	0.024		-0.003
Nitrate (Nitrogen)	mg/L	0.169		80.31	1.467	0.243		-0.036
Barium (Total)	mg/L	0.075		1.33	0.030	0.144		0.173
Barium (Dissolved)	mg/L	0.073		1.28	0.030	0.127		0.057
Cadmium (Total)	mg/L	0.000		0.010	0.000	0.000		0.000
Iron (Total	mg/L	0.206		1.28	0.025	0.315		0.089
Iron (Dissolved)	mg/L	0.053		0.41	0.008	0.031		0.070
Manganese (Total)	mg/L	-0.010		0.43	0.034	-0.002		0.005
Lead (Total)	mg/L	0.001		0.20	0.004	0.003		0.001
Lead (Dissolved)	mg/L	0.000		0.15	0.003	0.002		0.000
Zinc (Total)	mg/L	0.000		1.02	0.034	-0.006		0.009

The effect of increasing zinc and cadmium in seepage from the North end of the TMF and discharge of mine water from the Jewelbox Hill Zone 1408 Portal were assessed. The loading from the Jewelbox Hill Portal was estimated by assuming that the mine will discharge at the rate which it is currently flooding and the discharge quality will be comparable to the current underground pool chemistry. The former assumption at least is conservative because flooding tends to be more rapid initially as the water table recovers.

The effect of the proposed TMF closure scenario was assessed qualitatively.

The model is generally conservative. It is assumed that chemical loads originating at the mine site are responsible for loads observed at downstream locations in the receiving environment. This assumes that there is no attenuation of loads in the streams below the mine. In reality, attenuation of heavy metals does occur, and the contribution from background will be greater than indicated. The current analysis generally ignores downstream attenuation by assuming that loads are conserved. It is possible that attenuation is occurring within the mine site, and that capacity for attenuation could be reduced at some time in the future. Attenuation over short distances is likely to occur as water flows through fine grained materials, for example, the North Dam seepage, South Dam seepage and flow in talus below the Burnick Portal. Both the dam seepage flow paths are very short, therefore, attenuation capacity was likely initially limited and is probably not a significant effect. The current analysis assumes that the entire load from the Burnick Portal enters the receiving environment because the load is based on the discharge from the portal, not the flow after it emerges from the talus. This analysis therefore assumes that no attenuation is occurring. Additional geochemical studies were done 2000 to investigate these effects. (Note – refer to the letter from SRK consulting to Bruce Donald dated March 12, 2007 that discusses the impact of 1380 Portal discharge on Camp Creek, included in Appendix E of DDRP).

The model used is considered conservative for the following reasons. The increase in loadings at MH-02 is acknowledged. The conclusion that the load from MH-02 is insignificant is based on the loading analysis. This loading at MH-02 is 1 or 2% of the total load to False Canyon Creek.

Less conservative assumptions that were used in the modeling include:

- Additional exposure of tailings will likely result in higher Zn loadings, but the increase in area will only possibly result in an additional 1 or 2%. This was not modeled because the effect was considered small.

- It is probable that submergence of tailings in the South Dam is having a beneficial effect, however the volume submerged currently is negligible.

4.4.2 Results – As Reported in the 2000 DDRP

Comparison of loads for the Tributary E and False Canyon Creek ("FCC") indicate that Tributary E contributes a relatively small load to the FCC basin (and Figure 4-1). Sulphate and zinc are probably the best indicators of the effect of mining and weathering of mineralized rock. Total sulphate load in Tributary E varies from 300 to 3000 kg/month whereas FCC at MH-11 varies from 2000 to 11,000 kg/month. Zinc load varies from 0.2 to 5 kg/month and 2 to 20 kg/month, respectively.

Tributary E indicates relatively complete accounting of load observed from the measured sources. The loads observed at MH-2 and MH-22 account for most load at MH-12. The weakest accounting occurs in January when the load at the sources exceeds the load at MH-12. This may reflect loss of load due to formation of ice in the creek. Back-calculation of background concentrations at MH-12 indicates low concentrations which are reasonable values for the region (Table 4-8). For example, sulphate is 5 to 6 mg/L and zinc is less than 0.004 mg/L. Sulphate and zinc at MH-21 have been 10 and 0.006 mg/L, respectively, and the concentrations are less than the whole basin inferred background at MH-16 (Table 4-8). Several negative concentrations were predicted for January due to the loss of load at MH-12.

Attenuation of metals in soils from the flow path between the Burnick underground and waste dumps (MH-22 and MH-12) is not expected to contribute significantly to downstream zinc concentration, if attenuation is lost at some point in time The extra load added at MH-16 is 4 – 6% (see Figure 4-1) if attenuation capacity is used up. This conservative assumption demonstrates that the load for Burnick is not large, and would therefore not impact downstream receiving waters.

The North Dam (MH-2) is the only source of increasing zinc concentrations in the mine area. Zinc loads appear to have stabilized. It is, nonetheless, a small source (<1 kg Zn/month) of metals in the FCC basin, typically representing 2% or less of the load observed MH-16. In January, the load is 22% of the load at MH-16, however, due to freezing, most of the load probably does not actually report to MH-16. Since this seepage is a small load, any increase of zinc concentrations or loads in the seepage will not have a significant effect on downstream water quality, even if zinc concentrations increase by a factor of 100%.

Loadings to FCC from the Main and Jewelbox Zones indicate that MH-4 is the largest single source of the load observed at MH-11 in June (3000 kg SO_4/month, 9 kg Zn/month). In other months, loads are lower and comparable to South Dam Seepage (MH-7), the only consistently flowing source. MH-5 flows intermittently and appears to account for a small proportion of surface water load in June (2% and 1% of sulphate and zinc, respectively). The calculations indicate that the bulk of zinc and sulphate load observed at MH-11 is not accounted for by the monitored sources (see Figure 4-1). Back-calculation of the concentrations applicable to the unaccounted for load indicates elevated sulphate and zinc concentrations (up to 20 mg SO_4/L and 0.079 mgZn/L). These concentrations are greater than the concentrations at MH-21 and the whole basin background values (Table 4-8). They are slightly greater than concentrations in MH-4. The unaccounted for load may reflect locally elevated background in the vicinity of Mt. Hundere or emergence of water originating in the Main and Jewelbox Zones. Pre-mining baseline monitoring was not specifically designed to separate sources of elevated background metal concentrations, hence, the actual source of the load cannot be evaluated. As noted previously, leaching is not expected to accelerate in any part of the Jewelbox or Main Zones. The current water chemistry is expected to persist indefinitely.

Attenuation of metals in the flow path down-gradient of MH-04 is not anticipated to be a significant factor in removal of zinc loads. Based on a comparison of the Main Pit load (105 kg/month at assumed 1 litre/second flow) with MH-04 (9.2 kg/month) it is considered unlikely that 90% of the load could be lost in the reach above MH-04. Camp Creek is fast flowing in coarse materials, providing little surface area for attenuation. A more likely explanation is that the flow from the Main Pit is short-lived (i.e. Not a continuous load addition) and is therefore not reflected at MH-04. Additional water quality sampling in Camp Creek at several locations when the Main Pit is discharging could confirm this.

Calculated sulphate and zinc loads potentially discharged from the Jewelbox 1408 Portal are 150 kg/month and 1.5 kg/month (annual average based on 30 day month). Lower loads might be expected during low flows in winter. The loads are comparable to current loads from the Burnick Portal and consequently represent a small probably stable load to FCC.

4.4.2.1 Tailings Management Facility (TMF) Closure Issues

Once the South Dam is removed as per the currently proposed closure scenario, the flow through the remaining berm will be related to the drainage area upstream. The seepage flow through the tailings will be a small component of the overall flow, and will be influenced by the permeability, the depth and the areal extent of the tailings.

The effect in the closure scenario would be to lower seepage rates through the South Dams remaining berm (due to the reduced head), maintain the current seepage rate through the North Dam and expose additional tailings. The latter effect is expected to be insignificant because very little tailings are currently underwater. Seepage out of the covered tailings at the south end of the impoundment is expected to be between 10 to 20 L/min after closure. Assuming that zinc concentrations are not solubility limited (due to the high solubility of zinc sulphate under pH neutral conditions), and that zinc possibly originates by slow oxidation of residual zinc sulphide, the closure scenario would not result in a significant increase in the zinc loads from the tailings. Zinc concentrations in seepage might increase due to the lower seepage flow.

4.4.3 2005 Sä Dena Hes Mine Water Quality and Loading Reassessment

In March 2005, SRK updated the water quality and loading assessment provided in the original 2000 DDRP. This update is provided in Appendix F and is titled "*Sä Dena Hes Mine Water Quality and Loading Re-Assessment* ".

The downstream loading re-assessment used a dilution model to back-calculate loading and concentrations in background (natural undisturbed) sources using known sources of loadings in the mine-disturbed area. This approach indicates the presence of any unknown sources (shown by

high calculated background) and attenuation effects (shown by low or negative calculated background).

The assessment focused on zinc as the main potential contaminant of concern and sulphate as an indicator of mine-related impacts that is not significantly affected by attenuation processes in surface waters. Generally, input data for years 2001, 2002 and 2003 were used. For the previous assessment included in the 2000 DDRP, input data were from 1996, 1997 and 1998.

The re-assessment resulted in reasonable background concentrations for zinc and sulphate comparable to the previous assessment, which indicated that all significant sources are known. Some changes in concentrations and loadings were apparent but these did not result in significant downstream effects in False Canyon Creek because the mine area occupies a relatively small part of the total catchment area.

The conclusions from this study were as follows:
Monitoring results indicate that some changes in water chemistry have occurred since the previous loading calculation presented in the DDRP, including:

- Negligible zinc loading effect from Main Zone 1380 Portal (MH-25) in MH-4 due to attenuation by contact with rock and soil along the subsurface flow path.
- Decreasing zinc concentrations in Camp Creek (MH-4).
- Increasing zinc concentrations and decreasing sulphate concentrations in the South Dam seepage (MH-7) which has apparently translated into decreasing sulphate concentrations at downstream stations in False Canyon Creek (MH-11 and MH-13). The increase in zinc concentrations at MH-7 is not apparent at MH-11 or MH-13.
- Significant decreasing zinc and increasing sulphate concentrations in seepage from the North Dam (MH-2). Flow rates appear to have increased resulting in no net decrease in zinc load and further increase in sulphate load.
- Negligible effect from zinc concentrations at MH-22 (North Hill Settlement Basin) due to attenuation in soils downslope from the monitoring location indicated by laboratory tests in 2002. Field inspections indicate that this flow does not connect by surface to Tributary E.

The loading analysis reflects these changes but does not indicate a significant effect on overall loadings in the False Canyon Creek catchment area because the contributions from mine site sources are relatively small in the context of the whole basin. The dominant source of sulphate and zinc loading in the catchment area is natural weathering of rocks and soil unrelated to mining activity.

The overall conclusions of the loading calculation are the same as those presented previously in the Detailed D&R Plan.

4.4.4 2009 Update of Water Quality Trends

Utilizing water quality data collected up to 2009, this section discusses the changes in water quality and the long term water quality trends. The data tables containing the monitoring data collected are contained in Appendix C of the DDRP. The associated water quality graphs discussed below are contained with Appendix D of the DDRP. Water quality will be reviewed as part of the previously noted mass loading assessment later in 2013.

4.4.4.1 South Fork False Canyon Creek

The main known sources in this catchment area are Camp Creek (MH-04) and seepage from the Reclaim Dam (MH-07). The east slope of Jewelbox Hill also contributes to the catchment area but not through visible surface flow. Intermittent flow is observed near the site gatehouse.

Camp Creek (MH-04) receives flow from the natural mineralized exposure on the north side of Jewelbox Hill as well as from the Main Zone Pit and 1380 Portal via subsurface flow. The 1380 Portal continues to be a source of elevated zinc loads far exceeding loads observed at MH-04. Investigations subsequent to the 2000 DDRP (SRK Consulting 2003) indicated that this load reduction is probably occurring as a result of attenuation in waste rock and talus below the portal. Further investigations by Teck identified that the surface flow in the gulley below the rock dump goes to ground approximately 500m before reaching Camp Creek. Additional attenuation of zinc loading may be occurring in this area as well. Regardless, in 2007 SRK Consulting prepared a technical memorandum that predicts that in the long term, even if there is no attenuation between

the 1380 Portal and MH-04, there would still not be an unacceptable impact on the receiving environment (see Appendix E of the DDRP).

Monitoring results for MH-04 to 2009 indicated that the zinc concentrations were continuing low and were largely unchanged since 1999 (Appendix D of the DDRP, Figure D-1). Similarly, Sulphate concentrations had also been variable on a month to month basis but trending around 15 mg/L for over ten years (Appendix D of the DDRP Figure D-1).

Monitoring data for the Reclaim Dam seepage (MH-7) was scattered due to sampling difficulties during the winters. Due to low flow and deep snow, samples are often contaminated by sediment during collection. Despite this, the long term trends for sulphate concentrations (Appendix D of the DDRP, Figure- D-2) showed an initial steeply decreasing trend which began when operations ceased, and over the 5 years previous to 2009 the trend had been flattening. Total zinc concentrations for MH-7 (Appendix D of the DDRP, Figure D-2) was variable since 1991 largely associated with suspended solids in the water. The long term trend of zinc concentrations from the mid 1990's has been level or slightly lower. In years recent to 2009, higher zinc concentrations were primarily associated with higher TSS levels measured in the winter months caused by sampling difficulties and do not suggest that there is an increase in zinc loading occurring.

MH-11 is roughly 3 km downstream of the Reclaim Dam. This site has showedsteady decrease in sulphate concentrations (Appendix D of the DDRP, Figure D-3) similar to the decrease at MH-07, and remained relatively stable since then. Zinc at MH-11 also showed a lowering trend (Appendix D of the DDRP, Figure D-3) since the early 1990's with a slight increase in 2008 and returning to the relatively stable longer term trend of low concentrations by 2009.

MH-13 is several kilometres downstream from MH-11 in False Canyon Creek. This site has also showed a steady decrease in sulphate concentrations initially (Appendix D of the DDRP, Figure D-4), and then showed relatively stable concentrations. Zinc concentrations have remained low (Appendix D of the DDRP, Figure D-4).

4.4.4.2 Tributary E Catchment

Seepage from the North Dam (MH-02) and the Burnick 1200 Portal Discharge (MH-22) are monitored in the Tributary E Catchment. The latter site receives the Burnick Portal discharge and runoff from the 1200 Portal area but it does not have a surface water connection to Tributary E.

MH-2 has shown significant trends since the DDRP was prepared. Sulphate concentrations, prior to 2009, continued to increase reaching 413 mg/L in 2003 (Appendix D of the DDRP, Figure D-5) and while there is scatter in the data, trends have leveled off between 2003 and 2009. The increase in sulphate concentrations was probably due to an increase in the influence of oxidation of tailings relative to drain down of residual dilute process water. In contrast, zinc concentrations, prior to 2009, reached peak levels near 0.41 mg/L in 1996 and then in 2003 through 2005 concentrations were sharply decreased (Appendix D of the DDRP, Figure D-5). As interpreted by SRK Consulting (2003), the decrease in zinc concentrations possibly reflected the removal of wind blown tailings from the dam face by SDMOC. While the problem of windblown tailings was apparently solved by the placement of a thin gravel cover on the dry tailings near the North Dam, zinc concentrations increased prior to 2009.

A closer examination of the data between 1999 and 2009 shows that difficulty sampling in the winter months due to snow is resulting is some samples being contaminated with sediment which results in abnormally high zinc concentrations. During the winter, flow rates are low, there are no erosional processes occurring and so the suspension of sediments in the water column is being created by the sampling process. Examination of data from samples where TSS concentrations in the winter are less than or equal to 10 mg/L (did not remove sample data from spring / summer / fall sampling where TSS concentrations were higher as these are reflective of actual conditions) indicated that while there were fluctuations, that a linear trend line for total zinc concentrations trended slightly lower and were below 0.15 mg/L.

Monitoring results for the Burnick Portal Discharge (MH-22) indicated gradual slightly decreasing sulphate concentrations below 40 mg/L. Despite significant variations in maximum and minimum total zinc concentrations yearly, there was a clear upwards trend from 1995 though until 2003. The trend peaked in 2003 and then until 2009 decreased back to about 1995 levels.

4.4.4.3 MH-16 (Combination of False Canyon Creek and Tributary E)

MH-16 is in False Canyon Creek downstream of the confluence with Tributary E. Like MH-11 and MH-13, sulphate concentrations since closure, initially decreased rapidly and have remained stable since with possibly a very slight decreasing trend since 2003 (Appendix D of the DDRP, Figure D-8). Likewise, zinc concentrations have remained very low since 2001 (Appendix D of the DDRP, Figure D-8).

4.4.5 2010 Update of Loading Assessment

The 2009 update of water quality trends in Section 4.4.4 did not identify and significant increasing trends of sulphate loading or zinc loading that would result in significantly changing the result in adding loads from the mine site to the False Canyon Creek catchment basin.

The 2005 SRK report *"Sä Dena Hes Mine Water Quality and Loading Re-Assessment "* concluded that:

> "the loading analysis reflects these changes but does not indicate a significant effect on overall loadings in the False Canyon Creek catchment area because the contributions from mine site sources are relatively small in the context of the whole basin. The dominant source of sulphate and zinc loading in the catchment area is natural weathering of rocks and soil unrelated to mining activity."

As the contribution to the False Canyon Creek are primarily natural in origin (i.e. non-mining activity related) and as mine related contributions are continuing to be stable, the loading assessment model was not updated. If water quality reviews at the next update to the DDRP indicate that the mine is discharging increasing sulphate or zinc loading to the basin, the loading assessment model will be updated and the results examined.

5.0 TERRESTRIAL RESOURCES

5.1 VEGETATION

The Sä Dena Hes mine site is located in the Liard Basin Ecoregion (ESWG, 1995). The site includes boreal forest, subalpine and alpine vegetation zones with treeline at an approximate elevation of 1400 masl. A terrain mapping program consisting of aerial photographic interpretation augmented with field reconnaissance was completed for the IEE. The reader is referred to the IEE, Volume IV, Section 2.1.2 (SRK, 1990) for a discussion of the terrain mapping that was conducted to document generalized terrain features and geomorphic hazards that might affect project facilities. A preliminary vegetation inspection was conducted in July 1999 and forms the basis for the following vegetative description of the site. Additional vegetation assessment work will be conducted in support of the ecological risk assessment in 2013/2014.

Climax vegetation in the boreal forest zone is; white spruce (*Picea glauca*), black spruce (*Picea mariana*), subalpine fir (*Abies lasiocarpa*) or a combination of these species. Black spruce and alpine fir are the most common boreal vegetation communities in the area. Black spruce forest is prevalent on poorly drained bogs and fens such as those in the tailings impoundment area. Open stands of black and white spruce are found on upland slopes. The area around the mill and camp upwards to the treeline is primarily subalpine fir.

Paper birch (*Betula papyrifera*) occurs on moist sites throughout the area. Trembling aspen (*Populus tremuloides*) is found on well-drained south-facing slopes, and balsam poplar (*Populus balsamifera*) colonizes alluvial gravel bars and other moderately well-drained disturbed sites. Lodgepole pine (*Pinus contorta*) forms pure even-age stands in some upland areas on the mine site, presumably following fire. Larch (*Larix laricina*) is found in lowland bogs along the main access road.

Willow (*Salix* spp.), alder (*Alnus crispa*), rose (*Rosa acicularis*) and Labrador tea (*Ledum groenlandicum*) are the common understorey shrubs. Mountain ash (*Sorbus scopulina*) is found in the tailings impoundment area. Ground cover is dominated primarily by kinnikinnick *(Arctostaphylos uva-ursi*), bearberry (*Arctostaphylos rubra*), crowberry (*Empetrum nigrum*),

ligonberry (*Vaccinium vitis-idaea*), bunchberry (*Cornus canadensis*) and toadflax (*Geocaulon lividum*).

Shrub birch (*Betula glandulosa*), along with alpine fir and willows dominate the subalpine zone. Low ericaceous shrubs are common in alpine areas, along with a groundcover of mosses and lichens.

Bluejoint reedgrass (*Calamagrostis canadensis*) is a prominent graminoid in the area, particularly in moist semi-shaded areas. Altai fescue (*Festuca altaica*) is dominant on drier slopes. Fowl bluegrass (*Poa palustris*) prevails in moist open areas. Slender wheatgrass (*Agropyron pauciflorum*), violet wheatgrass (*Agropyron violaceum*) and bearded wheatgrass (*Agropyron subsecundum*) are the primary invaders of disturbed areas.

Legumes are not prominent in the native flora. Elegant milk vetch (*Astragalus eucosmus*) and arctic lupine (*Lupinus arcticus*) are the most common indigenous legumes in the Sä Dena Hes area.

Soils

Genetic materials throughout the mine site area are primarily morainal, fluvial or glacofluvial. Organics overlying morainal or fluvial material occur in wetlands such as the tailings impoundment areas. Upper alpine zones are bedrock while zones of colluvium occur on the steeper upland slopes.

A layer of silty loam or gravely sandy loam supports white spruce and mixed deciduous forests. These moderately well drained soils are slightly acidic to neutral (pH 6.1 to 7.3) with low to moderate organic matter and with a low level of available nutrients. Wetlands supporting black spruce vegetation have soils of mesic, fibric peat or silty loam. These poorly drained soils are slightly to strongly acidic, have high organic matter and have very little nutrients available. Alpine and subalpine vegetation is found on moderately well drained silty loam or loamy sand. These soils are slightly acid to neutral with low organic matter and with a low level of available nutrients.

5.2 WILDLIFE

The Sä Dena Hes mine site is located within the False Canyon Creek watershed and the mine access road traverses the headwaters of various tributaries of the Tom Creek watershed. The area encompasses several mature mountains with a predominance of boreal forest and limited alpine and sub-alpine terrain. This habitat is capable of supporting various ungulates, large carnivores, other fur-bearers and many bird species. However, species that generally exploit alpine zones are rare due to the limited availability of this habitat in the area.

Wildlife utilization and habitat potential investigation within the Sä Dena Hes Mine project area was undertaken in 1989 to complement similar studies conducted in the area by other agencies. This investigation involved a review of published and unpublished reports on wildlife in the Southeast Yukon, wildlife surveys and trapline catch information, interviews with personnel knowledgeable about the area, and field reconnaissance. Refer to Section 2.4 within the "Mt. Hundere Development Initial Environmental Evaluation, Supporting Document IV, Biophysical Evaluation" (SRK, 1990).

As noted within the IEE, moose are the most prevalent ungulate in the study area, with sightings from the timberline to the valley bottoms. Currently, moose are very infrequent visitors to the project area, and the Company is not aware of any moose mortalities. The Sä Dena Hes project area also provides good black bear habitat, although only occasionally seen within the vicinity of the mine site itself. Beaver sign has been noted along virtually all watercourses and at all lakes in the study area. An assessment of beaver activity in the area was completed in 1998 (LES, 1998). Cycles of flooding and abandonment attributable to beavers result in ponded wetlands used by many species including waterfowl.

No further wildlife investigations have been completed in the project study area since those reported in the IEE. Additional wildlife and habitat assessment work will be conducted in support of the ecological risk assessment in 2013/2014.

6.0 AQUATIC RESOURCES

6.1 FISHERIES

Fisheries monitoring programs have continued to be conducted concurrently with the biological monitoring program. The current water license requires fish monitoring every two years during periods when the mine is not active. The mine has not been active since the mid 1990s. Fisheries monitoring began in 1994 (LES 1995). The following provides a summary of fisheries program findings to 2009.

Baseline fisheries investigations of drainages within the Sä Dena Hes study area were completed by Environmental Sciences Ltd. (ESL) on the False Canyon Creek drainage in June and September of 1989 as a component of the Initial Environmental Evaluation for the Mt. Hundere Development. ESL also conducted fish surveys on the Tom Creek drainage as well as on a tributary to Francis River, where grayling and slimy sculpin were captured. A summary of the results from this investigation are provided in Chapter 2.5 of the report entitled "*Mt. Hundere Development Initial Environmental Evaluation*, Volume IV Biophysical Evaluation of Project Site, (SRK, 1990).

Updated results from the water use license fisheries monitoring are summarized below. The reader is referred to the following reports for a detailed discussion of the fisheries investigations since the Detailed Reclamation Plan was initially submitted in 2000.

- *Environmental Monitoring at False Canyon Creek, 2000.* Prepared for Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2000).
- *Environmental Monitoring at False Canyon Creek, 2002.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2002).
- *Environmental Monitoring at False Canyon Creek, 2004.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2004).

- *Environmental Monitoring at False Canyon Creek, 2006.* Prepared for Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2006).
- *Environmental Monitoring at False Canyon Creek, 2008.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2008).
- *Environmental Monitoring at False Canyon Creek, 2010.* Prepared for Teck Reources Ltd. Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2011).
- *Environmental Monitoring at False Canyon Creek, 2012.* Prepared for Teck Reources Ltd. Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2012).

All of the existing fisheries data on the False Canyon Creek drainage have been summarized and are presented in Table 6-1. Locations of fish monitoring stations are provided in Figure 6-1.

During the study conducted in 1992, fish tissues were analyzed for metals, although this was not a requirement of the licence. The concentrations found in the liver and muscle of Arctic Grayling and Whitefish, and in the whole bodies of sculpins, were similar to concentrations in fish captured in an unaffected watershed (Blind Creek), indicating that there was no effect from the Sä Dena Hes Mine. In 1998, habitat and utilization assessments were also conducted on North Creek upstream and downstream of the North Creek dike and no fish were captured.

A variety of techniques were used during the investigations; electro-shocker (gas and battery operated), minnow trapping, seine netting, gill netting, angling and visual observations. All of the existing fisheries data on the False Canyon Creek drainage have been summarized and are presented in Table 6-1. Locations of fish monitoring stations are provided in Figure 6-1.

Pre- and post-development fish sampling indicate that fish production capabilities in the upper False Canyon Creek drainage are relatively low. The most productive area within the system appears to be the lower reaches of False Canyon Creek near the confluence with the Frances River.

Four species of fish were found within the False Canyon Creek drainage since 2000: Slimy sculpin (Cottus cognatus), Arctic grayling (Thymallus arcticus), round whitefish (Prosopium cylindraceum), and burbot (Lota lota). One exception is the unusual capture in 2012 at site MH20 of a single lake chub, a species that has not been recorded in the False Creek Canyon drainage previously. Slimy sculpin continue to be the most abundant species captured, followed by Arctic grayling

The sites MH-13 and MH-20 were monitored during each of the eleven surveys. Only slimy sculpin were captured at MH-13 although several fishing methods were employed. This site is a beaver/wetland complex with low velocity flow. The slimy sculpin population however, continued to be stable and the habitat supports all life history stages of this species.

Arctic grayling and slimy sculpin dominated the catch at MH-20 with incidental occurrences of whitefish and char. This site displays suitable fish habitat with stable banks and gravel substrate, and good riffle/pool ratio.

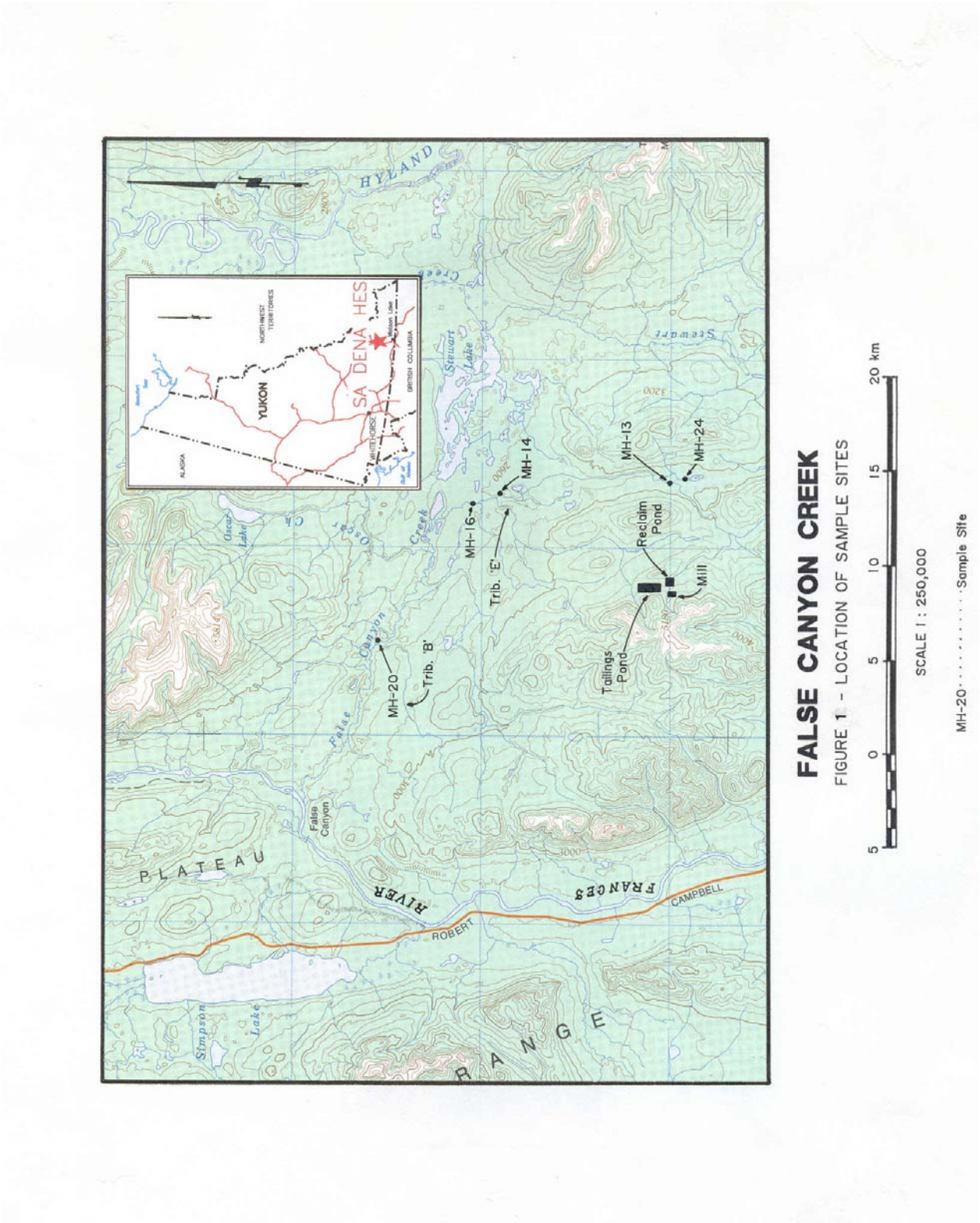
The fisheries data was generally consistent with the past studies. While the absolute number of fish captured varies from year to year, the fish assemblage in the catch is consistent and is itself an indication of stability in the fish community. Slimy sculpins continued to be the dominant species captured throughout the drainage, and the only species present at MH13. The presence of Arctic grayling and whitefish were again confirmed in the False Canyon Creek drainage however no whitefish were captured or observed in 2012. A single lake chub was captured in the study area in 2012; the first documented occurrence since the commencement of monitoring.

Table 6-1 Summary of Fish Species Captured In the False Canyon Creek Drainage

COMPARISON OF FISH CATCH AT THREE SAMPLING SITES OVER A 20 YEAR PERIOD			
SPECIES	**SAMPLE SITE**	**CATCH (#)**	
		1992 to 2010* **(Average)**	**2012 (Total)**
Slimy sculpin	MH13	21.8	21
	MH16	12.3	11
	MH20	14.9	13
Arctic grayling	MH13	0	0
	MH16	2.9	6
	MH20	4.7	0
Burbot	MH13	0	0
	MH16	1.0	0
	MH20	0.5	4
Lake chub	MH13	0	0
	MH16	0	0
	MH20	0	1

* Note: MH16 was not sampled during 1992 and 1994.

Figure 6-1 Regional Water Quality Fish, Benthic & Stream Sediment Monitoring Stations



6.2 BENTHIC INVERTEBRATES

Two baseline benthic invertebrate investigations were conducted within the Sä Dena Hes study area prior to mine development. In September 1989, ESL collected baseline benthic invertebrates from 23 sites. Samples from only three of these sites were identified and analyzed, and the remaining 20 were archived. A discussion of this study was provided in the report entitled "*Mt. Hundere Development Initial Environmental Evaluation*, Volume IV Biophysical Evaluation of Project Site, (SRK, 1990). In July 1990, Environmental Protection Services (EP) of Whitehorse, Yukon, conducted baseline biological monitoring at ten sites, four of which lie within the False Canyon Creek drainage. Details of this study are reported in the "*Mount Hundere Baseline Study, June 1988 and June 1990*. Data Report No. 94-02. Environmental Protection Branch. 1994

Biological monitoring programs have continued according to water license specifications, every two years since 1992. The reader is referred to the following reports for a detailed discussion of the benthic invertebrate investigations from 2000 to 2009:

- *Environmental Monitoring at False Canyon Creek, 2000.* Prepared for Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2000).
- *Environmental Monitoring at False Canyon Creek, 2002.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2002).
- *Environmental Monitoring at False Canyon Creek, 2004.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2004).
- *Environmental Monitoring at False Canyon Creek, 2006.* Prepared for Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2006).
- *Environmental Monitoring at False Canyon Creek, 2008.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2008).

- *Environmental Monitoring at False Canyon Creek, 2010.* Prepared for Teck Resources Ltd. Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2011).
- *Environmental Monitoring at False Canyon Creek, 2012.* Prepared for Teck Resources Ltd. Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2012).

Biological monitoring station locations are shown in Figure 6-1. The licence states that sampling should also be undertaken at MH14 and MH18 for the benthos, fish and sediment surveys. MH14 was submerged from 1996 to 2006, and the alternate site MH16, located two kilometers downstream, had been used for those studies. The present sampling location at MH14 is now no longer flooded, however in the pursuit of consistency, MH16 was again used as the sample site rather than MH14. Regular water samples are collected quarterly at MH14 however. MH16 is also a quarterly water quality station and is located on the main stem of False Canyon Creek. This area is presently unaffected by beaver activity and is representative of a more stable environment than MH14.

Invertebrates were sampled at three similar locations per site. The samples were collected from an undisturbed, fast flowing, gravel strewn riffle habitat at each of the sites. Collections were made with a Surber sampler (area = 0.0929 m^2) which had a 300 micron mesh net. The bed material within the frame was cleaned and washed by hand, with the fast flowing current carrying the disturbed bottom fauna and detritus into the collection bag. The level of effort for each sample and at each site was comparable. The captured invertebrates and detritus were placed in one-litre Nalgene bottles, preserved in 10% formalin, and shipped to Charles Low, PhD, an entomologist in Victoria, B.C., for sorting, identification and enumeration.

At the lab, all samples were washed through two screens with mesh sizes 1 millimetre and 180 microns. All of the organisms retained by the coarse screen were counted and identified, whereas the organisms on the 180 micron screen were subsampled as necessary. A Folsom plankton splitter was used for the subsampling. The majority of the benthos was identified to the genus level.

Data collected from False Canyon Creek since 1992 have been summarized and compiled in Table 6-2. Population densities were greatest in 1998 at MH13 and in 2010 at MH16 and MH20, (

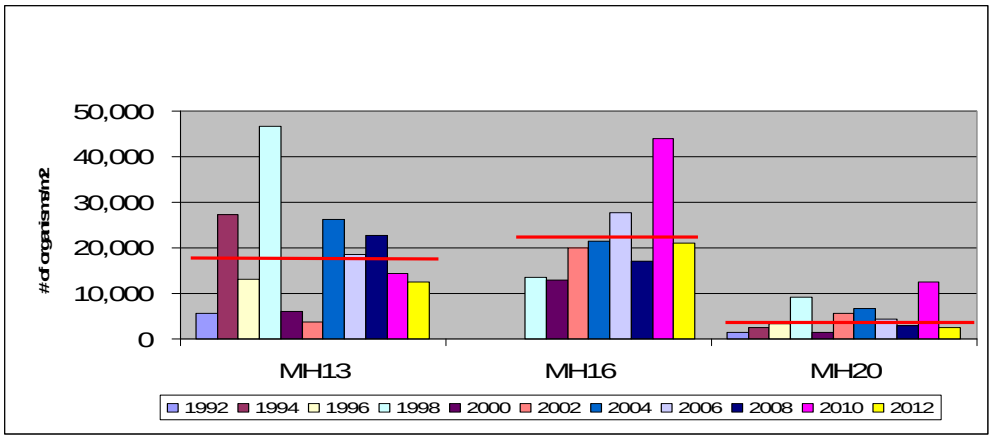
Figure 6-2). The population at MH13 has fluctuated considerably over time which probably reflects the instability of this site.

Taxonomic richness has continued to fluctuate over time at MH13 and MH20, but has been relatively stable at MH16. The community at MH13 was at its most diverse in 2004. The most diverse communities at MH16 and MH20 occurred in 2006 with an overall record number of 76 different organisms identified at MH16. The number of sensitive taxa has varied significantly at MH13, but has been very low during recent surveys. This was likely due to natural degradation in habitat quality. The communities at MH16 and MH20 continue to have high numbers of sensitive taxa.

Table 6-2 Summary of Benthic Invertebrate Data in the False Canyon Creek Drainage

Site	Year	Total Abundance	Diversity	Density (# of organisms/m²)	Dominant Taxa	Total # of Sensitive Taxa
MH13	1992	1,562	25	5,605	Diptera	7
	1994	7,631	37	27,380	Ephemeroptera & Diptera	9
	1996	3,682	57	13,211	Diptera	8
	1998	13,033	30	46,764	Diptera	2
	2000	1,704	50	6,114	Plecoptera & Diptera	4
	2002	1,020	43	3,660	Diptera	3
	2004	7,289	72	26,153	Diptera	9
	2006	5,168	46	18,543	Diptera	4
	2008	6,319	50	22,673	Diptera & Plecoptera	8
	2010	4,003	33	14,363	Ostracoda & Diptera	0
	2012	3,465	53	12,433	Diptera & Other	3
MH16	1998	3,754	60	13,470	Diptera & Ephemeroptera	10
	2000	3,578	65	12,838	Diptera & Ephemeroptera	9
	2002	5,588	67	20,050	Diptera & Ephemeroptera	8
	2004	5,995	63	21,510	Diptera & Ephemeroptera	10
	2006	7,445	76	27,713	Diptera	10
	2008	4,769	58	17,112	Diptera & Ephemeroptera	8
	2010	12,266	52	44,011	Diptera	6
	2012	5,893	61	21,145	Diptera	8
MH20	1992	394	22	1,414	Ephemeroptera	6
	1994	720	31	2,583	Ephemeroptera & Diptera	8
	1996	936	54	3,358	Ephemeroptera & Diptera	12
	1998	2,564	59	9,200	Ephemeroptera & Diptera	10
	2000	412	28	1,478	Diptera & Ephemeroptera	6
	2002	1,591	43	5,709	Diptera	6
	2004	1,853	56	6,648	Diptera & Ephemeroptera	11
	2006	1,196	64	4,291	Ephemeroptera & Diptera	11
	2008	826	49	2,964	Ephemeroptera & Diptera	7
	2010	3,474	54	12,465	Diptera & Ephemeroptera	8
	2012	682	52	2,447	Ephemeroptera	10

Figure 6-2: Community Density by Site Over Time



The dominance of the respective communities has remained virtually unchanged over the study period. Diptera has been the dominant or co-dominant order at MH13 during every sampling period. Ephemeroptera and/or Diptera have been the dominant orders at MH16 and MH20 over time.

The temporal data generally indicates that the community at MH13 fluctuates depending on the changing habitat characteristics during the particular sampling period. Although abundance varies somewhat over time, the communities at MH16 and MH20 are relatively stable.

Overall, the benthic invertebrate communities within the False Canyon Creek drainage have remained relatively diverse and have had good representation from the major groups of organisms that are usually present in lotic waters. The dominance of the respective communities has remained virtually unchanged over the study period, with Diptera the dominant of co-dominant order at MH13 during every sampling event. Ephemeroptera and/or Diptera have bee the dominant orders at MH16 and MH20 over the course of the study period.

6.3 STREAM SEDIMENTS

Stream sediment monitoring has continued according to water license specifications, every two years since 1992. The reader is referred to the following reports for a detailed discussion of the stream sediment investigations from 2000 to 2009:

- *Environmental Monitoring at False Canyon Creek, 2000.* Prepared for Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2000).
- *Environmental Monitoring at False Canyon Creek, 2002.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2002).
- *Environmental Monitoring at False Canyon Creek, 2004.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2004).
- *Environmental Monitoring at False Canyon Creek, 2006.* Prepared for Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2006).

- *Environmental Monitoring at False Canyon Creek, 2008.* Prepared for Sä Dena Hes Operating Corporation, Teck Cominco Ltd. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2008).
- *Environmental Monitoring at False Canyon Creek, 2010.* Prepared for Teck Resources Ltd. Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2011).
- *Environmental Monitoring at False Canyon Creek, 2012.* Prepared for Teck Resources Ltd. Sä Dena Hes Operating Corporation. (Laberge Environmental Services and Can-Nic-A-Nick Environmental. 2012).

Results from the stream sediment monitoring studies are summarized below.

Baseline stream sediment samples were collected by Environmental Protection Services (EP) in 1988 and 1990 (EPS, 1994). Stream sediment samples have been collected concurrently during the biological monitoring program as described in the water licence, every two years since 1992. In 1998 assessments were also conducted on North Creek upstream and downstream of the North Creek dike. Sediment data have been summarized and are presented in Table 6-3. Stream sediment sample locations are shown in Figure 6-1.

High levels of lead and zinc were found in the 1988 samples collected by EP from a site identified as "headwaters of False Canyon Creek" at 60°32'N by 128°57'W. This site may lie within the vicinity of the ore body. No corresponding licence station exists at this location and samples were only collected in 1988.

Table 6-3 Summary of Metals in Stream Sediments at Sä Dena Hes

COMPARISON OF METALS (ug/g) IN SEDIMENTS OVER THE STUDY PERIOD						
Site	**Year**	**Arsenic**	**Copper**	**Cadmium**	**Lead**	**Zinc**
MH - 13	1992	**17.0**	21.7	**1.2**	**65**	**256**
	1994	**11.5**	22.8	**1.5**	**47**	**216**
	1996	**12.0**	19.2	**1.7**	27	**160**
	1998	**14.0**	20.7	**1.2**	**37**	**174**
	2000	**17.3**	24.1	**2.1**	**71**	**266**
	2002	**8.1**	17.8	**1.2**	24	**148**
	2004	**9.6**	23.5	**1.3**	30	**185**
	2006	**18.2**	23.9	**2.4**	**38**	**224**
	2008	**12.8**	22.0	**1.9**	**48**	**226**
	2010	**16.1**	24.5	**1.9**	**38**	**233**
	2012	**16.2**	22.9	**2.0**	28	**199**
MH - 16	1998	<8	9.2	0.4	8	72
	2000	**11.3**	9.8	0.4	8	80
	2002	**6.0**	13.0	**0.8**	11	90
	2004	**7.8**	17.5	**1.0**	13	118
	2006	**8.4**	14.6	**0.8**	11	96
	2008	5.9	13.8	**0.8**	11	95
	2010	**9.3**	20.0	**1.4**	15	**138**
	2012	4.3	10.4	0.6	8	82
MH - 20	1992	**13.0**	22.1	<0.1	15	78
	1994	<10	20.6	0.5	9	70
	1996	**9.0**	16.6	**1.5**	9	69
	1998	**10.0**	18.7	0.3	11	74
	2000	**7.3**	23.0	0.3	13	88
	2002	4.6	16.9	0.3	8	57
	2004	**6.1**	22.9	0.4	10	78
	2006	**6.0**	18.0	0.3	8	66
	2008	5.8	21.2	0.4	10	75
	2010	**9.3**	16.8	0.5	8	75
	2012	6.0	21.2	0.6	9.0	69.2

Note: ISQG = Interim freshwater Sediment Quality Guidelines, in **bold** where exceeded.
PEL = Probable Effects Level (>50% of adverse effects occur above this level), shaded and in bold where exceeded.

Sediment results were compared to data collected in previous studies in the previously mentioned annual reports. Arsenic concentrations have consistently surpassed the Interim Sediment Quality Guideline (ISQG) and have approached or exceeded the Probable Effects Level (PEL) at MH13. Concentrations at MH13 have ranged between 18.2 mg/L to 8.1 mg/L since 1990. The concentrations do not appear to have impacted the aquatic communities.

Copper levels remain well below the ISQG, which has been changed since 2000. As the copper ISQG was raised from 22.7 to 35.9, this is not a significant issue with respect to sediment copper concentrations. Concentrations were very similar at MH13 and downstream at MH20. Levels at MH16, located between these two sites, were lower.

Cadmium, lead and zinc concentrations were significantly higher in the sediments at MH13 than downstream at MH16 and MH20. The ISQG cadmium was exceeded on all occasions at MH 13, and frequently at MH16. There has been one exceedance at MH20 in 1996, which is considered an anomalous reading. Concentrations of lead in the stream sediments at MH 16 and MH20 continue to be much lower than at MH13, and are well below the ISQG. Lead levels in the sediments at MH13 have frequently exceeded the ISQG over the study period. Zinc concentrations in the stream sediments are greater than at the other two sites, and have exceeded the ISQG on each sampling event.

In general, the concentrations of the various metals have remained relatively consistent in the sediments at MH20. Concentrations tended to fluctuate more widely in the sediments at MH13 and moderately in the sediments at MH16.

7.0 LAND USE AND TENURE

This section addresses other projects or activities within the general Sä Dena Hes Mine project area. Land use in the area surrounding the Sä Dena Hes Mine property was addressed in the IEE for the project (SRK, 1990). The IEE should be referred to for a detailed discussion of the results of those investigations. Table 7-1 provides a summary of projects/activities within this area. The information was obtained from a number of government agencies and boards responsible for the issuance of various permit authorizations. Mineral and land tenure resource maps were also obtained from the DIAND Mining Recorder and DIAND Land Resources.

There have been several activities in the area, most of which have been focused around the Robert Campbell Highway. Yukon Territorial Government and Federal Government departments have also historically conducted various activities within the highway right-of-way, such as right of clearing, maintenance, and geotechnical investigations. There are a few privately held lots along the highway and various First Nation site specific and settlement land claims within the general vicinity of the property area. In addition to the mineral claims held by the Sä Dena Hes Operating Corporation, there are a number of mineral claims held within the area by various parties. Various trapping concessions are held in the project area and actively trapped. Currently trapping and hunting are the primary activities in the project area. Much of the hunting is conducted from the roadways. Various trapping concessions are held in the project area and are summarized in Table 7-1.

The importance of cultural resources such as recreational, traditional, and special uses of land, including hunting and trapping are addressed in the following section. Implementation of closure measures are not expected to interfere with other current land uses in the area.

Table 7-1 List of Activities in the Project Area

Activity Type	Permit Licence Holder	Comments
MAP SHEET 105 A/6		
MINERAL TENURE		
MC Lots. 1-21	Glimmer Resources	Mineral claims designated GMS (expire 01/08/11)
MC Lots. 1-21	Minfocus International Inc.	Mineral claims designated BOMB (expire 99/10/10)
MC Lots 1-32	Pacific Bay Minerals	Mineral claims designated CAM (expire 02/02/26)
MC Lots 13-1583 (various)	Cominco	Mineral claims designated HOLMES (expire 01/12/15)
MC Lots 1-144	McCrory Holdings Ltd.	Mineral claims designated EAGLE (expire 05/08/24)
WATER USE		
LAND USE/Mineral LAND USE		
YA3W436 (expired 96/04/30)	Kaska Forest Resources	Activities related to forestry THA Liard Block
YA5Q925 (closed 97/09/13)	YTG - CTS	Blanket maintenance km 10-50.5 Robert Campbell Hwy.
YA6S187	YTG - CTS - Transportation and Engineering	Geotechnical investigations at various locations between km 55-232 Robert Campbell Hwy.
YA6E255 (closed 98/04/21)	YTG - CTS	Right of Way clearing km 55-232 Robert Campbell Hwy.
YA6S260 (expired 99/01/31)	YTG - CTS - Transportation and Engineering	Geotechnical investigations at various locations between km 34-222 Robert Campbell Hwy.
YA7N301 (closed 98/04/30)	Geological Survey of Canada - Dr. Isa Asudeh	Seismic geological investigations
YA7X296 (closed)	Ivan Johnson	Establish a portable sawmill on the site within a timber operating unit, in the vicinity of km 43 Robert Campbell Hwy.
OTHER		
S-67, S-68, S-168, S-265, S-79	Liard First Nation	Site Specific Lands
Various Trapping Concessions continued from other map sheets (see below)		

Activity Type	Permit Licence Holder	Comments
MAP SHEET 105 A/10		
MINERAL TENURE		
MC Lots 42-46	Sä Dena Hes Operating Corp.	Mineral claims designated JEWEL (expire 99/08/24)
MC Lots 120-308	Sä Dena Hes Operating Corp.	Mineral claims designated HUN (expire 09/03/01)
MC Lots 329-422	Sä Dena Hes Operating Corp.	Mineral claims designated HUN (expire 02/09/06)
MC Lots 1-8	Sä Dena Hes Operating Corp.	Mineral claims designated HAWK (expire 03/08/24)
MC Lots 1-78	Sä Dena Hes Operating Corp.	Mineral claims designated CIMA (expire 09/03/01)
MC Lots 1-12, 40, 41	Sä Dena Hes Operating Corp.	Mineral claims designated MICA (expire 09/03/01)
MC Lots 1-22	Sä Dena Hes Operating Corp.	Mineral claims designated THUNDER (expire 03/08/24)
MC Lots 1-10, 19, 20	Alex Black	Mineral claims designated ECHO (expire 99/10/05)
WATER USE		
IN90-002	Mount Hundere Joint Venture	Original water licence for project was to expire 00/09/15. Licence was amended QZ97-025 by new owner Sä Dena Hes Operating Corp.
QZ97-025	Sä Dena Hes Operating Corp.	
MS97-091 (expires 04/12/31)	Sä Dena Hes Operating Corp.	Type B Water Licence To construct a runoff catchment berm, at km 15.5 of main mine access road
Other		
S-219	Liard First Nation	Site Specific Land
R-15	Liard First Nation	Settlement Land
Registered Trapping Concession #356	Jim Stewart/Andy Szabo	Trapping Concession
MAP SHEET 105 A/07		
MINERAL TENURE		
MC Lots 1-144 (various active)	Sä Dena Hes Operating Corp.	Mineral claims designated GMN (expire 05/10/26)
LAND USE/Mineral LAND USE		
Tom Creek Lookout Site	DIAND - Fire Management	Lookout tower and cabin designated YFS 001
OTHER		
R-15	Liard First Nation	Settlement Lands
Registered Trapping Concession #358	Leo Stewart	Trapping concession
Registered Trapping Concession #359	Alice Brodhagen	Trapping concession

8.0 CULTURAL RESOURCES

The cultural resources of the study area have been previously examined as part of the IEE (SRK, 1990). The results of the Heritage Resource Overview found that the archaeological potential of the study area is low and no zones of high or even moderate potential are encroached by the development. However it is noted in the study recommendations that the area is relatively unknown in terms of heritage resource site distribution and recommends an awareness of the potential for discovery. The reader is referred to Appendix B of Volume III (Socio-economic Evaluation) of the IEE (SRK, 1990) which provides a more complete description of the heritage resource value of the region.

An evaluation in 1990 of current use of the Mount Hundere area by Liard First Nation residents found that primary use of the area was for hunting, fishing, and trapping. No spiritual or special places were identified. The study hypothesized that the impact of the project would not necessarily come from the mine itself, but rather the increased pressure of hunting from both natives and non-natives along the access road. For a more comprehensive description the reader is referred to the aforementioned IEE Volume III Appendix C (SRK, 1990).

Trapping and hunting continue to be the primary activities in the project area. There are several active trapping concessions in the area and the opportunity for hunting access via the Robert Campbell Highway is readily available. The project area is generally part of the Liard First Nation's traditional territory and continues to provide for First Nation's and other subsistence users. Resource usage is expected to continue at existing levels for trapping, hunting, recreational, and subsistence use. This will be verified in consultation with Liard First Nation representatives as part of the ecological risk assessment that will be conducted in 2013 and 2014.

9.0 AIR QUALITY

Past and current air quality for the project area is good. A small fleet of diesel equipment will be in use at the mine and exhaust emissions from the combustion of fossil fuels are mitigated following standard industrial procedures for emission control. Experience operating an underground mine fosters an acute awareness of exhaust emissions. Appropriate control measures are employed to control fugitive dust at the mill site, load-out, mining operations, and from road use.

10.0 STABILITY ANALYSIS

10.1 INTRODUCTION

In the 2000 submission of the DDRP, the following Tailings Management Facility closure scenarios were presented:

Scenario 1: Close the tailings impoundment based on the current volume and distribution of tailings within the facility; or

Scenario 2: Deposit an additional 1.8 million tonnes of tailings into the impoundment over a period of 4 years.

Stability analyses of the North and South Dams were undertaken as part of evaluation of the two closure scenarios.

The closure scenarios for the Tailings Management Facility have now been further evaluated and a revised version of Scenario 1 is currently proposed. This section discusses the physical stability of the North Dam of the tailings impoundment in the context of this closure scenario.

10.2 GENERAL DESCRIPTION OF THE TAILINGS IMPOUNDMENT

The tailings impoundment occupies a north-south valley segment with an earthfill dam at either end (the North and South Dams, as shown in Figure 10-1). The area between the North and South Dams is about 1100 m long and up to 350 m wide. The small earthfill cofferdam approximately midway between the two dams coincides with the catchment line that separates drainage to the north and south of the impoundment.

The North Dam has a current crest elevation of 1098 m and is about 12 m high. The South Dam currently has a crest elevation of 1096 m and is about 16 m high.

The area of the impoundment is approximately 21 hectares. The total impoundment catchment is 134 hectares.

10.3 CLOSURE SCENARIO

10.3.1 General

The North Dam will remain at its current elevation and the South Dam will be largely removed (Figure 10-1 and Figure 10-2). A small sediment berm will be left in place of the South Dam, with the invert elevation established so as to prevent the escape of tailings and to eliminate or, at least, minimize the impoundment of water, at an elevation of 1080.3 m. The berm crest elevation will be 1084.7 m, and the height of the berm at the downstream crest will be approximately 3.3 m.

The stability of the North Dam requires evaluation as a closure issue, while that of the South Dam does not.

Riprapped channel for realignment of Camp Creek and Spillway.
Design Flow (1000 Year) = 15.6 m^3/s*
Channel Base Width = 4m
Depth of Flow = 0.8m
Side Slopes = 2:1 (H:V)
D_{50} (Riprap) = 0.3m
Riprap Depth = 0.45m
S = 0.019
* Note: 15.6m^3/s is the total design flow for the catchment area including the south dam flow

Camp Creek Diversion (To be removed)

Reclaim pipeline (To be removed)

Realignment of Camp Creek into the old creek bed

Remove existing spillway

Excavate south Dam fill material, salvage for tailings cover and revegetate. Retain low profile berm along upstream toe of original dam and construction spillway within berm to Inv. El. 1083m to accommodate design flood. See Figure 10-2 for details.

Revegetate footprint of Dam

Dismantle Decant tower and cover debris with overburden Seal Decant Pipe

Regrade and vegetate Borrow Area

Toe of Dam

FLOW

Construct Plunge Pool

Reclaim Pond Spillway and exit Chute (To be removed)

Drain Pond to below 1083m elevation

Sediment Retaining Structure min. Crest El. 1084.75m

Remove Rock Toe Buttress (Salvage rock for riprap in spillway)

Drain pond, remove Dam and revegetate footprint

Existing Rock Toe buttress (Salvage rock for use in channel)

Recontour Tailings surface to provide positive drainage to the South.
Design intended to ensure no ponded water.
Place 300mm soil cover over tailings to control dust, provide growth medium improve runoff.

Breach Cofferdam and remove Sluice Gate and Culvert

Revegetate D/S Slope

Breach Intercept ditches and restore to erosion resistant drainage patterns

508500 E

CAMP CREEK

Structure	Catchment Area (sq.m)	Design Flow (cu.m/s)	Channel Width (m)	Sideslope H:V	Depth of Flow (m)	Channel Slope (%)	Crest El. (m)	Riprap D_{50} (m)
Spillway in new berm	1.33	5.4	4	2:1	0.75	na	1083	0.3
Channel from Spillway to realigned Camp Creek	1.33	5.4	4	2:1	0.31	8	na	0.8
Camp Creek Channel	4.47	15.6	4	2:1	0.79	1.9	na	0.35

LEGEND

- Covered Tailings
- Cover and Revegetate
- Sediment Retaining Structure
- Major Contours
- Edge of Road
- Water Pipe
- Realigned Flow Channel
- Tailings Line
- Creek

0 20 40 60 80 100
Scale in Metres

NOTE

Topographic contour data and aerial photos were obtained from McElhanney and are based on August 15, 2012 LiDAR survey. Coordinate system is UTM NAD 83CSRS zone 9V.

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SRK JOB NO.: 1CT008.037

FILE NAME: 1CT008035_SDH-DC_Figures-10-1 and 2.dwg

Teck

Sä Dena Hes Project

Sa Dena Hes Detailed Decommissioning and Reclamation Plan

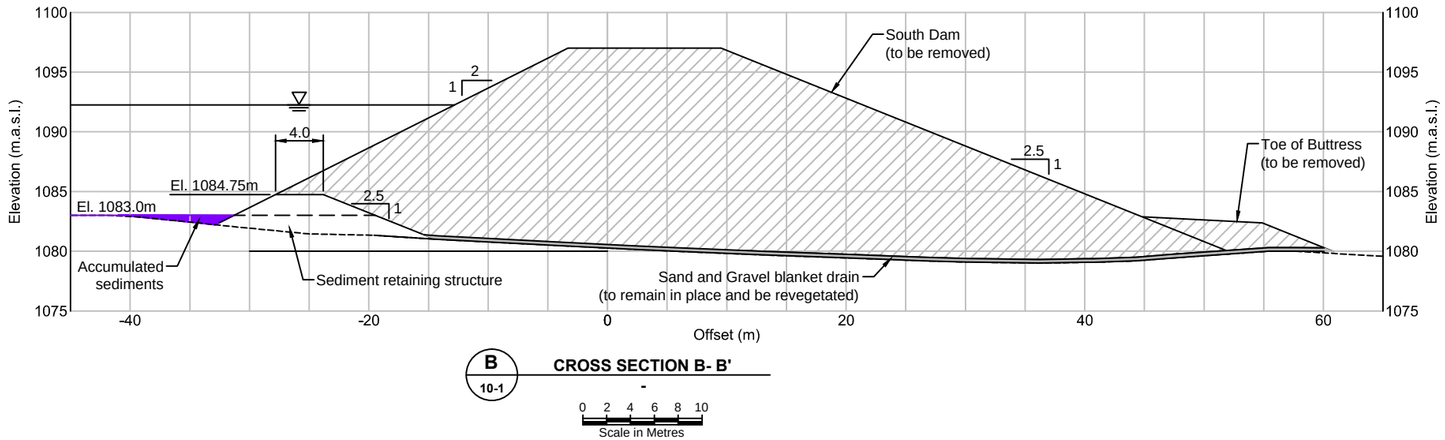
TMF Decommissioning

DATE: Jan. 31, 2013 | APPROVED: PH | FIGURE: 10-1

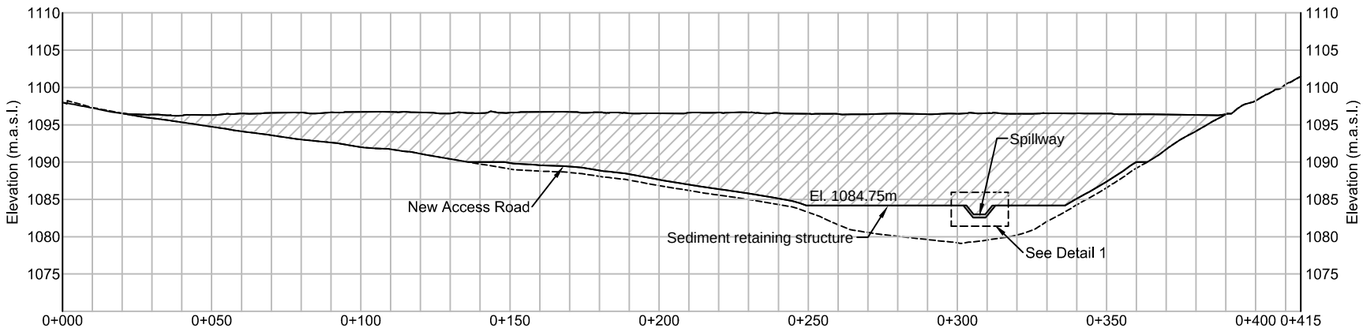
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LEGEND

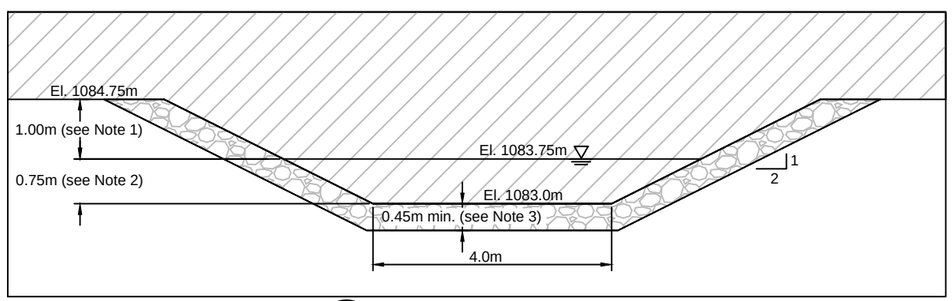
- Existing Ground
- Pre-existing Ground
- Bathymetry
- Remove
- Riprap



B
10-1
CROSS SECTION B- B'
-
0 2 4 6 8 10
Scale in Metres



A
10-1
Profile A - A'
2.5x Vertical Exaggeration
Horizontal: 0 10 20 30 40 50
Scale in Metres
Vertical: 0 4 8 12 16 20
Scale in Metres



1
-
Detail 1
Spillway
0 0,5 1 1,5 2 2,5
Scale in Metres

NOTES

1. Assume 1m freeboard.
2. Depth of flow based on design flow of 5.4m ^{3}/s (1000 year event).
3. Riprap depth is 1.5 times D_{50}.

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Teck

Sä Dena Hes Project

Sa Dena Hes Detailed Decommissioning and Reclamation Plan

TMF Decommissioning Sections and Detail

DATE:	APPROVED:	FIGURE:
Jan. 31, 2013	PH	10-2

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10.3.2 North Dam Configuration

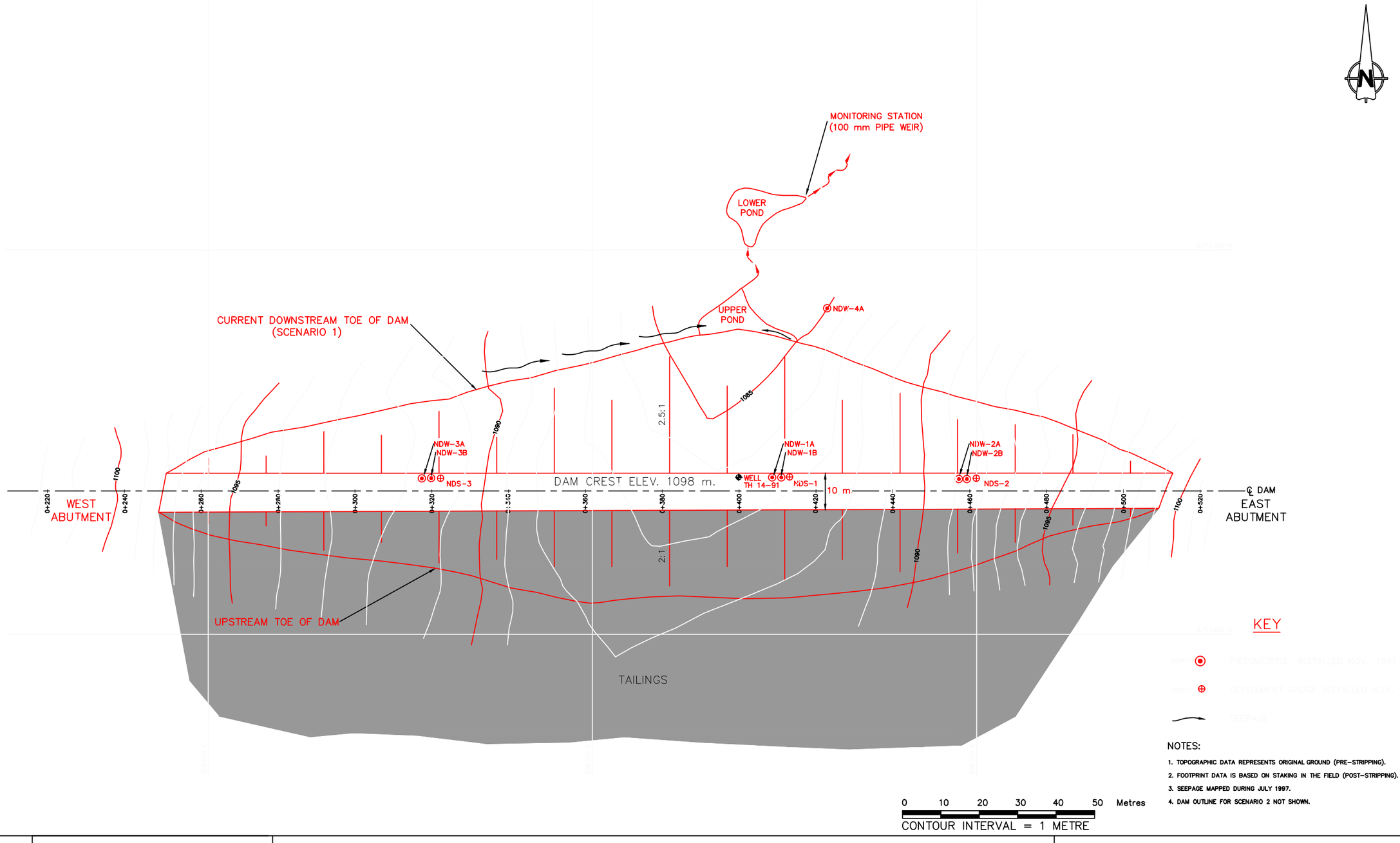
The current crest elevation of the North Dam is 1098 m, which corresponds to a dam height of 12 m relative to the downstream toe (Figure 10-3 and Figure 10-4). It has an upstream slope of 2H:1V (horizontal:vertical) and a downstream slope of 2.5H:1V. In cross-section, the dam consists of three zones: an upstream silty till zone, a central sandy till filter zone and a sand/gravel downstream zone.

10.3.3 Foundation Conditions at the North Dam

The thin cover of organic soils present at the site of the North Dam was removed during initial construction. Foundation conditions, therefore, consist of about 1 to 4 m of till, which grades from a gravelly, silty sand to a sandy, gravelly silt overlying shale bedrock (Figure 10-4).

10.3.4 North Dam Performance

The North Dam was constructed during October and November 1990. Sand boils were observed emanating from the area immediately downstream of the dam in 1991, as water was stored behind the dam in preparation for plant startup. However, tailings were subsequently deposited against the North Dam and the sand boil activity gradually diminished, with no recent evidence of any fines in the seepage.



Cominco

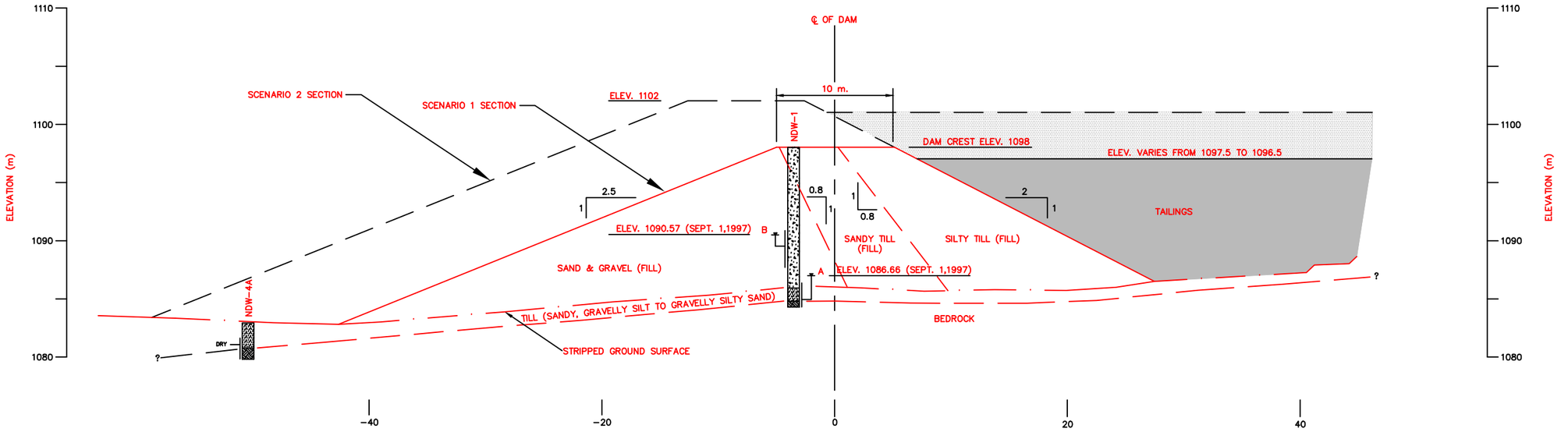
SRK Consulting
Engineers and Scientists

SA DENA HES DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

NORTH DAM
PLAN VIEW OF EXISTING STRUCTURE

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	CCS	10-3	
DATE: AUG. 6,1999	PROJ. NO. 1CC005.05		

FILE REF.: 2.DWG



KEY

- SANDY TILL (FILL)
- SILTY TILL (FILL)
- SAND & GRAVEL (FILL)
- SILTY SAND (TILL)
- GRAVELLY SILTY SAND (TILL)
- SAND & GRAVEL (NATIVE)
- BEDROCK
- PIEZOMETERIC HEAD FOR FILTER ZONE INDICATED

0 4 8 12 16 20 Metres

Cominco

SRK Consulting
Engineers and Scientists

SA DENA HES DETAILED DECOMMISSIONING AND RECLAMATION PLAN

NORTH DAM – SECTION 0+400

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	CCS	10-4	
DATE: AUG. 6,1999	PROJ. NO. 1CC005.05		

FILE REF.: 3.DWG

Since shutdown, seepage has been observed along the toe of the dam (see Section 3.2). However, most of this seepage originates from groundwater discharge from the hillsides on either side of the valley.

Aside from relatively minor concerns with previous foundation seepage and sand boil activity, the North Dam has experienced no physical stability problems.

10.3.5 North Dam Stability Analysis

As part of the original dam design studies completed in 1990 for the Initial Environmental Evaluation (SRK, 1990), stability analyses were completed using a limit equilibrium slope stability program, PC-SLOPE. The original analyses were done for the South Dam only because it was higher than the North Dam and had a thicker sequence of foundation soils than the North Dam. Therefore, the safety factors computed for the South Dam were expected to be equal to or lower than for the North Dam. The 1990 results are shown in Table 10-1.

Table 10-1 Factor of Safety Results from Original 1990 Design Analyses

Conditions at the South Dam*	**Computed Factor of Safety**	
	Static Loading	**Pseudo-static Loading (a_{max} =0.069g)**
Starter dam, end-of-construction	1.4	
Final dam, long term	1.7	1.4

*Factor of safety at the North Dam will be greater than or equal to that of the South Dam.

The pseudo-static method was used to evaluate dam stability during an earthquake. This method is considered appropriate where neither liquefaction nor major pore pressure buildup is anticipated, which is the case for the dams at Sä Dena Hes. The horizontal acceleration used in the pseudo-static analyses was 0.069g. This value was based on the peak horizontal acceleration for the 1:475 year seismic event, 0.055g, multiplied by an amplification factor, 1.25, that accounts for possible amplification of the seismic wave through the foundation soils. A value of 1.25 is conservative for the conditions at the tailings impoundment.

The current factor of safety for the North Dam has been determined using the computer program, SLOPE/W, recent piezometric data and the 1:1000-year seismic event. The results are summarized in Table 10-2 and in Figure 10-5.

Table 10-2 Current Factors of Safety, Scenario 1, North Dam

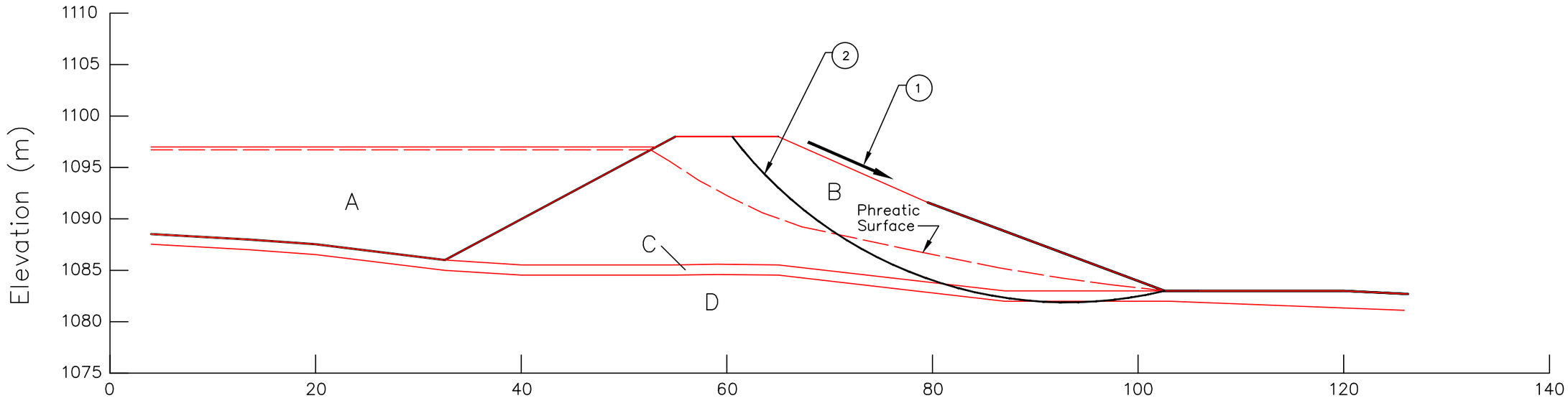
Failure Surface	Description	Factors of Safety (1:1000yr seismic event)	
		Static	Psuedo-Static (a_{max}=0.089g)
1	Slope Face	1.63	1.28
2	Deep	1.83	1.43

In the long term, the phreatic level in the tailings that abut the North Dam will be at or below the cofferdam that separates the drainage catchments for the North and South Dams (i.e. elevation 1098, or less). Piezometric conditions are not likely to be as severe as they have been previously and may well be similar to what they are presently. The safety factors shown in Table 10-2 and Figure 10-5 are, therefore, conservative representations of the long-term conditions at the North Dam.

The peak acceleration used in the analysis was 0.089 g, which corresponds to the 1:1000 year seismic event 0.071g, times as amplification factor of 1.25 to account for the foundation sediments. As failure of the tailings dams does not pose a significant risk to public health and safety after closure, the minimum return period of 1000 years as specified in the water license was adopted in calculating the factors of safety. This is based on the following factors:

- The levels of contaminants are low.
- There is no potential for acid generation.
- The surface area of the impoundment is less than 50 ha.
- After closure there is very low risk to public safety.

This is consistent with the guidelines recommended in the publication “Mine Reclamation in the Northwest Territories and the Yukon”, Indian and Northern Affairs Canada (INAC, 1992).



Material Properties Assumed in Stability Analysis				
Layer	Description	Unit Weight (kN/m^3)	Effective Angle of Friction (ϕ)	Effective Cohesion C' (kPa)
A	Tailings	18.0	25	0
B	Sand & Gravel	20.6	33	0
C	Sandy, Gravelly Silt - Till	20.6	35	0
D	Bedrock	19.5	45	0

Failure Surface	Description	Factors of Safety	
		Static	Pseudo-Static (a_{max}=0.089g)
1	Slope Face	1.63	1.28
2	Deep	1.83	1.43

FILE REF.: NORTH-DAM-STABILITY.DWG

Cominco

SRK Consulting
Engineers and Scientists

SA DENA HES DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

NORTH DAM
STABILITY ANALYSIS

DRAWN BY:	CHECKED BY:	FIGURE NO.	REV.
MH	CCS	10-5	
DATE: AUG. 9,1999	PROJ. NO. 1CC005.05		

10.4 CONCLUSIONS AND RECOMMENDATIONS

Under the current closure scenario, the South Dam would be removed and berm constructed in its place, and only the North Dam would be left standing. The North Dam is classed as having a low environmental impact for purposes of closure design and there are no public safety concerns.

The historic performance of the North Dam and recent stability analyses indicate that its critical factor of safety corresponds to a sliding failure along its downstream slope. The long-term factors of safety against such a failure are 1.63 under static loading conditions and 1.28 under pseudo-static conditions corresponding to the 1:1000 year seismic event. These results exceed the minimum safety factors associated with conventional closure criteria. As a result, no additional activities are required for purposes of the North Dam slope stability.

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SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN
MARCH 2013 UPDATE

Teck

TECK Metals Ltd.

APPENDIX C - WATER QUALITY DATA

Prepared by:

ACCESS
CONSULTING GROUP

srk consulting

Water Quality (2006 to 2011)

MH-02 North Dam Seepage

Collect Date/Time		2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Collect Date/Time		10-Jan	05-Feb	10-Mar	21-May	13-Jun	05-Jul	14-Aug	15-Sep	15-Oct	01-Nov	16-Dec	17-Jan	18-Jan	19-Jan	19-Feb	21-Mar	26-Mar	27-Apr	21- Mav	19-Jun	19-Jun	19-Jul	12-Aug	15-Sep
pH - Lab	pH	7.8	8.1	8	8.3	8.3	8.3	8.2	8.2	8.1	8.2	7.9	7.9			8.1		8.1	7.9	8.1		8.1	8.2	8.1	8
pH - Field	pH	7.43	7.52	7.16	7.86	7.63	7.83	7.67	7.76	7.46	7.13	6.64		7.21		7.55		7.47	7.19	7.34	7.59	7.59	8.07	7.66	7.35
Conductivity - Field	uS/cm																								
Conductivity - Lab	uS/cm	1170	1180	1240	1020	1010	1060	1060	1020	1040	1050	1200	1190			1210		1140	1230	526		869	960	961	920
Total Suspended Solids	mg/L	<4	4	8	<4	<4	<4	<4	<4	<4	<4	17	39			<4		19	4	<4		<4	<4	<4	<4
Total Dissolved Solids	mg/L	960	886	930	750	746	796	786	770	762	736	896	910			904		840	932	364		676	698	710	710
Turbidity	NTU	5.2	6.7	7.8	1.6	1.8	2.5	2.1	3	3.1	2.7	57.5	44.9			2.1		12.4	12.8	1.4		1.5	1.1	1.7	1.6
Turbidity - field	NTU	1290	1230	1300	890	680	1030	900	910	970	990	940		930		1030		960	990	470	750		710	700	710
Flow	L/min	5.00	5	5.00		23.00	10.00	8.00	16.00	5.00	5.00	4.00		4.00	4.00		4.00			10.00		10.00	7.00	5.00	
Hardness	mg/L	670	680	700	600	600	610	610	590	640	590	680	632			680		650	716	272		499	559	542	544
Alkalinity - CaCO3	mg/L	346	346	352	326	313	318	323	329	326	328	325	324			332		361	323	173		272	296	300	311
Alkalinity	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Sulphate	mg/L	341	406	383	274	303	302	331	309	273	292	369	392			401		285	377	102		232	247	240	252
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	422	423	430	398	382	388	394	401	398	400	397	395			405		440	394	211		332	361	366	379
Ammonia Nitrogen	mg/L	0.13	0.164	0.178	0.083	0.073	0.032	0.061	0.095	0.114	0.112	0.127	0.183			0.191		0.113	0.168	0.016		0.065	0.056	0.045	0.079
Nitrate-Nitrite	mg/L	0.06	0.05	0.06	<0.02	<0.02	<0.02	0.02	0.03	<0.02	<0.02	<0.02	0.03			0.02		0.02	0.03	<0.02		<0.02	<0.02	<0.02	0.03
Cyanide - Total	mg/L	0.0012	0.0011	0.001	0.0016	0.0017	0.0013	0.001	0.0011	0.0012	0.0012	0.0008	0.001			0.0009		0.0008	0.0009	<0.0005		<0.0005	0.0011	0.0011	0.0011
Aluminum - Total	mg/L	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	0.004	<0.02	0.08	0.03			<0.02		0.05	0.03	0.02		0.02	0.04	0.04	<0.02
Antimony - Total	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.05			<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05
Arsenic - Total	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.002	<0.05	<0.05	<0.05			<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05
Barium - Total	mg/L	0.108	0.115	0.123	0.11	0.113	0.105	0.101	0.099	0.096	0.086	0.145	0.093			0.1		0.105	0.11	0.059		0.094	0.105	0.102	0.088
Beryllium - Total	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002			<0.0002		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05
Boron - Total	mg/L	<0.008	<0.008	<0.008	<0.008	0.01	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.01			0.011		<0.008	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008
Cadmium - Total	mg/L	0.00351	0.00035	0.00041	0.00032	0.00034	0.00016	0.00018	0.00023	0.00022	0.00018	0.00069	3E-04			0.0004		0.00037	0.00041	0.001		0.00053	0.00019	0.00018	0.0002
Chromium - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	0.006	<0.005			<0.005		0.006	<0.005	<0.005		0.005	0.006	<0.005	<0.005
Cobalt - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0028	<0.005	0.005	<0.005			<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Copper - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0003	<0.005	<0.005	<0.005			<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Iron - Total	mg/L	0.798	1.3	1.47	0.466	0.473	0.42	0.479	0.517	0.601	0.505	9.21	0.351			0.297		1.69	1.41	0.262		0.343	0.306	0.433	0.364
Lead - Total	mg/L	0.00198	0.00236	0.0054	0.00214	0.0022	0.00212	0.00139	0.00836	0.00048	0.00048	0.0205	0.002			0.0029		0.0113	0.00482	0.006		0.00134	0.00182	0.0139	0.0007
Lithium - Total	mg/L									0.002															
Manganese - Total	mg/L	2.62	2.9	3.3	2.6	2.59	2.91	2.91	2.82	3.04	2.49	7.95	2.8			3.42		4.18	3.49	0.856		2.04	2.08	2.08	2.34
Mercury - Total	mg/L																								
Molybdenum - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Nickel - Total	mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008			<0.008		<0.008	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008
Phosphorus - Total	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1
Selenium - Total	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.001	<0.03	<0.03	<0.03			<0.03		<0.03	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03
Silicon - Total	mg/L	5.75	5.62	5.83	4.78	4.86	4.36	5.16	5.18	5.6	5.19	4.82	5.63			5.31		6.94	5.49	2.53		3.99	4.69	4.69	4.74
Silver - Total	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.01	<0.01	<0.01			<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01
Strontium - Total	mg/L	0.757	0.773	0.794	0.67	0.685	0.745	0.7	0.683	0.69	0.648	0.705	0.738			0.748		0.794	0.777	0.307		0.564	0.666	0.637	0.602
Tellurium - Total	mg/L																								
Thallium - Total	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.0001	<0.03	<0.03	<0.03			<0.03		<0.03	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03
Tin - Total	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			<0.02		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02
Titanium - Total	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003			<0.003		<0.003	<0.003	<0.003		<0.003	<0.003	<0.003	<0.003
Uranium - Total	mg/L	0.00315	0.00326	0.00343	0.00288	0.0028	0.00272	0.00267	0.00259	0.00252	0.00285	0.00189	0.003			0.0029		0.00257	0.00288	1E-03		0.00189	0.00233	0.0023	0.0023
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.147	0.14	0.147	0.082	0.081	0.063	0.067	0.08	0.099	0.088	0.168	0.139			0.146		0.127	0.129	0.21		0.1	0.078	0.1	0.078
Zirconium - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Calcium - Total	mg/L	232	235	240	209	209	208	208	203	219	202	235	216			235		208	249	97.1		176	195	188	187
Magnesium - Total	mg/L	22.9	23	23.6	18.6	18.7	22	21.7	20.7	21.8	20.3	23.3	22.5			22.3		31.7	22.7	7.27		14.8	17.6	17.9	18.6
Potassium - Total	mg/L	1	1	1	1	1	1	2	2	2	<1	1	2			1		1	1	1		2	2	2	2
Sodium - Total	mg/L	17.5	17.4	17.3	14.4	14.4	17.8	18.6	15.8	16	14.7	13.9	15.8			15.5		16.1	15.8	7.36		11.3	16.4	14.8	15.3
Sulphur - Total	mg/L	108	117	124	94.6	96.8	102	99.8	95.6	97.4	91.8	123	105			124		106	136	36.9		78.6	90.3	84.6	82.7

Water Quality (2006 to 2011)

MH-02 North Dam Seepage

Collect Date/Time		2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2009	2009	2009
Collect Date/Time		**18-Sep**	**21-Oct**	**14-Nov**	**15-Nov**	**03-Dec**	**04-Jan**	**11-Feb**	**03-Mar**	**03-Mar**	**02-Apr**	**27-Jun**	**02-Jul**	**19-Jul**	**23-Jul**	**15-Aug**	**18-Aug**	**03-Sep**	**23-Oct**	**14-Nov**	**01-Dec**	**18-Jan**	**13-Feb**	**18-Mar**
pH - Lab	pH		8	8.1		7.9	8	8.1		8	8		8.2	8.1		8.2		8.2	8.2	8.1	8	8	8	8
pH - Field	pH		7.84		7.21	7.79	7.83	7.25	7.77		7.29	7.90			7.82		7.74	7.87	7.64	7.90	7.93	7.80	8.30	7.40
Conductivity - Field	uS/cm																							
Conductivity - Lab	uS/cm		970	1000		1100	1000	1100		1100	1200		990	1000		1000		1000	990	1100	1100	1100	1200	1300
Total Suspended Solids	mg/L		<4	5		82	5	4		11	37		<4	<4		<4		<4	7	6	14	39	<4	25
Total Dissolved Solids	mg/L		730	760		790	750	840		850	940		730	700		710		660	830	950	1000	840	850	930
Turbidity	NTU		0.5	1.4		38	5.1	5.7		10.2	72.6		2.4	1.4		1.2		1.6	2.2	0.3	1.2	6	1	12.5
Turbidity - field	NTU		810		700	710																		
Flow	L/min	14.00	5.00		12.00	12.00	12.00	12.00	14.00		15.00	20.00		18.00			15.00	15.00		15.00	17.00			
Hardness	mg/L		599	621		723	682	661		713	740		166	583		559		584	595	589	709	597	699	778
Alkalinity - CaCO3	mg/L		280	280		290	270	310		350	330		280	300		320		310	280	290	280	300	290	290
Alkalinity	mg/L		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphate	mg/L		289	286		331	328	350		371	416		290	270		270		260	16	340	350	360	390	480
Hydroxide (OH)	mg/L		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L		340	350		360	330	380		430	400		340	370		390		380	350	350	340	360	350	360
Ammonia Nitrogen	mg/L		0.155	0.162		0.127	0.162	0.135		0.133	0.158		0.033	0.007		0.029		0.05	0.097	0.193	0.185	0.19	0.273	0.224
Nitrate-Nitrite	mg/L		0.03	0.04		0.04	0.05	0.07		0.05	0.05		<0.02	0.16		0.03		<0.02	0.02	0.03	0.03	0.14	0.06	0.06
Cyanide - Total	mg/L		0.008	0.0011		0.0008	0.0018	0.0008		0.001	0.002		0.0107	<0.0005		0.0007		0.001	0.0007	0.0009	0.0007	0.0014	0.0011	<0.0005
Aluminum - Total	mg/L		0.009	0.113		0.912	0.089	0.02		0.032	0.102		0.035	0.017		0.009		0.008	0.018	0.023	0.039	0.044	0.008	0.112
Antimony - Total	mg/L		<0.0005	<0.0005		0.0005	<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L		0.0007	0.001		0.0064	0.0017	0.0011		0.002	0.01		0.0013	0.002		0.0013		0.0017	0.0021	0.0018	0.0018	0.0044	0.0006	0.0039
Barium - Total	mg/L		0.088	0.087		0.133	0.093	0.09		0.095	0.162		0.049	0.108		0.078		0.09	0.085	0.084	0.085	0.107	0.088	0.133
Beryllium - Total	mg/L		<0.0001	<0.0001		0.0001	<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001		<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001		<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L		0.048	0.007		0.027	0.01	<0.005		<0.005	<0.005		<0.05	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium - Total	mg/L		0.00101	0.0005		0.00294	0.00171	0.0007		0.00116	0.005		<0.00003	8E-04		0.0003		0.000408	0.00042	0.00324	0.00388	0.0108	0.000355	0.00508
Chromium - Total	mg/L		<0.001	<0.001		0.002	<0.001	<0.001		<0.001	<0.001		0.002	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt - Total	mg/L		0.0027	0.0029		0.0063	0.0033	0.0027		0.0031	0.01		0.0015	0.003		0.0019		0.002	0.0027	0.0038	0.004	0.0041	0.0035	0.0065
Copper - Total	mg/L		0.0034	0.0016		0.0069	0.0027	0.0007		0.0196	0.005		0.0005	3E-04		0.0003		0.0042	0.0002	0.0012	0.0013	0.0022	0.0008	0.0022
Iron - Total	mg/L		0.357	0.571		4.55	0.986	0.89		2.57	13.8		0.278	0.433		0.268		0.306	0.769	1.19	1.39	4.18	0.266	3.58
Lead - Total	mg/L		0.00336	0.0335		0.322	0.0434	0.0077		0.012	0.084		0.0008	0.011		0.0013		0.00159	0.00549	0.0624	0.0473	0.123	0.00179	0.104
Lithium - Total	mg/L																							
Manganese - Total	mg/L		2.15	2.36		5.19	2.76	2.44		2.89	8.02		1.08	2.27		1.91		2.21	2.61	2.79	2.89	3.16	3.01	4.37
Mercury - Total	mg/L																							
Molybdenum - Total	mg/L		<0.001	<0.001		0.001	<0.001	<0.001		<0.001	0.002		0.001	<0.001		<0.001		<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
Nickel - Total	mg/L		0.001	0.002		0.005	0.001	0.001		0.001	0.003		<0.001	0.001		0.001		0.001	0.001	0.009	0.002	0.002	0.002	0.002
Phosphorus - Total	mg/L																							
Selenium - Total	mg/L		0.0001	0.0001		0.0002	0.0001	0.0001		0.0002	2E-04		0.0003	5E-04		0.0002		0.0001	0.0002	0.0002	0.0001	0.0002	0.0001	0.0002
Silicon - Total	mg/L		4.95	4.6		6.35	5.36	5.54		5.21	5.55		4.38	4.75		4.29		4.5	5.31	5.57	5.91	5.44	5.9	5.33
Silver - Total	mg/L		<0.00002	3E-05		0.00026	0.00003	<0.00002		<0.00002	4E-05		<0.00002	<0.00002		<0.00002		<0.00002	<0.00002	0.00002	0.00002	0.00003	<0.00002	0.00003
Strontium - Total	mg/L		0.611	0.614		0.731	0.73	0.726		0.765	0.785		0.302	0.672		0.628		0.697	0.648	0.688	0.8	0.689	0.716	0.89
Tellurium - Total	mg/L																							
Thallium - Total	mg/L		<0.00005	<0.00005		0.00011	<0.00005	<0.00005		<0.00005	<0.00005		<0.00005	<0.00005		<0.00005		<0.00005	<0.00005	0.00006	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L		<0.005	0.007		0.044	<0.005	<0.005		0.005	0.009		0.007	<0.005		<0.005		0.018	0.011	0.014	<0.005	<0.005	<0.005	<0.005
Uranium - Total	mg/L		0.00227	0.0026		0.00261	0.00272	0.0027		0.00273	0.002		0.00057	0.003		0.0027		0.00249	0.0025	0.00298	0.00291	0.00269	0.00302	0.00319
Vanadium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L		0.156	0.158		0.507	0.134	0.117		0.112	0.215		0.072	0.188		0.091		0.124	0.173	0.238	0.177	0.349	0.167	0.352
Zirconium - Total	mg/L		<0.0005	<0.0005		0.0009	<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L		214	221		257	242	230		250	260		45.1	202		194		201	205	206	250	209	245	272
Magnesium - Total	mg/L		15.6	16.6		19.7	19	21		21.7	22.4		12.9	19.2		18.5		20.2	20.1	17.9	20.4	18.4	21.6	23.7
Potassium - Total	mg/L		1.72	1.71		1.95	1.86	1.85		1.91	1.65		2.21	1.63		1.84		1.82	1.65	1.67	1.99	1.57	1.86	2.11
Sodium - Total	mg/L		14.8	15.1		16	15.7	14.9		17	14		1850	15.4		14.5		14.6	13.7	14	17.3	13	15	16.6
Sulphur - Total	mg/L		104	103		121	128	127		135	137		114	93		92		98	103	121	130	112	148	166

Water Quality (2006 to 2011)

MH-02 North Dam Seepage

Collect Date/Time		2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Collect Date/Time		13-Apr	18-May	15-Jun	20-Jul	16-Aug	19-Aug	24-Sep	24-Sep	23-Oct	15-Nov	09-Dec	13-Jan	16-Feb	07-Mar	11-Apr	04-May	14-Jun	20-Jul	15-Aug	16-Aug	21-Sep	23-Oct
pH - Lab	pH	8	8.1	8.3	8.2		8.3		8.2	8.1	8.2	8.1	7.9	8.1	7.8	8.1	7.9	8.1	8.26	8.17		8.08	8.23
pH - Field	pH	7.67	7.80	7.80	7.92	7.91		7.89		7.79	7.87	7.83	7.90	7.93	7.86	7.75	7.81	7.95	7.85		8.54	7.85	7.72
Conductivity - Field	uS/cm																						
Conductivity - Lab	uS/cm	1300	1100	830	1100		1030		958	1000	996	1110	1120	1150	1170	1150	1060	861	1040	1060		998	1040
Total Suspended Solids	mg/L	19	5	<4	<4		<4		<4	<4	13	17	<4	<4	5	44	8	<4	<4	<4		<4	9
Total Dissolved Solids	mg/L	1000	830	570	760		730		700	720	730	780	220	150	860	860	800	700	710	750		760	740
Turbidity	NTU	5.7	3.2	0.9	1.2		1.1		1.5	1.6	3.5	21.6	10.5	18.2	11.3	32.2	2.1	0.7	0.8	0.7		0.6	9
Turbidity - field	NTU																						
Flow	L/min	15.00	30.00	60.00	15.00	14.00		15.00		15.00	15.00	10.00	10.00	8.00	8.00	10.00	12.00		10.00		10.00	10.00	10.00
Hardness	mg/L	731	560	446	627		582		549	565	611	708	667	663	665	693	550	518	577	585		566	593
Alkalinity - CaCO3	mg/L	300	300	260	310		300		300	310	280	290	310	310	310	300	260	210	300	300		240	270
Alkalinity	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Sulphate	mg/L	470	400	180	300		270		210	280	270	330	260	340	330	380	380	260	260	310		300	270
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Bicarbonate (HCO3)	mg/L	370	370	320	370		370		360	380	340	360	380	380	370	360	310	260	370	360		290	340
Ammonia Nitrogen	mg/L	0.212	0.111	0.039	0.023		0.022		0.071	0.108	0.154	0.196	0.173	0.165	0.156	0.164	0.16	0.1	0.038	0.035		0.12	0.22
Nitrate-Nitrite	mg/L	0.04	0.03	<0.02	<0.02		<0.02		<0.02	0.02	0.02	1.33	0.03	0.03	0.04	0.06	0.03	<0.02	<0.02	<0.02		<0.02	<0.02
Cyanide - Total	mg/L	0.0006	0.0009	0.0033	<0.0005		0.0006		<0.0005	0.0005	<0.0005	0.0008	0.0016	0.0009	<0.0005	0.0006	<0.0005	0.0006	0.0011	<0.001		<0.001	<0.0005
Aluminum - Total	mg/L	0.064	0.027	0.007	0.01		<0.003		<0.003	0.004	0.12	0.063	0.005	0.006	0.006	0.084	0.028	0.004	0.006	0.014		0.009	0.06
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Arsenic - Total	mg/L	0.0017	0.0023	0.0011	0.002		0.0017		0.0011	0.0011	0.0025	0.0036	0.0013	0.0011	0.0014	0.0047	0.0023	0.001	0.001	0.0012		0.0005	0.0017
Barium - Total	mg/L	0.114	0.11	0.085	0.099		0.086		0.079	0.08	0.096	0.108	0.097	0.1	0.097	0.128	0.098	0.079	0.077	0.076		0.075	0.086
Beryllium - Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001
Bismuth - Total	mg/L	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.096		<0.05	<0.05
Cadmium - Total	mg/L	0.000663	0.000589	0.00085	0.0002		0.0002		0.000218	0.00023	0.00324	0.00773	0.00029	0.000344	0.00033	0.00517	0.0026	0.000193	0.000114	9E-05		0.000082	0.000324
Chromium - Total	mg/L	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Cobalt - Total	mg/L	0.0048	0.0028	0.0015	0.0019		0.002		0.002	0.0023	0.0039	0.0048	0.0033	0.0031	0.0031	0.0048	0.0035	0.0016	0.0013	0.0014		0.0017	0.0028
Copper - Total	mg/L	0.0024	0.011	0.0005	0.0004		0.0003		0.0003	0.0003	0.0018	0.0015	0.001	0.0009	0.0017	0.008	0.0022	0.0006	0.0002	0.0015		0.0006	0.0066
Iron - Total	mg/L	1.13	1.24	0.214	0.421		0.305		0.193	0.478	1.85	3.47	1.46	0.974	1.29	7.58	1.84	0.196	0.212	0.261		0.168	0.898
Lead - Total	mg/L	0.00852	0.00466	0.00112	0.0062		0.0005		0.000466	0.000727	0.0976	0.0883	0.00143	0.00122	0.00165	0.0698	0.0352	0.000636	0.000575	0.0007		0.00157	0.0199
Lithium - Total	mg/L																						
Manganese - Total	mg/L	3.45	3.06	1.33	1.83		1.93		1.91	2.42	3.56	4.13	3.31	2.93	2.97	3.49	3.22	1.36	1.15	1.32		1.83	2.4
Mercury - Total	mg/L																						
Molybdenum - Total	mg/L	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Nickel - Total	mg/L	0.002	0.001	<0.001	0.001		0.001		0.001	0.001	0.002	0.002	0.001	0.002	0.001	0.002	0.002	0.001	0.001	0.001		0.016	0.002
Phosphorus - Total	mg/L																						
Selenium - Total	mg/L	<0.0001	<0.0001	0.0003	0.0002		0.0001		0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0002	0.0001	<0.0001	0.0001	<0.0001		<0.0001	0.0001
Silicon - Total	mg/L	5.61	4.97	4	5.18		4.12		4.91	5.09	5.32	6.68	6.18	5.5	5.4	5.96	5.33	4.3	4.49	5.19		4.84	5.15
Silver - Total	mg/L	<0.00002	<0.00002	<0.00002	<0.00002		<0.00002		<0.00002	<0.00002	<0.00002	0.00003	<0.00002	<0.00002	<0.00002	0.00004	<0.00002	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002
Strontium - Total	mg/L	0.812	0.684	0.54	0.752		0.703		0.621	0.652	0.689	0.766	0.715	0.752	0.709	0.793	0.628	0.634	0.731	0.734		0.666	0.697
Tellurium - Total	mg/L																						
Thallium - Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005		<0.00005	<0.00005	<0.00005	0.00015	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Uranium - Total	mg/L	0.00291	0.00212	0.00195	0.0026		0.0026		0.00214	0.00234	0.00266	0.00274	0.00247	0.00271	0.00264	0.00276	0.00213	0.00203		0.0025		0.00226	0.00234
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Zinc - Total	mg/L	0.246	0.306	0.16	0.061		0.073		0.116	0.13	0.267	0.318	0.143	0.152	0.15	0.279	0.193	0.058	0.041	0.04		0.077	0.115
Zirconium - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Calcium - Total	mg/L	256	193	157	216		201		191	196	215	250	233	232	233	243	195	179	199			194	206
Magnesium - Total	mg/L	22.2	19.1	13.2	21.2		19.6		17.7	18.4	18.2	20.2	20.8	20.3	20.3	21.1	15.4	16.9	19.3			19.6	18.8
Potassium - Total	mg/L	2.12	1.5	1.57	1.43		1.83		2.27	1.62	1.84	2.01	1.75	1.72	1.7	1.96	1.88	1.64	1.56			2.28	1.9
Sodium - Total	mg/L	15.4	9.71	10.8	15.2		13.9		11.4	11.7	13.5	14.6	13.5	13.6	12.9	14	9.78	10.5	12.9			12	12.4
Sulphur - Total	mg/L	166	94	81	113		106		99	101	115	142	148	126	132	149	117	100	101			117	119

Water Quality (2006 to 2011)

MH-02 North Dam Seepage

Collect Date/Time		2010	2010	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011
Collect Date/Time		14-Nov	11-Dec	21-Jan	12-Feb	13-Mar	16-Mar	05-Apr	23-May	25-May	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep	08-Oct	15-Nov	05-Dec
pH - Lab	pH	7.93	8.12	7.9	7.87	7.92		8		8.17	7.02		8.21	8.05	8.09	8.19	8.14	8.01
pH - Field	pH	7.98	7.76	7.69	7.77		7.57		7.75			7.45	7.85	7.90	7.63	7.97	7.33	7.75
Conductivity - Field	uS/cm																	
Conductivity - Lab	uS/cm	1060	1050	1120	1150	1190		1170		651	374		1010	929	952	972	1010	1030
Total Suspended Solids	mg/L	<4	<4	<4	6	20		6		<4	<4		<4	<4	<4	<4	<4.0	5.3
Total Dissolved Solids	mg/L	740	780	810	850	870		890		420	720		720	720	730	650	694	708
Turbidity	NTU	1.8	1.4	4.7	3	7.2		4.2		0.3	0.7		0.6	0.4	0.4	0.2	0.95	1.58
Turbidity - field	NTU																	
Flow	L/min	10.00	10.00	6.00	6.00		6.00	6.00	10.00			14.00	16.00	14.00	14.00	12.00	10.00	10.00
Hardness	mg/L	626	609	646	261	679		667		335	511		541	542	593	561	538	506
Alkalinity - CaCO3	mg/L	280	290	300	290	290		290		190	260		200	270	280	280	297	285
Alkalinity	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Sulphate	mg/L	300	320	300	340	370		370		150	290		250	220	210	270	249	292
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Bicarbonate (HCO3)	mg/L	340	350	360	350	360		360		230	320		250	330	350	350	362	347
Ammonia Nitrogen	mg/L	0.17	0.077	0.12	0.099	0.098		0.11		0.018	0.029		0.036	0.011	0.036	0.078	0.0771	0.118
Nitrate-Nitrite	mg/L	<0.02	0.04	0.04	0.05	0.05		0.05		<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	0.031	0.021
Cyanide - Total	mg/L	0.0007	<0.0005	0.0009	0.0011	0.0006		0.0008		0.001	0.002		<0.0005	<0.0005	<0.0005	0.0006	0.00073	<0.00050
Aluminum - Total	mg/L	0.012	0.02	0.033	0.06	0.157		0.12		<0.01	<0.01		0.019	0.003	<0.003	0.003	0.014	<0.01
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		0.001		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.001	0.0012	0.0018	0.0013	0.0037		0.0029		0.0005	9E-04		0.001	0.0008	0.0006	0.0005	0.0014	0.0005
Barium - Total	mg/L	0.086	0.089	0.111	0.041	0.115		0.11		0.063	0.083		0.066	0.069	0.068	0.064	0.078	0.066
Beryllium - Total	mg/L	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002		<0.0002		<0.0002	<0.0002		<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.05	<0.1	<0.1	<0.1		<0.1		<0.1	<0.1		<0.05	<0.05	<0.05	<0.05	<0.1	<0.1
Cadmium - Total	mg/L	0.000105	0.000151	0.0006	0.0002	0.0005		0.0006		0.0002	2E-04		0.00013	0.00002	0.00009	0.0001	0.0002	0.0002
Chromium - Total	mg/L	<0.001	<0.001	<0.002	<0.002	<0.002		<0.002		<0.002	<0.002		0.001	<0.001	<0.001	<0.001	<0.002	<0.002
Cobalt - Total	mg/L	0.0024	0.0025	0.0027	0.0014	0.0033		0.0029		0.0006	0.001		0.0009	0.0008	0.0008	0.0012	0.0018	0.0017
Copper - Total	mg/L	0.0009	0.0004	0.028	0.001	0.03		0.032		<0.001	<0.001		0.0103	0.0003	0.0003	0.0003	<0.001	0.002
Iron - Total	mg/L	0.283	0.38	1.2	0.627	1.86		1.82		0.113	0.156		0.378	0.107	0.126	0.122	0.597	0.241
Lead - Total	mg/L	0.0043	0.00801	0.0117	0.0106	0.0279		0.0224		0.0008	0.001		0.001	0.0002	0.0004	0.0003	0.0021	0.0019
Lithium - Total	mg/L			<0.01	<0.01	<0.01		<0.01		<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Manganese - Total	mg/L	2.18	2.02	2.61	1.2	2.86		2.83		0.594	1.14		0.587	0.471	0.743	1.16	2.16	1.5
Mercury - Total	mg/L												<0.00005	<0.00005	<0.00005	<0.00005		
Molybdenum - Total	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001		0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel - Total	mg/L	<0.001	0.001	0.002	0.001	0.002		0.002		<0.001	<0.001		0.003	<0.001	<0.001	<0.001	<0.001	0.002
Phosphorus - Total	mg/L																	
Selenium - Total	mg/L	<0.0001	0.0001	<0.0008	<0.0008	<0.0008		<0.0008		<0.0008	<0.0008		0.0002	0.0002	<0.0001	0.0001	<0.0008	<0.0008
Silicon - Total	mg/L	5.53	5.14	5.49	2.16	5.31		5.22		3.28	3.64		4.65	4.69	4.72	4.71	4.4	4.66
Silver - Total	mg/L	<0.00002	<0.00002	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.0001		<0.00002	<0.00002	<0.00002	<0.00002	<0.0001	<0.0001
Strontium - Total	mg/L	0.731	0.692	0.758	0.303	0.787		0.81		0.407	0.746		0.645	0.617	0.626	0.613	0.621	0.609
Tellurium - Total	mg/L																	
Thallium - Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005		<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.005	<0.01	<0.01	<0.01		<0.01		<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Uranium - Total	mg/L	0.00241	0.00259	0.0026	0.001	0.0025		0.0027		0.0013	0.002		0.0019	0.0019	0.0018	0.0018	0.0019	0.002
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.083	0.085	0.155	0.051	0.123		0.119		0.071	0.043		0.036	0.031	0.049	0.091	0.084	0.08
Zirconium - Total	mg/L	<0.0005	<0.0005	<0.002	<0.002	<0.002		<0.002		<0.002	<0.002		<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002
Calcium - Total	mg/L	215	212	224	91	238		233		120	178		188	191	204	196	186	175
Magnesium - Total	mg/L	21.4	19.3	21	8	20		21		9	16		17.3	15.9	20	17.5	17.8	17
Potassium - Total	mg/L	1.85	1.55	2	<1	2		2		1	2		1.67	1.89	1.89	1.7	1.57	1
Sodium - Total	mg/L	14.2	11.5	13	5	13		12		6	10		13.7	10.4	12.1	10.9	12.1	11
Sulphur - Total	mg/L	131	115	127	52	136		136		<60	114		100	102	110	100	106	90

Water Quality (2006 to 2011)

MH-1B Reclaim Pond Discharge

Collect Date/Time		2006	2006	2006	2006	2006	2006	2007	2007	2007	2008	2008	2008	2008	2009	2009	2009	2009	2009	2009
Collect Date/Time		02-Jan	08-Jan	09-Apr	11-Apr	12-Jun	11-Sep	19-Jun	17-Sep	07-Dec	24-Mar	21-Jun	27-Jun	21-Oct	18-Jan	31-Mar	15-Jul	20-Jul	21-Sep	25-Dec
pH - Lab	pH		8	7.7		8	8.4	8.2	8.1	8.2	8.3	8.3		8.5	8.2	8.2	8.2		8.2	8.2
pH - Field	pH	8.37	8.37	7.87	7.87	8.18	7.65	8.24	8.04	8.04	8.06		8.05	8.32	8.18			8	8.01	
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm		407	211		261	321	271	336	350	540	320		380	410	420	290		341	422
Total Suspended Solids	mg/L		<4	<4		<4	<4	<4	<4	<4	10	<4		8	6	5	<4		4	<4
Total Dissolved Solids	mg/L		266	140		152	200	191	212	220	330	210		270	220	250	170		190	320
Turbidity	NTU		0.3	0.5		2.1	1	1.5	0.7	0.9	3	1.6		3.9	1.7	1.1	0.1		0.8	1.2
Turbidity - field	NTU			220.00		280.00		260.00	280.00	270.00										
Flow	L/min																			
Hardness	mg/L		220	120		140	180	158	200	209	362	179		210	215	240	162		193	256
Alkalinity - CaCO3	mg/L		194	83.2		119	152	135	167	170	270	150		190	200	210	140		160	200
Alkalinity	mg/L		<0.5	<0.5		<0.5	1.5	<0.5	<0.5	<0.5	<0.5	<0.5		4.2	<0.5	<0.5	<0.5		<0.5	<0.5
Sulphate	mg/L		26.5	35.2		16.9	19.9	17.3	21.9	19.5	57	16		21	26	27	11		19	26
Hydroxide (OH)	mg/L		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Carbonate (CO3)	mg/L		<0.5	<0.5		<0.5	1.8	<0.5	<0.5	<0.5	<0.5	<0.5		5	<0.5	<0.5	<0.5		<0.5	<0.5
Bicarbonate (HCO3)	mg/L		237	102		145	182	165	204	210	320	180		220	240	250	180		200	250
Ammonia Nitrogen	mg/L		0.044	0.119		0.081	0.006	<0.005	<0.005	0.025	0.012	<0.005		<0.005	0.028	<0.005	<0.005		0.019	0.031
Nitrate-Nitrite	mg/L		0.03	0.34		<0.02	<0.02	<0.02	<0.02	<0.02	0.07	<0.02		<0.02	0.12	0.05	0.14		<0.02	<0.02
Cyanide - Total	mg/L		<0.0005	0.0015		<0.0005	0.0006	<0.0005	<0.0005	<0.0005	0.0011	<0.0005		<0.0005	0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Aluminum - Total	mg/L		<0.02	<0.02		0.02	0.02	0.04	<0.02	0.007	0.009	0.05		0.091	0.011	0.006	0.011		0.05	0.008
Antimony - Total	mg/L		<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.0005	0.0007	<0.0005		<0.0005	<0.0005	0.0027	<0.0005		<0.0005	0.0006
Arsenic - Total	mg/L		<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	0.0006	0.001	0.0004		0.0009	0.0006	0.0006	0.0004		0.0006	0.0006
Barium - Total	mg/L		0.039	0.014		0.029	0.034	0.032	0.039	0.049	0.05	0.036		0.037	0.044	0.045	0.023		0.041	0.049
Beryllium - Total	mg/L		<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001
Bismuth - Total	mg/L		<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Boron - Total	mg/L		<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	0.006	<0.005	<0.05		<0.05	<0.05	<0.05	<0.05		<0.05	<0.05
Cadmium - Total	mg/L		0.00038	0.00011		0.00063	0.00019	0.0005	0.00012	0.000076	0.00009	0.000342		0.000143	0.00025	0.000111	0.00023		0.000189	0.000215
Chromium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Cobalt - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Copper - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0.0041	0.0043	0.0011		0.0018	0.0103	0.0017	0.0004		0.0023	0.0046
Iron - Total	mg/L		0.011	0.021		0.118	0.028	0.091	0.049	0.063	0.017	0.096		0.218	0.034	0.021	0.017		0.128	0.033
Lead - Total	mg/L		0.00285	0.00223		0.0323	0.00313	0.00675	0.0107	0.000746	0.000837	0.00597		0.0216	0.00361	0.00221	0.00048		0.00698	0.00224
Lithium - Total	mg/L																			
Manganese - Total	mg/L		0.003	0.006		0.079	0.011	0.04	0.013	0.003	0.008	0.027		0.038	0.011	0.009	0.002		0.03	0.008
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0.002	0.005	0.002		0.002	0.002	0.002	<0.001		0.002	0.002
Nickel - Total	mg/L		<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.001	0.001	<0.001		<0.001	<0.001	<0.001	<0.001		<0.001	<0.001
Phosphorus - Total	mg/L		<0.1	<0.1		<0.1	<0.1	<0.1	<0.1											
Selenium - Total	mg/L		<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	0.0006	0.0012	0.0008		0.0007	0.0008	0.0007	0.0005		0.0008	0.0009
Silicon - Total	mg/L		2.28	1.59		1.92	2	2.07	2.09	2.46	6.06	2.22		2.51	2.82	3.23	3.31		2.38	3.47
Silver - Total	mg/L		<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.00002	<0.00002	<0.00002		0.00002	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002
Strontium - Total	mg/L		0.264	0.149		0.161	0.212	0.182	0.244	0.255	0.479	0.215		0.269	0.292	0.312	0.198		0.257	0.313
Tellurium - Total	mg/L																			
Thallium - Total	mg/L		<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005
Tin - Total	mg/L		<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Titanium - Total	mg/L		<0.003	<0.003		<0.003	<0.003	<0.003	<0.003	<0.005	<0.005	<0.005		0.013	<0.005	<0.005	<0.005		<0.005	<0.005
Uranium - Total	mg/L		0.00162	0.00104		0.00093	0.0012	0.00088	0.00119	0.0011	0.00283	0.00125		0.00144	0.00173	0.00159	0.000722		0.00122	0.0018
Vanadium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Zinc - Total	mg/L		0.033	0.04		0.105	0.028	0.087	0.031	0.029	0.022	0.049		0.046	0.038	0.038	0.006		0.059	0.063
Zirconium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Calcium - Total	mg/L		70.2	29.3		48.7	61.7	53.1	65.7	70.3	109	59.5		68	69.9	77.4	59.6		63.9	83.9
Magnesium - Total	mg/L		9.84	12.1		5.42	7.46	6.19	8.64	8.17	21.5	7.34		9.88	9.94	11.3	3.13		8.24	11.3
Potassium - Total	mg/L		<1	<1		<1	<1	<1	<1	1.08	2.05	0.83		0.83	0.88	0.93	0.37		0.89	1.06
Sodium - Total	mg/L		1.06	1.17		0.52	0.76	0.55	0.82	1.2	2.16	0.69		0.87	0.95	0.98	0.8		0.76	1.11
Sulphur - Total	mg/L		8.5	10		5.8	6.8	5.8	7	6	20	6		10	9	9	4		19	10

Water Quality (2006 to 2011)

MH-1B Reclaim Pond Discharge

Collect Date/Time		2010	2010	2010	2011	2011	2011	2011	2011	2011
Collect Date/Time		28-May	26-Sep	20-Dec	13-Mar	16-Mar	22-Jun	23-Jun	08-Oct	23-Dec
pH - Lab	pH	8.1	8.27	7.86	8.03			8.04	8.22	8.13
pH - Field	pH	7.99	8.29	8.07		8.01	8.01		8.02	8.00
Conductivity - Field	uS/cm									
Conductivity - Lab	uS/cm	272	376	144	443			278	398	435
Total Suspended Solids	mg/L	4	<4	65	6			7	4	<4.0
Total Dissolved Solids	mg/L	170	210	140	270			150	220	246
Turbidity	NTU	5.6	3.3	22.3	1.7			5.7	1.1	1.34
Turbidity - field	NTU									
Flow	L/min									
Hardness	mg/L	153	214	87.8	245			165	208	218
Alkalinity - CaCO3	mg/L	120	170	61	200			110	180	193
Alkalinity	mg/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.50
Sulphate	mg/L	23	28	11	34				39	43.8
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.50
Bicarbonate (HCO3)	mg/L	150	210	74	250			140	220	235
Ammonia Nitrogen	mg/L	0.039	0.08	0.049	0.018			0.031	0.025	0.041
Nitrate-Nitrite	mg/L	<0.02	<0.02	<0.02	0.03			<0.02	<0.02	<0.020
Cyanide - Total	mg/L	0.0005	<0.001	0.0011	0.0008			<0.0005	<0.0005	<0.00050
Aluminum - Total	mg/L	0.102	0.017	0.004	<0.01			0.132	0.096	<0.01
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.0008	0.0006	0.0002	0.0007			0.0008	0.0008	0.0005
Barium - Total	mg/L	0.034	0.039	0.019	0.047			0.037	0.042	0.042
Beryllium - Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0002			<0.0002	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.05	<0.05	<0.1			<0.1	<0.1	<0.1
Cadmium - Total	mg/L	0.000678	0.000152	0.000059	0.0001			0.0012	0.0006	0.0004
Chromium - Total	mg/L	<0.001	<0.001	<0.001	<0.002			<0.002	<0.002	<0.002
Cobalt - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0031	0.0016	0.0015	0.005			0.004	0.003	0.002
Iron - Total	mg/L	0.452	0.1	0.006	0.03			0.296	0.281	0.02
Lead - Total	mg/L	0.0717	0.015	0.00122	0.0021			0.0473	0.0445	0.0045
Lithium - Total	mg/L				<0.01			<0.01	<0.01	<0.01
Manganese - Total	mg/L	0.137	0.034	0.002	0.029			0.098	0.185	0.044
Mercury - Total	mg/L									
Molybdenum - Total	mg/L	0.002	0.003	0.001	0.004			0.002	0.003	0.003
Nickel - Total	mg/L	0.001	<0.001	<0.001	<0.001			0.001	0.001	0.001
Phosphorus - Total	mg/L									
Selenium - Total	mg/L	0.0009	0.0009	0.0003	0.0009			0.002	0.0011	0.0011
Silicon - Total	mg/L	2.79	1.86	0.812	2.46			2.96	2.97	2.94
Silver - Total	mg/L	0.00006	<0.00002	<0.00002	<0.0001			<0.0001	<0.0001	<0.0001
Strontium - Total	mg/L	0.203	0.286	0.124	0.339			0.202	0.288	0.295
Tellurium - Total	mg/L									
Thallium - Total	mg/L	0.00008	<0.00005	<0.00005	<0.00005			0.00007	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.005	<0.005	<0.01			<0.01	<0.01	<0.01
Uranium - Total	mg/L	0.0014	0.00174	0.000819	0.002			0.0013	0.0019	0.0018
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.142	0.034	0.013	0.035			0.179	0.117	0.083
Zirconium - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.002			<0.002	<0.002	<0.002
Calcium - Total	mg/L	51.9	69.5	28	80			55	66	70
Magnesium - Total	mg/L	5.63	9.81	4.38	11			7	10	11
Potassium - Total	mg/L	0.88	0.87	0.41	1			<1	<1	<1
Sodium - Total	mg/L	0.57	0.92	1.02	1			<1	1	<1
Sulphur - Total	mg/L	7	11	13	<60			<60	<60	<60

Water Quality (2006 to 2011)

MH-04 Camp Creek

Collect Date/Time		2006	2006	2006	2006	2006	2006	2007	2007	2007	2008	2008	2008	2008	2008	2009	2009	2009	2009	2009
Collect Date/Time		08-Jan	08-Jan	09-Apr	11-Apr	12-Jun	11-Sep	19-Jun	17-Sep	07-Dec	24-Mar	21-Jun	27-Jun	27-Jun	21-Oct	18-Jan	31-Mar	15-Jul	20-Jul	21-Sep
pH - Lab	pH		7.9	8.2		8.2	8.4	8.2	8.1	8.2	8.2	8.3			8.4	8.2	8.3	8.4		8.1
pH - Field	pH		8.5	8.48	8.48	8.11	8.39	8.19	8.17	8.41	8.2		8.24		8.32	8.27			8.36	8.26
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm		319	325		277	339	262	297	300	310	280			310	310	320	350		314
Total Suspended Solids	mg/L		<4	5		<4	<4	<4	<4	<4	6	6			<4	<4	<4	<4		<4
Total Dissolved Solids	mg/L		208	218		172	206	186	190	190	190	150			230	160	190	210		160
Turbidity	NTU		0.2	2.2		0.1	0.4	0.3	0.2	0.9	0.5	0.5			0.2	0.7	0.9	0.6		0.1
Turbidity - field	NTU			370.00		280.00		280.00	300.00	300.00										
Flow	L/min	2.00					400.00	272.00	136.00	120.00	80.00			3000.00	2500.00					90.00
Hardness	mg/L		170	210		160	200	152	178	174	179	42.8			165	162	168	196		168
Alkalinity - CaCO3	mg/L		154	188		136	167	132	150	150	160	130			150	150	150	170		150
Alkalinity	mg/L		<0.5	<0.5		<0.5	2.5	<0.5	<0.5	<0.5	<0.5	<0.5			2.1	<0.5	<0.5	2.3		<0.5
Sulphate	mg/L		15.1	5.4		10.2	16.8	12.8	14.8	14.4	14	9.4			17	14	14	17		15
Hydroxide (OH)	mg/L		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5
Carbonate (CO3)	mg/L		<0.5	<0.5		<0.5	3	<0.5	<0.5	<0.5	<0.5	<0.5			2.5	<0.5	<0.5	2.7		<0.5
Bicarbonate (HCO3)	mg/L		188	229		166	197	161	183	180	200	160			180	190	190	210		190
Ammonia Nitrogen	mg/L		<0.005	0.019		0.006	<0.005	<0.005	<0.005	<0.005	0.005	<0.005			<0.005	0.007	<0.005	0.012		<0.005
Nitrate-Nitrite	mg/L		0.34	<0.02		0.2	0.17	0.17	0.2	0.31	0.29	0.16			0.28	0.37	0.28	0.02		0.17
Cyanide - Total	mg/L		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0348			<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Aluminum - Total	mg/L		<0.02	0.04		0.03	<0.02	0.03	<0.02	0.015	0.075	0.037			0.009	0.016	0.005	0.044		0.075
Antimony - Total	mg/L		<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Arsenic - Total	mg/L		<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	0.0004	0.0004	0.0004			0.0006	0.0003	0.0003	0.0005		0.0003
Barium - Total	mg/L		0.022	0.292		0.02	0.035	0.019	0.026	0.022	0.024	0.012			0.021	0.023	0.023	0.041		0.027
Beryllium - Total	mg/L		<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
Bismuth - Total	mg/L		<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001		<0.001
Boron - Total	mg/L		<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.005	<0.005	<0.05			<0.05	<0.05	<0.05	<0.05		<0.05
Cadmium - Total	mg/L		0.00037	0.00006		0.00023	0.00017	0.00025	0.00023	0.00027	0.000255	0.00004			0.000281	0.00026	0.000227	0.000259		0.000226
Chromium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.001			<0.001	<0.001	<0.001	<0.001		<0.001
Cobalt - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0.0005	0.0007	0.0005			0.0005	<0.0002	0.0007	0.0019		0.0015
Iron - Total	mg/L		0.017	0.036		0.03	0.019	0.017	0.011	0.021	0.097	0.049			<0.005	0.02	0.006	0.09		0.034
Lead - Total	mg/L		0.00061	0.00055		0.0011	0.00058	0.00108	0.00071	0.000591	0.00125	0.00033			0.000472	0.000547	0.000215	0.00367		0.000126
Lithium - Total	mg/L																			
Manganese - Total	mg/L		0.001	0.005		0.002	0.004	0.001	0.003	0.002	0.002	0.001			0.001	<0.001	<0.001	0.01		0.004
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001	0.002		<0.001
Nickel - Total	mg/L		<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001		<0.001
Phosphorus - Total	mg/L		<0.1	<0.1		<0.1	<0.1	<0.1	<0.1											
Selenium - Total	mg/L		<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	0.0007	0.0009	0.0005			0.0008	0.0008	0.0008	0.0011		0.0006
Silicon - Total	mg/L		3.14	3.05		2.76	3.21	2.7	3.08	2.91	3.2	3.15			3.3	3.58	3.56	2.61		3.23
Silver - Total	mg/L		<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.00002	<0.00002	<0.00002			<0.00002	<0.00002	<0.00002	<0.00002		<0.00002
Strontium - Total	mg/L		0.191	0.133		0.175	0.212	0.165	0.199	0.199	0.226	0.131			0.205	0.21	0.214	0.236		0.212
Tellurium - Total	mg/L																			
Thallium - Total	mg/L		<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	<0.00005	<0.00005	<0.00005			<0.00005	<0.00005	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L		<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005		<0.005
Titanium - Total	mg/L		<0.003	<0.003		<0.003	<0.003	<0.003	<0.003	<0.005	<0.005	0.006			0.011	<0.005	<0.005	<0.005		<0.005
Uranium - Total	mg/L		0.00107	0.00313		0.00065	0.00105	0.00065	0.00082	0.000915	0.00103	0.00028			0.000839	0.000995	0.000938	0.00135		0.00069
Vanadium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005		<0.005
Zinc - Total	mg/L		0.007	<0.005		0.007	0.009	0.01	0.008	0.008	0.008	0.007			0.01	0.008	0.007	0.041		0.014
Zirconium - Total	mg/L		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Calcium - Total	mg/L		62.5	59.3		58.7	72	56.5	65.5	64.3	65.8	13.4			60.9	59.4	61.9	66.5		61.8
Magnesium - Total	mg/L		3.19	14.7		2.65	4.19	2.62	3.38	3.37	3.56	2.28			3.21	3.26	3.36	7.18		3.39
Potassium - Total	mg/L		<1	<1		<1	<1	<1	<1	0.4	0.41	4.21			0.4	0.36	0.38	1.05		0.55
Sodium - Total	mg/L		0.87	0.67		0.71	0.97	0.7	0.93	0.9	0.95	1850			0.83	0.85	0.84	0.64		1.71
Sulphur - Total	mg/L		4.7	1.2		3.6	6	4.5	5.2	4	5	6			6	5	5	9		17

Water Quality (2006 to 2011)

MH-04 Camp Creek

Collect Date/Time		2009	2009	2010	2010	2010	2010	2011	2011	2011	2011	2011	2011
Collect Date/Time		09-Dec	25-Dec	21-Mar	28-May	26-Sep	20-Dec	13-Mar	16-Mar	22-Jun	23-Jun	08-Oct	23-Dec
pH - Lab	pH		8.1	8.3	8.1	8.22	7.67	8.08		8.06		8.28	8.18
pH - Field	pH		8.24	8.46	8.23	8.31	8.36		8.24	8.08		8.29	8.24
Conductivity - Field	uS/cm												
Conductivity - Lab	uS/cm		387	316	308	312	177	319		290		333	311
Total Suspended Solids	mg/L		<4	<4	4	<4	29	<4		<4		<4	<4.0
Total Dissolved Solids	mg/L		200	180	190	160	130	190		160		180	162
Turbidity	NTU		22.6	0.2	1.4	0.1	41.2	0.3		0.3		<0.1	0.55
Turbidity - field	NTU												
Flow	L/min	200.00		200.00	400.00	300.00	150.00		8.00		400.00	1500.00	250.00
Hardness	mg/L		174	172	174	170	72	162		163		177	152
Alkalinity - CaCO3	mg/L		210	150	150	150	79	160		140		160	149
Alkalinity	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.50
Sulphate	mg/L		8.4	13	14	16	6.1	13				15	14.3
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.50
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.50
Bicarbonate (HCO3)	mg/L		250	190	190	180	96	190		170		200	182
Ammonia Nitrogen	mg/L		0.012	<0.005	0.016	0.18	<0.005	0.031		0.012		0.074	0.0076
Nitrate-Nitrite	mg/L		0.13	0.26	0.34	0.16	0.1	0.27		0.24		0.14	0.219
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.001	0.0007	<0.0005		<0.0005		<0.0005	<0.00050
Aluminum - Total	mg/L		0.014	0.006	0.085	0.005	0.023	0.019		0.186		0.116	0.012
Antimony - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005
Arsenic - Total	mg/L		0.0004	0.0004	0.0004	0.0002	0.0001	<0.0004		0.0006		0.0005	<0.0004
Barium - Total	mg/L		0.023	0.025	0.025	0.022	0.012	0.025		0.03		0.036	0.021
Beryllium - Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002		<0.0002		<0.0002	<0.0002
Bismuth - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001
Boron - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.1		<0.1		<0.1	<0.1
Cadmium - Total	mg/L		0.000249	0.000226	0.00035	0.00029	0.000133	0.0003		0.0011		0.0003	0.0002
Chromium - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.002		<0.002		<0.002	<0.002
Cobalt - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005
Copper - Total	mg/L		0.0007	0.0011	0.0006	0.0004	0.0004	0.011		0.001		<0.001	<0.001
Iron - Total	mg/L		0.02	0.018	0.136	0.029	0.034	0.056		0.297		0.206	0.022
Lead - Total	mg/L		0.00107	0.00122	0.00297	0.000707	0.000493	0.0028		0.0212		0.0129	0.0006
Lithium - Total	mg/L							<0.01		<0.01		<0.01	<0.01
Manganese - Total	mg/L		0.002	<0.001	0.005	0.002	0.001	0.017		0.032		0.021	0.002
Mercury - Total	mg/L												
Molybdenum - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001
Nickel - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001
Phosphorus - Total	mg/L												
Selenium - Total	mg/L		0.0008	0.001	0.0007	0.0007	0.0003	<0.0008		<0.0008		<0.0008	<0.0008
Silicon - Total	mg/L		3.73	3.68	3.29	3.47	1.47	3.12		3.25		3.26	2.94
Silver - Total	mg/L		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0001		<0.0001		<0.0001	<0.0001
Strontium - Total	mg/L		0.206	0.22	0.222	0.208	0.098	0.217		0.215		0.239	0.201
Tellurium - Total	mg/L												
Thallium - Total	mg/L		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005		<0.00005	<0.00005
Tin - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005
Titanium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.01		<0.01		<0.01	<0.01
Uranium - Total	mg/L		0.000942	0.000936	0.000933	0.000845	0.000442	0.001		0.0008		0.0011	0.0008
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005
Zinc - Total	mg/L		0.009	0.009	0.009	0.008	<0.005	<0.01		0.032		0.022	<0.01
Zirconium - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.002		<0.002		<0.002	<0.002
Calcium - Total	mg/L		64.1	63.4	64.4	62.9	26.1	59		60		63	56
Magnesium - Total	mg/L		3.46	3.37	3.18	3.26	1.63	3		3		5	3
Potassium - Total	mg/L		0.39	0.37	0.5	0.47	0.2	<1		<1		<1	<1
Sodium - Total	mg/L		0.91	0.85	0.74	0.84	0.38	<1		<1		1	<1
Sulphur - Total	mg/L		6	<3	4	6	10	<60		<60		<60	<60

Water Quality (2006 to 2011)

MH-05 Portal Creek

Collect Date/Time		2006	2009
Collect Date/Time		14-Jun	15-Jun
pH - Lab	pH	8.2	8.1
pH - Field	pH	8.13	8.28
Conductivity - Field	uS/cm		
Conductivity - Lab	uS/cm	358	340
Total Suspended Solids	mg/L	<4	<4
Total Dissolved Solids	mg/L	222	210
Turbidity	NTU	<0.1	0.1
Turbidity - field	NTU	380.00	
Flow	L/min	91.00	40.00
Hardness	mg/L	200	174
Alkalinity - CaCO3	mg/L	128	130
Alkalinity	mg/L	<0.5	<0.5
Sulphate	mg/L	52.2	46
Hydroxide (OH)	mg/L	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	156	160
Ammonia Nitrogen	mg/L	0.005	<0.005
Nitrate-Nitrite	mg/L	2.7	1.62
Cyanide - Total	mg/L	<0.0005	<0.0005
Aluminum - Total	mg/L	<0.02	0.005
Antimony - Total	mg/L	<0.05	<0.0005
Arsenic - Total	mg/L	<0.05	0.0013
Barium - Total	mg/L	0.01	0.009
Beryllium - Total	mg/L	<0.0002	<0.0001
Bismuth - Total	mg/L	<0.05	<0.001
Boron - Total	mg/L	<0.008	<0.05
Cadmium - Total	mg/L	0.00026	0.00026
Chromium - Total	mg/L	<0.005	<0.001
Cobalt - Total	mg/L	<0.005	<0.0005
Copper - Total	mg/L	<0.005	0.0009
Iron - Total	mg/L	<0.005	0.007
Lead - Total	mg/L	0.00259	0.0025
Lithium - Total	mg/L		
Manganese - Total	mg/L	0.001	<0.001
Mercury - Total	mg/L		
Molybdenum - Total	mg/L	<0.005	<0.001
Nickel - Total	mg/L	<0.008	<0.001
Phosphorus - Total	mg/L	<0.1	
Selenium - Total	mg/L	<0.03	0.0025
Silicon - Total	mg/L	4.31	4.53
Silver - Total	mg/L	<0.01	<0.00002
Strontium - Total	mg/L	0.194	0.191
Tellurium - Total	mg/L		
Thallium - Total	mg/L	<0.03	<0.00005
Tin - Total	mg/L	<0.02	<0.005
Titanium - Total	mg/L	<0.003	<0.005
Uranium - Total	mg/L	0.00096	0.00091
Vanadium - Total	mg/L	<0.005	<0.005
Zinc - Total	mg/L	0.019	0.018
Zirconium - Total	mg/L	<0.005	<0.0005
Calcium - Total	mg/L	74	64.3
Magnesium - Total	mg/L	3.26	3.15
Potassium - Total	mg/L	<1	0.52
Sodium - Total	mg/L	0.83	0.86
Sulphur - Total	mg/L	15.9	19

Water Quality (2006 to 2011)

MH-06 Reclaim Pond Discharge

Collect Date/Time		2006	2006	2006	2007	2007	2007	2007	2007	2007	2007	2008	2008	2009	2009	2009	2010	2010	2010	2010
Collect Date/Time		21-Jun	28-Jun	05-Jul	21-May	29-May	06-Jun	13-Jun	19-Jun	19-Jun	12-Aug	24-Jun	27-Jun	13-Feb	07-Jun	15-Jun	14-Jun	20-Jun	12-Jul	18-Jul
pH - Lab	pH	8.4	8.4			8.2	8.2	8.1				8.4			8.3	8.3	8.4		8.36	8.35
pH - Field	pH								8.22	8.22				8.34		8.01	8.25	7.93	8.21	8.19
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm	329	331			280	280	280				330			290	290	313		328	326
Total Suspended Solids	mg/L	6	10			6	6	6				<4			<4	<4	<4		<4	<4
Total Dissolved Solids	mg/L	210	218			174	176	176				180			170	170	180		190	180
Turbidity	NTU	3.4	1.4			1.1	1.8	1.8				1.1			1.6	1	0.7		0.6	0.6
Turbidity - field	NTU								290											
Flow	L/min			3800.00	3700.00					3700.00	3700.00		3800.00		3700.00	3700.00			500.00	500.00
Hardness	mg/L	190	190			158	156	156				192			160	156	165		160	162
Alkalinity - CaCO3	mg/L	162	162			139	139	138				160			150	150	160		160	160
Alkalinity	mg/L	2.8	3			<0.5	<0.5	<0.5				1.4			<0.5	<0.5	2.5		3.3	2.9
Sulphate	mg/L	14.1	14			13.6	12.8	12.6				17			12	23	15		17	17
Hydroxide (OH)	mg/L	<0.5	<0.5			<0.5	<0.5	<0.5				<0.5			<0.5	<0.5	<0.5		<0.5	<0.5
Carbonate (CO3)	mg/L	3.3	3.6			<0.5	<0.5	<0.5				1.6			<0.5	<0.5	3		4	3.4
Bicarbonate (HCO3)	mg/L	190	190			170	170	169				190			180	180	180		190	190
Ammonia Nitrogen	mg/L	<0.005	<0.005			0.013	0.029	0.021				<0.005			<0.005	<0.005	0.06		0.019	0.028
Nitrate-Nitrite	mg/L	<0.02	<0.02			0.02	<0.02	<0.02				<0.02			<0.02	<0.02	<0.02		<0.02	<0.02
Cyanide - Total	mg/L	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005				<0.0005			<0.0005	<0.0005	<0.0005		0.0011	0.0009
Aluminum - Total	mg/L	0.1	0.04			0.1	0.08	0.08				0.028			0.017	0.013	0.011		0.009	0.01
Antimony - Total	mg/L	<0.05	<0.05			<0.05	<0.05	<0.05				<0.0005			<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Arsenic - Total	mg/L	<0.05	<0.05			<0.05	<0.05	<0.05				0.0006			0.0004	0.0004	0.0003		0.0005	0.0005
Barium - Total	mg/L	0.056	0.057			0.045	0.045	0.044				0.049			0.042	0.041	0.044		0.044	0.043
Beryllium - Total	mg/L	<0.0002	<0.0002			<0.0002	<0.0002	<0.0002				<0.0001			<0.0001	<0.0001	<0.0001		<0.0001	<0.0001
Bismuth - Total	mg/L	<0.05	<0.05			<0.05	<0.05	<0.05				<0.001			<0.001	<0.001	<0.001		<0.001	<0.001
Boron - Total	mg/L	<0.008	<0.008			<0.008	<0.008	<0.008				<0.05			<0.05	<0.05	<0.05		<0.05	<0.05
Cadmium - Total	mg/L	0.00005	0.00006			0.00006	0.00005	0.00005				0.000054			0.000053	0.000038	0.000022		0.000043	0.000037
Chromium - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005				<0.001			<0.001	<0.001	<0.001		0.001	<0.001
Cobalt - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005				<0.0005			<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Copper - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005				0.0015			0.0019	0.0012	0.0008		0.0009	0.0021
Iron - Total	mg/L	0.186	0.083			0.182	0.174	0.166				0.059			0.054	0.047	0.031		0.028	0.023
Lead - Total	mg/L	0.00246	0.0014			0.00354	0.00322	0.00304				0.00134			0.00111	0.000861	0.000535		0.000576	0.00053
Lithium - Total	mg/L																			
Manganese - Total	mg/L	0.022	0.017			0.053	0.052	0.051				0.02			0.029	0.027	0.014		0.01	0.009
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005				0.002			0.002	0.001	0.002		0.002	0.002
Nickel - Total	mg/L	<0.008	<0.008			<0.008	<0.008	<0.008				<0.001			<0.001	<0.001	<0.001		<0.001	0.001
Phosphorus - Total	mg/L	<0.1	<0.1			<0.1	<0.1	<0.1												
Selenium - Total	mg/L	<0.03	<0.03			<0.03	<0.03	<0.03				0.0008			0.0008	0.0008	0.0007		0.0005	0.0005
Silicon - Total	mg/L	2.45	2.42			2.21	2.21	2.18				2.67			2.54	2.52	2.42		2.14	2.2
Silver - Total	mg/L	<0.01	<0.01			<0.01	<0.01	<0.01				<0.00002			<0.00002	<0.00002	<0.00002		<0.00002	<0.00002
Strontium - Total	mg/L	0.237	0.243			0.193	0.192	0.19				0.252			0.211	0.205	0.234		0.236	0.229
Tellurium - Total	mg/L																			
Thallium - Total	mg/L	<0.03	<0.03			<0.03	<0.03	<0.03				<0.00005			<0.00005	<0.00005	<0.00005		<0.00005	<0.00005
Tin - Total	mg/L	<0.02	<0.02			<0.02	<0.02	<0.02				<0.005			<0.005	<0.005	<0.005		<0.005	<0.005
Titanium - Total	mg/L	<0.003	<0.003			<0.003	<0.003	<0.003				<0.005			<0.005	<0.005	<0.005		<0.005	<0.005
Uranium - Total	mg/L	0.00081	0.00088			0.00065	0.00068	0.00068				0.00102			0.000997	0.000992	0.000969			
Vanadium - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005				<0.005			<0.005	<0.005	<0.005		<0.005	<0.005
Zinc - Total	mg/L	0.006	<0.005			0.009	0.009	0.007				0.006			0.009	0.006	<0.005		0.027	0.013
Zirconium - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005				<0.0005			<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Calcium - Total	mg/L	63.9	65.1			54.7	54.2	54.2				65.2			53.6	52.6	55.3		52.4	53.9
Magnesium - Total	mg/L	6.46	6.56			5.12	5.08	5.03				7.19			6.25	6.09	6.48		7	6.65
Potassium - Total	mg/L	<1	<1			<1	<1	<1				0.94			0.83	0.79	0.83		0.78	0.75
Sodium - Total	mg/L	1.03	1.05			0.72	0.69	0.69				1.09			0.82	0.75	0.79		0.77	0.73
Sulphur - Total	mg/L	5.2	5.5			4.7	4.7	4.6				5			9	7	4		6	6

Water Quality (2006 to 2011)

MH-06 Reclaim Pond Discharge

Collect Date/Time		2010	2010	2010	2011	2011	2011	2011	2011	2011
Collect Date/Time		23-Aug	02-Sep	16-Sep	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep	08-Oct
pH - Lab	pH	8.16	8.36	8.33	8.32	8.16	8.2	8.17	8.2	8.22
pH - Field	pH					8.07	8.01	8.48	8.15	8.02
Conductivity - Field	uS/cm									
Conductivity - Lab	uS/cm	321	321	325	264	276	308	313	330	339
Total Suspended Solids	mg/L	<4	<4	<4	<4	<4	<4	<4	4	<4
Total Dissolved Solids	mg/L	170	160	170	140	150	200	210	210	190
Turbidity	NTU	0.7	0.5	1.8	1.5	0.9	0.6	0.8	0.9	1.2
Turbidity - field	NTU									
Flow	L/min					500.00	500.00	500.00	500.00	500.00
Hardness	mg/L	175	159	173	137	147	151	176	186	187
Alkalinity - CaCO3	mg/L	150	160	160	130	130	140	140	150	160
Alkalinity	mg/L	<0.5	2.1	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphate	mg/L	19	19	19	17		22	24	22	24
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	2.5	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	180	190	190	160	160	170	170	180	190
Ammonia Nitrogen	mg/L	0.11	<0.05	0.04	0.021	0.028	0.014	0.01	0.009	0.046
Nitrate-Nitrite	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cyanide - Total	mg/L	<0.001	<0.001	<0.001	0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L	<0.003	0.008	0.015	0.032	0.012	0.01	0.014	0.008	0.013
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.0005	0.0001	0.0002	0.0005	0.0004	0.0005	0.0006	0.0006	0.0005
Barium - Total	mg/L	0.046	0.046	0.048	0.041	0.044	0.04	0.047	0.047	0.046
Beryllium - Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.05	<0.05	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
Cadmium - Total	mg/L	0.000022	0.000038	0.000019	0.006	<0.0001	0.0032	0.00006	0.00006	0.00005
Chromium - Total	mg/L	<0.001	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001
Cobalt - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0009	0.001	0.0013	<0.001	<0.001	0.0014	0.0011	0.0009	0.001
Iron - Total	mg/L	0.042	0.026	0.045	0.09	0.046	0.055	0.038	0.036	0.087
Lead - Total	mg/L	0.000923	0.0011	0.00171	0.0094	0.0026	0.0056	0.0034	0.0014	0.0016
Lithium - Total	mg/L				<0.01	<0.01	<0.005	<0.005	<0.005	<0.005
Manganese - Total	mg/L	0.033	0.031	0.119	0.022	0.017	0.023	0.017	0.05	0.116
Mercury - Total	mg/L						<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum - Total	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Nickel - Total	mg/L	<0.001	0.017	0.017	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus - Total	mg/L									
Selenium - Total	mg/L	0.0006	0.0005	0.0006	0.0009	0.0008	0.001	0.0011	0.0007	0.0008
Silicon - Total	mg/L	2.5	2.28	2.58	2.04	2.16	2.1	2.31	2.24	2.48
Silver - Total	mg/L	<0.00002	<0.00002	<0.00002	<0.0001	<0.0001	<0.00002	<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L	0.253	0.242	0.249	0.202	0.207	0.202	0.238	0.239	0.248
Tellurium - Total	mg/L									
Thallium - Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.005	<0.005	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005
Uranium - Total	mg/L	0.000994	0.000974	0.00109	0.001	0.001	0.001	0.0013	0.0012	0.0012
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	<0.005	0.006	0.01	0.616	0.011	0.368	0.014	0.011	0.009
Zirconium - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.0005	<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	57.4	51.8	56.8	46	49	50.3	58.4	61	62.2
Magnesium - Total	mg/L	7.61	7.26	7.65	5	6	6.05	7.37	8.12	7.61
Potassium - Total	mg/L	0.83	0.89	0.94	<1	<1	0.76	0.81	0.79	0.8
Sodium - Total	mg/L	0.9	0.8	0.85	<1	<1	0.82	0.85	1.08	0.93
Sulphur - Total	mg/L	6	7	7	<60	<60	8	9	9	8

Water Quality (2006 to 2011)

MH-06B Reclaim Pond

Collect Date/Time		2006	2006	2006	2006	2006	2007	2007	2007	2008	2008	2008	2008	2009	2009	2009	2009	2009	2010	2010
Collect Date/Time		02-Jan	09-Apr	11-Apr	12-Jun	11-Sep	19-Jun	17-Sep	07-Dec	24-Mar	21-Jun	27-Jun	21-Oct	18-Jan	15-Jul	20-Jul	21-Sep	25-Dec	28-May	21-Jun
pH - Lab	pH	7.9	8.1		8.2	8.3	8.2	8.2	8.2	8	8.3		8.5	8.2	8.4		8.2	8.1	8.2	7.6
pH - Field	pH	8.29	8.46	8.46	8.08	8.28	8.2	8.17	8.16	8.01		8.17	8.04	8.11		7.98	8.14		8.01	
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm	382	424		239	349	271	335	360	1400	320		370	520	330		331	368	292	44
Total Suspended Solids	mg/L	<4	5		<4	<4	13	<4	<4	<4	<4		10	<4	<4		<4	<4	<4	<4
Total Dissolved Solids	mg/L	256	276		150	208	188	214	220	960	190		250	300	200		170	290	180	170
Turbidity	NTU	0.8	2.4		0.9	1.1	1.2	0.5	0.9	0.6	1.2		2.6	1.2	1		1.8	1.8	0.8	0.6
Turbidity - field	NTU		490		260		290	310	330											
Flow	L/min																			
Hardness	mg/L	210	260		130	200	156	201	207	1010	198		205	282	197		180	210	161	161
Alkalinity - CaCO3	mg/L	186	216		116	178	137	175	180	780	150		180	260	170		160	180	150	22
Alkalinity	mg/L	<0.5	<0.5		<0.5	0.9	<0.5	<0.5	<0.5	<0.5	<0.5		3.9	<0.5	1.9		<0.5	<0.5	<0.5	<0.5
Sulphate	mg/L	19.1	37		11.3	14.3	13.7	15.2	19.3	122	14		18	28	14		14	17	14	13
Hydroxide (OH)	mg/L	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5		<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5		4.6	<0.5	2.3		<0.5	<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	227	263		141	214	168	214	210	950	190		210	320	200		200	220	180	27
Ammonia Nitrogen	mg/L	0.028	0.01		0.056	0.01	0.037	0.021	0.029	<0.005	<0.005		<0.005	0.076	0.032		0.006	0.034	0.035	<0.5
Nitrate-Nitrite	mg/L	<0.02	0.07		<0.02	<0.02	<0.02	<0.02	<0.02	0.19	<0.02		<0.02	0.03	<0.02		<0.02	0.03	<0.02	<0.02
Cyanide - Total	mg/L	<0.0005	0.0006		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0015	<0.0005		<0.0005	0.0006	<0.0005		0.0006	0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L	<0.02	0.02		0.02	0.03	0.15	<0.02	0.01	0.007	0.123		0.051	0.007	0.034		0.033	0.01	0.012	0.013
Antimony - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.0005	0.001	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	0.0005	0.0035	0.0006		0.0009	0.0006	0.0005		0.0005	0.0006	0.0003	0.0004
Barium - Total	mg/L	0.056	0.064		0.035	0.056	0.045	0.054	0.049	0.18	0.048		0.048	0.071	0.049		0.048	0.053	0.041	0.046
Beryllium - Total	mg/L	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.005	0.016	<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05
Cadmium - Total	mg/L	0.00002	0.00006		0.00007	0.00003	0.00008	0.00003	0.00005	0.00004	0.000056		0.000032	0.00015	0.000054		0.000026	0.000088	0.000025	0.000023
Chromium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
Cobalt - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0.0015	0.0054	0.0013		0.0017	0.0038	0.0014		0.0012	0.005	0.0007	0.001
Iron - Total	mg/L	0.014	0.027		0.052	0.047	0.282	0.045	0.028	0.01	0.266		0.11	0.02	0.071		0.081	0.021	0.044	0.038
Lead - Total	mg/L	0.00016	0.00082		0.00103	0.00079	0.00339	0.0043	0.000433	0.000095	0.00359		0.00154	0.000655	0.00366		0.000341	0.00101	0.000787	0.000593
Lithium - Total	mg/L																			
Manganese - Total	mg/L	0.009	0.006		0.023	0.023	0.058	0.034	0.005	0.001	0.04		0.026	0.003	0.011		0.045	0.005	0.027	0.012
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0.002	0.018	0.002		0.002	0.003	0.002		0.002	0.002	0.001	0.002
Nickel - Total	mg/L	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.001	0.002	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
Phosphorus - Total	mg/L	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1												
Selenium - Total	mg/L	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	0.0006	0.0036	0.0007		0.0007	0.0009	0.0007		0.0006	0.0008	0.0006	0.0006
Silicon - Total	mg/L	2.9	3.54		1.95	2.63	2.29	2.63	2.63	19.6	2.78		2.68	3.91	2.82		2.45	3.13	2.33	2.26
Silver - Total	mg/L	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002		0.00002	<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L	0.257	0.337		0.159	0.24	0.187	0.253	0.256	1.49	0.242		0.262	0.387	0.251		0.252	0.274	0.228	0.23
Tellurium - Total	mg/L																			
Thallium - Total	mg/L	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.003	<0.003		<0.003	<0.003	<0.003	<0.003	<0.005	<0.005	0.006		0.014	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Uranium - Total	mg/L	0.00118	0.00138		0.00069	0.00098	0.00073	0.00097	0.00113	0.00689	0.00102		0.00121	0.00189	0.00115		0.000985	0.00129	0.000991	0.001
Vanadium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	<0.005	0.02		0.013	<0.005	0.009	0.006	0.01	<0.005	0.008		0.01	0.02	0.007		0.006	0.023	0.007	<0.005
Zirconium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	70.7	84.4		46.8	70.3	54.2	68.5	69.6	307	67.2		68.2	93.7	66.7		60.3	69.1	54.5	53.9
Magnesium - Total	mg/L	7.46	13.1		4.3	6.71	5.02	7.35	8.18	58.5	7.21		8.43	11.7	7.38		7.22	9.07	5.99	6.39
Potassium - Total	mg/L	<1	2		<1	<1	<1	<1	0.95	8.35	0.98		0.93	1.33	0.91		0.85	1.01	0.83	0.77
Sodium - Total	mg/L	1.23	2.14		0.66	1.17	0.72	1.03	1.05	8.22	1.01		1.02	1.45	0.91		0.82	1.11	0.73	0.73
Sulphur - Total	mg/L	6.2	10.5		4	5.3	4.6	5.6	6	49	6		8	10	5		16	6	5	5

Water Quality (2006 to 2011)

MH-06B Reclaim Pond

Collect Date/Time		2010	2011	2011	2011
Collect Date/Time		26-Sep	23-Jun	08-Oct	23-Dec
pH - Lab	pH	8.15	8.15	8.13	7.98
pH - Field	pH	8.29	8.07	8.07	8.08
Conductivity - Field	uS/cm				
Conductivity - Lab	uS/cm	324	273	339	369
Total Suspended Solids	mg/L	10	<4	<4	<4.0
Total Dissolved Solids	mg/L	180	140	160	194
Turbidity	NTU	4	1.5	0.7	1.11
Turbidity - field	NTU				
Flow	L/min				
Hardness	mg/L	152	151	175	188
Alkalinity - CaCO3	mg/L	150	130	160	168
Alkalinity	mg/L	<0.5	<0.5	<0.5	<0.50
Sulphate	mg/L	18		24	26.9
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.50
Bicarbonate (HCO3)	mg/L	190	150	190	205
Ammonia Nitrogen	mg/L	<0.005	0.016	0.064	0.0187
Nitrate-Nitrite	mg/L	<0.02	<0.02	<0.02	0.06
Cyanide - Total	mg/L	<0.001	<0.0005	<0.0005	0.00073
Aluminum - Total	mg/L	0.068	0.022	0.013	<0.01
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.0008	0.0005	0.0006	0.0005
Barium - Total	mg/L	0.051	0.04	0.046	0.047
Beryllium - Total	mg/L	<0.0001	<0.0002	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.1	<0.1	<0.1
Cadmium - Total	mg/L	0.000068	<0.0001	<0.0001	<0.0001
Chromium - Total	mg/L	<0.001	<0.002	<0.002	<0.002
Cobalt - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0013	0.001	0.001	0.001
Iron - Total	mg/L	0.158	0.057	0.073	0.029
Lead - Total	mg/L	0.00368	0.0036	0.0028	0.0004
Lithium - Total	mg/L		<0.01	<0.01	<0.01
Manganese - Total	mg/L	0.168	0.019	0.105	0.029
Mercury - Total	mg/L				
Molybdenum - Total	mg/L	0.002	0.002	0.002	0.002
Nickel - Total	mg/L	<0.001	<0.001	<0.001	0.001
Phosphorus - Total	mg/L				
Selenium - Total	mg/L	0.0005	0.0009	<0.0008	<0.0008
Silicon - Total	mg/L	2.2	2.37	2.42	2.75
Silver - Total	mg/L	<0.00002	<0.0001	<0.0001	<0.0001
Strontium - Total	mg/L	0.266	0.189	0.254	0.254
Tellurium - Total	mg/L				
Thallium - Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.01	<0.01	<0.01
Uranium - Total	mg/L	0.00107	0.001	0.0013	0.0012
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.007	0.016	<0.01	0.012
Zirconium - Total	mg/L	<0.0005	<0.002	<0.002	<0.002
Calcium - Total	mg/L	47.8	51	58	63
Magnesium - Total	mg/L	7.94	6	8	7
Potassium - Total	mg/L	0.91	<1	<1	<1
Sodium - Total	mg/L	1.11	<1	1	<1
Sulphur - Total	mg/L	7	<60	<60	<60

Water Quality (2006 to 2011)

MH-07 Reclaim Dam Seepage

Collect Date/Time		2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2007
Collect Date/Time		10-Jan	05-Feb	10-Mar	19-May	21-May	13-Jun	05-Jul	14-Aug	15-Sep	15-Oct	01-Nov	16-Dec	17-Jan	18-Jan	19-Jan	19-Feb	21-Mar	26-Mar
pH - Lab	pH	8	8.3	8.2	8.5		8.4	8.4	8.3	8.4	8.3	8.3	8.2		8.2		8.2		8.2
pH - Field	pH	8.09	8.17	7.74	8.17	8.17	8.34	8.28	8.09	8.14	7.88	7.82	7.69	7.87	7.87		7.91		7.88
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm	453	441	455	463		465	458	453	459	462	467	445		423		433		436
Total Suspended Solids	mg/L	<4	<4	31	7		17	<4	<4	<4	<4	<4	<4		17		5		6
Total Dissolved Solids	mg/L	296	252	260	268		276	274	252	270	268	278	250		262		248		244
Turbidity	NTU	1	1	12.4	2		0.9	0.2	0.1	0.2	0.3	0.3	0.6		34		0.7		1.6
Turbidity - field	NTU	490	480	490		470	490	470	460	460	470	500	470	430			420		440
Flow	L/min	27.00	29	32.00	45.00		91.00	23.00	20.00	60.00	25.00	25.00	25.00	28.00		28.00		30.00	
Hardness	mg/L	250	250	250	290		280	270	260	270	280	260	250		253		233		235
Alkalinity - CaCO3	mg/L	234	232	235	256		254	241	259	246	251	252	221		221		222		223
Alkalinity	mg/L	<0.5	<0.5	<0.5	8.2		5	5.6	2.5	3.9	1.9	1.7	<0.5		<0.5		<0.5		<0.5
Sulphate	mg/L	15.2	17.1	15	10.1		11.3	12.2	<0.5	13.9	12.9	12.9	12.4		13.9		14		13.5
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5		<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	9.9		6	6.7	3	4.7	2.3	2.1	<0.5		<0.5		<0.5		<0.5
Bicarbonate (HCO3)	mg/L	286	283	286	292		298	280	310	290	302	304	269		269		271		272
Ammonia Nitrogen	mg/L	<0.005	0.015	<0.005	<0.005		0.008	<0.005	0.035	0.006	<0.005	0.008	<0.005		<0.005		<0.005		<0.005
Nitrate-Nitrite	mg/L	0.17	0.12	0.13	0.35		0.33	0.16	0.12	0.12	0.15	0.13	0.18		0.2		0.19		0.19
Cyanide - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005		0.0005
Aluminum - Total	mg/L	0.04	<0.02	0.3	0.05		0.07	<0.02	<0.02	0.04	0.011	0.02	<0.02		1.28		0.02		0.07
Antimony - Total	mg/L	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05		<0.05		<0.05		<0.05
Arsenic - Total	mg/L	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05		<0.05		<0.05		<0.05
Barium - Total	mg/L	0.074	0.078	0.092	0.068		0.067	0.088	0.088	0.084	0.085	0.082	0.116		0.157		0.106		0.113
Beryllium - Total	mg/L	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002		<0.0002		<0.0002
Bismuth - Total	mg/L	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05		<0.05		<0.05
Boron - Total	mg/L	<0.008	<0.008	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008		0.009		<0.008		<0.008
Cadmium - Total	mg/L	0.00054	0.00055	0.00094	0.00056		0.00058	0.0005	0.00055	0.00061	0.00054	0.00057	0.0008		0.00489		0.00075		0.00102
Chromium - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005		<0.005		<0.005		<0.005
Cobalt - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.005	<0.005		<0.005		<0.005		<0.005
Copper - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	0.0003	<0.005	<0.005		<0.005		<0.005		<0.005
Iron - Total	mg/L	0.075	0.037	1.2	0.12		0.169	<0.005	0.006	0.082	0.013	0.013	0.009		1.97		0.028		0.102
Lead - Total	mg/L	0.0103	0.0051	0.0256	0.0294		0.0287	0.00245	0.00145	0.00795	0.00181	0.00197	0.00303		0.62		0.0218		0.0385
Lithium - Total	mg/L										0.003								
Manganese - Total	mg/L	0.076	0.061	0.225	0.119		0.119	0.017	0.034	0.067	0.05	0.073	0.134		1.9		0.109		0.171
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005
Nickel - Total	mg/L	<0.008	<0.008	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008		<0.008		<0.008		<0.008
Phosphorus - Total	mg/L	<0.1	<0.1	0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1
Selenium - Total	mg/L	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	<0.001	<0.03	<0.03		<0.03		<0.03		<0.03
Silicon - Total	mg/L	3.77	3.75	4.32	3.08		3.14	3.27	3.94	3.83	4.06	3.82	4.31		6.65		4.36		4.43
Silver - Total	mg/L	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.0001	<0.01	<0.01		<0.01		<0.01		<0.01
Strontium - Total	mg/L	0.291	0.293	0.299	0.314		0.314	0.319	0.3	0.306	0.314	0.297	0.296		0.307		0.279		0.289
Tellurium - Total	mg/L																		
Thallium - Total	mg/L	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03	<0.0001	<0.03	<0.03		<0.03		<0.03		<0.03
Tin - Total	mg/L	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02		<0.02		<0.02
Titanium - Total	mg/L	<0.003	<0.003	<0.003	<0.003		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003		0.037		<0.003		<0.003
Uranium - Total	mg/L	0.00101	0.00091	0.00095	0.00086		0.00084	0.00087	0.00088	0.00097	0.00087	0.00092	0.00102		0.00109		0.00104		0.00112
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		0.009		<0.005		<0.005
Zinc - Total	mg/L	0.16	0.155	0.196	0.123		0.124	0.138	0.157	0.159	0.163	0.158	0.206		1.34		0.206		0.243
Zirconium - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005
Calcium - Total	mg/L	81.3	81.9	82.7	82.5		81.1	83.9	85.2	86.9	91.6	84.6	84.8		86.2		80.4		80.9
Magnesium - Total	mg/L	11.7	11	11.8	19.8		19.6	13.6	12.2	12.1	12.3	11.6	8.11		9.03		7.79		8.05
Potassium - Total	mg/L	<1	1	<1	<1		<1	<1	1	1	1	<1	1		2		<1		1
Sodium - Total	mg/L	1.93	1.88	1.96	1.25		1.16	1.78	1.91	1.78	1.83	1.67	2.01		1.93		1.85		1.9
Sulphur - Total	mg/L	4.6	5	4.7	3.7		3.7	4.8	4.5	4.9	4.5	4.2	4.7		4.7		4.5		4.6

MH-07 Reclaim Dam Seepage

Collect Date/Time		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008
Collect Date/Time		27-Apr	21-May	19-Jun	19-Jun	19-Jul	12-Aug	15-Sep	18-Sep	21-Oct	14-Nov	15-Nov	03-Dec	04-Jan	11-Feb	03-Mar	03-Mar	02-Apr	24-Jun
pH - Lab	pH	8.2	8.3		8.3	8.3	8.2	8.2		8.2	8.2		8.2	8.3	8.3		8.3	8.4	8.4
pH - Field	pH	8.05	8.00	8.24	8.24	7.94	8.06	7.93		8.05		7.91	8.23	8.21	7.96	8.00		7.99	
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm	415	479		482	486	478	450		420	410		400	400	400		400	400	500
Total Suspended Solids	mg/L	<4	<4		<4	<4	<4	<4		<4	<4		5	<4	<4		<4	61	<4
Total Dissolved Solids	mg/L	252	276		278	276	280	274		260	260		250	290	240		240	250	290
Turbidity	NTU	0.5	0.7		0.4	0.3	0.3	0.3		0.3	0.5		1.2	0.6	1.1		0.6	0.4	0.3
Turbidity - field	NTU	430	430	460		430	450	420		410		400	370						
Flow	L/min		45.00		45.00	40.00	35.00		60.00	35.00		50.00	60.00	60.00	65.00	65.00		70.00	
Hardness	mg/L	234	271		280	291	271	270		234	231		255	237	226		237	245	329
Alkalinity - CaCO3	mg/L	214	268		263	264	260	251		220	210		210	200	200		210	210	270
Alkalinity	mg/L	<0.5	<0.5		<0.5	3.50	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	3.6	6.4
Sulphate	mg/L	13.8	7.9		11	11.1	15.7	11.5		22.2	16.3		17	18.7	18.8		17.1	19	8.9
Hydroxide (OH)	mg/L	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5		<0.5	4.20	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	4.4	7.7
Bicarbonate (HCO3)	mg/L	261	327		320	313	317	306		270	260		250	240	240		250	250	320
Ammonia Nitrogen	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		0.026	0.011		<0.005	<0.005	0.007		<0.005	0.034	<0.005
Nitrate-Nitrite	mg/L	0.12	0.55		0.27	0.27	0.23	0.14		0.13	0.14		0.13	0.13	0.15		0.13	0.14	0.38
Cyanide - Total	mg/L	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	0.0007	<0.0005		<0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L	<0.02	0.03		0.04	0.03	<0.02	<0.02		0.008	0.011		0.019	<0.001	0.026		0.026	0.013	0.009
Antimony - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		0.0003	0.0003		0.0003	<0.0001	0.0003		0.0003	0.0004	0.0002
Barium - Total	mg/L	0.075	0.054		0.068	0.072	0.072	0.08		0.08	0.087		0.086	<0.001	0.079		0.074	0.069	0.06
Beryllium - Total	mg/L	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002		<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008		0.029	<0.005		0.017	<0.005	<0.005		<0.005	<0.005	<0.05
Cadmium - Total	mg/L	0.00059	0.00035		0.00048	0.00061	0.00045	0.00052		0.0005	0.000514		0.000499	0.000534	0.000529		0.000534	0.000474	0.000334
Chromium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Cobalt - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		0.0002	0.0005		0.0007	<0.0002	0.0005		0.0007	0.0005	0.0004
Iron - Total	mg/L	0.01	0.042		0.053	0.02	0.01	0.025		0.016	0.049		0.037	<0.005	0.056		0.057	0.017	0.015
Lead - Total	mg/L	0.00343	0.00527		0.00672	0.00547	0.00242	0.00326		0.00194	0.00273		0.00297	0.00248	0.00471		0.0039	0.00157	0.00319
Lithium - Total	mg/L																		
Manganese - Total	mg/L	0.064	0.066		0.063	0.098	0.089	0.071		0.185	0.244		0.275	<0.001	0.228		0.185	0.146	0.055
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		0.001	0.001		0.002	<0.001	0.002		0.001	0.001	<0.001
Nickel - Total	mg/L	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008		<0.001	<0.001		0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Phosphorus - Total	mg/L	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1											
Selenium - Total	mg/L	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03		0.0003	0.0003		0.0003	<0.0001	0.0003		0.0003	0.0003	0.0003
Silicon - Total	mg/L	3.47	2.68		3.04	3.22	3.22	3.62		3.32	3.53		3.47	<0.1	3.57		3.49	3.42	3.3
Silver - Total	mg/L	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01		<0.00002	<0.00002		<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L	0.272	0.307		0.31	0.337	0.318	0.31		0.283	0.282		0.301	<0.001	0.264		0.278	0.289	0.382
Tellurium - Total	mg/L																		
Thallium - Total	mg/L	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03		<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.003	<0.003		<0.003	<0.003	<0.003	<0.003		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	0.008	<0.005
Uranium - Total	mg/L	0.00081	0.00072		0.00085	0.00084	0.00093	0.00096		0.000877	0.000983		0.000907	0.000946	0.000928		0.000939	0.00085	0.00089
Vanadium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.159	0.071		0.114	0.132	0.115	0.147		0.116	0.116		0.119	<0.005	0.097		0.086	0.09	0.055
Zirconium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	77.5	74.1		81.7	83.2	79.3	84.3		74.5	74.8		83.4	78	74.2		77.4	81.9	89.6
Magnesium - Total	mg/L	9.95	21		18.5	20.1	17.8	14.4		11.7	10.8		11.3	10.2	9.91		10.6	9.91	25.6
Potassium - Total	mg/L	<1	1		<1	1	<1	<1		0.9	0.92		1.16	1.03	0.99		1.03	0.99	0.74
Sodium - Total	mg/L	1.57	0.91		1.32	1.28	1.25	1.7		1.46	1.49		1.87	1.53	1.41		1.65	1.52	1.29
Sulphur - Total	mg/L	4.8	2.7		3.9	4	3.8	4.2		4	6		6	6	6		6	6	3

MH-07 Reclaim Dam Seepage

Collect Date/Time		2008	2008	2008	2008	2008	2008	2008	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009
Collect Date/Time		27-Jun	19-Jul	23-Jul	15-Aug	18-Aug	03-Sep	23-Oct	14-Nov	01-Dec	18-Jan	13-Feb	18-Mar	13-Apr	18-May	15-Jun	20-Jul	16-Aug	19-Aug
pH - Lab	pH		8.2		8.3		8.2	8.5	8.3	8.2	8.2	8.2	8.2	8.3	8.4	8.4	8.3		8.4
pH - Field	pH	8.19		8.08		8.12	8.20	8.00	8.01	8.28	8.26		7.78	7.91	8.25	7.99	8.08	8.11	
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		450		460		1000	470	460	440	350	440	450	450	470	500	480		463
Total Suspended Solids	mg/L		<4		<4		<4	<4	<4	11	7	<4	21	<4	<4	<4	<4		<4
Total Dissolved Solids	mg/L		250		250		480	320	290	280	220	280	300	270	290	280	260		270
Turbidity	NTU		0.2		0.3		0.4	0.3	0.1	3.9	1.3	3.5	4.7	0.6	5	0.2	0.2		0.2
Turbidity - field	NTU																		
Flow	L/min	80.00	80.00			70.00	60.00		60.00	60.00				60.00	90.00	60.00	60.00	50.00	
Hardness	mg/L		260		267		299	269	281	268	192	260	265	256	256	294	280		269
Alkalinity - CaCO3	mg/L		230		250		310	260	250	230	180	240	240	240	260	280	260		250
Alkalinity	mg/L		<0.5		<0.5		<0.5	8.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.5	5.9	2		5.7
Sulphate	mg/L		13		14		13	13	13	13	19	17	14	15	12	9.4	11		12
Hydroxide (OH)	mg/L		<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5
Carbonate (CO3)	mg/L		<0.5		<0.5		<0.5	11	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.2	7	2.4		6.9
Bicarbonate (HCO3)	mg/L		280		310		380	290	310	280	220	290	290	290	300	330	320		300
Ammonia Nitrogen	mg/L		<0.005		<0.005		<0.005	<0.005	0.01	<0.005	<0.005	0.078	<0.005	0.033	<0.005	0.011	0.007		0.007
Nitrate-Nitrite	mg/L		0.17		0.15		0.12	0.1	0.09	0.13	0.36	0.1	0.09	0.07	0.48	0.32	0.14		0.09
Cyanide - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	0.0006		<0.0005
Aluminum - Total	mg/L		0.006		0.008		0.012	0.008	0.007	0.176	0.036	0.027	0.203	0.058	0.085	0.006	0.006		0.022
Antimony - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Arsenic - Total	mg/L		0.0002		0.0003		0.0003	0.0005	0.0004	0.0006	0.0004	0.0003	0.0006	0.0003	0.0003	0.0002	0.0003		0.0003
Barium - Total	mg/L		0.069		0.079		0.085	0.075	0.068	0.076	0.042	0.076	0.086	0.074	0.06	0.062	0.08		0.083
Beryllium - Total	mg/L		<0.0001		<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
Bismuth - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Boron - Total	mg/L		<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05
Cadmium - Total	mg/L		0.000519		0.000536		0.000582	0.000475	0.000394	0.00124	0.00023	0.000437	0.00128	0.000386	0.000588	0.000448	0.000487		0.000567
Chromium - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Cobalt - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L		0.0003		0.0004		0.0003	0.0006	0.0006	0.0008	0.0017	0.0005	0.001	0.0024	0.0051	0.0004	0.0003		0.0013
Iron - Total	mg/L		0.01		0.022		0.029	0.019	0.055	0.38	0.081	0.057	0.452	0.156	0.157	0.013	0.014		0.023
Lead - Total	mg/L		0.00282		0.00195		0.00297	0.00207	0.00181	0.0306	0.0016	0.00917	0.0313	0.00231	0.00484	0.00308	0.00145		0.00169
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.197		0.132		0.19	0.077	0.084	0.42	0.004	0.064	0.307	0.098	0.078	0.052	0.069		0.094
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		0.001		0.001		0.001	0.001	0.001	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	0.001		0.001
Nickel - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Phosphorus - Total	mg/L																		
Selenium - Total	mg/L		0.0004		0.0003		0.0002	0.0002	0.0002	0.0003	0.0008	<0.0001	0.0001	<0.0001	0.0003	0.0002	0.0003		0.0002
Silicon - Total	mg/L		3.1		3.78		3.77	4.05	3.84	3.45	3.89	3.99	3.44	3.91	3.08	3.29	3.66		3.28
Silver - Total	mg/L		<0.00002		<0.00002		<0.00002	<0.00002	0.00004	0.00004	<0.00002	<0.00002	0.00003	<0.00002	<0.00002	<0.00002	<0.00002		<0.00002
Strontium - Total	mg/L		0.313		0.321		0.356	0.337	0.352	0.343	0.247	0.32	0.339	0.311	0.331	0.342	0.341		0.333
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.00005		<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Titanium - Total	mg/L		<0.005		<0.005		<0.005	0.008	0.005	0.009	<0.005	<0.005	0.005	0.005	<0.005	<0.005	<0.005		<0.005
Uranium - Total	mg/L		0.000845		0.000978		0.000979	0.000996	0.00104	0.000995	0.00141	0.00106	0.000938	0.000848	0.000925	0.000934	0.001		0.00103
Vanadium - Total	mg/L		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Zinc - Total	mg/L		0.087		0.109		0.107	0.156	0.108	0.179	0.016	0.139	0.253	0.171	0.132	0.09	0.131		0.157
Zirconium - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Calcium - Total	mg/L		78.1		83.6		97.1	84.4	90	85.8	68.5	82.6	83.4	81.3	74.5	81.9	84.6		83.8
Magnesium - Total	mg/L		15.7		14.2		13.7	14.1	13.7	13.1	4.98	13.1	13.7	12.9	17	21.8	16.7		14.4
Potassium - Total	mg/L		0.84		1.05		1.11	0.95	0.97	0.99	0.49	0.95	0.99	0.94	0.7	0.72	0.82		0.92
Sodium - Total	mg/L		1.29		1.7		1.62	1.51	1.61	1.64	1.08	1.54	1.61	1.59	1.16	1.17	1.43		1.51
Sulphur - Total	mg/L		4		5		5	5	5	5	5	6	5	8	6	8	5		<3

MH-07 Reclaim Dam Seepage

Collect Date/Time		2009	2009	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Collect Date/Time		24-Sep	24-Sep	23-Oct	15-Nov	09-Dec	13-Jan	16-Feb	07-Mar	11-Apr	04-May	14-Jun	20-Jul	15-Aug	16-Aug	21-Sep	23-Oct	14-Nov	11-Dec
pH - Lab	pH		8.3	8.2	8.4	8.3	8.2	8.2	8.1	8.1	8.3	8.5	8.35	8.28		8.51	8.36	8.02	8.21
pH - Field	pH	8.23		8.02	8.11	8.07	8.13	8.43	8.34	8.43	8.01	8.31	7.97		8.58	8.10	8.01	8.03	7.98
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		438	419	407	350	351	407	407	418	398	418	451	454		467	470	486	472
Total Suspended Solids	mg/L		<4	<4	<4	<4	9	<4	<4	<4	8	<4	<4	<4		<4	<4	<4	22
Total Dissolved Solids	mg/L		250	240	170	190	860	220	230	220	220	240	240	260		260	260	250	260
Turbidity	NTU		0.8	1.1	0.4	1.1	1.1	1.2	0.8	0.3	5.1	0.2	0.2	0.3		0.3	1.1	0.9	11
Turbidity - field	NTU																		
Flow	L/min	50.00		50.00	45.00	40.00	40.00	40.00	40.00	45.00	50.00		50.00		45.00	30.00	25.00	20.00	15.00
Hardness	mg/L		257	245	228	202	193	225	224	244	218	249	229	265		265	250	279	285
Alkalinity - CaCO3	mg/L		240	220	220	170	170	210	210	210	210	230	250	240		250	240	250	250
Alkalinity	mg/L		0.8	<0.5	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	7	4.4	<0.5		8.7	2.3	<0.5	<0.5
Sulphate	mg/L		13	14	13	13	14	17	16	17	12	13	12	12		13	18	16	16
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L		1	<0.5	2.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.4	5.3	<0.5		10	2.8	<0.5	<0.5
Bicarbonate (HCO3)	mg/L		290	270	260	210	210	250	250	260	260	260	290	300		290	290	310	310
Ammonia Nitrogen	mg/L		<0.005	0.009	0.016	<0.005	0.013	0.024	<0.005	<0.005	0.037	0.08	0.023	0.025		0.011	0.075	0.063	0.035
Nitrate-Nitrite	mg/L		0.12	0.1	0.09	0.24	0.24	0.12	0.11	0.1	0.27	0.17	0.1	0.06		0.04	0.05	0.03	0.04
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005	0.0008	0.0005	0.0446	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	<0.001		<0.001	<0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L		0.005	0.011	0.006	0.007	0.015	0.017	0.01	0.006	0.104	0.006	0.009	0.012		0.012	0.008	0.367	1.58
Antimony - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	0.0006
Arsenic - Total	mg/L		0.0003	0.0003	0.0002	0.0004	0.0004	0.0002	0.0003	0.0001	0.0003	0.0002	0.0002	0.0002		<0.0001	0.0002	0.0002	0.0042
Barium - Total	mg/L		0.078	0.076	0.078	0.039	0.041	0.072	0.069	0.07	0.06	0.07	0.068	0.079		0.075	0.07	0.087	0.136
Beryllium - Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.077		<0.05	<0.05	<0.05	<0.05
Cadmium - Total	mg/L		0.000671	0.000534	0.000462	0.000163	0.000169	0.000454	0.000514	0.000528	0.00258	0.000508	0.000464	0.000556		0.00067	0.000858	0.000941	0.00405
Chromium - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	0.002
Cobalt - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	0.0022
Copper - Total	mg/L		0.0005	0.0005	0.0004	0.0006	0.0016	0.0005	0.0004	<0.0002	0.001	0.0003	0.0003	0.0003		0.0009	0.0005	0.0013	0.0103
Iron - Total	mg/L		0.022	0.031	0.016	0.013	0.03	0.031	0.009	0.027	0.201	0.017	0.02	0.05		0.02	0.027	0.033	3.57
Lead - Total	mg/L		0.00188	0.00175	0.00176	0.000432	0.000955	0.00301	0.00223	0.00194	0.0631	0.00214	0.00187	0.00203		0.00199	0.00255	0.00246	0.153
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.133	0.174	0.181	0.002	0.003	0.079	0.068	0.065	0.608	0.11	0.078	0.063		0.053	0.097	0.119	1.22
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		0.001	0.001	0.001	<0.001	<0.001	0.001	0.001	0.001	<0.001	0.001	0.001	0.001		<0.001	<0.001	<0.001	<0.001
Nickel - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.001	<0.001		0.017	0.001	<0.001	0.007
Phosphorus - Total	mg/L																		
Selenium - Total	mg/L		0.0002	0.0003	0.0003	0.0008	0.0009	0.0003	0.0003	0.0002	0.0003	0.0003	0.0001	0.0001		<0.0001	0.0001	<0.0001	0.0002
Silicon - Total	mg/L		3.86	3.8	3.4	3.81	4.02	3.62	3.61	3.67	2.89	3.65	3.19	4.03		3.89	3.55	4.02	5.69
Silver - Total	mg/L		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002	0.00019
Strontium - Total	mg/L		0.318	0.311	0.282	0.237	0.238	0.29	0.276	0.296	0.275	0.321	0.305	0.352		0.344	0.339	0.358	0.363
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	0.00014
Tin - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	0.054
Uranium - Total	mg/L		0.000939	0.000871	0.000974	0.00126	0.00116	0.000943	0.000958	0.000986	0.000868	0.000846		0.00105		0.000932	0.000935	0.000917	0.000923
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	0.005
Zinc - Total	mg/L		0.17	0.139	0.122	0.013	0.011	0.119	0.114	0.151	0.424	0.122	0.126	0.139		0.212	0.3	0.48	1
Zirconium - Total	mg/L		<0.0005	<0.0005	0.0014	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L		81.1	77.6	72.3	72.8	69.3	72.7	72.7	78.1	65.9	75.2	70.1			83.1	79.3	87.4	90.6
Magnesium - Total	mg/L		13.3	12.5	11.6	4.84	4.97	10.6	10.3	11.9	13	14.8	13			14.1	12.5	14.7	14.3
Potassium - Total	mg/L		0.96	0.92	0.87	0.49	0.51	0.87	0.87	0.9	0.65	0.91	0.83			1.05	0.74	0.85	1.16
Sodium - Total	mg/L		1.4	1.28	1.26	0.99	1.01	1.26	1.21	1.39	0.95	1.26	1.23			1.6	1.44	1.96	2.02
Sulphur - Total	mg/L		6	8	8	7	5	3	6	6	<3	6	5			6	6	6	5

Water Quality (2006 to 2011)

MH-07 Reclaim Dam Seepage

Collect Date/Time		2011	2011	2011	2011	2011	2011	2011	2011	2011
Collect Date/Time		23-May	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep	08-Oct	15-Nov	05-Dec
pH - Lab	pH	8.39	8.46		8.3	8.12	8.34	8.36	8.3	8.19
pH - Field	pH	8.07		7.87	7.98	8.45	8.32	8.05	8.05	8.12
Conductivity - Field	uS/cm									
Conductivity - Lab	uS/cm	433	462		467	463	471	473	483	420
Total Suspended Solids	mg/L	<4	<4		<4	<4	<4	<4	<4.0	36.8
Total Dissolved Solids	mg/L	220	270		280	280	280	240	274	224
Turbidity	NTU	0.7	0.2		0.1	0.1	0.1	0.4	0.48	29.1
Turbidity - field	NTU									
Flow	L/min	40.00		90.00	90.00	80.00	80.00	80.00	80.00	80.00
Hardness	mg/L	239	240		250	253	271	244	245	209
Alkalinity - CaCO3	mg/L	230	260		220	240	260	250	256	217
Alkalinity	mg/L	3.3	3.5		<0.5	<0.5	3.9	3.8	<0.50	<0.50
Sulphate	mg/L	9	13		14	15	14	15	14.2	12.2
Hydroxide (OH)	mg/L	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Carbonate (CO3)	mg/L	4	4.2		<0.5	<0.5	4.6	4.5	<0.50	<0.50
Bicarbonate (HCO3)	mg/L	270	310		270	290	310	290	313	264
Ammonia Nitrogen	mg/L	0.009	0.016		0.028	0.009	0.013	0.029	0.0075	0.006
Nitrate-Nitrite	mg/L	0.55	0.27		0.21	0.15	0.15	0.12	0.12	0.094
Cyanide - Total	mg/L	0.0008	0.0012		<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050
Aluminum - Total	mg/L	0.02	<0.01		0.009	0.005	<0.003	0.006	0.017	0.535
Antimony - Total	mg/L	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	<0.0004	<0.0004		0.0002	0.0001	0.0002	0.0002	<0.0004	0.0014
Barium - Total	mg/L	0.044	0.053		0.062	0.062	0.065	0.067	0.053	0.067
Beryllium - Total	mg/L	<0.0002	<0.0002		<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.1	<0.1		<0.05	<0.05	<0.05	<0.05	<0.1	<0.1
Cadmium - Total	mg/L	0.0007	0.0009		0.00069	0.00054	0.00053	0.00055	0.0005	0.0012
Chromium - Total	mg/L	<0.002	<0.002		<0.001	<0.001	<0.001	<0.001	<0.002	<0.002
Cobalt - Total	mg/L	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007
Copper - Total	mg/L	<0.001	<0.001		0.0034	0.0002	0.0002	0.0003	0.001	0.002
Iron - Total	mg/L	0.048	0.02		0.08	0.01	0.012	0.02	0.047	1.16
Lead - Total	mg/L	0.0246	0.0071		0.0046	0.0034	0.0028	0.0034	0.0055	0.0855
Lithium - Total	mg/L	<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Manganese - Total	mg/L	0.068	0.043		0.052	0.051	0.048	0.038	0.044	0.174
Mercury - Total	mg/L				<0.00005	<0.00005	<0.00005	<0.00005		
Molybdenum - Total	mg/L	<0.001	<0.001		0.001	<0.001	<0.001	0.001	<0.001	<0.001
Nickel - Total	mg/L	<0.001	<0.001		0.001	<0.001	<0.001	<0.001	<0.001	0.003
Phosphorus - Total	mg/L									
Selenium - Total	mg/L	<0.0008	<0.0008		0.0004	0.0005	0.0002	0.0002	<0.0008	<0.0008
Silicon - Total	mg/L	2.53	2.84		3.4	3.55	3.74	3.37	3.15	3.39
Silver - Total	mg/L	<0.0001	<0.0001		<0.00002	<0.00002	<0.00002	<0.00002	<0.0001	<0.0001
Strontium - Total	mg/L	0.294	0.318		0.313	0.307	0.327	0.363	0.32	0.279
Tellurium - Total	mg/L									
Thallium - Total	mg/L	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	0.015
Uranium - Total	mg/L	0.0008	0.0011		0.0009	0.0009	0.0009	0.001	0.0008	0.0007
Vanadium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.14	0.169		0.168	0.147	0.136	0.133	0.154	0.325
Zirconium - Total	mg/L	<0.002	<0.002		<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002
Calcium - Total	mg/L	67	69		74.9	75.7	81.4	73.7	73.5	64
Magnesium - Total	mg/L	17	16		15.3	15.6	16.4	14.6	15	12
Potassium - Total	mg/L	<1	<1		0.85	0.88	0.88	0.8	0.73	<1
Sodium - Total	mg/L	<1	1		2.18	1.18	1.49	1.29	1.47	1
Sulphur - Total	mg/L	<60	<60		7	6	5	4	4	<60

Water Quality (2006 to 2011)

MH-08 Burnick Creek

Collect Date/Time		2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007	2007	2007
Collect Date/Time		10-Jan	05-Feb	10-Mar	19-May	19-May	21-May	13-Jun	13-Jun	05-Jul	14-Aug	15-Sep	15-Oct	01-Nov	16-Dec	16-Dec	17-Jan	18-Jan	19-Jan	19-Feb
pH - Lab	pH	7.8	8.2	8.2		8.3			8.3	8.4	8.3	8.3	8.3	8.2		8.2		8.1		8.2
pH - Field	pH	8.19	8.23	8.12	8.35		8.35	8.39	8.39	8.35	8.27	8.36	8.10	8.02	8.12	8.12	8.0	8.00		8.02
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm	294	296	297		216			281	271	270	264	268	269		290		284		301
Total Suspended Solids	mg/L	<4	<4	<4		7			<4	<4	<4	<4	<4	<4		<4		<4		<4
Total Dissolved Solids	mg/L	226	162	172		122			176	176	158	156	164	154		154		170		170
Turbidity	NTU	0.2	0.4	0.3		1.1			0.2	0.4	<0.1	0.4	0.1	0.2		0.8		1.6		<0.1
Turbidity - field	NTU	320	330	330			230		310	280	280	310	280	290		310	310			310
Flow	L/min	7.00	5	5.00		8.00			91.00	14.00	8.00	28.00	4.00	3.00		4.00	4.00		4.00	
Hardness	mg/L	160	160	160		120			160	170	150	150	160	140		160		160		159
Alkalinity - CaCO3	mg/L	150	154	153		114			149	140	142	139	139	141		143		150		155
Alkalinity	mg/L	<0.5	<0.5	<0.5		<0.5			<0.5	1.4	1.2	1	<0.5	<0.5		<0.5		<0.5		<0.5
Sulphate	mg/L	6.2	7.6	6.4		3.5			2.5	3	<0.5	3.9	5.2	5.3		4.1		4.6		5.7
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5		<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5		<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5		<0.5			<0.5	1.7	1.4	1.2	<0.5	<0.5		<0.5		<0.5		<0.5
Bicarbonate (HCO3)	mg/L	183	187	187		139			181	168	171	167	170	172		175		183		189
Ammonia Nitrogen	mg/L	<0.005	0.012	<0.005		0.006			<0.005	<0.005	<0.005	0.015	<0.005	<0.005		<0.005		<0.005		<0.005
Nitrate-Nitrite	mg/L	0.11	0.1	0.11		0.07			0.04	0.04	0.03	0.04	0.07	0.07		0.1		0.1		0.1
Cyanide - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005		<0.0005
Aluminum - Total	mg/L	<0.02	<0.02	<0.02		0.08			<0.02	1.18	<0.02	0.13	0.006	0.02		<0.02		0.05		<0.02
Antimony - Total	mg/L	<0.05	<0.05	<0.05		<0.05			<0.05	<0.05	<0.05	<0.05	<0.001	<0.05		<0.05		<0.05		<0.05
Arsenic - Total	mg/L	<0.05	<0.05	<0.05		<0.05			<0.05	<0.05	<0.05	<0.05	0.001	<0.05		<0.05		<0.05		<0.05
Barium - Total	mg/L	0.059	0.063	0.065		0.036			0.078	0.105	0.054	0.047	0.053	0.049		0.062		0.064		0.062
Beryllium - Total	mg/L	<0.0002	<0.0002	<0.0002		<0.0002			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002		<0.0002		<0.0002
Bismuth - Total	mg/L	<0.05	<0.05	<0.05		<0.05			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05		<0.05		<0.05
Boron - Total	mg/L	<0.008	<0.008	<0.008		<0.008			<0.008	<0.008	<0.008	<0.008	<0.008	<0.008		<0.008		<0.008		0.008
Cadmium - Total	mg/L	0.00014	0.00016	0.00004		0.00005			0.00011	0.00117	0.00004	0.00016	0.00003	0.00004		0.00009		0.00004		0.00003
Chromium - Total	mg/L	<0.005	<0.005	<0.005		<0.005			<0.005	<0.005	<0.005	<0.005	<0.001	<0.005		<0.005		<0.005		<0.005
Cobalt - Total	mg/L	<0.005	<0.005	<0.005		<0.005			<0.005	<0.005	<0.005	<0.005	<0.0005	<0.005		<0.005		<0.005		<0.005
Copper - Total	mg/L	<0.005	<0.005	<0.005		<0.005			<0.005	0.007	<0.005	<0.005	0.0004	<0.005		<0.005		<0.005		<0.005
Iron - Total	mg/L	0.02	0.03	0.009		0.138			0.016	1.9	0.01	0.215	0.013	0.021		0.028		0.044		0.016
Lead - Total	mg/L	0.00065	0.0112	0.00015		0.00077			0.00006	0.00813	0.00009	0.00075	0.00004	0.00009		0.00065		0.00066		0.00024
Lithium - Total	mg/L												<0.002							
Manganese - Total	mg/L	0.008	0.016	<0.001		0.008			0.002	0.199	0.004	0.017	0.003	0.009		0.019		0.005		0.002
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L	<0.005	<0.005	<0.005		<0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005
Nickel - Total	mg/L	<0.008	<0.008	<0.008		<0.008			<0.008	<0.008	<0.008	<0.008	<0.008	<0.008		<0.008		<0.008		<0.008
Phosphorus - Total	mg/L	<0.1	<0.1	<0.1		<0.1			<0.1	0.2	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1
Selenium - Total	mg/L	<0.03	<0.03	<0.03		<0.03			<0.03	<0.03	<0.03	<0.03	<0.001	<0.03		<0.03		<0.03		<0.03
Silicon - Total	mg/L	4.07	4.08	4.23		3.36			4.99	6.62	3.85	5.61	4.16	3.77		3.99		4.1		4.03
Silver - Total	mg/L	<0.01	<0.01	<0.01		<0.01			<0.01	<0.01	<0.01	<0.01	<0.0001	<0.01		<0.01		<0.01		<0.01
Strontium - Total	mg/L	0.17	0.18	0.181		0.131			0.149	0.177	0.164	0.145	0.171	0.153		0.178		0.183		0.176
Tellurium - Total	mg/L																			
Thallium - Total	mg/L	<0.03	<0.03	<0.03		<0.03			<0.03	<0.03	<0.03	<0.03	<0.0001	<0.03		<0.03		<0.03		<0.03
Tin - Total	mg/L	<0.02	<0.02	<0.02		<0.02			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02		<0.02		<0.02
Titanium - Total	mg/L	<0.003	<0.003	<0.003		<0.003			<0.003	0.021	<0.003	<0.003	<0.003	<0.003		<0.003		<0.003		<0.003
Uranium - Total	mg/L	0.00085	0.00079	0.00086		0.00046			0.00063	0.00092	0.00061	0.0007	0.00064	0.00065		0.00073		0.00076		0.00076
Vanadium - Total	mg/L	<0.005	<0.005	<0.005		<0.005			<0.005	0.007	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005
Zinc - Total	mg/L	0.008	0.008	<0.005		0.007			0.017	0.097	<0.005	0.014	<0.005	<0.005		<0.005		0.005		<0.005
Zirconium - Total	mg/L	<0.005	<0.005	<0.005		<0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005
Calcium - Total	mg/L	54	56.1	56.4		43			53.8	57.6	52.4	50.2	56	49.4		54.6		54.6		54.4
Magnesium - Total	mg/L	5.45	5.71	5.82		3.36			6.46	6.27	4.9	4.9	4.87	4.45		5.43		5.67		5.57
Potassium - Total	mg/L	<1	<1	<1		<1			<1	<1	<1	<1	<1	<1		<1		<1		<1
Sodium - Total	mg/L	0.91	0.86	0.84		0.65			0.71	0.93	0.9	0.84	0.88	0.76		0.89		0.81		0.91
Sulphur - Total	mg/L	1.9	2.1	2.1		1.3			1.1	1.9	1.9	1.7	2	1.8		2.1		2		2

Water Quality (2006 to 2011)

MH-08 Burnick Creek

Collect Date/Time		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008
Collect Date/Time		21-Mar	26-Mar	27-Apr	21-May	19-Jun	19-Jun	19-Jul	12-Aug	15-Sep	18-Sep	21-Oct	14-Nov	15-Nov	03-Dec	04-Jan	11-Feb	03-Mar	03-Mar
pH - Lab	pH		8.2	8.2	8.1		8.2	8.3	8.3	8.1		8.2	8.2		8.2	8.2	8.2		8.2
pH - Field	pH		8.02	8.01	7.99	8.38	8.38	8.22	8.36	8.17		8.19		8.19	8.46	8.31	8.16	8.21	
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		300	306	209		232	236	252	250		260	270		280	280	310		300
Total Suspended Solids	mg/L		<4	<4	25.0		<4	5	<4	<4		<4	<4		<4	<4	<4		6
Total Dissolved Solids	mg/L		172	184	132		144	136	148	154		160	160		170	160	180		170
Turbidity	NTU		0.3	0.3	13.3		0.5	1.4	0.1	0.2		0.4	0.3		0.7	0.7	0.6		0.2
Turbidity - field	NTU		310	310	470	230		230	260	250		280		270	280				
Flow	L/min	4.00			7.00		7.00	6.00	5.00		26.00	5.00		20.00	24.00	22.00	20.00	20.00	
Hardness	mg/L		160	172	114		129	134	139	146		156	150		168	159	167		174
Alkalinity - CaCO3	mg/L		154	158	108		119	122	130	134		140	140		150	140	150		150
Alkalinity	mg/L		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5
Sulphate	mg/L		5.7	5.3	3.2		4.1	3.5	5.6	3.4		6.6	5.4		6	5.8	7.7		6.1
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5
Bicarbonate (HCO3)	mg/L		188	193	132		146	148	159	164		170	170		180	170	180		190
Ammonia Nitrogen	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		0.01	<0.005		0.006	<0.005	<0.005		<0.005
Nitrate-Nitrite	mg/L		0.11	0.09	0.13		0.08	0.05	0.04	0.03		0.08	0.09		0.09	0.09	0.12		0.1
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	0.0011	<0.0005		<0.0005
Aluminum - Total	mg/L		0.05	<0.02	0.64		0.02	0.15	<0.02	0.02		0.007	0.006		0.028	<0.001	0.018		0.009
Antimony - Total	mg/L		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		0.0009
Arsenic - Total	mg/L		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		0.0012	0.0011		0.0012	<0.0001	0.001		0.001
Barium - Total	mg/L		0.066	0.07	0.047		0.038	0.044	0.047	0.051		0.057	0.058		0.064	<0.001	0.068		0.063
Beryllium - Total	mg/L		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002		<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.0001
Bismuth - Total	mg/L		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Boron - Total	mg/L		<0.008	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008		0.02	<0.005		0.012	<0.005	<0.005		<0.005
Cadmium - Total	mg/L		0.00006	0.00005	0.00012		0.00005	0.00005	0.00004	0.00004		0.000045	0.000036		0.000052	0.000044	0.000041		0.000039
Chromium - Total	mg/L		0.006	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Cobalt - Total	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		0.0004	0.0002		0.0034	<0.0002	0.0006		0.0016
Iron - Total	mg/L		0.266	0.015	0.888		0.046	0.169	0.059	0.033		0.03	0.033		0.083	<0.005	0.052		0.032
Lead - Total	mg/L		0.00048	0.00013	0.00235		0.00053	0.00047	0.00101	0.00017		0.00016	0.0036		0.00121	0.000296	0.000399		0.000241
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.007	0.001	0.03		0.003	0.006	0.006	0.013		0.019	0.022		0.033	<0.001	0.019		0.021
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		0.007	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		0.001	0.001		0.001	<0.001	0.002		0.001
Nickel - Total	mg/L		<0.008	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Phosphorus - Total	mg/L		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1									
Selenium - Total	mg/L		<0.03	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03		0.0006	0.0005		0.0007	<0.0001	0.0007		0.0007
Silicon - Total	mg/L		4.15	4.31	3.95		3.47	3.82	3.75	3.87		4.16	3.79		4.16	<0.1	4.19		4
Silver - Total	mg/L		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01		<0.00002	<0.00002		<0.00002	<0.00002	<0.00002		<0.00002
Strontium - Total	mg/L		0.181	0.19	0.13		0.141	0.156	0.158	0.162		0.181	0.168		0.195	<0.001	0.181		0.191
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.03	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03		<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Titanium - Total	mg/L		<0.003	<0.003	0.013		<0.003	<0.003	<0.003	<0.003		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Uranium - Total	mg/L		0.00082	0.00079	0.00044		0.00051	0.00052	0.00057	0.00061		0.000663	0.000761		0.000765	0.000785	0.000821		0.000824
Vanadium - Total	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Zinc - Total	mg/L		<0.005	<0.005	0.024		<0.005	0.006	0.006	<0.005		<0.005	<0.005		0.008	<0.005	0.008		0.007
Zirconium - Total	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005
Calcium - Total	mg/L		54.5	58.8	39.8		45.5	47.1	48.6	50.8		53.8	51.5		58	54.5	56.5		59
Magnesium - Total	mg/L		5.78	6.1	3.51		3.67	3.94	4.28	4.64		5.15	5.1		5.63	5.58	6.23		6.58
Potassium - Total	mg/L		<1	<1	<1		<1	<1	<1	<1		2.14	0.33		0.44	0.34	0.36		0.38
Sodium - Total	mg/L		0.85	0.96	0.55		0.68	0.68	0.76	0.84		755	0.82		0.98	0.89	0.97		1.03
Sulphur - Total	mg/L		2.1	2.3	1.2		1.6	1.4	1.6	1.7		<3	<3		<3	<3	<3		<3

Water Quality (2006 to 2011)

MH-08 Burnick Creek

Collect Date/Time		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009
Collect Date/Time		02-Apr	24-Jun	27-Jun	19-Jul	23-Jul	15-Aug	18-Aug	03-Sep	23-Oct	14-Nov	01-Dec	18-Jan	13-Feb	18-Mar	13-Apr	18-May	15-Jun	20-Jul	16-Aug
pH - Lab	pH	8.3	8.3		8.2		8.3		8.3	8.4	8.2	8.2	8.2	8.1	8.2	8.2	8.3	8.3	8.3	
pH - Field	pH	8.17		8.13		8.24		8.26	8.17	8.25	8.37	8.43	8.25	8.51	8.36	8.19	8.35	8.32	8.26	8.34
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm	300	250		260		270		270	270	270	270	280	280	290	300	290	240	260	
Total Suspended Solids	mg/L	<4	<4		<4		<4		5	<4	4	<4	30	<4	4	<4	<4	<4	<4	
Total Dissolved Solids	mg/L	190	150		140		150		140	190	180	170	160	170	210	190	190	140	140	
Turbidity	NTU	0.5	0.4		0.2		0.2		0.3	0.2	0.1	0.1	3.1	0.4	1.6	0.2	<0.1	0.4	0.2	
Turbidity - field	NTU																			
Flow	L/min	20.00		30.00	25.00			25.00	25.00		25.00	20.00				20.00	60.00	40.00	25.00	23.00
Hardness	mg/L	183	141		135		133		173	141	149	163	154	153	165	208	153	130	138	
Alkalinity - CaCO3	mg/L	160	120		130		140		140	140	140	140	150	150	150	160	160	130	140	
Alkalinity	mg/L	1.4	<0.5		<0.5		1.1		0.6	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.7	<0.5	
Sulphate	mg/L	8	4.6		5.2		5.6		4.8	5	5.2	5.1	6.9	6.4	5.8	6.3	6.6	4.5	4.1	
Hydroxide (OH)	mg/L	<0.5	<0.5		<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Carbonate (CO3)	mg/L	1.7	<0.5		<0.5		1.3		0.7	2.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	0.8	<0.5	
Bicarbonate (HCO3)	mg/L	190	150		150		170		170	170	170	170	180	190	190	190	190	150	170	
Ammonia Nitrogen	mg/L	<0.005	<0.005		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.037	<0.005	<0.005	<0.005	
Nitrate-Nitrite	mg/L	0.11	0.05		0.04		0.03		0.03	0.06	0.08	0.09	0.19	0.1	0.1	0.08	0.09	0.07	0.02	
Cyanide - Total	mg/L	<0.0005	<0.0005		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	
Aluminum - Total	mg/L	0.011	0.053		0.013		0.01		0.026	0.01	0.007	0.031	0.378	0.014	0.026	0.007	0.057	0.051	0.014	
Antimony - Total	mg/L	0.0006	<0.0005		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Arsenic - Total	mg/L	0.0011	0.0012		0.0012		0.0011		0.0011	0.0013	0.0011	0.0011	0.0019	0.001	0.0013	0.0004	0.0011	0.0012	0.0011	
Barium - Total	mg/L	0.058	0.045		0.046		0.046		0.056	0.049	0.049	0.056	0.071	0.066	0.078	0.045	0.067	0.041	0.051	
Beryllium - Total	mg/L	<0.0001	<0.0001		<0.0001		<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Bismuth - Total	mg/L	<0.001	<0.001		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Boron - Total	mg/L	<0.005	<0.05		<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Cadmium - Total	mg/L	0.000035	0.000039		0.000031		0.000041		0.000036	0.000038	0.000046	0.000067	0.000149	0.000061	0.000063	0.000026	0.000037	0.000033	0.000035	
Chromium - Total	mg/L	<0.001	0.002		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Cobalt - Total	mg/L	<0.0005	<0.0005		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Copper - Total	mg/L	0.0009	0.0018		0.0003		0.0003		0.0004	0.0006	0.0012	0.0046	0.0015	0.0009	0.001	0.0014	0.0009	0.0004	0.0004	
Iron - Total	mg/L	0.051	0.077		0.017		0.027		0.052	0.039	0.033	0.074	0.63	0.072	0.098	0.012	0.017	0.072	0.015	
Lead - Total	mg/L	0.000367	0.000483		0.000065		0.000083		0.000145	0.000302	0.000339	0.00229	0.00256	0.000552	0.000596	0.000035	0.000192	0.000278	0.000025	
Lithium - Total	mg/L																			
Manganese - Total	mg/L	0.026	0.004		0.004		0.008		0.01	0.007	0.002	0.011	0.036	0.011	0.018	<0.001	<0.001	0.003	0.004	
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L	0.001	0.001		0.001		0.001		0.001	0.001	0.001	0.001	0.001	0.001	0.001	<0.001	0.001	0.001	0.001	
Nickel - Total	mg/L	<0.001	0.001		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Phosphorus - Total	mg/L																			
Selenium - Total	mg/L	0.0007	0.0005		0.0005		0.0005		0.0005	0.0005	0.0005	0.0005	0.0007	0.0006	0.0008	0.0006	0.0007	0.0004	0.0004	
Silicon - Total	mg/L	4.09	4		3.59		3.62		3.88	4.27	4.02	4.49	4.75	4.64	3.77	3.84	4.55	4.04	3.4	
Silver - Total	mg/L	<0.00002	<0.00002		<0.00002		<0.00002		<0.00002	<0.00002	0.00003	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	
Strontium - Total	mg/L	0.195	0.169		0.168		0.155		0.197	0.173	0.183	0.189	0.186	0.197	0.199	0.25	0.197	0.156	0.169	
Tellurium - Total	mg/L																			
Thallium - Total	mg/L	<0.00005	<0.00005		<0.00005		<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	
Tin - Total	mg/L	<0.005	<0.005		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Titanium - Total	mg/L	0.007	<0.005		<0.005		<0.005		<0.005	0.009	<0.005	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Uranium - Total	mg/L	0.000832	0.000563		0.000602		0.000645		0.000616	0.000655	0.000697	0.000699	0.000806	0.000877	0.000757	0.000701	0.000741	0.000538	0.000582	
Vanadium - Total	mg/L	<0.005	<0.005		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Zinc - Total	mg/L	<0.005	0.013		<0.005		<0.005		<0.005	<0.005	<0.005	0.005	0.013	<0.005	0.007	0.016	0.012	<0.005	<0.005	
Zirconium - Total	mg/L	<0.0005	<0.0005		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Calcium - Total	mg/L	62.6	49.1		47.1		45.7		60.2	48.6	51.2	56.2	52.5	52	55.4	74.3	52	45.4	47.8	
Magnesium - Total	mg/L	6.4	4.56		4.15		4.66		5.41	4.78	5.04	5.58	5.54	5.58	6.48	5.51	5.6	4.06	4.47	
Potassium - Total	mg/L	0.37	0.34		0.27		0.28		0.33	0.33	0.33	0.38	0.34	0.35	0.36	0.54	0.41	0.33	0.25	
Sodium - Total	mg/L	1.01	0.87		0.77		0.82		0.91	0.8	0.86	0.98	0.88	0.87	0.93	1.11	0.87	0.72	0.75	
Sulphur - Total	mg/L	<3	<3		<3		<3		<3	<3	<3	<3	<3	<3	<3	8	<3	4	4	

Water Quality (2006 to 2011)

MH-08 Burnick Creek

Collect Date/Time		2009	2009	2009	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Collect Date/Time		19-Aug	24-Sep	24-Sep	23-Oct	15-Nov	09-Dec	13-Jan	16-Feb	07-Mar	11-Apr	04-May	14-Jun	20-Jul	15-Aug	16-Aug	21-Sep	23-Oct	14-Nov
pH - Lab	pH	8.4		8.2	8.1	8.3	8.2	8.2	8	8	8.3	8.1	8.2	8.25	8.21		8.35	8.27	8.11
pH - Field	pH		8.32		8.51	8.27	8.21	8.20	8.34	8.48	8.53	8.33	8.05	8.51		9.02	8.30	8.21	8.24
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm	265		259	287	271	282	292	1110	297	306	279	237	263	267		279	287	282
Total Suspended Solids	mg/L	<4		<4	<4	<4	<4	<4	<4	<4	<4	5	<4	<4	9		<4	<4	<4
Total Dissolved Solids	mg/L	150		160	160	120	140	170	150	170	180	170	130	140	160		150	150	150
Turbidity	NTU	0.1		0.5	0.7	0.3	0.9	0.4	9.3	0.4	0.2	0.1	0.1	0.2	0.7		0.2	0.5	0.1
Turbidity - field	NTU																		
Flow	L/min		20.00		15.00	10.00	10.00	10.00	10.00	8.00	15.00	20.00		20.00		20.00	15.00	10.00	10.00
Hardness	mg/L	141		147	135	148	156	167	158	162	163	154	121	138	144		156	154	156
Alkalinity - CaCO3	mg/L	140		140	140	150	150	150	300	150	160	150	120	140	140		150	150	140
Alkalinity	mg/L	1.1		<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		2.2	<0.5	<0.5
Sulphate	mg/L	4.4		3.5	5.7	4.4	5.6	5		5.7	7.4	5.4	11	3.9	5.1		5.9	5.8	5.8
Hydroxide (OH)	mg/L	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	1.4		<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		2.6	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	170		170	170	180	180	190	360	190	200	190	150	170	170		170	180	180
Ammonia Nitrogen	mg/L	<0.005		<0.005	<0.005	<0.005	<0.005	0.008	0.217	0.01	<0.005	0.027	0.13	0.022	0.02		0.059	0.069	0.057
Nitrate-Nitrite	mg/L	0.03		0.38	0.07	0.07	0.09	0.09	0.04	0.1	0.1	0.05	0.07	0.04	0.03		0.04	0.06	0.06
Cyanide - Total	mg/L	0.0007		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.001	<0.001		<0.001	<0.0005	<0.0005
Aluminum - Total	mg/L	0.017		0.006	0.007	0.004	0.013	0.008	0.006	0.01	0.005	0.004	0.012	0.012	0.086		0.01	0.006	0.019
Antimony - Total	mg/L	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.0012		0.0014	0.0012	0.0012	0.0011	0.001	0.001	0.0011	0.0009	0.001	0.0011	0.0012	0.0013		0.0007	0.0009	0.001
Barium - Total	mg/L	0.054		0.051	0.046	0.057	0.058	0.067	0.068	0.073	0.07	0.065	0.038	0.047	0.055		0.058	0.062	0.066
Beryllium - Total	mg/L	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.064		<0.05	<0.05	<0.05
Cadmium - Total	mg/L	0.000035		0.000024	0.000072	0.00004	0.000027	0.000033	0.000026	0.000033	0.000037	0.000023	0.000024	0.000033	0.000044		0.00003	0.000039	0.000093
Chromium - Total	mg/L	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001		<0.001	<0.001	<0.001
Cobalt - Total	mg/L	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0003		0.0003	0.0008	0.0002	0.0002	0.0007	0.0004	0.0008	0.0005	0.0004	0.0005	<0.0002	0.0004		0.0005	0.0007	0.0041
Iron - Total	mg/L	0.04		0.023	0.033	0.029	0.039	0.026	0.037	0.038	0.054	0.026	0.019	0.025	0.165		0.023	0.032	0.039
Lead - Total	mg/L	0.000097		0.000084	0.00187	0.00009	0.000205	0.000697	0.000375	0.000243	0.00124	0.000095	0.000138	0.000099	0.000379		0.000157	0.000331	0.000406
Lithium - Total	mg/L																		
Manganese - Total	mg/L	0.009		0.005	0.006	0.016	0.018	0.018	0.018	0.021	0.02	0.009	0.002	0.006	0.012		0.006	0.018	0.019
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L	0.001		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		0.001	0.001	0.001
Nickel - Total	mg/L	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.017	<0.001	<0.001
Phosphorus - Total	mg/L																		
Selenium - Total	mg/L	0.0005		0.0005	0.0004	0.0005	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	0.0004	0.0005	0.0005		0.0006	0.0006	0.0005
Silicon - Total	mg/L	3.66		4.24	3.92	4.34	4.45	4.36	4.37	4.43	4.39	4.28	3.72	3.9	4.31		4.43	4.19	4.34
Silver - Total	mg/L	<0.00002		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L	0.173		0.177	0.161	0.181	0.175	0.196	0.19	0.203	0.192	0.184	0.154	0.163	0.181		0.18	0.195	0.196
Tellurium - Total	mg/L																		
Thallium - Total	mg/L	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Uranium - Total	mg/L	0.000639		0.000607	0.000634	0.000694	0.000709	0.000735	0.000791	0.000809	0.000854	0.000751	0.00058		0.000651		0.000672	0.000704	0.000696
Vanadium - Total	mg/L	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Zinc - Total	mg/L	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Zirconium - Total	mg/L	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	48.9		50.9	46.6	50.7	53.5	56.9	53.4	55	54.8	52.2	42.2	48			53.4	52.8	52.7
Magnesium - Total	mg/L	4.69		4.89	4.46	5.15	5.38	6.05	5.89	5.89	6.38	5.79	3.81	4.44			5.41	5.41	5.95
Potassium - Total	mg/L	0.27		0.35	0.33	0.31	0.34	0.35	0.33	0.33	0.35	0.5	0.33	0.27			0.39	0.33	0.36
Sodium - Total	mg/L	0.79		0.86	0.79	0.82	0.86	0.89	0.86	0.83	0.9	0.83	0.71	0.74			0.84	0.85	0.95
Sulphur - Total	mg/L	<3		3	<3	<3	4	<3	<3	<3	5	<3	<3	<3			3	4	<3

Water Quality (2006 to 2011)

MH-08 Burnick Creek

Collect Date/Time		2010	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011
Collect Date/Time		11-Dec	21-Jan	12-Feb	13-Mar	16-Mar	05-Apr	23-May	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep	08-Oct	15-Nov	05-Dec
pH - Lab	pH	8.12	8.04	8.05	7.95		8.11	8.2	8.24		8.34	7.35	8.23	8.13	8.19	8.16
pH - Field	pH	8.07	8.32	8.26		8.15		8.22		8.36	8.27	8.51	8.40	8.27	8.14	8.28
Conductivity - Field	uS/cm															
Conductivity - Lab	uS/cm	291	302	300	315		303	239	227		260	477	257	264	274	278
Total Suspended Solids	mg/L	<4	<4	<4	<4		<4	<4	6		<4	<4	<4	<4	<4.0	<4.0
Total Dissolved Solids	mg/L	150	150	160	180		170	140	130		140	150	130	140	158	150
Turbidity	NTU	0.2	0.2	0.4	0.2		0.2	0.3	1.1		<0.1	0.1	<0.1	0.1	0.22	0.57
Turbidity - field	NTU															
Flow	L/min	10.00	8.00	6.00		8.00	8.00	10.00		16.00	16.00	18.00	16.00	10.00	10.00	10.00
Hardness	mg/L	158	160	158	171		164	127	107		124	136	147	138	140	139
Alkalinity - CaCO3	mg/L	150	150	140	160		160	120	120		130	42	130	130	142	141
Alkalinity	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Sulphate	mg/L	6.8	6.4	6.8	35		5.7	4	5.2		4.4	6.2	4.8	4.8	5.45	6.53
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Bicarbonate (HCO3)	mg/L	180	190	170	200		190	150	150		160	51	160	160	174	172
Ammonia Nitrogen	mg/L	0.006	<0.005	0.022	0.018		0.006	0.008	0.007		0.028	0.005	<0.005	<0.005	0.0117	0.0152
Nitrate-Nitrite	mg/L	0.08	0.08	0.09	0.09		0.09	0.11	0.08		0.03	0.04	0.04	0.05	0.095	0.09
Cyanide - Total	mg/L	<0.0005	0.0007	0.0012	<0.0005		0.00100	0.00100	0.0008		<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050
Aluminum - Total	mg/L	0.019	<0.01	0.042	<0.01		<0.01	0.027	0.053		0.011	0.006	0.004	0.011	<0.01	0.013
Antimony - Total	mg/L	<0.0005	<0.0005	0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.0011	0.0009	0.0012	0.001		0.0009	0.001	0.0012		0.001	0.001	0.0012	0.0011	0.001	0.0011
Barium - Total	mg/L	0.066	0.069	0.078	0.075		0.07	0.054	0.038		0.044	0.047	0.045	0.046	0.052	0.048
Beryllium - Total	mg/L	<0.0001	<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002		<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1		<0.05	<0.05	<0.05	<0.05	<0.1	<0.1
Cadmium - Total	mg/L	0.000113	<0.0001	0.0005	<0.0001		<0.0001	<0.0001	<0.0001		0.00006	<0.00001	0.00004	0.00004	<0.0001	<0.0001
Chromium - Total	mg/L	<0.001	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002		<0.001	<0.001	<0.001	<0.001	<0.002	<0.002
Cobalt - Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0032	<0.001	0.021	0.002		0.001	<0.001	<0.001		0.0021	0.0003	<0.0002	0.0002	0.001	<0.001
Iron - Total	mg/L	0.062	0.029	0.124	0.104		0.045	0.063	0.088		0.063	0.015	0.011	0.032	0.037	0.071
Lead - Total	mg/L	0.00126	0.0005	0.0466	0.0004		0.0004	0.0002	0.0005		0.0007	<0.0002	<0.0002	0.0005	0.0005	0.0003
Lithium - Total	mg/L		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Manganese - Total	mg/L	0.02	0.019	0.039	0.033		0.025	0.004	0.008		0.007	0.004	0.004	0.007	0.015	0.017
Mercury - Total	mg/L										<0.00005	<0.00005	<0.00005	<0.00005		
Molybdenum - Total	mg/L	0.001	0.001	0.001	0.001		0.001	<0.001	0.001		0.001	0.001	0.001	0.001	0.001	0.001
Nickel - Total	mg/L	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus - Total	mg/L															
Selenium - Total	mg/L	0.0007	<0.0008	<0.0008	<0.0008		<0.0008	<0.0008	<0.0008		0.0005	0.0006	0.0005	0.0005	<0.0008	<0.0008
Silicon - Total	mg/L	4.35	4.43	4.24	4.29		4.2	3.3	3.08		3.43	3.89	3.81	3.84	3.74	3.71
Silver - Total	mg/L	<0.00002	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.00002	<0.00002	<0.00002	<0.00002	<0.0001	<0.0001
Strontium - Total	mg/L	0.195	0.198	0.192	0.208		0.191	0.159	0.152		0.152	0.163	0.166	0.169	0.171	0.176
Tellurium - Total	mg/L															
Thallium - Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Uranium - Total	mg/L	0.000779	0.0007	0.0008	0.0008		0.0008	0.0005	0.0006		0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Vanadium - Total	mg/L	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.008	<0.01	0.032	<0.01		<0.01	<0.01	<0.01		0.009	<0.005	<0.005	<0.005	<0.01	<0.01
Zirconium - Total	mg/L	<0.0005	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002		<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002
Calcium - Total	mg/L	53.6	54	54	58		55	43	37		42.7	47.1	51.1	47.8	47.3	47
Magnesium - Total	mg/L	5.92	6	6	6		6	5	3		4.21	4.46	4.78	4.53	5.17	5
Potassium - Total	mg/L	0.37	<1	<1	<1		<1	<1	<1		0.26	0.27	0.32	0.29	0.33	<1
Sodium - Total	mg/L	0.91	<1	<1	1		<1	<1	<1		1.17	0.77	0.94	0.74	0.89	<1
Sulphur - Total	mg/L	<3	<60	<60	<60		<60	<60	<60		<3	<3	<3	<3	<3	<60

Water Quality (2006 to 2011)

MH-11 Upper False Canyon Creek

Collect Date/Time		2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2007
Collect Date/Time		10-Jan	05-Feb	10-Mar	21-May	23-May	14-Jun	14-Jun	05-Jul	14-Aug	15-Sep	15-Oct	01-Nov	17-Dec	17-Jan	18-Jan	19-Jan	19-Feb	21-Mar	26-Mar
pH - Lab	pH	8.1	8.3	8.3		8.2		8.3	8.4	8.4	8.4	8.3	8.2	8.2	8.2			8.3		8.2
pH - Field	pH	8.38	8.28	8.28	8.24	8.24	8.30	8.3	8.51	8.49	8.32	8.18	8.13	8.14		8.07		8.05		8.04
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm	415	418	422		296		298	322	330	336	336	339	405	399			439		430
Total Suspended Solids	mg/L	<4	<4	4		<4		<4	<4	<4	<4	<4	<4	<4	<4			<4		<4
Total Dissolved Solids	mg/L	266	244	246		178		186	214	208	198	200	200	224	246			244		248
Turbidity	NTU	0.4	0.3	0.2		0.7		0.3	0.2	<0.1	0.1	0.2	0.3	0.3	0.4			0.2		1
Turbidity - field	NTU	450	460	490	320			310	340	340	320	350	360	430		410		450		450
Flow	L/min		5500	5750.00		4500.00		6300.00	5000.00	4000.00	4000.00	4000.00	4000.00	4000.00		4000.00	4000.00		4000.00	
Hardness	mg/L	230	230	230		170		170	180	190	190	200	180	220	232			233		240
Alkalinity - CaCO3	mg/L	211	216	217		147		146	176	167	165	160	167	199	211			224		223
Alkalinity	mg/L	<0.5	<0.5	<0.5		<0.5		<0.5	2.9	3	2.1	1.4	<0.5	<0.5	<0.5			<0.5		<0.5
Sulphate	mg/L	14.1	16.3	15.1		10.4		13.1	12.7	1.1	17.8	18.3	16.9	11.5	13.4			13		12.5
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5		<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5		<0.5		<0.5	3.4	3.6	2.6	1.7	<0.5	<0.5	<0.5			<0.5		<0.5
Bicarbonate (HCO3)	mg/L	257	263	265		179		179	208	197	196	192	204	243	258			273		272
Ammonia Nitrogen	mg/L	<0.005	<0.005	<0.005		<0.005		0.011	<0.005	<0.005	0.011	<0.005	0.008	<0.005	<0.005			<0.005		<0.005
Nitrate-Nitrite	mg/L	0.13	0.08	0.08		0.17		0.18	0.16	0.15	0.19	0.27	0.25	0.1	0.08			0.19		0.2
Cyanide - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005		0.0005
Aluminum - Total	mg/L	<0.02	<0.02	0.03		0.09		0.06	<0.02	<0.02	<0.02	0.019	0.03	<0.02	0.03			0.07		0.15
Antimony - Total	mg/L	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.05			<0.05		<0.05
Arsenic - Total	mg/L	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.05			<0.05		<0.05
Barium - Total	mg/L	0.078	0.081	0.086		0.031		0.03	0.034	0.035	0.035	0.035	0.033	0.077	0.084			0.108		0.118
Beryllium - Total	mg/L	<0.0002	<0.0002	<0.0002		<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002			<0.0002		<0.0002
Bismuth - Total	mg/L	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05		<0.05
Boron - Total	mg/L	<0.008	<0.008	<0.008		<0.008		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008			0.008		<0.008
Cadmium - Total	mg/L	0.00033	0.00007	0.00011		0.0002		0.00019	0.00017	0.00016	0.00016	0.00016	0.00028	0.00011	0.00008			0.00107		0.00134
Chromium - Total	mg/L	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005			<0.005		<0.005
Cobalt - Total	mg/L	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.005	<0.005	<0.005			<0.005		<0.005
Copper - Total	mg/L	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	0.0008	<0.005	<0.005	<0.005			<0.005		<0.005
Iron - Total	mg/L	0.067	0.064	0.132		0.147		0.082	0.006	0.006	0.007	0.024	0.021	0.045	0.054			0.093		0.22
Lead - Total	mg/L	0.00076	0.00041	0.00249		0.00239		0.00146	0.00056	0.00049	0.00045	0.00066	0.00631	0.00112	0.00075			0.0488		0.0783
Lithium - Total	mg/L											<0.002								
Manganese - Total	mg/L	0.022	0.021	0.025		0.006		0.005	0.002	0.003	0.003	0.003	0.003	0.018	0.019			0.208		0.261
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		<0.005
Nickel - Total	mg/L	<0.008	<0.008	<0.008		<0.008		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008			<0.008		<0.008
Phosphorus - Total	mg/L	<0.1	<0.1	<0.1		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1		<0.1
Selenium - Total	mg/L	<0.03	<0.03	<0.03		<0.03		<0.03	<0.03	<0.03	<0.03	<0.001	<0.03	<0.03	<0.03			<0.03		<0.03
Silicon - Total	mg/L	3.91	3.83	4.02		3.02		3.08	2.91	3.35	3.18	3.38	3.11	3.71	3.89			4.37		4.63
Silver - Total	mg/L	<0.01	<0.01	<0.01		<0.01		<0.01	<0.01	<0.01	<0.01	<0.0001	<0.01	<0.01	<0.01			<0.01		<0.01
Strontium - Total	mg/L	0.259	0.267	0.271		0.19		0.195	0.222	0.214	0.217	0.22	0.197	0.261	0.278			0.277		0.292
Tellurium - Total	mg/L																			
Thallium - Total	mg/L	<0.03	<0.03	<0.03		<0.03		<0.03	<0.03	<0.03	<0.03	<0.0001	<0.03	<0.03	<0.03			<0.03		<0.03
Tin - Total	mg/L	<0.02	<0.02	<0.02		<0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			<0.02		<0.02
Titanium - Total	mg/L	<0.003	<0.003	<0.003		<0.003		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003			<0.003		<0.003
Uranium - Total	mg/L	0.00137	0.00109	0.00139		0.00081		0.00081	0.00093	0.00094	0.00111	0.001	0.00103	0.00116	0.00122			0.00104		0.00111
Vanadium - Total	mg/L	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		<0.005
Zinc - Total	mg/L	0.011	0.008	0.018		0.009		0.008	0.008	0.009	0.005	0.014	0.033	0.017	0.018			0.259		0.315
Zirconium - Total	mg/L	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		<0.005
Calcium - Total	mg/L	75.9	77	77.4		61.9		63.2	66.8	68.8	70.6	74.3	64.4	75.6	77.4			80.5		82.5
Magnesium - Total	mg/L	9.45	9.62	9.87		3.5		3.51	4.18	4.32	4.37	4.38	4.03	8.68	9.52			7.73		8.15
Potassium - Total	mg/L	<1	<1	1		<1		<1	<1	<1	<1	<1	<1	<1	1			1		1
Sodium - Total	mg/L	1.53	1.51	1.59		0.79		0.72	0.96	1.03	1.02	0.98	0.91	1.37	1.41			1.85		1.91
Sulphur - Total	mg/L	4.5	4.7	4.7		3.7		4.2	4.9	5.3	6.3	6.6	5.5	4.6	4.6			4.4		4.7

Water Quality (2006 to 2011)

MH-11 Upper False Canyon Creek

Collect Date/Time		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008
Collect Date/Time		27-Apr	21-May	19-Jun	19-Jun	19-Jul	12-Aug	15-Sep	18-Sep	21-Oct	14-Nov	15-Nov	03-Dec	04-Jan	11-Feb	03-Mar	03-Mar	02-Apr	24-Jun
pH - Lab	pH	8.3	8.2		8.3	8.2	8.3	8.3		8.3	8.3		8.3	8.3	8.3		8.3	8.4	8.4
pH - Field	pH	8.14	8013.00	8.34	8.34	8.52	8.42	8.31		8.25		8.38	8.34	8.34	8.13	8.17		8.19	
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm	415	292		288	308	326	320		330	350		340	340	370		350	350	300
Total Suspended Solids	mg/L	<4	70		6	<4	<4	<4		<4	<4		<4	<4	<4		<4	<4	<4
Total Dissolved Solids	mg/L	254	182		180	178	186	196		210	240		210	230	250		220	230	170
Turbidity	NTU	0.3	31.5		1.2	0.6	0.6	0.1		0.3	0.3		0.3	0.5	1.4		0.2	0.3	0.3
Turbidity - field	NTU	420	410	300		290	330	280		340		340	340						
Flow	L/min		11600.00		11600.00	7300.00	11000.00		3800.00	3700.00		3500.00	350.00	350.00	350.00	380.00		400.00	
Hardness	mg/L	240	166		161	173	182	186		195	195		217	206	199		213	216	184
Alkalinity - CaCO3	mg/L	215	147		143	149	161	162		170	170		170	170	180		180	180	140
Alkalinity	mg/L	<0.5	<0.5		<0.5	<0.5	1.4	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	3.1	1.2
Sulphate	mg/L	12.5	9.6		13.1	11.9	14.5	14.4		13.4	13.6		14.5	13.8	15.4		13.5	15.2	11
Hydroxide (OH)	mg/L	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5		<0.5	<0.5	1.7	<0.5		<0.5	<0.5		<0.5	1	<0.5		<0.5	3.7	1.4
Bicarbonate (HCO3)	mg/L	263	179		174	181	193	197		210	210		210	200	220		220	220	170
Ammonia Nitrogen	mg/L	<0.005	<0.005		<0.005	0.059	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	0.007
Nitrate-Nitrite	mg/L	0.12	0.25		0.08	0.14	0.04	0.11		0.22	0.28		0.27	0.26	0.25		0.25	0.27	0.13
Cyanide - Total	mg/L	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	0.0006		<0.0005	0.0007	<0.0005		<0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L	<0.02	1.42		0.06	0.06	0.04	<0.02		0.009	0.009		0.015	<0.001	0.023		0.016	0.01	0.233
Antimony - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		0.0004	0.0004		0.0005	<0.0001	0.0004		0.0005	0.0005	0.0007
Barium - Total	mg/L	0.077	0.054		0.037	0.031	0.047	0.035		0.038	0.039		0.04	<0.001	0.043		0.042	0.037	0.036
Beryllium - Total	mg/L	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002		<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008		0.013	<0.005		0.01	<0.005	<0.005		<0.005	<0.005	<0.05
Cadmium - Total	mg/L	0.00061	0.00051		0.00013	0.00021	0.0001	0.00022		0.000226	0.000246		0.000303	0.00057	0.000522		0.000464	0.000549	0.000389
Chromium - Total	mg/L	<0.005	0.005		<0.005	<0.005	<0.005	<0.005		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001
Cobalt - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0002	0.0002		0.0015	<0.0002	0.0008		0.0027	0.0004	0.0009
Iron - Total	mg/L	0.009	1.95		0.113	0.064	0.115	0.007		0.018	0.012		0.04	<0.005	0.038		0.03	0.018	0.354
Lead - Total	mg/L	0.00372	0.0207		0.00342	0.00262	0.00288	0.00255		0.00204	0.0028		0.00556	0.00921	0.0093		0.00703	0.00774	0.0291
Lithium - Total	mg/L																		
Manganese - Total	mg/L	0.066	0.053		0.029	0.004	0.015	0.004		0.003	0.004		0.013	<0.001	0.009		0.011	0.008	0.03
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.001	<0.001		<0.001	<0.001	0.001		<0.001	0.001	<0.001
Nickel - Total	mg/L	<0.008	<0.008		<0.008	<0.008	<0.008	<0.008		<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	0.001
Phosphorus - Total	mg/L	<0.1	0.1		<0.1	<0.1	<0.1	<0.1											
Selenium - Total	mg/L	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03		0.0007	0.0006		0.0008	<0.0001	0.0008		0.0008	0.0008	0.0005
Silicon - Total	mg/L	3.56	4.74		2.52	3.08	2.59	3.09		3.37	2.92		3.28	<0.1	3.57		3.48	3.5	3.32
Silver - Total	mg/L	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01		<0.00002	<0.00002		<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L	0.278	0.199		0.189	0.21	0.233	0.214		0.231	0.23		0.253	<0.001	0.233		0.249	0.252	0.228
Tellurium - Total	mg/L																		
Thallium - Total	mg/L	<0.03	<0.03		<0.03	<0.03	<0.03	<0.03		<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.003	0.039		<0.003	<0.003	<0.003	<0.003		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	0.007	0.01
Uranium - Total	mg/L	0.00085	0.0008		0.00072	0.00077	0.00094	0.00106		0.00117	0.00134		0.00133	0.00139	0.00136		0.00141	0.00145	0.000879
Vanadium - Total	mg/L	<0.005	0.006		<0.005	<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.165	0.043		0.011	0.013	0.012	0.019		0.02	0.029		0.042	<0.005	0.065		0.051	0.065	0.035
Zirconium - Total	mg/L	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	79.5	59.4		57.2	63.4	63.5	67.5		70.5	70.4		78.4	74.6	71		76.1	77.7	66.6
Magnesium - Total	mg/L	10.2	4.28		4.3	3.56	5.83	4.28		4.69	4.75		5.15	4.91	5.25		5.61	5.28	4.19
Potassium - Total	mg/L	<1	1		<1	<1	<1	<1		0.49	0.48		0.66	0.53	0.53		0.56	0.53	0.49
Sodium - Total	mg/L	1.62	0.72		0.74	0.8	0.91	1		1.03	0.97		1.42	1.11	1.09		1.19	1.11	1.04
Sulphur - Total	mg/L	5	3.4		4.5	4.4	5	5.1		5	5		5	6	5		6	5	4

Water Quality (2006 to 2011)

MH-11 Upper False Canyon Creek

Collect Date/Time		2008	2008	2008	2008	2008	2008	2008	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009
Collect Date/Time		27-Jun	19-Jul	23-Jul	15-Aug	18-Aug	03-Sep	23-Oct	14-Nov	01-Dec	18-Jan	13-Feb	18-Mar	13-Apr	18-May	15-Jun	20-Jul	16-Aug	19-Aug
pH - Lab	pH		8.2		8.4		8.4	8.5	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.3	8.3		8.5
pH - Field	pH	8.41		8.28		8.31	8.38	8.36	8.23	8.56	8.31	8.56	8.41	8.29	8.36	8.28	8.40	8.36	
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		310		330		330	340	340	350	440	350	360	370	370	290	320		327
Total Suspended Solids	mg/L		<4		<4		<4	<4	<4	<4	45	<4	<4	<4	<4	<4	<4		<4
Total Dissolved Solids	mg/L		170		190		170	210	210	200	240	210	220	240	250	180	180		190
Turbidity	NTU		0.2		0.1		1	0.2	0.2	0.2	21.5	0.3	1	0.2	0.1	0.4	0.3		0.1
Turbidity - field	NTU																		
Flow	L/min	6200.00	4000.00			3500.00	4000.00		3500.00	3000.00				2500.00	4500.00	6500.00	4000.00	4000.00	
Hardness	mg/L		169		174		214	189	192	216	248	186	194	164	206	158	179		183
Alkalinity - CaCO3	mg/L		150		170		160	170	170	170	230	180	180	190	190	150	160		170
Alkalinity	mg/L		<0.5		2.9		2.7	3.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.3	1.3	<0.5		3.3
Sulphate	mg/L		15		13		17	16	12	14	14	14	14	15	12	11	11		11
Hydroxide (OH)	mg/L		<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5
Carbonate (CO3)	mg/L		<0.5		3.5		3.2	4.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.9	1.5	<0.5		4
Bicarbonate (HCO3)	mg/L		180		200		190	200	210	210	290	220	220	230	230	180	200		200
Ammonia Nitrogen	mg/L		<0.005		<0.005		<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.016	<0.005	<0.005	<0.005		<0.005
Nitrate-Nitrite	mg/L		0.14		0.11		0.19	0.22	0.23	0.24	0.2	0.26	0.25	0.23	0.24	0.09	0.1		0.08
Cyanide - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.001	<0.0005		<0.0005
Aluminum - Total	mg/L		0.01		0.051		0.009	0.009	0.025	0.026	0.365	0.006	0.006	0.011	0.013	0.041	0.011		0.013
Antimony - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Arsenic - Total	mg/L		0.0004		0.0005		0.0004	0.0006	0.0005	0.0005	0.0008	0.0004	0.0005	0.001	0.0004	0.0004	0.0004		0.0004
Barium - Total	mg/L		0.031		0.034		0.036	0.035	0.033	0.037	0.082	0.039	0.043	0.07	0.046	0.034	0.035		0.037
Beryllium - Total	mg/L		<0.0001		<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
Bismuth - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Boron - Total	mg/L		<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05
Cadmium - Total	mg/L		0.000181		0.000227		0.000175	0.000156	0.000184	0.000221	0.00144	0.000153	0.000143	0.000158	0.000168	0.000165	0.00021		0.000179
Chromium - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Cobalt - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L		0.0004		0.0006		0.0003	0.0003	0.0014	0.0035	0.0016	0.0003	0.0003	0.0004	0.0005	0.0008	0.0003		0.0003
Iron - Total	mg/L		0.013		0.124		0.02	<0.005	0.091	0.057	0.732	0.009	0.007	0.012	0.023	0.067	0.015		0.021
Lead - Total	mg/L		0.000481		0.00163		0.000338	0.000403	0.00189	0.00453	0.0733	0.000631	0.000628	0.000592	0.000608	0.00474	0.000597		0.000594
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.002		0.006		0.002	0.002	0.003	0.004	0.393	<0.001	<0.001	0.002	0.004	0.013	0.002		0.002
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001		<0.001
Nickel - Total	mg/L		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Phosphorus - Total	mg/L																		
Selenium - Total	mg/L		0.0006		0.0006		0.0007	0.0007	0.0007	0.0007	0.0002	0.0007	0.0009	0.0004	0.0007	0.0006	0.0007		0.0007
Silicon - Total	mg/L		2.98		3.3		3.28	3.47	3.45	3.83	4.32	3.78	2.83	3.63	3.93	2.99	3.49		2.94
Silver - Total	mg/L		<0.00002		<0.00002		<0.00002	<0.00002	0.00002	<0.00002	0.00005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002		<0.00002
Strontium - Total	mg/L		0.216		0.215		0.253	0.236	0.248	0.26	0.31	0.242	0.25	0.196	0.278	0.206	0.226		0.232
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.00005		<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Titanium - Total	mg/L		<0.005		<0.005		<0.005	0.01	0.008	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Uranium - Total	mg/L		0.000899		0.00104		0.00103	0.00112	0.00134	0.00122	0.00114	0.00141	0.00131	0.00117	0.00108	0.000852	0.000953		0.00105
Vanadium - Total	mg/L		<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Zinc - Total	mg/L		0.006		0.01		0.006	0.01	0.01	0.011	0.268	0.01	0.016	<0.005	0.011	0.013	0.009		0.006
Zirconium - Total	mg/L		<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
Calcium - Total	mg/L		61.5		62.7		78.2	68.2	69.1	77.7	79.2	66.5	68.9	55.5	74.2	55.9	64.9		66
Magnesium - Total	mg/L		3.63		4.3		4.66	4.59	4.7	5.26	12.1	4.84	5.41	6.19	5.12	4.52	4.05		4.32
Potassium - Total	mg/L		0.37		0.42		0.5	0.5	0.5	0.57	0.89	0.46	0.5	0.36	0.59	0.59	0.36		0.42
Sodium - Total	mg/L		0.88		1		1.07	0.98	1.03	1.23	1.5	0.97	1.01	0.94	1	0.8	0.88		1.01
Sulphur - Total	mg/L		4		5		7	7	6	6	5	7	6	5	5	5	7		5

Water Quality (2006 to 2011)

MH-11 Upper False Canyon Creek

Collect Date/Time		2009	2009	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Collect Date/Time		24-Sep	24-Sep	23-Oct	15-Nov	09-Dec	13-Jan	16-Feb	07-Mar	11-Apr	04-May	14-Jun	20-Jul	16-Aug	16-Aug	21-Sep	21-Sep	23-Oct	14-Nov
pH - Lab	pH		8.3	8.2	8.4	8.2	8.3	8.3	8.2	8.3	8.2	8.3	8.44		8.35		8.38	8.34	8.17
pH - Field	pH	8.27		8.12	8.30	8.34	8.38	8.45	8.51	8.31	8.23	8.21	8.52	8.86		8.29		8.30	8.21
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		322	342	340	412	409	360	361	363	325	309	333		324		335	345	350
Total Suspended Solids	mg/L		<4	<4	<4	<4	5	<4	<4	<4	<4	<4	15		<4		<4	<4	<4
Total Dissolved Solids	mg/L		190	200	170	220	250	190	190	210	200	180	180		190		190	180	190
Turbidity	NTU		0.6	0.7	0.2	1	2.3	1.1	0.4	274	0.5	0.2	1.3		0.4		0.6	0.2	0.3
Turbidity - field	NTU																		
Flow	L/min	2500.00		2500.00	2500.00	2000.00	2500.00	2500.00	2500.00	2700.00	3000.00		3500.00	4000.00		4000.00		3500.00	3000.00
Hardness	mg/L		184	190	184	244	247	195	196	208	177	177	180		177		171	184	191
Alkalinity - CaCO3	mg/L		160	170	170	210	210	180	180	180	170	160	160		160		160	170	170
Alkalinity	mg/L		0.7	<0.5	2.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.3	4.8		2.5		2.4	1.4	<0.5
Sulphate	mg/L		16	15	13	13	14	16	14	15	11	16	14		17		18	17	15
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L		0.8	<0.5	2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.7	5.7		3		2.9	1.6	<0.5
Bicarbonate (HCO3)	mg/L		190	210	210	260	260	220	220	220	210	190	190		190		190	200	210
Ammonia Nitrogen	mg/L		<0.005	<0.005	<0.005	0.008	0.009	0.32	<0.005	<0.005	0.012	0.05	0.03		0.02		0.097	0.074	0.053
Nitrate-Nitrite	mg/L		0.18	0.21	0.2	0.11	0.13	0.24	0.25	0.22	0.17	0.15	0.06		0.04		0.04	0.21	0.19
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0033	<0.0005	<0.0005	<0.0005	<0.0005	0.001		<0.001		<0.001	<0.0005	<0.0005
Aluminum - Total	mg/L		0.006	0.012	0.013	0.011	0.065	0.011	0.009	0.014	0.014	0.023	0.156		0.023		0.018	0.008	0.047
Antimony - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L		0.0005	0.0004	0.0004	0.0002	0.0003	0.0004	0.0005	0.0004	0.0004	0.0006	0.0008		0.0006		<0.0001	0.0003	0.0003
Barium - Total	mg/L		0.034	0.034	0.037	0.081	0.079	0.043	0.043	0.047	0.041	0.035	0.043		0.043		0.043	0.038	0.041
Beryllium - Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	<0.001
Boron - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		0.058		<0.05	<0.05	<0.05
Cadmium - Total	mg/L		0.000229	0.000169	0.000157	0.000465	0.000493	0.000461	0.000488	0.000683	0.000174	0.000168	0.000285		0.000152		0.000101	0.000152	0.000273
Chromium - Total	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001		<0.001		<0.001	<0.001	<0.001
Cobalt - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005
Copper - Total	mg/L		0.0005	0.0004	<0.0002	0.0005	0.0008	0.0012	0.0022	0.0024	0.0013	0.0005	0.001		0.0013		0.0009	0.0011	0.0025
Iron - Total	mg/L		0.015	0.03	0.033	0.019	0.142	0.021	<0.005	0.033	0.022	0.04	0.295		0.063		0.035	0.013	0.031
Lead - Total	mg/L		0.0015	0.000441	0.000809	0.00198	0.013	0.01	0.0093	0.0107	0.00129	0.00122	0.0155		0.00545		0.00227	0.000658	0.0133
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.004	0.005	0.003	0.2	0.168	0.008	0.007	0.006	0.017	0.006	0.029		0.017		0.075	0.002	0.003
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001		0.002		0.002	<0.001	<0.001
Nickel - Total	mg/L		<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		0.017	<0.001	<0.001
Phosphorus - Total	mg/L																		
Selenium - Total	mg/L		0.0008	0.0006	0.0007	0.0003	0.0003	0.0008	0.0008	0.0009	0.0007	0.0007	0.0006		0.0006		0.0006	0.0008	0.0007
Silicon - Total	mg/L		3.44	3.58	3.34	4.01	4.19	3.82	3.81	3.97	3.55	3.26	3.09		2.84		2.76	3.51	3.78
Silver - Total	mg/L		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.0002		<0.00002		<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L		0.23	0.24	0.235	0.293	0.298	0.249	0.245	0.257	0.227	0.233	0.241		0.254		0.234	0.248	0.249
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005		<0.00005	<0.00005	<0.00005
Tin - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
Titanium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
Uranium - Total	mg/L		0.000949	0.00108	0.00118	0.000943	0.000965	0.00133	0.00141	0.00143	0.00107	0.000931			0.00118		0.0011	0.00114	0.00115
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
Zinc - Total	mg/L		0.018	0.008	0.009	0.122	0.126	0.061	0.066	0.101	0.015	0.012	0.036		0.016		0.024	0.009	0.033
Zirconium - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L		66.1	68.4	66.2	79	79.6	69.9	70.4	74	63.6	62.8	62.8				57.9	66.3	68.3
Magnesium - Total	mg/L		4.48	4.55	4.6	11.4	11.6	5.01	5.01	5.55	4.52	4.97	5.57				6.4	4.53	5.04
Potassium - Total	mg/L		0.54	0.5	0.45	0.94	1	0.5	0.49	0.56	0.73	0.62	0.6				0.78	0.46	0.51
Sodium - Total	mg/L		0.97	0.96	0.93	1.33	1.35	1	0.97	1.1	1.04	0.88	0.85				0.91	0.96	1.08
Sulphur - Total	mg/L		8	7	5	7	7	5	7	4	<3	7	7				7	6	5

Water Quality (2006 to 2011)

MH-11 Upper False Canyon Creek

Collect Date/Time		2010	2011	2011	2011	2011	2011	2011	2011	2011	2011
Collect Date/Time		11-Dec	23-May	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep	08-Oct	15-Nov	05-Dec
pH - Lab	pH	8.15	8.23	7.69		8.32	8.24	8.15	8.16	8.23	7.87
pH - Field	pH	8.24	8.24		8.24	8.14	8.62	8.42	8.17	8.36	8.16
Conductivity - Field	uS/cm										
Conductivity - Lab	uS/cm	358	268	1		319	315	329	338	347	331
Total Suspended Solids	mg/L	12	84	<4		<4	<4	<4	<4	<4.0	<4.0
Total Dissolved Solids	mg/L	200	150	160		190	180	170	190	218	166
Turbidity	NTU	4.4	21.5	0.9		0.4	0.3	0.4	0.6	0.25	0.19
Turbidity - field	NTU										
Flow	L/min	2000.00	2000.00		3500.00	4000.00	4000.00	4000.00	4000.00	3500.00	3500.00
Hardness	mg/L	200	149	136		154	174	193	172	182	161
Alkalinity - CaCO3	mg/L	180	130	140		150	150	150	160	161	159
Alkalinity	mg/L	<0.5	<0.5	1.1		1.5	<0.5	<0.5	<0.5	<0.50	<0.50
Sulphate	mg/L	15	13	13		14	18	17	19	24.2	13.7
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.50	<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5	1.3		1.8	<0.5	<0.5	<0.5	<0.50	<0.50
Bicarbonate (HCO3)	mg/L	210	150	170		180	180	190	200	197	194
Ammonia Nitrogen	mg/L	<0.005	<0.005	0.016		0.017	0.023	0.008	<0.005	0.017	0.0106
Nitrate-Nitrite	mg/L	0.21	0.29	0.13		0.07	0.1	0.1	0.07	0.04	0.208
Cyanide - Total	mg/L	<0.0005	0.0013	0.001		<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050
Aluminum - Total	mg/L	0.462	1.23	0.031		0.014	0.01	0.008	0.013	<0.01	0.015
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic - Total	mg/L	0.0011	0.0021	0.0004		0.0005	0.0005	0.0004	0.0004	0.0005	0.0004
Barium - Total	mg/L	0.048	0.051	0.031		0.036	0.036	0.037	0.036	0.041	0.034
Beryllium - Total	mg/L	<0.0001	<0.0002	<0.0002		<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002
Bismuth - Total	mg/L	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	<0.1	<0.1		<0.05	<0.05	<0.05	<0.05	<0.1	<0.1
Cadmium - Total	mg/L	0.00107	0.0006	0.0002		0.00019	0.00016	0.00016	0.00012	<0.0001	0.0003
Chromium - Total	mg/L	<0.001	<0.002	<0.002		0.001	<0.001	<0.001	<0.001	<0.002	<0.002
Cobalt - Total	mg/L	<0.0005	0.001	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0032	0.004	0.002		0.0017	0.0006	0.0005	0.0005	<0.001	0.002
Iron - Total	mg/L	0.617	2.29	0.057		0.562	0.021	0.021	0.047	<0.02	0.033
Lead - Total	mg/L	0.162	0.0166	0.0016		0.0022	0.0021	0.0015	0.0056	0.0005	0.0062
Lithium - Total	mg/L		<0.01	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Manganese - Total	mg/L	0.04	0.067	0.008		0.016	0.007	0.018	0.047	0.008	0.005
Mercury - Total	mg/L					<0.00005	<0.00005	<0.00005	<0.00005		
Molybdenum - Total	mg/L	<0.001	<0.001	<0.001		0.002	0.001	0.001	0.001	0.002	<0.001
Nickel - Total	mg/L	0.002	0.003	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Phosphorus - Total	mg/L										
Selenium - Total	mg/L	0.001	0.001	<0.0008		0.0008	0.0009	0.0007	0.0007	<0.0008	<0.0008
Silicon - Total	mg/L	4.51	4.33	2.47		2.67	2.94	2.86	2.7	2.4	3.07
Silver - Total	mg/L	0.00013	<0.0001	<0.0001		<0.00002	<0.00002	<0.00002	<0.00002	<0.0001	<0.0001
Strontium - Total	mg/L	0.258	0.196	0.202		0.211	0.224	0.227	0.228	0.236	0.219
Tellurium - Total	mg/L										
Thallium - Total	mg/L	0.00013	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	0.011	0.031	<0.01		<0.005	<0.005	<0.005	<0.005	<0.01	<0.01
Uranium - Total	mg/L	0.00133	0.0009	0.0009		0.001	0.001	0.001	0.001	0.0011	0.0012
Vanadium - Total	mg/L	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.344	0.042	<0.01		0.02	0.016	0.013	0.012	<0.01	0.025
Zirconium - Total	mg/L	<0.0005	<0.002	<0.002		<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002
Calcium - Total	mg/L	71.3	53	48		54.1	61.3	67.9	60.2	61.4	58
Magnesium - Total	mg/L	5.4	4	4		4.71	5.01	5.66	5.38	7.05	4
Potassium - Total	mg/L	0.54	<1	<1		0.51	0.52	0.59	0.57	0.77	<1
Sodium - Total	mg/L	1.04	<1	<1		1.1	0.85	1.09	0.81	0.99	<1
Sulphur - Total	mg/L	5	<60	<60		6	6	8	5	9	<60

Water Quality (2006 to 2011)

MH-13 False Canyon Creek - Upper (

Collect Date/Time		2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2009	2009	2009
Collect Date/Time		27-Mar	27-Mar	08-Jun	30-Aug	15-Dec	09-Apr	22-Jul	13-Sep	13-Sep	27-Nov	07-Mar	17-Jun	27-Jun	10-Oct	28-Dec	30-Mar	24-Jun	25-Jul
pH - Lab	pH		8.2	8.2	8.3	8.3	7.9	8.2	8.1	8.1	8.2	8.1	8.3		8.5	8.2	8.3	8.3	
pH - Field	pH	8.5		8.05	8.02	7.33	7.04	8.06	8.02	8.02	8.1	7.97		8.45	8.3	8.23			8.15
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		387	261	388	400	233	306	338	338	360	410	310		380	370	390	310	
Total Suspended Solids	mg/L		<4	20	14	<4	9	<4	7	7	<4	<4	8		5	8	<4	7	
Total Dissolved Solids	mg/L		238	164	210	220	144	178	202	202	210	210	170		250	210	220	170	
Turbidity	NTU		1.2	9	4.9	0.4	2.7	0.6	1	1	0.4	0.4	0.6		1.4	1	1.7	1.6	
Turbidity - field	NTU	450		280		380	250	300		310	350								
Flow	L/min																		
Hardness	mg/L		140	150	220	220	124	177	197	197	218	237	188		203	201	228	174	
Alkalinity - CaCO3	mg/L		218	157	200	202	117	160	181	181	190	220	160		210	200	210	160	
Alkalinity	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1		5.3	<0.5	<0.5	<0.5	
Sulphate	mg/L		12.2	6.4	5.9	6.8	7.7	6.1	4.5	4.5	11.3	12.5	8.9		6.6	8.2	9.3	6.2	
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2		6.4	<0.5	<0.5	<0.5	
Bicarbonate (HCO3)	mg/L		266	191	244	246	143	195	221	221	230	270	190		240	240	250	190	
Ammonia Nitrogen	mg/L		<0.005	0.058	0.046	0.178	0.454	0.009	0.012	0.012	0.037	0.017	<0.005		<0.005	0.024	<0.005	0.088	
Nitrate-Nitrite	mg/L		0.12	0.07	<0.02	0.09	0.06	0.02	0.03	0.03	0.04	0.18	0.04		0.04	0.22	0.14	0.07	
Cyanide - Total	mg/L		<0.0005	0.0006	0.0006	<0.0005	0.0017	<0.0005	<0.0005	<0.0005	0.0009	<0.0005	0.0005		<0.0005	<0.0005	<0.0005	0.0007	
Aluminum - Total	mg/L		0.05	0.17	0.07	<0.02	0.03	0.06	0.03	0.03	0.005	0.006	0.255		0.028	0.018	0.027	0.278	
Antimony - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Arsenic - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.0001	<0.0001	0.0005		0.0004	0.0001	0.0003	0.0006	
Barium - Total	mg/L		0.093	0.104	0.15	0.145	0.114	0.127	0.142	0.142	0.182	0.169	0.134		0.149	0.156	0.157	0.12	
Beryllium - Total	mg/L		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	
Bismuth - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	
Boron - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.009	<0.005	<0.05		<0.05	<0.05	<0.05	<0.05	
Cadmium - Total	mg/L		0.00005	0.00008	0.00018	0.00003	0.00019	0.0001	0.00003	0.00003	0.000026	0.000011	0.000156		0.000019	0.000036	0.000037	0.00021	
Chromium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.001		<0.001	<0.001	<0.001	<0.001	
Cobalt - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Copper - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0009	0.0006	0.0016		0.0003	0.0008	0.0013	0.0046	
Iron - Total	mg/L		0.169	0.386	0.519	0.207	1.23	0.157	0.295	0.295	0.008	0.008	0.47		0.207	0.111	0.252	0.61	
Lead - Total	mg/L		0.00126	0.00096	0.00124	0.00058	0.00118	0.00048	0.00015	0.00015	0.000521	0.000446	0.00177		0.000207	0.000581	0.000574	0.00153	
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.013	0.018	0.102	0.018	0.229	0.01	0.017	0.017	0.002	0.001	0.018		0.02	0.003	0.011	0.022	
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001		<0.001	<0.001	0.001	<0.001	
Nickel - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.001	<0.001	0.001		<0.001	<0.001	<0.001	0.001	
Phosphorus - Total	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1									
Selenium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.0011	0.0015	0.0008		0.0005	0.0006	0.0007	0.0005	
Silicon - Total	mg/L		3.44	2.68	2.88	3.21	2.53	2.85	2.82	2.82	2.28	2.9	3.05		3.12	3.56	3.67	3.35	
Silver - Total	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002	<0.00002	
Strontium - Total	mg/L		0.134	0.14	0.191	0.197	0.112	0.177	0.189	0.189	0.213	0.254	0.194		0.209	0.207	0.216	0.173	
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	
Tin - Total	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	
Titanium - Total	mg/L		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.005	<0.005	0.007		0.01	<0.005	<0.005	0.008	
Uranium - Total	mg/L		0.0007	0.00087	0.00124	0.00149	0.00046	0.00074	0.00087	0.00087	0.000458	0.000563	0.000922		0.000954	0.00137	0.00149	0.000846	
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	
Zinc - Total	mg/L		0.011	<0.005	<0.005	0.01	<0.005	0.005	0.013	0.013	0.005	<0.005	0.011		<0.005	<0.005	0.006	0.012	
Zirconium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Calcium - Total	mg/L		34.5	46	65.8	63.5	31.2	53.2	58.8	58.8	61.6	64.6	55.7		58.4	58.9	65	51.9	
Magnesium - Total	mg/L		13.2	8.5	13.1	14.7	11.1	10.6	12.3	12.3	15.6	18.4	11.9		13.8	13.2	15.9	10.8	
Potassium - Total	mg/L		<1	<1	<1	<1	2	1	<1	<1	0.64	0.63	0.52		0.47	0.47	0.44	0.48	
Sodium - Total	mg/L		888	0.69	1.04	1.03	1.1	0.93	1.06	1.06	1.11	1.2	1.18		1.03	1.24	1.03	0.86	
Sulphur - Total	mg/L		3.2	2.2	2.4	3.2	2	2	2.1	2.1	4	5	3		4	<3	5	4	

Water Quality (2006 to 2011)

MH-13 False Canyon Creek - Upper (

Collect Date/Time		2009	2009	2009	2010	2010	2010	2010	2010	2011	2011	2011	2011	2011	2011
Collect Date/Time		16-Sep	21-Sep	26-Dec	19-Mar	23-May	28-May	28-Sep	31-Dec	28-Mar	30-Mar	22-Jun	07-Oct	08-Oct	23-Dec
pH - Lab	pH		8.2	8.2	8.2		8.1	8.22	7.95		8.35	8	7.95		8.07
pH - Field	pH	8.16		8.22	8.27	8.21		8.25	8.24	8.13		8.16		8.02	8.35
Conductivity - Field	uS/cm														
Conductivity - Lab	uS/cm		342	365	376		253	354	382		382	244	332		371
Total Suspended Solids	mg/L		<4	<4	<4		28	<4	5		<4	9	<4		<4.0
Total Dissolved Solids	mg/L		170	200	210		150	190	200		210	130	180		190
Turbidity	NTU		0.5	1.1	0.8		10.1	1.3			0.8	2.3	0.8		1.31
Turbidity - field	NTU														
Flow	L/min														
Hardness	mg/L		185	209	214		142	180	222		209	137	164		194
Alkalinity - CaCO3	mg/L		180	200	200		140	180	200		200	130	170		192
Alkalinity	mg/L		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		3.4	<0.5	<0.5		<0.50
Sulphate	mg/L		6.9	6.7	7.7		5.7	8.7	7.5		8.8		8.2		9.52
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.50
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		4.1	<0.5	<0.5		<0.50
Bicarbonate (HCO3)	mg/L		220	240	250		170	220	240		240	150	210		234
Ammonia Nitrogen	mg/L		<0.005	0.016	<0.005		0.026	0.039	0.009		0.006	0.008	0.106		0.0127
Nitrate-Nitrite	mg/L		<0.02	0.09	0.11		0.07	<0.02	0.09		<2	0.04	0.02		0.086
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005		0.0006	<0.0005	0.0007		<0.0005	<0.0005	<0.0005		<0.00050
Aluminum - Total	mg/L		0.033	0.027	0.015		0.492	0.011	0.054		0.044	0.077	0.024		0.041
Antimony - Total	mg/L		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005
Arsenic - Total	mg/L		0.0003	0.0002	0.0002		0.0008	0.0002	0.0003		<0.0004	0.0005	<0.0004		<0.0004
Barium - Total	mg/L		0.146	0.156	0.157		0.118	0.122	0.159		0.145	0.1	0.117		0.139
Beryllium - Total	mg/L		<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.0002	<0.0002	<0.0002		<0.0002
Bismuth - Total	mg/L		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Boron - Total	mg/L		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05		<0.1	<0.1	<0.1		<0.1
Cadmium - Total	mg/L		0.000019	0.000077	0.000041		0.000099	0.00003	0.000143		<0.0001	<0.0001	<0.0001		<0.0001
Chromium - Total	mg/L		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.002	<0.002	<0.002		<0.002
Cobalt - Total	mg/L		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L		0.0019	0.0004	0.0011		0.0023	0.0005	0.0053		0.001	<0.001	0.002		<0.001
Iron - Total	mg/L		0.195	0.191	0.144		1.02	0.216	0.43		0.201	0.296	0.353		0.327
Lead - Total	mg/L		0.00003	0.00018	0.00207		0.00137	0.000778	0.000752		0.0005	0.0007	0.0021		0.0005
Lithium - Total	mg/L										<0.01	<0.01	<0.01		<0.01
Manganese - Total	mg/L		0.012	0.022	0.012		0.029	0.016	0.039		0.036	0.018	0.041		0.02
Mercury - Total	mg/L														
Molybdenum - Total	mg/L		<0.001	<0.001	0.001		<0.001	0.001	0.001		<0.001	<0.001	<0.001		0.001
Nickel - Total	mg/L		<0.001	<0.001	<0.001		0.002	<0.001	<0.001		<0.001	<0.001	0.001		0.002
Phosphorus - Total	mg/L														
Selenium - Total	mg/L		0.0005	0.0005	0.0007		0.0005	0.0005	0.0005		<0.0008	<0.0008	<0.0008		<0.0008
Silicon - Total	mg/L		2.82	3.78	3.48		3.36	2.86	3.6		3.08	2.78	3.35		3.12
Silver - Total	mg/L		<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002		<0.0001	<0.0001	<0.0001		<0.0001
Strontium - Total	mg/L		0.208	0.201	0.219		0.154	0.189	0.22		0.218	0.144	0.181		0.202
Tellurium - Total	mg/L														
Thallium - Total	mg/L		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Titanium - Total	mg/L		<0.005	<0.005	<0.005		0.007	<0.005	<0.005		<0.01	<0.01	<0.01		<0.01
Uranium - Total	mg/L		0.00082	0.00117	0.00166		0.000954	0.00129	0.00145		0.0016	0.0007	0.0008		0.0013
Vanadium - Total	mg/L		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Zinc - Total	mg/L		0.012	0.005	<0.005		0.011	<0.005	0.007		<0.01	<0.01	<0.01		<0.01
Zirconium - Total	mg/L		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.002	<0.002	<0.002		<0.002
Calcium - Total	mg/L		55.5	60.8	62.8		42.7	52.9	63		62	40	48		57
Magnesium - Total	mg/L		11.4	13.9	13.9		8.67	11.7	15.6		13	9	11		13
Potassium - Total	mg/L		0.55	0.47	0.43		0.59	0.43	0.56		<1	<1	<1		<1
Sodium - Total	mg/L		1.26	1.07	1.04		0.69	0.88	1.11		<1	<1	<1		<1
Sulphur - Total	mg/L		12	<3	<3		<3	5	<3		<60	<60	<60		<60

Water Quality (2006 to 2011)

MH-14 Tributary E - u/s False Canyo

Collect Date/Time		2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2009	2009	2009
Collect Date/Time		27-Mar	27-Mar	08-Jun	30-Aug	15-Dec	09-Apr	22-Jul	13-Sep	13-Sep	27-Nov	07-Mar	17-Jun	27-Jun	10-Oct	28-Dec	30-Mar	24-Jun	25-Jul
pH - Lab	pH		8.2	8.3	8.2	8.3	8.1	8.3	8	8	8.2	8.2	8.4		8.4	8.4	8.3	8.3	
pH - Field	pH	8.45		7.98	7.86	7.52	7.71	8.24	8.16	8.16	8.11	8.21		8.17	8.21	8.19			8.24
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		375	291	401	404	374	315	365	365	370	390	310		380	410	400	330	
Total Suspended Solids	mg/L		14	<4	<4	51	11	6	<4	<4	24	5	10		<4	30	<4	<4	
Total Dissolved Solids	mg/L		230	166	222	210	228	184	214	214	220	210	170		260	230	230	190	
Turbidity	NTU		4.5	0.2	0.3	1	3.4	0.9	0.3	0.3	6.6	2.2	0.8		0.1	2.7	3	1	
Turbidity - field	NTU	420		310		410	390	310		320	350								
Flow	L/min																		
Hardness	mg/L		240	170	240	220	213	183	217	217	234	230	159		207	219	224	187	
Alkalinity - CaCO3	mg/L		211	155	216	205	200	166	199	199	200	210	160		210	220	210	170	
Alkalinity	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4		4	2.8	<0.5	1.1	
Sulphate	mg/L		11.1	5.8	6.1	5.4	6.9	5.8	6	6	8.8	8.6	8.1		5.5	10	9.3	7	
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.6		4.8	3.3	<0.5	1.3	
Bicarbonate (HCO3)	mg/L		258	189	263	250	244	203	243	243	240	260	190		250	260	260	210	
Ammonia Nitrogen	mg/L		<0.005	0.029	<0.005	<0.005	0.02	<0.005	<0.005	<0.005	0.013	<0.005	<0.005		<0.005	0.038	0.024	0.012	
Nitrate-Nitrite	mg/L		0.14	<0.02	0.08	0.09	0.13	<0.02	0.05	0.05	0.1	0.13	0.05		0.05	0.23	0.13	0.04	
Cyanide - Total	mg/L		<0.005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0016	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Aluminum - Total	mg/L		0.06	<0.02	0.02	0.09	0.06	0.22	<0.02	<0.02	1.38	0.105	0.126		0.016	0.045	0.1	0.064	
Antimony - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Arsenic - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.0014	0.0004	0.0004		0.0003	0.0002	0.0004	0.0003	
Barium - Total	mg/L		0.19	0.119	0.177	0.179	0.172	0.144	0.179	0.179	0.233	0.171	0.11		0.178	0.182	0.182	0.131	
Beryllium - Total	mg/L		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	
Bismuth - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	
Boron - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.007	<0.005	<0.05		<0.05	<0.05	<0.05	<0.05	
Cadmium - Total	mg/L		0.00009	0.00004	0.00008	0.00004	0.00009	0.00011	0.00003	0.00003	0.000295	0.000033	0.000135		0.000026	0.000026	0.000039	0.000061	
Chromium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.003	<0.001	0.001		<0.001	<0.001	<0.001	<0.001	
Cobalt - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0009	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Copper - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0037	0.001	0.0015		0.0003	0.0005	0.0013	0.0014	
Iron - Total	mg/L		0.43	0.031	0.025	0.194	0.382	0.398	0.009	0.009	2.76	0.381	0.356		0.023	0.178	0.349	0.177	
Lead - Total	mg/L		0.00082	0.0006	0.00007	0.00024	0.00103	0.00061	0.0003	0.0003	0.00236	0.000513	0.00119		0.000499	0.000176	0.000509	0.00244	
Lithium - Total	mg/L																		
Manganese - Total	mg/L		0.025	0.003	<0.001	0.002	0.021	0.02	<0.001	<0.001	0.104	0.019	0.012		0.001	0.005	0.019	0.013	
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001		0.001	<0.001	<0.001	<0.001	
Nickel - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.003	<0.001	0.002		<0.001	<0.001	<0.001	<0.001	
Phosphorus - Total	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1									
Selenium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.0011	0.001	0.0006		0.0004	0.0009	0.0009	0.0007	
Silicon - Total	mg/L		4.08	2.88	3.67	3.57	3.62	3.17	3.75	3.75	4.63	3.55	2.48		4.13	4	3.87	3.22	
Silver - Total	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00006	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002	<0.00002	
Strontium - Total	mg/L		0.25	0.144	0.204	0.213	0.222	0.197	0.203	0.203	0.231	0.254	0.165		0.21	0.245	0.244	0.198	
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	
Tin - Total	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	
Titanium - Total	mg/L		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.025	<0.005	<0.005		0.007	<0.005	<0.005	<0.005	
Uranium - Total	mg/L		0.00088	0.00075	0.00089	0.00088	0.00081	0.00068	0.00078	0.00078	0.000895	0.000893	0.000921		0.000813	0.000836	0.000803	0.000779	
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	
Zinc - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	0.021	0.006	0.014		<0.005	<0.005	0.006	<0.005	
Zirconium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	
Calcium - Total	mg/L		69.1	50	70.2	65.4	61.6	54.3	63.8	63.8	69.2	66.6	47.4		59.7	60.8	63	55.2	
Magnesium - Total	mg/L		16.4	10.7	15.1	14.5	14.5	11.6	14.1	14.1	14.9	15.5	9.85		14.1	16.4	16.1	12	
Potassium - Total	mg/L		<1	<1	<1	<1	<1	<1	<1	<1	0.94	0.61	0.43		0.51	0.67	0.6	0.44	
Sodium - Total	mg/L		1.77	0.89	1.18	1.26	1.42	1.08	1.22	1.22	1.63	1.64	1		1.07	1.52	1.48	1.09	
Sulphur - Total	mg/L		3.1	2.1	2.7	2.9	3.3	2.3	2.2	2.2	3	4	<3		3	3	5	<3	

Water Quality (2006 to 2011)

MH-14 Tributary E - u/s False Canyo

Collect Date/Time		2009	2009	2010	2010	2010	2010	2010	2011	2011	2011	2011	2011	2011
Collect Date/Time		16-Sep	26-Dec	19-Mar	23-May	28-May	28-Sep	31-Dec	28-Mar	30-Mar	22-Jun	07-Oct	08-Oct	23-Dec
pH - Lab	pH	8.1	8.2	8.3		8.2	8.26	7.98		8.12	7.92	8.16		7.9
pH - Field	pH	8.22	8.2	8.22	8.25		8.37	8.32	8.16		8.12		8.2	8.28
Conductivity - Field	uS/cm													
Conductivity - Lab	uS/cm	348	392	381		369	363	401		391	253	361		382
Total Suspended Solids	mg/L	18	<4	<4		<4	<4	<4		<4	5	<4		<4.0
Total Dissolved Solids	mg/L	180	170	180		210	190	200		210	140	180		196
Turbidity	NTU	1.1	2.5	1.8		<0.1	1.2			1.6	1.6	0.9		1.63
Turbidity - field	NTU													
Flow	L/min													
Hardness	mg/L	194	224	222		214	180	232		230	151	178		200
Alkalinity - CaCO3	mg/L	180	210	200		200	190	200		200	130	190		196
Alkalinity	mg/L	<0.5	<0.5	0.7		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.50
Sulphate	mg/L	7.3	8.4	8.6		7	9.2	8.5		8.6		8.8		10.2
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5	0.8		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.50
Bicarbonate (HCO3)	mg/L	220	250	250		250	230	250		250	160	230		240
Ammonia Nitrogen	mg/L	0.009	0.014	<0.005		0.021	0.023	<0.05		0.015	0.007	0.04		0.0157
Nitrate-Nitrite	mg/L	<0.02	0.13	0.14		0.1	<0.02	0.13		0.14	<0.02	0.03		0.111
Cyanide - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	0.0007		<0.0005	<0.0005	<0.0005		<0.00050
Aluminum - Total	mg/L	0.049	0.056	0.017		0.004	0.016	0.025		<0.01	0.031	0.033		0.026
Antimony - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005
Arsenic - Total	mg/L	0.0004	0.0003	0.0003		<0.0001	0.0002	0.0003		<0.0004	0.0005	<0.0004		<0.0004
Barium - Total	mg/L	0.153	0.175	0.175		0.16	0.14	0.184		0.184	0.115	0.148		0.157
Beryllium - Total	mg/L	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001		<0.0002	<0.0002	<0.0002		<0.0002
Bismuth - Total	mg/L	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Boron - Total	mg/L	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05		<0.1	<0.1	<0.1		<0.1
Cadmium - Total	mg/L	0.00003	0.000062	0.00009		0.000032	0.000046	0.000159		<0.0001	<0.0001	<0.0001		<0.0001
Chromium - Total	mg/L	0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.002	<0.002	<0.002		<0.002
Cobalt - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L	0.0013	0.0012	0.0008		0.0006	0.0005	0.0083		<0.001	<0.001	<0.001		0.002
Iron - Total	mg/L	0.279	0.282	0.232		0.016	0.308	0.287		0.233	0.352	0.246		0.287
Lead - Total	mg/L	0.000218	0.000488	0.0013		0.00018	0.00125	0.00115		0.0009	0.0006	0.0003		0.0062
Lithium - Total	mg/L									<0.01	<0.01	<0.01		<0.01
Manganese - Total	mg/L	0.013	0.018	0.013		<0.001	0.023	0.027		0.017	0.031	0.019		0.022
Mercury - Total	mg/L													
Molybdenum - Total	mg/L	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Nickel - Total	mg/L	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Phosphorus - Total	mg/L													
Selenium - Total	mg/L	0.0007	0.0009	0.0011		0.0007	0.0006	0.0009		0.0009	<0.0008	<0.0008		0.0009
Silicon - Total	mg/L	2.98	4.27	3.98		3.47	2.98	4.08		3.7	3.16	2.66		3.27
Silver - Total	mg/L	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002	<0.00002		<0.0001	<0.0001	<0.0001		<0.0001
Strontium - Total	mg/L	0.22	0.235	0.248		0.222	0.211	0.249		0.26	0.156	0.234		0.229
Tellurium - Total	mg/L													
Thallium - Total	mg/L	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Titanium - Total	mg/L	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.01	<0.01	<0.01		<0.01
Uranium - Total	mg/L	0.00068	0.000859	0.000946		0.000895	0.000786	0.000796		0.0009	0.0006	0.0008		0.0008
Vanadium - Total	mg/L	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005		<0.005
Zinc - Total	mg/L	<0.005	0.007	0.005		<0.005	0.006	0.006		<0.01	<0.01	<0.01		<0.01
Zirconium - Total	mg/L	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005		<0.002	<0.002	<0.002		<0.002
Calcium - Total	mg/L	57	63.2	64.3		62.1	52	65.3		66	44	50		57
Magnesium - Total	mg/L	12.5	16	15.1		14.4	12.1	16.8		16	10	13		14
Potassium - Total	mg/L	0.59	0.64	0.55		0.46	0.5	0.65		<1	<1	<1		<1
Sodium - Total	mg/L	1.26	1.65	1.47		1.15	1.23	1.66		2	<1	2		1
Sulphur - Total	mg/L	14	4	<3		<3	5	3		<60	<60	<60		<60

Water Quality (2006 to 2011)

MH-16 Tributary C - d/s False Canyo

Collect Date/Time		2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2008	2008	2008	2010	2010	2011	2011	2011
Collect Date/Time		27-Mar	27-Mar	08-Jun	30-Aug	15-Dec	09-Apr	22-Jul	13-Sep	13-Sep	27-Nov	07-Mar	17-Jun	27-Jun	28-Sep	31-Dec	28-Mar	28-Mar	30-Mar
pH - Lab	pH		8.1	8.3	8.3	8.2	8.2	8.3	7.5	7.5	8.2	8.3	8.4		8.32	8.09			8.46
pH - Field	pH	8.67		8.18	8.31	8.06	8.06	8.36	8.3	8.3	8.16	8.14		8.21	8.52	8.36	8.16	8.1	
Conductivity - Field	uS/cm																		
Conductivity - Lab	uS/cm		195	281	382	403	384	320	898	898	370	380	320		375	405			397
Total Suspended Solids	mg/L		<4	6	<4	<4	<4	6	<4	<4	<4	<4	5		<4	<4			<4
Total Dissolved Solids	mg/L		112	150	220	214	232	184	216	216	230	210	170		210	230			210
Turbidity	NTU		2.1	0.8	0.7	0.6	1.1	1.1	0.9	0.9	1.4	1	1.1		0.9				1.2
Turbidity - field	NTU	230		300		400	410	310		300	350								
Flow	L/min																		
Hardness	mg/L		110	170	230	220	163	182	216	216	220	227	183		197	232			234
Alkalinity - CaCO3	mg/L		110	147	207	203	209	170	409	409	200	220	160		200	210			220
Alkalinity	mg/L		<0.5	1.2	2.3	<0.5	<0.5	1.4	<0.5	<0.5	<0.5	1.2	1.3		2.1	<0.5			4.9
Sulphate	mg/L		3.1	6.9	4.9	5.7	4.5	4.8	5	5	8	6.8	8.1		7.9	7.5			7.6
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5			<0.5
Carbonate (CO3)	mg/L		<0.5	1.4	2.7	<0.5	<0.5	1.7	<0.5	<0.5	<0.5	1.4	1.6		2.5	<0.5			5.8
Bicarbonate (HCO3)	mg/L		134	176	246	248	255	204	499	499	240	260	190		240	250			250
Ammonia Nitrogen	mg/L		<0.005	<0.005	0.044	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		0.05	<0.05			0.01
Nitrate-Nitrite	mg/L		0.03	0.02	<0.02	0.1	0.12	<0.02	<0.02	<0.02	0.08	0.11	0.02		<0.02	0.11			0.11
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	0.0052	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	0.0008			<0.0005
Aluminum - Total	mg/L		0.05	0.07	0.02	<0.02	<0.02	0.09	0.02	0.02	0.022	0.013	0.096		0.017	0.015			0.145
Antimony - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005			<0.0005
Arsenic - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.0003	0.0003	0.0005		0.0002	0.0003			<0.0004
Barium - Total	mg/L		0.159	0.122	0.175	0.169	0.132	0.145	0.163	0.163	0.157	0.17	0.129		0.152	0.185			0.19
Beryllium - Total	mg/L		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001			<0.0002
Bismuth - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001		<0.001	<0.001			<0.001
Boron - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.006	<0.005	<0.05		<0.05	<0.05			<0.1
Cadmium - Total	mg/L		0.00005	0.00003	0.00007	0.00003	0.00001	0.00003	0.00003	0.00003	0.00001	0.000042	0.000055		0.000028	0.000011			<0.0001
Chromium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001		<0.001	<0.001			<0.002
Cobalt - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005			<0.0005
Copper - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0004	0.0005	0.0007		0.0003	0.0002			<0.001
Iron - Total	mg/L		0.127	0.198	0.175	0.144	0.179	0.228	0.174	0.174	0.187	0.088	0.254		0.191	0.163			0.138
Lead - Total	mg/L		0.0102	0.00031	0.00015	0.00006	0.00021	0.0002	0.00037	0.00037	0.000087	0.000086	0.000538		0.000838	0.000036			0.0003
Lithium - Total	mg/L																		<0.01
Manganese - Total	mg/L		0.005	0.014	0.012	0.012	0.012	0.017	0.012	0.012	0.011	0.005	0.015		0.013	0.015			0.014
Mercury - Total	mg/L																		
Molybdenum - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.001	0.001		<0.001	0.001			0.001
Nickel - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.001	<0.001	<0.001		<0.001	<0.001			<0.001
Phosphorus - Total	mg/L		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1									
Selenium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.0006	0.0007	0.0006		0.0004	0.0006			<0.0008
Silicon - Total	mg/L		1.7	2.72	3.18	3.48	3.53	3.06	3.07	3.07	3.49	3	2.8		3.14	3.88			3.67
Silver - Total	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.00002	<0.00002	<0.00002		<0.00002	<0.00002			<0.0001
Strontium - Total	mg/L		0.072	0.156	0.209	0.207	0.158	0.183	0.204	0.204	0.205	0.232	0.181		0.204	0.229			0.246
Tellurium - Total	mg/L																		
Thallium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005			<0.00005
Tin - Total	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.005	<0.005	<0.005		<0.005	<0.005			<0.005
Titanium - Total	mg/L		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.005	<0.005	<0.005		<0.005	<0.005			<0.01
Uranium - Total	mg/L		0.00197	0.00076	0.00082	0.00084	0.00085	0.00065	0.00081	0.00081	0.000915	0.000951	0.000963		0.000871	0.000887			0.001
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005			<0.005
Zinc - Total	mg/L		0.041	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007		<0.005	<0.005			<0.01
Zirconium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005			<0.002
Calcium - Total	mg/L		31.9	50	67.6	62.8	42.6	53.4	63	63	64.3	65.2	53.9		55.9	63.7			67
Magnesium - Total	mg/L		8.04	10.3	14.3	14.6	13.8	11.8	14.2	14.2	14.3	15.5	11.8		13.9	17.7			16
Potassium - Total	mg/L		<1	<1	<1	<1	2	<1	<1	<1	0.47	0.52	0.45		0.49	0.52			<1
Sodium - Total	mg/L		0.37	0.9	1.34	1.31	974	0.93	1.33	1.33	1.3	1.5	1.1		1.13	1.46			1
Sulphur - Total	mg/L		0.5	2.5	2.2	2.9	2.6	2	2.4	2.4	3	<3	3		<3	<3			<60

Water Quality (2006 to 2011)

MH-16 Tributary C - d/s False Canyo

Collect Date/Time		2011	2011	2011	2011
Collect Date/Time		22-Jun	07-Oct	08-Oct	23-Dec
pH - Lab	pH	8.06	8.25		8.13
pH - Field	pH	8.21		8.18	8.15
Conductivity - Field	uS/cm				
Conductivity - Lab	uS/cm	261	360		386
Total Suspended Solids	mg/L	33	<4		<4.0
Total Dissolved Solids	mg/L	140	180		200
Turbidity	NTU	8.6	0.8		1.74
Turbidity - field	NTU				
Flow	L/min				
Hardness	mg/L	168	162		196
Alkalinity - CaCO3	mg/L	130	190		202
Alkalinity	mg/L	<0.5	<0.5		<0.50
Sulphate	mg/L		7.8		8.95
Hydroxide (OH)	mg/L	<0.5	<0.5		<0.50
Carbonate (CO3)	mg/L	<0.5	<0.5		<0.50
Bicarbonate (HCO3)	mg/L	160	230		246
Ammonia Nitrogen	mg/L	0.007	0.014		0.052
Nitrate-Nitrite	mg/L	0.02	<0.02		0.1
Cyanide - Total	mg/L	<0.0005	0.0005		0.00078
Aluminum - Total	mg/L	0.469	0.011		0.014
Antimony - Total	mg/L	<0.0005	<0.0005		<0.0005
Arsenic - Total	mg/L	0.001	<0.0004		<0.0004
Barium - Total	mg/L	0.151	0.137		0.157
Beryllium - Total	mg/L	<0.0002	<0.0002		<0.0002
Bismuth - Total	mg/L	<0.001	<0.001		<0.001
Boron - Total	mg/L	<0.1	<0.1		<0.1
Cadmium - Total	mg/L	0.0001	<0.0001		<0.0001
Chromium - Total	mg/L	<0.002	<0.002		<0.002
Cobalt - Total	mg/L	<0.0005	<0.0005		<0.0005
Copper - Total	mg/L	0.002	<0.001		<0.001
Iron - Total	mg/L	1.2	0.129		0.194
Lead - Total	mg/L	0.0023	0.0005		0.0003
Lithium - Total	mg/L	<0.01	<0.01		<0.01
Manganese - Total	mg/L	0.068	0.011		0.013
Mercury - Total	mg/L				
Molybdenum - Total	mg/L	0.001	0.001		<0.001
Nickel - Total	mg/L	0.002	<0.001		<0.001
Phosphorus - Total	mg/L				
Selenium - Total	mg/L	<0.0008	<0.0008		<0.0008
Silicon - Total	mg/L	3.67	2.44		3.27
Silver - Total	mg/L	<0.0001	<0.0001		<0.0001
Strontium - Total	mg/L	0.166	0.203		0.204
Tellurium - Total	mg/L				
Thallium - Total	mg/L	<0.00005	<0.00005		<0.00005
Tin - Total	mg/L	<0.005	<0.005		<0.005
Titanium - Total	mg/L	<0.01	<0.01		<0.01
Uranium - Total	mg/L	0.0008	0.0009		0.0009
Vanadium - Total	mg/L	<0.005	<0.005		<0.005
Zinc - Total	mg/L	<0.01	<0.01		<0.01
Zirconium - Total	mg/L	<0.002	<0.002		<0.002
Calcium - Total	mg/L	47	45		56
Magnesium - Total	mg/L	12	12		14
Potassium - Total	mg/L	<1	<1		<1
Sodium - Total	mg/L	<1	1		1
Sulphur - Total	mg/L	<60	<60		<60

Water Quality (2006 to 2011)

MH-22 Burnick Portal Discharge

Collect Date/Time		2006	2006	2006	2006	2006	2006	2006	2007	2007	2007	2008	2008	2009	2009	2009	2009	2009	2009	2010
Collect Date/Time		13-Jun	13-Jun	05-Jul	14-Aug	15-Sep	15-Oct	01-Nov	15-Sep	18-Sep	21-Oct	27-Jun	03-Sep	15-Jun	20-Jul	16-Aug	19-Aug	24-Sep	24-Sep	14-Jun
pH - Lab	pH		7.9	8.3	8.3	8.3	8.2	8.1					8.3	8.2	8.1		8.3		8.1	8.1
pH - Field	pH	8.2		8.41	8.43	8.20	8.16	8.18	8.07			8.47	8.43	8.14	8.07	8.17		8.17		8.22
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm		231	270	283	291	290	293					280	220	260		274		270	234
Total Suspended Solids	mg/L		<4	<4	<4	<4	<4	<4					<4	<4	<4		<4		<4	<4
Total Dissolved Solids	mg/L		160	174	184	182	178	182					140	140	130		140		190	140
Turbidity	NTU		0.4	0.6	0.2	0.1	0.1	0.2					0.4	0.9	0.4		0.8		0.8	0.2
Turbidity - field	NTU	250		270	300	490	310	300	220											
Flow	L/min		8.00	19.00	20.00	58.00	12.00	8.00		14.00	0.00		40.00	75.00	60.00	50.00				
Hardness	mg/L		120	140	150	160	160	150					149	109	143		138		147	121
Alkalinity - CaCO3	mg/L		95.2	96.3	106	108	104	106					100	88	99		100		100	92
Alkalinity	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	<0.5	<0.5		<0.5		<0.5	<0.5
Sulphate	mg/L		32.7	34.8	45.3	42.3	42.3	42.6					37	22	31		34		25	30
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	<0.5	<0.5		<0.5		<0.5	<0.5
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	<0.5	<0.5		<0.5		<0.5	<0.5
Bicarbonate (HCO3)	mg/L		116	118	130	132	127	130					130	110	120		130		130	110
Ammonia Nitrogen	mg/L		0.007	<0.005	<0.005	0.011	<0.005	<0.005					<0.005	<0.005	<0.005		<0.005		<0.005	0.06
Nitrate-Nitrite	mg/L		0.22	0.21	0.18	0.18	0.19	0.18					0.15	0.19	0.16		0.14		0.16	0.18
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005					<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005
Aluminum - Total	mg/L		<0.02	<0.02	<0.02	<0.02	0.003	<0.02					0.008	0.025	0.009		0.012		0.006	0.007
Antimony - Total	mg/L		<0.05	<0.05	<0.05	<0.05	0.003	<0.05					0.0032	0.003	0.0037		0.0046		0.0039	0.0033
Arsenic - Total	mg/L		<0.05	<0.05	<0.05	<0.05	0.005	<0.05					0.0038	0.0044	0.0044		0.0046		0.0053	0.0049
Barium - Total	mg/L		0.02	0.017	0.017	0.017	0.016	0.015					0.016	0.014	0.017		0.017		0.016	0.014
Beryllium - Total	mg/L		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002					<0.0001	<0.0001	<0.0001		<0.0001		<0.0001	<0.0001
Bismuth - Total	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05					<0.001	<0.001	<0.001		<0.001		<0.001	<0.001
Boron - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008					<0.05	<0.05	<0.05		<0.05		<0.05	<0.05
Cadmium - Total	mg/L		0.00362	0.00196	0.002	0.00228	0.00226	0.00232					0.00246	0.00181	0.00221		0.00231		0.00239	0.00203
Chromium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.001	<0.005					<0.001	<0.001	<0.001		<0.001		<0.001	<0.001
Cobalt - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.0005	<0.005					<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005
Copper - Total	mg/L		<0.005	<0.005	<0.005	<0.005	0.0003	<0.005					0.0004	0.0012	0.0003		<0.0002		<0.0002	0.0002
Iron - Total	mg/L		0.022	0.012	<0.005	<0.005	0.009	0.011					0.013	0.057	0.011		0.015		0.011	0.014
Lead - Total	mg/L		0.00166	0.00076	0.00055	0.00056	0.00049	0.00069					0.00092	0.00142	0.000666		0.000738		0.000546	0.000516
Lithium - Total	mg/L						0.007													
Manganese - Total	mg/L		0.003	0.003	<0.001	<0.001	<0.001	<0.001					0.002	0.007	0.001		<0.001		0.001	0.004
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L		0.008	0.011	0.009	0.013	0.012	0.01					0.011	0.011	0.011		0.012		0.011	0.011
Nickel - Total	mg/L		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008					0.003	0.002	0.003		0.003		0.003	0.003
Phosphorus - Total	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1												
Selenium - Total	mg/L		<0.03	<0.03	<0.03	0.03	0.013	<0.03					0.0115	0.0078	0.011		0.0125		0.0131	0.0092
Silicon - Total	mg/L		4.2	3.97	4.58	4.44	4.76	4.44					4.1	4.44	4.14		3.65		4.85	4.68
Silver - Total	mg/L		<0.01	<0.01	<0.01	<0.01	<0.0001	<0.01					<0.00002	<0.00002	<0.00002		<0.00002		<0.00002	<0.00002
Strontium - Total	mg/L		0.166	0.219	0.224	0.237	0.251	0.227					0.24	0.178	0.219		0.219		0.242	0.211
Tellurium - Total	mg/L																			
Thallium - Total	mg/L		<0.03	<0.03	<0.03	<0.03	<0.0001	<0.03					<0.00005	<0.00005	<0.00005		<0.00005		<0.00005	<0.00005
Tin - Total	mg/L		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					<0.005	<0.005	<0.005		<0.005		<0.005	<0.005
Titanium - Total	mg/L		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003					<0.005	<0.005	<0.005		<0.005		<0.005	<0.005
Uranium - Total	mg/L		0.00218	0.00338	0.00394	0.00471	0.00434	0.00454					0.00386	0.00231	0.00344		0.00405		0.00377	0.00279
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	<0.005	<0.005		<0.005		<0.005	<0.005
Zinc - Total	mg/L		0.418	0.327	0.41	0.436	0.471	0.443					0.314	0.195	0.332		0.372		0.439	0.279
Zirconium - Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	<0.0005
Calcium - Total	mg/L		42.2	46.3	50.1	52	53.6	48.7					49.1	36.3	47.3		45.4		48.2	39.9
Magnesium - Total	mg/L		4.19	6	6.73	6.67	6.48	6.03					6.53	4.47	5.95		6.04		6.36	5.25
Potassium - Total	mg/L		<1	<1	<1	<1	<1	<1					0.59	0.46	0.53		0.54		0.56	0.52
Sodium - Total	mg/L		0.73	0.88	0.94	0.94	0.93	0.88					0.88	0.74	0.83		0.81		0.93	0.82
Sulphur - Total	mg/L		10.2	11.6	12.6	13.6	14	13					13	11	12		12		14	11

Water Quality (2006 to 2011)

MH-22 Burnick Portal Discharge

Collect Date/Time		2010	2010	2010	2010	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011
Collect Date/Time		20-Jul	15-Aug	16-Aug	22-Sep	22-Sep	23-Oct	14-Nov	23-May	25-May	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep	08-Oct
pH - Lab	pH	8.14	8.11			8.2	8.16	7.99		5.06	8.3		8.25	8.09	8.14	8.09
pH - Field	pH	8.58		8.84		8.27	8.24	8.28	8.08			8.26	8.18	8.60	8.38	8.31
Conductivity - Field	uS/cm															
Conductivity - Lab	uS/cm	273	283			300	296	296		227	228		265	263	272	280
Total Suspended Solids	mg/L	<4	<4			<4	<4	<4		<4	<4		<4	<4	<4	<4
Total Dissolved Solids	mg/L	150	180			170	160	160		140	130		170	160	130	150
Turbidity	NTU	0.5	0.1			0.1	0.4	0.3		1.8	0.4		0.1	0.2	<0.1	<0.1
Turbidity - field	NTU															
Flow	L/min	35.00		60.00	35.00		30.00	25.00	40.00			50.00	50.00	50.00	40.00	40.00
Hardness	mg/L	132	142			148	141	171		112	111		120	129	151	135
Alkalinity - CaCO3	mg/L	110	110			110	110	100		53	90		98	97	100	100
Alkalinity	mg/L	<0.5	<0.5			<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Sulphate	mg/L	35	38			41	42	45		38	29		32	34	33	38
Hydroxide (OH)	mg/L	<0.5	<0.5			<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5	<0.5			<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	130	130			130	130	130		65	110		120	120	120	120
Ammonia Nitrogen	mg/L	0.022	0.025			<0.05	0.07	0.046		<0.005	0.017		0.007	<0.005	0.013	<0.005
Nitrate-Nitrite	mg/L	0.16	0.15			0.14	0.14	0.12		0.17	0.2		0.19	0.16	0.18	0.15
Cyanide - Total	mg/L	0.0008	<0.001			<0.001	<0.0005	<0.0005		0.0008	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L	0.009	0.023			0.006	0.003	0.014		0.052	0.011		0.007	0.008	0.003	0.004
Antimony - Total	mg/L	0.0033	0.0034			0.0042	0.0033	0.0034		0.0017	0.0029		0.0029	0.0031	0.003	0.0032
Arsenic - Total	mg/L	0.004	0.0041			0.0043	0.0042	0.0054		0.0042	0.0041		0.0041	0.0046	0.0045	0.004
Barium - Total	mg/L	0.015	0.016			0.019	0.016	0.018		0.014	0.014		0.015	0.014	0.015	0.015
Beryllium - Total	mg/L	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001		<0.0002	<0.0002		<0.0001	<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.001	<0.001			<0.001	<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05	0.053			<0.05	<0.05	<0.05		<0.1	<0.1		<0.05	<0.05	<0.05	<0.05
Cadmium - Total	mg/L	0.00233	0.00265			0.00269	0.00262	0.00268		0.0032	0.002		0.00208	0.00238	0.00236	0.00212
Chromium - Total	mg/L	0.001	<0.001			<0.001	<0.001	<0.001		<0.002	<0.002		<0.001	<0.001	<0.001	<0.001
Cobalt - Total	mg/L	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
Copper - Total	mg/L	0.0006	0.0006			0.0006	0.0003	0.0014		<0.001	<0.001		0.0013	0.0026	<0.0002	0.0002
Iron - Total	mg/L	0.01	0.054			<0.005	<0.005	0.172		0.113	0.021		0.027	0.02	<0.005	0.006
Lead - Total	mg/L	0.000449	0.000595			0.00167	0.000596	0.00228		0.0041	0.0008		0.0007	0.0007	0.0003	0.001
Lithium - Total	mg/L									<0.01	<0.01		<0.005	0.005	0.006	0.005
Manganese - Total	mg/L	0.001	<0.001			<0.001	<0.001	0.002		0.006	0.005		0.002	0.001	0.001	<0.001
Mercury - Total	mg/L												<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum - Total	mg/L	0.011	0.012			0.011	0.011	0.012		0.005	0.012		0.01	0.01	0.01	0.012
Nickel - Total	mg/L	0.003	0.003			0.019	0.004	0.003		0.002	0.003		0.003	0.003	0.003	0.003
Phosphorus - Total	mg/L															
Selenium - Total	mg/L	0.0112	0.0127			0.0152	0.0141	0.0178		0.0141	0.0101		0.0109	0.0122	0.012	0.011
Silicon - Total	mg/L	4.09	4.34			4.44	4.24	5.42		4.45	3.71		3.74	4.45	4.31	3.98
Silver - Total	mg/L	<0.00002	<0.00002			<0.00002	<0.00002	<0.00002		<0.0001	<0.0001		<0.00002	<0.00002	<0.00002	<0.00002
Strontium - Total	mg/L	0.216	0.235			0.26	0.251	0.266		0.211	0.197		0.196	0.211	0.219	0.23
Tellurium - Total	mg/L															
Thallium - Total	mg/L	<0.00005	<0.00005			<0.00005	<0.00005	<0.00005		<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005
Tin - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Titanium - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005		<0.01	<0.01		<0.005	<0.005	<0.005	<0.005
Uranium - Total	mg/L		0.00418			0.00423	0.00431	0.00437		0.0025	0.0029		0.003	0.0032	0.0033	0.0036
Vanadium - Total	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Zinc - Total	mg/L	0.345	0.41			0.553	0.493	0.555		0.372	0.236		0.29	0.364	0.391	0.308
Zirconium - Total	mg/L	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005		<0.002	<0.002		<0.0005	<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	43.4				48	46.2	56.7		38	36		39.4	42.2	49.8	44.3
Magnesium - Total	mg/L	5.83				6.77	6.29	7.22		4	5		5.28	5.73	6.57	5.88
Potassium - Total	mg/L	0.52				0.66	0.58	0.68		<1	<1		0.48	0.5	0.53	0.49
Sodium - Total	mg/L	0.75				0.81	0.83	0.98		<1	<1		0.91	0.78	1.01	0.74
Sulphur - Total	mg/L	12				15	15	16		<60	<60		10	12	14	11

Water Quality (2006 to 2011)

MH-22A Burnick Portal Discharge-by

Collect Date/Time		2006	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008
Collect Date/Time		13-Jun	21-May	19-Jun	19-Jun	19-Jul	12-Aug	15-Sep	24-Jun	27-Jun	19-Jul	23-Jul	15-Aug	18-Aug
pH - Lab	pH	7.9			8.1	8.2	8.3	8.1	8.1		8.1		8.3	
pH - Field	pH	8.34		8.31	8.31	8.27	8.45					8.14		8.21
Conductivity - Field	uS/cm													
Conductivity - Lab	uS/cm	217			209	225	247	259	220		250		270	
Total Suspended Solids	mg/L	<4			<4	<4	<4	<4	<4		<4		<4	
Total Dissolved Solids	mg/L	142			132	140	150	164	140		140		150	
Turbidity	NTU	0.5			0.4	0.5	0.6	0.2	0.3		0.2		0.5	
Turbidity - field	NTU	230		220		220	240							
Flow	L/min	68.00	54.00		54.00	50.00	45.00			70.00	60.00			60.00
Hardness	mg/L	120			116	118	131	137	118		129		145	
Alkalinity - CaCO3	mg/L	83.6			83.6	85.8	94.9	97.5	83		88		100	
Alkalinity	mg/L	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	
Sulphate	mg/L	25.1			23.4	25.5	29.4	34.8	23		31		37	
Hydroxide (OH)	mg/L	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	
Carbonate (CO3)	mg/L	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	
Bicarbonate (HCO3)	mg/L	102			102	105	116	119	100		110		120	
Ammonia Nitrogen	mg/L	0.005			<0.005	<0.005	<0.005	<0.005	0.006		<0.005		<0.005	
Nitrate-Nitrite	mg/L	0.25			0.21	0.17	0.19	0.17	0.17		0.15		0.13	
Cyanide - Total	mg/L	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005		<0.0005	
Aluminum - Total	mg/L	0.05			0.05	0.04	<0.02	<0.02	0.013		0.011		0.018	
Antimony - Total	mg/L	<0.05			<0.05	<0.05	<0.05	<0.05	0.0027		0.0027		0.0035	
Arsenic - Total	mg/L	<0.05			<0.05	<0.05	<0.05	<0.05	0.004		0.0041		0.0048	
Barium - Total	mg/L	0.014			0.015	0.014	0.016	0.016	0.015		0.016		0.017	
Beryllium - Total	mg/L	<0.0002			<0.0002	<0.0002	<0.0002	<0.0002	<0.0001		<0.0001		<0.0001	
Bismuth - Total	mg/L	<0.05			<0.05	<0.05	<0.05	<0.05	<0.001		<0.001		<0.001	
Boron - Total	mg/L	<0.008			<0.008	<0.008	<0.008	<0.008	<0.05		<0.05		<0.05	
Cadmium - Total	mg/L	0.00181			0.00163	0.00176	0.00189	0.00183	0.00202		0.00225		0.00089	
Chromium - Total	mg/L	<0.005			<0.005	<0.005	<0.005	<0.005	<0.001		<0.001		0.002	
Cobalt - Total	mg/L	<0.005			<0.005	<0.005	<0.005	<0.005	<0.0005		<0.0005		<0.0005	
Copper - Total	mg/L	<0.005			<0.005	<0.005	<0.005	<0.005	0.0004		0.0003		0.0004	
Iron - Total	mg/L	0.103			0.185	0.047	0.014	0.006	0.024		0.013		0.036	
Lead - Total	mg/L	0.00273			0.00146	0.00155	0.00526	0.00081	0.000962		0.000972		0.00082	
Lithium - Total	mg/L													
Manganese - Total	mg/L	0.012			0.008	0.007	0.004	0.003	0.006		0.004		0.003	
Mercury - Total	mg/L													
Molybdenum - Total	mg/L	<0.005			0.01	0.009	0.01	0.01	0.012		0.01		0.012	
Nickel - Total	mg/L	0.009			<0.008	<0.008	<0.008	<0.008	0.003		0.002		0.002	
Phosphorus - Total	mg/L	<0.1			<0.1	<0.1	<0.1	<0.1						
Selenium - Total	mg/L	<0.03			<0.03	<0.03	<0.03	<0.03	0.0086		0.0091		0.0123	
Silicon - Total	mg/L	4.37			3.88	4.49	4.09	3.99	4.16		3.58		4.52	
Silver - Total	mg/L	<0.01			<0.01	<0.01	<0.01	<0.01	<0.00002		<0.00002		<0.00002	
Strontium - Total	mg/L	0.181			0.168	0.197	0.194	0.199	0.181		0.202		0.21	
Tellurium - Total	mg/L													
Thallium - Total	mg/L	<0.03			<0.03	<0.03	<0.03	<0.03	<0.00005		<0.00005		<0.00005	
Tin - Total	mg/L	<0.02			<0.02	<0.02	<0.02	<0.02	<0.005		<0.005		<0.005	
Titanium - Total	mg/L	<0.003			<0.003	<0.003	<0.003	<0.003	<0.005		<0.005		0.008	
Uranium - Total	mg/L	0.00239			0.00226	0.00241	0.00318	0.00357	0.00229		0.00295		0.00181	
Vanadium - Total	mg/L	<0.005			<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	
Zinc - Total	mg/L	0.216			0.192	0.237	0.282	0.332	0.161		0.226		0.315	
Zirconium - Total	mg/L	<0.005			<0.005	<0.005	<0.005	<0.005	<0.0005		<0.0005		<0.0005	
Calcium - Total	mg/L	39.4			39.1	39.8	43.8	45.4	39.3		43		47.6	
Magnesium - Total	mg/L	4.39			4.36	4.55	5.24	5.7	4.72		5.33		6.4	
Potassium - Total	mg/L	<1			<1	<1	<1	<1	0.48		0.5		1.1	
Sodium - Total	mg/L	0.71			0.75	0.76	0.86	0.84	0.82		0.88		1830	
Sulphur - Total	mg/L	8.1			8.1	8.7	10.2	11.1	9		9		16	

Water Quality (2006 to 2011)

MH-25 Main Zone 1380 Portal

Collect Date/Time		2006	2006	2006	2006	2006	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008
Collect Date/Time		13-Jun	14-Jun	05-Jul	14-Aug	15-Sep	21-May	19-Jun	19-Jun	19-Jul	12-Aug	15-Sep	18-Sep	21-Oct	27-Jun	19-Jul	23-Jul	15-Aug	18-Aug	03-Sep
pH - Lab	pH		6.6	7.5	7.6	7.5			7.4	7.5	7.5	7.4				7.3		7.4		7.5
pH - Field	pH	7.46	7.46	7.42	7.61	7.72		7.23	7.23	7.38	7.51	7.35			8.47		7.30		7.46	7.37
Conductivity - Field	uS/cm																			
Conductivity - Lab	uS/cm		372	584	548	596			346	496	533	518				510		480		530
Total Suspended Solids	mg/L		28	20	<4	17			49	<4	30	10				<4		6		18
Total Dissolved Solids	mg/L		272	466	410	458			292	362	396	398				370		320		350
Turbidity	NTU		4.3	10.4	0.3	0.6			4.2	0.7	2.8	1.8				0.4		2.2		12.2
Turbidity - field	NTU		380	600	560	690		370		440	490	510								
Flow	L/min		39.00	5.00	4.00	6.00	22.00		22.00	12.00	18.00		12.00	0.00		15.00			10.00	10.00
Hardness	mg/L		150	250	240	260			148	199	191	225				203		192		220
Alkalinity - CaCO3	mg/L		30.6	32.2	43.7	39			29.7	34.2	38.4	46.9				41		47		49
Alkalinity	mg/L		<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5				<0.5		<0.5		<0.5
Sulphate	mg/L		145	250	245	257			141	189	205	209				180		180		210
Hydroxide (OH)	mg/L		<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5				<0.5		<0.5		<0.5
Carbonate (CO3)	mg/L		<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5				<0.5		<0.5		<0.5
Bicarbonate (HCO3)	mg/L		37.3	39.3	53.4	47.6			36.2	41.7	46.8	57.2				51		57		59
Ammonia Nitrogen	mg/L		0.009	<0.005	0.005	0.016			<0.005	<0.005	<0.005	<0.005				<0.005		<0.005		<0.005
Nitrate-Nitrite	mg/L		0.36	0.55	0.7	0.77			0.29	0.51	0.53	0.65				0.44		0.56		0.64
Cyanide - Total	mg/L		<0.0005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005				<0.0005		<0.0005		<0.0005
Aluminum - Total	mg/L		0.39	0.38	0.03	0.17			0.97	0.11	0.2	0.26				0.009		0.064		0.306
Antimony - Total	mg/L		<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	0.08	<0.05				<0.0005		<0.0005		0.0007
Arsenic - Total	mg/L		<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05				<0.0001		0.0003		0.0011
Barium - Total	mg/L		0.015	0.017	0.012	0.013			0.022	0.014	0.012	0.015				0.011		0.012		0.018
Beryllium - Total	mg/L		0.0003	<0.0002	<0.0002	<0.0002			0.0003	<0.0002	0.0003	<0.0002				<0.0001		<0.0001		<0.0001
Bismuth - Total	mg/L		<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	<0.05				<0.001		<0.001		<0.001
Boron - Total	mg/L		<0.008	<0.008	<0.008	<0.008			<0.008	<0.008	<0.008	<0.008				<0.05		<0.05		<0.05
Cadmium - Total	mg/L		0.302	0.402	0.323	0.4			0.32	0.371	0.421	0.311				0.44		0.305		0.376
Chromium - Total	mg/L		<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	0.005	<0.005				<0.001		<0.001		<0.001
Cobalt - Total	mg/L		0.009	<0.005	<0.005	0.007			0.008	0.006	0.011	<0.005				0.0056		0.0018		0.0043
Copper - Total	mg/L		0.007	<0.005	<0.005	<0.005			0.011	<0.005	0.011	<0.005				0.0007		0.0008		0.0032
Iron - Total	mg/L		2.86	1.43	0.095	0.797			3.54	0.417	1.66	0.536				0.025		0.172		0.687
Lead - Total	mg/L		3.36	1.07	0.0852	1.53			4.2	0.551	9.32	0.31				0.0758		0.126		0.271
Lithium - Total	mg/L																			
Manganese - Total	mg/L		0.503	0.198	0.123	0.303			0.638	0.254	0.369	0.154				0.135		0.062		0.228
Mercury - Total	mg/L																			
Molybdenum - Total	mg/L		<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005				<0.001		<0.001		<0.001
Nickel - Total	mg/L		<0.008	<0.008	<0.008	<0.008			<0.008	<0.008	<0.008	<0.008				<0.001		0.001		0.003
Phosphorus - Total	mg/L		0.1	<0.1	<0.1	<0.1			0.1	<0.1	<0.1	<0.1								
Selenium - Total	mg/L		<0.03	<0.03	<0.03	<0.03			<0.03	<0.03	<0.03	<0.03				0.0045		0.0038		0.0047
Silicon - Total	mg/L		5.32	4.8	4.19	4.74			6.79	3.53	4.54	4.28				3.54		3.38		4.18
Silver - Total	mg/L		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01				0.00004		0.00013		0.00026
Strontium - Total	mg/L		0.052	0.091	0.082	0.088			0.051	0.075	0.068	0.08				0.082		0.075		0.093
Tellurium - Total	mg/L																			
Thallium - Total	mg/L		<0.03	<0.03	<0.03	<0.03			<0.03	<0.03	<0.03	<0.03				<0.00005		<0.00005		<0.00005
Tin - Total	mg/L		<0.02	<0.02	<0.02	<0.02			<0.02	<0.02	<0.02	<0.02				<0.005		<0.005		<0.005
Titanium - Total	mg/L		<0.003	<0.003	<0.003	<0.003			0.021	<0.003	<0.003	<0.003				<0.005		0.01		0.017
Uranium - Total	mg/L		0.00015	0.00011	0.00005	0.00011			0.00023	0.00009	0.00015	0.00012				0.00005		0.000067		0.00013
Vanadium - Total	mg/L		<0.005	<0.005	<0.005	<0.005			0.006	<0.005	0.008	<0.005				<0.005		<0.005		<0.005
Zinc - Total	mg/L		36.6	50	42.1	48.1			41.8	41	42.4	37				39.5		29		36.6
Zirconium - Total	mg/L		<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005				<0.0005		<0.0005		<0.0005
Calcium - Total	mg/L		57.5	95.9	91.1	98.2			54.8	75.9	72.5	85.6				77.6		72.8		83.2
Magnesium - Total	mg/L		2.13	3.27	2.81	3			2.74	2.41	2.39	2.69				2.33		2.46		2.88
Potassium - Total	mg/L		<1	<1	<1	<1			<1	<1	4	<1				0.54		0.47		0.57
Sodium - Total	mg/L		0.24	0.64	0.71	0.7			0.48	0.44	0.66	0.63				0.6		0.87		0.75
Sulphur - Total	mg/L		50.6	88.6	77.3	87.2			51	69.8	65.2	71				68		64		76

Water Quality (2006 to 2011)

MH-25 Main Zone 1380 Portal

Collect Date/Time		2009	2009	2009	2009	2009	2010	2010	2010	2010	2011	2011	2011	2011	2011
Collect Date/Time		20-Jul	16-Aug	19-Aug	24-Sep	24-Sep	14-Jun	20-Jul	15-Aug	16-Aug	15-Jun	23-Jun	18-Jul	22-Aug	19-Sep
pH - Lab	pH	7.1		7.4		7.4	7.2	7.38	7.57		8.33		7.43	5.54	7.18
pH - Field	pH	7.87	7.90		7.96		7.51	7.82		8.01		7.85	7.56	7.85	7.62
Conductivity - Field	uS/cm														
Conductivity - Lab	uS/cm	480		515		528	385	462	413		284		473	3	514
Total Suspended Solids	mg/L	25		21		10	15	8	40		7		12	13	9
Total Dissolved Solids	mg/L	340		360		410	270	310	270		260		330	360	340
Turbidity	NTU	19.2		9.2		4.1	4.6	3.8	24.5		2.8		2.3	1.4	1.3
Turbidity - field	NTU														
Flow	L/min	10.00	12.00					10.00		8.00		40.00	30.00	30.00	15.00
Hardness	mg/L	199		202		218	158	174	182		130		178	180	237
Alkalinity - CaCO3	mg/L	35		39		42	29	39	53		29		31	2.5	43
Alkalinity	mg/L	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5
Sulphate	mg/L	180		180		180	150	170	150		160		170	180	200
Hydroxide (OH)	mg/L	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5
Carbonate (CO3)	mg/L	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5		<0.5		<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	43		48		52	35	48	64		36		38	3	53
Ammonia Nitrogen	mg/L	<0.005		<0.005		<0.005	<0.05	0.016	0.037		0.018		0.012	0.012	0.011
Nitrate-Nitrite	mg/L	0.39		0.37		0.61	0.34	0.44	0.47		0.28		0.48	0.46	0.53
Cyanide - Total	mg/L	0.0006		<0.0005		<0.0005	<0.0005	0.0008	<0.001		<0.0005		<0.0005	<0.0005	<0.0005
Aluminum - Total	mg/L	0.595		0.624		0.169	0.244	0.109	1.3		0.09		0.121	0.084	0.053
Antimony - Total	mg/L	0.0007		0.0011		0.0007	0.0012	0.0005	0.0015		0.0008		<0.0005	0.0005	<0.0005
Arsenic - Total	mg/L	0.0014		0.002		0.0007	0.0007	0.0003	0.0033		<0.0004		0.0004	0.0003	0.0001
Barium - Total	mg/L	0.016		0.02		0.015	0.013	0.011	0.027		0.01		0.012	0.013	0.011
Beryllium - Total	mg/L	0.0001		0.0002		<0.0001	<0.0001	<0.0001	0.0002		<0.0002		<0.0001	<0.0001	<0.0001
Bismuth - Total	mg/L	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	<0.001
Boron - Total	mg/L	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05		<0.1		<0.05	<0.05	<0.05
Cadmium - Total	mg/L	0.33		0.349		0.387	0.31	0.286	0.23		0.334		0.259	0.31	0.333
Chromium - Total	mg/L	<0.001		<0.001		<0.001	<0.001	0.001	0.002		<0.002		<0.001	<0.001	<0.001
Cobalt - Total	mg/L	0.0019		0.0024		0.0055	0.0053	0.0028	0.0022		0.0064		0.0019	0.0036	0.0024
Copper - Total	mg/L	0.0042		0.0053		0.0034	0.0033	0.0013	0.0076		0.002		0.0027	0.0017	0.001
Iron - Total	mg/L	1.08		1.79		0.478	1.35	0.301	2.67		0.445		0.288	0.365	0.086
Lead - Total	mg/L	0.167		0.457		0.536	1.08	0.301	0.548		0.404		0.337	0.372	0.069
Lithium - Total	mg/L										<0.01		<0.005	<0.005	<0.005
Manganese - Total	mg/L	0.075		0.229		0.354	0.242	0.104	0.276		0.185		0.082	0.206	0.115
Mercury - Total	mg/L												<0.00005	<0.00005	<0.00005
Molybdenum - Total	mg/L	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	<0.001
Nickel - Total	mg/L	0.005		0.006		0.003	0.003	0.002	0.009		0.002		0.003	0.002	0.001
Phosphorus - Total	mg/L														
Selenium - Total	mg/L	0.004		0.0043		0.0042	0.0037	0.0038	0.0031		0.004		0.0047	0.0042	0.0044
Silicon - Total	mg/L	4.93		6.29		4.35	4.36	3.43	6.7		2.79		3.2	3.48	3.87
Silver - Total	mg/L	0.00054		0.00102		0.0002	0.00058	0.00023	0.0013		0.0003		0.00027	0.00007	0.0001
Strontium - Total	mg/L	0.08		0.086		0.087	0.065	0.072	0.072		0.065		0.08	0.078	0.091
Tellurium - Total	mg/L														
Thallium - Total	mg/L	0.00007		0.00036		0.0003	0.00007	0.00033	0.00011		0.00066		0.0005	0.00011	<0.00005
Tin - Total	mg/L	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005		<0.005		<0.005	<0.005	<0.005
Titanium - Total	mg/L	0.014		0.022		0.006	0.007	<0.005	0.035		<0.01		<0.005	<0.005	<0.005
Uranium - Total	mg/L	0.000082		0.00017		0.00022	0.00017		0.000206		0.0001		0.0001	0.0001	<0.0001
Vanadium - Total	mg/L	<0.005		<0.005		<0.005	<0.005	<0.005	0.006		<0.005		<0.005	<0.005	<0.005
Zinc - Total	mg/L	33.2		35.9		40	29.6	28.7	24.1		31.3		28.1	29.9	37.5
Zirconium - Total	mg/L	<0.0005		<0.0005		<0.0005	<0.0005	<0.0005	0.0006		<0.002		<0.0005	<0.0005	<0.0005
Calcium - Total	mg/L	74.9		76.3		82.7	59.8	66.1			49		67.3	68.3	89.1
Magnesium - Total	mg/L	2.89		2.75		2.78	2.23	2.29			2		2.41	2.39	3.54
Potassium - Total	mg/L	0.56		0.53		0.53	0.53	0.47			<1		0.5	0.47	0.53
Sodium - Total	mg/L	0.55		0.59		0.6	0.4	0.59			<1		0.7	0.48	0.8
Sulphur - Total	mg/L	71		72		77	58	63			<60		64	67	87

SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN
MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX D - WATER QUALITY GRAPHS

Prepared by:

ACCESS
CONSULTING GROUP

FIGURE D-1
MH-4 - CAMP CREEK

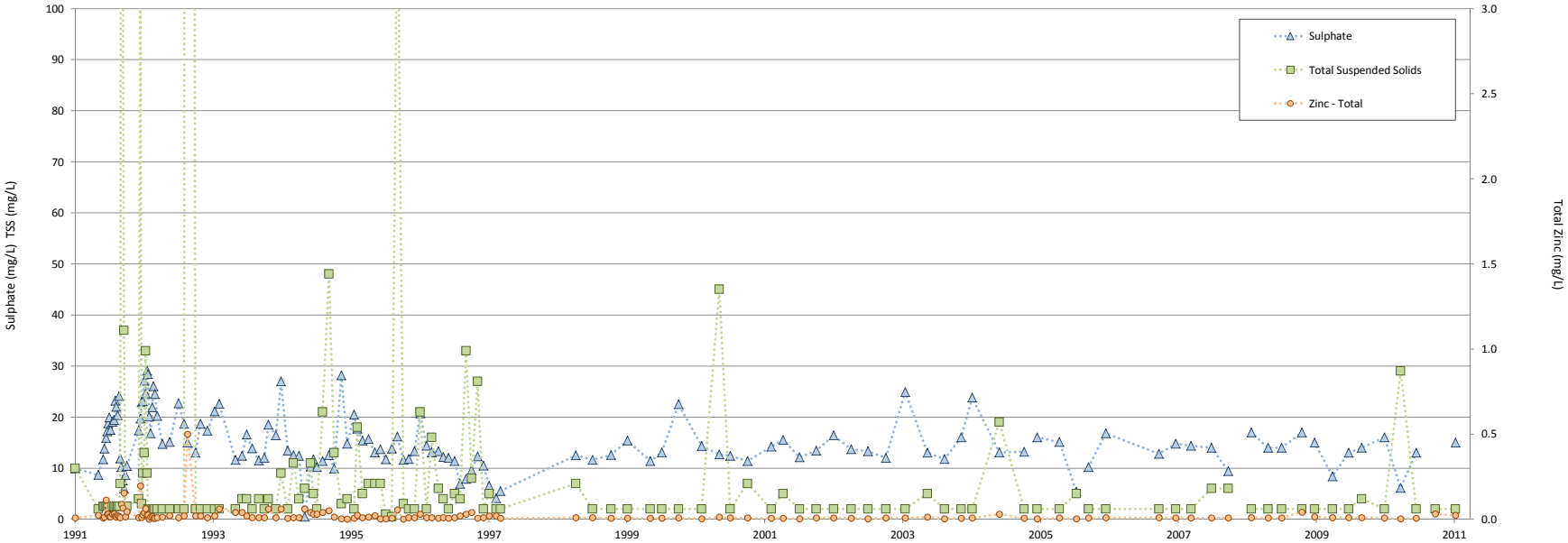


FIGURE D-2
MH-7 - RECLAIM DAM SEEPAGE

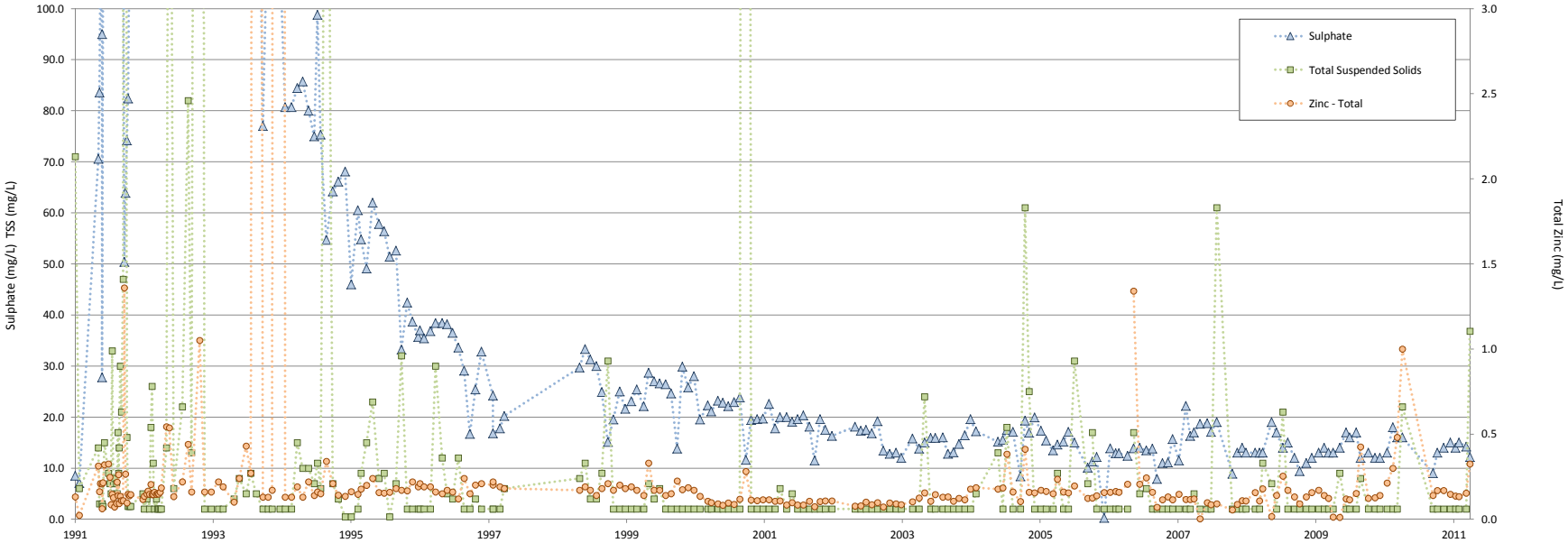


FIGURE D-3
MH-11 - UPPER FALSE CREEK CANYON

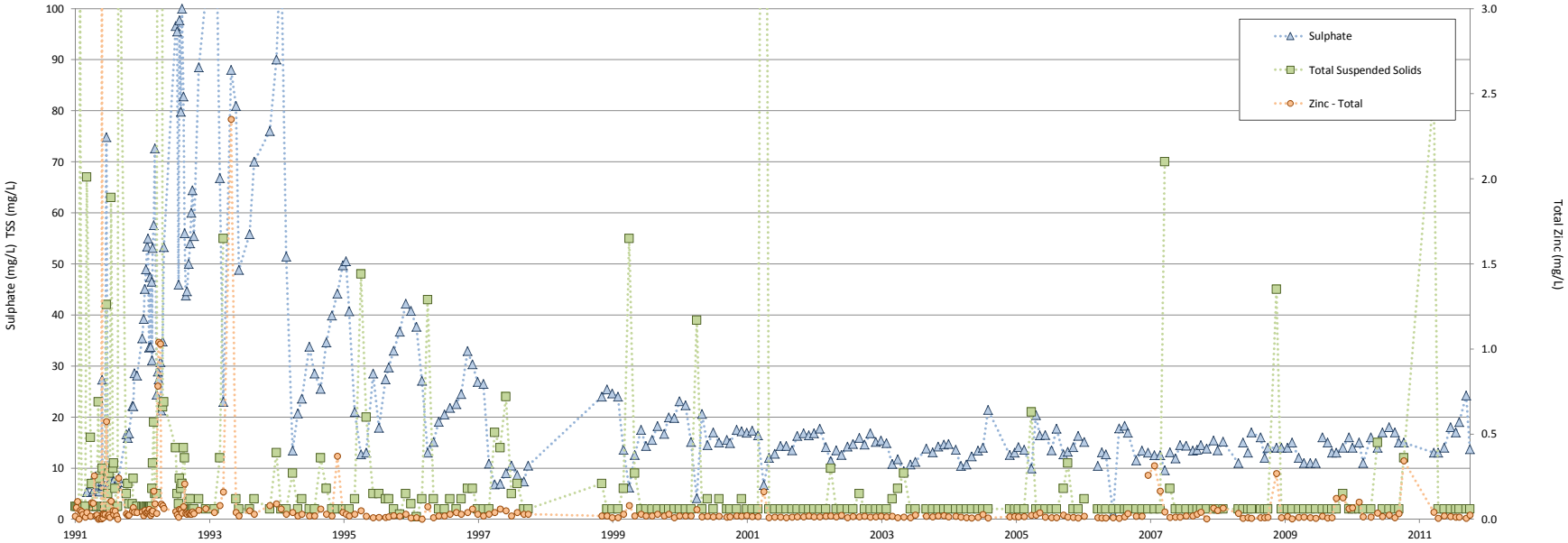


FIGURE D-4
MH-13 - FALSE CANYON CREEK - UPPER CREEK

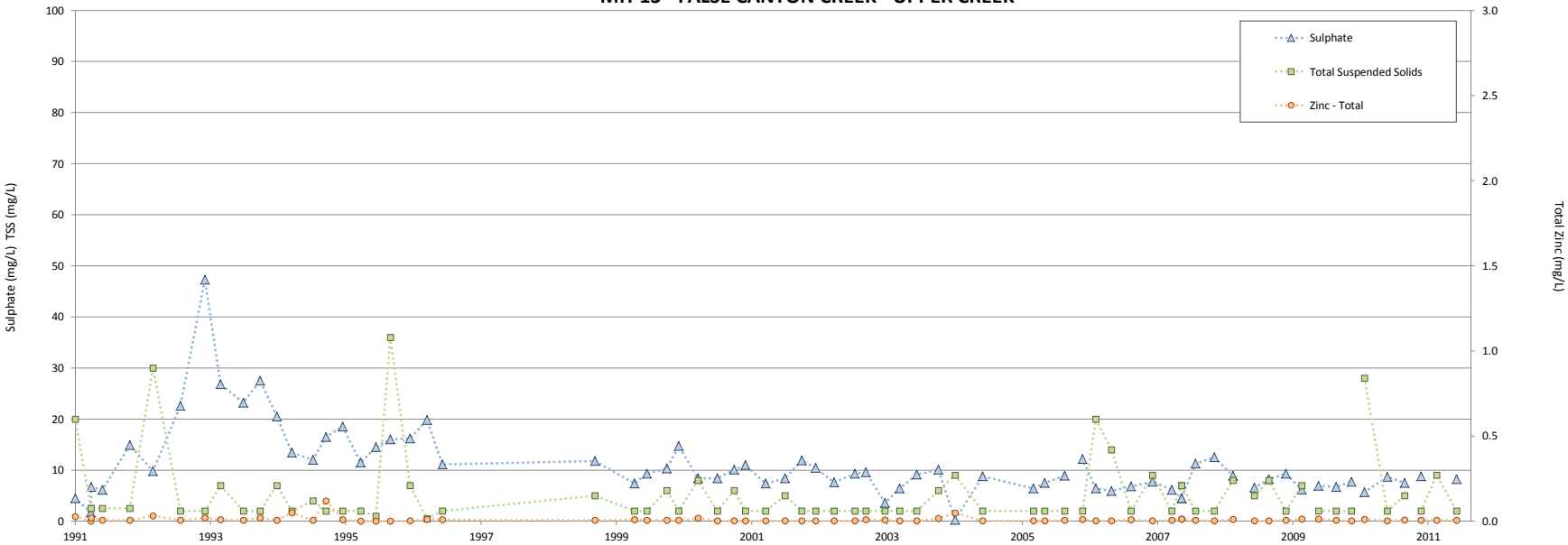


FIGURE D-5
MH-2 - NORTH DAM SEEPAGE

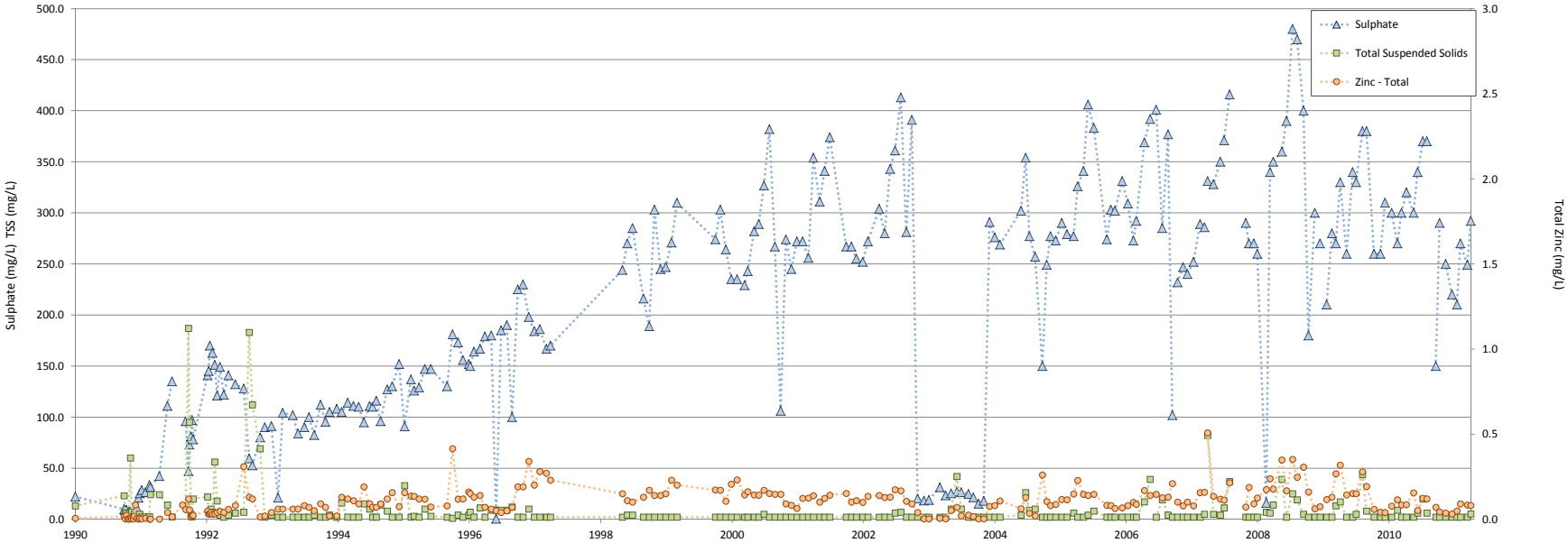


FIGURE D-6

MH-22 - BURNICK PORTAL DISCHARGE

TOTAL SUSPENDED SOLIDS / TOTAL ZINC

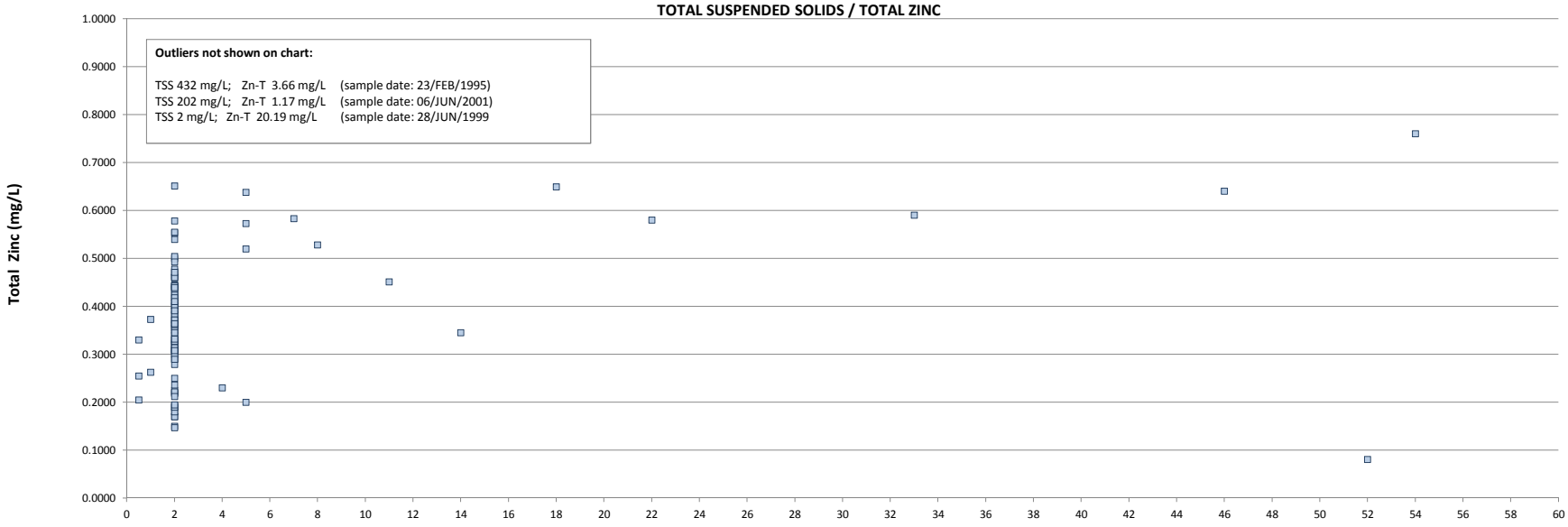


FIGURE D-7
MH-22 - BURNICK PORTAL DISCHARGE

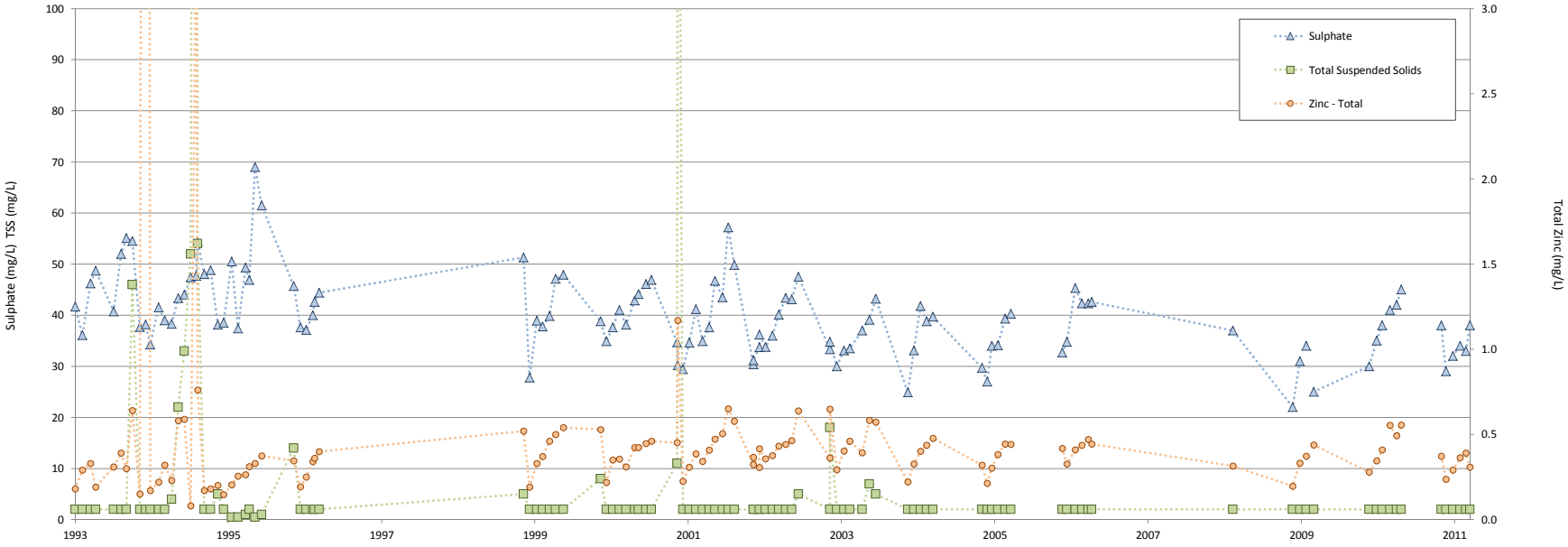
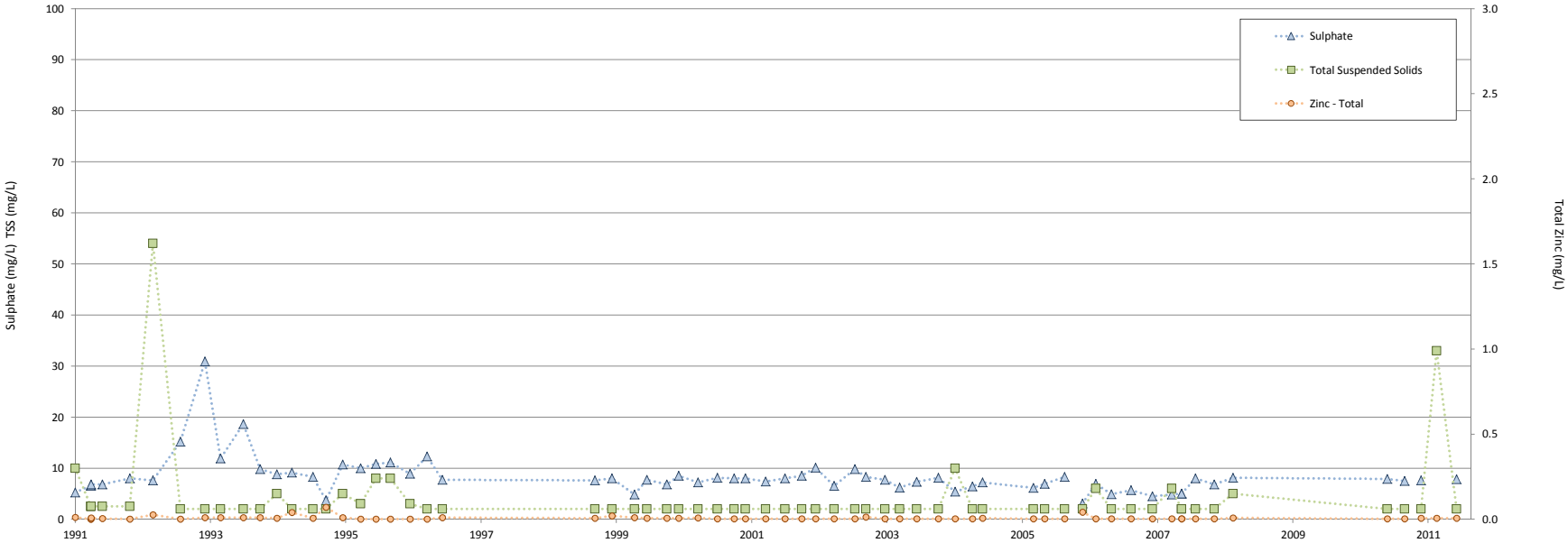


FIGURE D-8
MH-16 - TRIBUTARY C - DOWNSTREAM OF FALSE CANYON CREEK



SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN
MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX E – MARCH 2007 SRK LETTER REPORT

"SÄ DENA HES MINE – 1380 PORTAL"

Prepared by:

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March 12, 2007
1CT008.014

Teck Cominco Limited
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Attention: Bruce Donald

Dear Bruce

Sä Dena Hes Mine – 1380 Portal

Following the meeting with agency representatives at the Yukon Government offices on September 12, 2006, it was agreed to provide a brief synthesis of the conceptual model for discharge and attenuation of zinc from the 1380 Portal and evaluation of the potential effect of loss of attenuation capacity in the headwaters of Camp Creek.

Description of Flow and Chemistry Observations

The 1380 Portal accesses a very short adit into the Main Zone. Drainage from the portal was first sampled in June 1999 as part of preparation of the Closure Plan. The drainage was clear, colourless and non-acidic but was found to contain 41 mg/L zinc.

Teck Cominco inspected the adit in June 2003 to determine the source of drainage from the portal. Two sources of inflowing groundwater were found (Figure 1). Zinc concentrations were relatively low (1.36 and 0.22 mg/L). The water was then observed to contact mineralized wall rubble and zinc concentrations increased to 40 to 46 mg/L. Concentrations did not increase further as the water flowed toward the portal (Figure 1).

Drainage exiting the portal had consistent chemistry when monitored every other day in June and July 2000. Zinc concentrations varied between 40 and 50 mg/L, and the water was near pH neutral and dominated by sulphate, calcium and zinc.

Following heavy rain in June 2003, flow from the portal was observed to flow in two directions (Figure 1). The major flow entered the waste rock dump on the slopes above the creek and flowed through the waste rock not far from the surface before entering the creek. The same condition had been observed in the previous year. This water was sampled in July 2002 and found to have similar total dissolved solids to the portal drainage but had slightly lower sulphate, much lower zinc (10 mg/L compared to 49 mg/L at the portal) but higher calcium and alkalinity. The water pH was also higher (7.8 compared to 7.2).

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The smaller component of flow from the portal followed the road down toward a former settling pond and then into the gully (Figure 1). Teck Cominco's monitoring of waters in the gully in June 2003 showed that dissolved zinc concentrations in the gully decreased from 34.7 mg/L to 11.1 mg/L before the flow disappeared (Figure 1). No significant increase in flow in the gully was observed to account for the decrease in zinc concentrations

Water chemistry resembling the flow in the gully is not seen at any locations downstream despite monitoring by SRK of several springs feeding the headwaters of Camp Creek in July 2002. These locations are all several hundred metres from the locations where flow in the gully disappears. The main spring feeding Camp Creek was dominated by calcium and alkalinity (Figure 1). Zinc concentrations were 0.013 mg/L and sulphate 26 mg/L. No aspects of the spring water chemistry allowed it to be linked to the flow in the gully. Flow and chemistry measurements in Camp Creek during the bi-daily monitoring in June and July 2000 showed that the zinc load in Camp Creek was much lower than in the 1380 Portal drainage. However, sulphate loads in Camp Creek were consistently higher than in the portal drainage.

Conceptual Model

Zinc in the portal drainage originates from leaching of sphalerite in decomposing mineralized rock inside the adit. Oxidation of sphalerite (ZnS) produces zinc sulphate which is readily dissolved. Thermodynamic calculations showed that the drainage water was at maximum solubility for zinc carbonate. This explained Teck Cominco's observation that the zinc concentration in the drainage along the floor of the adit did not increase despite contact with mineralized rock along the flow path.

The decrease in zinc concentrations in the waste rock pile and along the gully may in part be explained by dilution but flows did not increase sufficiently to account for the decrease in zinc concentration from about 40 mg/L to near 10 mg/L. Thermodynamic calculations again showed that the waters were near maximum solubility for zinc carbonate despite the decrease in zinc concentrations. This could be explained by reaction of the drainage waters with dissolving marble causing the observed increase in pH and precipitation of zinc as zinc carbonate. This demonstrated that natural attenuation of zinc occurs by contact with the marble waste rock and talus in the gully.

There are two reasonable explanations for the increase in sulphate load in Camp Creek but deficit of zinc load in Camp Creek. Either the flow in the gully does not report to Camp Creek and the zinc and sulphate load in Camp Creek are from some other source, or the flow in the gully reports to Camp Creek but zinc is removed from the gully flow before it joins Camp Creek. The explanation for lack of zinc in this case would also need to account for the presence of sulphate load greater than found emanating from the portal. The monitoring data do not allow the two explanations to be evaluated.

SRK evaluated the second explanation experimentally by applying portal drainage to crushed marble comparable to the talus and natural rock placed in a laboratory column. The results clearly showed that sulphate was unaffected by passage through the column but zinc was removed becoming undetectable (<0.001 mg/L). The column was dismantled and rock near the top of the column was cemented by a zinc-bearing mineral which confirmed that the zinc was removed by precipitation. Zinc removal was far more effective than could be confirmed by thermodynamic calculations. While this did not prove that this removal mechanism occurs in the field, it confirmed that the natural soils at the site are capable of very efficiently removing zinc from the portal drainage. Removal of zinc could occur by two attenuation mechanisms. The first involves reaction with dissolving marble waste rock near the portal to produce zinc carbonate and resulted in concentrations near 10 mg/L. The second mechanism occurs in the soils further down slope and results in concentrations near 0.001 mg/L. Based on the results of the experiment, SRK calculated that the flow path length (600 m) between the gully and Camp Creek contained sufficient attenuation capacity to explain the lack of zinc load in Camp Creek in the time since the portal was opened.

The column experiment suggested that the rock had a finite attenuation capacity to remove zinc to low levels and it was predicted that this attenuation capacity could eventually be exhausted. Therefore, agency representatives have requested an evaluation of the effect of loss of attenuation capacity in the soils on water quality in Camp Creek. The results of a simple dilution calculation are provided in Table 1. The effect of loss of attenuation capacity is shown by the columns labelled "Breakthrough", which is simulated by assuming that the dominant load in the gully comes from the 1380 Portal and that the breakthrough concentration would be 10 mg/L. This concentration was selected (rather than the 40 to 50 mg/L observed at the portal) because the first zinc removal step occurs by reaction between dissolving limestone and the portal drainage which would be expected to persist and not be affected by formation of precipitates as occurs in the soil.

Table 1 shows that at location MH4 in Camp Creek predicted zinc concentrations are about 0.1 mg/L due to the roughly 100 times dilution in the Camp Creek. Further downstream at MH11 below the effect of South Dam seepage and Jewel Box Hill, predicted zinc concentrations are 0.04 to 0.06 mg/L. At MH13 in South False Canyon Creek, predicted concentrations are 0.01 to 0.02 mg/L. In reality, other chemical and biological factors will result in lower zinc concentrations than predicted by dilution effects alone.

The Metal Mining Effluent Regulations (MMER) do not currently apply to the Sa Dena Hes mine as it was not operating at the time that the MMER came into effect. However, if the mine re-starts production, the MMERs would then apply. The MMER would require that the mine meet the Schedule 4 authorized limit for metals concentrations at the Final Discharge Point. Teck Cominco assert (B. Donald, personal communication), based on MMER definitions, a logical location for this compliance point would be at MH11. The Schedule 4 authorized limit for zinc is 0.5 mg/L, the same as the current Water Licence standard. At MH4 the predicted zinc concentrations would be well below the 0.5 mg/L MMER standard, and at MH11, they would almost meet CCME guidelines (0.03 mg/L).

Conclusions

The conceptual model currently consists of the following components:

- Zinc sourced from dissolution of sphalerite oxidation products.
- Partial attenuation of zinc in the waste rock and gully below the 1380 Portal by interaction with dissolving marble-rich waste rock and soils.
- Strong attenuation of zinc in soils downstream of where the gully flow disappears.
- Minimal dilution of zinc concentrations by dilute surface waters.
- Unknown fate of gully drainage.

Using the conceptual model, and assuming that flow from the gully does report to Camp Creek, it was predicted that in the event of total loss of zinc attenuation capacity of the soils, zinc concentrations in Camp Creek would remain well below MMER standards and by MH11 (the logical "Final Discharge Point") could almost meet the CCME criterion.

Please contact the undersigned if you have any questions.

Yours truly,

SRK Consulting (Canada) Inc.



Stephen Day, P.Geo.
Principal Geochemist

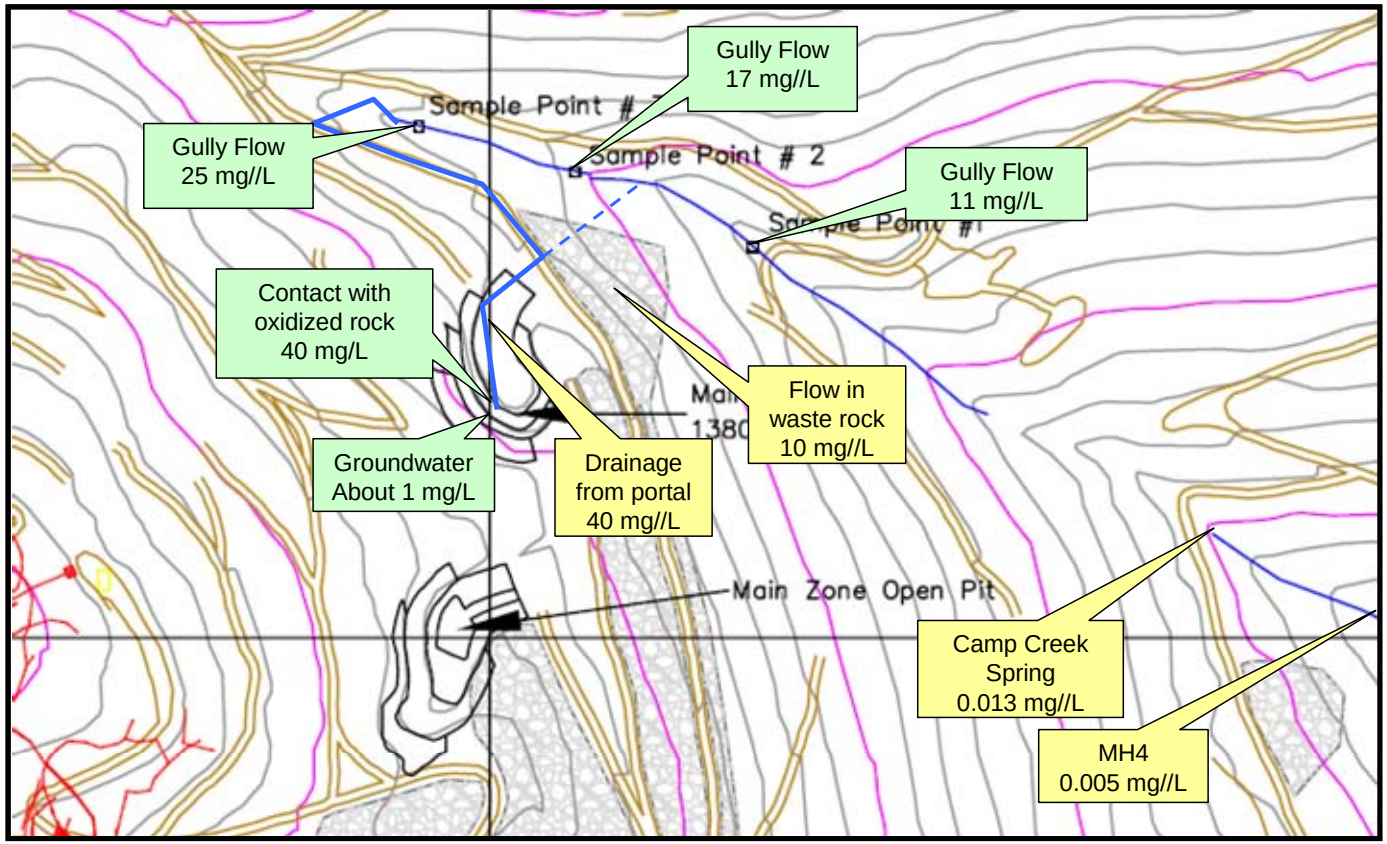


Figure 1: Compilation of Dissolved Zinc Concentrations as Determined by SRK (1999, 2000, 2002) (Yellow boxes) and Teck Cominco (2003) (Green boxes). Approximate flow paths between the portal and gully are shown.

Table 1: Calculated Effect on Camp Creek Water Quality Due to Loss of Attenuation Capacity in the Soils Below 1380 Portal

Month	1380 Portal		MH4			MH11			MH13		
	Flow	Zinc Breakthrough	Flow	Zinc Current	Zinc Breakthrough	Flow	Zinc Current	Zinc Breakthrough	Flow	Zinc Current	Zinc Breakthrough
	m^3/mo	mg/L	m^3/mo	mg/L	mg/L	m^3/mo	mg/L	mg/L	m^3/mo	mg/L	mg/L
June	2592	10	248570	0.007	0.1	667269	0.02	0.06	2093002	0.005	0.02
August	625	10	71502	0.006	0.1	203186	0.01	0.04	651751	0.005	0.01
October	446	10	51151	0.008	0.1	168422	0.01	0.04	568190	0.005	0.01

SÄ DENA HES OPERATING CORPORATION

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DETAILED DECOMMISSIONING & RECLAMATION PLAN
MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX F – JANUARY 2005 SRK LETTER REPORT
"WATER QUALITY AND LOADING RE-ASSESSMENT"

Prepared by:

srk consulting

Sä Dena Hes Mine

Water Quality and Loading Re-Assessment

Report Prepared for

TeckCominco Ltd.



Report Prepared by



January 2005

Sä Dena Hes Mine

Water Quality and Loading Re-Assessment

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Appendix A. Location of Monitoring Stations

1 Introduction

Appendix B of the 2000 Detailed Decommissioning & Reclamation (D&R) Plan for the Sä Dena Hes Mine contained an evaluation of loadings in surface water flows as a tool for evaluating reclamation priorities. Inputs to the model were based on flow and water quality data available up to 1998 during which water quality was changing following cessation of mining at the site in 1992. The current Type "A" Licence requires an update of the loading calculations. SRK Consulting (Canada) Inc. (SRK) was retained by TeckCominco Ltd. to review water quality data collected in the last six years and re-calculate the loadings. The purpose of the review was to determine whether significant changes in water chemistry have occurred and how these might affect overall loadings from the site.

2 Methods

2.1 Water Quality Trends

The original water quality database containing water quality data up to December 1998 was updated using information provided by TeckCominco. The original and revized databases were merged into a single spreadsheet. Water quality trends were evaluated using time-series plots. Based on previous experience, the review was focussed on the following parameters for the indicated reasons:

- **Sulphate**. Sulphate is an indicator of the effect of the site on surface water chemistry due to oxidation of sulphide minerals in mine facilities although it may also be released by leaching of natural sulphate minerals. After leaving the individual mine sources, sulphate is typically chemically conservative[1] at Sä Dena Hes due to the effects of dilution which prevents precipitation of sulphates. It is therefore a useful parameter for understanding trends and tracking sources of load.

- **Total Suspended Solids (TSS)**. TSS was evaluated because the database contains metal concentrations determined primarily on unfiltered samples. It typically therefore provides an indication of possible differences between leaching effects which release metals in dissolved form and erosional processes that release metals in suspended form. Suspended matter may also be produced by chemical precipitation though this does not appear to be a common process at Sä Dena Hes.

[1] "Conservative" in this context means that the mass of sulphate is unchanged. Concentrations may fluctuate due to addition of water, but once a quantity of sulphate is added to the water it is not removed from solution either by formation of a solid or by chemical transformation to another dissolved species.

- **Total Zinc**. Dissolved zinc concentrations are a direct indicator of release of zinc produced by oxidation of zinc sulphide. Provided that TSS is very low, total zinc loadings can also be used to indicate the effects of zinc leaching from mine facilities.

2.2 Loading Calculation

The loading calculation approach was comparable to that used for the 2000 Detailed D&R Plan. The overall flow network considered in the loading calculation is shown in Figure 1. Monitoring locations are shown in Appendix A.

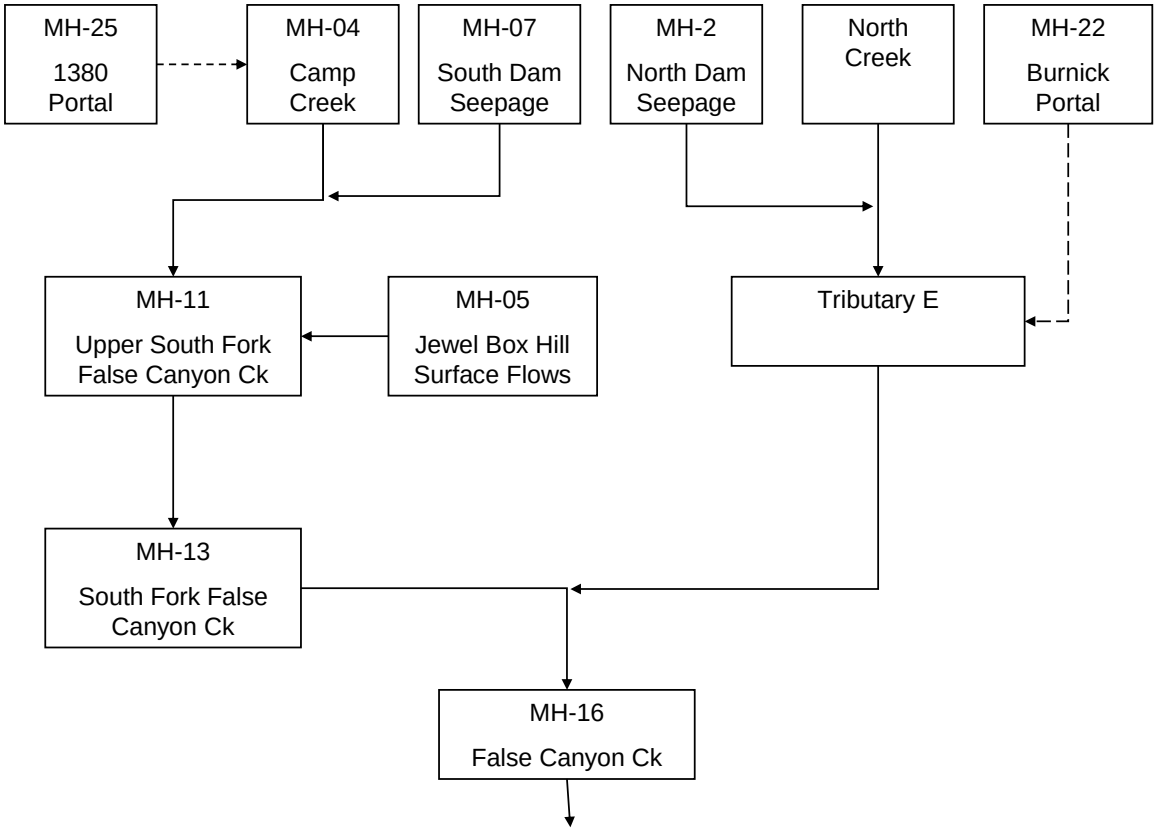


Figure 1. Flow Network Used in Loading Calculations. Solid lines indicate surface flow connections. Dashed line indicates subsurface flow connection.

The flow network used in the 2000 Detailed D&R Plan considered MH-22 (North Hill Settlement Basin) as a direct surface flow connection to Tributary E. Subsequent work reported by SRK Consulting (2003) has demonstrated that MH-22 does not have a surface connection to Tributary E and that soils in the slopes below MH-22 significantly attenuate zinc concentrations to low levels (<0.001 mg/L). Sulphate is not attenuated and monitoring sulphate concentrations are used for calculation. The original loading balance has been re-calculated and the current loading balance calculated using attenuated zinc concentrations for MH-22 indicated by laboratory studies.

MH-25 (Main Zone 1380 Portal) was not specifically included in the 2000 Detailed D&R Plan because the source is part of the MH-4 catchment though not through surface flow. The approach used to include MH-25 in the load balance is the same as that for MH-22. Attenuated zinc concentrations from laboratory tests and sulphate concentrations from site monitoring were used as inputs to the load balance.

The inputs to the loading calculation are surface water flows and chemistry. In the previous version, data collected from the three years prior to and including 1998 (ie 1996, 1997 and 1998) were used to calculate monthly median concentrations and flow rates. For the current version, a similar approach was used though 2004 was not included because the complete dataset for that year was not available. If possible, median input values were calculated for 2001, 2002 and 2003. For sites with limited data, the range was expanded. MH-04 statistics were estimated from 1999 to 2003. Data collected from MH-02 in 2003 and 2004 are believed to be erroneous by TeckCominco and were not used. Data from 2000 were used instead. Data for MH-25 were available for 2002 and 2003.

For small discrete flows (MH-02, MH-07, MH-22 and MH-25), flow rates are routinely recorded at the time of water sample collection. Median flow rates were calculated based on the year ranges indicated above. Flow measurements are not collected for the creeks (Camp Creek, False Canyon Creek). For the load calculations, average monthly flows calculated for the 2000 Detailed D&R Plan were used for the creeks.

Loadings were calculated for sulphate and zinc for the reasons indicated in Section 2.1. The loads for each source in each month are calculated in kg/month. To evaluate the significance of sources of individual loadings in the basin, the percentages of load compared to the load at the lowest station (MH-16) were calculated.

Finally, the background zinc and sulphate loadings and concentrations for each component of the basin were back-calculated using:

Background Loading = Loading at Station – Loading at Upstream Sources

Background Concentration =

(Loading at Station – Loading at Upstream Sources)/(Flow at Station – Flow at Upstream Sources)

The background loading calculation provides the context for the mine area loadings by indicating the contribution from natural weathering of soils and background in the catchment basin. The background concentrations indicate variations in the natural release of sulphate and zinc, potential missing sources in the mine area, and overall reliability of the balance.

3 Results and Discussion

3.1 Data Trends

3.1.1 South Fork False Canyon Creek

The main known sources in this catchment area are Camp Creek (MH-04) and seepage from the South Dam (MH-07). The east slope of Jewelbox Hill also contributes to the catchment area but not through visible surface flow. Intermittent flow is observed near the site gatehouse.

Camp Creek (MH-04) receives flow from the natural mineralized exposure on the north side of Jewelbox Hill as well as from the Main Zone Pit and 1380 Portal (MH-25) via subsurface flow. The 1380 Portal continues to be a source of elevated zinc concentrations and loads exceeding loads at MH-04 (Figure 2). Investigations subsequent to the 2000 Detailed D&R Plan (SRK Consulting 2003) indicated that this load reduction is probably occurring as a result of strong attenuation in waste rock and talus below the portal.

Monitoring results for MH-04 indicate that zinc concentrations have been low and decreasing slightly since 1998 (Figure 3). Sulphate concentrations have been relatively stable for at least ten years.

Monitoring data for the South Dam seepage (MH-07) show a continuing long term decrease in sulphate concentrations which began when operations ceased. Zinc concentrations appeared to increase in the late 1990s reaching concentrations approaching 0.3 mg/L following a trend opposite to sulphate. Zinc concentrations decreased from 1998 to 2001. In 2003 and 2004, zinc concentrations increased from 0.07 mg/L to 0.18 mg/L (Figure 4).

Limited data are available for MH-05 and were not included in the review or subsequent loading calculations.

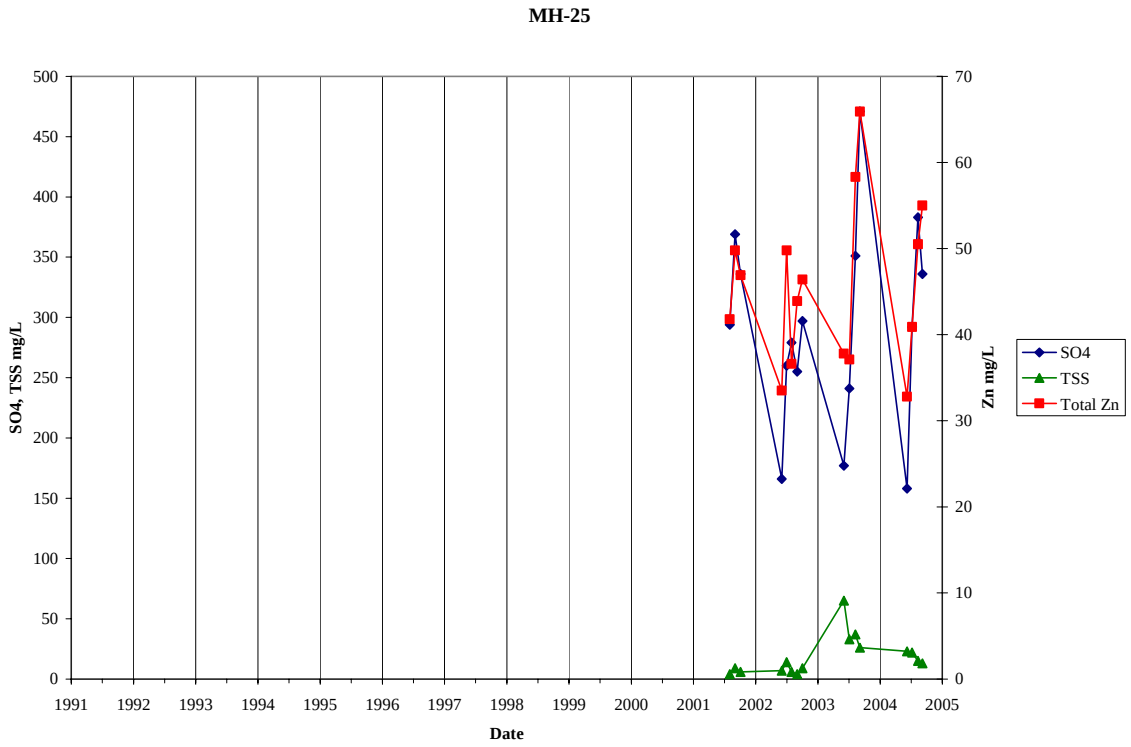


Figure 2. Monitoring Results for 1380 Portal (MH-25).

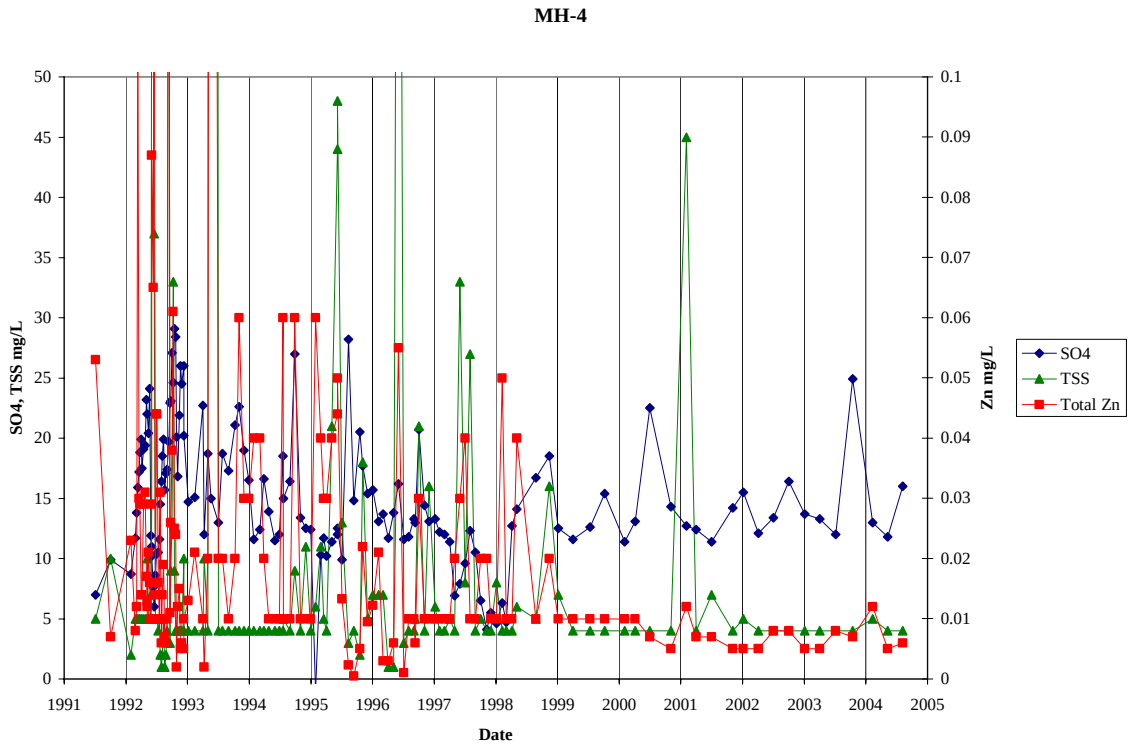


Figure 3. Monitoring Results for Camp Creek at MH-4

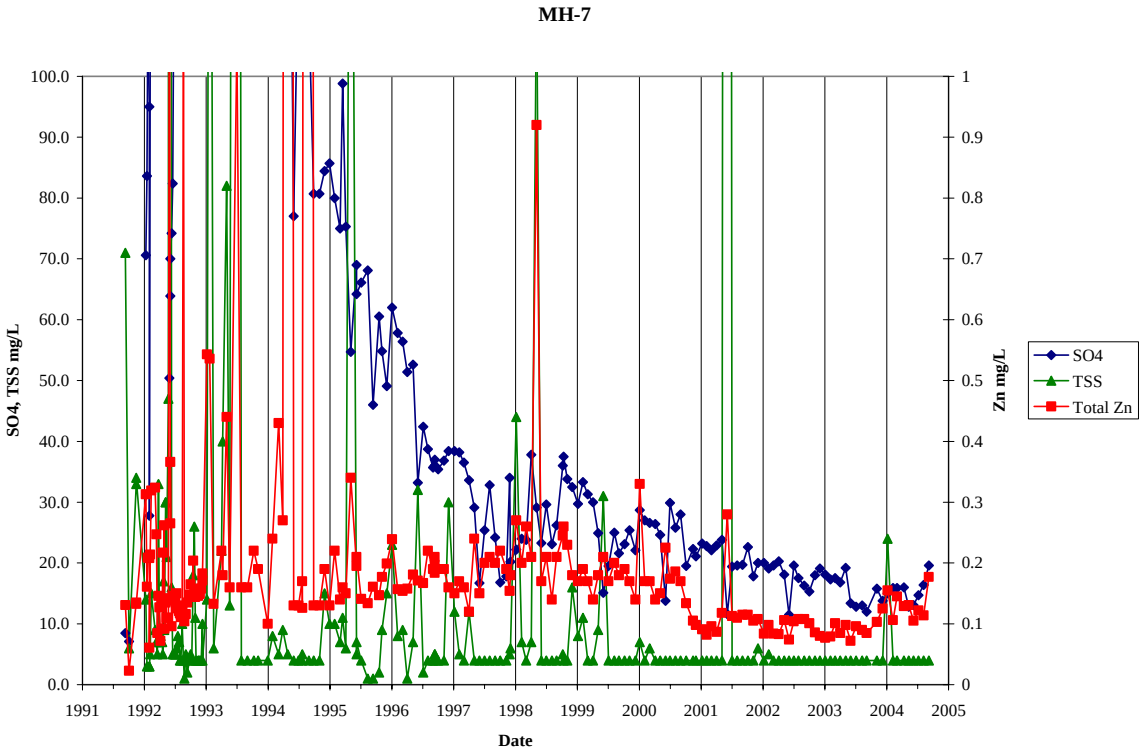


Figure 4. Monitoring Results for South Dam Seepage (MH-07)

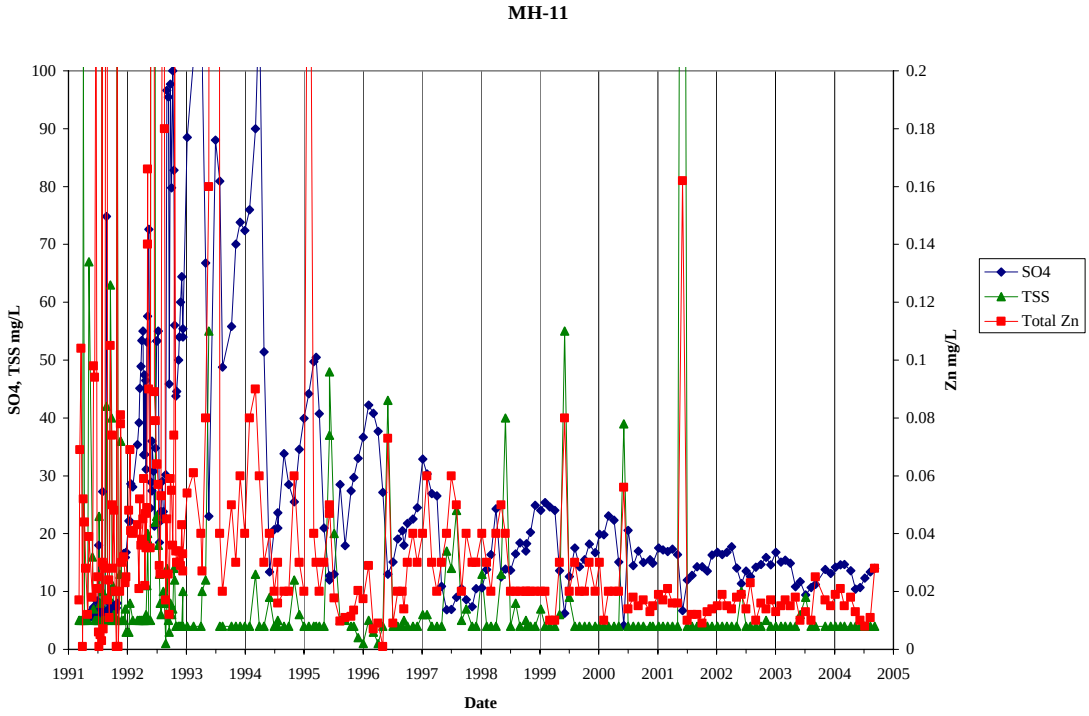


Figure 5. Monitoring Results for MH-11

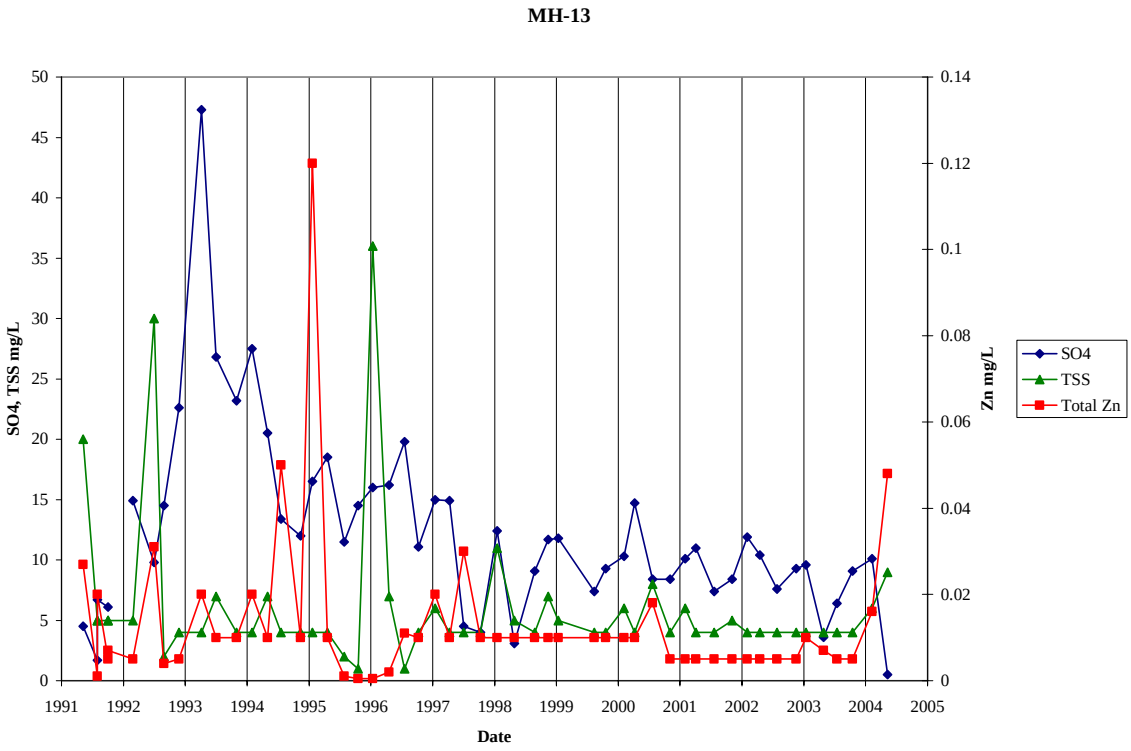


Figure 6. Monitoring Results for MH-13.

MH-11 is roughly 3 km downstream of the South Dam. This site has shown a steady decrease in sulphate concentrations matching the decrease at MH-07 (Figure 5). Zinc has shown the same general trend though with a slight upward trend since 2001. The zinc concentration in September 2004 was 0.028 mg/L.

MH-13 is several kilometres downstream from MH-11 in False Canyon Creek. This site has also shown a steady decrease in sulphate concentrations. Zinc concentrations have remained low (Figure 6). The last two results in 2004 showed a slight increase to 0.048 mg/L, but this appears to be related to a corresponding increase in TSS to 9 mg/L.

3.1.2 Tributary E Catchment

Seepage from the North Dam (MH-02) and the North Hill Settlement Basin (MH-22) are monitored in the Tributary E Catchment. As shown in Figure 1, the latter site receives the Burnick Portal discharge and runoff from the 1200 Portal area but does not have a surface water connection to Tributary E.

MH-2 has shown significant trends since the Detailed D&R Plan was prepared (Figure 7). Sulphate concentrations continued to increase reaching 413 mg/L in 2003. In contrast, zinc concentrations reached peak levels near 0.3 mg/L in 1998 and have since decreased to less than 0.1 mg/L. The decrease in zinc concentrations probably reflects the removal of wind blown tailings from the dam

face by TeckCominco. The increase in sulphate concentrations is maybe due to increase in the influence of oxidation of tailings relative to draindown of residual dilute process water.

In mid-2003, the monitoring results indicated a very sharp decrease in all parameters and then increased again in 2004 to levels observed prior to the decrease. The reason for this discontinuous trend is unknown. No changes in the physical environment at the North Dam occurred during this period. TeckCominco has indicated that it most likely represents technician error.

Monitoring results for the North Hill Settlement Basin (MH-22) indicate stable slightly decreasing sulphate concentrations below 50 mg/L and erratic possibly increasing zinc concentrations (Figure 8). Zinc concentrations vary widely seasonally from 0.2 to 0.6 mg/L. The long term increase is suggested by increases in the lowest and highest concentrations observed. The increase may be a result of continuing decomposition of sphalerite boulders in the underground mine and waste rock dump at the portal.

3.1.3 MH-16

MH-16 is in False Canyon Creek downstream of the confluence with Tributary E. Like MH-11 and MH-13, sulphate concentrations initially decreased but have remained stable since 1998 (Figure 9). Likewise, zinc concentrations have remained very low since 2001.

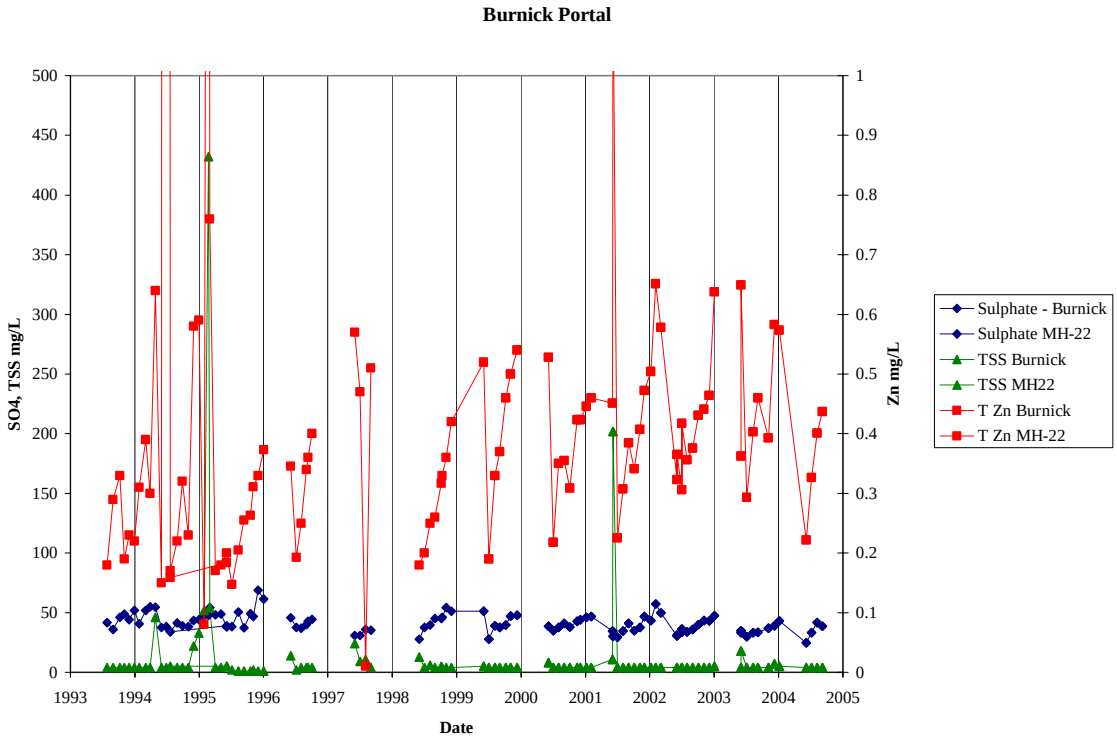


Figure 7. Monitoring Results for North Dam Seepage (MH-02).

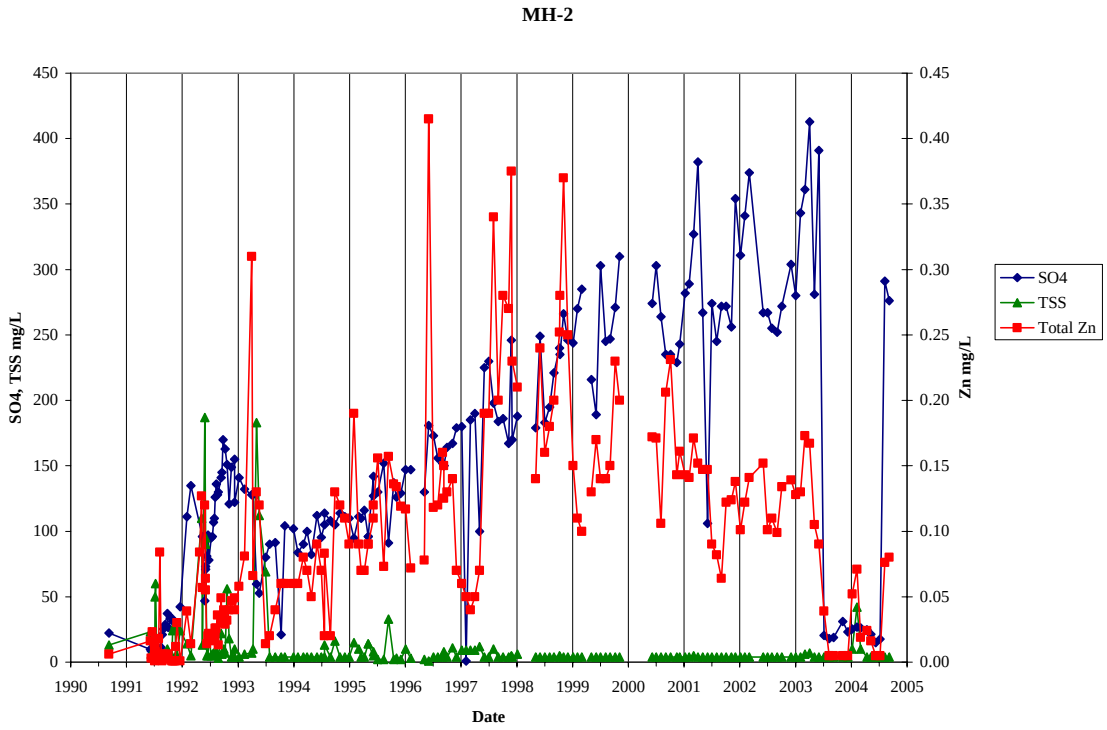


Figure 8. Monitoring Results for North Hill Settlement Basin (MH-22)

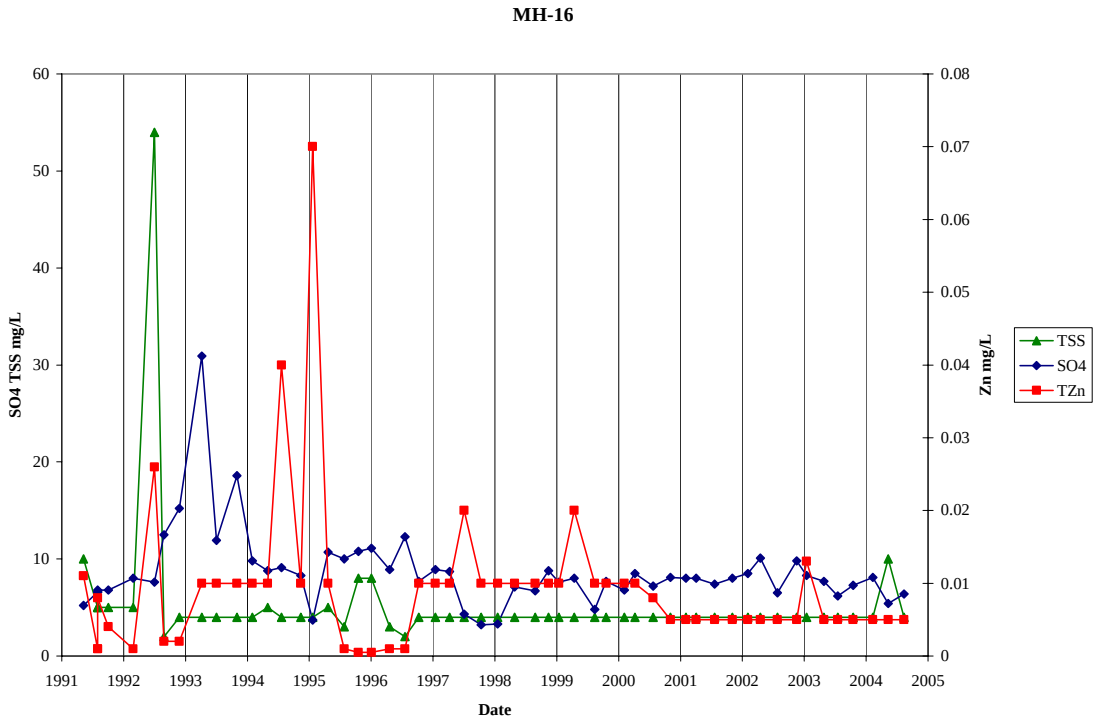


Figure 9. Monitoring Results for False Canyon Creek Below Tributary E.

3.2 Loading Calculation

In the following discussion, the loading calculations presented in the 2000 D&R Plan are referred to as the “1998” results. The current calculations are referred to as the “2003” results.

Results of the loading calculation are presented in Table 1. In the catchment area originating from the south side of the site, the largest sulphate loading from areas affected by mining is Camp Creek (MH-4). MH-25 may contribute part of the sulphate but negligible zinc load through subsurface flow. The balance of sulphate load may originate from small waste rock dumps, roads and natural mineralized exposures on Jewel Box Hill.

South Dam seepage is less important as a source of sulphate loading. Sulphate concentrations are slightly higher than Camp Creek but the flow volume is much lower. The dam seepage in contrast contributes comparable zinc load to Camp Creek due to the higher zinc concentrations in the former. The proportion of loading at MH-16 from these sources is relatively low with the majority of loading originating from natural background sources rather than the mine area, but the effect of the slight changes since the late 1990s is apparent. The increase in sulphate concentrations and decrease in zinc concentrations has translated to MH-04 becoming a slightly greater source of sulphate and a lesser source of zinc in 2003 compared to 1998. The South Dam seepage (MH-7) has decreased as a source of sulphate but generally increased as a source of zinc.

Table 1. Summary of Loading Calculation.

				2003								2000 Detailed D&R Plan			
				Flow and Load at Station				Load Proportion of MH-16		Calculated Background		Load Proportion of MH-16		Calculated Background	
Month, Basin and Site	Measured Flow L/min	SO_4 mg/L	Zn mg/L	Calc'd Flow dm^3/mo	Flow Used m^3/mo	SO_4 kg/mo	Zn kg/mo	SO_4 %	Zn %	SO_4 mg/L	Zn mg/L	SO_4 %	Zn %	SO_4 mg/L	Zn mg/L
South Fork Catchment															
Attenuated MH-25															
January	10	317	0.001	15	446	141	0.0	4%	0%						
June	60	172	0.001	249	2592	445	0.0	1%	0%						
August	14	293	0.001	72	625	183	0.0	1%	0%						
October	10	317	0.001	51	446	141	0.0	1%	0%						
MH-04															
January	-	14	0.005	15	14850	203	0.1	6%	2%			5%	9%		
June	-	14	0.007	249	248570	3505	1.6	8%	5%			4%	15%		
August	-	16	0.006	72	71502	1144	0.4	9%	4%			7%	5%		
October	-	16	0.008	51	51151	839	0.4	6%	4%			6%	7%		
MH-07															
January	102	21	0.123		4553	94	0.6	3%	15%			19%	89%		
June	200	13	0.165		8640	114	1.4	0%	5%			1%	3%		
August	150	18	0.112		6696	121	0.7	1%	8%			1%	5%		
October	178	21	0.125		7924	167	1.0	1%	11%			1%	6%		
MH-11															
January	-	17	0.015	43	42759	718	0.6	21%	17%	18	0.0003	47%	97%	48	0.000
June	7621	11	0.019	667	667269	7607	12.7	18%	42%	10	0.024	16%	39%	19	0.03
August	6486	12	0.011	203	203186	2387	2.2	18%	23%	9	0.008	22%	28%	20	0.0021
October	8304	15	0.013	168	168422	2442	2.1	18%	23%	13	0.006	22%	37%	22	0.028
MH-13															
January	-	10	0.008	138	137835	1358	1.0	40%	28%	7	0.004	60%	133%	5	0.008
June	-	9	0.005	2093	2093002	18628	10.5	43%	35%	8	-0.002	79%	108%	31	0.029
August	-	8	0.005	652	651751	5377	3.3	40%	34%	7	0.002	43%	20%	8	-0.003
October	-	9	0.005	568	568190	5171	2.8	39%	31%	7	0.002	37%	21%	7	-0.006
Tributary E Catchment															
MH-2															
January	15	297	0.122		670	199	0.1	6%	2%			11%	22%		
June	150	267	0.152		6480	1730	1.0	4%	3%			1%	2%		
August	32	255	0.094		1406	358	0.1	3%	1%			1%	1%		
October	40	272	0.134		1786	486	0.2	4%	3%			1%	2%		
Attenuated MH-22															
January	23	46	0.001		1027	47	0.0	1%	0%			4%	0%		
June	172	32	0.001		7409	239	0.0	1%	0%			1%	0%		
August	112	34	0.001		5000	169	0.0	1%	0%			1%	0%		
October	113	38	0.001		5022	188	0.0	1%	0%			0%	0%		
Whole Basin															
MH-16															
January	-	8	0.009	413	413117	3367	3.7	100%	100%	7	0.008	100%	100%	5	-0.003
June	-	7	0.005	5993	5993369	43452	30.0	100%	100%	7	0.005	100%	100%	3	-0.003
August	-	7	0.005	1938	1937863	13371	9.7	100%	100%	6	0.005	100%	100%	8	0.01
October	-	7	0.005	1825	1825002	13323	9.1	100%	100%	7	0.004	100%	100%	8	0.009

Notes:
1. Concentrations at MH-4 were not available for June, and were not available for June and August for MH-13 and MH-16. Concentrations indicated are averages for the nearest available months.

The downstream stations MH-11 and MH-13 show that sulphate and zinc loadings have not changed significantly since 1998. Some months show slight increases since 1998 while others show decreases. The differences reflect variability in the monitoring data rather than any significant monthly differences. The decrease in sulphate concentrations was already well-established in 1998 hence the lack of a systematic difference between 1998 and 2003.

The calculation of typically positive but low background sulphate and zinc concentrations indicates that both sulphate and zinc are behaving as chemically conservative parameters (see Section 2.1) and that there is probably little load attenuation occurring downstream of the site. Background zinc and sulphate concentrations at MH-11 are slightly greater than at MH-13 as expected due to the local effect of Jewelbox Hill at MH-11 which could include load from the site not accounted for by measured sources as well as natural runoff from mineralized outcrops. The same effect was apparent in 1998.

In the Tributary E catchment, the significance of MH-2 as a source of sulphate has increased due to the increase in sulphate concentrations. At the same time, seepage volumes appear to have increased by a factor of about 80% on average further increasing the sulphate load. This also explains why zinc loads have not decreased despite the decrease in zinc concentrations.

Sulphate concentrations from MH-22 (North Hill Settlement Basin) are not attenuated by contact with soils along the subsurface connection but contribute a low proportion of the sulphate loading in the basin which has not changed significantly since 1998. The recalculation of zinc loads using the attenuated concentrations indicated by testwork shows that this site contributes less than 0.1% of zinc load to MH-16.

It is not possible to calculate a load balance or baseline concentrations for Tributary E because station MH-12 is no longer monitored.

Comparison of all sources of loading with MH-16 indicates that not all loading at MH-16 can be accounted for by known mine area sources. For example, in June, only 12% of sulphate and 13% of zinc load comes from known mine site discharges to surface water. A further 6% and 29% of sulphate and zinc respectively appears to originate as non-point sources (mine and natural) in the Jewelbox Hill area. The remaining balance of 82% of sulphate and 58% of zinc is background loading in the basin not related to the mine. Overall, background weathering and erosion is the largest source of loading of these parameters in the basin.

4 Conclusions

Monitoring results indicate that some changes in water chemistry have occurred since the previous loading calculation presented in the Detailed D&R Plan, including:

- Negligible zinc loading effect from Main Zone 1380 Portal (MH-25) in MH-4 due to attenuation by contact with rock and soil along the subsurface flowpath.
- Decreasing zinc concentrations in Camp Creek (MH-4).
- Increasing zinc concentrations and decreasing sulphate concentrations in the South Dam seepage (MH-7) which has apparently translated into decreasing sulphate concentrations at downstream stations in False Canyon Creek (MH-11 and MH-13). The increase in zinc concentrations at MH-7 is not apparent at MH-11 or MH-13.
- Significant decreasing zinc and increasing sulphate concentrationsn in seepage from the North Dam (MH-2). Flow rates appear to have increased resulting in no net decrease in zinc load and further increase in sulphate load.
- Negligible effect from zinc concentrations at MH-22 (North Hill Settlement Basin) due to attenuation in soils downslope from the monitoring location indicated by laboratory tests in 2002. Field inspections indicate that this flow does not connect by surface to Tributary E.

The loading analysis reflects these changes but does not indicate a significant effect on overall loadings in the False Canyon Creek catchment area because the contributions from mine site sources are relatively small in the context of the whole basin. The dominant source of sulphate and zinc loading in the catchment area is natural weathering of rocks and soil unrelated to mining activity.

The overall conclusions of the loading calculation are the same as those presented previously in the Detailed D&R Plan.

5 References

Access Mining Consultants and SRK Consulting. 2000. Sä Dena Hes Mine Detailed Decommissioning & Reclamation Plan. Prepared for Cominco Ltd. February 2000.

SRK Consulting 2003. 2002 Geochemical Projects - Sä Dena Hes Mine. Reported prepared for TeckCominco Ltd. March 2003.

Appendix A

Location of Monitoring Stations

500000
510000
520000
6720000
6710000
6700000
6690000

MH-20
MH-21
MH-19
MH-16
MH-14
MH-18
MH-15
MH-17
MH-22
MH-12
MH-02
MH-04
MH-07
MH-25
MH-11
MH-13
MH-24

Stewart Lake
False Canyon Creek Tributary B
Tributary D
Tributary E
False Canyon Creek
Stewart Creek
Tom Lake
Little Tom Lake
Tom Creek
Tom Creek

CLAIM BOUNDARY
BURNICK ZONE
NORTH CREEK DYKE
MT. HUNDERE
TAILINGS IMPOUNDMENT
MAIN ZONE
JEWELBOX HILL ZONE
MILL SITE
ACCESS ROAD
ROBERT CAMPBELL HIGHWAY

NTS: 105 A/06, 105 A/07
105 A/10, 105 A/11

CONTOUR INTERVAL 100 FEET

0 1000 2000 3000 4000 5000 metres
1:100,000

NOTE
BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

LEGEND
- WATER MONITORING STATION
- FISH MONITORING STATION
- BENTHIC MONITORING STATION

SRK Consulting
Engineers and Scientists

teckcominco

SA DENA HES
Water Quality and Loading Re-Assessment

SITE PLAN

PROJECT NO.	DATE	APPROVED	FIGURE
1CT008.06	Jan. 2005	S.D.	1

FILE NO.: 1CT008.06_Jan_Water_Quality_Assessment\2006 Drawings\Figure 1.dwg

SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN
MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX G – FEBRUARY 2013 SRK LETTER REPORT

"SÄ DENA HES – 1380 PORTAL DISCHARGE INVESTIGATION"

Prepared by:

srk consulting

Sä Dena Hes—1380 Portal Discharge Investigation

Report Prepared for

Teck



Report Prepared by

srk consulting

SRK Consulting (Canada) Inc.
1CT008.032
February 2013

Sä Dena Hes—1380 Portal Discharge Investigation

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SRK Project Number 1CT008.032

February 2013

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Appendices

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Appendix B: Tabulated Potentiometric Bromide Monitoring Data

1 Introduction

The Sä Dena Hes Mine, located in the Yukon about 70 km north of Watson Lake, is a former zinc-lead mine that is currently in care and maintenance. The 1380 Portal (Figure 1) has been identified as a potential important source of zinc loadings (SRK 2007) at Sä Dena Hes. Previous investigations have not definitively shown the 1380 Portal discharge flows to Camp Creek.

In September 2012, Teck Resources requested SRK Consulting (Canada) Inc. conduct a field investigation to evaluate the fate and transport of discharge from the 1380 Portal at the Sä Dena Hes Mine. This report summarizes the results of this investigation and makes recommendations for future work.

1.1 Background

The 1380 Portal accesses a short adit into the Main Zone. The 1380 Portal has been identified as a key source of zinc loads at Sä Dena Hes, with concentrations above 30 mg/L (SRK 2012). Leaching of decomposing mineralized rock inside the adit is the likely zinc source (SRK 2007). The discharge from the portal infiltrates into the ground near the portal.

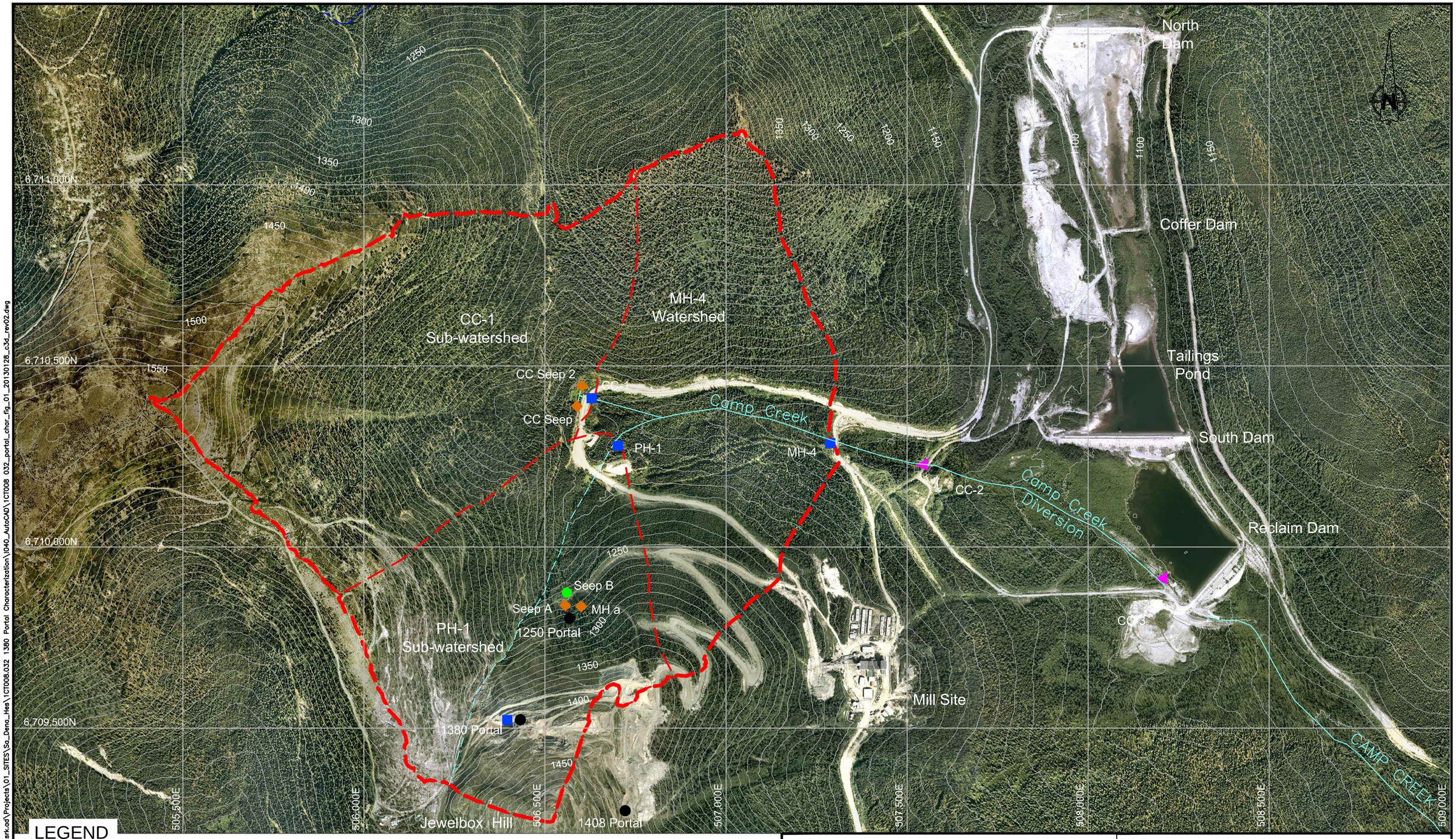
The conceptual model for the fate and transport of the discharge from the 1380 Portal assumes water infiltrates through waste rock and native ground, then flows as groundwater following surface topography toward the gully that is the source of Camp Creek (SRK 2007). Along this flowpath, the discharge from the portal mixes with other groundwater. This combined groundwater flow should eventually discharge to Camp Creek along the reach from the spring at an old pump house (PH-1) located below the haulroad to the tailings impoundment (Figure 1). However, zinc loading from the 1380 Portal are not observed downgradient in Camp Creek (SRK 2005). Zinc is likely attenuated initially by dissolving marble talus as the discharge flows into the gulley and subsequently by contact with the soils and aquifer materials in the gulley. Column testing has shown these constituents are removed by soils in the area (Day and Blowes 2005). The sulphate loading in Camp Creek is greater than the loading from the 1380 Portal, meaning sulphate is added to Camp Creek from sources other than the 1380 Portal.

There are two possible explanations for the increased sulphate load and decreased zinc load in Camp Creek:

- The flow in the gully does not report to Camp Creek and the sulphate load in Camp Creek is from some other source, or
- The flow in the gully reports to Camp Creek, but zinc is attenuated and sulphate loading is from unimpacted groundwater discharge to Camp Creek.

The monitoring data from the previous investigations (SRK 2007) did not allow for these explanations to be evaluated.

A tracer study and additional water quality sampling were conducted at Teck's request to improve the understanding of the fate and transport of the 1380 Portal discharge. While zinc loading from the 1380 Portal was the primary driver for this investigation, lead and cadmium concentrations are also elevated in the portal discharge. Lead and cadmium concentrations and loading at the site will be investigated in a separate assessment.



FILE REF.: \\van-svr0.van.no.srk.ad\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\040_AutoCAD\1CT008_032_portal_char_fig_01_20130128_c3d_rev02.dwg

LEGEND

Water Monitoring Locations

- Flow, Anions, Isotopes, Total & Dissolved Metals
- Anions and Flow
- Anions, Isotopes, and Dissolved Metals
- Anions, Isotopes, Total & Dissolved Metals
- Portal

- MH-4 Watershed
- PH-1 and CC-1 Sub-Watersheds
- Continuous Flow
- Intermittent Flow

0 100 200 300 400 500

Scale in Metres

CONTOUR INTERVAL=10m

NOTE

Topographic contour data was provided by Teck Metals and is based on 2012 Aerial photography (Lidar). Coordinate system is UTM NAD 83 zone 9v.

srk consulting

Teck

SA DENA HES - 1380 PORTAL DISCHARGE INVESTIGATION

Water Sampling Locations

PROJECT NO.	DATE	APPROVED	FIGURE
1CT008.032	Jan. 2013	TRS	1

2 Investigation Objectives and Approach

The purpose of the study was to understand the fate and transport of the 1380 Portal discharge. This investigation used three lines of evidence:

- Mass loading assessment,
- Stable isotope sampling and analysis, and
- Bromide tracer study.

Water quality samples were collected, and surface water flows measured to prepare chemical mass balances to evaluate mass loading. The objectives of the mass balances were to verify the results of previous investigations and provide data to compliment the tracer study.

Samples for the analysis of stable isotopes of hydrogen and oxygen in water were collected and analyzed. These samples were collected to assess if the isotopic signature of the various water sources could be used to establish the presence of 1380 Portal discharge in Camp Creek.

The objective of the tracer study was to evaluate the hypothesis that water from 1380 Portal does reach Camp Creek. A known mass of sodium bromide was added to the portal discharge and downstream locations were monitored. Monitoring data from the tracer study was analyzed to evaluate:

- Travel time for the tracer to reach Camp Creek (rapid appearance of the tracer could indicate a short flowpath or high groundwater velocities),
- Where the tracer appears in Camp Creek (i.e., at the springs feeding Camp Creek or further downstream), and
- Whether some part of the load does not report to Camp Creek.

3 Results and Discussion

3.1 Water Quality and Flow

Surface water conditions in late September are representative of baseflow. Surface water flows and water quality were monitored along the inferred flowpath from 1380 Portal to Camp Creek and at other seepage sources in the Camp Creek watershed that reports to MH-4. Sample locations are shown on Figure 1. Sub-watershed boundaries are also shown on Figure 1. The two sub-watersheds report to CC-1 and PH-1.

3.1.1 Surface Water Flow Measurements

Surface water flows were measured at the 1380 Portal, PH-1, MH-4, and CC-1. The “velocity area” method was used to measure flow at PH-1, CC-1, CC-2, CC-3 and MH-4. The “bucket and stop watch” method was used to measure discharge from the 1380 Portal. Staff gauges were installed at PH-1, MH-4 and CC-1.

Table 1: Flow rates from the monitoring locations.

Location	Flow Rate (L/s)
1380 Portal	0.4
PH-1	10.4
MH-4	19.4
CC-1	3.9
CC-2	19.3
CC-3	18.8

Source: \\VAN-SVR0\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\!080_Deliverables\Portal_1380_Field_Invest_Report\020_Tables\SDH_19SepTo19Nov2012_ISE_compiled REV02_mdp_trs.xlsx

The discharge from the 1380 Portal flows a short distance from the portal entrance before infiltrating into the ground. This discharge likely then flows as shallow groundwater into the top of the Camp Creek watershed.

CC-1 is located in the sub-drainage just to the north of the main portion of Camp Creek watershed. Surface flow in this sub-drainage first appears from two seeps just west of the haul road. This flow crosses the road in a culvert and eventually mixes with the flow from PH-1 above MH-4.

Sustained surface flow in Camp Creek first occurs at PH-1. PH-1 is located just downgradient of an old pump house. MH-4 is an existing water monitoring location. The flow in Camp Creek almost doubles between PH-1 and MH-4, likely from groundwater discharge.

CC-2 is located further downgradient of MH-4. The flow in Camp Creek at CC-2 is similar to MH-4, suggesting that over this reach of the stream there is no net gain or loss of flow.

CC-3 is located in the Camp Creek Diversion just west of the Reclaim Pond. Flow at this location is slightly less than the upstream reaches.

Staff gauge readings were recorded during the tracer study (Table 2). There were no significant changes in surface water flow during the tracer study. Staff gauge readings generally decreased over the study.

Table 2: Staff gauge readings during the tracer study.

Location	Date	Time	Staff Gauge (m)
PH-1	18-Sep-12	16:30	0.05
	19-Sep-12	10:19	0.05
	19-Sep-12	16:35	0.055
	20-Sep-12	9:44	0.06
	20-Sep-12	15:37	0.055
	21-Sep-12	9:45	0.06
	21-Sep-12	16:10	0.06
	22-Sep-12	10:20	0.06
	22-Sep-12	19:35	0.06
	23-Sep-12	9:00	0.06
	23-Sep-12	15:05	0.06
	24-Sep-12	19:00	0.042
	25-Sep-12	9:30	0.042
	26-Sep-12	16:00	0.041
	27-Sep-12	16:00	0.040
CC-1	19-Sep-12	15:28	0.06
MH-4	18-Sep-12	18:00	0.068
	20-Sep-12	10:20	0.068
	21-Sep-12	11:27	0.068
	21-Sep-12	16:52	0.068
	22-Sep-12	9:15	0.066
	22-Sep-12	15:00	0.066
	23-Sep-12	9:10	0.064

Source: \\VAN-SVR0\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\!080_Deliverables\Portal_1380_Field_Invest_Report\020_Tables\SDH_19SepTo19Nov2012_ISE_compiled REV03_mdp_trs.xlsx

3.1.2 Water Quality

Water samples were collected for total and dissolved metals, anions, and general water chemistry. Samples were shipped to ALS Laboratory in Burnaby, BC for analysis. Copies of all lab reports are in Appendix A.

Water samples were analyzed to quantify the following parameters:

- Total Metals,
- Dissolved Metals,
- Nitrate,
- Nitrite,
- Sulphate,
- Chloride,
- Bromide,
- Total Dissolved Solids,
- pH,
- Conductivity, and
- Alkalinity.

Total and dissolved metal concentrations, are shown in Table 3. Anion concentrations, and general chemistry data are shown in Table 4.

Table 3: Total and dissolved metals concentrations.

	Sample ID	Date Sampled	Time Sampled	Aluminum (Al) mg/L	Antimony (Sb) mg/L	Arsenic (As) mg/L	Barium (Ba) mg/L	Beryllium (Be) mg/L	Bismuth (Bi) mg/L	Boron (B) mg/L	Cadmium (Cd) mg/L	Calcium (Ca) mg/L	Chromium (Cr) mg/L	Cobalt (Co) mg/L	Copper (Cu) mg/L	Iron (Fe) mg/L	Lead (Pb) mg/L	Lithium (Li) mg/L	Magnesium (Mg) mg/L	Manganese (Mn) mg/L	Mercury (Hg) mg/L	Molybdenum (Mo) mg/L	Nickel (Ni) mg/L	Phosphorus (P) mg/L	Potassium (K) mg/L	Selenium (Se) mg/L	Silicon (Si) mg/L	Silver (Ag) mg/L	Sodium (Na) mg/L	Strontium (Sr) mg/L	Thallium (Tl) mg/L	Tin (Sn) mg/L	Titanium (Ti) mg/L	Uranium (U) mg/L	Vanadium (V) mg/L	Zinc (Zn) mg/L
Total Metals	1380 PORTAL	18-SEP-12	15:39	0.028	<0.00050	<0.00050	0.0123	<0.00050	<0.0025	<0.050	0.394	92.8	<0.00050	0.00418	<0.0025	0.134	0.112	<0.0025	2.84	0.196	<0.000010	<0.00025	<0.0025	<0.050	0.55	0.00593	3.93	0.000100	0.60	0.0926	<0.000050	<0.00050	<0.050	<0.000050	<0.0050	37.5
	PH-1	18-SEP-12	14:00	<0.0030	0.00014	0.00055	0.0162	<0.00010	<0.00050	<0.010	0.000667	60.9	0.00025	<0.00010	0.00050	<0.010	0.00129	0.00147	3.59	0.000097	<0.000010	0.000903	<0.00050	<0.050	0.54	0.00153	3.19	0.000023	0.703	0.136	<0.000010	<0.00010	<0.010	0.000903	<0.0010	0.0132
	MH-4	18-SEP-12	11:10	0.0052	0.00013	0.00039	0.0208	<0.00010	<0.00050	<0.010	0.000266	62.1	0.00023	<0.00010	0.00061	<0.010	0.000272	0.00142	3.23	0.000726	<0.000010	0.000714	<0.00050	<0.050	0.44	0.00090	3.15	0.000017	0.789	0.194	<0.000010	<0.00010	<0.010	0.000793	<0.0010	0.0063
	CC-1	18-SEP-12	14:30	0.0062	0.00013	0.00037	0.0110	<0.00010	<0.00050	<0.010	0.000088	52.3	0.00028	<0.00010	0.00076	0.011	0.00106	0.00103	2.07	0.000689	<0.000010	0.000622	<0.00050	<0.050	0.32	0.00029	2.61	0.000028	0.753	0.188	<0.000010	<0.00010	<0.010	0.000676	<0.0010	0.0059
	PORTAL_B	23-SEP-12	10:45	0.0072	0.00012	0.00046	0.0205	<0.00010	<0.00050	<0.010	0.000269	74.0	0.00015	<0.00010	0.00069	0.018	0.000527	0.00228	7.33	0.00123	<0.000010	0.000868	<0.00050	<0.050	0.96	0.00353	3.11	<0.000010	0.770	0.176	<0.000010	<0.00010	<0.010	0.00163	0.0013	0.0069
Dissolved Metals	1380 PORTAL	18-SEP-12	15:39	<0.0050	<0.00050	<0.00050	0.0110	<0.00050	<0.0025	<0.050	0.375	89.3	<0.00050	0.00384	<0.0010	<0.010	0.0413	<0.0025	2.68	0.173	<0.000010	<0.00025	<0.0025	<0.050	0.51	0.00603	3.65	<0.000050	0.56	0.0898	<0.000050	<0.00050	<0.050	0.000050	<0.0050	38.8
	PH-1	18-SEP-12	14:00	<0.0010	0.00012	0.00054	0.0165	<0.00010	<0.00050	<0.010	0.000688	62.4	0.00013	<0.00010	<0.00020	<0.010	0.00106	0.00178	3.63	0.000066	<0.000010	0.000953	<0.00050	<0.050	0.54	0.00154	3.26	<0.000010	0.701	0.144	<0.000010	<0.00010	<0.010	0.000880	<0.0010	0.0120
	MH-4	18-SEP-12	11:10	0.0015	0.00012	0.00037	0.0204	<0.00010	<0.00050	<0.010	0.000261	61.9	0.00012	<0.00010	<0.00020	<0.010	0.000132	0.00137	3.20	0.000417	<0.000010	0.000706	<0.00050	<0.050	0.43	0.00087	3.13	<0.000010	0.786	0.186	<0.000010	<0.00010	<0.010	0.000763	<0.0010	0.0045
	CC-1	18-SEP-12	14:30	<0.0010	0.00013	0.00036	0.0107	<0.00010	<0.00050	<0.010	0.000123	52.7	0.00027	<0.00010	<0.00020	<0.010	0.000591	0.00101	2.05	0.000180	<0.000010	0.000627	<0.00050	<0.050	0.31	0.00029	2.58	<0.000010	0.760	0.192	<0.000010	<0.00010	<0.010	0.000666	<0.0010	0.0059
	CC SEEP	23-SEP-12	13:30	0.0011	0.00014	0.00037	0.00702	<0.00010	<0.00050	<0.010	0.000076	47.8	0.00020	<0.00010	<0.00020	<0.010	0.000232	0.00084	1.93	<0.000050	<0.000010	0.000373	<0.00050	<0.050	0.27	0.00022	2.68	<0.000010	0.765	0.167	<0.000010	<0.00010	<0.010	0.000527	<0.0010	0.0019
	CC SEEP2	23-SEP-12	11:10	<0.0010	<0.00010	0.00014	0.0392	<0.00010	<0.00050	<0.010	0.000102	67.1	0.00019	<0.00010	<0.00020	<0.010	0.000079	0.00114	2.56	<0.000050	<0.000010	0.000868	<0.00050	<0.050	0.38	0.00087	2.87	<0.000010	0.914	0.261	<0.000010	<0.00010	<0.010	0.00105	<0.0010	0.0031
	MH-A	23-SEP-12	12:10	<0.0010	0.00011	0.00016	0.0196	<0.00010	<0.00050	<0.010	0.000924	71.1	0.00017	<0.00010	<0.00020	<0.010	0.000438	0.00213	8.10	<0.000050	<0.000010	0.00115	<0.00050	<0.050	0.77	0.00434	3.18	<0.000010	0.664	0.166	<0.000010	<0.00010	<0.010	0.00164	<0.0010	0.0236
	PORTAL_A	23-SEP-12	11:15	0.0015	0.00013	0.00210	0.0161	<0.00010	<0.00050	<0.010	0.000110	70.0	<0.00010	<0.00010	<0.00020	<0.010	0.000131	0.00223	5.33	<0.000050	<0.000010	0.000660	<0.00050	<0.050	0.63	0.00374	3.05	<0.000010	1.16	0.147	<0.000010	<0.00010	<0.010	0.00250	0.0081	0.0018
	PORTAL_B	23-SEP-12	10:45	0.0019	0.00012	0.00039	0.0204	<0.00010	<0.00050	<0.010	0.000219	75.8	<0.00010	<0.00010	<0.00020	<0.010	0.000144	0.00210	7.39	0.000274	<0.000010	0.000843	<0.00050	<0.050	0.96	0.00357	3.14	<0.000010	0.757	0.173	<0.000010	<0.00010	<0.010	0.00162	0.0011	0.0046

Source: \\VAN-SVR0\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\!080_Deliverables\Portal_1380_Field_Invest_Report\020_Tables\[SDH Chemistry Tables for Report 1CT008_032_REV00_mdp.xls]

Table 4: Anion concentrations and general chemistry data.

Sample ID	Date Sampled	Time Sampled	Bromide (Br) mg/L	Chloride (Cl) mg/L	Fluoride (F) mg/L	Nitrate (as N) mg/L	Nitrite (as N) mg/L	Sulphate (SO4) mg/L
1380 PORTAL	18-SEP-12	15:39	<0.050	<0.50	0.098	0.458	0.0028	242
1380 PORTAL	22-SEP-12	12:02	<0.050	<0.50	0.101	0.401	0.0028	229
PH-1	18-SEP-12	14:00	<0.050	<0.50	0.243	0.452	<0.0010	31.7
PH-1	19-SEP-12	16:35	<0.050	<0.50	0.251	0.429	<0.0010	32.7
PH-1	20-SEP-12	09:44	<0.050	<0.50	0.250	0.437	<0.0010	33.5
PH-1	21-SEP-12	11:12	<0.050	<0.50	0.249	0.448	<0.0010	33.9
PH-1	21-SEP-12	16:36	<0.050	<0.50	0.252	0.447	<0.0010	33.9
PH-1	22-SEP-12	19:35	<0.050	<0.50	0.250	0.457	<0.0010	34.5
PH-1	22-SEP-12	11:05	<0.050	<0.50	0.250	0.455	<0.0010	34.4
PH-1	23-SEP-12	09:00	<0.050	<0.50	0.250	0.457	<0.0010	34.6
PH-1	23-SEP-12	15:15	<0.050	<0.50	0.249	0.450	<0.0010	34.9
MH-4	18-SEP-12	11:10	<0.050	<0.50	0.169	0.253	<0.0010	18.8
MH-4	19-SEP-12	11:27	<0.050	<0.50	0.183	0.249	<0.0010	20.3
MH-4	20-SEP-12	14:58	<0.050	<0.50	0.185	0.257	<0.0010	20.6
MH-4	20-SEP-12	16:43	<0.050	<0.50	0.184	0.257	<0.0010	20.6
MH-4	21-SEP-12	12:18	<0.050	<0.50	0.184	0.259	<0.0010	20.8
MH-4	21-SEP-12	16:51	<0.050	<0.50	0.183	0.259	<0.0010	20.7
MH-4	22-SEP-12	09:15	<0.050	<0.50	0.175	0.238	<0.0010	19.8
MH-4	22-SEP-12	20:05	<0.050	<0.50	0.182	0.261	<0.0010	20.8
MH-4	23-SEP-12	09:10	<0.050	<0.50	0.180	0.259	<0.0010	20.7
MH-4	23-SEP-12	15:40	<0.050	<0.50	0.181	0.243	<0.0010	20.7
CC-1	18-SEP-12	14:30	<0.050	<0.50	0.060	0.0839	<0.0010	8.11
CC-1	20-SEP-12	16:27	<0.050	<0.50	0.065	0.0806	<0.0010	8.33
CC-1	23-SEP-12	14:55	<0.050	<0.50	0.066	0.0775	<0.0010	8.40
CC-2	20-SEP-12	14:45	<0.050	<0.50	0.175	0.239	<0.0010	19.9
CC-3	20-SEP-12	17:00	<0.050	<0.50	0.158	0.171	<0.0010	19.0
CC SEEP	23-SEP-12	13:30	<0.050	<0.50	0.054	0.107	<0.0010	7.48
CC SEEP2	23-SEP-12	11:10	<0.050	<0.50	0.054	0.129	<0.0010	7.61
MH-A	23-SEP-12	12:10	<0.050	<0.50	0.164	0.432	<0.0010	78.2
PORTAL_A	23-SEP-12	11:15	<0.050	<0.50	0.126	0.468	<0.0010	79.6
PORTAL_B	22-SEP-12	14:28	<0.050	<0.50	0.145	0.0222	<0.0010	77.8
PORTAL_B	23-SEP-12	10:45	<0.050	<0.50	0.147	0.0329	<0.0010	78.1

Source: \\VAN-SVR0\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\l080_Deliverables\Portal_1380_Field_Invest_Report\020_Tables\[SDH Chemistry Tables for Report 1CT008_032_REV00_mdp.xls

SRK reviewed and validated all the analytical results to assure that the data was of sufficient quality for the analysis.

An ion balance was used to check the completeness of the analytical suite for each sample by evaluating whether the parameters analyzed created an electrically neutral solution. The sum of the major anion and cation charge equivalents should balance for each sample analyzed. The balance is calculated as:

$$Ion\ Balance\ \% = \left|\frac{sum\ of\ cations - sum\ of\ anions}{sum\ of\ cations + sum\ of\ anions}\right| x\ 100$$

Ion balances less than 10% are generally considered to be acceptable. Balances greater than 10% should be examined to determine the cause of the imbalance. Samples with low ionic strength (EC<100 µS/cm) usually have poor ion balances.

The ion balances for the Sä Dena Hes Project water samples from CC-1, PH-1, MH-4 and 1380 Portal were all below 10%, and are considered complete and acceptable. The ion balances evaluation show that the water samples are electronically neutral and the analytical suite of parameters are complete.

The water quality of the 1380 Portal differs from all other monitoring locations. Zinc and sulphate concentrations are much higher than downgradient locations. At PH-1 zinc concentration is 2,840 times lower than at 1380 Portal. Sulphate concentrations are seven times lower at PH-1 than at the 1380 Portal.

The same trend of lower concentrations at MH-4 relative to PH-1 is also observed. Zinc concentration is 5,950 times lower at MH-4 than at 1380 Portal. Sulphate concentrations are 12 times lower than at the 1380 Portal.

The mass loading of these constituents at the monitoring locations was evaluated using the water quality and flow data.

3.2 Load Balances

Mass loadings of zinc and sulphate were calculated for CC-1, PH-1, MH-4 and 1380 Portal and load balances were prepared for these constituents at PH-1 and MH-4. These constituents were chosen because their concentrations in the 1380 Portal discharge are much greater than the other monitoring locations. The mass load balances are used to evaluate missing mass loads that are lost or gained along the flowpath from the 1380 Portal to PH-1 and MH-4. Along this flowpath, the discharge from the 1380 Portal mixes with other groundwater in the watershed. The load from this groundwater will contribute to the load observed at the downstream monitoring locations. The materials that the groundwater flows through can also attenuate dissolved constituents.

The mass load balances for PH-1 and MH-4 are described by the following equations:

$$\text{MH-4} = 1380\ \text{Portal} + \text{CC-1} + \text{R}_1$$

$$\text{PH-1} = 1380\ \text{Portal} + \text{R}_2$$

R_1 and R_2 are residual terms in the load balances. These terms are estimated as the difference between the known loading sources and any excess (positive residual term) or deficit (negative residual term) loadings are attributed to either the loading from unimpacted groundwater in the watershed or attenuation by media the groundwater flows through. Any measurement errors in flows or the analytical results are also captured by the residual terms. The results of the mass loading evaluation are shown in Table 5.

The residual term for zinc is negative at both PH-1 and MH-4. This is consistent with previous studies (SRK 2005, SRK 2007) and implies that these constituents are attenuated within Camp Creek watershed.

Also similar to the previous studies, sulphate loadings are higher at PH-1 and MH-4 than at the 1380 Portal. The percent of the total sulphate loading at MH-4 and PH-1 that is attributable to groundwater is 65% and 70%, respectively. Most of the groundwater sulphate loading occurs from groundwater discharge up gradient of PH-1. The sulphate loadings that occur between the portal and PH-1 and the portal and MH-4 are similar.

Table 5: Summary of calculated loadings for the samples at Sä Dena Hes.

Sample ID	Zinc kg/d	Sulphate kg/d
CC-1	0.0020	2.73
1380 PORTAL	1.30	8.36
PH-1	0.012	28.48
MH-4	0.011	31.51
R_1	-1.28	20.41
R_2	-1.28	20.12

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\
!080_Deliverables\Portal_1380_Field_Invest_Report\020_Tables\[Sa_Dena_Hes_load_balances_1CT008_032REV00mdp.xlsx]

Assuming the sulphate load is from groundwater discharge, an average groundwater sulphate concentration can be calculated by dividing the residual term from the load balances by the estimated flow of groundwater discharge over each stretch. Groundwater discharge rates from the 1380 Portal to MH-1 and the 1380 Portal to PH-1 are estimated by difference in flow. This assumes that the increase in flow between surface water monitoring locations is only the result of groundwater discharge. Groundwater discharge rates from the Portal to MH-1 and the 1380 Portal to PH-1 are 15.5 L/s and 10 L/s, respectively. The average groundwater sulphate concentrations that would result in the observed increase in sulphate loadings at MH-4 and PH-1 are 15 mg/L and 23 mg/L, respectively.

3.2.1 Summary and Conclusions for the Load Balances

The mass loading balances show that zinc from the 1380 Portal is attenuated within the watershed and that other groundwater mixes with the discharge from the portal, increasing the sulphate load. The estimate sulphate concentration for this groundwater is 15 mg/L to 23 mg/L is greater than CC-1 or seeps where this tributary originates from (~8 mg/L, Table 4). This is not unexpected because the watershed that reports to PH-1 (Figure 1) contains mineralized areas. The seeps near the 1250 Portal had sulphate concentrations greater than 70 mg/L. The data and this analysis are consistent with the hypothesis that the discharge from the 1380 Portal flows to PH-1 and MH-4. The unique chemical signature of the 1380 Portal discharge is not apparent at PH-1 and MH-4 because of attenuation and dilution by other groundwater in the watersheds.

3.3 Isotope Analysis

3.3.1 Isotopes Characterization of Water Sources at Sä Dena Hes

Water samples were collected for the analysis of oxygen and hydrogen isotopes ($\delta^{18}O$ and δD). D denotes deuterium or ^{2}H. Samples were sent to the Saskatchewan Isotope Laboratory in Saskatoon, SK. The purpose of this analysis was to characterize the various water sources in the Camp Creek watershed. The isotope signatures of the water sources were used to quantify water mixing and to estimate an isotopic signature for unimpacted groundwater discharge in the watershed.

3.3.2 Method and Reporting of Isotope Analysis

All water samples collected for isotope analysis were submitted to the Saskatchewan Isotope Laboratory at the University of Saskatchewan. Samples were analyzed for δD and $\delta^{18}O$ by gas isotope ratio mass spectrometry using a Thermo Finnigan TC/EA coupled to a ConFlo III and a Delta Plus XL mass spectrometer.

The δD and $\delta^{18}O$ results are reported as the relative difference between D/ ^{1}H and $^{18}O/^{16}O$ abundance ratios for the samples and the Vienna Standard Mean Ocean Water (VSMOW), expressed in per mil (‰). The precision of δD and $\delta^{18}O$ analyses were ± 2 and ± 0.5‰, respectively.

3.3.3 Isotope Analysis Results

The δD and $\delta^{18}O$ results for the water monitoring location are presented in Table 6. The δD and $\delta^{18}O$ data plot near the global meteoric water line (Figure 2). The CC-1, MH-4, and PH-1 water samples plot in the lower left corner near the water line. The 1380 Portal sample plots in the upper right corner and below the water line.

The water samples from CC-1, MH-4 and PH-1 have δD values ranging from -172.0 to -175.3‰ and $\delta^{18}O$ values ranging from -22.5 to -22.8‰. The water sample from the 1380 Portal had a δD value of 161.7‰ and $\delta^{18}O$ value of -20.3‰. The waters from CC-1, MH-4 and PH-1 have similar sources and appear to be analytically equivalent (Figure 2). The isotopic signature of the 1380 Portal discharge is distinct from the other water sampled. The range of δD and $\delta^{18}O$ values from CC-1, MH-4, PH-1, and 1380 Portal suggest the water from 1380 Portal is from a different source than the waters from CC-1, MH-4, and PH-1.

Table 6: Summary of the δD and $\delta^{18}O$ sample values collected at Sä Dena Hes

Sample Location	Sampling Date	δD ‰	$\delta^{18}O$ ‰
CC-1	17-Sep-12	-172.0	-22.5
1380 Portal	17-Sep-12	-161.7	-20.3
MH-4	17-Sep-12	-175.3	-22.7
PH-1	17-Sep-12	-173.4	-22.8

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Sa_Dena_Hes\1CT008.032 1380 Portal Characterization\!080_Deliverables\Portal_1380_Field_Invest_Report\020_Tables\[Sa Dena Hes Isotopes 1CT008_032REV01_mdp.xlsx]

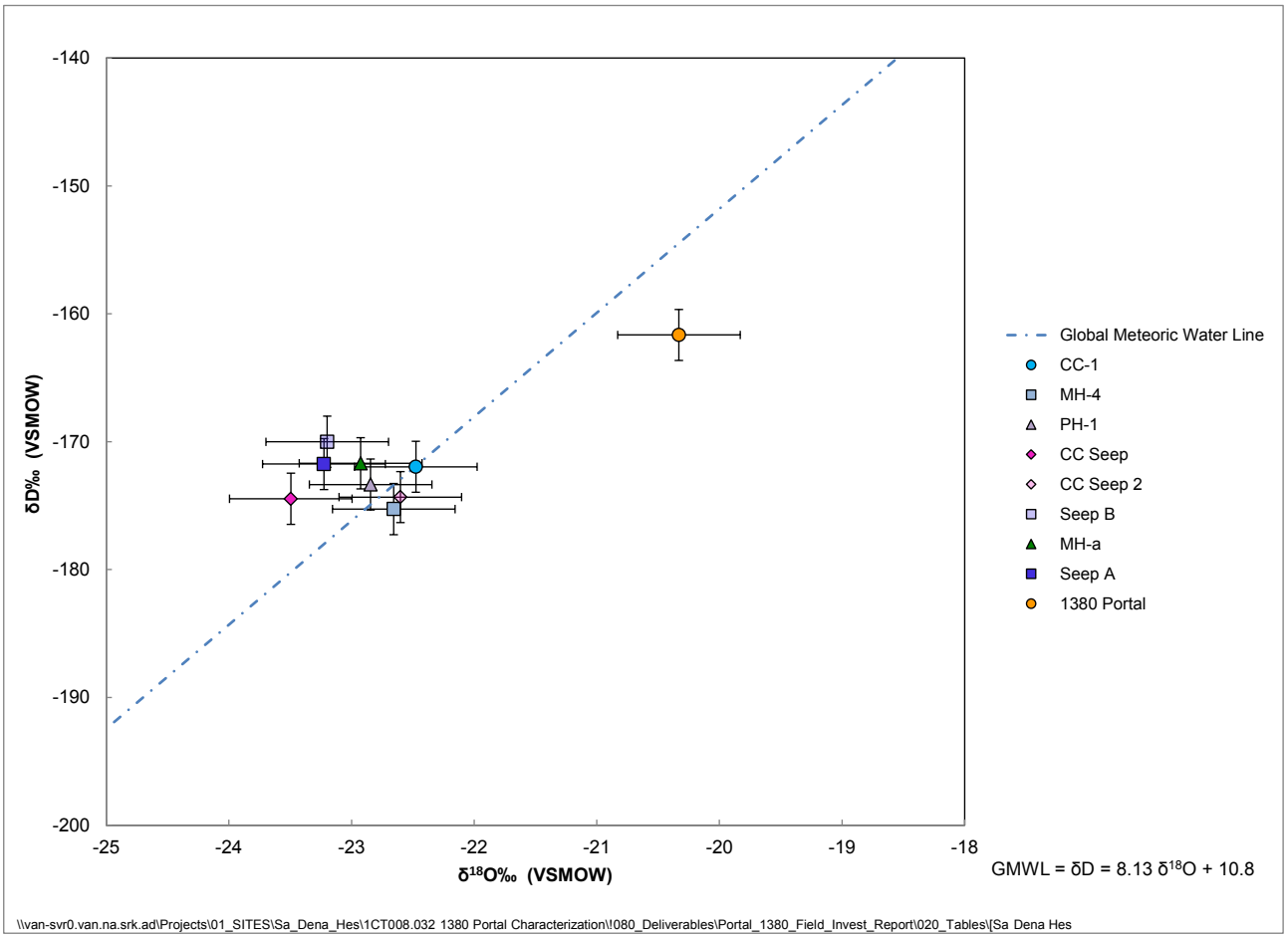


Figure 2: Plot of δD versus $\delta^{18}O$ for the water samples collected at Sä Dena Hes with a precision of δD of ± 2 and $\delta^{18}O$ of ± 0.5‰.

As the 1380 Portal discharge flows down the watershed it mixes with other groundwater and its unique isotope signature becomes diluted. The isotope signature of groundwater that mixes with the 1380 Portal discharge was estimated using the distinct isotope signatures and flow rates from the monitoring locations. The purpose of this analysis is to compare the estimated groundwater signature to the isotope signature of seeps and surface water to assess if the signature is similar or differs. If the estimated groundwater isotope signature is similar to other seeps or surface water sources, the hypothesis that the 1380 Portal discharge flows to Camp Creek is supported.

Water at PH-1 is made up of a mixture of the 1380 Portal water and other groundwater sources upgradient of PH-1. The isotope and flow data are used to estimate the isotope signature of groundwater that mixes with the portal discharge that eventually discharges to surface water is estimated using the equations:

$$Q_{1380\ Portal} + Q_{Groundwater} = Q_{PH\text{-}1} \quad (1)$$

$$\delta_{PH\text{-}1} = \chi\delta_{1380Portal} + (1\text{-}\chi)\delta_{Groundwater} \quad (2)$$

where Q is flow (L/s) and X is the fraction of 1380 Portal water contributing to the total flow at PH-1 or $Q_{1380\ Portal}/ Q_{PH\text{-}1}$.

Groundwater discharge contributes 96% of the flow at PH-1. The estimated isotope signature of this groundwater is a δD of -173.8‰ and a $\delta^{18}O$ of -22.9‰. The estimated groundwater isotope signature is plotted with isotope signature of the 1380 Portal and PH-1 (Figure 3).

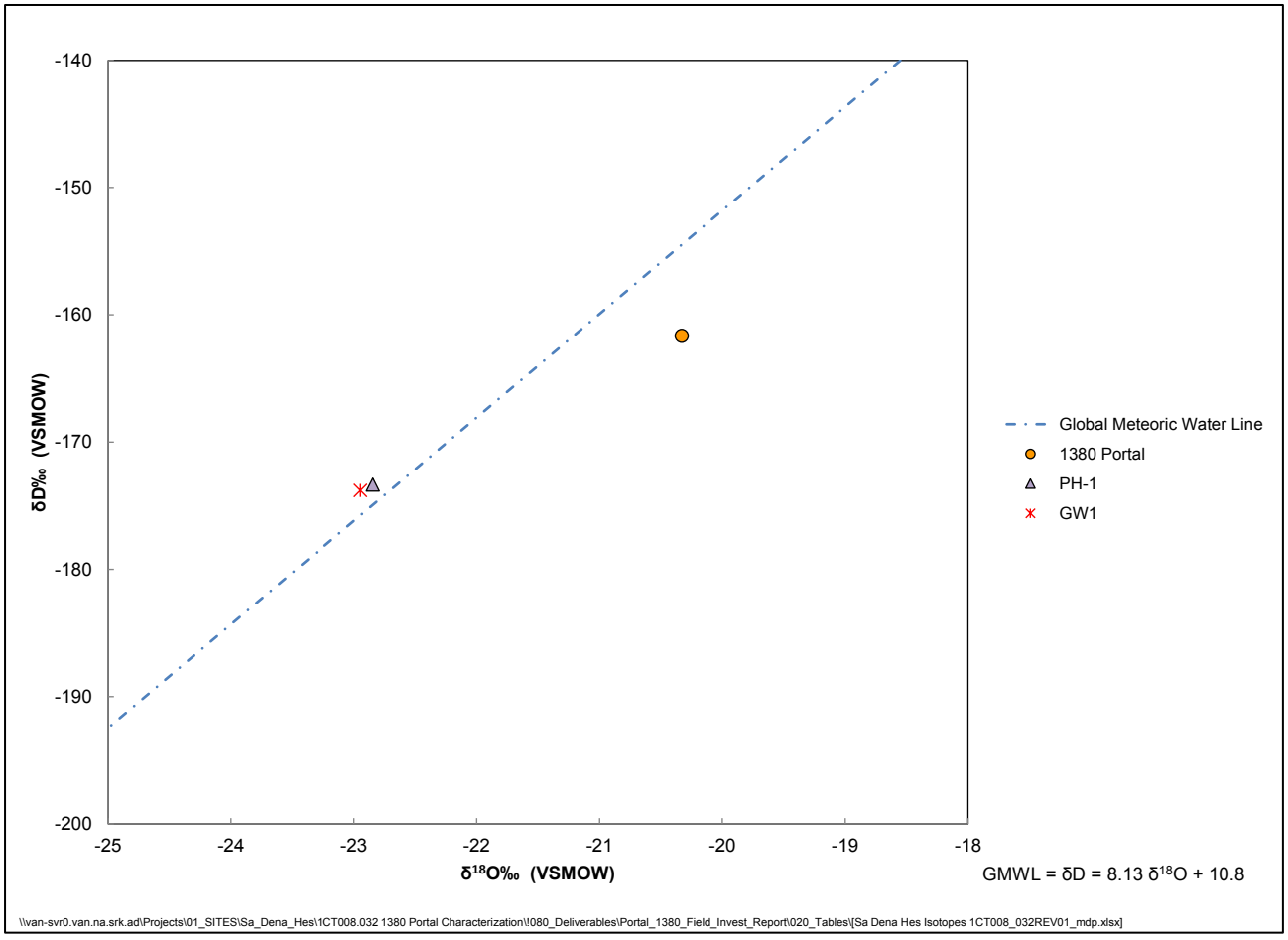


Figure 3: Plot of δD versus $\delta^{18}O$ for the water sources for PH-1 water.

Figure 3 shows that the estimated isotope signature of groundwater is similar to all other seep and surface water sources. This analysis supports the hypothesis that the 1380 Portal discharge mixes with other groundwater and the unique isotope signature of the 1380 Portal becomes diluted.

3.3.4 Summary and Conclusions for Isotope Analysis

The isotope values for all surface water sources and seeps are similar. The isotope signature of the 1380 Portal is unique and this water is likely from a different water source. Despite this unique isotope signature, the flow from the 1380 Portal is so much smaller than the other groundwater flow in the watershed that the unique isotope signature is no longer distinct at downgradient monitoring locations. This is supported by the estimated isotope signature of groundwater that mixes with 1380 Portal water, which is similar to the signature of other water sources sampled.

3.4 Tracer Study

A tracer study was conducted to better understand the fate and transport of the discharge from the 1380 Portal. The results from the tracer study were to be used to establish flow continuity in the gully, and to verify whether portal water reaches Camp Creek.

3.4.1 Tracer Test Methods

Sodium bromide was selected as the tracer, because it is chemically conservative, non-toxic, is soluble, has very low background concentrations, and has a detection limit of 0.01 mg/L using a bromide specific electrode (USEPA 1996). A bromide tracer was added to the 1380 Portal discharge as the water infiltrated into the waste rock pile. Water quality was subsequently monitored for bromide at downgradient locations in the Camp Creek watershed.

On September 18, 2012, 6,000 g sodium bromide stock solution was added to the discharge from the 1380 Portal with a peristaltic pump. The bromide solution concentration was 200 g/L. Flow from the portal was approximately 0.4 L/s. The background bromide concentration in the portal discharge was not quantified. The bromide stock solution was added initially at 300 mL/min from 15:39 to approximately 16:00 when the peristaltic pump battery failed. The battery was then changed and the bromide addition rate was increased to 500 mL/min from 16:30 to 17:30. The remainder of the stock solution was added over this time. The concentration of bromide in the portal discharge after the addition of the concentrated bromide ranged from 2470 mg/L to 4080 mg/L, using the portal flow rate, bromide stock solution concentration and addition rate, and assuming that the portal discharge bromide concentration is 0.05 mg/L. Assuming all the bromide travels to the downgradient sample locations without dispersion along the flowpath, these bromide addition rates would have resulted in bromide concentrations of 130 mg/L and 70 mg/L at PH-1 and MH-4, respectively.

3.4.2 Monitoring

Bromide specific electrodes were used to continuously monitor in-situ at MH-4 and PH-1. Bromide specific electrodes monitor the electrical potential difference that results from increased bromide concentration in the water (USEPA 1996). The bromide concentration is inversely proportionate to the electrical potential. In addition, instantaneous measurements were also made using a bromide specific electrode opportunistically at other locations. Interference by other ions is unlikely given the high concentrations that must be present to cause interference (USEPA 1996). The sensors were calibrated prior to installation using 1 or 2 point calibrations, depending on the sensor, and the calibration was checked daily. Periodically samples for laboratory bromide analysis were collected.

A ThermoScientific Orion Star A321 sensor, calibrated using a 1 point calibration, with 1 mg/L bromide standard, was installed at PH-1, with electrical potential measurements logged continuously at intervals that ranged from 1 to 5 minutes during the period from September 18 at 13:55 to September 23 at 15:09, with some gaps.

The sensor required time for readings to stabilize after periods when it was necessary to remove the sensor probe from the water for calibration, troubleshooting and downloading. Millivolt reading varied from this range when the sensor was stabilizing.

An Oakton pH620 sensor, calibrated using a 2 point calibration, with 1 and 10 mg/L bromide standards, was installed at MH-4, with electrical potential logged continuously at 5 minute intervals (for most of the study) during the period from September 19 at 15:37 to September 22 at 9:08, with some gaps. In addition to electrical potential measurements, the measurements were converted to bromide concentrations by this sensor. As with the ThermoScientific sensor, the Oakton sensor required time for readings to stabilize after calibration, troubleshooting and downloading. Variations in the measurements occurred during this stabilization period.

A ThermoScientific Orion Star A221 sensor calibrated with 1 mg/L bromide standard, was used for instantaneous electrical potential readings at several locations including at CC-1. Readings were taken after the readings had stabilized.

On site bromide monitoring ended on 27 September 2012. From 6 October to 19 November 2012, water samples were collected from MH-4 and shipped to Whitehorse for bromide analysis using an ion specific electrode.

3.4.3 Tracer Study Results

The in-situ monitoring results using the bromide specific electrodes are shown in Figure 4. All potentiometric bromide monitoring data are tabulated in Appendix B. Analytical bromide results for water samples collected during the tracer study are shown in Table 4. Both sets of data show that bromide was not detected at any monitoring location over the sampling period. The bromide concentration data were relatively constant during the testing period indicating that the bromide added was not detected. The in-situ monitoring data frequently show an initial spike in values followed by a steep decline. This decline is an artifact of the electrode stabilizing during the initial period when it is placed back in the water at the monitoring location following calibration. A likely explanation for the tracer not arriving at PH-1 or MH-4 is presented in Section 3.4.4 below.

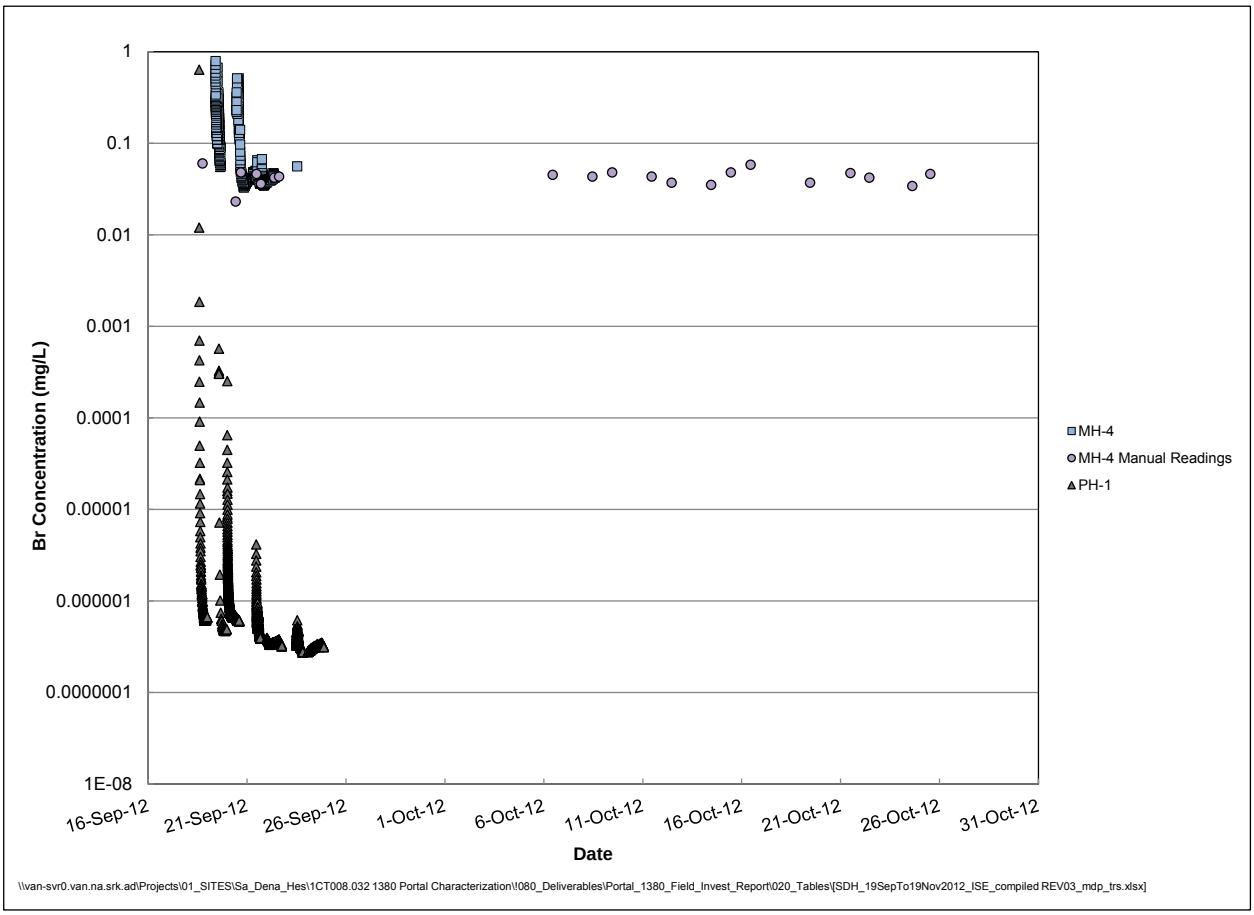


Figure 4: In-situ bromide monitoring data from the tracer study.

3.4.4 Travel Time Estimate

The 1380 Portal is located in steep terrain near the top of the watershed and discharges water with relatively high zinc concentration at a flow rate of about 0.4 L/minute. This discharge seeps into the ground shortly after it daylights from the portal and likely mixes with local groundwater as it flows downgradient. The hydrogeology of the watershed has not been characterized. Given the topography and geologic setting there is likely little unconsolidated material overlying bedrock at higher elevation in the watershed. The thickness of the unconsolidated material is likely greater at lower elevations in the watershed. Groundwater likely flows within intermittently contiguous channels in the underlying fractured bedrock and sandy silt/till valley fill.

Despite the lack of hydrogeologic information an order of magnitude range of groundwater travel time from the portal to monitoring location PH-1 can be estimated. Groundwater velocity (v) is a function of the groundwater gradient (dh/dl), effective porosity (ne) and hydraulic conductivity (K):

$$v = \frac{-\frac{dh}{dl}\,K}{n_e}$$

This relationship was used to estimate the average linear velocity of groundwater using these assumptions:

- The groundwater gradient follows topography (dh/dl = 0.25 m/m),
- The hydraulic conductivity ranges from 10^{-6} m/s to 10^{-4} m/s, and
- An effective porosity (0.1).

The range of hydraulic conductivity used is typical of silty sand and/or fractured bedrock. Effective porosity can range between 0.1 and 0.25. The value used in this analysis was conservatively assumed to be 0.1. A higher effective porosity would result in lower groundwater velocities.

Groundwater velocity estimates range from 0.22 m/d to 22 m/d as a function of the hydraulic conductivity. The distance from the 1380 Portal to monitoring location PH-1 is approximately 800 m. Average travel times for groundwater near the 1380 Portal to flow to PH-1 range from 36 days to 10 years. The median travel time estimate is 1 year.

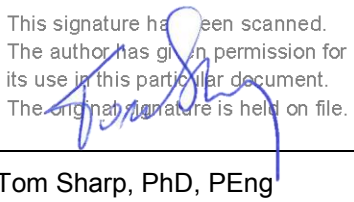
Given the range of travel times from the 1380 Portal to PH-1, it is likely that the slug of bromide added during the tracer study has not yet arrived at PH-1. The range of travel times results from uncertainty in the hydraulic conductivity of the material groundwater flows through. The hydraulic conductivities used in this analysis are characteristic of sandy silt, till or weathered bedrock. Groundwater flow at higher elevations in the watershed is likely through weathered bedrock. Weathered bedrock would be expected to have even lower hydraulic conductivities and even longer travel times. The tracer study results should be interpreted in context of these groundwater flow estimates. The range of travel time estimates identifies the current knowledge of the hydrogeology of the Camp Creek watershed, and points to a data gap for understanding the fate and transport of zinc in the 1380 Portal discharge.

It is likely that groundwater velocities vary seasonally. In the freshet groundwater elevations should rise in response to increased infiltration. The surficial material may have higher hydraulic conductivities. Additionally, it was observed that a portion of the discharge from the portal flowed as surface water down into the upper portion of Camp Creek watershed (SRK 2005). When this occurs the average travel time from the portal to PH-1 is reduced.

4 Conclusions

At the time of the tracer study, the portal discharge all infiltrated and would flow as groundwater toward the PH-1 and MH-4. Along the flowpath to PH-1, zinc is attenuated, and the discharge would mix with unimpacted groundwater within the watershed. The results of the investigation are consistent with the hypothesis that the Portal 1380 discharge mixes and is diluted by other groundwater in the watershed before it discharges at PH-1 and/or MH-4. The results of the mass balances and isotope analysis support this explanation. Estimates of the travel time for the bromide added to the 1380 Portal suggest that when the portal discharge infiltrates, it would take between 36 days to 10 years for the tracer to reach PH-1. Over the duration of the short-term tracer study (four weeks), it is unlikely the bromide would have arrived at the downstream water monitoring locations in the Camp Creek watershed.

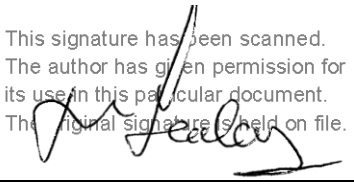
This report, **"Sä Dena Hes – 1380 Portal Discharge Investigation"**, was prepared by:



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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN

MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX H – FIRST NATIONS CONSULTATION

To: Bruce Donald, Manager, Dormant Properties, Teck Metals Ltd.

From: Christine Callihoo, Counterflow Community Planning Inc.

Regarding: Sä Dena Hes Closure Plan Update: First Nation Consultation

Date: February 04, 2013

The following summary focuses upon Teck Metals Ltd. ('Teck') First Nation engagement and consultation efforts as it relates to the Sä Dena Hes Closure Project ('Project'). The information provided is based upon Counterflow Community Planning's ('Counterflow') knowledge and participation to date of said Project. As a result, there may be further related information, such as the engagement with LFN as part of the work Golder (KNG) completed for the third party review, not included in this summary that Counterflow may not be aware of.

Introduction

Teck has been working with the Liard First Nation (LFN) leadership to ensure the Sä Dena Hes Mine Decommissioning and Reclamation Project ('Project') is able to provide benefits to the local communities, with a specific focus on the Liard First Nation and other members of the Kaska Collaboration Agreement.

Teck is focused on establishing a strong working relationship with the LFN leadership by engaging with the LFN community regarding the Project.

The Kaska have formal internal agreements (protocols) articulating the agreed upon approach and the Nation selection as to who will lead proponent engagement for the various areas in the Yukon and Northern BC. Under this agreement, the LFN are the designated lead First Nation for the aforementioned Project.

More recently, Teck met with Chief McMillian of the LFN in Whitehorse March 20, 2012 to discuss Teck's desire to re-initiate the working relationship with the Nation for the Project. During this meeting, the original *1997 Sä Dena Hes Socio-Economic Participation Agreement* was discussed, noting that it was dated and did not anticipate the mine not going into operation. However, it was agreed by both parties that while some of the details are not pertinent, many of the terms and clauses remain applicable and desirable to both parties.

In a collaborative manner, Teck and the LFN leadership revised and updated the original *1997 Sä Dena Hes Socio-Economic Participation Agreement* to reflect the change in mining focus – from development to that of decommissioning – and to incorporate more meaningful language based upon the general knowledge and experience gained since the initial Agreement. The resulting refinements to the Agreement were finalized by both parties with the letter to the LFN leadership September 14, 2012.

Teck's approach to working with the Liard First Nation to date has been one of seeking to establish a working relationship between the two parties that enables value-for-value benefits as well as the optimization of the economic opportunities within the Nation and locally in the Watson Lake area.

The following section provides a chronological accounting of the communications by way of in-person meetings, teleconferencing and email as well as LFN community newsletters, between the two parties from March 2012 to January 2013. The details provided illustrate Teck and LFN's commitment to maintaining a working relationship through ongoing, periodic communication and engagement.

Chronological Accounting of First Nation Activities to Date

Table 1

Topic	**Date**	**Type of Communication**	**Participants**
1997 Sä Dena Hes Socio-Economic Participation Agreement – permanent closure and next steps	March 20, 2012	Meeting in Whitehorse, YT	LFN & Teck
1997 Sä Dena Hes Socio-Economic Participation Agreement – permanent closure and confirming discussed next steps from March meeting	April 23, 2012	Letter	Chief MacMillan
1997 Sä Dena Hes Socio-Economic Participation Agreement – permanent closure and confirming discussed next steps from March meeting	April 27, 2012	Conference call	LFN & Teck
3rd party review of the current Closure Plan – project scope confirmation	May 6, 2012	Memo	Chief MacMillan, Trevor Harding
Sä Dena Hes Reclamation – Business / Socio-economic Opportunities and project planning / timeline	June 12, 2012	Meeting in Calgary, AB	LFN & Teck
Sä Dena Hes Mine General Project Update	July 2012	LFN Community Newsletter (attached)	LFN membership
Implementation of the 1997 Sä Dena Hes Mine Socio-Economic Participation Agreement between LFN & Teck in the Sä Dena Hes Decommissioning Project 2012-2015	September 14, 2012	Letter	Chief MacMillan
Sä Dena Hes Mine Project update and community dialogue	Oct 17, 2012	LFN Community Dinner & Meeting	LFN membership and leadership
Sä Dena Hes Mine Project update and detailed responses to the 19 questions	October 2012	LFN Community Newsletter	LFN membership and leadership

posed by the community at the Oct. 17th meeting		(attached)	
Sä Dena Hes Reclamation – Business / Socio-economic Opportunities	Dec 18, 2012	LFN and Teck Teleconference	LFN & Teck
Sä Dena Hes Reclamation – Business / Socio-economic Opportunities	February 2013	Meeting in Whitehorse, YT	LFN & Teck

Of specific note in the above table is the LFN community dinner and meeting on October 17, 2012. The primary focus of the meeting was to provide a Sä Dena Hes Mine project update and to encourage community dialogue. The meeting was hosted at the community recreational centre and was attended by approximately 50 members of the community (including a number of wee-ones!). The evening commenced with a thoughtful welcome by Chief MacMillan, which was then followed by a prayer by an Elder. The people in attendance were treated to a wonderful dinner prepared by LFN catering.

Upon completion of the dinner, the Teck team was provided the opportunity to present an overview of the Project, making note of illustrative pictures in the Power Point presentation throughout. The community in attendance showed clear interest in the Project, providing numerous questions that the Teck team endevoured to answer; where a response was not readily available, a commitment was made to follow up.

As committed to by Teck, a lengthy newsletter was provided to the LFN community (attached), by way of the LFN Communications Coordinator, two weeks following the meeting which included 19 detailed responses, a project timeline update, and a follow up contact if further information was sought.

In addition to the ongoing communication and engagement between Teck and the LFN, Teck committed the required funds to enable the LFN to have an environmental consultant of their choice conduct a review of the current Closure Plan to identify potential items/issues that require further study during the 2012 field season and going forward. In the review scope, the environmental consultant was required to engage the LFN by way of hiring of an LFN member to partake in the review process, providing updates to the LFN leadership accordingly.

In addition to Teck's ongoing engagement and consultation with the LFN, following dialogue with the LFN and securing permission, Teck began direct communication with the Ross River First Nation (RRFN). In December 10, 2012, Teck provided a briefing that included the following:

1) Summary (and copy of the newsletter) regarding the LFN community dinner and meeting attended by Teck representatives Oct. 17, 2012 in Watson Lake
2) A suggested Communications Protocol to guide Teck and the RRDC communication activities
3) Sä Dena Hes Mine site location map
4) Contact information for Bruce Donald, Manager, Dormant Properties, Teck Resources Limited
5) The Sä Dena Hes Mine Project Timeline for 2012 – 2015 for review
6) The offer to provide a hard copy of the draft Sä Dena Hes Mine Closure Plan for the Nation's review and interest.

Teck has a desire to ensure the RRFN remains apprised of the Sä Dena Hes Closure Plan, and is committed to providing future project updates for the interest of the RRFN membership.

Future First Nation Consultation & Engagement Activities

Teck's approach to working with the Liard First Nation in 2013 and into the future will be based upon the solid working relationship established and maintained between Teck and the LFN to date.

Teck anticipates a meeting in April 2013 in Watson Lake, YT with the LFN leadership and community (similar format as the Oct. 17, 2012 community dinner and meeting) to provide a project update, detail prospects for the LFN membership to engage in socio-economic opportunities, and for Teck to address any questions and/or requests for further information regarding the Project.

Following the meeting, Teck will again summarize the engagement and provide a follow up LFN community newsletter for review, especially for those with an interest but were unable to attend the meeting.

In addition, Teck will continue to apprise the Ross River First Nation (RRFN) on the Project by way of the newsletter provided to the LFN. The newsletter includes contact details providing the opportunity to members of the RRFN to follow up if there is an interest to do so; Teck welcomes this.

Conclusion

The above summary of Teck's First Nation engagement and consultation efforts from March 2012 to today is based upon the accumulated notes, communications, and participation by Counterflow as it relates to the Sä Dena Hes Closure Project. I trust the summary satisfies the requested requirements.

Sincerely,



Christine Callihoo, MSc, RPP, MCIP
Land Use & Community Planner

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SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN

MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX I – Environmental Monitoring at False Creek Canyon, 2012

ENVIRONMENTAL MONITORING

AT

FALSE CANYON CREEK, 2012

For

Teck Resources Ltd

Sä Dena Hes Operating Corporation,

Submitted by

Laberge Environmental Services
&
Can-Nic-A-Nick Environmental Sciences

December 2012

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1.0 INTRODUCTION

The Sä Dena Hes Operating Corporation is a joint venture comprised of Teck Resources Limited (Teck) at 50 percent and 50 percent Pan-Pacific Metal Mining Corp., a wholly-owned subsidiary of Korea Zinc. The Joint Venture purchased the Sä Dena Hes lead/zinc property north of Watson Lake, Yukon, in March 1994. Teck is the operator under the joint venture agreement.

The current use of water and disposal of waste at the property is governed by Water Licence Number QZ99-045 which was re-issued by the Yukon Territory Water Board in January 2002 and will expire on December 31st, 2015. Active mining and milling occurred from July 1991 until temporary shut down on December 2, 1992. There has been no production at Sä Dena Hes since operations were suspended in 1992 and the property has since been maintained in a temporary shut down mode. The water licence requires that certain fish, benthic invertebrate and sediment monitoring programs be carried out every two years (Part F, Sections 57 to 67).

Teck engaged Laberge Environmental Services (LES) and Can-Nic-A-Nick Environmental Sciences to conduct the monitoring programs required for 2012. This report presents the results of the programs with some comparisons made with previous studies conducted in 1992 (P.A. Harder and Associates, 1993), in 1994 (LES and WMEC, 1995), in 1996 (LES, 1996), in 1998 (LES and Can-Nic-A-Nick, 1998), in 2000 (LES and Can-Nic-A-Nick, 2000), in 2002 (LES and Can-Nic-A-Nick, 2002) in 2004 (LES and Can-Nic-A-Nick, 2004), in 2006 (LES and Can-Nic-A-Nick, 2006), in 2008 and in 2010 (LES and Can-Nic-A-Nick, 2011).

2.0 STUDY AREA

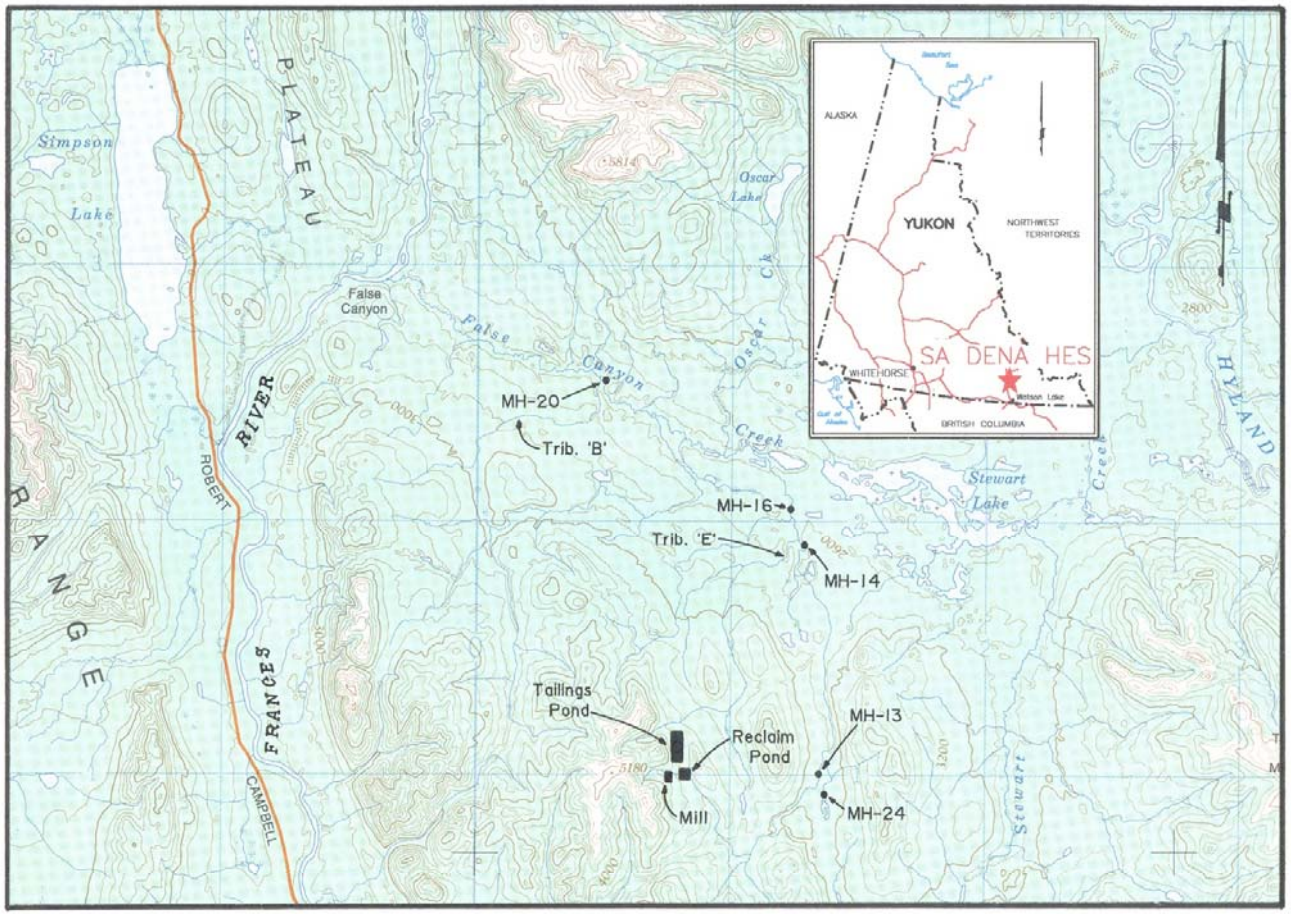
The study area is located in the upper part of the Liard River basin, 40 air kilometres, and 70 road kilometres north of Watson Lake.

The Sä Dena Hes property lies within the ecoregion known as Liard Basin. This ecoregion is characterized by low hills separated by broad plains and surrounded by mountains and plateaus. The low elevation, moderate precipitation and relatively long, warm summers results in vigorous forest growth, most notably in the floodplains of the major rivers of the area (Ecoregion Working Group, 2004)

The mine is primarily an underground operation with potential for two small open pits. Waste dumps and sediment ponds are situated in tributary drainages. Tailings and wastewater are discharged to the tailings pond. (Note that the mill and mine have not operated since December 2, 1992.) The tailings pond water flows to the reclaim pond which is licensed to discharge to upper False Canyon Creek, a tributary of the Frances River, during specified time periods each year.

The sample sites are within the drainage basin of False Canyon Creek which has a total catchment area of 492 km^2. The Frances River discharges into the Liard River 55 kilometres downstream from the confluence with False Canyon Creek. Three sites on False Canyon Creek (MH13, MH16 and MH20) were sampled for water, sediment, fish and benthos (Figure 1). The site locations, descriptions and types of monitoring are outlined in Table 1.

The licence states that sampling should also be undertaken at MH14 and MH18 for the benthos, fish and sediment surveys. MH14 was submerged between 1996 to 2006, and the alternate site MH16, located two kilometers downstream, had been used for those studies. The present sampling location at MH14 is now no longer flooded, however in the pursuit of consistency, MH16 was again used as the sample site rather than MH14. Regular water samples are collected quarterly at MH14 however. MH16 is also a quarterly water quality station and is located on the main stem of False Canyon Creek. This area is presently unaffected by beaver activity and is representative of a more stable environment than MH14.



FALSE CANYON CREEK

FIGURE 1 - LOCATION OF SAMPLE SITES

5 0 5 10 15 20 km

SCALE 1 : 250,000

MH-20 · · · · · · · · · · · Sample Site

As with all previous monitoring surveys, a suitable landing site could not be located for MH18. To maintain consistency with the 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008 and 2010 studies, MH20 was sampled for benthos instead of MH19.

TABLE 1
SAMPLE SITE DESCRIPTIONS

SITE #	DESCRIPTION	COORDINATES	SAMPLE TYPE
MH13	False Canyon Cr approx 10 km d/s of reclaim pond.	60° 31' 21.1" N 128° 45' 34.6" W	WQ, SS, BI, F
MH16	False Canyon Cr. approx 22 km d/s of reclaim pond	60° 37' 37.3" N 128° 46' 53.2" W	WQ, SS, BI, F
MH20	False Canyon Cr approx 33 km d/s of reclaim pond	60° 39' 06.8" N 128° 51' 32.4" W	WQ, SS, BI, F

WQ = water quality SS = stream sediments
BI = benthic invertebrates F = fish

Site MH24, on the headwaters of False Canyon Creek, was to serve as the control site since 1998, as it is unaffected by any potential mining activity. It was discovered in 1998 that the site characteristics and sampling limitations were similar to those associated with MH14. Specifically, MH24 was underlain with water with no defined stable channel, and no safe landing site. These conditions make this site unsuitable as a background/control site for the monitoring program and no attempts were made to collect any data in 2012.

2.1 Sample Site Descriptions

MH13

MH13 is located on the main stem of False Canyon Creek approximately ten kilometres downstream of the reclaim pond in a beaver/wetland complex. In 2012 water levels appeared normal. During the survey conducted in 2008, water levels were very low throughout the area of MH13 (LES, 2008) but were at typical levels by the 2010 survey. Benthic invertebrates have frequently been difficult to collect here due to unconfined channels, deep pools, and altered watercourses resulting from beaver activity. Similar conditions were encountered in 2012.

MH14

MH14 is located on the main stem of False Canyon Creek approximately twenty kilometres downstream of the reclaim pond in a beaver/wetland complex. This reach has undergone considerable alteration since the survey in 1994. Beaver dams in 1996 had caused flooding of the original site and this continued to be the case until 2006. No sampling, other than routine water quality (see annual report) was undertaken in 2012.

MH16

MH16 is located on the main stem of False Canyon Creek approximately twenty-two kilometres downstream of the reclaim pond. The channel is moderately well confined and appears stable with well-vegetated banks. This site has changed very little over time.

MH20

MH20 is located on the main stem of False Canyon Creek approximately thirty-three kilometres downstream of the reclaim pond and approximately 13 kilometres upstream of the confluence with the Frances River. The channel is well defined and stable with exposed gravel bars throughout the reach. The physical characteristics of this site have remained essentially unchanged since the monitoring program commenced in 1992, with the exception of several downed trees, which had recently fallen into the stream in 2008. This has had the effect of creating new gravel bars and a more mobile substrate within the sampling reach.

MH24

As stated earlier, a site for MH24 had not been established due to wet conditions. If appropriate conditions were met (confined channel, and stable banks and substrate), this site would have been located on upper False Canyon Creek upstream of the confluence with the reach on which MH13 is situated. MH24 would then have represented a control/background site for the downstream, potentially mine affected sites. As this was not possible, assessments of the fish communities at sites MH13, MH16 and MH20 shall continue to act as monitors of changes in water quality. All of these sites now have considerable fisheries, sediment, water quality and benthic invertebrate data, collected over many years providing an opportunity for trend and cumulative effects analyses. In addition, the less mobile slimy sculpin community associated with the beaver/wetland complex at MH13 serves virtually as an in-stream bioassay of surface waters originating from the mine.

3.0 METHODS

The environmental monitoring programs described below were completed on August 14th and 15th, 2012. All sites were accessed by helicopter.

3.1 Water Quality

Water quality samples were collected at each site. The samples were collected in a fast flowing section of the stream, prior to any other sampling activity.

3.1.1 Field Measurements

In-situ measurements were taken at each site. Temperature, conductivity and pH measurements were obtained using a Hanna multi-probe. Dissolved oxygen concentrations were measured with a YSI 550A dissolved oxygen meter.

3.1.2 Chemical Analyses

All sample bottles were supplied by Maxxam Analytics Inc of Burnaby, B.C. At each site, samples were collected in one litre plastic bottles for sulphates, alkalinity and nonfilterable residue. Samples to be analyzed for total metals were collected in 250 ml plastic bottles. The dissolved metals samples were filtered in the field using disposable sterile syringes and in-line filters (filter pore size 0.45 microns). Dissolved and total metals samples were preserved with nitric acid. All sample bottles with the exception of the dissolved metals sample, were partially filled and rinsed three times prior to collecting sample waters. The dissolved metals sample bottle was rinsed three times with the filtrate. Samples were kept cool prior to shipment to Maxxam.

3.2 Sediment Sampling

Triplicate sediment samples were collected from MH13, MH16 and MH20. Sample sites were selected from areas of deposition along the stream bank, generally characterized by the finest grain size evident at the site. Samples were collected with a stainless steel trowel and placed in

ziplock freezer bags. The samples were packed with ice packs when shipped to Maxxam in B.C. At the lab the samples were dried, passed through a 100 mesh (0.15 mm) stainless steel sieve, and then run through an ICP analysis to determine total metals levels.

3.3 Benthic Invertebrates

Benthic invertebrates were sampled at three similar locations per site. The samples were collected from an undisturbed, fast flowing, gravel strewn riffle habitat at each of the sites where possible. Collections were made with a Surber sampler (area = 0.0929 m^2) which had a 300 micron mesh net. The bed material within the frame was cleaned and washed by hand, with the fast flowing current carrying the disturbed bottom fauna and detritus into the collection bag. The level of effort for each sample and at each site was comparable. The captured invertebrates and detritus were placed in one-litre Nalgene bottles, preserved in 10% formalin, and shipped to Leslie Davenport of Sandpiper Biological Services, an entomologist in Victoria, B.C., for sorting, identification and enumeration.

At the lab, all samples were washed through two screens with mesh sizes 1 millimetre and 180 microns. All of the organisms retained by the coarse screen were counted and identified, whereas the organisms on the 180 micron screen were subsampled as necessary. A Folsom plankton splitter was used for the subsampling. The majority of the benthos was identified to the genus level.

3.4 Fish Monitoring

Three sites on False Canyon Creek (MH13, MH16, and MH20) were sampled for the presence of fish in mid August of 2012. Fieldwork was completed on August 14th and 15th. The methodology and timing of the assessment was consistent with all previous monitoring projects for the watershed. The current water license requires fish monitoring every two years during periods when the mine is not active. The mine has not been active since the early 1990s. Fisheries monitoring began in 1994 (LES 1995).

The purpose of the fish monitoring program in False Canyon Creek is to build a long-term database on species utilization at each of the survey sites. Should the mine become active in the future the database will be used for effects monitoring in the drainage. Sites MH13 and

MH20 have been consistently monitored since the stations were established in the early 1990s.

As in the past, a Smith Route model LR24 battery powered electrofisher was the primary method used for establishing fish presence at each site. A conductivity meter was used to measure the conductivity of the surface flows at each site to assist in determining the most appropriate settings of the electrofisher. The shocking time (seconds) and settings used to collect fish were recorded for each sampling site. Three Gee type minnow traps were additionally set overnight at each of the sampling sites using methods described by the Yukon River Panel (2007). Angling and seining were additionally used at sites MH16 and MH20. Angling employed the use of flies and small spinners. The time spent angling was used as an index of sampling effort. All captured fish were identified and measured. The numbers of lure strikes were also noted. A 1.5 X 7 meter seine net (6.3 mm oval mesh) was used to sample shallow water sidebars at site MH20. All captured fish were identified and measured for a length (± 1mm) and weight (± 0.1gm). Weight was determined using an Ohaus Scout II digital scale. All fish were live released at site of capture.

4.0 RESULTS AND DISCUSSION

4.1 Water Quality

Water quality samples were collected from each of the three sites on the main channel of False Canyon Creek during the 2012 study. A blind duplicate was collected at MH20. All data are presented in Appendix B. Of the 34 metals analyzed, 18 were below detection at each site in both the total and dissolved states (antimony, beryllium, bismuth, boron, chromium, cobalt, lead, lithium, mercury, nickel, silver, sulphur, titanium, thallium, tin, vanadium, zinc and zirconium).

The results for the field data and for the specified licensed parameters are presented in Table 2. Concentrations of the various water quality parameters were compared to the Canadian Council of Ministers of the Environment (CCME, 1999) guidelines for the protection of freshwater aquatic life. It is important to note that the limits as set out under the Water Licence issued by the Yukon Territory Water Board apply to the discharge point and there is no obligation to meet the CCME criteria in the receiving waters at this time.

The waters of the study area were cool, slightly alkaline and well aerated.

Conductivity is generally a measure of dissolved ions in water. Conductivity at all sites was relatively high, predominately due to the concentrations of calcium and magnesium ions.

Alkalinity is a measure of water's ability to neutralize acid. The creeks sampled in this study had high alkalinity values and the waters were hard to very hard, providing this region with a relatively good buffering capacity. Hardness is an important modifying factor in water quality as it can significantly influence the form and hence toxicity of numerous heavy metals. In general terms, the toxicity of certain metals is lowered with an increase in hardness.

Sulphate levels were low at all sites ranging from 5.3 to 6.0 mg/L. Natural sulphate concentrations in surface waters have been found to vary from 3 to 80 mg/L (CCREM, 1987). Sulphate can contribute to changes in pH in water systems. The alkaline waters of the False Canyon Creek drainage are a reflection of naturally high carbonate/bicarbonate and low sulphate concentrations.

TABLE 2
WATER QUALITY DATA, August 14, 2012

Sample Site	**MH13**	**MH16**	**MH20**	Detection Limit	CCME Guideline for freshwater aquatic life
Time Sampled	10:45	12:30	15:15		
Temp °C	8.3	9.9	12.0		
pH: in-situ	8.10	8.34	8.24		6.5 to 9.0
pH: lab	8.45	8.41	8.38		
Conductivity (uS/cm) field	350	355	279		
Conductivity (uS/cm) Lab	359	366	284		
Dissolved Oxygen (ppm)	10.5	10.8	10.3		
Dissolved Oxygen (%)	90	96	95		
Alkalinity mg/L as CaCO3	194	202	154	0.5	
Sulphate (mg/L)	6.6	5.3	5.3	1.0	
Total Suspended Solids (ppm)	<4.0	<4.0	<4.0	4	
Cu: total (ug/L)	0.38	0.26	0.39	0.20	4
Cu: dissolved (u/gL)	0.5	0.34	1.79*	0.20	
Pb: total (ug/L)	<0.20	<0.20	<0.20	0.20	6
Pb: dissolved (ug/L)	<0.20	<0.20	<0.20	0.20	
Zn: total (ug/L)	<5.0	<5.0	<5.0	5.0	30
Zn: dissolved (ug/L)	<5.0	<5.0	<5.0	5.0	
Fe: total (ug/L)	237	185	193	5.0	300
Fe: dissolved (ug/L)	76.2	60.0	57.3	5.0	
Total Hardness mg/L as CaC03	197	203	157		

* It is unknown why this sample appears contaminated with copper. The duplicate collected here had a copper concentration in line with the other two sites on False Canyon Creek.

False Creek Canyon waters were clear and total suspended solids were not detected at any of the sites.

Concentrations of the examined metals were low where detected and the CCME guidelines for copper, iron, lead and zinc were met at all of the sites.

Concentrations of potential toxicants in water collected during the past eleven surveys (1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010 and 2012) are compiled in Table 3. The

majority of the analyses were below the method detection limit. The method detection limit (MDL) has decreased over time providing more precision at lower concentrations. The concentration of cadmium has slightly exceeded the MDL at each of the sites on rare occasions. The analytical procedure in 2000 allowed for a lower MDL for copper resulting in reportable copper values at each site from 2000 to the present. There was an anomalous dissolved copper concentration at MH20 in 2012, but the analysis of the duplicate sample collected here does not confirm this above normal concentration. The level of nickel has consistently been below the MDL with the exception of a low concentration documented in the 1998 dissolved sample at MH16. Zinc has been occasionally detected at each of the sites.

The low concentrations of detected metals throughout the study area over the study period indicate good water quality for the support of freshwater aquatic life.

TABLE 3

COMPARISON OF POTENTIAL TOXICANTS AT EACH OF THE SITES OVER THE STUDY PERIOD

Site	Year	Cadmium		Copper		Nickel		Lead		Zinc	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MH - 13	1992	<0.0005	<0.0005	<0.001	<0.001	<0.008	<0.008	0.002	<0.001	0.004	<0.002
	1994	<0.0001	<0.0001	<0.002	<0.001	<0.01	<0.008	<0.003	<0.001	<0.01	<0.002
	1996	<0.0001	<0.0001	<0.002	<0.001	<0.01	<0.008	<0.003	<0.001	0.07	<0.002
	1998	<0.002	<0.002	<0.003	0.001	<0.01	<0.008	<0.03	<0.02	<0.01	<0.002
	2000	0.00008	<0.00002	0.0008	0.0006	<0.01	<0.008	<0.001	<0.001	<0.005	<0.005
	2002	<0.00001	0.00002	0.0006	0.0005	<0.008	<0.008	<0.0005	<0.0005	0.01	<0.005
	2004	0.00002	<0.00001	0.0003	0.0004	<0.008	<0.008	<0.0005	<0.0005	<0.005	<0.005
	2006	0.00001	0.00001	0.0003	0.0003	<0.008	<0.008	<0.0005	<0.0005	<0.005	<0.005
	2008	0.00003	0.00003	0.0004	0.0004	<0.001	<0.001	<0.0002	<0.0002	<0.005	<0.005
	2010	not reported	0.00002	0.0003	0.0006	<0.001	<0.001	<0.0002	<0.0002	<0.005	<0.005
	2012	0.000026	0.000019	0.00038	0.0005	<0.0010	<0.0010	<0.00020	<0.00020	<0.0050	<0.0050
MH - 16	1992	<0.0005	<0.0005	<0.001	<0.001	<0.008	<0.008	0.003	<0.001	0.002	<0.002
	1998	<0.002	<0.002	0.004	0.001	<0.01	0.010	<0.03	<0.02	<0.01	<0.002
	2000	0.00002	<0.00002	0.0006	0.0006	<0.01	<0.008	<0.001	<0.001	<0.005	<0.005
	2002	<0.00001	<0.00001	0.0005	0.0005	<0.008	<0.008	<0.0005	<0.0005	0.009	<0.005
	2004	0.00002	<0.00001	0.0003	0.0004	<0.008	<0.008	<0.0005	<0.0005	<0.005	<0.005
	2006	0.00002	<0.00001	0.0004	0.0003	<0.0008	<0.008	<0.0005	<0.0005	<0.005	<0.005
	2008	0.00001	0.00004	0.0003	0.0008	<0.001	<0.001	<0.0002	0.0002	<0.005	0.005
	2010	not reported	<0.00001	0.0002	0.0002	<0.001	<0.001	<0.0002	<0.0002	<0.005	<0.005
	2012	0.000012	<0.000010	0.00026	0.00034	<0.0010	<0.0010	<0.00020	<0.00020	<0.0050	<0.0050
MH - 20	1992	<0.0005	<0.0005	<0.001	<0.001	<0.008	<0.008	0.002	0.001	0.002	<0.002
	1994	<0.0001	<0.0001	<0.002	<0.001	<0.01	<0.008	<0.003	<0.001	<0.01	<0.002
	1996	<0.0001	<0.0001	<0.002	<0.001	<0.01	<0.008	<0.003	<0.001	0.01	<0.002
	1998	<0.002	<0.002	<0.003	<0.001	<0.01	<0.008	<0.03	<0.02	<0.01	<0.002
	2000	<0.00002	<0.00002	0.0008	0.0005	<0.01	<0.008	<0.001	<0.001	<0.005	<0.005
	2002	<0.00001	<0.00001	0.0006	0.0005	<0.008	<0.008	<0.0005	<0.0005	0.009	<0.005
	2004	<0.00001	<0.00001	0.0003	0.0005	<0.008	<0.008	<0.0005	0.0006	<0.005	<0.005
	2006	0.00001	<0.00001	0.0003	0.0003	<0.008	<0.008	<0.0005	<0.0005	<0.005	<0.005
	2008	0.00001	0.00001	0.0005	0.0004	<0.001	<0.001	<0.0002	<0.0002	<0.005	<0.005
	2010	not reported	<0.00001	0.0003	0.0003	<0.001	<0.001	<0.0002	<0.0002	<0.005	<0.005
	2012	<0.000010	<0.000010	0.00039	0.00179	<0.0010	<0.0010	<0.00020	<0.00020	<0.0050	<0.0050

NOTE: All units are expressed as mg/L

4.2 Sediments

The results for the metals analyses of all stream sediments samples are presented in Appendix B with the water quality data. Of the 30 metals analyzed, only sodium was not detected.

Seven elements (As, Cd, Cr, Cu, Hg, Pb, and Zn) were chosen for closer examination as these can be potentially toxic to aquatic systems. The data for the triplicates was averaged per site and standard deviation was performed to determine the spread of the data (Table 4). Metals in sediments are often difficult to interpret because levels can vary widely as a function of natural mineralization of local soils in a given watershed. The standard deviation analysis shows that representative samples were collected at the sites.

Table 4
METAL CONCENTRATIONS (mg/kg) IN THE INDIVIDUAL SEDIMENT SAMPLES, AUGUST 2012

	pH	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc
MH-13A	8.24	19.1	2.18	17.9	23.0	30.5	0.095	208
MH-13B	8.18	13.3	1.85	18.1	23.3	25.4	0.090	188
MH-13C	8.10	16.2	2.02	19.3	22.4	27.2	0.091	200
Mean:	**8.17**	**16.20**	**2.02**	**18.43**	**22.90**	**27.70**	**0.09**	**198.67**
S.D.:	**0.07**	**2.90**	**0.17**	**0.76**	**0.46**	**2.59**	**0.00**	**10.07**
MH-16A	8.25	5.14	0.639	47.6	12.9	9.10	<0.050	91.8
MH-16B	8.16	4.38	0.641	16.8	10.8	9.13	0.054	88.5
MH-16C	8.55	3.52	0.432	22.7	7.51	6.23	<0.050	64.5
Mean:	**8.32**	**4.35**	**0.57**	**29.03**	**10.40**	**8.15**	**0.05**	**81.60**
S.D.:	**0.20**	**0.81**	**0.12**	**16.35**	**2.72**	**1.67**	**-----**	**14.90**
MH-20A	8.25	6.88	0.551	37.0	20.8	9.42	0.060	70.3
MH-20B	8.30	5.56	0.596	35.9	20.9	9.03	0.203	70.2
MH-20C	8.33	5.54	0.546	112	21.9	8.43	0.055	67.0
Mean:	**8.29**	**5.99**	**0.56**	**61.63**	**21.20**	**8.96**	**0.11**	**69.17**
S.D.:	**0.04**	**0.77**	**0.03**	**43.62**	**0.61**	**0.50**	**0.08**	**1.88**

The mean concentrations of these metals were compared to the CCME (1999) interim freshwater sediment quality guidelines (ISQG), and to the probable effects levels (PEL). Concentrations greater than the PEL have a 50% incidence of creating adverse biological effects (Table 5).

Metal concentrations were generally low throughout and the PEL was not exceeded at any site for any of the parameters examined. The stream sediments at MH13 had the highest concentrations of the metals examined, with the exception of chromium. The highest concentration was recorded

in the stream sediments at MH20, where it exceeded the ISQG. The ISQG for arsenic was exceeded at MH13 and MH20. The concentration of zinc exceeded the ISQG at MH13.

TABLE 5

SUMMARY OF METAL CONCENTRATIONS (mg/kg) IN THE STREAM SEDIMENTS, AUGUST 2012

STATION NUMBER STATION DESCRIPTION	MH - 13 False Canyon Creek 10 km d/s	MH - 16 False Canyon Creek 22 km d/s	MH - 20 False Canyon Creek 33 km d/s	**ISQG**	**PEL**
pH	8.17	8.32	8.29		
ARSENIC	**16.2**	4.3	**6.0**	5.9	17.0
CADMIUM	**2.02**	0.57	0.56	0.6	3.5
CHROMIUM	18.4	29.0	**61.6**	37.3	90.0
COPPER	22.9	10.4	21.2	35.7	197.0
LEAD	27.7	8.2	9.0	35.0	91.3
MERCURY	0.09	0.05	0.11	0.2	0.486
ZINC	**199**	82	69	123	315

Note: ISQG = Interim freshwater Sediment Quality Guidelines, in **bold** where exceeded.
PEL = Probable Effects Level (>50% of adverse effects occur above this level), shaded and in **bold** where exceeded.

Sediment results were compared to data collected in previous studies for sites MH13, MH16 and MH20 (Table 6 and Figures 2 to 6). The applicable ISQG and/or PEL were plotted on each figure. The concentration of arsenic in the sediments has consistently surpassed the ISQG at each site and approached or exceeded the PEL at MH13. These levels do not appear to have impacted the aquatic communities (see sections 4.3 and 4.4).

Copper levels remain well below the ISQG of 37.3 mg/kg. Concentrations were very similar at MH13 and downstream at MH20. Levels at MH16, located between these two sites, were lower.

Cadmium, lead and zinc concentrations were significantly higher in the sediments at MH13 than downstream at MH16 and MH20. The ISQG for cadmium was exceeded on all occasions at MH13, and frequently at MH16. There was an anomalous reading of cadmium at MH20 in 1996, which exceeded the ISQG. This may be attributable to sampling or lab error as concentrations have consistently been 0.5 ug/g or lower during all the other sampling periods.

Concentrations of lead in the stream sediments at MH16 and MH20 continue to be much lower than at MH13, and are well below the ISQG. Lead levels in the sediments at MH13 have frequently exceeded the ISQG over the study period.

Zinc concentrations in the stream sediments at MH13 are greater than at the other two sites, and have exceeded the ISQG on each sampling event.

TABLE 6

COMPARISON OF METALS (ug/g) IN SEDIMENTS OVER THE STUDY PERIOD

Site	Year	Arsenic	Copper	Cadmium	Lead	Zinc
MH - 13	1992	**17.0**	21.7	**1.2**	**65**	**256**
	1994	**11.5**	22.8	**1.5**	**47**	**216**
	1996	**12.0**	19.2	**1.7**	27	**160**
	1998	**14.0**	20.7	**1.2**	**37**	**174**
	2000	**17.3**	24.1	**2.1**	**71**	**266**
	2002	**8.1**	17.8	**1.2**	24	**148**
	2004	**9.6**	23.5	**1.3**	30	**185**
	2006	**18.2**	23.9	**2.4**	**38**	**224**
	2008	**12.8**	22.0	**1.9**	**48**	**226**
	2010	**16.1**	24.5	**1.9**	**38**	**233**
	2012	**16.2**	22.9	**2.0**	28	**199**
MH - 16	1998	<8	9.2	0.4	8	72
	2000	**11.3**	9.8	0.4	8	80
	2002	**6.0**	13.0	**0.8**	11	90
	2004	**7.8**	17.5	**1.0**	13	118
	2006	**8.4**	14.6	**0.8**	11	96
	2008	5.9	13.8	**0.8**	11	95
	2010	**9.3**	20.0	**1.4**	15	**138**
	2012	4.3	10.4	0.6	8	82
MH - 20	1992	**13.0**	22.1	<0.1	15	78
	1994	<10	20.6	0.5	9	70
	1996	**9.0**	16.6	**1.5**	9	69
	1998	**10.0**	18.7	0.3	11	74
	2000	**7.3**	23.0	0.3	13	88
	2002	4.6	16.9	0.3	8	57
	2004	**6.1**	22.9	0.4	10	78
	2006	**6.0**	18.0	0.3	8	66
	2008	5.8	21.2	0.4	10	75
	2010	**9.3**	16.8	0.5	8	75
	2012	6.0	21.2	0.6	9.0	69.2

Note: ISQG = Interim freshwater Sediment Quality Guidelines, in **bold** where exceeded.
PEL = Probable Effects Level (>50% of adverse effects occur above this level), shaded and in bold where exceeded.

In general, the concentrations of the various metals have remained relatively consistent in the stream sediments at MH20. Concentrations tended to fluctuate more widely in the sediments at MH13 and moderately in the sediments at MH16.

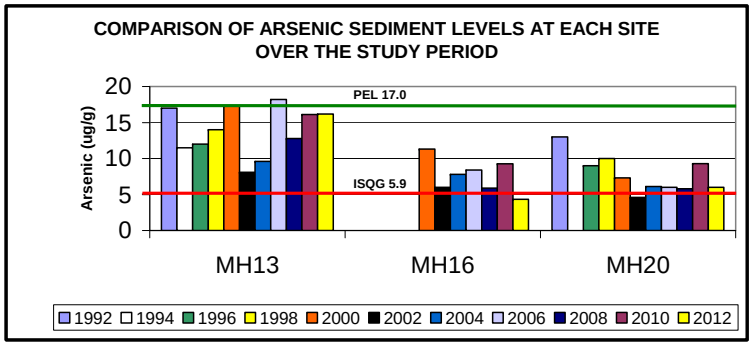


Figure 2

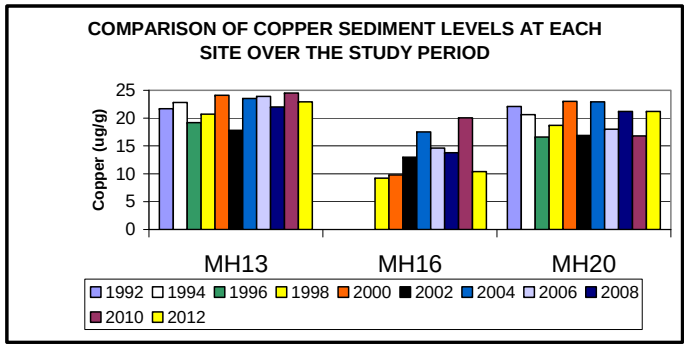


Figure 3

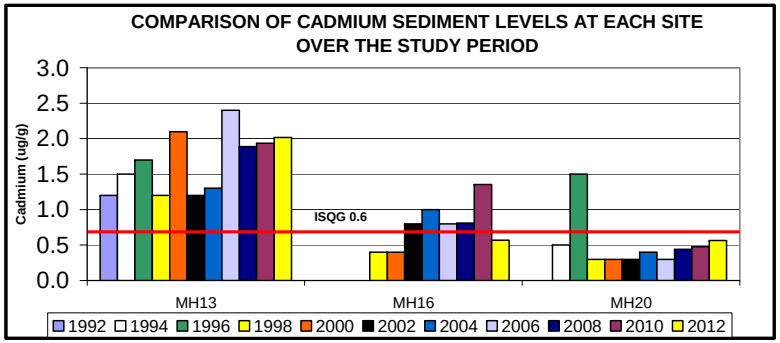


Figure 4

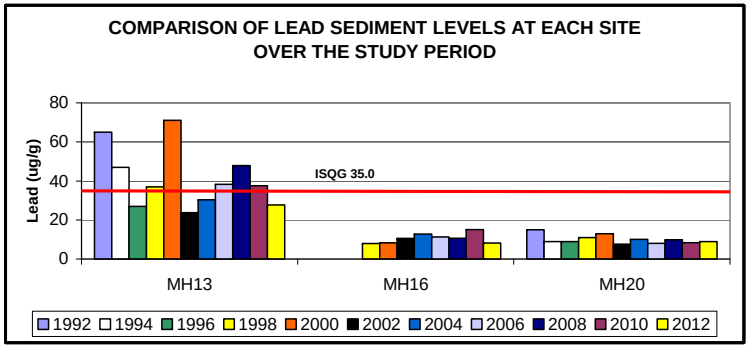


Figure 5

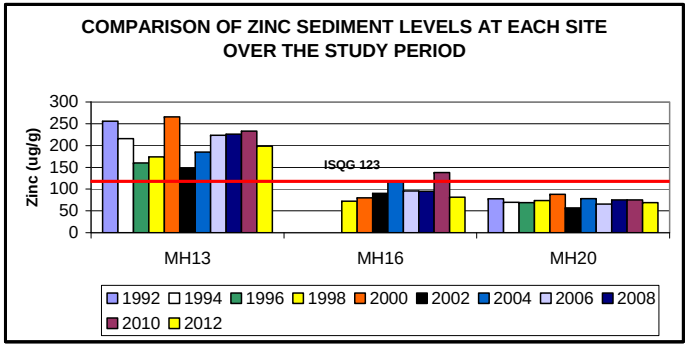


Figure 6

4.3 Benthic Invertebrates

Four phyla were found in the study area: Arthropoda, Nematoda, Annelida and Platyhelminthes. A total of 10,400 benthic invertebrates, representing 93 different taxonomic groups, were identified within these phyla. These data are presented in Appendix C.

4.3.1 Abundance and Taxonomic Richness

The total number of organisms of the triplicates for each site was summed to give a total abundance value for that site. The total populations were 3,465 individuals at MH13, 5,893 individuals at MH16, and 682 individuals at MH20. Density was calculated for each site and these values followed the same trend as the abundance values.

Taxonomic richness was determined for each site by enumerating all the different taxonomic groups identified from species to phylum as a measure of community diversity. The community at MH16 had the greatest diversity. The communities at MH13 and MH20 were similar. To further characterize the taxonomic wealth of each community, the diversity was related to the population size using the formula: (Diversity – 1) divided by the natural log of the population. The community at MH20 had the greatest taxonomic wealth and the community at MH13 the least. All of the above data are included in Table 7.

TABLE 7 GENERAL STATISTICS ON THE BENTHIC COMMUNITIES, 2012

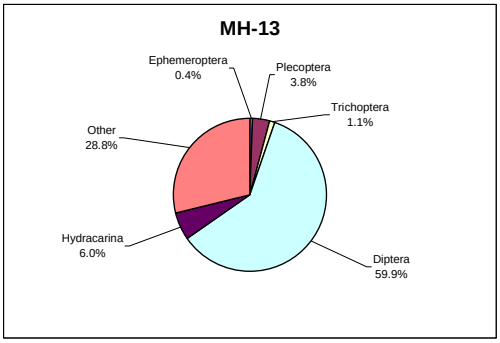
Site	Abundance	Density (#/m^2)	Diversity	Taxonomic Richness
MH-13	3,465	12,433	53	6.4
MH-16	5,893	21,145	61	6.9
MH-20	682	2,447	52	7.8

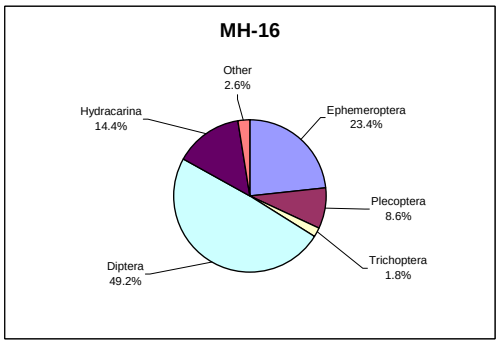
4.3.2 Distribution

The percent composition of the major taxonomic groups was calculated for each station (Figure 7). Based on the percentages of each group, taxa were classified with respect to their dominance within the benthic community for each site (Table 8). The group “Other” includes invertebrates

from Aranea, Collembola, Coleoptera, Cladocera, Copepoda, Oligochaeta, Ostracoda, Platyhelminthes and Nematoda.

FIGURE 7 COMPOSITION OF TAXONOMIC GROUPS AT EACH SITE





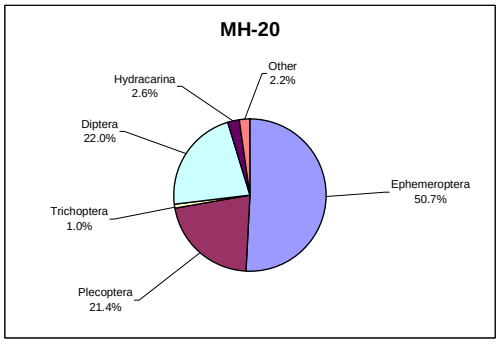


TABLE 8 TAXONOMIC DISTRIBUTION OF BENTHIC INVERTEBRATES

DOMINANT (>25%)	SUBDOMINANT (10% to 24.9%)	COMMON (1.0% to 9.9%)	RARE (0.1% to 0.9%)
Diptera Other		Hydracarina Plecoptera Trichoptera	Ephemeroptera

DOMINANT (>25%)	SUBDOMINANT (10% to 24.9%)	COMMON (1.0% to 9.9%)	RARE (0.1% to 0.9%)
Diptera	Ephemeroptera Hydracrina	Plecoptera Other Tricoptera	

DOMINANT (>25%)	SUBDOMINANT (10% to 24.9%)	COMMON (1.0% to 9.9%)	RARE (0.1% to 0.9%)
Ephemeroptera	Diptera Plecoptera	Hydracarina Other Trichoptera	

Diptera (true flies) was the dominant group at MH13 and MH16. Other, the majority of which were Nematoda, Copepoda and Ostracoda, shared dominance at MH13. Ephemeroptera (mayflies) was the dominant group at MH20. There were no subdominant groups at MH13. Ephemeroptera and Hydracarina were the subdominant groups at MH16 and Diptera and Plecoptera were the

subdominant groups at MH20. Ephemeroptera was rare at MH13 and the remaining groups were common at the sites.

Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), known as EPT, are sensitive to most types of pollution (Rosenberg and Resh, 1993). Lehmkuhl (1979) has identified several groups within these insect orders that have very low tolerance to chemical pollution. Eleven of these taxa (six taxa within Plecoptera, three taxa within Ephemeroptera and two taxa within Trichoptera) have been identified in the study area. Table 9 summarizes the presence or absence of each of these taxa per site.

TABLE 9
Presence (+) and Absence (-) of Sensitive Taxa at False Canyon Creek Study Area, 2012

Sensitive Taxa	MH13	MH16	MH20
Plecoptera			
Capniidae	+	+	+
Chloroperlidae	-	+	+
Nemouridae	+	+	+
Perlodidae	-	+	+
Perlidae	-	-	+
Taeniopterygidae	-	-	+
Ephemeroptera			
Ephemerellidae	-	+	+
Rhrithrogena sp.	-	-	+
Epeorus	-	+	+
Trichoptera			
Brachycentriidae	+	+	+
Rhyacophilidae	-	+	-
Total # of sensitive taxa:	3	8	10

After Lehmkuhl (1979)

Only three of the sensitive taxa were collected at MH13. The habitat here is not conducive to populations of EPT due to the lack of clean washed gravels with a relatively high velocity of flow. The flow was very sluggish in this reach with a high degree of fines comprising the substrate.

Other zones within this reach consisted of beaver dams or flooded willow areas.

Eight of the eleven sensitive taxa were identified at MH16 and ten at MH20. High representation of these sensitive organisms at MH16 and MH20 indicates good water and stream sediment quality for the support of benthic invertebrates.

4.3.3 Comparisons with Past Data

Data collected biannually from False Canyon Creek since 1992 have been summarized and compiled in Table 10. Population densities were greatest in 1998 at MH13, and in 2010 at MH16 and MH20 (Figure 8). The red bar in Figure 8 represents the mean density of that community. The population at MH13 has fluctuated considerably over the study period which probably reflects the instability of this site. Population numbers have consistently been lower downstream at MH20 than at the other two upstream sites.

Diversity has continued to fluctuate over time at MH13 and MH20, but has been relatively stable at MH16. Overall, the communities at MH16 have been the most diverse.

The number of sensitive taxa has varied significantly at MH13 but has been very low during recent surveys. This was likely due to natural degradation in habitat quality. The communities at MH16 and MH20 continue to have high numbers of sensitive taxa.

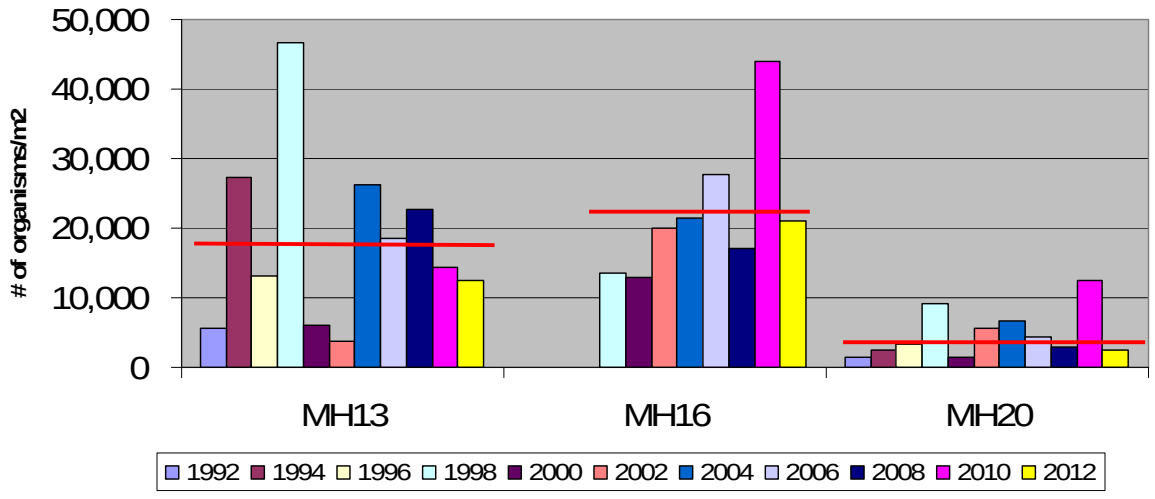
The dominance of the respective communities has remained virtually unchanged over the study period. Diptera has been the dominant or co-dominant order at MH13 during every sampling period, with the addition of Ostracoda as the dominant order in 2010. Ephemeroptera and/or Diptera have been the dominant orders at MH16 and MH20 over time.

The temporal data generally indicates that the community at MH13 fluctuates depending on the changing habitat characteristics during the particular sampling period. Although abundance varies somewhat over time, the communities at MH16 and MH20 are relatively stable.

Table 10
COMPARISON OF BENTHIC DATA OVER THE STUDY PERIOD

Site	Year	Total Abundance	Diversity	Density (# of organisms/m²)	Dominant Taxa	Total # of Sensitive Taxa
MH13	1992	1,562	25	5,605	Diptera	7
	1994	7,631	37	27,380	Ephemeroptera & Diptera	9
	1996	3,682	57	13,211	Diptera	8
	1998	13,033	30	46,764	Diptera	2
	2000	1,704	50	6,114	Plecoptera & Diptera	4
	2002	1,020	43	3,660	Diptera	3
	2004	7,289	72	26,153	Diptera	9
	2006	5,168	46	18,543	Diptera	4
	2008	6,319	50	22,673	Diptera & Plecoptera	8
	2010	4,003	33	14,363	Ostracoda & Diptera	0
	2012	3,465	53	12,433	Diptera & Other	3
MH16	1998	3,754	60	13,470	Diptera & Ephemeroptera	10
	2000	3,578	65	12,838	Diptera & Ephemeroptera	9
	2002	5,588	67	20,050	Diptera & Ephemeroptera	8
	2004	5,995	63	21,510	Diptera & Ephemeroptera	10
	2006	7,445	76	27,713	Diptera	10
	2008	4,769	58	17,112	Diptera & Ephemeroptera	8
	2010	12,266	52	44,011	Diptera	6
	2012	5,893	61	21,145	Diptera	8
MH20	1992	394	22	1,414	Ephemeroptera	6
	1994	720	31	2,583	Ephemeroptera & Diptera	8
	1996	936	54	3,358	Ephemeroptera & Diptera	12
	1998	2,564	59	9,200	Ephemeroptera & Diptera	10
	2000	412	28	1,478	Diptera & Ephemeroptera	6
	2002	1,591	43	5,709	Diptera	6
	2004	1,853	56	6,648	Diptera & Ephemeroptera	11
	2006	1,196	64	4,291	Ephemeroptera & Diptera	11
	2008	826	49	2,964	Ephemeroptera & Diptera	7
	2010	3,474	54	12,465	Diptera & Ephemeroptera	8
	2012	682	52	2,447	Ephemeroptera	10

FIGURE 8 COMMUNITY DENSITY PER SITE OVER THE STUDY PERIOD



4.4 Fish

4.4.1 Fish Distribution and Abundance

Slimy sculpin (*Cottus cognatus*) and Arctic grayling (*Thymallus arcticus*) continue to be the most common species captured or observed at sampling sites in False Canyon Creek. The only other species captured in 2012 were juvenile burbot (*Lota lota*) and a single chub (*Couesius plumbeus*). Table 11 summarizes fish capture results using the various gear types at the three surveyed sites in the False Canyon Creek drainage in 2012. Individual fish length and weight data for each site is presented in Table 1 of Appendix D.

TABLE 11

SUMMARY OF SAMPLING EFFORT AND TOTAL CATCH USING VARIOUS FISH CAPTURE METHODS AT EACH SAMPLING LOCATION, AUGUST 2012.

SAMPLE SITE	CAPTURE METHOD	SAMPLE EFFORT	CATCH				OBSERVATIONS
			Arctic Grayling	Burbot	Slimy Sculpin	Lake Chub	
MH13	MNT	22.5 hrs	0	0	1	0	
MH13	Electro	512 sec	0	0	20	0	5 sculpin
MH16	MNT	21.5 hrs	0	0	0	0	
MH16	Electro	660 sec	5	0	11	0	12 sculpin + fry
MH16	Angling	15 min	1	0	0	0	7 grayling strikes
MH20	MNT	20.3 hrs	0	3	0	0	
MH20	Electro	675 sec	0	1	13	1	12 sculpin + fry
MH20	Seine	150 m^2	0	0	0	0	
MH20	Angling	20 min	0	0	0	0	1 grayling strike

Legend: MNT = Minnow trap (3 traps)
Electro = Electrofisher
Seine = Pole Seine (2 sweeps)
Angle = Angling

As with all previous sampling, slimy sculpin were once again the only fish species represented in the catch at site MH13. Arctic grayling have never been captured at site MH13. The rate of capture at this site was similar to the 1992 to 2010 average of about 21 sculpin for each sampling event (Table 12). The average capture rates were also similar to previous monitoring years at sites MH16 and MH20. Overall, slimy sculpin ranged in size from 27 to 90 mm in total length representing juvenile to adult life history stages. Slimy sculpin fry were more frequently observed at sites MH16 and MH20. It is interesting to note that the capture of large adult sculpin (> 90mm TL) are more common at the headwater sites of the False Canyon Creek drainage (MH13 and MH16) as depicted in Figure 1 of Appendix D using historic catch data.

TABLE 12
COMPARISON OF FISH CATCH AT THREE SAMPLING SITES OVER A 20 YEAR PERIOD

SPECIES	SAMPLE SITE	CATCH (#)	
		1992 to 2010* (Average)	2012 (Total)
Slimy sculpin	MH13	21.8	21
	MH16	12.3	11
	MH20	14.9	13
Arctic grayling	MH13	0	0
	MH16	2.9	6
	MH20	4.7	0
Burbot	MH13	0	0
	MH16	1.0	0
	MH20	0.5	4
Lake chub	MH13	0	0
	MH16	0	0
	MH20	0	1

* Note that MH16 was not sampled during 1992 and 1994.

Captured Arctic grayling at site MH16 represented fry, juvenile and adult life history phases. Fork lengths of captured fish ranged from 43 to 258 mm. Several juvenile Arctic grayling were also observed at this site while angling. Arctic grayling were not captured at site MH20 although an observation of a single fish was made indicating low densities during the survey. Historically, all life history stages of Arctic grayling have been represented in the catch at site MH20 as depicted in Figure 2 of Appendix D.

Species of whitefish (*Prosopium sp*) and char (*Salvelinus sp*) that were captured in low numbers during previous monitoring programs were not represented in the catch in 2012. Unusual in 2012 was the capture of a single lake chub at site MH20, a species that has not been recorded in the False Canyon Creek drainage previously. Whitefish, chub and char are all known to inhabit the Liard River basin (Anon. 1996, McPhail 2007, LES 2004). Dolly Varden, most likely bull trout, are apparently abundant at the confluence with the Frances River and are utilized as part of a food fishery (Donnessey, pers. com., 2006). A total of 4 juvenile burbot were also captured at site MH20 in 2012. This species has been documented at sites MH16 and MH20 previously.

Fish distribution and catch comparisons for all sites sampled in 2012 generally indicate little change in the dominant fish types or their relative abundance when compared to previous surveys (Table 12). While the absolute number of captured fish varies from year to year, the species composition continues to be consistent and is itself an indication of stability of the fish community. Notable in 2012 was the absence of whitefish and char in the catch. These species have been always captured in low numbers and can easily be undetected. Another notable observation during the 2012 survey was the capture of a chub, which is a type of minnow that is found throughout most of Canada and northern USA.

4.4.2 Fish Habitat

Water levels were moderately high and did not vary much between sites in False Canyon Creek during the sampling period in 2012. Beaver activity at site MH13 continues to be a major influence on the aquatic environs at this location. Water levels were moderately high at this site compared to 2008 where they were dramatically reduced. The many barriers, debris piles and active beaver dams continue to impede the upstream movement of other species and prevent their colonization.

Flows at sites MH16 and MH20 appeared moderately high at the time of the survey. Evidence of channel modifying flows and flooding was evident in many areas along the banks of the creek.

Snags and accumulations of woody debris that were apparent during previous years were notably absent or repositioned. Some sections of the stream had new areas where the banks had become unstable. None-the-less, the main channel continues to provide good fish cover values in the form of deep pools, overhanging vegetation and accumulations of woody debris. The mature forest that predominates the riparian habitat along the banks of the channel remains healthy. The Liard River drainage experienced extreme flooding during the spring and early summer of 2012 as a result of wetter than normal conditions prevailing in the Yukon (Environment Canada 2012). Site-specific physical habitat descriptions for all three sites have been previously described (LES 1998).

5.0 SUMMARY

No anomalies were apparent in the water quality during the 2012 study. The alkaline waters of the drainage were hard to very hard, well aerated, and clear, and concentrations of metals were low where detected and met the applicable CCME guidelines for the protection of freshwater aquatic life.

Metal concentrations in the sediments at MH13 were higher than at MH16 and MH20, indicating its location in a mineralized area. The concentrations of various metals have exceeded the CCME guidelines for the protection of freshwater aquatic life at MH13 over the 20 year study period. Concentrations of metals have fluctuated over time at MH13 but have remained relatively stable at MH16 and MH20. Generally, the stream sediment quality is suitable for the support of freshwater aquatic life.

Benthic invertebrate communities on the main stem of False Canyon Creek at MH16 and MH20 were diverse and had good representation from the major groups of organisms that are usually present in lotic waters. The population at MH13 appeared stressed in 2012 with little to no representation from the EPT orders. The composition of the community at MH13 is a reflection of the physical habitat here, which is significantly different than that at MH16 and MH20.

The fisheries data was generally consistent with the past studies. While the absolute number of fish captured varies from year to year, the fish assemblage in the catch is consistent and is itself an indication of stability in the fish community. Slimy sculpins continued to be the dominant species captured throughout the drainage, and the only species present at MH13. The presence of Arctic grayling and burbot were again confirmed in the False Canyon Creek drainage. No whitefish were captured or observed in 2012, however a single lake chub was captured in the study area; the first documented occurrence since the commencement of monitoring.

The examination of the matrices studied during the 2012 monitoring programs, indicates that all three sites are stable and very little change has been detected over the past two decades.

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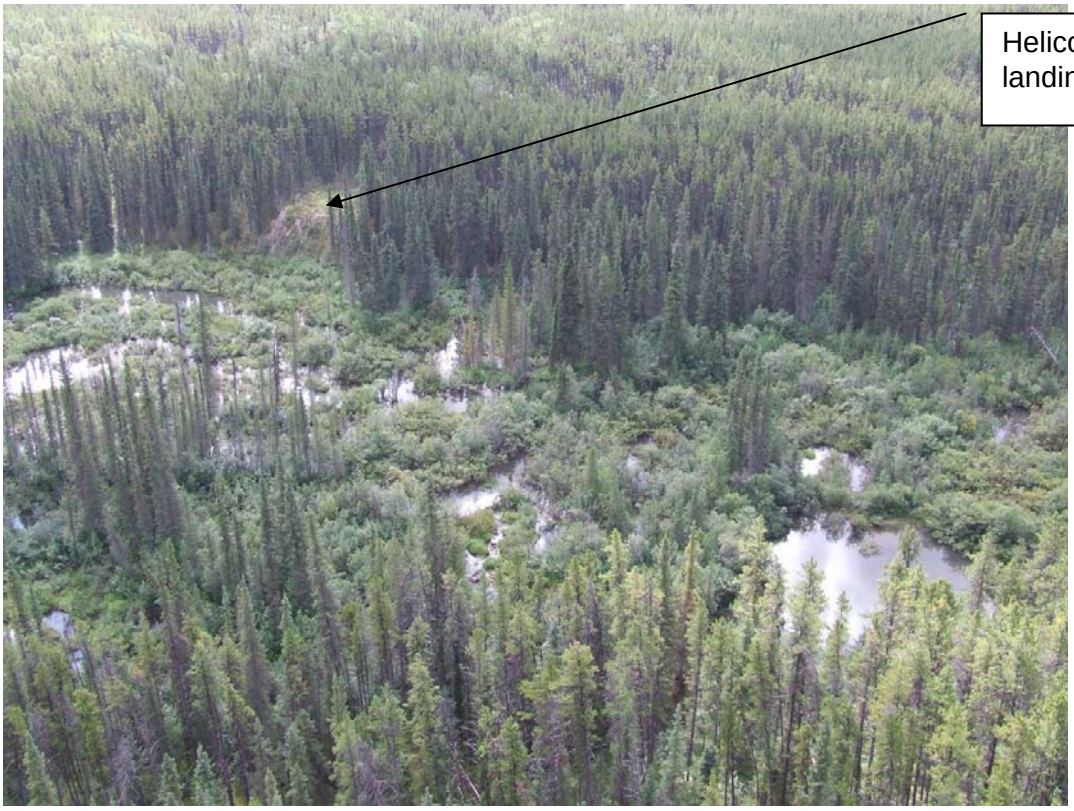
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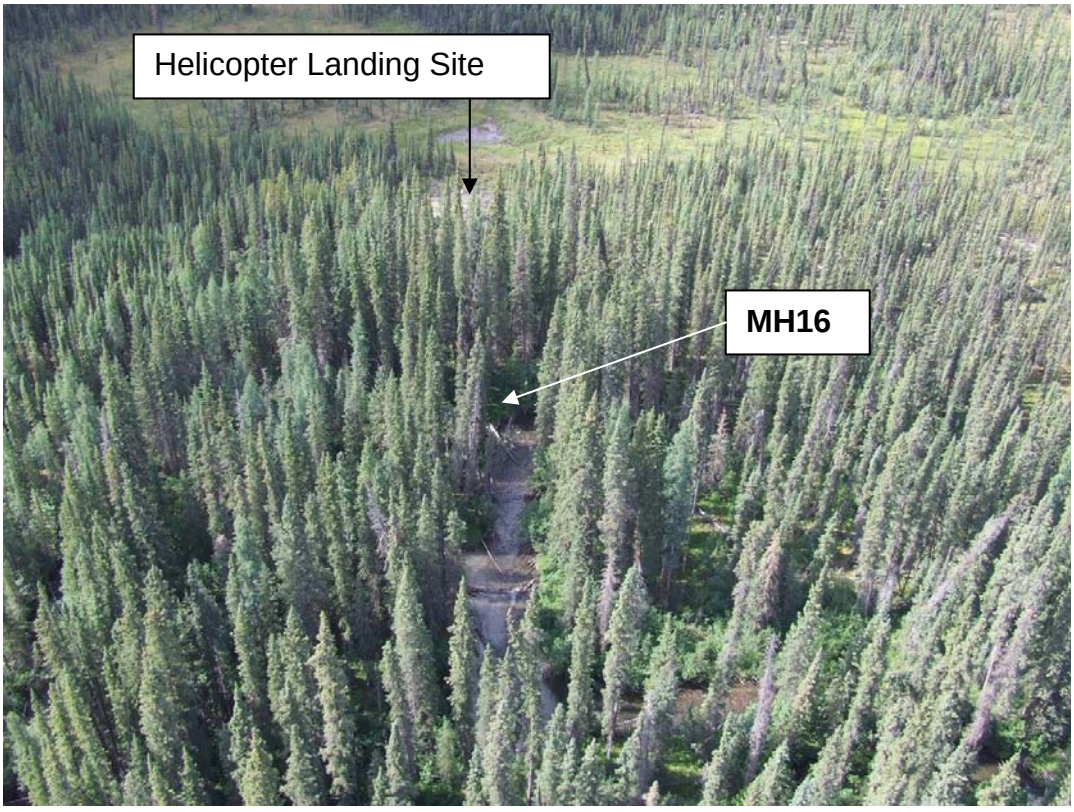
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APPENDIX A

PHOTOGRAPHS, AUGUST 2012



The wetland complex at MH13, August 14th, 2012.



Sampling location of MH16 on False Canyon Creek, August 14th, 2012.



MH20, helicopter lands on the exposed gravel bar, August 14th, 2012.



The downed trees at MH20 have acted as deposition traps and this gravel/sand bar has increased in size since 2010, August 14th, 2012.

APPENDIX B

WATER QUALITY AND STREAM SEDIMENT

ANALYTICAL DATA, 2012

Maxxam

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Your P.O. #: 8152
Your Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your C.O.C. #: G032605

Attention: BONNIE BURNS
LABERGE ENVIRONMENTAL SERVICES
P.O. BOX 21072
WHITEHORSE, YT
CANADA Y1A6P7

Report Date: 2012/08/27

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B272680
Received: 2012/08/16, 13:20

Sample Matrix: Soil
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
GS Special Analysis	9	N/A	2012/08/23		
Elements by ICPMS (total)	9	2012/08/21	2012/08/21	BBY7SOP-00001	EPA 6020A
pH (2:1 DI Water Extract)	9	2012/08/22	2012/08/22	BBY6SOP-00028	Carter, SSMA 16.2

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	4	2012/08/20	2012/08/21	BBY6SOP-00026	SM2320B
Conductance - water	2	N/A	2012/08/21	BBY6SOP-00026	SM-2510B
Conductance - water	2	N/A	2012/08/22	BBY6SOP-00026	SM-2510B
Hardness Total (calculated as CaCO3)	4	N/A	2012/08/23	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	4	N/A	2012/08/21	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	4	N/A	2012/08/22	65-A-002-10	EPA 1631B
Mercury (Total) by CVAF	4	2012/08/21	2012/08/22	65-A-002-10	EPA 1631B
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	4	N/A	2012/08/21	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	4	N/A	2012/08/21	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	4	2012/08/17	2012/08/23	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	4	2012/08/22	2012/08/23	BBY7SOP-00002	EPA 6020A
Filter and HNO3 Preserve for Metals	4	N/A	2012/08/17	BBY6WI-00001	EPA 200.2
pH Water	4	N/A	2012/08/21	BBY6SOP-00026	SM-4500H+B
Sulphate by Automated Colourimetry	4	N/A	2012/08/20	BBY6SOP-00017	SM4500-SO42
Total Suspended Solids	4	N/A	2012/08/18	BBY6SOP-00034	SM - 2540 D

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Raoul Jain, Burnaby Project Manager
Email: RJain@maxxam.ca
Phone# (604) 639-2618

==========

Maxxam Job #: B272680
Report Date: 2012/08/27

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Total cover pages: 2

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		EF2576	EF2577	EF2578	EF2579	EF2580	EF2581	EF2582	EF2583	EF2584		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13A**	**MH-13B**	**MH-13C**	**MH-16A**	**MH-16B**	**MH-16C**	**MH-20A**	**MH-20B**	**MH-20C**	**RDL**	**QC Batch**
Parameter												
Special Analysis	N/A	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	SEE NOTE(1)	N/A	6111399

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		EF2572	EF2573	EF2574	EF2575		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13**	**MH-16**	**MH-20**	**BD**	**RDL**	**QC Batch**
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD	FIELD	N/A	ONSITE
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L	194	202	154	152	0.50	6099687
Alkalinity (PP as CaCO3)	mg/L	4.46	4.03	2.59	<0.50	0.50	6099687
Bicarbonate (HCO3)	mg/L	226	236	181	185	0.50	6099687
Carbonate (CO3)	mg/L	5.35	4.84	3.11	<0.50	0.50	6099687
Hydroxide (OH)	mg/L	<0.50	<0.50	<0.50	<0.50	0.50	6099687
Anions							
Dissolved Sulphate (SO4)	mg/L	6.55	5.30	5.27	5.45	0.50	6099215
Physical Properties							
Conductivity	uS/cm	359	366	284	283	1.0	6099691
pH	pH Units	8.45	8.41	8.38	8.26		6099692
Physical Properties							
Total Suspended Solids	mg/L	<4.0	<4.0	<4.0	<4.0	4.0	6094755

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Dried and Sieved through 100 mesh

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EF2572	EF2573	EF2574	EF2575		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13**	**MH-16**	**MH-20**	**BD**	**RDL**	**QC Batch**
Misc. Inorganics							
Dissolved Hardness (CaCO3)	mg/L	196	203	152	152	0.50	6093428
Elements							
Dissolved Mercury (Hg)	ug/L	<0.010	<0.010	<0.010	<0.010	0.010	6105180

RDL = Reportable Detection Limit

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EF2572	EF2573	EF2574	EF2575		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13**	**MH-16**	**MH-20**	**BD**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS							
Dissolved Aluminum (Al)	ug/L	8.2	3.7	4.1	3.9	3.0	6096497
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6096497
Dissolved Arsenic (As)	ug/L	0.49	0.41	0.44	0.44	0.10	6096497
Dissolved Barium (Ba)	ug/L	143	167	132	130	1.0	6096497
Dissolved Beryllium (Be)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	6096497
Dissolved Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	6096497
Dissolved Boron (B)	ug/L	<50	<50	<50	<50	50	6096497
Dissolved Cadmium (Cd)	ug/L	0.019	<0.010	<0.010	<0.010	0.010	6096497
Dissolved Chromium (Cr)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	6096497
Dissolved Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6096497
Dissolved Copper (Cu)	ug/L	0.50	0.34	1.79(1)	0.31	0.20	6096497
Dissolved Iron (Fe)	ug/L	76.2	60.0	57.3	56.7	5.0	6096497
Dissolved Lead (Pb)	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	6096497
Dissolved Lithium (Li)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6096497
Dissolved Manganese (Mn)	ug/L	13.8	9.9	28.1	28.1	1.0	6096497
Dissolved Molybdenum (Mo)	ug/L	1.2	1.3	1.1	1.1	1.0	6096497
Dissolved Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	6096497
Dissolved Selenium (Se)	ug/L	0.55	0.59	0.41	0.38	0.10	6096497
Dissolved Silicon (Si)	ug/L	3110	3290	3320	3340	100	6096497
Dissolved Silver (Ag)	ug/L	<0.020	<0.020	<0.020	<0.020	0.020	6096497
Dissolved Strontium (Sr)	ug/L	205	213	172	170	1.0	6096497
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6096497
Dissolved Tin (Sn)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6096497
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6096497
Dissolved Uranium (U)	ug/L	1.29	0.90	0.61	0.60	0.10	6096497
Dissolved Vanadium (V)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6096497
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6096497
Dissolved Zirconium (Zr)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6096497
Dissolved Calcium (Ca)	mg/L	58.3	59.0	43.4	43.5	0.050	6090960
Dissolved Magnesium (Mg)	mg/L	12.2	13.5	10.6	10.5	0.050	6090960
Dissolved Potassium (K)	mg/L	0.319	0.370	0.508	0.513	0.050	6090960
Dissolved Sodium (Na)	mg/L	0.892	1.17	1.24	1.27	0.050	6090960
Dissolved Sulphur (S)	mg/L	<3.0	<3.0	<3.0	<3.0	3.0	6090960

RDL = Reportable Detection Limit
(1) - Dissolved greater than total. Reanalysis yields similar results.

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		EF2572	EF2573	EF2574	EF2575		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13**	**MH-16**	**MH-20**	**BD**	**RDL**	**QC Batch**
Calculated Parameters							
Total Hardness (CaCO3)	mg/L	197	203	157	154	0.50	6090956
Elements							
Total Mercury (Hg)	ug/L	<0.010	<0.010	<0.010	<0.010	0.010	6104096

RDL = Reportable Detection Limit

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		EF2572	EF2573	EF2574	EF2575		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13**	**MH-16**	**MH-20**	**BD**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L	8.0	8.2	14.1	15.1	3.0	6106883
Total Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6106883
Total Arsenic (As)	ug/L	0.59	0.48	0.52	0.55	0.10	6106883
Total Barium (Ba)	ug/L	146	166	133	130	1.0	6106883
Total Beryllium (Be)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	6106883
Total Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	6106883
Total Boron (B)	ug/L	<50	<50	<50	<50	50	6106883
Total Cadmium (Cd)	ug/L	0.026	0.012	<0.010	0.011	0.010	6106883
Total Chromium (Cr)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	6106883
Total Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6106883
Total Copper (Cu)	ug/L	0.38	0.26	0.39	0.32	0.20	6106883
Total Iron (Fe)	ug/L	237	185	193	189	5.0	6106883
Total Lead (Pb)	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	6106883
Total Lithium (Li)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6106883
Total Manganese (Mn)	ug/L	19.0	13.8	32.6	31.6	1.0	6106883
Total Molybdenum (Mo)	ug/L	1.1	1.2	1.2	1.1	1.0	6106883
Total Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	6106883
Total Selenium (Se)	ug/L	0.58	0.53	0.41	0.49	0.10	6106883
Total Silicon (Si)	ug/L	3150	3330	3550	3510	100	6106883
Total Silver (Ag)	ug/L	<0.020	<0.020	<0.020	<0.020	0.020	6106883
Total Strontium (Sr)	ug/L	212	221	178	173	1.0	6106883
Total Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6106883
Total Tin (Sn)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6106883
Total Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6106883
Total Uranium (U)	ug/L	1.31	0.90	0.62	0.61	0.10	6106883
Total Vanadium (V)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6106883
Total Zinc (Zn)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6106883
Total Zirconium (Zr)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6106883
Total Calcium (Ca)	mg/L	58.0	58.7	45.0	44.2	0.050	6090961
Total Magnesium (Mg)	mg/L	12.6	13.8	10.9	10.6	0.050	6090961
Total Potassium (K)	mg/L	0.326	0.379	0.523	0.507	0.050	6090961
Total Sodium (Na)	mg/L	0.931	1.21	1.30	1.29	0.050	6090961
Total Sulphur (S)	mg/L	<3.0	<3.0	<3.0	<3.0	3.0	6090961

RDL = Reportable Detection Limit

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		EF2576	EF2577	EF2578	EF2579	EF2580	EF2581	EF2582	EF2583	EF2584		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14		
	UNITS	**MH-13A**	**MH-13B**	**MH-13C**	**MH-16A**	**MH-16B**	**MH-16C**	**MH-20A**	**MH-20B**	**MH-20C**	**RDL**	**QC Batch**
Physical Properties												
Soluble (2:1) pH	pH Units	8.24	8.18	8.10	8.25	8.16	8.55	8.25	8.30	8.33	0.010	6100203
Total Metals by ICPMS												
Total Aluminum (Al)	mg/kg	9440	9710	10200	6810	6800	5310	7660	7380	7270	100	6100199
Total Antimony (Sb)	mg/kg	1.07	1.11	1.19	0.59	0.54	0.45	0.71	0.68	0.69	0.10	6100199
Total Arsenic (As)	mg/kg	19.1	13.3	16.2	5.14	4.38	3.52	6.88	5.56	5.54	0.50	6100199
Total Barium (Ba)	mg/kg	396	342	357	239	261	259	215	208	190	0.10	6100199
Total Beryllium (Be)	mg/kg	<0.40	0.48	<0.40	<0.40	<0.40	<0.40	0.42	0.44	<0.40	0.40	6100199
Total Bismuth (Bi)	mg/kg	0.16	0.14	0.17	<0.10	<0.10	<0.10	0.13	0.12	0.12	0.10	6100199
Total Cadmium (Cd)	mg/kg	2.18	1.85	2.02	0.639	0.641	0.432	0.551	0.596	0.546	0.050	6100199
Total Calcium (Ca)	mg/kg	9550	10200	8750	7480	7270	6210	9200	9430	8640	100	6100199
Total Chromium (Cr)	mg/kg	17.9	18.1	19.3	47.6	16.8	22.7	37.0	35.9	112	1.0	6100199
Total Cobalt (Co)	mg/kg	9.97	8.33	9.80	5.43	5.14	4.36	9.20	8.72	8.57	0.30	6100199
Total Copper (Cu)	mg/kg	23.0	23.3	22.4	12.9	10.8	7.51	20.8	20.9	21.9	0.50	6100199
Total Iron (Fe)	mg/kg	32500	26400	29800	15500	14800	16000	21500	20400	20100	100	6100199
Total Lead (Pb)	mg/kg	30.5	25.4	27.2	9.10	9.13	6.23	9.42	9.03	8.43	0.10	6100199
Total Magnesium (Mg)	mg/kg	4770	4740	4910	4460	4270	4000	7490	7440	7280	100	6100199
Total Manganese (Mn)	mg/kg	1430	527	997	383	244	216	380	397	349	0.20	6100199
Total Mercury (Hg)	mg/kg	0.095	0.090	0.091	<0.050	0.054	<0.050	0.060	0.203	0.055	0.050	6100199
Total Molybdenum (Mo)	mg/kg	1.25	1.36	1.31	0.76	0.59	0.58	1.19	1.28	1.38	0.10	6100199
Total Nickel (Ni)	mg/kg	30.5	27.5	30.8	19.0	18.0	16.1	49.0	48.5	47.1	0.80	6100199
Total Phosphorus (P)	mg/kg	814	848	844	669	686	663	618	589	584	10	6100199
Total Potassium (K)	mg/kg	763	713	857	553	519	409	631	616	630	100	6100199
Total Selenium (Se)	mg/kg	2.35	2.52	2.30	1.03	1.13	0.72	1.12	0.99	0.98	0.50	6100199
Total Silver (Ag)	mg/kg	0.455	0.439	0.453	0.166	0.181	0.115	0.176	0.185	0.175	0.050	6100199
Total Sodium (Na)	mg/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	100	6100199
Total Strontium (Sr)	mg/kg	49.4	49.1	45.7	30.3	30.3	25.4	42.4	42.1	42.0	0.10	6100199
Total Thallium (Tl)	mg/kg	0.138	0.124	0.141	0.085	0.075	0.061	0.076	0.075	0.072	0.050	6100199
Total Tin (Sn)	mg/kg	0.24	0.27	0.29	0.22	0.23	0.21	0.29	0.25	0.29	0.10	6100199
Total Titanium (Ti)	mg/kg	48.9	61.9	79.7	88.1	93.7	115	83.6	87.5	80.4	1.0	6100199
Total Vanadium (V)	mg/kg	27.5	27.2	28.8	19.0	22.2	27.3	22.9	21.6	19.0	2.0	6100199
Total Zinc (Zn)	mg/kg	208	188	200	91.8	88.5	64.5	70.3	70.2	67.0	1.0	6100199
Total Zirconium (Zr)	mg/kg	1.39	1.37	1.28	1.05	1.10	1.13	1.88	2.15	2.43	0.50	6100199

RDL = Reportable Detection Limit

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

General Comments

Sample EF2572-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample EF2573-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample EF2574-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample EF2575-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
6094755	Total Suspended Solids	2012/08/18	98	80 - 120	100	80 - 120	<4.0	mg/L	NC	20		
6096497	Dissolved Aluminum (Al)	2012/08/21	110	80 - 120	109	80 - 120	<3.0	ug/L	NC	20		
6096497	Dissolved Antimony (Sb)	2012/08/21	100	80 - 120	103	80 - 120	<0.50	ug/L	NC	20		
6096497	Dissolved Arsenic (As)	2012/08/21	106	80 - 120	102	80 - 120	<0.10	ug/L	NC	20		
6096497	Dissolved Barium (Ba)	2012/08/21	97	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Beryllium (Be)	2012/08/21	104	80 - 120	98	80 - 120	<0.10	ug/L	NC	20		
6096497	Dissolved Bismuth (Bi)	2012/08/21	101	80 - 120	102	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Cadmium (Cd)	2012/08/21	104	80 - 120	102	80 - 120	<0.010	ug/L	NC	20		
6096497	Dissolved Chromium (Cr)	2012/08/21	100	80 - 120	102	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Cobalt (Co)	2012/08/21	100	80 - 120	102	80 - 120	<0.50	ug/L	NC	20		
6096497	Dissolved Copper (Cu)	2012/08/21	97	80 - 120	101	80 - 120	<0.20	ug/L	NC	20		
6096497	Dissolved Iron (Fe)	2012/08/21	103	80 - 120	107	80 - 120	<5.0	ug/L	NC	20		
6096497	Dissolved Lead (Pb)	2012/08/21	96	80 - 120	100	80 - 120	<0.20	ug/L	NC	20		
6096497	Dissolved Lithium (Li)	2012/08/21	98	80 - 120	98	80 - 120	<5.0	ug/L				
6096497	Dissolved Manganese (Mn)	2012/08/21	101	80 - 120	102	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Molybdenum (Mo)	2012/08/21	100	80 - 120	105	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Nickel (Ni)	2012/08/21	102	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Selenium (Se)	2012/08/21	108	80 - 120	104	80 - 120	<0.10	ug/L	NC	20		
6096497	Dissolved Silver (Ag)	2012/08/21	101	80 - 120	104	80 - 120	<0.020	ug/L	NC	20		
6096497	Dissolved Strontium (Sr)	2012/08/21	94	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
6096497	Dissolved Thallium (Tl)	2012/08/21	88	80 - 120	101	80 - 120	<0.050	ug/L	NC	20		
6096497	Dissolved Tin (Sn)	2012/08/21	98	80 - 120	101	80 - 120	<5.0	ug/L	NC	20		
6096497	Dissolved Titanium (Ti)	2012/08/21	107	80 - 120	96	80 - 120	<5.0	ug/L	NC	20		
6096497	Dissolved Uranium (U)	2012/08/21	96	80 - 120	97	80 - 120	<0.10	ug/L	NC	20		
6096497	Dissolved Vanadium (V)	2012/08/21	101	80 - 120	99	80 - 120	<5.0	ug/L	NC	20		
6096497	Dissolved Zinc (Zn)	2012/08/21	118	80 - 120	106	80 - 120	<5.0	ug/L	NC	20		
6096497	Dissolved Boron (B)	2012/08/21					<50	ug/L	NC	20		
6096497	Dissolved Silicon (Si)	2012/08/21					<100	ug/L	NC	20		
6096497	Dissolved Zirconium (Zr)	2012/08/21					<0.50	ug/L	NC	20		
6099215	Dissolved Sulphate (SO4)	2012/08/20	NC	80 - 120	97	80 - 120	<0.50	mg/L	0.2	20		
6099687	Alkalinity (Total as CaCO3)	2012/08/21	NC	80 - 120	97	80 - 120	<0.50	mg/L	0.2	20		
6099687	Alkalinity (PP as CaCO3)	2012/08/21					<0.50	mg/L	NC	20		
6099687	Bicarbonate (HCO3)	2012/08/21					<0.50	mg/L	0.2	20		
6099687	Carbonate (CO3)	2012/08/21					<0.50	mg/L	NC	20		
6099687	Hydroxide (OH)	2012/08/21					<0.50	mg/L	NC	20		
6099691	Conductivity	2012/08/22			99	80 - 120	<1.0	uS/cm	0	20		
6100199	Total Antimony (Sb)	2012/08/21	88	75 - 125	97	75 - 125	<0.10	mg/kg			100	70 - 130
6100199	Total Arsenic (As)	2012/08/21	96	75 - 125	100	75 - 125	<0.50	mg/kg			98	70 - 130
6100199	Total Barium (Ba)	2012/08/21	NC	75 - 125	101	75 - 125	<0.10	mg/kg			103	70 - 130

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
6100199	Total Beryllium (Be)	2012/08/21	101	75 - 125	103	75 - 125	<0.40	mg/kg				
6100199	Total Cadmium (Cd)	2012/08/21	100	75 - 125	102	75 - 125	<0.050	mg/kg			106	70 - 130
6100199	Total Chromium (Cr)	2012/08/21	101	75 - 125	105	75 - 125	<1.0	mg/kg			104	70 - 130
6100199	Total Cobalt (Co)	2012/08/21	101	75 - 125	107	75 - 125	<0.30	mg/kg			92	70 - 130
6100199	Total Copper (Cu)	2012/08/21	100	75 - 125	107	75 - 125	<0.50	mg/kg			92	70 - 130
6100199	Total Lead (Pb)	2012/08/21	103	75 - 125	105	75 - 125	<0.10	mg/kg	4.4	35	98	70 - 130
6100199	Total Manganese (Mn)	2012/08/21	NC	75 - 125	105	75 - 125	<0.20	mg/kg			103	70 - 130
6100199	Total Mercury (Hg)	2012/08/21	95	75 - 125	105	75 - 125	<0.050	mg/kg			86	70 - 130
6100199	Total Molybdenum (Mo)	2012/08/21	102	75 - 125	103	75 - 125	<0.10	mg/kg			101	70 - 130
6100199	Total Nickel (Ni)	2012/08/21	NC	75 - 125	105	75 - 125	<0.80	mg/kg			92	70 - 130
6100199	Total Selenium (Se)	2012/08/21	98	75 - 125	100	75 - 125	<0.50	mg/kg				
6100199	Total Silver (Ag)	2012/08/21	99	75 - 125	100	75 - 125	<0.050	mg/kg				
6100199	Total Strontium (Sr)	2012/08/21	NC	75 - 125	102	75 - 125	<0.10	mg/kg			107	70 - 130
6100199	Total Thallium (Tl)	2012/08/21	91	75 - 125	98	75 - 125	<0.050	mg/kg			90	70 - 130
6100199	Total Tin (Sn)	2012/08/21	95	75 - 125	95	75 - 125	<0.10	mg/kg				
6100199	Total Titanium (Ti)	2012/08/21	29(1)	75 - 125	101	75 - 125	1.0, RDL=1.0	mg/kg			105	70 - 130
6100199	Total Vanadium (V)	2012/08/21	NC	75 - 125	99	75 - 125	<2.0	mg/kg			98	70 - 130
6100199	Total Zinc (Zn)	2012/08/21	NC	75 - 125	102	75 - 125	<1.0	mg/kg			92	70 - 130
6100199	Total Aluminum (Al)	2012/08/21					<100	mg/kg			96	70 - 130
6100199	Total Calcium (Ca)	2012/08/21					<100	mg/kg			94	70 - 130
6100199	Total Iron (Fe)	2012/08/21					<100	mg/kg			101	70 - 130
6100199	Total Magnesium (Mg)	2012/08/21					<100	mg/kg			86	70 - 130
6100199	Total Phosphorus (P)	2012/08/21					<10	mg/kg			80	70 - 130
6100199	Total Bismuth (Bi)	2012/08/21					<0.10	mg/kg				
6100199	Total Potassium (K)	2012/08/21					<100	mg/kg				
6100199	Total Sodium (Na)	2012/08/21					<100	mg/kg				
6100199	Total Zirconium (Zr)	2012/08/21					<0.50	mg/kg				
6100203	Soluble (2:1) pH	2012/08/22			102	96 - 104			0.3	20		
6104096	Total Mercury (Hg)	2012/08/22	91	80 - 120	81	80 - 120	<0.010	ug/L	NC	20		
6105180	Dissolved Mercury (Hg)	2012/08/22	116	80 - 120	105	80 - 120	<0.010	ug/L	NC	20		
6106883	Total Aluminum (Al)	2012/08/23	102	80 - 120	102	80 - 120	<3.0	ug/L	NC	20		
6106883	Total Antimony (Sb)	2012/08/23	97	80 - 120	96	80 - 120	<0.50	ug/L	NC	20		
6106883	Total Arsenic (As)	2012/08/23	99	80 - 120	98	80 - 120	<0.10	ug/L	NC	20		
6106883	Total Barium (Ba)	2012/08/23	95	80 - 120	97	80 - 120	<1.0	ug/L	NC	20		
6106883	Total Beryllium (Be)	2012/08/23	98	80 - 120	93	80 - 120	<0.10	ug/L	NC	20		
6106883	Total Bismuth (Bi)	2012/08/23	100	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
6106883	Total Cadmium (Cd)	2012/08/23	99	80 - 120	98	80 - 120	<0.010	ug/L	NC	20		
6106883	Total Chromium (Cr)	2012/08/23	98	80 - 120	97	80 - 120	<1.0	ug/L	NC	20		
6106883	Total Cobalt (Co)	2012/08/23	96	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		

Maxxam Job #: B272680
Report Date: 2012/08/27

LABERGE ENVIRONMENTAL SERVICES
Client Project #: SA DENA HES
Site Location: SA DENA HES, YUKON
Your P.O. #: 8152

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
6106883	Total Copper (Cu)	2012/08/23	NC	80 - 120	97	80 - 120	<0.20	ug/L	0.4	20		
6106883	Total Iron (Fe)	2012/08/23	94	80 - 120	105	80 - 120	<5.0	ug/L	1.3	20		
6106883	Total Lead (Pb)	2012/08/23	94	80 - 120	96	80 - 120	<0.20	ug/L	NC	20		
6106883	Total Lithium (Li)	2012/08/23	94	80 - 120	94	80 - 120	<5.0	ug/L	NC	20		
6106883	Total Manganese (Mn)	2012/08/23	NC	80 - 120	99	80 - 120	<1.0	ug/L	0.01	20		
6106883	Total Molybdenum (Mo)	2012/08/23	98	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
6106883	Total Nickel (Ni)	2012/08/23	96	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
6106883	Total Selenium (Se)	2012/08/23	103	80 - 120	103	80 - 120	<0.10	ug/L	NC	20		
6106883	Total Silver (Ag)	2012/08/23	98	80 - 120	98	80 - 120	<0.020	ug/L	NC	20		
6106883	Total Strontium (Sr)	2012/08/23	NC	80 - 120	98	80 - 120	<1.0	ug/L	0.2	20		
6106883	Total Thallium (Tl)	2012/08/23	95	80 - 120	100	80 - 120	<0.050	ug/L	NC	20		
6106883	Total Tin (Sn)	2012/08/23	105	80 - 120	103	80 - 120	<5.0	ug/L	NC	20		
6106883	Total Titanium (Ti)	2012/08/23	105	80 - 120	94	80 - 120	<5.0	ug/L	NC	20		
6106883	Total Uranium (U)	2012/08/23	92	80 - 120	94	80 - 120	<0.10	ug/L	NC	20		
6106883	Total Vanadium (V)	2012/08/23	100	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
6106883	Total Zinc (Zn)	2012/08/23	NC	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
6106883	Total Boron (B)	2012/08/23					<50	ug/L	NC	20		
6106883	Total Silicon (Si)	2012/08/23					<100	ug/L	1.5	20		
6106883	Total Zirconium (Zr)	2012/08/23					<0.50	ug/L	NC	20		

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Maxxam

4606 Canada Way, Burnaby, BC Canada V5G 1K5 Ph: 604 734 7276 Toll Free: 1 800 665 8566 Fax: 604 731 2386

CHAIN OF CUSTODY RECORD

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G 032605

Maxxam Job#: B272680

Invoice To: Require Report? Yes ☑ No ☐

Company Name: Teck Resources Ltd.
Contact Name: Dave Ryder
Address: Bag 2000
Kimberley BC PC: V1A
Phone / Fax#: Ph: Fax:
E-mail: Dave.Ryder@teck.com

Report To:

Company Name: Laberge Environmental Services
Contact Name: Bonnie Burns
Address: PO Box 21072
Whitehorse YT PC: Y1A 6P7
Phone / Fax#: Ph: 867-668-6835 Fax:
E-mail: bonnieburns@northwestel.net

PO #:
Quotation #:
Project #:
Proj. Name: Sa Dena Hes
Location: Sa Dena Hes, Yukon
Sampled By: Bonnie Burns

REGULATORY REQUIREMENTS SERVICE REQUESTED:

- ☐ CSR
- ☑ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

- ☐ Regular Turn Around Time (TAT) (5 days for most tests)
- ☐ RUSH (Please contact the lab)
- ☐ 1 Day ☐ 2 Day ☐ 3 Day

Date Required:

Special Instructions:

Return Cooler ☐ Ship Sample Bottles (please specify) ☐

ANALYSIS REQUESTED

	Sample Identification	Lab Identification	Sample Type	Date/Time Sampled
1	MH-13	EF2572	H_2O	Aug 14/12
2	MH-16	73	H_2O	"
3	MH-20	74	H_2O	"
4	~~DUPLICATE~~ BD	75	H_2O	"
5	MH-13A	76	Soil	"
6	MH-13B	77	Soil	"
7	MH-13C	78	Soil	"
8	MH-16A	79	Soil	"
9	MH-16B	80	Soil	"
10	MH-16C	81	Soil	"
11	MH-20A	82	Soil	"
12	MH-20B	83	Soil	"
	MH-20C	84		

B272680

Laboratory Use Only

*Relinquished by:	Date (YY/MM/DD):	Time:	Received by:	Date (YY/MM/DD):	Time:
BBurns	12/08/15		Laurel Berthier	2012/08/16	13:20

Time Sensitive ☐

Temperature on Receipt (°C): 9, 9, 11

Custody Seal Intact on Cooler? Yes ☐ No ☐ NA

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Maxxam International Corporation o/a Maxxam Analytics

APPENDIX C

BENTHIC INVERTEBRATE DATA, 2012

APPENDIX C

BENTHIC INVERTEBRATE DATA, 2012

			LH	13A	13B	13C		16A	16B	16C		20A	20B	20C		Total	%
			stage														
Numbers reported are totals																	
Subsampling- fine fraction only						1/4		1/4	1/4								
	Family	**Genus/ species**															
PHYLUM ARTHROPODA																	
Class Insecta		Unid				4										4	0.04
Ephemeroptera																	
Ephemeroptera			A					1		1						2	0.02
	Unid J or Damaged		N	2	8			85	112	27		8	3	17		262	2.61
	Ameletidae	Ameletus sp	N		3											3	0.03
	Baetidae	Baetis sp	N	1	1			271	131	129		101	26	93		753	7.50
	Caenidae	Unid J	N					274	193							467	4.65
	Ephemerellidae	Unid J or Damaged	N							51		7	3	1		62	0.62
	Ephemerellidae	Drunella coloradensis	N					10		5						15	0.15
	Ephemerellidae	Drunella doddsi	N					9				1	3	3		16	0.16
	Ephemerellidae	Drunella spinifera	N					19	19	8		6		4		56	0.56
	Ephemerellidae	Serratella sp						12	2			9		4		27	0.27
	Heptageniidae	Unid J or Damaged	N					8				7	4	10		29	0.29
	Heptageniidae	Cinygmula sp	N					3	3	2		3	3	15		29	0.29
	Heptageniidae	Epeorus sp	N							6		2	5	5		18	0.18
	Heptageniidae	Rhrithrogena sp	N											3		3	0.03
Plecoptera																	
Plecoptera			A														
	Unid J or Damaged			5	28	52		211	108	66		28	8	19		525	5.23
	Capniidae		N	2	5	24			1	2		11	9	23		77	0.77
	Chloroperlidae	Unid J or Damaged	N										16	7		23	0.23
	Chloroperlidae	Sweltsa sp group	N					3	2			8		10		23	0.23
	Nemouridae	Unid J or Damaged	N					4								4	0.04
	Nemouridae	Zapada sp	N	4	11			88	9	9		2				123	1.23
	Perlidae	Hesperoperla sp												1		1	0.01
	Perlodidae	Unid J or Damaged	N											1		1	0.01
	Perlodidae	Megarcys sp	N							2			1	1		4	0.04
	Taeniopterygidae	Unid J or Damaged	N										1			1	0.01
Trichoptera																	
Trichoptera			A					1								1	0.01
Trichoptera			P						1							1	0.01
	Unid J or Damaged		N	2	21			9	13	9		2				56	0.56
	Brachycentridae	Brachycentrus sp	N					2	1	1						4	0.04
	Brachycentridae	Micrasema sp	N		10				4	2						16	0.16
	Glossosomatidae	Agapetus sp	N							7						7	0.07
	Glossosomatidae	Glossosoma sp	N					8	4							12	0.12
	Hydropsychidae	Unid J or Damaged	N					19		5		1		1		26	0.26
	Hydroptilidae	Unid J or Damaged	N						4	1				1		6	0.06
	Hydroptilidae	Oxyethica sp											1			1	0.01
	Limnephilidae	Unid J or Damaged	N	2												2	0.02
	Limnephilidae	Ecclisomyia sp	N		2											2	0.02
	Limnephilidae	Psychoglypha sp	N		1											1	0.01
	Rhyaciphilidae	Rhyacophila brunnea or vao	N					4	2	7						13	0.13
	Rhyacophilidae	Rhyacophila vepulsa	N					1		3		1				5	0.05
Coleoptera																	
	Dytiscidae	Unid J or Damaged	L		1	1										2	0.02
	Staphylinidae		A		1											1	0.01
Diptera			P											1		1	0.01
Diptera	Unid J or Damaged			6	7				4	3		1	2			23	0.23
Diptera A			A		1	4		1								6	0.06
	Athericidae	Atherix sp	L														
	Ceratopogonidae	Bezzia or Palpomyia sp	L					1	1							2	0.02
	Ceratopogonidae	Probezzia sp		1												1	0.01
	Chironomidae Adult		A					4		1		3	2			10	0.10
	Chironomidae Pupa		P	9	43	13		24	9	11		2	4	3		118	1.18
	Chironomidae	Unid J or Damaged	L	22	149	56		175	259	68		14	3	18		764	7.61
	Chironomidae	Chironomini	L	14	475	263		176	108	26		9	1	1		1,073	10.69
	Chironomidae	Diamesinae			70	214		33	37	6						360	3.59
	Chironomidae	Orthocladiinae	L	88	67	167		473	930	242		15	5	41		2028	20.20
	Chironomidae	Tanypodinae	L	28	136	135				3				1		303	3.02
	Empididae	Unid J	L							1						1	0.01
	Empididae	Chelifera/Metachela sp	L	1	1			44	50	7				2		105	1.05
	Empididae	Clinocera sp	L	1	4	5		1	2	4						17	0.17
	Muscidae	Limnophora sp	L		1	1										2	0.02
	Psychodidae	Pericoma/Telmatoscopus sp	L		32	4		98	58	3			1			196	1.95

A = adult Unid J = unidentified juvenile Unid = unidentifed L = larvae N = nymph terr = terrestrial

APPENDIX C

BENTHIC INVERTEBRATE DATA, 2012

			LH	13A	13B	13C		16A	16B	16C		20A	20B	20C		Total	%
			stage														
Numbers reported are totals																	
Subsampling- fine fraction only						1/4		1/4	1/4								
	Simuliidae	Prosimulium sp	L					4					2			6	0.06
	Simuliidae	Simulium sp	L		1			12	4	2				1		20	0.20
	Simuliidae	Simulium sp	P											1		1	0.01
	Tipulidae Unid J	L	L	8	1			1	4				1			15	0.15
	Tipulidae	Dicranota sp	L	2	35	6		4				5	2	8		62	0.62
	Tipulidae	Hesperoconopa sp	L					4								4	0.04
	Tipulidae	Hexatoma sp	L	3	1			1				1				6	0.06
Collembola																	
	Unid J				1							1				2	0.02
	Isotomidae	Isotomurus sp			2											2	0.02
Aranea	terr			1												1	0.01
Hydracarina																	
	Unid or Damaged			11	28	93		295	235	52		8		2		724	7.21
	Hygrobatidae	Hygrobates sp			45			8								53	0.53
	Hygrobatidae	Atractides sp		1					4							5	0.05
	Lebertiidae	Lebertia sp		2	9	1		17	20	1		1	1			52	0.52
		Oribatei sp (terr)			12	4										16	0.16
	Sperchontidae	Sperchon sp			3			19	13	5		1				41	0.41
	Torrenticolidae	Testudacarus sp						72	84	21		3		2		182	1.81
Cladocera																	
	Bosminidae	Bosmina longirostris										2				2	0.02
	Chydoridae	Alona sp				4										4	0.04
	Chydoridae	Chydorus sp		2												2	0.02
	Daphnidae	Daphnia sp										1				1	0.01
	Polyphemidae	Polyphemus pediculus										1				1	0.01
Copepoda																	
	Cyclopoida			22	86	64			4			1	1			178	1.77
	Harpacticoida			4	7	72				1				1		85	0.85
Ostracoda		Unid J/D		1	2	4										7	0.07
	Candonidae	Candona sp		10	72	80							3			165	1.64
	Candonidae	Cypria sp			4											4	0.04
	Candonidae	Cyclocypris sp		1	10	8				1						20	0.20
PHYLUM ANNELIDA																	
Class Oligochaeta		Unid J															
	Enchytraidae			91	19	46		45	31	1		1	2	1		237	2.36
	Naididae			1	2											3	0.03
	Naididae	Chaetogaster sp				16										16	0.16
	Naididae	Nais sp			1											1	0.01
PHYLUM PLATYHELMINTHES																	
	Planariidae	Polycelis coronata						5	12							17	0.17
PHYLUM NEMATODA				44	21	292		16	33	5						411	4.09
Cottidae (Sculpin)					2											2	
Total per sample				392	1440	1633		2575	2511	807		267	113	302		10040	100.00
Total per site				3465				5893				682					
Taxonomic Richness/sample				32	45	27		46	38	41		34	27	33		93	
Taxonomic Richness/site				53				61				52					

A = adult Unid J = unidentified juvenile Unid = unidentifed L = larvae N = nymph terr = terrestrial

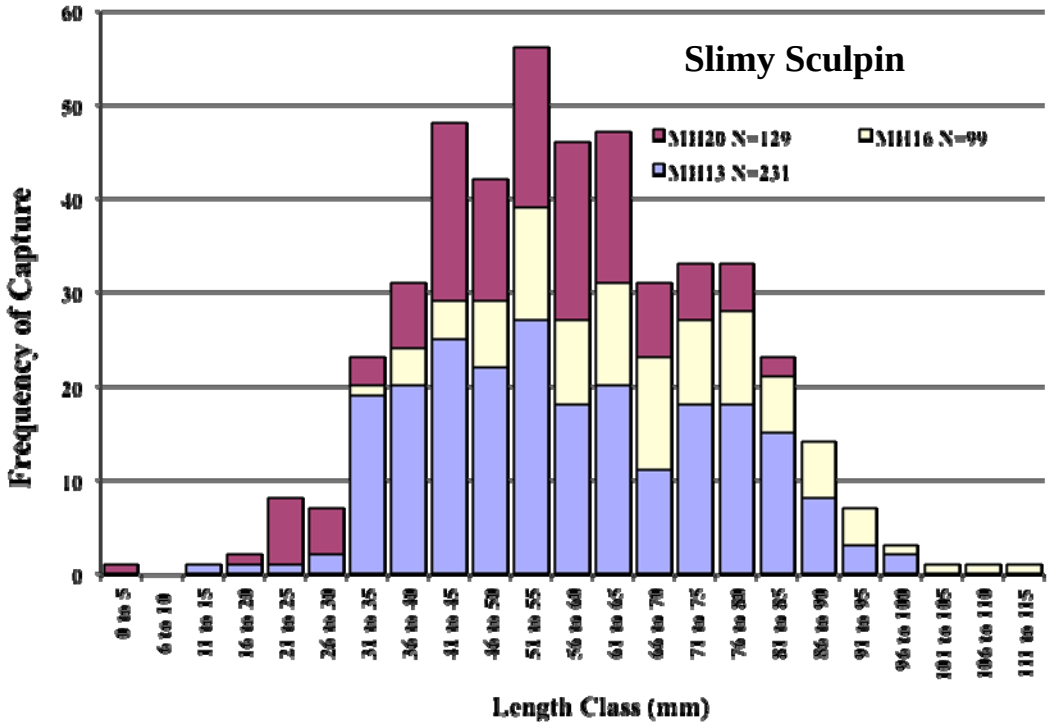
APPENDIX D

FISH DATA 2012

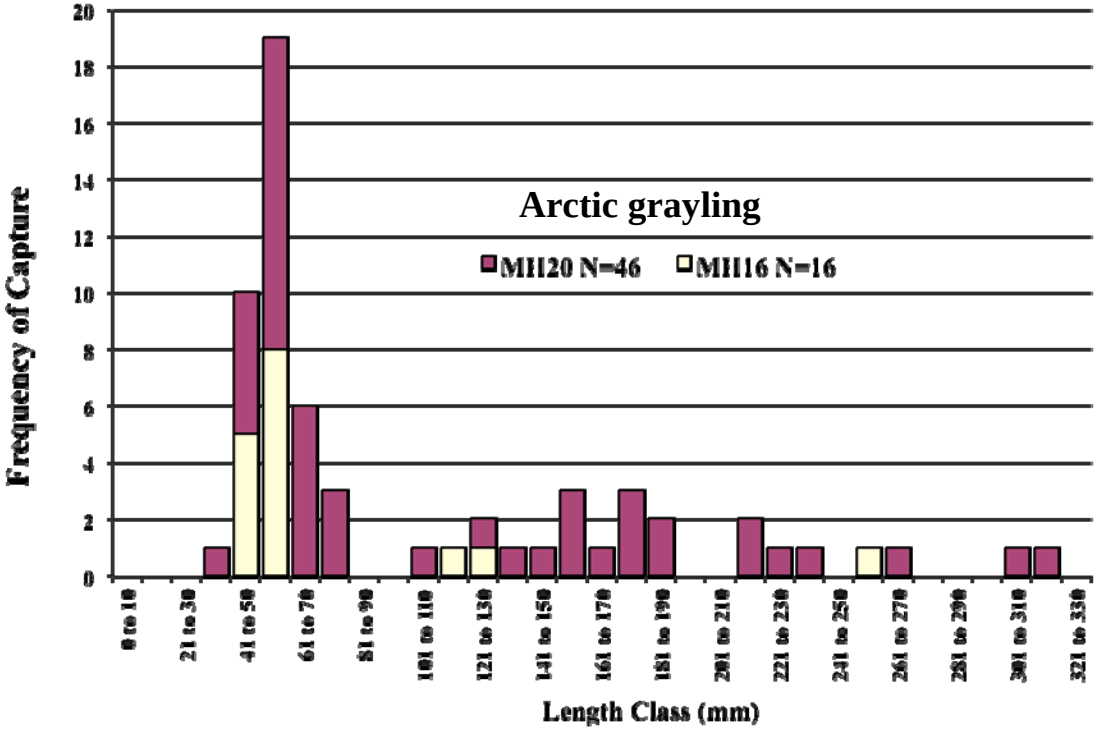
APPENDIX D TABLE 1: LENGTH DATA COLLECTED FROM FISH CAPTURED DURING SAMPLING OF FALSE CANYON CREEK, AUGUST 2012.

Species	Sample Site	Length (mm)	Weight (gms)
Arctic Grayling	MH16	43	1.0
Arctic Grayling	MH16	45	1.1
Arctic Grayling	MH16	48	1.4
Arctic Grayling	MH16	114	17.8
Arctic Grayling	MH16	121	16.3
Arctic Grayling	MH16	258	-
Burbot	MH20	140	14.5
Burbot	MH20	160	26.3
Burbot	MH20	190	35.0
Burbot	MH20	220	39.5
Lake Chub	MH20	53	2.1
Slimy Sculpin	MH13	36	0.5
Slimy Sculpin	MH13	42	0.7
Slimy Sculpin	MH13	43	0.9
Slimy Sculpin	MH13	43	1.0
Slimy Sculpin	MH13	45	0.8
Slimy Sculpin	MH13	47	1.0
Slimy Sculpin	MH13	47	1.1
Slimy Sculpin	MH13	48	1.1
Slimy Sculpin	MH13	51	1.3
Slimy Sculpin	MH13	52	1.4
Slimy Sculpin	MH13	53	1.4
Slimy Sculpin	MH13	54	1.6
Slimy Sculpin	MH13	56	1.7
Slimy Sculpin	MH13	60	2.1
Slimy Sculpin	MH13	61	2.0
Slimy Sculpin	MH13	61	2.4

Species	Sample Site	Length (mm)	Weight (gms)
Slimy Sculpin	MH13	62	2.1
Slimy Sculpin	MH13	65	2.6
Slimy Sculpin	MH13	68	2.9
Slimy Sculpin	MH13	73	3.7
Slimy Sculpin	MH13	78	3.7
Slimy Sculpin	MH16	30	3.0
Slimy Sculpin	MH16	43	4.1
Slimy Sculpin	MH16	56	4.2
Slimy Sculpin	MH16	57	2.9
Slimy Sculpin	MH16	58	2.7
Slimy Sculpin	MH16	59	1.6
Slimy Sculpin	MH16	60	1.2
Slimy Sculpin	MH16	64	1.2
Slimy Sculpin	MH16	72	1.0
Slimy Sculpin	MH16	75	0.8
Slimy Sculpin	MH16	90	1.3
Slimy Sculpin	MH20	27	1.4
Slimy Sculpin	MH20	29	1.0
Slimy Sculpin	MH20	34	1.1
Slimy Sculpin	MH20	42	1.0
Slimy Sculpin	MH20	46	0.6
Slimy Sculpin	MH20	46	1.0
Slimy Sculpin	MH20	49	0.2
Slimy Sculpin	MH20	50	0.8
Slimy Sculpin	MH20	51	0.9
Slimy Sculpin	MH20	52	0.9
Slimy Sculpin	MH20	58	0.5
Slimy Sculpin	MH20	60	0.6
Slimy Sculpin	MH20	77	0.1



APPENDIX D FIGURE 1: LENGTH FREQUENCIES OF SLIMY SCULPIN MEASURED AT SITES OF CAPTURE IN FALSE CANYON CREEK, YUKON, 1994 TO 2012.



APPENDIX D FIGURE 2: LENGTH FREQUENCY OF ARCTIC GRAYLING MEASURED AT SITES OF CAPTURE IN FALSE CANYON CREEK, YUKON, 1994 TO 2012.

SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

DETAILED DECOMMISSIONING & RECLAMATION PLAN

MARCH 2013 UPDATE

TECK Metals Ltd.

APPENDIX J :

Phase I and II Environmental Site Assessment prepared by Golder Associates

Provided electronically on CD