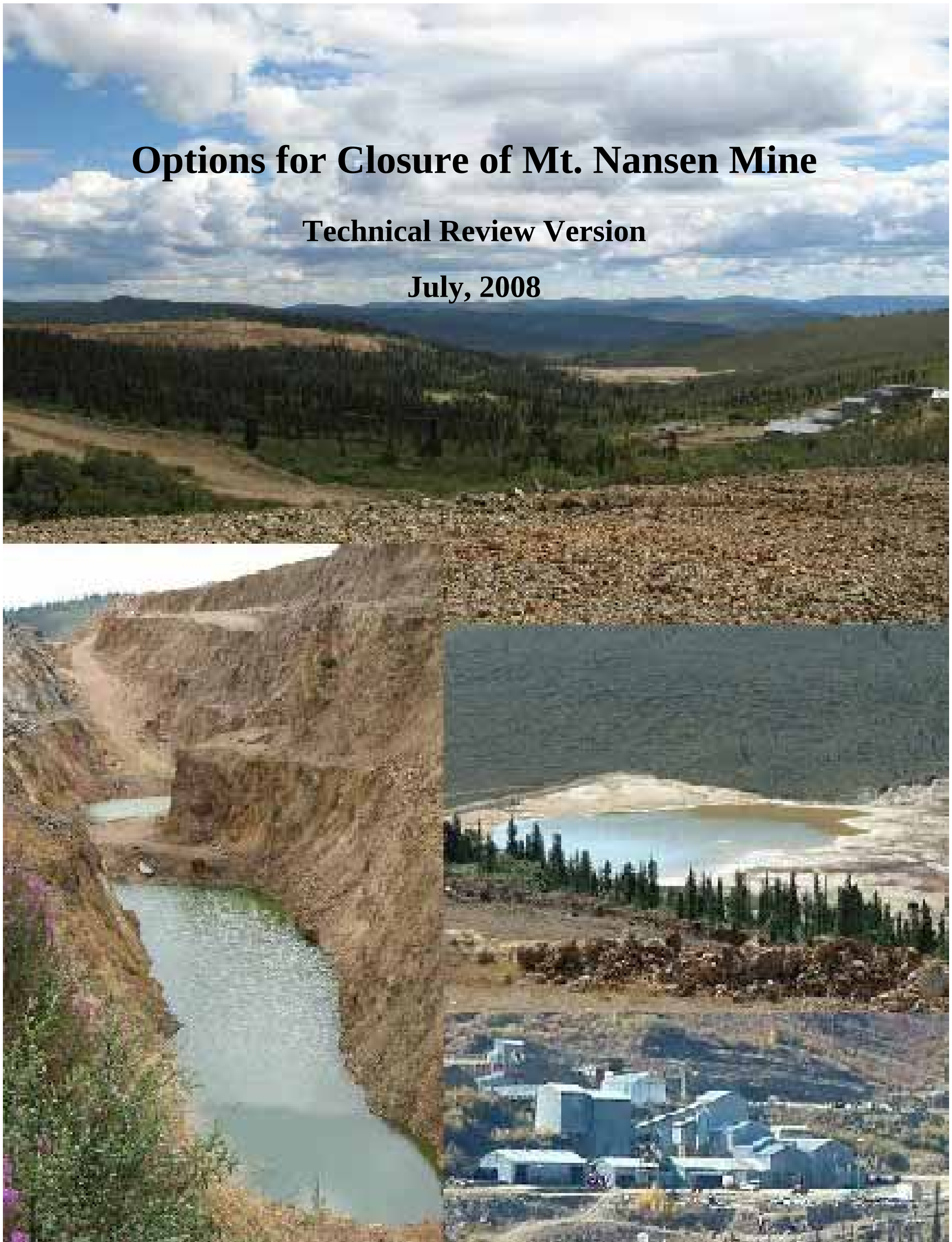
Options for Closure of Mt. Nansen Mine

Technical Review Version

July, 2008



Yukon

Energy, Mines and Resources

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1. Introduction

1.1. Purpose of Document

Closure of the Mt. Nansen mine site is a technically complex project. Over the past several years, investigative work has been undertaken at the site to gain understanding of the site conditions, processes and challenges. Presently, sufficient study and planning has been completed in order to determine and present the most technically feasible and economically responsible options for closure. Many stakeholders are involved in the selection of the final closure plan for the Mt. Nansen Mine Site. This document is intended for stakeholders as an informative outline of the viable options being considered for various features of the mine, providing a broad overview of the technical information and directing reviewers to the relevant reports for more detailed information on hydrogeology, tailing chemistry, water quality, etc. Also provided are preliminary cost estimates and risk assessments for the various options. This document is intended to form the framework for further discussions on closure options.

1.2. Outline

This report will provide an overview of the closure process, history of the mine, a summary of the main environmental issues at the site and remediation work completed to date, a listing of technical studies completed to date, information on elements of mine closure for which there is only one option being considered, closure options for mine elements where there is more than one alternative, an assessment of the options, and, cost estimates

1.3. Closure Process

1.3.1. Original Plan

The original closure plan provided by the mine operator in the 1995 Initial Environmental Evaluation was very brief, general, and based on several assumptions that have since proven to be inaccurate such as acceptable water quality in the tailings pond and seepage, a stable and frozen tailings dam, non-acid generating tailings, and no problems with water or water quality in the pit. The focus of the plan was largely in remediating physical disturbances to the land such as filling in portals from old mine workings, contouring and revegetation of waste rock dumps, roads and old excavation trenches, removal of buildings, and the creation of a wetland area in the tailings pond. As much of the current issue with the site relates to dam structural stability and the hydrology and chemistry of the tailings and pit, the original plan was severely deficient, and the given cost estimate of roughly $450,000 was grossly inadequate. The operator was to provide a detailed decommissioning and reclamation plan by December 31, 1997. A plan was submitted in 1998, with little more significant detail than the first. Although some of the plan may be useable where physical reclamation of disturbed areas is concerned, the larger issues of the tailings pond and the open pit are not adequately addressed.

Since the mine was abandoned by the operator in 1999, various studies and investigations have been undertaken by DIAND Water Resources (1999-2003) and YG (2003 to present) to further understand the state of the mine site including various aspects of water and geochemistry, hydrogeology, physical stability and contamination. These studies are discussed in more detail later in this document.

1.3.2. Closure Objectives

In recognition of the many stakeholders with interest in the mine site closure, the initiative was undertaken to develop a set of closure objectives to guide the process of closure planning. These objectives capture the interests and values of the parties involved, some of which may not be considered in a purely technical assessment of the options. Particular emphasis was put on making the goals measurable or otherwise determinant so that choices made during the closure process may be meaningfully compared and assessed for their ability to meet those goals. More discussion on assessment the options with respect to the closure objectives is provided in section 4 of this document, and the closure objectives are presented in Appendix C.

To develop the community objectives, Traditional Knowledge and community values interviews were conducted as part of the Terrestrial and Aquatic Effects Study. A mine tour and objectives discussion were held with Chief, Council, staff members and other citizens and a community meeting was held specific to identifying community interests. The results of these initiatives were formed into objectives. Several meetings were held with the LSCFN coordinator and staff to discuss how to make the objectives measurable. Technical advice was received from the LSCFN technical advisor. Additional follow up was completed at a subsequent community meeting to address issues that weren't considered for objectives in the initial meetings and then the community objectives were finalized in plain language. This entire process for the development of objectives took a year and a half.

The Town of Carmacks (Mayor and Council) were asked whether the community would like to have their own input. Their preference was to go with the LSCFN objectives. The GY Project Manager and Community Advisor have followed up with Mayor and Council to talk about the final version and Mayor and Council have confirmed that community interests have been adequately covered from their perspective.

Within the Government of Yukon, other departments and EMR Branches were consulted on GY Objectives through the internal YESAA Practitioners' Forum; almost no feedback was received. A special effort was made to have discussions with the Department of Environment, and some suggestions that were received from Environment were incorporated into the final draft of GY objectives.

For Federal Government departments, the preference from DIAND was that they make the call to all Federal Departments. Objectives were received from the Department of Fisheries and Oceans, Environment Canada, Health Canada and DIAND; however, they generally were not measurable and were mostly regulatory or technical in nature. Significant effort was made to have discussions with each department on the intent of the objectives and to go through and make all of the Federal Objectives measurable. DIAND expressed a few objections to some of the wording of the community objectives feeling that the way they were worded made them impossible to achieve, but the community did not wish to make changes.

1.3.3. Closure Schedule

1.3.3.1. Options Selection

Options for the final closure of the site have been generated and are presented in this document for the purposes of analysis, discussion and selection. This document is intended to be released in early Summer 2008, circulated and discussed Summer 2008, and for option selection workshops to be held in Fall/Early Winter 2008.

As Canada (DIAND) is financially responsible for the closure activities, it has the final decision on the closure plan; however, Canada has indicated that it will only proceed on recommendations endorsed by all three parties: Canada, Yukon and LSCFN. A selection process for the three parties has been drafted, but has not yet been finalized. The draft process is summarized as follows. A group of technical advisors appointed by DIAND will review the proposed options, and provide feedback and technical expertise. Options will be evaluated by all parties on the ability of the option to satisfy the closure objectives, technical feasibility, and cost. If all parties are in agreement, the recommended options will be referred to senior officials from each of the three parties for approval. If there is disagreement among the three parties at a working level, each party will put forth their analysis of the options to their senior officials, and it will be up to the senior officials to come to a decision.

1.3.3.2. Closure Plan

Once the closure options have been selected, the final closure plan will be prepared based on the given options. Work on assembling the necessary background information and drafting of portions of the document not related to options selection is underway. The plan is tentatively scheduled for submission to the Yukon Environmental and Socio-economic Assessment Board for an Executive Committee Screening in Spring 2009.

1.3.3.3. Implementation

Implementation of the closure plan is projected to commence Summer 2010 at the earliest, Spring 2011 at the latest dependent on completion of the YESAA process and acquisition of necessary regulatory approvals. In the mean time, site maintenance by the resident caretaker and bi-weekly water sampling by a local consultant are ongoing.

2. Background

2.1. Mine History

The Mt. Nansen Mine is an abandoned gold and silver mine located 60 km west of Carmacks, and 180 km north of Whitehorse. The current property covers approximately 1,200 hectares and is within the Little Salmon Carmacks First Nation traditional territory. The mine is accessible year round by a 60 km long all weather road from Carmacks, YT.

The property was initially explored in the 1940s with periodic exploration of the local deposits since. Mining operations have occurred over three separate but short periods during the past 40 years. In 1968-1969 approximately 10,000 tonnes of ore from the Huestis and Webber underground developments were treated through a newly constructed floatation mill. The operation closed down due to poor gold and silver recoveries. The Brown-McDade deposit was explored underground from an adit collared adjacent to Pony Creek.

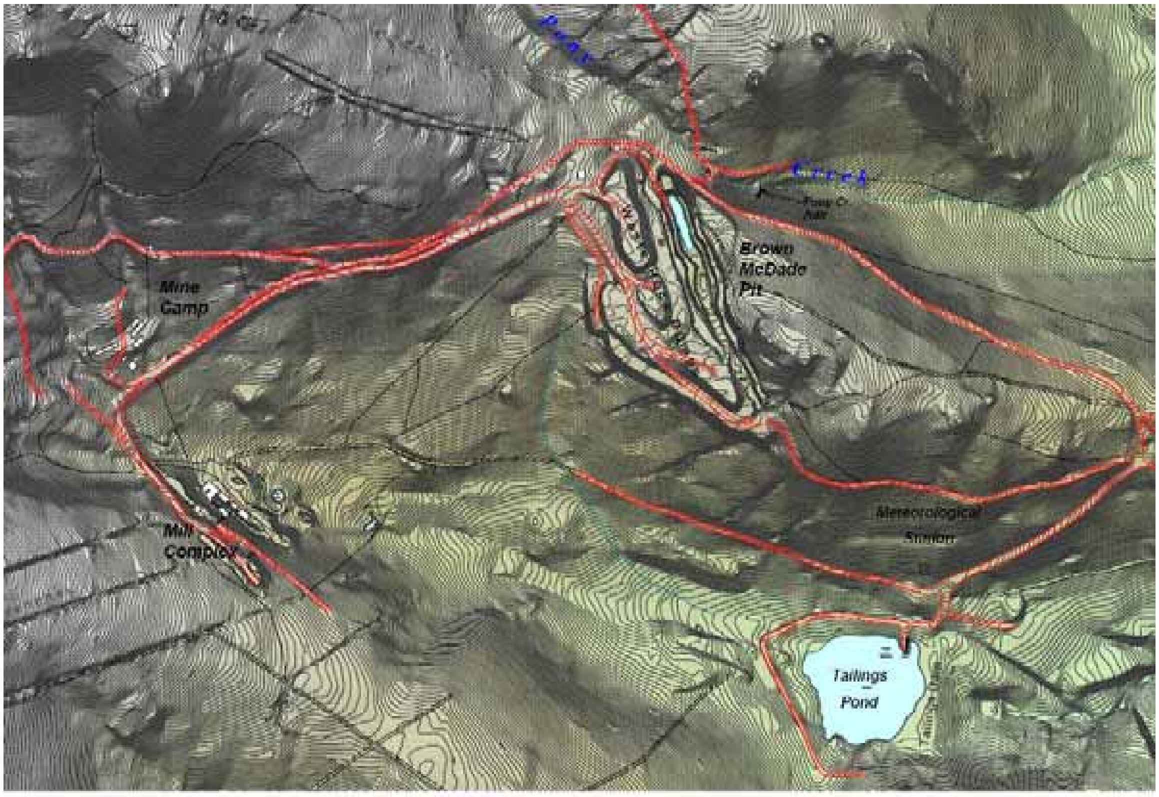
In 1975-1976 approximately 5,000 tonnes of ore from the Huestis deposit were processed through the existing mill. Again, poor recoveries forced the premature closing of this operation.

In 1996-1999 BYG Natural Resources Inc. (BYG) brought the mine back into production with ore from the Brown-McDade zone. This was an open pit operation feeding the existing mill at a rate approaching 500 tonnes per day. Production ceased over a six-month period in 1997-1998 while modifications were done to the milling operation to deal with higher than expected clay content of ore. The BYG operation ceased for good on February 17, 1999, largely due to difficulties meeting their water license requirements, lower than expected recoveries of gold and silver through their milling process, and an inability to meet required financial security payments.

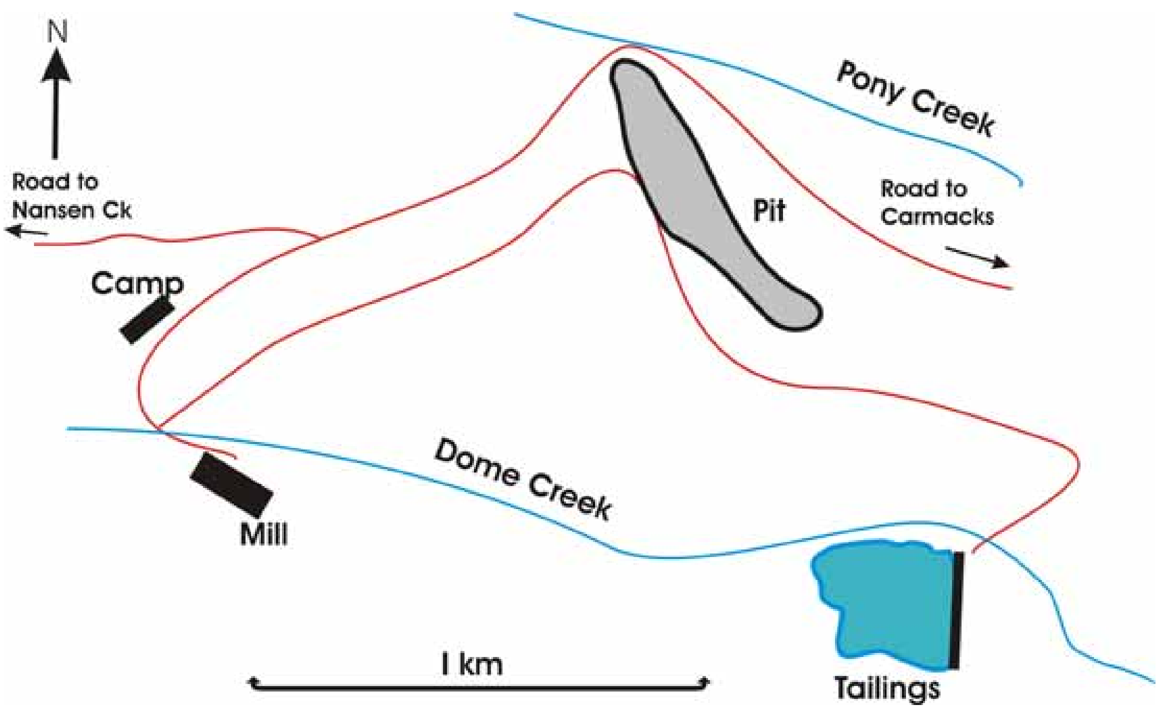
Total ore production of the BYG operation was reported as 269,000 tonnes. Total gold production amounted to 35,700 ounces. Total capital investment was approximately $14,000,000. The project generated operating profits in only two quarters. Serious environmental concerns during the later stages of operation included problems with the structure and operation of the tailings dam, discharges from the water treatment plant repeatedly failing toxicity tests, and four licence amendment applications from the company requesting suspension of effluent non-toxicity requirements.

In February 1999, BYG Natural Resources Inc. declared voluntary receivership. D. Manning and Associates Inc. were appointed receiver for physical assets. Richter & Partners were appointed by the company for liquid assets. In July 1999, D. Manning and Associates resigned and left the property. The federal Department of Indian Affairs and Northern Development (DIAND), as the regulator responsible for issuing the water license for the operation, hired former D. Manning staff to keep water treatment systems operating.

In August 1999, DIAND formally declared the property abandoned and took over under Section 39 of the then *Yukon Waters Act*. In 2000, a review by Strathcona Mineral Services Ltd. concluded ".... there is no prospect for a resumption of mining activity based upon known mineral resources and current precious metal markets ..." and ".... unless there is a major improvement in metal prices there is unlikely to be a resumption of serious exploration on the property." Even with improved metal prices today, further production from the Brown-McDade deposit would not be economic.



Site Plan (Cropped from): Gartner Lee Ltd. 2004. Mount Nansen Mine Project Overview Map. Produced for Abandoned Mines Project Office - Energy, Mines and Resources.



Simplified Site Plan

In April 2003 the Devolution Transfer Agreement between Canada and the Yukon came into force and project management was taken over by Government of Yukon (GY). In April 2004, GY and DIAND successfully petitioned the Supreme Court of the Yukon Territory to put BYG Natural Resources Inc. into receivership. PricewaterhouseCoopers (PwC) was appointed as Interim Receiver. In late 2006 PwC petitioned the courts to put BYG into bankruptcy under the *Bankruptcy and Insolvency Act*. PwC has sold off 199 of the peripheral claims on the property that were not impacted by BYG's production activities, and 22 claims have lapsed, leaving 65 of the original 286 claims under the Receiver's control.

GY has enacted an Order-In-Council (OIC) placing a prohibition from staking (quartz and placer) over approximately 1200 hectares of land covering the mine site footprint. Although the quartz claims underlying this area are in the control of the Interim Receiver, open fractions occurred throughout the area. With the staking prohibition in place no one will be allowed to re-stake this ground and possibly interfere with remedial efforts. The OIC has no effect on existing claim holders as long as their claims remain in good standing. The OIC and existing land withdrawals will be revisited once final closure is completed.

2.2. Site Environmental Issues

Upon abandonment of the mine and the subsequent takeover by DIAND, the state of the mine site was investigated for environmental liability. (See reports – Conor Pacific, June 2000 and Strathcona Minerals, December 2000) The main issues identified were with the stability of the tailings impoundment, water quality, and site infrastructure.

Site overview facing southeast

2.2.1. Tailings Impoundment

2.2.1.1. Structural

A preliminary dam safety assessment by EBA and Klohn Crippen in 1999/2000 found no evidence of imminent dam failure, but indicated possible problems with the dam structure including obvious thawing of foundation soils, the presence of organics and loose sand within the foundation, and high seepage rates.

The stability of the tailings impoundment was thoroughly assessed by EBA in 2000/2001 (reported in 2002). They found that construction of the dam was probably not completely in agreement with the design, likely with insufficient foundation stripping and insufficient compaction of the sand fill which may have affected the permafrost, seepage rates and stability of the dam. The design also called for a tailings beach with a width of 50m directly upstream of the dam that was to be formed as the tailings were deposited into the impoundment. The actual tailings beach did not meet the 50m width in the design which likely partially influenced the higher than expected seepage rates. The water balance of the tailings impoundment exceeded the design water balance resulting in problems with higher than expected water volumes behind the dam, which contribute to the problems with seepage and stability.

Yearly maintenance is required to remove the silt/sand build up within the diversion channel around the impoundment. Repairs to the tailings impoundment since mine shutdown in 1999 include the replacement of the seepage control dyke in 2000, and upgrading to the emergency spillway in 2000/2001. EBA advised in their 2002 report that even with the upgrades, the underlying construction of the spillway is possibly inconsistent and therefore the reliability of the structure is suspect. Currently, water levels are relatively low and therefore the spillway is not an issue. However, if the dam is to remain for closure, the spillway will need upgrading if it remains necessary to the function of the impoundment.

A new dam assessment will be conducted in July 2008 which will include a cost estimate to upgrade the existing dam, should it remain in place.

Seepage from Main Dam

2.2.1.2. Tailings Material

Tailings material was classified by Kwong *et al.* (CANMET 2002) and found to belong to four main types: oxide-rich silt; oxide-rich clayey silt; sulphide-rich silt; and, sulphide-rich clayey silt, with an estimated make up of 35.0% oxide silt, 29.8% oxide clay, 16.5%

sulphidic silt, and 18.7% sulphidic clay. The sulphide-rich tailings are mostly found in the western half of the impoundment and at shallower depths, although pockets occur elsewhere in the tailings impoundment. This is consistent with the sequential mining and processing of the ore deposit, in that the sulphide ore was largely mined in the later part of the mine operation, and the resulting tailings would have been deposited in the pond near the end of operation. The mean particle size for the silt samples was 30-119um with a trimodal distribution (modes varying from 55-142um, 6-7um, and 0.4-0.5um). The mean particle size for the clayey silt samples was 4.8-13um with a bimodal distribution (modes varying from 4-8um and 0.3-0.4um). Geochemical analysis shows the tailings to have high levels of arsenic (up to 0.6%), copper (up to 0.06%), lead (up to 0.6%), antimony (up to 0.1%) and zinc (up to 0.3%). Silver content ranges from 10-80ug/g but gold is generally below detection (<4ug/g). An undeterminable portion of the copper content is likely attributable to the copper sulphate used during water treatment, and not the parent ore of which the copper content was minimal.

Tailings Impoundment, 2004 – pond water volume has since decreased

2.2.1.3. Water Quality

During operations, tailings pond water had to be pumped up to the mill site on a seasonal basis for treatment prior to discharge to Dome Creek. After shutdown and abandonment by the company in 1999, DIAND converted some of the mill process tanks into an improved water treatment system and continued to treat tailings pond water on a seasonal basis with a modified INCO SO_2 process. In 2005, it was determined that the cyanide and metal concentrations in the tailings pond and seepage water were below discharge criteria for the mine's operational water license and water treatment prior to discharge ceased.[1] Water was first discharged directly from the seepage collection pond below the dam and later, from the tailings pond itself. Seepage water was pumped back into the pond from 1999-2005, but now is pumped directly to Dome Creek continuously year round. Tailings pond water is pumped for a period of four to six weeks directly from the pond to Dome Creek in the summer. Release of water from the tailings pond is required for dam stability reasons. With the onset of discharge, a more rigorous sampling program was instituted and will be maintained until direct discharge ceases or until there is no risk of contamination from the discharge. Unless water quality degrades, water discharge will continue in future years until the final fate of the tailings has been determined. If water quality does degrade, there is sufficient storage capacity in the impoundment for to provide for enough time to install a new, portable water treatment system. The previously used water treatment facilities at the mill are scheduled for demolition in 2008/2009. This portable water treatment system is presently being considered regardless of the current state of water quality within the tailings impoundment, as closure work at the site may disturb the tailings or pit water, temporarily resulting in water that requires treatment.

Currently, water quality sampling is ongoing year round on a biweekly basis. The previous focus of the sampling was to determine if the water quality met the water licence criteria for discharge, and monitor other sites in the area for comparison. Recently, giving consideration to possibly establishing site specific water quality objectives for the site, the focus of analysis has shifted to comparison with CCME guidelines for the protection of aquatic life. As in some cases the CCME guideline is far below the water license criteria, the detection limits for much of the previous sampling has been significantly higher than the CCME guideline, making direct comparison impossible. Water quality sampling will continue, and a full year of data for comparison to CCME guidelines will be compiled by November 2008. It is important to note that reference samples from the surrounding area, as well as upstream samples for Dome and Victoria creeks indicate that some parameters are naturally above the CCME guidelines due to mineralization in the area, and not from effects of hard rock mining activity. Discussions will be held with regulatory agencies this summer regarding appropriate water quality standards for the site.

Graphs of water quality parameters of concern at the site are included in Appendix A.

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[1] The water quality criteria in BYG's Water Use Licence (QZ94-004) are as follows:

pH	6.0-8.5 pH units	Chromium (total)	0.04 mg/l
Suspended Solids	50 mg/l	Copper (total)	0.2 mg/l
Toxicity (LC_{50})	100% (96 hour LC50 bioassay using rainbow trout)	Iron (total)	1.0 mg/l
		Lead	0.1 mg/l
WAD Cyanide	0.1 mg/l	Manganese	0.5 mg/l
Total Cyanide	0.3 mg/l	Mercury	5.0 ug/l
Antimony (total)	0.15 mg/l	Nickel (total)	0.3 mg/l
Arsenic (dissolved)	0.15 mg/l	Silver	0.10 mg/l
Barium (total)	1.0 mg/l	Zinc (total)	0.30 mg/l
Cadmium (total)	0.02 mg/l		

2.2.2. Open Pit and Underground Workings

The Brown-McDade deposit consists of naturally weathered oxide ores overlaying sulphides. The screening and licensing of the BYG operation included the condition that the mining would not occur past the oxide zone and into the sulphide zone as exposing the sulphide ore to open air and water would cause problems with acid rock drainage and metal leaching. However, in 1998 BYG was found to be mining and milling sulphide ores. The open pit also intersected and dug up the Pony Creek drift and part of the adit, which had exposed sulphides. Upon shut-down, a portion of the base of the pit was exposed sulphides. Relatively small amounts of sulphide tailings are within the tailings pond and small amounts of sulphide waste rock remain exposed on site.

During operations no significant volume of water collected in the open pit, and the Pony Creek adit was dry. Since shut down, water has collected in the pit and the pit has been partially pumped out three times, in 2001, 2002 and 2004 (GLL MN056-R30 Figure 8) in order to lower the water level and prevent the water from entering the open Pony Creek adit and spilling through to the Pony Creek drainage. A hydraulic bulkhead was installed in the adit in 2006 to further prevent the possibility of future through flow. The water level has varied for the past few years, with a tendency to increase in the summer and decrease in the winter; however, water in the pit has remained at least 3m below the exposed adit. A 2004 water balance investigation by Gartner Lee Ltd. suggested that the water level would likely fluctuate for 6-8 years before stabilizing.

Pony Creek Drainage and Brown-McDade Pit

The Brown-McDade pit contains approximately 8,000-10,000 cubic metres of water in the north end. Hydrogeological studies have shown that in addition to input from precipitation, the main source of water to the pit may be along a prominent fault structure that intersects the Pony Creek drainage. Over the past two years, the pit has been slowly losing water, believed to be because the input through the fault structure has slowed down substantially. Whether this is a long-term or short-term trend is unknown at this time. There are no surface discharges of water from the pit; the water seeps through the pit floor.

The only elevated metal in the pit water is zinc. A graph of zinc levels over time in the pit is included in Appendix A. Concentrations ranged from 0.5 – 1.5 mg/l during 2007. The discharge standard for zinc in the previous water licence is 0.3 mg/l. Other metals are all below the discharge limits of the previous licence. Bioremediation to reduce the level of zinc in the pit water was started later in the summer of 2006 and continued for all of the 2007 season. This process involves algae trapping the zinc, which is then fixed in sediments when the algae dies and sinks to the bottom.

Signage was installed in 2006, around the perimeter of the pit warning people of the hazard. Depending on the closure option chosen for the pit, final pit security measures including a ditch and berm system and/or partial backfill may be completed.

Signage around pit

There are three underground mine areas on the original property, none of which have water quality discharge concerns. Deteriorating timbers in the upper Huestis portal area were rotted and the adit had partially collapsed resulting in a significant safety hazard. This Huestis adit portal was blocked and the surrounding land re-contoured in 2006. Rock was pulled down over the portal covering it, rails and scrap were removed from the site, and the waste dump was re-contoured. The Webber adit formed part of the claims which were sold off in 2007. As is mentioned above, the Pony Creek adit system that intersects and is partially exposed by the Brown-McDade pit had a hydraulic bulkhead installed in 2006 to ensure that if the water level in the Brown-McDade pit increases there will be no flow from the pit, through the adit, and into Pony Creek.

2.2.3. Acid Rock Drainage and Metal Leaching Potential

2.2.3.1. Geology

The Mt. Nansen property is underlain by Paleozoic metamorphosed meta-sedimentary schists and gneiss that have been intruded by Cretaceous felsic plutonic and later mafic to intermediate volcanic rocks. The youngest rocks on the property comprise quartz feldspar porphyry dykes and sills cutting all units.

The Huestis and Webber deposits which were the two deposits mined underground in the 1960's and 70's are hosted in the older gneissic rocks related to steeply dipping northeast trending faults. The Brown-McDade deposit is hosted primarily in granodiorite to quartz monzonite and related to northwest trending faults dipping 50 to 70 degrees to the southwest. The Brown McDade deposit itself is a series of quartz veins ranging in width from two to eight metres. The quartz veins contain pyrite and arsenopyrite with lesser amounts of galena, sphalerite, chalcopyrite, and stibnite. Fine grained gold and silver occurs as inclusions in the sulphide minerals, primarily the pyrite and arsenopyrite.

Moderate to intense amounts of propylitic alteration consisting of epidote, calcite, hornblende along with local argillic alteration along vein margins near surface created a large amount of clay within the deposit. The property was not affected by the latest glaciation and weathering has produced an oxidized zone altering sulphides to limonite up to depths of 70 metres in the Brown McDade deposit.

Mining of the sulphide portions of the Brown McDade were prohibited under the mine's operating water licence. Due to the uneven transitional nature of the sulphide/oxide contact and the disregard by the company of many aspects of their regulatory requirements, some sulphide material was mined during BYG's operations. The amount of sulphide ore and related waste rock is unknown but suspected to be small compared to the overall operation.

Approximately 2.3 million tonnes of waste rock were extracted from the Brown McDade pit. Based on drill hole examination the waste rock can be characterized as follows:

- Prophylitic altered granodiorite: 70%
- Quartz feldspar porphyry: 20%
- Unaltered granodiorite: 10%

2.2.3.2. Acid Base Accounting and Metal Leaching

A number of pre-mining and post-mining characterizations of the acid rock and metal leaching potential of the waste rock and vein material have been carried out. These are summarized in the following section:

1. 1985: An initial assessment of the acid rock drainage characteristics of all deposits on the property was conducted in 1985. Only three samples (two of the mineralized zone and one of the Brown McDade wall rock were collected. The descriptions of these samples are vague. Standard acid base accounting (ABA) testing was done, showing uncertain to likely generation of acid from the mineralized zone and unlikely generation from the wall rock.

2. 1989: Eleven samples of waste rock and vein material from drill core that was collected in 1988 were subjected to ABA procedures. Compilation reports on these samples reported in 1995 that some of these samples were not representative of material to be excavated in the future pit. The range of these results are summarized in the following table:

Sample Description	Total Sulphur (%)	Neutralization Potential / Acid Producing Ratio (NP/AP)
Altered granodiorite wall rock	0.06 – 0.11	4-13.5
Unaltered granodiorite wall rock	0.3-1.35	0.76-1.88
Feldspar porphyry dykes	0.29-0.54	0.06-6.5
Brown McDade vein	0.03-14.6	0.005-3

3. A comprehensive assessment program was completed in 1994 in support of the company's environmental evaluation submission. Thirty seven representative samples were collected from drill core representing the entire area to be open pitted. Samples were subjected to ABA, metal scans and distilled water leach tests. The range of these results with the means in brackets, are summarized below. The estimated percent of the amount of each rock in the deposit as determined from drilling is included.

Sample Description	Paste pH	Total Sulphur (%)	NP/AP Ratio
Upper altered granodiorite 9 samples (60%)	7.4-8.2 (7.98)	0.06-0.37 (0.24)	2.7-14.3 (7.2)
Lower altered granodiorite 6 samples (10%)	6.6-8.2 (7.57)	0.20-1.45 (0.51)	0.7-8.3 (3.7)
Upper feldspar porphyry 7 samples (15%)	7.8-8.3 (7.98)	0.08-0.66 (0.28)	3.0-27.2 (14.1)
Lower feldspar porphyry 3 samples (5%)	5.8-8.4 (7.2)	0.01-0.35 (0.57)	0.4-4.1 (2.7)
Footwall granodiorite 12 samples (10%)	7.1-9.0 (8.3)	0.07-1.16 (0.49)	0.6-25.1 (5.1)

The 24 hour distilled water leaching tests used composite samples from the five rock groupings above. The testing concluded that no appreciable leachable metals were observed. Arsenic and antimony leachate was below 0.05 mg/l and zinc ranged from 0.01 to 0.28 mg/l.

4. In 1999 after the site was abandoned, INAC conducted an environmental site assessment which included limited ABA and metal leaching testing. Six samples of wall rock were collected from the north end of the pit and two from the south end, and subjected to standard ABA and Special Waste Extraction Procedure (SWEP) testing. Results are summarized in the table below:

Sample Description	Paste pH	Total Sulphur (%)	NP/AP Ratio
North End of pit (4 samples)	3.7-7.5	0.35-19.48	0-2.6
South End of pit (2 samples)	7.6-7.9	0.02-0.06	5.3-13.5

SWEP extract testing showed arsenic ranging from 30-231 ppb, antimony from 10-123 ppb and zinc from 5-12180 ppb

5. In 2007 YG EMR-AAM collected samples from the northwest west dump adjacent to the pit. This dump is one of the later waste dumps, consisting of approximately 20,000 cubic metres of waste rock and is likely to contain more sulphide rich material. A total of six composite samples were collected from the entire dump in order to gather a bulk characterization of the ABA, total metals and metal leaching characteristics of that dump.

Two random composite grab samples were collected from both the top and toe of the dump. Two samples of mineralized vein material and altered granodiorite/volcanic units with visible sulphides, and one sample each of altered and unaltered granodiorite were collected. Approximate composition of the dump is shown in brackets beside the description. The results are summarized below:

Sample Description	Paste pH	Total Sulphur (%)	NP/AP Ratio
Composite Top	7.1	1.54	0.94
Composite Toe	7.0	0.74	2.72
Mineralized vein (<1%)	5.0	10.2	0.04
Sulphide bearing wall rock (1-2%)	7.3	4.72	0.61
Altered granodiorite (70%)	7.1	0.58	3.59
Unaltered granodiorite (27%)	7.9	0.12	5.33

TCLP testing rather than the standard SWEP testing was done on the samples, due to a lab transmittal mix-up. This testing showed results below laboratory detection limits for arsenic and antimony (<1 mg/l) for all samples. Leachable copper up to 8.51 mg/l was obtained from vein material. Zinc values ranged from 1.05 mg/l in unaltered granodiorite to 45.5 mg/l in the toe composite sample.

2.2.3.3. Discussion

The results of the ABA and metal leaching testing indicate that overall the potential for acid generation and metal leaching at this site are low. Some mineralized rock has definite potential for ARD/ML, but the volume of these units is very small compared to the remainder of the waste.

Pit water samples which are a good indication of the overall leachability and acid potential of the pit wall rocks and waste rock corroborate the testing completed. Pit water pH remains neutral to slightly alkaline with leachable zinc noticed in the 1.0-2.0 mg/l range.

Prior to closure implementation, further testing will be completed on waste rock in order to determine criteria for use of any waste rock for construction purposes. These criteria will form part of the closure plan.

2.2.4. Infrastructure

The mill complex and associated buildings remain as they have been since the site was abandoned. Portions of the mill were converted for water treatment purposes in 1999. This facility has not been required since 2004. Most hazardous chemicals and low level PCB containing transformers were removed from the site in 2006. An investigation of remaining unidentified substances was undertaken in Spring 2008, with demolition of the mill and crusher buildings intended to start Summer/Fall 2008. The majority of the potentially hazardous or contaminated materials remaining on site are mill process wastes similar to tailings that have been left as residue or sediments in the bottom of tanks. The contaminants in these materials vary, but tend to be relatively high levels of metals (usually As, Cu, Pb and Zn) and in some cases CN. A few samples were of unused industrial chemicals, sediments in mix tanks with extremely high concentrations of copper (presumed to be from the copper sulphate used in the water treatment process), carbon with high metal levels, and sludge resulting from ferric sulphate use. These materials will be removed prior to demolition. Once the mill and crusher buildings are removed the area will be assessed for any contaminants that may be present.

Mt. Nansen Mill Complex

Several facilities will remain onsite for use during closure including: a bunkhouse for 10-15 people; kitchen/dining hall; a genset with a backup generator in an independent location; a warehouse; a workshop; and, a field maintenance building. The final fate of these facilities will be discussed as part of the closure options selection process.

Enquiries have been received from mining companies about the purchase of certain mill components and the Interim Receiver has been handling these issues. A year long caretaker remains on site to protect assets, maintain pumps and other infrastructure, and ensure unauthorized people are kept off the site.

2.3. Remediation Work Done to Date

Several projects have been undertaken at the site to deal with more immediate safety or environmental concerns. These projects are considered to have no alternatives and were undertaken prior to the completion of the formal closure plan as part of the care and maintenance of the site.

Projects completed to date:

- Water treatment from 1999-2004 until the tailings and seepage water reached the discharge standards in the mine operation water licence;
- Installation of seepage capture dam;
- Improvements to the emergency spillway;

- Installation of a hydraulic plug in the Pony Creek adit to stop pit water from flowing down gradient into the Pony Creek drainage and improvements to adit portal stability;

Pony Creek Adit before improvements

Pony Creek Adit after improvements – a locked gate prevents access inside

- Installation of three monitoring wells around the Brown-McDade pit;
- Removal of hazardous chemicals from throughout the site; and,
- Huestis portal rehabilitation.

Additional projects planned to start summer 2008 are:

- Removal of ~5000m^3 waste rock from Pony Creek area – this waste rock is along side the creek and a small portion is within the wetted perimeter of the creek. There is a minor but demonstrable detrimental effect on water quality of the creek. The waste rock will be relocated to a dry are of the open pit.
- Relocation of ~8000m^3 low grade ore stockpile – the current location of the stockpile allows for wind to distribute dust with high metal levels to the surrounding vegetation. The ore will be relocated to a dry area of the open pit.
- Mill demolition – the unused mill and crusher buildings will be demolished, removing the safety hazards and liability of these deteriorating buildings. The attached workshop, warehouse and generator buildings will remain for continued use during closure.
- Test filling of old exploration trench – an old exploration trench near the mill will be filled to provide an example for the community of the impacts of filling in the old trenches that have already revegetated.

2.4. Site investigations completed to date

Since shutdown, work on the Mt. Nansen project has largely consisted of care and maintenance of the site, and site investigations to determine the site conditions for closure planning purposes. Brief descriptions of investigations and reports produced to date are included in the Mt. Nansen report listing in Appendix B. Copies of these documents for review are available at the YG Abandoned Mines Office. A list of these investigative reports by subject is included below.

2.4.1. Tailings Impoundment

Dam Safety Assessment – Klohn Krippen 99/00

Dam Safety Assessment – EBA 2002

Review of Instrumentation and Data (piezometers and thermistors), Tailings and Seepage Dams – EBA 2004, 2006, 2007

2.4.2. Tailings Chemistry/Hydrology

Assessment of Chemical Stability of Impounded Tailings at Mt. Nansen – CANMET 2002

Water Balance of Tailings Pond – Gartner Lee 2005

Mineralogy of Tailings – Jambor 2005

Pit Water Bioremediation Assessment – Lorax 2006 (misleading title, also includes information on tailings chemistry)

Tailings Porewater Assessment – Lorax 2008

2.4.3. Pit

Brown McDade Hydrological & Hydrogeological Investigation – Gartner Lee 2004

Brown-McDade Pit Summer Monitoring – Data summary report – Gartner Lee 2005

McDade Pit Desktop Hydrogeological Study – Gartner Lee 2007

Hydrogeological Site Characterization at Brown McDade Pit, Mt. Nansen – Gartner Lee 2008

Pit Water Bioremediation Assessment – Lorax 2006

2.4.4. Site Assessments

Review of Environmental & Reclamation Issues/Review of Resources & Economic Potential - Strathcona Mineral Services 2000

Historical Review, Site Assessment & Field Sampling Program - Conor Pacific 2000

Terrestrial & Aquatic Effects Study 2005/06 – EDI 2007

2.4.5. Revegetation

Mine Site Reclamation Report - Arctic Alpine Reclamation Group 2006

2.4.6. Health and Safety

Hazardous Materials Inventory & Site Assessment – Kearah & Weri 2006

Human Health Screening Level Risk Assessment – SENES Consultants 2003

Risk Assessment, Conceptual Closure Plan & Cost Estimate – EBA 2004

2.4.7. Geology

Geological Exploration Summary – R.W. Stroshein 2006

2.5. Consultation

Consultation with the Little Salmon Carmacks First Nation, the broader community of Carmacks and other government departments and agencies has been ongoing since 2003.

2.5.1. Little Salmon/Carmacks First Nation (LSCFN)

Between 2003 and 2006, most work with LSCFN was through the Lands Director. YG-AAM held a couple of community meetings yearly to keep the community informed and receive feedback. Yearly updates were provided to Chief and Council. Capacity issues prevented LSCFN from being more directly involved. Traditional knowledge interviews and info as part of the Terrestrial and Aquatic Effects Study were accomplished to the satisfaction of the First Nation in 2005.

In 2006, a full time coordinator and assistant were hired for LSCFN and communication and collaboration between YG-AAM and LSCFN has increased. Since then, there have been several community meetings and mine tours for locals, and more effort has been made to talk to locals within the community. In cooperation with the First Nation, articles have been published in the local paper and a plain language brochure and poster were created summarizing the results of the Terrestrial and Aquatic Effects study. The assistant is regularly involved in the bi-weekly collection of water samples and has also participated in the collection of benthos samples from the creeks. YG-AAM staff and the LSCFN Coordinator and assistant continue to try to update Chief and Council on a regular basis.

2.5.2. Community of Carmacks

Yearly updates are provided to Mayor and Council and the LSCFN Coordinator provides articles to the local paper as is noted above.

2.5.3. Other Government Departments and Agencies

Periodic updates on the progress and issues at Mt. Nansen are provided to YG-Community Services, YG-Environment, DFO, Health Canada and Environment Canada. These and other departments are also contacted for input or discussion when pertinent issues or questions arise.

As funding for the site is provided by Canada under the Federal Contaminated Sites Action Plan, quarterly reports on the status of the mine site are prepared by the regional DIAND Environment Directorate with information from the GY Project Manager. These reports include information on employment at the site including work hours and what portion of the work is done by First Nations and northerners; safety statistics including any safety training, accidents or near misses; and also a comparison to the yearly work plan for the site to determine if work is proceeding on schedule. The report for the fourth quarter includes additional information on remaining site liabilities and budget details. These reports are sent to relevant regional directors, and DIAND Headquarters in Ottawa.

Community Meeting, January 2008

3. Closure Options

Many of the activities required for decommissioning of the site are not technically complex and standard methods can be applied. The *Yukon Mine Site and Reclamation Closure Policy* will be used for guidance. Physical disturbances such as roads and waste rock piles are generally not contentious and will follow the broad principle of leaving the land in a stable state, consistent with surrounding terrain. Other components of the closure plan, namely the tailings and pit, are more complex and have some options with differing risks and costs. The presentation of these options for evaluation prior to deciding on the final closure plan is the purpose of this document.

3.1. Closure activities with no options

Some activities with no options have been completed already or are planned for 2008. These are listed in section 2.3 above. Other activities include:

- waste dump stabilization and vegetation;
- removal of culverts on site roads and re-establishment of natural drainages;
- removal of unused buildings* and associated structures (fuel tanks, water and septic) and backfilling, contouring and revegetation of foundations;
- road contouring, scarification and revegetation**;
- removal and disposal of any remaining chemicals on site; and
- clean-up of any contaminants resulting from historic spills.

The infilling of old exploration trenches will be discussed as part of consultation for the final closure plan. Although the trenches may be unattractive and are felt by some to be a potential safety hazard for people and wildlife, there is significant revegetation that has gone on in the trenches over the decades since they were formed. Disturbing the ground again for the purpose of smoothing the landscape may or may not be seen as desirable. A test trench will be backfilled in 2008 for demonstration purposes so that people can see what the resulting impacts will be.

Infrastructure waste from the demolition will be minimized as much as possible with an emphasis on reuse and recycling, but it is likely that a moderate amount of solid waste will require disposal on-site or possibly at a designated area off-site. Any disposal facility will be planned and a solid waste disposal permit may be required under the *Yukon Environment Act*. Wood and wood products may be burned with the appropriate permit if necessary.

Revegetation plans will likely include the use of native seed mixes and planting of live native vegetation. Native seed mixes for use in alpine and sub-alpine areas are commercially available. Local seed collection may also be a possibility. The desired end results of revegetation are slope stability, erosion control and a return of the disturbed

* the bunkhouse/kitchen facility and the workshop/generator section of the mill may be left in place if there is a firm plan for their future ownership, use and maintenance.

** Some roads on site may be left in place depending on the removal or continued use of the buildings. The main road is required for access to properties past the mine site and is maintained by the Government of Yukon, Department of Highways and Public Works. There are no plans to remove or alter this main road as part of the closure plan.

areas to natural use and wildlife habitat. Soil amendments will be considered if deemed appropriate.

3.2. Tailings Impoundment Options

The key points specific to dealing with the tailings identified by EBA in an assessment of closure options (2004) are:

- to prevent contamination to the environment;
- to prevent acid mine drainage (and the resultant leaching of metals);
- to minimize the requirement for long-term maintenance and monitoring; and
- to return the area to a stable state, consistent with the natural surroundings

Three possible options have been identified for closure of the tailings facility:

1) Upgrade the dam and leave the tailings in place with contouring and possibly a cap;
2) Remove tailings out of the Dome Creek channel to a new facility on the side of the Dome Creek valley, just below the current tailings impoundment; or
3) Remove the tailings to the Brown-McDade open pit.

Main Dam and Seepage Pond

These three options have been assessed at different times by Brodie (2002), EBA (2004) and from a geochemical perspective by Lorax (2008). The reports are available from YG EMR-AAM. A summary of each of the three options is provided below, but readers should refer to the reports for more detailed information.

For all the options, it is assumed that appropriate geotechnical materials for any construction, drainage or capping requirements can be found within a suitable haulage distance. However, sources will need to be identified once the closure options are selected and material requirements and quantity estimates are known.

3.2.1. Option 1: leave tailings in place, upgrade dam, improve drainage to reduce water within the impoundment

The water quality in the pond and seepage has been acceptable with respect to the criteria in the mine's water licence during operations, and has been directly discharged as necessary since 2005. Sampling has continued on a bi-weekly basis. It should be noted that the Brodie Report was written in 2002 before acceptable water quality was achieved, and therefore it contains discussion of continued treatment needs and associated costs that are no longer directly applicable. The possibility of future treatment being required if the attenuation mechanisms currently at work in the tailings are exhausted has not yet been fully assessed.

Exclusive of any possible future water treatment requirements, leaving the tailings in their current location requires:

- improvements to, and long-term maintenance of the diversion channel and spillway which are constructed with the coarse, aeolian sands of the valley – During mine operations, excessive seepage from the ditch through to the pond contributed to filling of the pond much more quickly than was predicted in the original water balance for the system. More solid and less permeable construction materials would be necessary for long term structures, and routine maintenance would still be required for the foreseeable future;
- reduction of water within the tailings via drains (wick drains within the tailings and/or a drainage trench and a French drain at the upstream end of the tailings impoundment);
- a low permeability cap for the tailings;
- revegetation of the tailings;
- contouring for desired surface drainage; and,
- stability improvements to the dam – The reduction of water would relieve some of the stress and potential seismic instability of the dam structure, but stability improvements would still be required. Brodie suggested a stabilizing buttress be constructed over the downstream face of the dam and critical areas of the abutments. A filter made of earthen materials would reduce the risk of piping failure in the dam. A toe buttress may be installed over the toe of the dam slope and wick drains to remove water from the loose layers existing within the current structure may be required to guard against liquefaction during a large seismic event.

During any active draining of the tailings facilitated by wick drains, water treatment of the drainage water may be required. Trenching tests in the tailings over winter has revealed areas of saturated clays with very low permeability which may reduce the effectiveness of wick drains.

From a geochemical perspective, this option has uncertainty associated with the ongoing attenuation of metals. The current attenuation processed could be finite and therefore a future increase in metal release into affected waters could occur. Long term monitoring would be required. This option is not amenable to easy incorporation of chemical amendments such as lime or ferric sulphate into the tailings.

Based on preliminary cost estimates, this would be the least expensive option in the short term. However, long term maintenance, inspection and monitoring costs would be ongoing. This option contains long term risk from weathering and erosion, and large seismic or flood events. (see section 4.4).

3.2.2. Option 2: Move tailings to a new impoundment facility

Moving the tailings to a new impoundment facility would include:

- the construction of a new, stable dam or other impoundment for the tailings;
- transport of all of the tailings and any contaminated native soils beneath the tailings and in the dam, either in a frozen state by truck, or liquefied and pumped out, or thickened, filtered and dry stacked;
- site water management of both the existing pore water in the tailings, site drainage, and any water that would be added if the tailings was turned to a slurry for pumping;
- short-term and long-term monitoring for stability, seepage and water quantity and quality;
- returning Dome Creek to its original channel; and,
- contouring and revegetating the area under the existing tailings impoundment.

New location would be the terrace in the right background (tailings pond is the left foreground with the dam across the middle)

If required, chemical amendments could be added to the tailings as they are handled and, as the tailings are not homogenous in either texture or chemistry, the tailings could be placed as is considered best from a physical and chemical standpoint. One sample point from the Lorax 2008 report that is believed to come from below the tailings pile, suggests that there may not be much vertical migration of contaminants into the native soils beneath. This sample is not considered conclusive, but is encouraging. The proposed relocation site is roughly 300m southeast of the existing tailings dam, on a large, flat, aeolian terrace on the valley flank, well away from the natural Dome Creek channel.

This option is the most expensive option, and would result in disturbance to the new site. Monitoring for drainage and water quality, and the stability of the structure would be required. This option contains long term risk from weathering and erosion, and large seismic or flood events.

3.2.3. Option 3: Move tailings to Brown-McDade open pit

The Brown-McDade open pit presents a convenient, geologically stable location for permanent storage of the tailings. Testing over the past winter suggests that the tailings freeze sufficiently to be excavated and transported by truck in the winter, so adding water to make a slurry, and pumping the tailings between their current location and the pit is likely unnecessary. Sections of the tailings that are drier could be moved in the summer. Amendments can be added as required, and different areas of the physically and chemically heterogeneous tailings can be placed in the most appropriate location and elevation in the pit. The tailings could also be commingled with some material from the waste rock pile adjacent the pit which has geotechnical and chemical advantages. The tailings could likely be kept wet or dry dependant on beneficial chemistry and there is also the possibility of putting a water repellent cap on top.

Activities required under this option are:

- removal of ~300,000m^3 of materials from within the tailings impoundment, contaminated materials below the tailings impoundment and contaminated parts of the dam structure;
- relocation of these materials to the pit;
- returning Dome Creek to its original channel; and,
- contouring and revegetating the area under the existing tailings impoundment.

The major advantage of relocating the tailings to the pit is the secure, long-term containment and removal of the liability and maintenance associated with the dam. As the final resting place of the tailings chosen for this closure plan is essentially intended to last forever, the increased physical security of having the tailings in the pit in comparison with the other options is apparent. The dam options may be stable for a very long time, but don't have quite the same certainty of containment over an extended time period. This is particularly relevant in consideration of major seismic events and floods with a return period in the magnitude of hundreds or thousands of years which are predicted to occur in the area.

Concerns with putting the tailings into the pit centre on the hydrology of the pit and the potential for contaminant migration through the groundwater. Gartner Lee Ltd. have assessed the hydrology of the pit and believe it to be a perched water table, with the majority of the water input entering as seepage at the north end of the pit from the Pony Creek drainage, and eventually leaving the pit as seepage into the groundwater table somewhere below, with probable eventual discharge into the Dome Creek system. Pit water levels have not yet stabilized (see section 2.2.2 or the Gartner Lee Ltd Reports listed in section 2.4.3 for more information). The long-term water balance of the system if the tailings are added has not yet been modelled; however, without intervention, the Pony Creek drainage should continue to seep into the pit, and the tailings material has significant water holding capacity due to much of it having a very fine-grained texture, so it is likely that the tailings could remain in a saturated state if no measures were taken to prevent it. The volume and texture of any materials placed in the pit will also have implications for the water balance.

Brown-McDade Pit

There are chemical pros and cons of leaving the tailings saturated vs. unsaturated (discussed in detail by Lorax, 2008). A saturated situation would stabilize the sulphide bearing tailings, preventing the mobilization of oxidizable metal species that may occur in an unsaturated environment, yet an unsaturated situation would be preferable for reducing arsenic mobilization through the dissolution of arsenic bearing iron oxyhydroxides, and for the continued destruction of nitrogen compounds (in particular CN, SCN and NH_3). Chemical amendments could be added to mitigate either situation. In addition, the nitrogen compounds are much more limited in quantity within the tailings relative to the metals and sulphate, and have been decreasing over time so it is likely that the nitrogen compounds have a much lower potential for very long term effects at the site. Lorax has identified some potential measures (chemical amendments, diffusion barrier) that may be part of final planning if the pit is the chosen option for the tailings location, and recommended further investigations (shake flask extractions, modelling of species with contrasting water balance scenarios) which may be undertaken in 2008. An additional measure Lorax puts forth for consideration is the draining of the current pit lake prior to placement of the tailings so that there is not an impact on the existing pit lake water from the input of tailings, and so that the tailings may be more easily placed in a planned manner. Drainage of the pit lake would likely require water treatment of the discharge.

Migration of tailing seepage into the groundwater below the pit is a concern with moving the tailings into the pit. Chemical and physical prevention techniques could be integrated into the design of the pit. Gartner Lee Ltd (2007) estimates dilution factors on pit seepage of the Dome Creek drainage at 25 times dilution, and the Victoria Creek drainage at 16,000 times dilution. These dilution factors are likely large enough to negate the toxicity of any contaminants seeping from the pit bottom. In addition, there is likely plenty of capacity for attenuation mechanisms to act on metal contaminants migrating from the pit along the groundwater flow path to any point down gradient where the water might daylight. Monitoring wells were installed in fall 2007 to better understand the groundwater in the immediate area. Preliminary assessment of the results supports the belief that the water table is perched, and seepage from the Pony Creek drainage is the major source of water for the pit. An artesian well near Victoria Creek, downstream of the mine site currently and historically has had good water quality. This well provides another monitoring site for the area.

The pit has potential to be divided into different regions so that materials can be left in different states. There are significant areas of the south end of the pit that are dry, and there is a large quantity of non-acid generating waste rock adjacent to the pit, that can be used as material to raise the grade of the pit bottom, used as cover material, used to form a dam within the pit or any other similar requirement. If necessary, fine grained material for use as a water or chemical migration barrier could be imported for such a use, and chemical amendments such as lime or ferric sulphate can be added as necessary. If in-pit disposal is the chosen option, the final design for the pit will include chemical and hydrological considerations, as well as the desired end state of the pit and any additional on-site materials that require a disposal location (discussed in section 3.3).

The cost estimate for the relocation of the tailings to the pit is slightly more expensive than leaving them in place and stabilizing the dam, but significantly cheaper than the cost estimate for moving them to a new tailings impoundment (see section 5).

If the tailings are moved to the open pit, the dam materials (consisting of sand and waste rock) would also be removed. Contaminated dam materials would be placed with the tailings in the pit, and uncontaminated materials would be notched to the appropriate width as part of the contouring operation for reclaiming the Dome Creek valley and re-establishing the creek channel.

3.2.4. Option 4: Freezing tailings in place

This option put forth by Brodie (2002) relies on leaving the tailings in a permanently frozen condition by either passive (cold air trap, thermosiphons) or active (refrigeration plant) methods. This option has been preliminarily rejected due to concerns with cost, difficulty with forming and maintaining permafrost, high volume of flowing water in the sub surface, potential for climate change effects and the need for long-term monitoring.

3.3. Open Pit Options

The options for the pit (exclusive of those mentioned in the tailings options above) essentially involve how much, and what materials to put in the pit. The three options are:

- leave the pit as is, with no infill;
- partially fill with waste rock and/or tailings; or
- completely fill in with waste rock and/or tailings

Due to the expense of transporting materials, there is a very wide range of costs between the three options. The cost estimates are provided in Section 5.

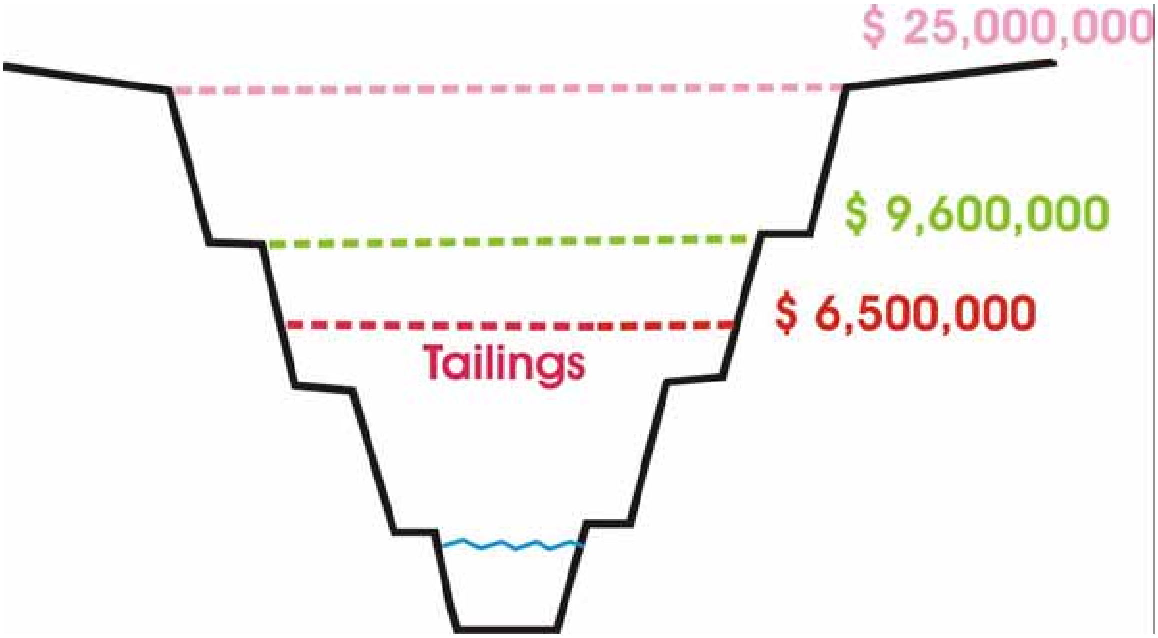
3.3.1. Option 1: Leave pit as it

This option would leave the pit lake as is which would allow for fluctuation and monitoring of water quality. Currently, the only water quality parameter of concern is zinc, which is slightly higher than the level allowed for tailings water discharge under BYG's operational water licence. This is not expected to change much if the pit is left as is. Without any intervention, the pit lake will likely remain over time, with yearly input coming from discharge from the Pony Creek drainage when un-frozen, and seepage out of the bottom of the pit all through the year. Some bio-remediation testing has been done in the pit water, with using algae to trap the dissolved zinc from the water column into the sediments. This work may be continued if the pit lake is to be left as is so that the zinc level in the pond water may be reduced. The sediment layer would also reduce the contact and reaction between the sulphides of the pit floor and the water.

This option would leave a large safety hazard at the site for both humans and animals. The walls of the pit are very steep and there is potential for animals and humans (particularly humans on fast moving recreational vehicles) to fall over the edge of the pit. The lake also presents a safety hazard being open water with a depth up to ~8m. Signage currently exists around the pit to warn of the danger. For this option, a ditch and berm structure would be constructed around the pit to deter wildlife, and act as a barrier to vehicular traffic.

3.3.2. Option 2: Partially fill pit

The total void volume of the pit (including that which is currently taken up by the pit lake) is just over 1,000,000m^3. Partially filling the pit would occur if the tailings are re-located to the pit, or waste rock could be used to fill the pit to above the lake level and remove the hazard of having an open water body on site. The volume of the tailings is estimated at roughly 280,000m^3 (with 140,000m^3 of that being porewater) (EBA 2002, GLL 2004) which is sufficient only to fill a portion of the pit. In addition, a layer of the native soil beneath the tailings, and part of the dam that is contaminated through seepage would have to be excavated and moved with the tailings. If spread uniformly, this material would probably fill the pit to a level between the 1st and 2nd benches from the top. The volume of non-acid generating waste rock available on site is estimated at just under 900,000m^3. Portions of this rock could be used to fill the pit to varying levels. As the amount of waste rock moved directly influences the cost of the option (estimated at \$20/m^3), it may be desirable to only move a portion of the rock to the pit. For example, moving just the tailings to the pit is estimated at approximately \$6.5 million. Partially filling the pit with waste rock to smooth the remaining slopes would be another few million (\$9.6 mil total), while filling the pit entirely with waste rock on top of the tailings would cost about \$25 million.



Costs for different pit-filling scenarios

If the pit is only partially filled in, there remains the potential danger of the steep slopes into the pit. Depending on the amount of material placed in the pit, there is potential to build up the sides of the pit to decrease the slope to something safer, leaving a rounded crest in place of where a steep drop now exists. A berm around the perimeter may or may not be necessary with this option, depending on the final slopes. This option may require an impermeable or low-permeability cap to help manage surface site water, and/or possibly some contouring to direct flows and prevent downward migration of precipitation into buried tailings or other materials that may be sensitive to water input.

There will be an as yet undetermined amount of demolition waste from the mill demolition in 2008/2009, particularly concrete from the building foundations that cannot be recycled or re-used, and may be buried on site. If so, the pit may provide a good location for solid waste disposal.

3.3.3. Option 3: Completely fill pit

The last option is to completely fill the pit. This would remove the physical safety hazard associated with the open pit. The filled pit would be contoured and sloped for positive drainage, and revegetated. The expense of transporting the required volume of material to the pit may be prohibitive, but the pit area would be left as close as is feasible to the original, pre-disturbance condition. Settling of the fill materials may occur over time, but not likely with any significant impact to the surface.

One potential problem with both options 2 and 3 is the prevention of access to the pit water. Whether exposed, or buried, it is likely that the perched water table will remain in the pit due to the differences in permeability of rock walls, and the materials filling the pit. If there were any significant future problems with the pit water quality, access to monitor and treat the water would have to be via drilled groundwater wells which is challenging and expensive. It is possible that infill of the pit could be engineered for preferential flow patterns within the fill materials and a sump and collection system into the bottom of the pit.

Brown-McDade Pit from a distance facing south

4. Assessment of Options

As is mentioned section 1.3.2 of this document, closure objectives for the project were generated through discussion with the community, First Nation and regulators as statements of the values that are important to be considered in formulation of the closure plan. The closure objectives are included as Appendix C. The assessment of how well the options presented in this document satisfy the closure objectives will be discussed at workshops in the fall, as an integral part of the selection of the preferred options. The technical feedback on the options resulting from the review of this document is anticipated to provide valuable information and advice on feasibility of the options and identify potential problems or possibly other options that have not yet been considered. Technical considerations for assessment of the options are discussed below.

4.1. Water Quality

Protection of water quality is one of the most important criteria for evaluating the options as water is the major medium for spreading contamination from the mining activities to the surrounding area.

The current water quality of the tailings pond is of acceptable quality, and the pit lake is only slightly above acceptable site levels when judged by the criteria established in the water license issued for the operation of the mine. The water licence criteria were to apply to both the operational phase discharges, and also for final reclamation effluent quality that would continue to drain from the tailings area via Dome Creek after final closure of the site. This site is no longer operated under the former, or any water licence.

Final water quality standards for the current closure plan have not yet been established. Environmental Dynamics Inc. (EDI) has undertaken a review of water quality data for the site, and for some reference sites in the area. Water quality objectives for the site will be discussed with the appropriate regulators and interested parties as a continuing part of the closure planning process. (See section 2.2.1.3 for more detail on Water Quality).

The closure options will be assessed on their ability to meet long term water quality protection standards, and the potential risks to water quality inherent in each option.

Some current unknowns that require further investigations are:

- if solid or chemical wastes are buried under the mill and adjacent areas;
- a long term water balance of the pit;
- a water balance for the pit based on different levels and methods of pit filling;
- potential loading of the pit water from input of tailings if water is not removed prior to placement of tailings fill; and,
- potential effects from tailings placed in the pit on groundwater discharging to Dome Creek.

Predictions on these unknowns will be undertaken in 2008/2009.

4.2. Ecological Health

Long term ecological health is imperative to restoring the area to a useable state that is acceptable to local area residents. In 2005/2006, EDI undertook a two-year terrestrial and aquatic effects survey of the Mt. Nansen area. They generally found low grade, but measurable contamination of a localized area around the pit, tailings pond and mill sites, as well as low grade impacts to water quality and aquatic habitat. Continuing aerial deposition of dust from tailings, the sides of the pit, and the ore stockpile, and previous dusting from mining/milling activities were indicated as the likely source of terrestrial contamination, while the tailings are the main source of aquatic contamination. The water in the pit does not discharge directly to surface, so although it is of reduced water quality, it is not likely significantly contributing to negative downstream effects.

The closure options will be assessed for their ability to reduce the potential for future contamination of the land, water and animals. Key points of this are:

- aerial dispersion of metals around mill, pit and tailings;
- plants with elevated metal levels near mill, tailings and pit;
- plants with elevated metal levels growing within tailings and low-grade ore stockpile;
- metals slightly higher in small mammals at mine site;
- negative impacts on water quality in headwaters of Dome Creek; and,
- Higher metal levels in upstream areas of Dome Creek near the mine.

4.3. Human Health

The primary concerns for human health are for physical site safety, and potential ingestion of contaminants though consumption of contaminated water, plants, meat, fish, mushrooms, lichen and/or berries harvested in the area.

Physical site safety is potentially affected by several mine features:

- safety and security of mine buildings and their contents (electrical, physical, confined spaces);
- a small amount of remaining industrial chemicals and possibly continued presence of industrial chemicals for water treatment if necessary;
- fuel tanks on site currently for use in care and maintenance of the property;
- presence of an open adit;
- presence of the open pit with steep walls;
- ponded water in the open pit;
- potential for rock falls within the pit;
- waste rock dumps with potentially unstable slopes;
- ponded water in the tailings pond as well as unstable, saturated, fine tailings;
- ponded water behind the seepage control dam;
- current dam structure has long-term stability concerns with extreme earthquake or flood events; and,
- Exploration trenches remain on site and present a potential hazard to snowmobile users and possibly to large animals.

Ingestion of contaminants through the consumption of country foods is of concern at the site. A conservative analysis, based on Tolerable Daily Intakes for a 50kg person and the unlikely assumption that a person's consumption of a particular animal or plant tissue would be sourced wholly from the relatively small area of the mine site, was completed as part of the Terrestrial and Aquatic effects study. The metal of most concern identified for each tissue was in many cases due to metals such as cadmium, iron, lead and mercury that are naturally occurring, and not elevated due to mining activities. However, arsenic was found to be a limiting factor for several different consumable tissues (caribou moss, Labrador tea, bolete mushrooms, Burbot flesh and liver, and spruce grouse flesh and gizzards), and therefore arsenic consumption from animal and plant tissues sourced at the site is a concern. It should be reiterated that the assumption noted above, that of the consumed tissues being sourced solely from the affected area, is an unlikely occurrence on a continued basis.

The closure options will be assessed for their ability to reduce potential for contaminants uptake by plants and animals, and aerial disposition of contaminants on to plants.

4.4. Risk Assessment

A preliminary subjective assessment of the risks of the various options is presented below. A more formal risk assessment for the preferred option will be presented in the closure plan for this project.

Tailings

Option 1: Leave tailings in place, upgrade dam, dewater tailings
This option leaves a cross valley dam in place, on unstable and degrading foundation material, and with a creek diversion around the tailings that currently requires annual maintenance.

HAZARD	CONSEQUENCE	RISK
Flood event in excess of design parameters	-failure of diversion -excess water behind dam	-increased instability of dam -possible failure and release of tailings -erosion of impoundment
Earthquake in excess of design parameters	-damage to dam, -liquefaction of foundation	-increased instability of dam -possible failure and release of tailings
Increased climatic warming	-accelerated degradation of foundation permafrost	-increased instability of dam -possible failure and release of tailings -increased seepage
Inability to dewater tailings or failure of drains/cap system	-higher water table behind dam	-increased instability of dam -flushing of metals from tailings

Inability to stabilize dam foundation	-increased foundation degradation	-increased instability of dam and dam failure
Inadequate dam upgrade	-dam does not meet necessary design safety factors	-increased instability of dam and dam failure
Inadequate local supply of dam construction material	-use of non-ideal materials -best technical design compromised	-increased cost to import proper materials -increased instability of dam
Improper geochemical characterization of entire tailings mass	-possible chemical/metal hot spots within tailings unrecognized	-release of metals to environment
Inadequate attenuation of metals from tailings	-current attenuation capacity exhausted	-release of metals to groundwater environment
Inadequate long term monitoring	-early indications of dam degradation or tailings metal release go unnoticed	-increased instability of dam and possible failure -release of metals from tailings
Lack of long term maintenance funding	-inability to maintain dam, diversion, tailings cap to design specifications	-increased instability of dam and possible failure -release of metals from tailings

Option 2: Move tailings to a new impoundment facility
This option involves the construction of a new impoundment outside of the centre of the valley in a dry location, relocation of tailings, and breaching of current cross valley dam.

HAZARD	CONSEQUENCE	RISK
Inadequate local supply of dam construction material	-use of non-ideal materials -best technical design compromised	-increased cost to import proper materials -increased instability of dam
Problems in movement of tailings	-construction delays or changes to procedures -inability to move all tailings from current impoundment	-increased cost of option -release of tailings to environment
Inability to dewater tailings or failure of drains/cap system	-higher water table behind dam, becomes a water retaining structure	-increased instability of dam -flushing of metals from tailings
Lack of long term maintenance funding	-inability to maintain dam, diversion, tailings cap to design specifications	-increased instability of dam and possible failure -release of metals from tailings

Option 3: Move tailings to Brown-McDade pit

HAZARD	CONSEQUENCE	RISK
Problems in movement of tailings	-construction delays or changes to procedures -inability to move all tailings from current impoundment	-increased cost of option -release of tailings to environment
Relocation of tailings to an area unaffected by tailings	-change in geochemical characteristics of tailings -increased mobilization of metals in pore water	-release of metals to environment -contamination of groundwater in pit vicinity

Open Pit

Option 1: Leave pit as is

HAZARD	CONSEQUENCE	RISK
Open hole with steep slopes	-animals and humans inadvertently falling in pit	-injury or death
Open water in north end of pit	-animals, or birds drinking pit water -animals, humans falling in pit water	-minor uptake of metals (zinc) -drowning
Unraveling pit walls	-slope failure, rocks falling to bottom	-injury or death to animals or humans in pit bottom
Exposure of pit walls to precipitation	-oxidation of sulphide rocks in pit walls and floor	-increased metal loading to pit lake and groundwater

Option 2: Partially fill pit

HAZARD	CONSEQUENCE	RISK
Open hole with steep slopes	-animals and humans inadvertently falling in pit	-injury or death
Unraveling pit walls	-slope failure, rocks falling to bottom	-injury or death to animals or humans in pit bottom
Moving tailings and/or waste rock to move into pit	-disturbing quasi-stabilized tailings or waste rock	-release of metals -increased cost of option

Option 3: Completely fill pit

HAZARD	CONSEQUENCE	RISK
Moving tailings and/or waste rock to move into pit	-disturbing quasi-stabilized tailings or waste rock	-release of metals -increased cost of option

5. Cost Estimates

Preliminary cost estimates of the options were provided by Brodie in 2002, and EBA in 2004. Upon review, much of the Brodie estimates contain components that are no longer being considered for implementation. EBA's 2004 estimates are more current and applicable. More detailed cost estimates for the options will be available in the fall for final closure selection

Closure Scenario Costs (EBA, 2004 – increased for inflation)

Closure Scenario	Estimated Cost ($CDN)
Upgrading and Closure of Current Facility	5,600,000
Removal of Tailings, In-pit Disposal	6,500,000
Removal of Tailings, New Impoundment	9,100,000

View of Mill from Tailings Pond

6. Summary

There are several environmental and safety issues presented by the abandoned Mt. Nansen Mine Site, with various options for how to address them. The closure planning process involves extensive scientific investigations, discussion and generation of closure objectives, proposal and analysis of options, and the selection of the final options for closure. The entire process is intended to be completely inclusive of the three government bodies, as well as the affected community, and reflect joint decision making.

The environmental issues at the site largely involve water quality, and the stability of the tailings mass. A final decision on which options to pursue will need to consider not just the immediate or short-term success of the action, but also the continued success and potential effects far into the future. The disturbance to the environment caused by the mining activities cannot be undone, but the potential for long-term environmental stability is believed to exist. Careful assessment of the options from a technical standpoint in conjunction with the values of the affected parties will facilitate the choice of the most appropriate options.

7. Appendices

A. Water Quality Graphs
B. Report Listing
C. Final Closure Objectives

Appendix A: Water Quality Graphs

Notes on Graphs

1. These graphs, particularly the multi-year graphs are intended to be illustrative of the water quality trends around the mine site. It is recognised that some of the older data had higher detection limits which generally appears as a flat line of data points, or points that dip into negative numbers.

2. The recent data with lower detection limits has been collected since November 2007. Given that many of the sampling points freeze up for various lengths of time over the winter, some of the locations (Dome Creek in particular) have very few data points since November 2007 and are therefore not solid indicators of water quality trends at those sites. Sampling continues on a bi-weekly basis to expand the data set.

3. The multi-year graphs have many data points with such a wide variation in y-value that in places where the concentration levels converge to a limited range, the points and lines cannot be distinguished. These multi-year graphs are presented to show the long-term trends; the graphs of recent data are more legible and are provided to show a representation of more current water quality. All locations are shown on one graph to reduce the number of graphs presented and provide for a visual comparison of the sites.

4. Graphs have been drawn in grey-scale so that colour printing is not required for the document. Unfortunately, this makes some of the lines hard to distinguish. Best efforts have been made to make them as legible as possible.

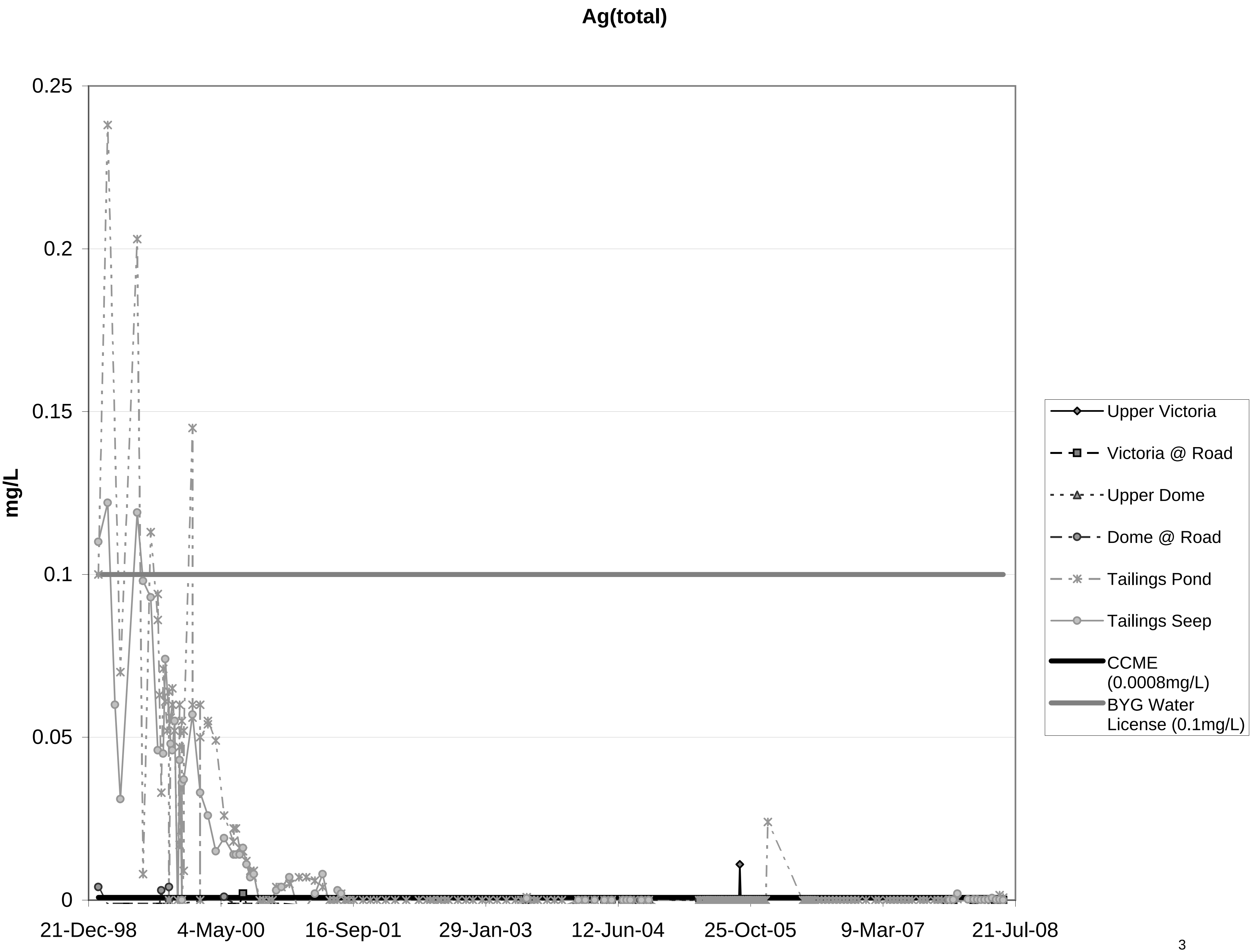
5. The parameters that are presented are those that are considered to be of primary interest for the site. For the pit location, only Zn is presented. CN, NH_3 and sulphate are shown only for the tailings pond and seep locations to illustrate the decreasing trend for these compounds.

6. Arsenic levels in Dome Creek are relatively high considering that similar levels are present in the tailings seep, indicating that the seep is not the main source of As in Dome Creek. Recent sample data from location D-X (near the mill, upstream of the tailings impoundment) has been included in the dissolved As graph to show that As levels are at a similar level in water unaffected by the tailings. Historical data from the 1980s and well water quality data for a well near the mill in the late 1990s (not presented here) show similar elevated As levels in the upper reaches of Dome Creek. It is unknown if this is entirely natural or if it has been affected by the Huestis underground workings in the area.

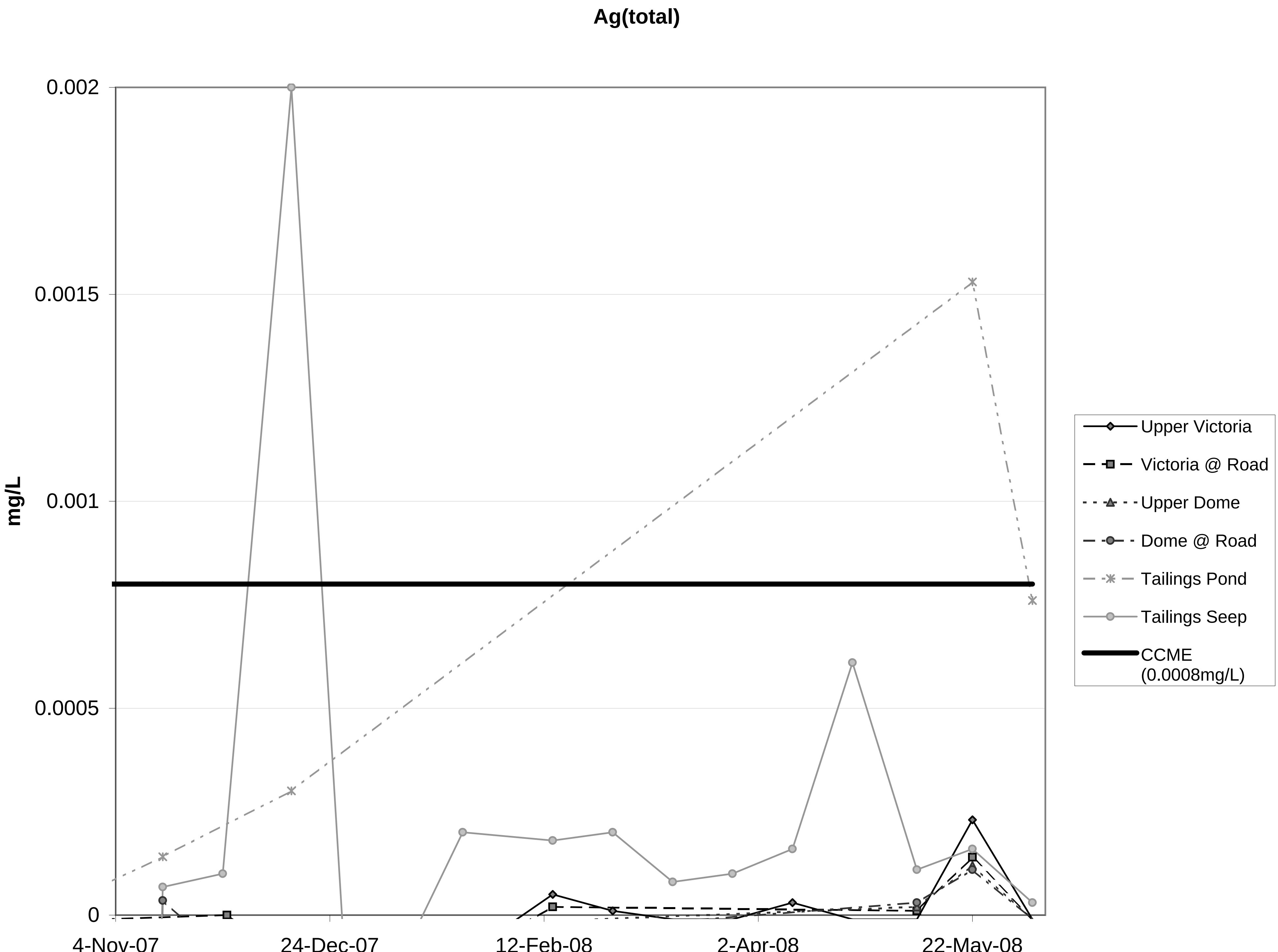
7. BYG Water License effluent quality standards and/or CCME guidelines for the protection of aquatic life are included where they fit within the data limits displayed in the graphs. In several charts, the water license level is far above the CCME level and the data displayed. Metals displayed are total metals (excepting arsenic) as the standards in the water license were either for total or

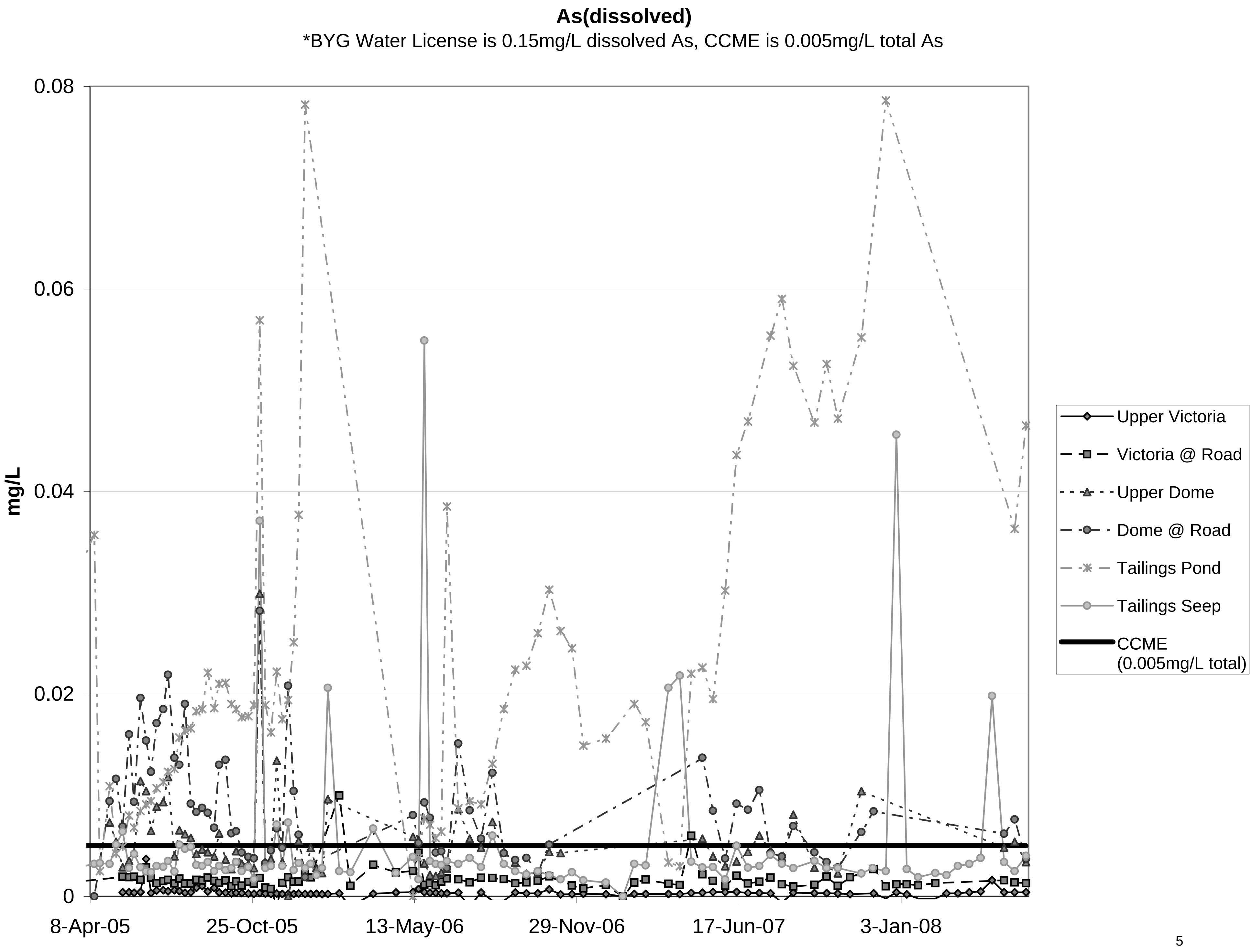
unspecified. For arsenic, the water license level was given for dissolved As, while the CCME guideline is only for total. Dissolved As is displayed here.

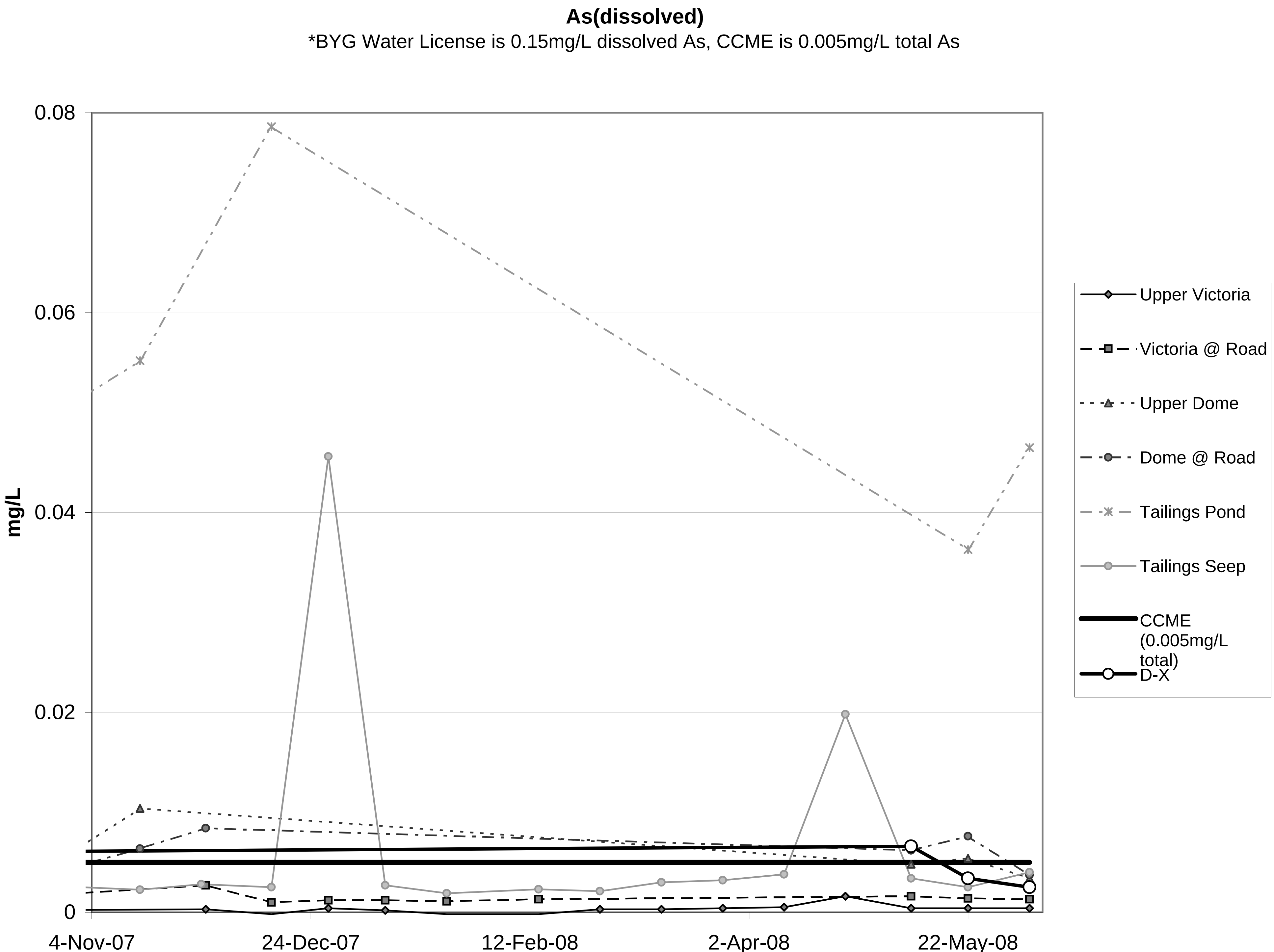
8. For the short-term cadmium graph, the tailings pond and seep are not displayed as they are significantly above the displayed data range. For the short-term copper graph, the tailings pond is not displayed for the same reason. These omitted locations are shown on the multi-year graphs.



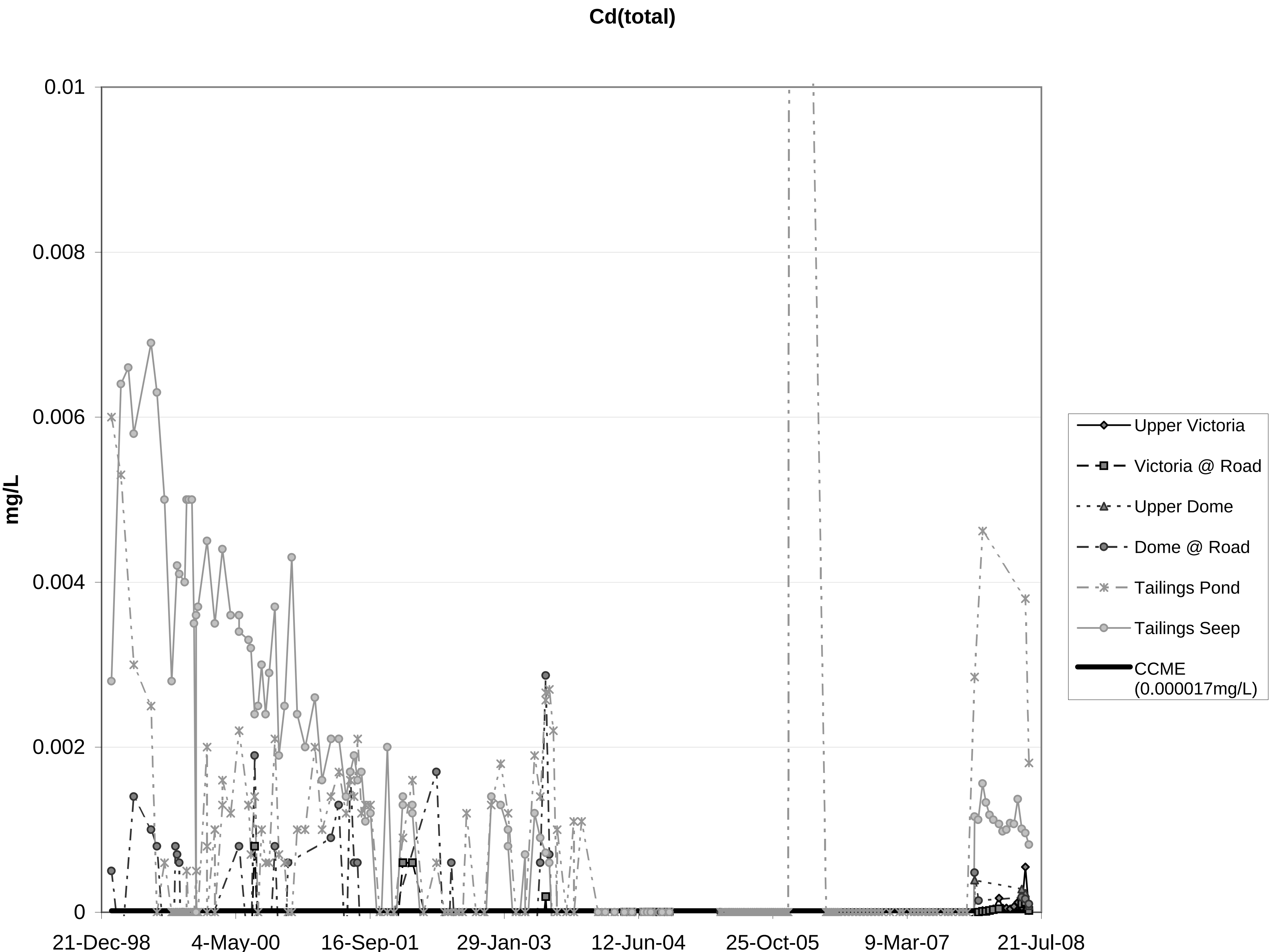
Ag(total)
0.25
0.2
0.15
0.1
0.05
0
mg/L
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.0008mg/L)
BYG Water License (0.1mg/L)


Ag(total)
mg/L
0.002
0.0015
0.001
0.0005
0
4-Nov-07
24-Dec-07
12-Feb-08
2-Apr-08
22-May-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME
(0.0008mg/L)

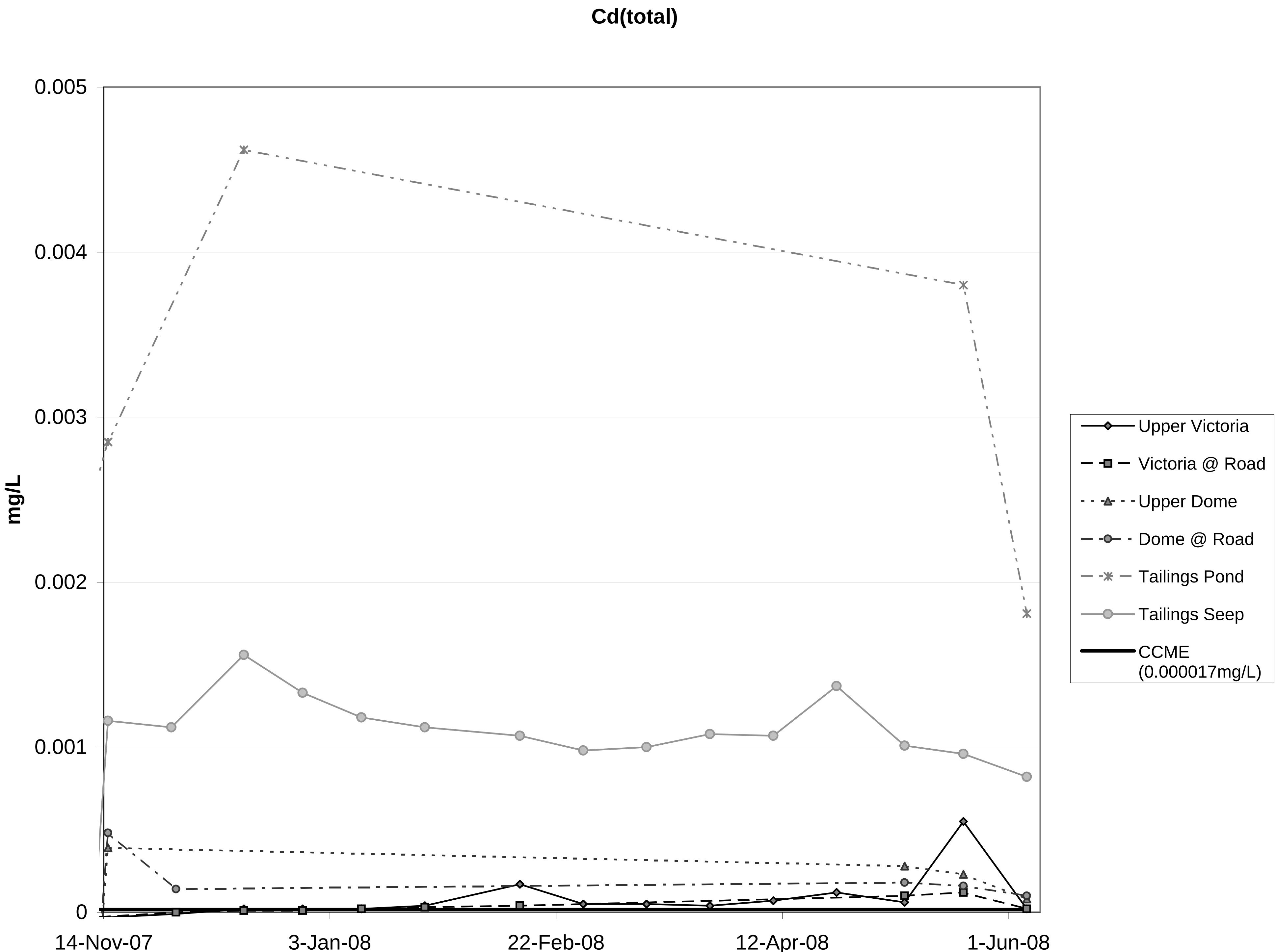

As(dissolved)
*BYG Water License is 0.15mg/L dissolved As, CCME is 0.005mg/L total As
mg/L
0.08
0.06
0.04
0.02
0
8-Apr-05
25-Oct-05
13-May-06
29-Nov-06
17-Jun-07
3-Jan-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.005mg/L total)



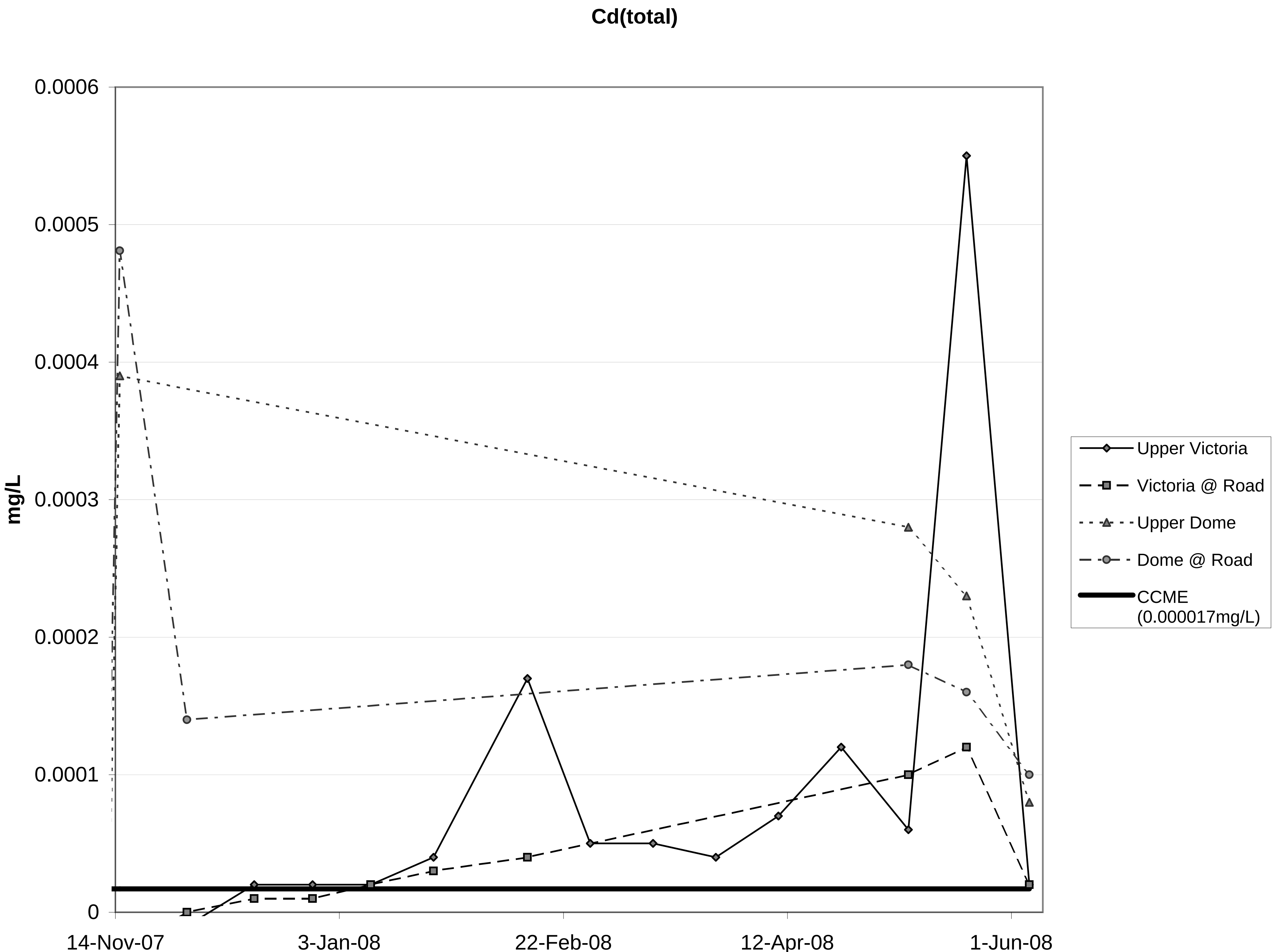
As(dissolved)
*BYG Water License is 0.15mg/L dissolved As, CCME is 0.005mg/L total As
mg/L
0.08
0.06
0.04
0.02
0
4-Nov-07
24-Dec-07
12-Feb-08
2-Apr-08
22-May-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.005mg/L total)
D-X

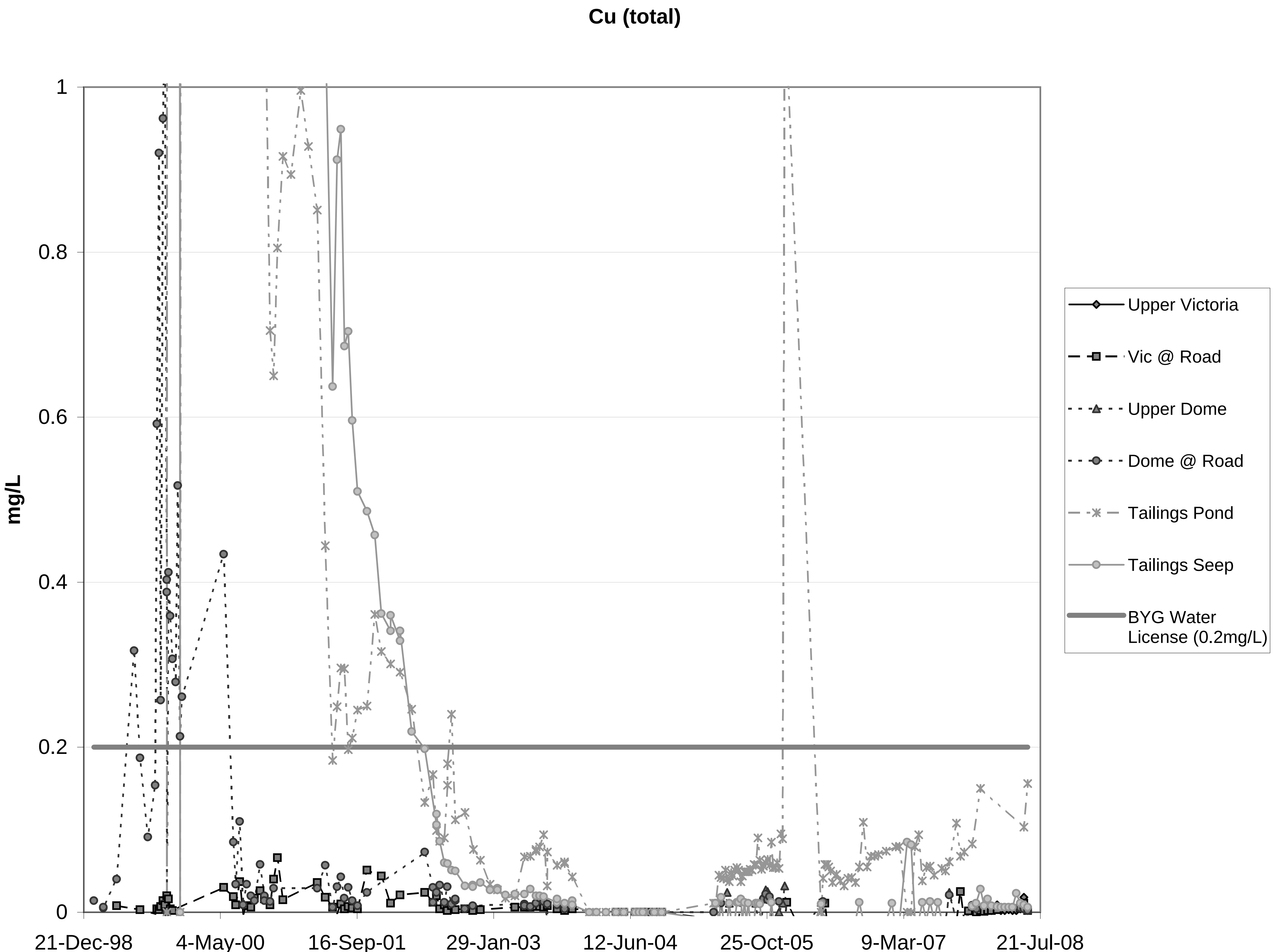


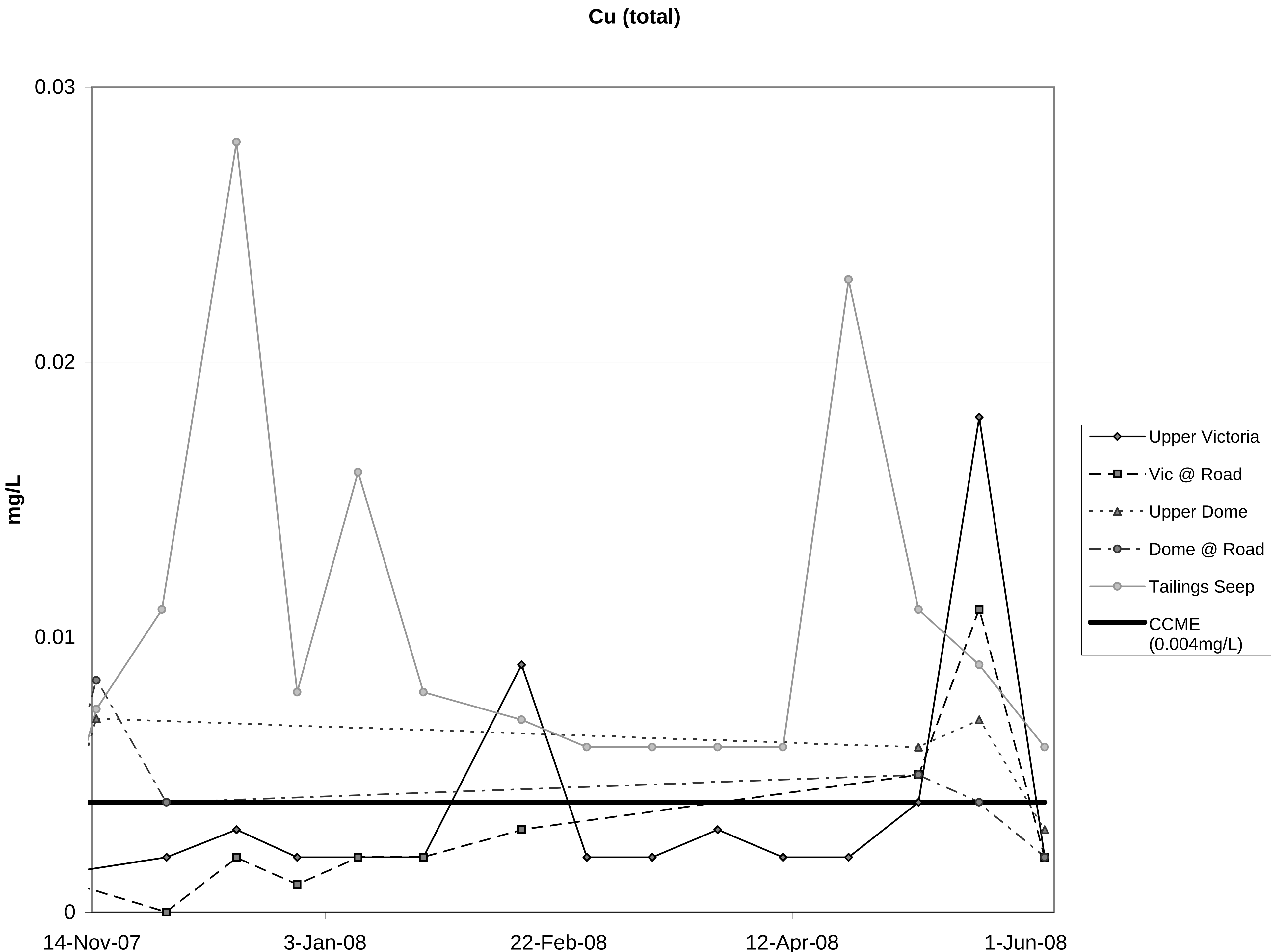
Cd(total)
mg/L
0.01
0.008
0.006
0.004
0.002
0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.000017mg/L)

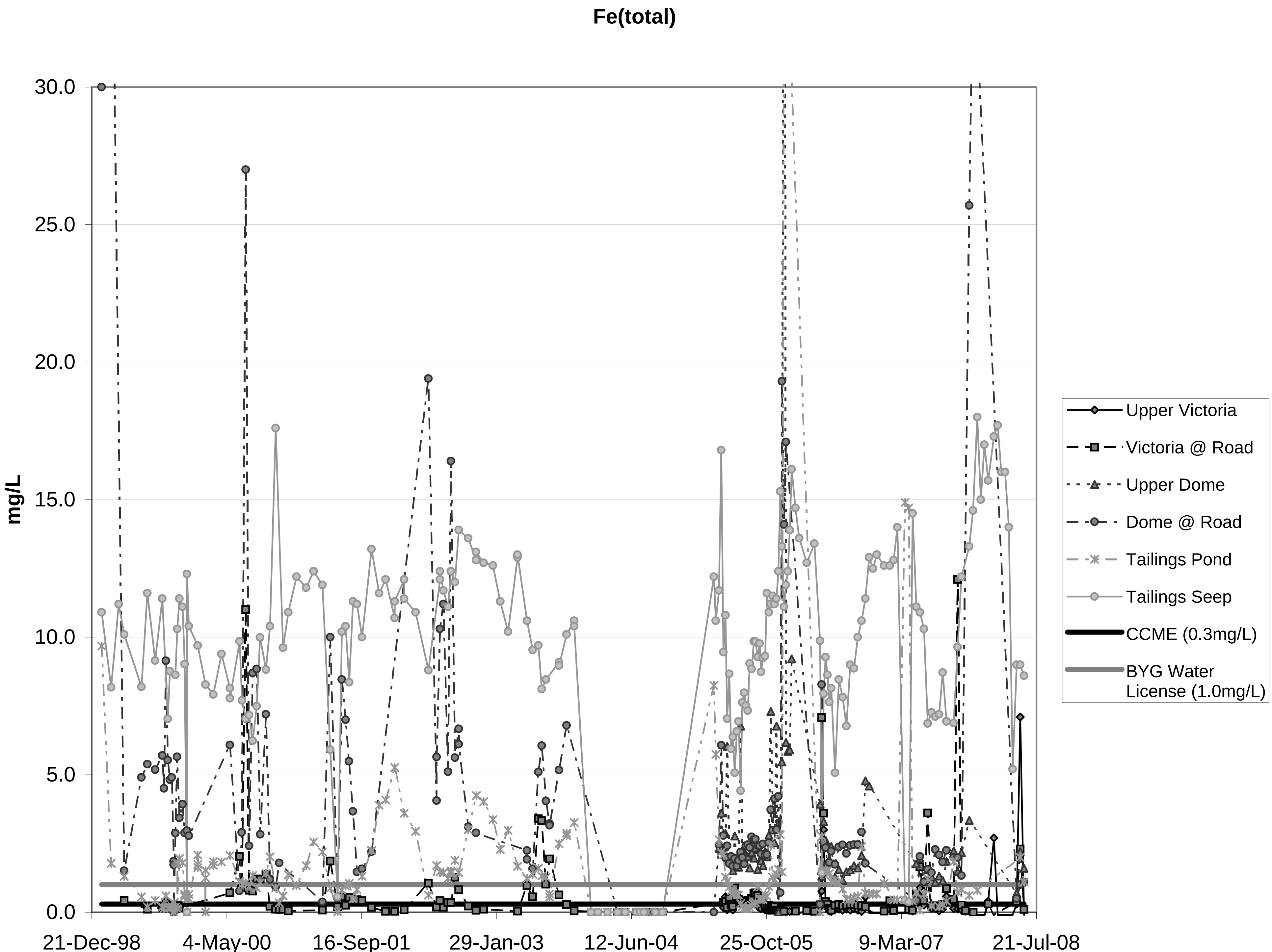


Cd(total)
0.005
0.004
0.003
0.002
0.001
0
mg/L
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
1-Jun-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.000017mg/L)

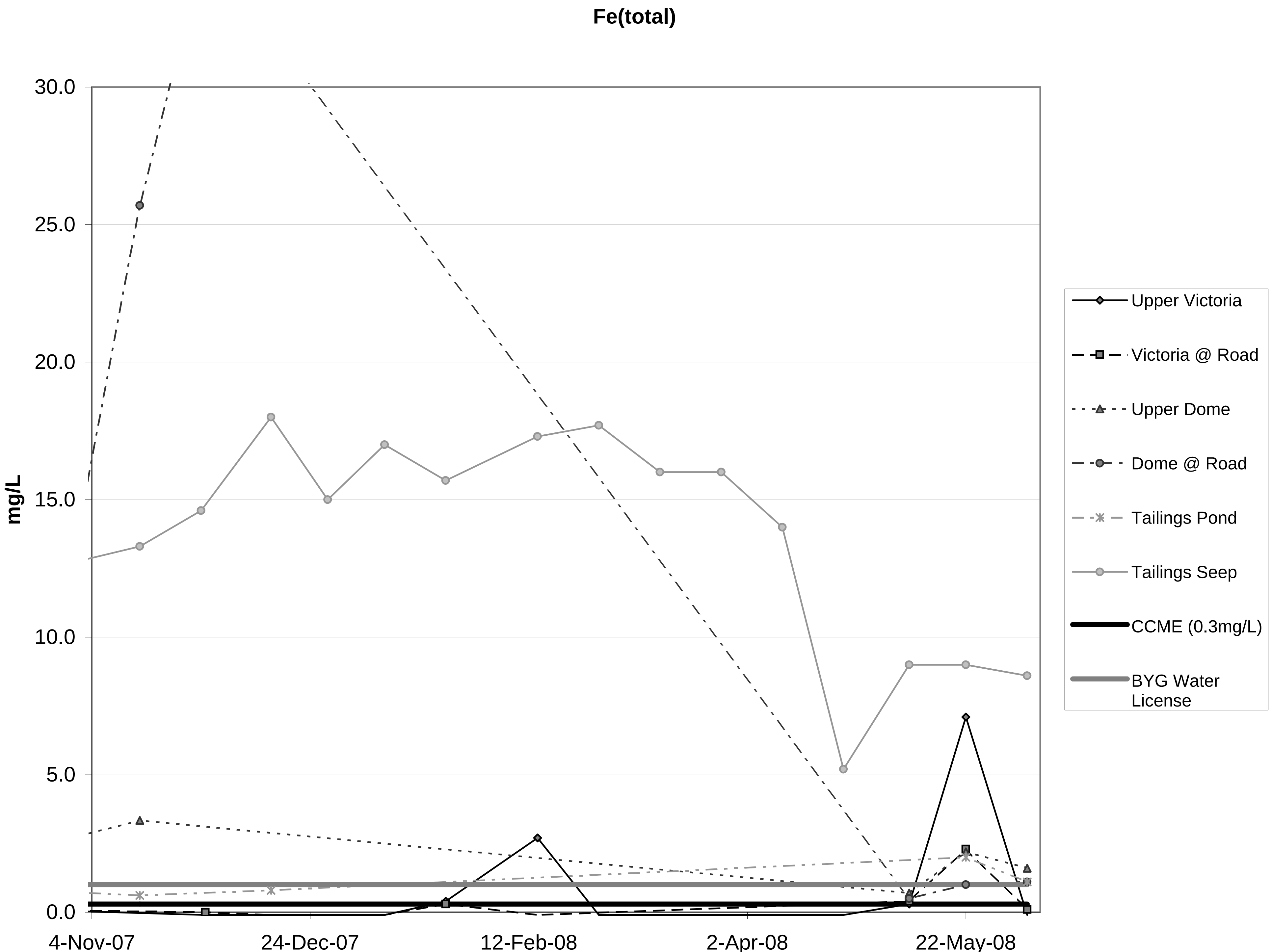

Cd(total)
mg/L
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
1-Jun-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
CCME
(0.000017mg/L)

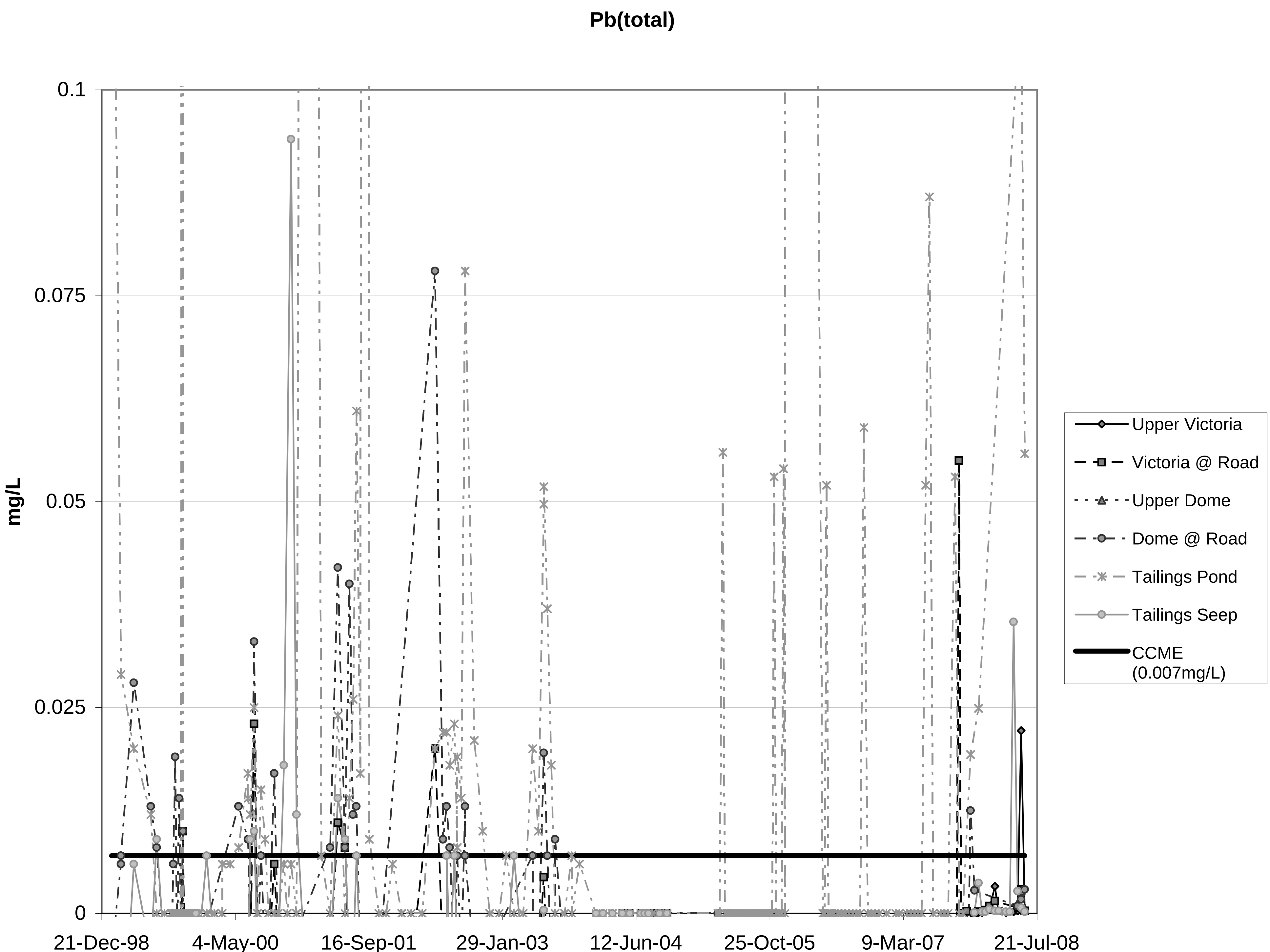

Cu (total)
mg/L
1
0.8
0.6
0.4
0.2
0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Upper Victoria
Vic @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
BYG Water License (0.2mg/L)

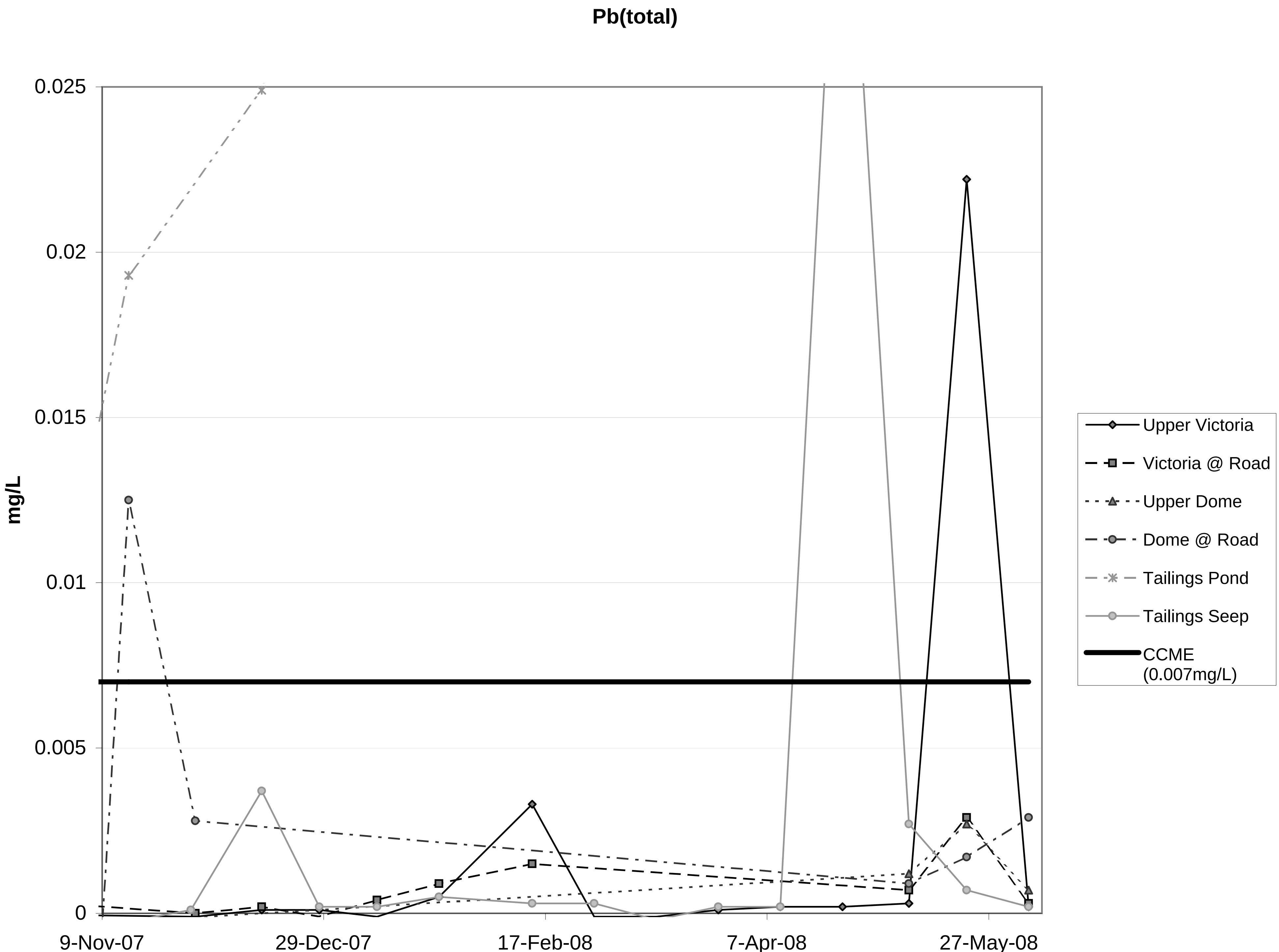

Cu (total)
mg/L
0.03
0.02
0.01
0
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
1-Jun-08
Upper Victoria
Vic @ Road
Upper Dome
Dome @ Road
Tailings Seep
CCME (0.004mg/L)



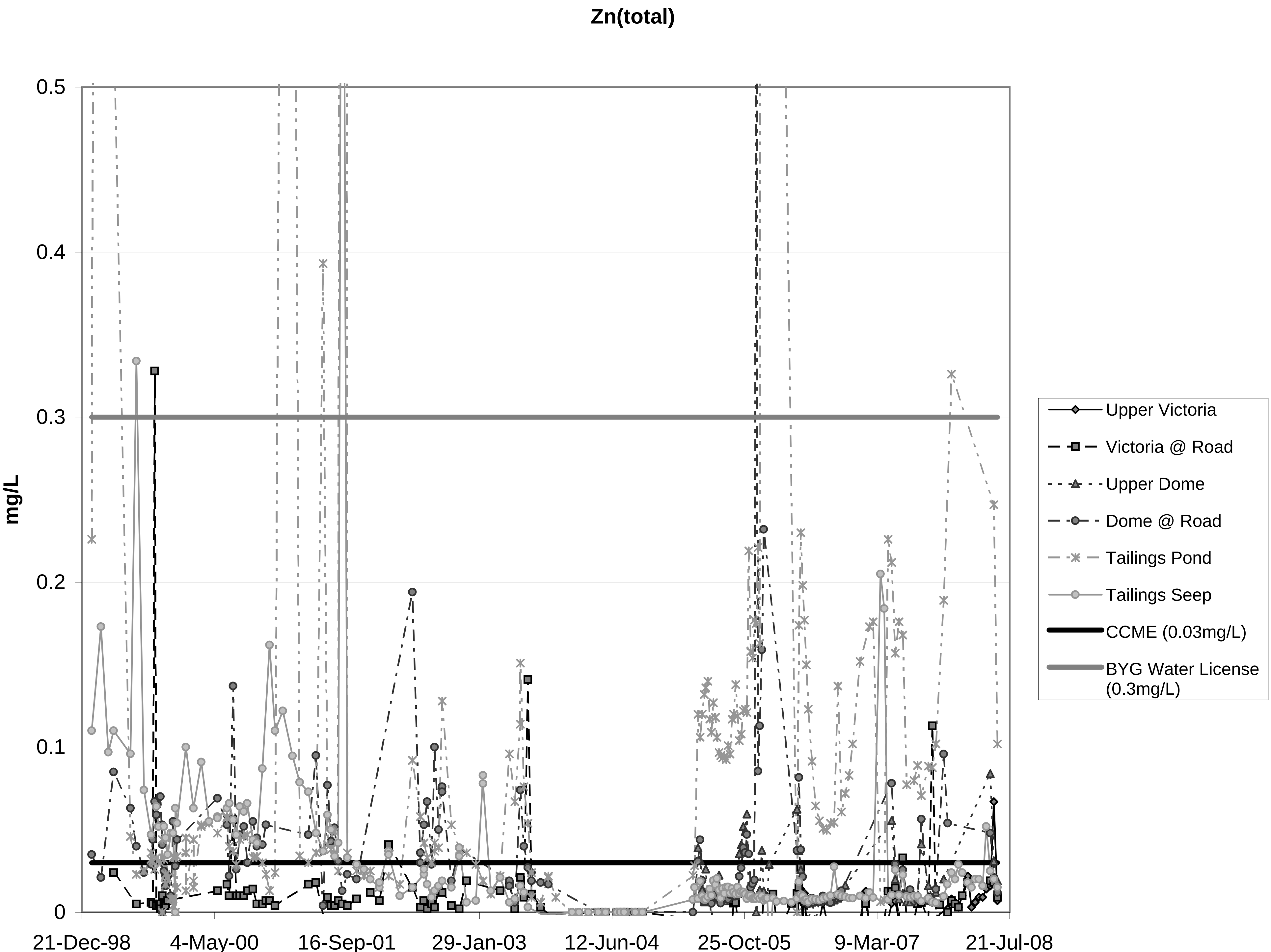
Fe(total)
mg/L
30.0
25.0
20.0
15.0
10.0
5.0
0.0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.3mg/L)
BYG Water License (1.0mg/L)

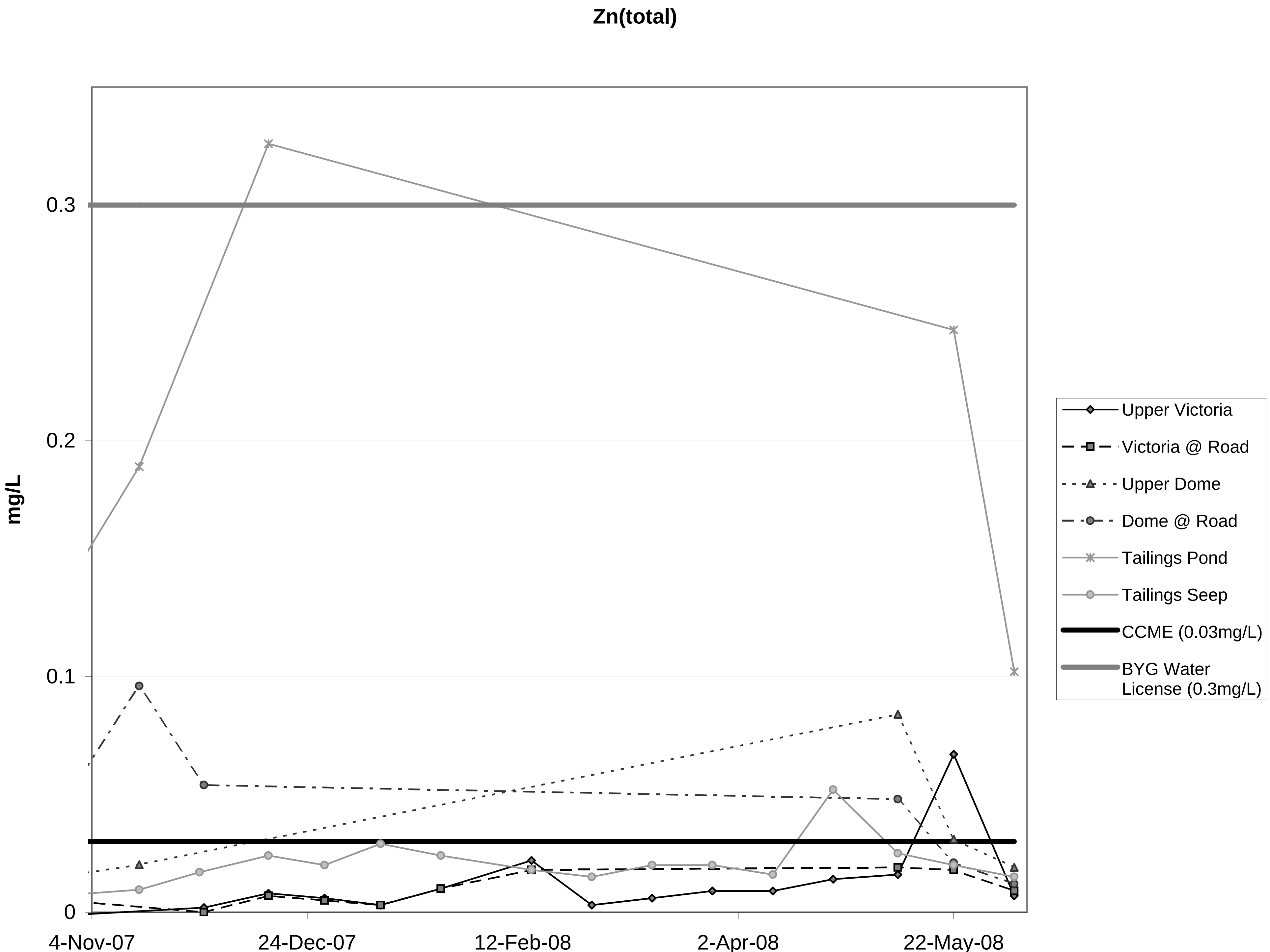

Fe(total)
mg/L
30.0
25.0
20.0
15.0
10.0
5.0
0.0
4-Nov-07
24-Dec-07
12-Feb-08
2-Apr-08
22-May-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.3mg/L)
BYG Water License


Pb(total)
mg/L
0.1
0.075
0.05
0.025
0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.007mg/L)

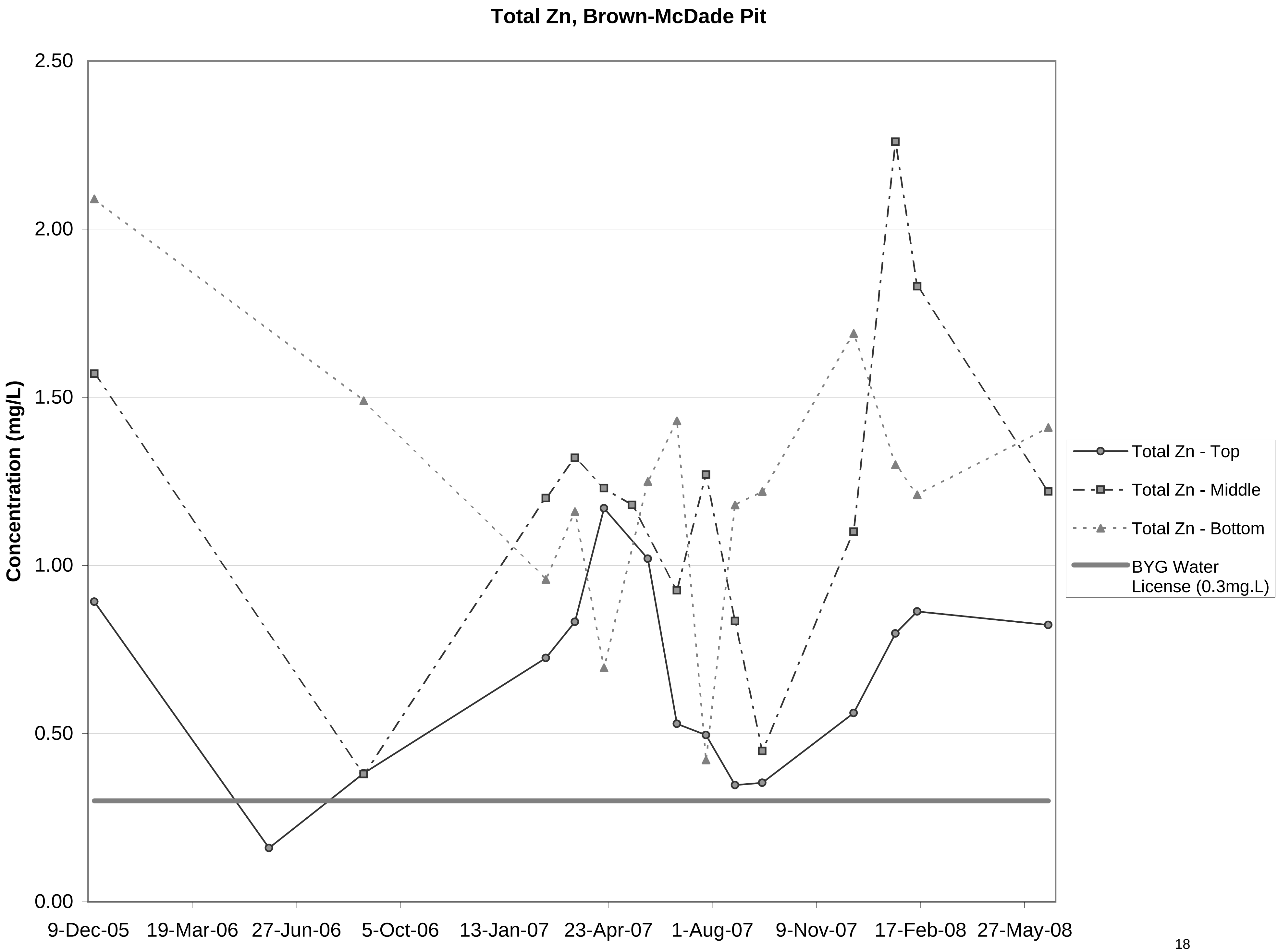


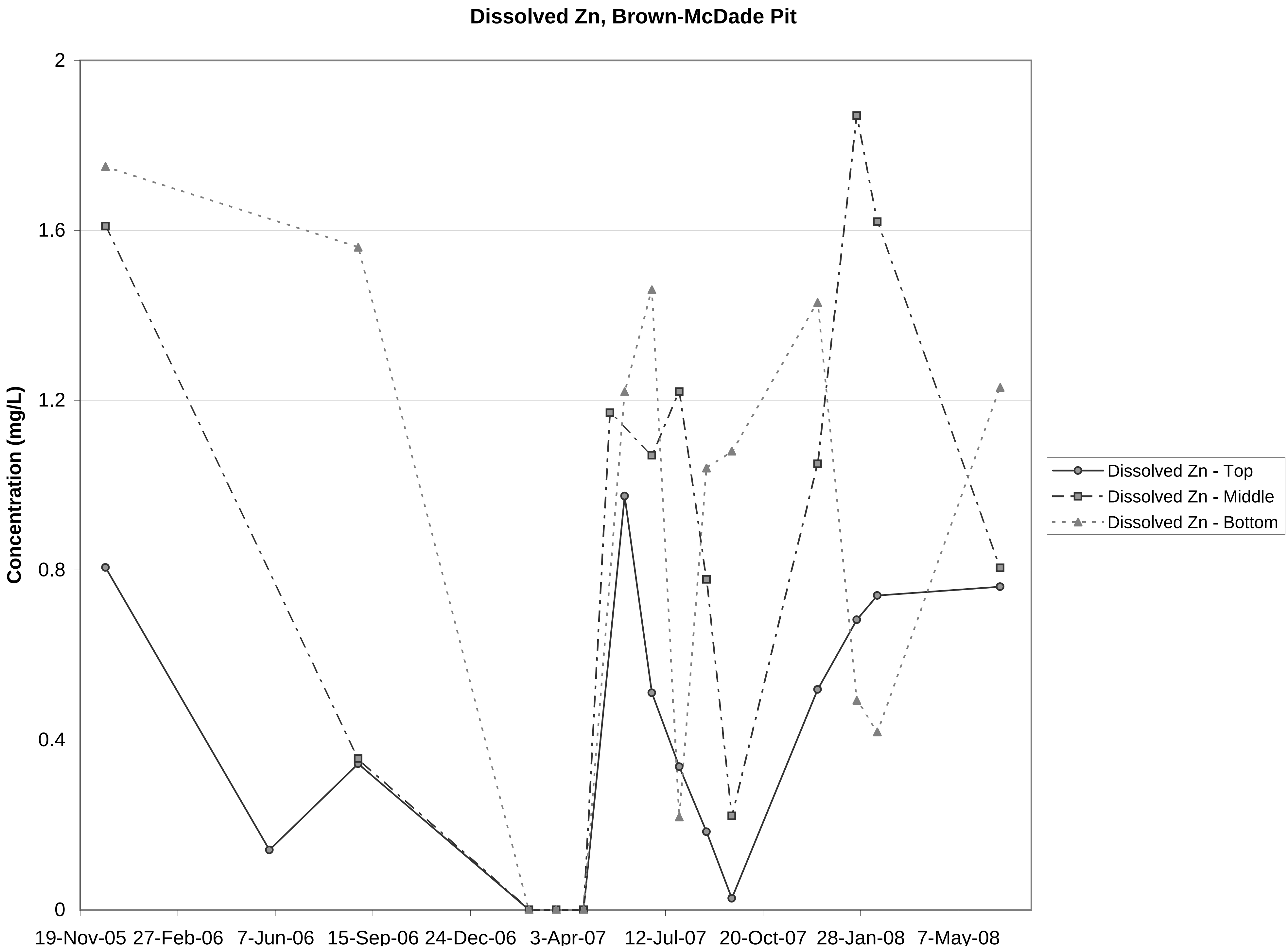
Pb(total)
0.025
0.02
0.015
0.01
0.005
0
mg/L
9-Nov-07
29-Dec-07
17-Feb-08
7-Apr-08
27-May-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.007mg/L)


Zn(total)
mg/L
0.5
0.4
0.3
0.2
0.1
0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.03mg/L)
BYG Water License (0.3mg/L)

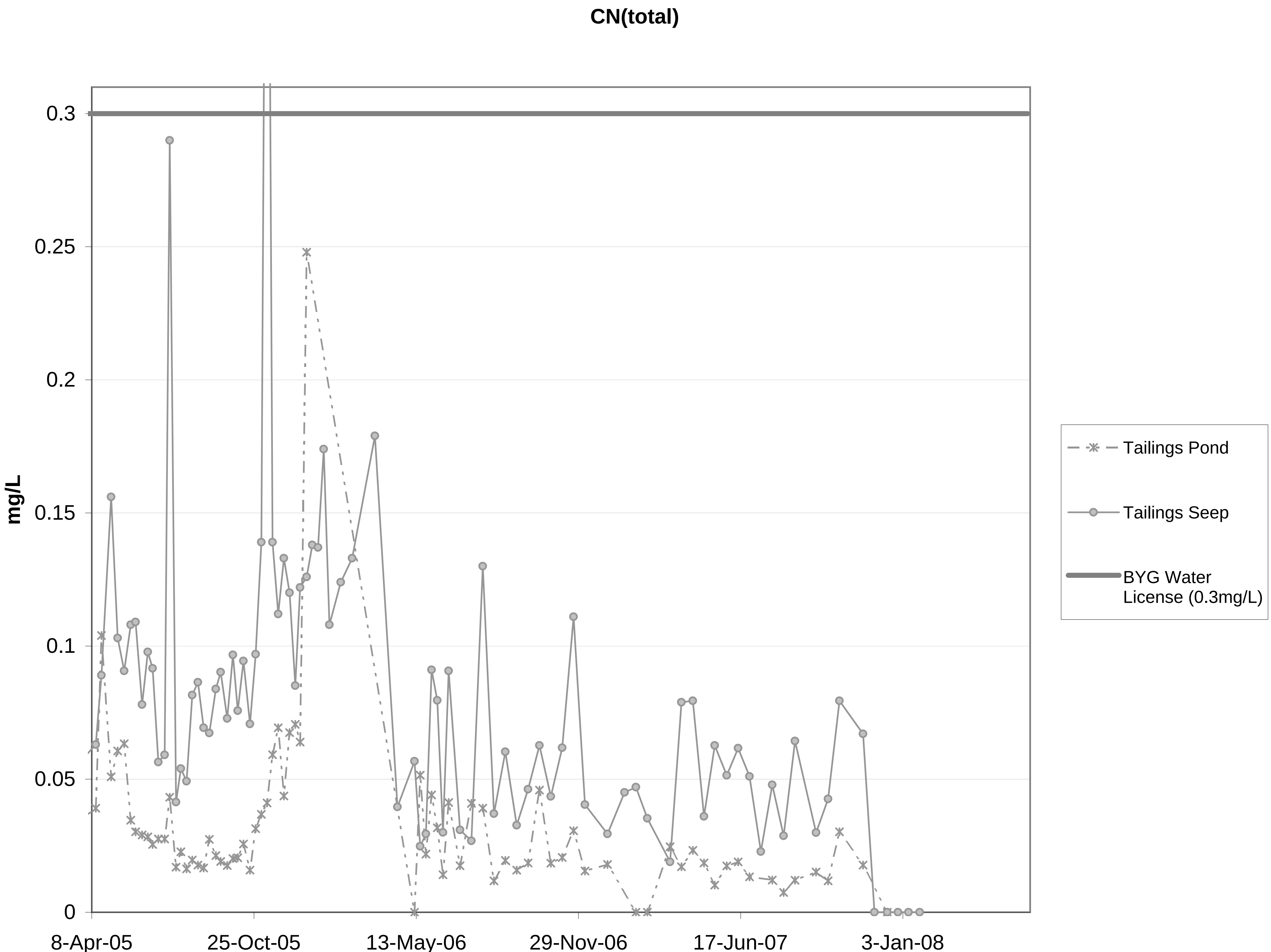


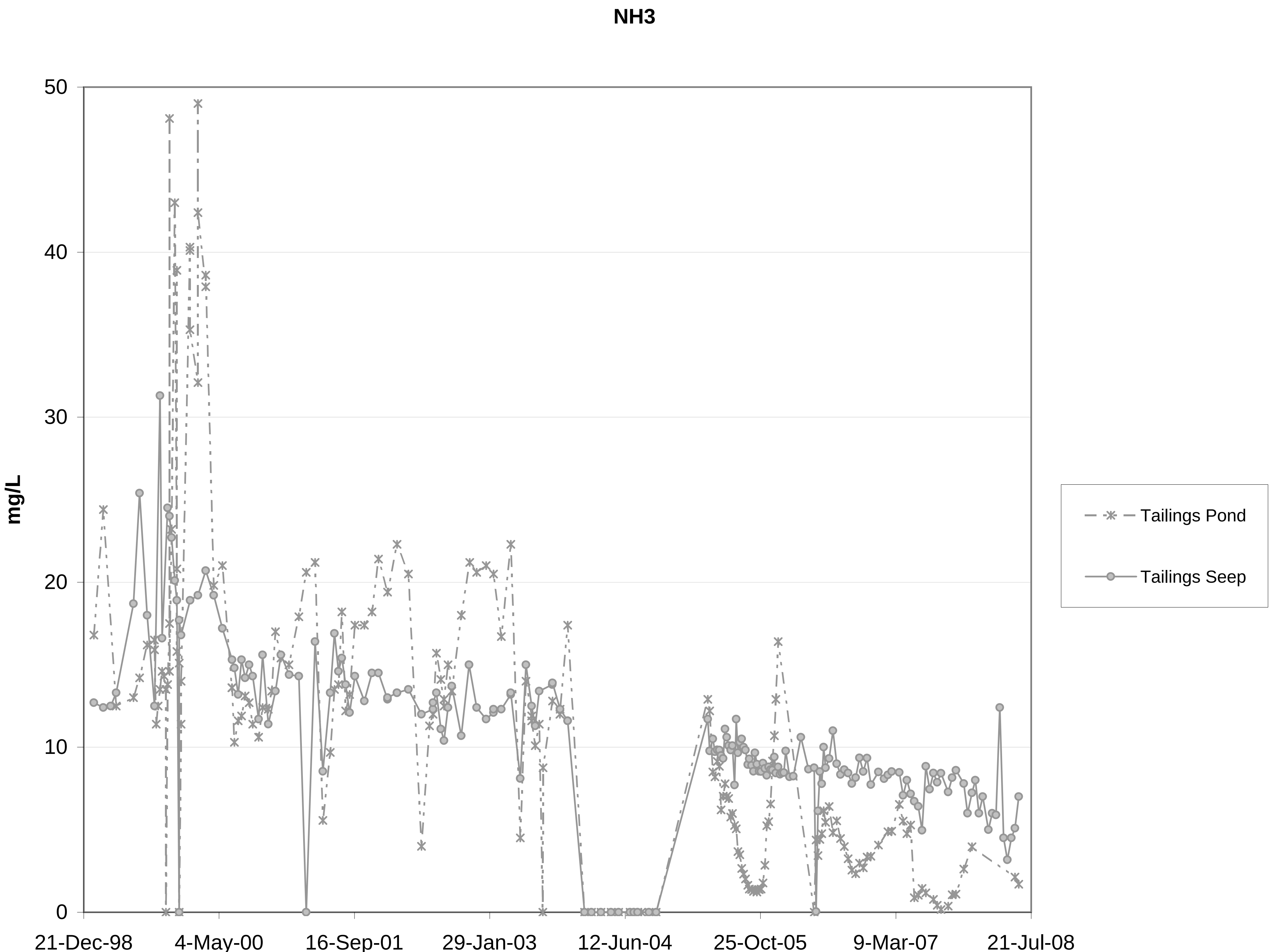
Zn(total)
mg/L
0.3
0.2
0.1
0
4-Nov-07
24-Dec-07
12-Feb-08
2-Apr-08
22-May-08
Upper Victoria
Victoria @ Road
Upper Dome
Dome @ Road
Tailings Pond
Tailings Seep
CCME (0.03mg/L)
BYG Water License (0.3mg/L)

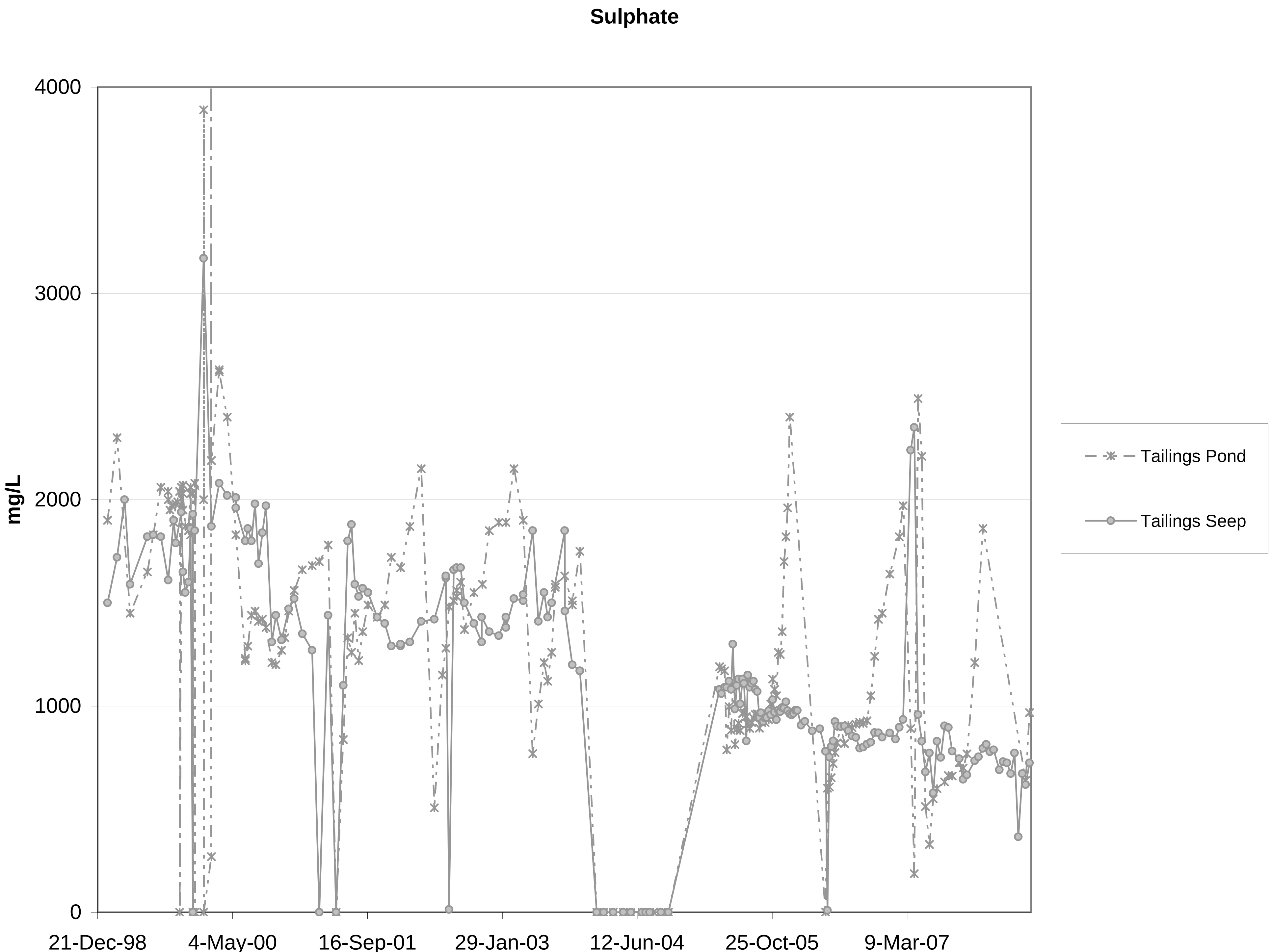

Total Zn, Brown-McDade Pit
Concentration (mg/L)
2.50
2.00
1.50
1.00
0.50
0.00
9-Dec-05
19-Mar-06
27-Jun-06
5-Oct-06
13-Jan-07
23-Apr-07
1-Aug-07
9-Nov-07
17-Feb-08
27-May-08
Total Zn - Top
Total Zn - Middle
Total Zn - Bottom
BYG Water License (0.3mg.L)



Dissolved Zn, Brown-McDade Pit
Concentration (mg/L)
2
1.6
1.2
0.8
0.4
0
19-Nov-05
27-Feb-06
7-Jun-06
15-Sep-06
24-Dec-06
3-Apr-07
12-Jul-07
20-Oct-07
28-Jan-08
7-May-08
Dissolved Zn - Top
Dissolved Zn - Middle
Dissolved Zn - Bottom


CN(total)
mg/L
0.3
0.25
0.2
0.15
0.1
0.05
0
8-Apr-05
25-Oct-05
13-May-06
29-Nov-06
17-Jun-07
3-Jan-08
Tailings Pond
Tailings Seep
BYG Water License (0.3mg/L)


NH3
mg/L
50
40
30
20
10
0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
21-Jul-08
Tailings Pond
Tailings Seep


Sulphate
mg/L
4000
3000
2000
1000
0
21-Dec-98
4-May-00
16-Sep-01
29-Jan-03
12-Jun-04
25-Oct-05
9-Mar-07
Tailings Pond
Tailings Seep

Appendix B: Report Listing

Report #	Report Name	For	Author	Date	Description
MN 056 - R01*	A Review of the Mt. Nansen Property	DIAND	Strathcona Mineral Services Ltd.	01-Dec-00	2000 Assessment of remaining economic potential of Mt. Nansen property. Includes information on environmental and reclamation issues.
MN 056 - R02*	Summary Data Report	DIAND	EBA Engineering Consultants Ltd.	01-Sep-02	Report and data from dam safety review for the tailings impoundment structure at Mt. Nansen completed in 2002, accompanies MN 056-R12.
MN 056 - R03	Geotechnical Data Review Report - Draft	DIAND	EBA Engineering Consultants Ltd.	01-Dec-99	Initial 1999 draft report on geotechnical data relating to dam safety. Information is updated in 2002 reports MN 056-R02 and MN 056-R12
MN 056 - R04*	Assessment of Chemical Stability of Impounded Tailings at Mt. Nansen	DIAND	CANMET Mining & Mineral Sciences Labs	01-Jun-02	Results of testing and analysis of tailings material from various sampling locations within the tailings impoundment. Summary of composition (texture and chemical constituents including remaining metals) of the tailings. Description of heterogeous distribution within the impoundment.
MN 056 - R05	Feasibility Study - Mill & Surface Facilities	Archer Cathro	Melis Engineering Ltd.	06-Jan-88	description of proposed milling circuit with estimated capital and monitoring costs for the Brown-McDade orebody
MN 056 - R06*	Version 1 - Historical Review, Site Assessment & Field Sampling Program-Final Report	DIAND	Conor Pacific	01-Jun-00	impacts, liability and site conditions prepared after abandonment in 2000 after DIAND assumed responsibility
MN 056 - R07*	Version 2 - Historical Review, Site Assessment & Field Sampling Program-Final Report	DIAND	Conor Pacific	01-Jun-00	same as MN 056-R06 above - possibly an edited version?
MN 056 - R08*	Dam Intrumentation Data & Assessment	EMR	EBA Engineering	01-Feb-04	report on data from piezometers and thermistors 2001-2003
MN 056 - R09*	Brown McDade Hydrological & Hydrogeological Investigation	EMR	Gartner Lee Ltd.	01-Jun-04	Initial study of hydrology and hydrogeology of the Brown-McDade pit, draft and final.
MN-056 - R09A*	Brown McDade Pit Hydrogeological & Geochemical Investigation - Draft	EMR	Gartner Lee	01-Mar-04	Draft of MN 056-R09 above
MN 056 - R10*	Risk Assessment, Conceptual Closure Plan & Cost Estimation	EMR	EBA Engineering	01-Mar-04	Study undertaken to consider the current condition and physical stability of the earthfill tailings dam, stability under extreme events, alternative scenarios for closure and cost estimation for each scenario
MN 056 - R11	Construction Report-Nansen Seepage Control Dyke & Spillway Upgrading	DIAND	EBA Engineering	01-Mar-03	Construction report for seepage control dyke and spillway upgrades undertaken in 2000-2001 which were identified as requiring urgent attention when the tailings impoundment was assessed. Contains structural drawings and info on instrument installations, photographs and daily construction reports in appendices.

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MN 056 - R12*	Dam Safety Assessment Tailings Facility	DIAND	EBA Engneering	01-May-02	Final dam safety assessment (see also MN 056-R02 and R03) with info on seizmic hazard, liquefaction potential, permafrost, seepage, phreatic surface, soil stability etc.
MN 056 - R13	Tailings Storage Study, Feasibility Design	BYG	Klohn-Crippen	26-Sep-94	1994 study assessing the potential locations for the tailings facility with preliminary design for the recommended option.
MN 056 - R14	Project Overview		BYG	01-Jun-94	Overview of planned BYG project, prepared and submitted prior to preparing IEE for EARP process.
MN 056 - R15	Environmental Update Report	Minerals	Environmental	01-Feb-89	baseline data
MN 056 - R16	Geological & Mineral Inventory for Nansen & Tawa AND Assessment of Economical Potential ofr Open Pit Mining of Oxidized Mineralization in the Brown-Mc	Archer, Cathro	BYG	01-Jan-89	title is self-explanatory
MN 056 - R17	Tailings Facility Preliminary Design Report	BYG	Klohn Leonoff Yukon	04-May-90	1990 report for BYG
MN 056 - R18	Tailings Dam Preliminary Design Report	Archo, Cathro	Klohn Leonoff Yukon	07-Dec-88	1988 report for Chevron
MN 056 - R19	IEE, Vol.1	BYG	T.W. Higgs Associates	01-Nov-94	Initial Environmental Evaluation Submitted under EARP process for regulatory review
MN 056 - R20	IEE, Vol.2	BYG	T.W.Higgs Associates	01-Nov-94	Initial Environmental Evaluation Submitted under EARP process for regulatory review - Volume 2 is Appendices
MN 056 - R21*	Review of Tailings Relocation Projects & Methodology	DIAND	Brodie Consulting	01-Dec-03	Review of methodologies, influential tailings properties and site conditions to be considered in relocation of tailings.
MN 056 - R22	Community Based Fish & Wildlife Management Plan	LSCFN	Carmacks Renewable Resources Council	01-Aug-04	Fish and Wildlife Management Plan for LSCFN traditional territory.
MN 056 - R23*	Arsenic in Plants Important to the Two Yukon First Nations: Impacts of gold Mining & Rec. Practises		Heather Nicholson	01-Dec-02	MSc thesis studying arsenic levels in traditionally consumed plants at different distances from Mt. Nanse, Arctic Gold and Silver, and Venus mine sites.
MN 056 - R25*	2005 Water Balance for Tailings Pond	EMR	Gartner Lee	10-Feb-06	title is self-explanatory
MN 056 - R26	1998 Effluent Quality Analysis Report	BYG	Vista Engineering	15-Jul-98	Effluent quality analysis produced to meet one of the requirements of a 1998 water licence ammendment, also contains a report with recommendation of measures to deal with excess water from diversion seepage.
MN 056 - R27*	Mineralogy of Tailings	EMR	J.L. Jambor	24-Nov-05	2005 characterization of six samples from the Mt. Nansen tailings impoundment

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MN 056 - R28	Laboratory Evaluation of the Inco Cyanide Removal Process	BYG	Process Research Assoicates	09-Sep-94	Report on lab testing of cyanide destruction process proposed for BYG Mt. Nansen project and ABA test on effluent residue
MN 056 - R29	Due Diligence Technical Audit	BYG	W.M. Calhoun, Inc.	23-Sep-95	Technical review of the BYG feasibilty study and financial projections - concludes that the project and supporting data are sound, but notes that a strong management team is important to the success of the operation.
MN-056 - R30*	Brown-McDade Pit Summer Monitoring - Data summary report	EMR	Gartner Lee	01-Mar-05	Pit volume data and water quality data for pit and Pony Creek, conclusions on water balance from 2004 summer field work.
MN-056 - R31*	Geological Exploration Summary	PWC	R.W. Stroshein	16-Feb-06	Summary of the geological potentail of claims and leases in the Dome Creek drainage area.
MN-056 - R32*	Bioremediation Assessment	EMR	Lorax	01-Feb-06	Assessment of data, defining of relevant geochemical mechanisms, discussion and recommendations with respect to bioremediation potential for the pit lake and tailings pond.
MN-056 - R33*	Instrumentation Data Review Tailings & Seepage Collection Dams	EMR	EBA	01-Jun-06	Data presentation, evaluation and recommendations from thermistors and piezometers installed at tailings and seepage dams. This report combines previously collected and reported data from 2003 and earlier with new data collected between May 2004 and November 2005.
MN-056 - R34*	Terrestrial Effects & Aquatic Studies - Volume 2	EMR	EDI	01-Jul-06	First year reports for 2 year Terrestrial and Aquatic Effects study. MN-056-R53, R-54 and R-55 are the final reports with data from both years.
MN-056 - R35*	Terrestrial Effects & Aquatic Studies - Volume 1	EMR	EDI	01-Jul-06	First year reports for 2 year Terrestrial and Aquatic Effects study. MN-056-R53, R-54 and R-55 are the final reports with data from both years.
MN-056 - R36*	Mine Site Reclamation Report	EMR	Arctic Alpine Reclamation Group	06-Oct-06	Seeding and revegetating pilot project at Huestis adit portal, and test plots on tailings, recommendations for seed mixes and rates, recommendations for future work.
MN-056 - R37*	Phase I - Tailings Pond Impound Area; Phase II - Mill Waste Rock Site Cover & Vegetation	EMR	Kearah Environmental Contracting	16-Oct-06	Proposal for 2 phase revegetation project, tailings pond and mill waste rock sites
MN-056 - R38*	Hazardous Materials Inventory & Site Assessment	EMR	Kearah & Weri	06-Oct-06	2006 inventory of chemical wastes at the mine site (most chemicals were removed in 2007).
MN-056 - R39*	Human Health Screening Level Risk Assessment	DIAND	SENES Consultants	01-Nov-03	Desktop exercise, general assessment of health risks at Mt Nansen site.

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MN-056 - R40	Updated Water License Application V2		BYG Natural Resources	01-Dec-95	BYG Dec 1, 1995 Water License application update - Volume 2 contains: Emergency response and spill plan; pit wall and floor ARD mitigation plan; pit seepage mitigation plan; thaw settlement performance and monitoring; liquefaction monitoring program; tailings ARD mitigation plan; tailings arsenic mitigation plan; effluent quality program; water balance; victoria creek archaeological; victoria creek culvert design; decommissioning plan schedule; security deposit
MN-056 - R41	Updated Water License Application V1		BYG Natural Resources	01-Dec-95	BYG Dec 1, 1995 Water License application update - Volume 1 contains: Construction quality assurance manual; design criteria report; operational monitoring plan; waste rock management and ARD plan
MN-056 - R42	Economic performance		Dolmage-Campbell & Assoc	11-Feb-69	1969 Consultants report on the estimated gross monthly revenue from the Mt. Nansen operation at that time with recommendations for improvements in the operation. This is not the same as the BYG operation 30 years later.
MN-056 - R43	Sulphide Mineralogy of the Brown McDade Zone		D. Lister	20-Dec-88	Brief area history, geology and geomorphology of region and property, geology and minerology of Brown-McDade zone.
MN-056 - R44	Update to Water License - Supporting Documents - Revisions		BYG Natural Resources	18-Dec-95	BYG Dec 18, 1995 Revisions to Water License Application Update
MN-056 - R45	Tailings Dam Cost Estimate		Klohn - Crippen	25-Oct-94	Title is self explanatory
MN-056 - R46	Tailings Facility Construction Report	BYG	Klohn - Crippen	12-Dec-96	Title is self explanatory
MN-056 - R47	Tailings Impoundment - Feasibility Design Update	BYG	Klohn - Crippen	04-Apr-95	Title is self explanatory
MN-056 - R48	Tailings Impoundment Final Design Report	BYG	Klohn - Crippen	10-Aug-95	Title is self explanatory
MN-056 - R49	Risk Assessment, Conceptual Closure Plan & Cost Estimate	EMR	EBA	04-Mar-07	Draft of MN 056-R10 above?
MN-056 - R50*	Pony Creek Adit Bulkhead	EMR	SRK	01-May-06	Site investigation and design for Pony Creek Adit bulkhead
MN-056 - R51*	Pony Creek Adit Bulkhead - Specifications	EMR	SRK	06-May-07	Specification for MN-056-R50 design above

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MN-056 - R52*	Instrumentation Data Review - Tailings & Seepage Collection Dams	EMR	EBA	06-Jun-07	Data presentation, evaluation and recommendations from thermistors and piezometers installed at tailings and seepage dams. This report combines previously collected and reported data from 2003 and earlier, and data collected between May 2004 and November 2005 with new data collected thoguh 2006.
MN-056 - R53*	Terrestrial & Aquatic Effects Study 2005-06 V1	EMR	EDI	07-Jan-07	Final report for 2 year terrestrial and aquatic effects study that looked at the extent of contamination resulting from the Mt. Nansen mine. Volume 1 is the report, Volumes 2 and 3 are appendices of collected data.
MN-056 - R54*	Terrestrial & Aquatic Effects Study 2005-06 V2	EMR	EDI	07-Jan-07	Final report for 2 year terrestrial and aquatic effects study that looked at the extent of contamination resulting from the Mt. Nansen mine. Volume 1 is the report, Volumes 2 and 3 are appendices of collected data.
MN-056 - R55*	Terrestrial & Aquatic Effects Study 2005-06 V3	EMR	EDI	07-Jan-07	Final report for 2 year terrestrial and aquatic effects study that looked at the extent of contamination resulting from the Mt. Nansen mine. Volume 1 is the report, Volumes 2 and 3 are appendices of collected data.
MN-056 - R56*	McDade Pit Desktop Hydrogeological Study	EMR	Gartner Lee	01-May-07	Conceptual groundwater/surface water flow model in the vacinity of the Brown-McDade pit with assessment of potential for environmental impacts to critical surface water receptors and assessment of the potential effects of partially backfilling the open pit with waste rock.
MN-056 - R57	Mill & Surface Facilities - Feasibility Study	Archer Cathro	Melis Engineering	06-Jan-88	1988 analysis of milling requirements for Brown-McDade ore and proposed mill circuit with drawings. Fairly close to actual mill facility with some differences.
MN-056 - R58	Report on 1989 Inspection	DIAND	GeoEngineering	01-Mar-90	1989 evaluation of proposed tailings sites. Concluded that neither site was entirely suitable. Both sites are in Dome Creek valley, upgradient of the eventual tailings dam. It appears the site of the actual tailings dam for the BYG operation was previously discounted and not considered further.
MN-056 - R59	IEE Addendum Report	BYG	T.W. Higgs Associates	01-Apr-95	April 1995 supplementary information in support of the IEE submitted in Nov 1994.
MN-056 - R60	Huestis & Webber Zones - Feasibility Study	BYG	Normand Lecuyer Enterprise Inc	01-Feb-97	1997 preliminary feasibility study of Huestis and Webber zones commissioned by BYG.

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MN-056 - R61*	Dam Safety Assessment of the Tailings Dam	DIAND	Klohn - Crippen	22-Oct-99	Report on initial phase of 1999 Dam Safety Assessment.
MN-056 - R62*	Dam Safety Assessment of the Tailings Dam	DIAND	Klohn - Crippen	14-Jan-00	Report on interim phase of 1999 Dam Safety Assessment.
MN-056 - R63	Review of Environmental & Reclamation Issues/Review of Resources & Economic Potential	DIAND	Strathcona Mineral Services	01-Mar-00	Draft of MN 056-R01.
MN-056 - R64*	Hydrogeological Site Characterization at Brown McDade Pit, Mt. Nansen	YG-AAM	Gartner Lee Ltd.	20-Mar-08	Results from installation of three groundwater monitoring wells, completion of water elevation survey, and collection of water quality samples.
MN-056 - R65*	Mt Nansen Site Specific Water Quality Investigation, and, Benthic Invertebrate Communities at the Mt. Nansen Mine Site	EMR	EDI	Apr-08	Report on ongoing water quality monitoring and recommendations with respect to establishing site specific water quality criteria, and, report on benthic communities in Dome and Victoria creeks.
MN-056 - R66*	Mount Nansen Tailings Porewater Assessment	EMR	Lorax Environmental	Apr-08	Report on investigation of 11 tailings porewater samples, analytical testing, composition, comparison to pond and seepage water quality, defining of dominant geochemical mechanisms, implications of in-pit tailings disposal and other potential tailings managment options.

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Appendix C: Final Closure Objectives

Mt. Nansen Closure Plan Objectives

Protect human health and safety.

Indian and Northern Affairs Canada

- Reduce and eliminate, where possible, risk to human health and safety.

Yukon Government

- Protect human health and safety

Community

- People using the area will be safe from remaining mine hazards.
- Animals, plants and berries around the mine site are safe to harvest and will stay that way.
- Water at mine site and downstream will be clean and safe for people to use.
- Mine metals in dust will not be able to build up more on plants and soils in years to come around the mine site.

Protect the environment including land, air, water, fish and wildlife.

Indian and Northern Affairs Canada

- Reduce and eliminate, where possible, risk to environmental health.

Department of Fisheries and Oceans

- Reduce the risk of current and future impacts from the Mt. Nansen mine on the aquatic resources and fish habitat to support healthy, productive fish populations in the Victoria/Nisling watershed.
- The valley of Dome Creek should be reclaimed to the extent practicable, to ensure physical stability and reduce the risk of transport of particulate matter to Victoria Creek.

Environment Canada

- Adverse impacts of surface and groundwater from the site are reduced to the extent possible.

Yukon Government

- Reduce and mitigate current and future negative environmental impacts.
- Protect ground water and surface water quality.
- Ensure the protection of and restore to the extent possible, useful aquatic and terrestrial habitat for native species. Reclamation conducive to natural regeneration where practical.

Community

- Animals using the area will be safe from remaining mine hazards.
- Water at the mine site, in the ground, and downstream will be as clean and safe as possible for the health of animals, plants and bugs.
- Mine metals in dust will not continue to build up on plants and soils around the mine site. This will help protect and improve the health of plants, animals and soils.
- Restore the land and water so that plants and animals can live there in the way they did before the mine.

Return Mine Site to an acceptable state of use that reflects original use where possible.

Indian and Northern Affairs Canada

- Return Mine Site to an acceptable state of use that reflects original use where practical.

Yukon Government

- Return land to an acceptable state of use that reflects original use where practical.
- Ensure the protection of and restore to the extent possible, aquatic and terrestrial habitat. Reclamation conducive to natural regeneration where practical.

Community

- Quality of water at the mine site and downstream will be clean and safe so it will not limit traditional use.
- The opportunity for traditional uses of the area will be restored and as close to before mining use as possible.

- Make the clean up so that, as the years go by, there will not have to be much work at the minesite to keep it clean and safe.

Maximize local, Yukon and First Nation benefits.

Indian and Northern Affairs Canada

- To maximize the social and economic benefits that may accrue to First Nations, and northerners when carrying out activities.

Yukon Government

- Provide economic opportunities for Little Salmon Carmacks First Nation members, Carmacks area residents and Yukoners in general.

Community

- Local people will be hired to help clean up at the mine.

Reduce Government Liability and Risk

Indian and Northern Affairs Canada

- Reduce federal liability for this site in the long term.
- Reduce long term site risk in a cost effective manner.

Yukon Government

- Reduce long term risk in a cost effective manner.

- Design of reclamation to minimize to the extent possible, long term treatment.

Closure Planning Core Values

- The community and the knowledge of local people will always be recognized and a part of decisions made about the Mt. Nansen mine site.
- Government to demonstrate leadership in the development of a closure plan and implementation of final closure/remediation of the Mt. Nansen Mine contaminated site.
- The safety of the plants, animals, fish and water will continue to be checked on and people will know how safe they are.
- People will be kept up to date about what it is like at the mine site.
- Use native seeds and plants. No introduction of invasive species.
- Use effective best practice remedial methods.
- Maximize value for dollar spent.
- Commitment to engage and involve affected communities, the Little Salmon Carmacks First Nation and other stakeholders in the process to evaluate closure alternatives.
- The LSCFN Final Agreement will be followed.

Related Community Concerns

- There will be an interpretive site located at the mine to explain how it was developed, how it was reclaimed in cooperation with the community.
- People will understand how contaminants move in the food chain and affect our health.
- Trenching around the minesite will be made safe.
- People who worked at the mine and assay lab will know if they were contaminated by the mine. History of health problems of those who worked at the mine will be investigated.
- There will be a full account of the mine operation based on interviews with former employees focusing on health and safety.
- The camp should be used until reclamation is complete.
- This area will not be mined again.