Gartner Lee Limited

June 25, 2004

Yukon Territory Water Board
Suite 106 - 419 Range Road
Whitehorse, Yukon
Y1A 3V1

Dear Board:

Re: Water Licence QZ03-059, Adaptive Management Plan

We are pleased to submit five bound copies and one unbound original of the report Anvil Range Mine Adaptive Management Plan Implementation Protocol, as required under Water Licence QZ03-059. Gartner Lee Limited has prepared this report on behalf of Deloitte & Touche Inc., in their capacity as Interim Receiver for Anvil Range Mining Corp. This report has been reviewed with various governmental agencies and stakeholder groups and their comment incorporated. The report is also enclosed in electronic format.

I trust that this information is self-explanatory. However, if you have any questions please do not hesitate to contact us.

Yours very truly,
GARTNER LEE LIMITED

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Senior Environmental Engineer

LSG:lg

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Anvil Range Mine Adaptive Management Plan Implementation Protocol

prepared for:

Deloitte & Touche Inc.
(in their capacity as interim receiver of Anvil Range Mining Corporation)

prepared by:

Gartner Lee Limited

reference:	**Date:**
GLL 40302	**June 2004**

distribution:

5 **Deloitte & Touche Inc. (plus electronic)**
6 **Yukon Water Board (plus electronic)**
4 **Gartner Lee Limited**

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A. Statistical Analysis

1. Introduction

The Anvil Range Mine, inclusive of both the Faro and Vangorda Plateau mine sites, is located near the Town of Faro, Yukon (Figure 1). The mine produced lead and zinc mineral concentrates from 1969 to 1998 and was, at one time, the largest open pit, lead-zinc mines in the world. All mining and processing operations ceased permanently in early 1998 when the mine owner, Anvil Range Mining Corporation, entered into receivership. The mine has been under the management of a court appointed interim receiver, Deloitte & Touche Inc., since April 1998.

The current Water Licence for the Anvil Range Mine (QZ03-059) provides primarily for the continuation of environmental care and maintenance activities to the end of 2008, when a Final Closure and Reclamation Plan is scheduled to be in place. The licenced care and maintenance activities address specifically water and facilities that require active management to ensure that adequate environmental protection is provided in the short term (i.e., to 2008).

In addition to water and facilities that will receive active management, there are other waters and facilities on the mine site that are recognized as representing potential environmental risks but which do not require immediate intervention. Long term management of these waters and facilities will be addressed in the Final Closure and Reclamation Plan. However, a short term management strategy is required to monitor for potential degradation of conditions to the point where active intervention might be necessary prior to the end of 2008 and to provide a framework for ensuring that appropriate management actions are implemented.

Such a strategy is provided for in the Water Licence through the Adaptive Management Plan (“AMP”). A conceptual AMP was developed and reviewed by parties to the Environmental Assessment and Water Licencing processes. This document provides the detailed AMP Implementation Protocol that follows from the conceptual plan as required under Part F, Item 54 of the Water Licence (Yukon Water Board (YWB), 2004):

> *An Adaptive Management Plan for the facilities authorized by this licence shall be prepared and submitted to the Board by June 30, 2004. The plan shall identify the indicators and triggers for action, the measures of statistically significant changes to be tracked, the monitoring locations and parameters, the sampling frequencies, the methods to be used to analyze and evaluate the data, and the actions to be taken.*
> *(QZ03-059, Part F, Item 54)*

2. Approach to the AMP Implementation Protocol

2.1 Objectives for the AMP

The AMP is a management tool that provides a consistent and predictable framework for responding to unforeseen environmental conditions that might result from the natural degradation of certain mine facilities and waters. This should provide the site manager with a pre-planned framework within which decisions can be quickly and efficiently made and should provide regulators with the security of a consistent and predictable approach to unforeseen conditions.

The AMP should be representative of the Precautionary Approach in that it intends to identify potential environmental risks as they emerge and to provide for a management response before an environmental impact occurs.

To be effective, the AMP must be linked to a monitoring program that is designed to provide an indication of when management intervention is necessary. In this way, confidence is provided that the information necessary for the assessment of environmental conditions is gathered and evaluated against predetermined “triggers” or “thresholds”.

Since the specific environmental conditions that may be encountered are, by definition, unknown, the AMP should not provide detailed descriptions of specific management responses. The AMP, rather, should provide general descriptions of a range of possible responses that may be adapted or otherwise used to guide the design of an appropriate response that best suits the needs of the specific environmental conditions that are encountered. This approach is inherent to the fundamental purpose of the AMP which is different, for example, from the purpose and nature of a spill response plan, which intends to provide detailed descriptions of specific actions to be taken in the event of a spill of a hazardous material or another event that may have immediate environmental impacts.

2.2 AMP Events

Eight AMP “events” were developed through the Environmental Assessment and Water Licence Renewal processes. These events represent possible future environmental conditions that would require a management response, if they were to occur.

The eight events are as follows:

1. Degraded Groundwater Quality in Rose Creek Valley Aquifer;
2. Degraded Water Quality in Vangorda Creek Downstream of the Mine Facilities;
3. Degraded Water Quality in Rose Creek Downstream of the Mine Facilities;

4. Degraded Seepage Quality from the Grum Rock Dump;
5. Degraded Water Quality in the North Fork of Rose Creek;
6. Water level in Grum Pit Reaches Maximum Desired Elevation;
7. Disruption of Fannin Sheep Migration Through the Mine Site; and
8. Wind Dispersed Tailings Result in Adverse Effects in the Terrestrial Environment.

The AMPs for each of these events are described individually in subsequent sections.

2.3 Common Elements

Each of the AMP events is described according to common elements. This ensures that a consistent approach is followed for each event that achieves the general objectives of the AMP Implementation Protocol. The common elements are as follows:

1. Description of the event and possible environmental consequences;
   As developed through the Environmental Assessment and Licence Renewal Processes
   The possible environmental consequences will lead to the narrative trigger and specific thresholds
2. Discussion of event-specific information or issues;
   Any unique issues or information that have a direct influence for applying the AMP
3. Narrative response trigger;
   As developed through the Environmental Assessment and Licence Renewal Processes
   The narrative trigger will lead to the specific indicators
4. Specific indicators;
   The environmental parameters to be monitored and assessed
5. Specific Thresholds;
   Defines the conditions, in terms of the specific indicators, when management actions should be taken
   There may be a series of staged thresholds for an individual event
6. Monitoring requirements;
   The frequency and means for monitoring of the specific indicators
7. Evaluation of monitoring results; and
   The means of evaluating whether any specific thresholds have been crossed
8. Approach to responses;
   As developed through the Environmental Assessment and Licence Renewal Processes
   Describes the approach to responses to be implemented if any specific thresholds have been crossed

A sequence of activities flowchart that illustrates how the AMP should be applied to individual events is provided in Figure 2.

2.4 Annual Review and Reporting

An annual review will be completed that assesses the adequacy and appropriateness of the elements of each event, such as trigger locations, specific indicators and thresholds and monitoring requirements. Updates, amendments or other changes to the AMP will be recommended to the Board based on this annual review

Each AMP Event includes a management review of the relevant data. The results of these reviews will be reported, where a trigger occurs, as part of the Monthly Reports submitted to the Board under Part A, Item 15 of the Water Licence. The results of these reviews will also be summarized in the Annual Environmental Report. Further, some of the AMP Elements include specific requirements for annual reviews.

These reviews will be completed by February 28 of each year such that the results can be included into the Annual Environmental Report that is required to be filed by February 28 of each year under Part A, Items 13 and 14 of the Water Licence.

3. AMP Event 1, Degraded Groundwater Quality in Rose Creek Valley Aquifer

3.1 Description

Groundwater in the Rose Creek Valley aquifer collects seepage and contaminants released from the surface tailings impoundments and has the potential to become contaminated to the degree where discharge from the aquifer to Rose Creek may result in a sustained adverse effect in Rose Creek. The groundwater quality in the Rose Creek Valley aquifer is presently measured twice per year, in spring and fall, at various locations within the tailings facility and downstream of the tailings facility. Samples are analyzed for dissolved metals, pH, temperature, conductivity, total dissolved solids, sulphate, and alkalinity as per the Water Licence (YWB 2004). Additional groundwater quality data is also provided for through a series of monitoring wells which were installed in 2003 as part the ongoing hydrogeological and geochemical investigations of the Rose Creek Tailings Facility and the Rose Creek Valley Aquifer.

Since degradation of groundwater quality is anticipated to occur progressively from the source area (tailings deposit) in a downgradient direction (Cross Valley Dam and downstream), the trigger locations for the implementation of the AMP are designed to provide for the early detection of emerging trends or "plumes". The trigger locations include locations downgradient of the tailings deposit as well as location directly underlying the tailings deposit as follows (Figure 3):

- Groundwater quality downgradient of the Cross Valley Dam (location P03-09);
- Groundwater quality at the Intermediate Dam, below the downstream extent of the tailings deposit (locations X24 and X25);
- Groundwater quality (i.e. the aquifer underlying the tailings deposit) approximately mid-length of the Intermediate Impoundment (location P03-08); and
- Groundwater quality at the Second Impoundment Dam, approximately mid-length of the tailings facility (location P03-04).

The environmental consequences of degraded water quality in the Rose Creek Valley aquifer are the potential exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Rose Creek, Anvil Creek and the Pelly River. Zinc is currently the primary contaminant of concern and zinc, iron and sulphate are currently the primary indicators of acid rock drainage.

A substantial amount of work has been carried out to characterize the environmental conditions in the Rose Creek Valley aquifer. This work serves to provide information that is important to the Adaptive Management Plan as well as the long term needs of the Final Closure and Reclamation Plan that is currently being developed. The results of the ongoing studies of the Rose Creek Valley aquifer need to be continually incorporated into the AMP.

3.2 Specific Information or Issues

An analysis of the 1998 to 2002 reference period data for the Rose Creek Valley aquifer at the Intermediate Dam at Stations X24 and X25 was carried out in preparation of the AMP protocol. A summary of this analysis is presented in Table 1 and Table 2. Water quality results below detection limit are assumed to be at detection limit for the purposed of statistical and graphical analysis. Details of the statistical analysis can be found in Appendix A. During the review of the reference period data from X24 at both the 6.5 m depth and the 28.3 m depth, extreme high values of dissolved zinc, two orders of magnitude higher than median, were identified for samples collected in June 2000: 2.5 and 2.84 mg/l respectively. Preliminary analysis of this data indicated that inclusion of these values strongly influences the statistical analysis of the data set, drawing the least squares regression line up towards them. As a result, these two outliers were not included in the data set for the statistical analysis of the reference period data. This provides for more conservative (protective) determination of the AMP thresholds for zinc. Additional monitoring information that is critical to the AMP is the groundwater quality data from key multi-level wells installed in 2003: P03-09, P03-08 and P03-04. A summary of the relevant 2003 water quality data from these wells is provided in Table 3.

Table 1. Summary of Reference Period Groundwater Quality Data for Rose Creek Aquifer at Location X24

X24A (Sample Depth – 6.5m)	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
Minimum	0.02	0.005	39
25 Percentile	0.03	0.01	457.25
Median	0.08	0.01	579
75 Percentile	0.188	0.01	729
Maximum	0.97	0.26	750
Number of Samples	10	9	10
Number of Non-detects	3	6	0
Significant Trend (Increasing or Decreasing)	No	No	No
X24C (Sample Depth – 16.5m)	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
Minimum	0.01	0.009	1
25 Percentile	0.05	0.01	764
Median	0.1	0.02	778
75 Percentile	0.24	0.03	980
Maximum	0.43	0.41	1140
Number of Samples	9	9	9
Number of Non-detects	1	5	1
Significant Trend (Increasing or Decreasing)	Decreasing	No	No
X24D (Sample Depth – 28.3m)	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
Minimum	0.01	0.01	447
25 Percentile	0.03	0.028	940.75
Median	0.065	0.03	1023
75 Percentile	0.273	0.03	1057
Maximum	0.44	0.17	1150
Number of Samples	10	9	10
Number of Non-detects	4	1	0
Significant Trend (Increasing or Decreasing)	Decreasing	No	No

Table 2. Summary of Reference Period Groundwater Quality Data for Rose Creek Aquifer at Location X25

X25A (Sample Depth – 9.0m)	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
Minimum	0.01	0.01	206
25 Percentile	0.0125	0.01	278.25
Median	0.1	0.01	289.5
75 Percentile	0.1675	0.055	293.5
Maximum	0.24	0.57	312
Number of Samples	10	10	10
Number of Non-detects	3	5	0
Significant Trend (Increasing or Decreasing)	No	No	No
X24B (Sample Depth – 19.2m)	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
Minimum	0.01	0.005	117
25 Percentile	0.08	0.01	337.5
Median	0.21	0.01	348
75 Percentile	0.49	0.02	394.5
Maximum	0.55	0.47	445
Number of Samples	11	11	11
Number of Non-detects	3	7	0
Significant Trend (Increasing or Decreasing)	No	No	No

Table 3. Summary of 2003 Groundwater Quality Data for Rose Creek Aquifer Multi-level Wells

P03-04	**Depth (m)**	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
P03-04-02	155	0.17	0.02	16
P03-04-03	135	2.87	0.029	599
P03-04-04	114	0.14	0.012	14
P03-04-05	84.5	0.15	0.016	16
P03-04-06	56	1510	2.12	4340
P03-08	**Depth (m)**	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
P03-08-01	106	<0.03	<0.005	33
P03-08-02	92	<0.03	0.005	154
P03-08-04	75	0.06	0.011	104
P03-08-05	70	0.31	0.165	147
P03-09	**Depth (m)**	**Dissolved Iron (mg/l)**	**Dissolved Zinc (mg/l)**	**Sulphate (mg/l)**
P03-09-01	114	6.57	<0.005	390
P03-09-02	105	6.83	<0.005	363
P03-09-03	88	0.04	<0.005	356
P03-09-04	77	<0.03	<0.005	365
P03-09-05	71	<0.03	<0.005	365
P03-09-06	61	<0.03	<0.005	394
P03-09-07	43	<0.03	<0.005	423
P03-09-08	30	0.07	<0.005	363
P03-09-09	24	0.19	<0.005	443

3.3 Narrative Trigger

The trigger for the implementation of the AMP is "contaminant concentrations in Rose Creek Valley Aquifer display a sustained and statistically significant increase over the 1998 to 2002 reference period".

3.4 Specific Indicators

The specific indicators that should be monitored in the Rose Creek Valley aquifer to provide the information necessary to assess whether the trigger has be achieved are:

- Dissolved Zinc (mg/l);
- Dissolved Iron (mg/l); and
- Sulphate (mg/l).

3.5 Specific Thresholds

The specific thresholds or triggers that will initiate an action plan, for any one of the specific indicators, will be as follows:

- Three consecutive monitoring results at X24 or X25 greater than the upper 75th percentile of the reference period (1998 – 2002); or
- A significant trend in the groundwater monitoring results from X24 and X25 defined as a statistically significant (0.05) increasing trend which, when extrapolated forward three years, would result in values greater than the 75th percentile. For this test, the least squares method of linear regression is used to fit a trend line to the data. This can be done using the LINEST function in Excel. The F-statistic for this regression is calculated from the ratio of the variances. The F-statistic is used to test the null hypothesis that the data is a random scatter of points with a zero slope. The calculated F-statistic is compared to critical values of F statistic found in standard statistics texts. If the F-statistic is greater than the critical value, the null hypothesis fails and the linear model is significant. Using a significance level of 0.05, if the calculated statistic is greater than the critical value, we can be 95% confident that the data is not a random scatter and the linear regression model is justified. For purposes of the AMP trend line prediction, data from 2003 and on should be used for the regression analysis. A minimum of 4 post-reference period results is required for the trend analysis. The recommended increase in monitoring frequency at the trigger locations, from twice per year to quarterly (as described in Section 3.6 following), will enable the application of the trend analysis at the end of the 2004 season.
- A statistically significant trend in the groundwater monitoring results from P03-09, P03-08 and P03-04. This trend analysis will be carried out using the same methodology described above. A minimum of 4 results is required for the trend analysis. The recommended increase in monitoring frequency at the trigger locations, from twice per year to quarterly (as described in Section 3.6 following), will enable the application trend analysis at the end of the 2004 season. Note that the assessment of 3 consecutive samples against statistics generated from the reference period can not be applied to the "03" monitoring wells (installed in 2003) since there is no reference period data for these wells.

3.6 Monitoring Requirements

The monitoring information required is quarterly determination of dissolved zinc, dissolved iron and sulphate concentrations at locations X24, X25, P03-09, P03-08 and P03-04 (all depths). The groundwater (versus tailings) results from these wells will be used for direct comparison to the specific thresholds and to enable an updated projected trend.

Additional monitoring information that is required for analysis should the AMP triggers be activated include water quality and water level data from other monitoring well locations associated with the Rose Creek Tailings Facility, as monitored under the Water Licence and the ongoing aquifer investigations.

Surface water quality stations associated with the tailings facility including surface seepage from the Rose Creek Tailings Facility, effluent flow from the Cross Valley Dam spillway, and surface flow and seepage from other mine facilities will also be relevant if the trigger is activated. The collection of this information is provided through the monitoring requirements of the Water Licence, except the frequency of monitoring of the trigger location monitoring wells is recommended to be increased from twice per year to four times per year. These will be distributed evenly as possible throughout the year given seasonal sampling limitations such as site access in spring and freezing of some of the wells in winter. The monitoring locations are outlined in Table 4 along with sample frequency. Where required to fulfill the AMP, additional monitoring requirements in excess of the Water Licence requirements have been added (highlighted in *italics* in Table 4).

Table 4. Summary of Water Quality Stations for Rose Creek Valley AMP

Sample Id.	Location	Frequency
Surface Samples		
X4	Intermediate Pond at Spillway	M
X5	Cross Valley Pond at surface outflow	M/WD
X5P	Cross Valley Pond at Spillway	M
X11	Cross Valley Dam North Seep	WS
X12	Cross Valley Dam South Seep	WS
X13	Cross Valley Dam Total Seepage	M
Groundwater Samples		
X16	Downstream of Tailings Facility	SF
X17	Downstream of Tailings Facility	SF
X18	Downstream of Tailings Facility	SF
X21	Secondary Impoundment Dam	SF
X24 and X25	Intermediate Dam	*4*
P01-01 to 11	Rose Creek Tailings Facility	SF
P03-01 to 03, P03-05 to 07	*Rose Creek Tailings Facility Multi-levels*	*SF*
P03-04, P03-08, P03- 09	*Rose Creek Tailings Facility Multi-levels*	*4*
Annual Seep Samples (plus other relevant observed freshet seeps)		

M = monthly, SF = spring and fall, A = annually, WD = weekly during discharge, WS – winter and summer, 4 = 4 times per year

3.7 Evaluation of monitoring results

The management review of the relevant groundwater quality data (X24, X25, P03-04, P03-08, and P0-09) will be made four times per year. This will be carried out when the water quality data is received from the laboratory. The laboratory turn around time for the standard analysis is approximately 2 weeks.

3.8 Approach to Responses

As per the general approach to the AMP, a staged response to degraded water quality in the Rose Creek Valley aquifer will be implemented if one of the triggers is activated. Four major steps are identified and summarized below. Although presented in a sequential order, some steps may occur concurrently or may be eliminated, depending on the individual circumstances of the trigger activation. In all cases, the approach to responses will be such that it expedites the process of responding to the trigger activation.

The initial response to the trigger will be the verification of the monitoring information. This will involve a comprehensive analysis of the laboratory results. The water quality at the trigger locations may then require re-sampling if warranted (i.e. QA/QC data or field notes indicates sampling issues/errors). This re-sampling could be done within approximately 2 weeks of the previous sampling time with the results available approximately 4 weeks from initial trigger activation. Upon verification of the monitoring data that a threshold has been crossed and that the mine site is the likely cause, the YG Water Inspector will be notified in writing of the circumstances.

Following this analysis, the next step will be to increase monitoring intensity to verify the initial indication, which activated the trigger. This may required additional groundwater sampling (locations and frequency). These modifications to the monitoring program will be done in consultation with technical experts and regulatory agencies.

Upon confirmation of the level of groundwater contamination, a comprehensive analysis of the other related monitoring results from the locations outlined in Table 4 and the ongoing aquifer studies will be carried out. The goal of this analysis is to provide for a preliminary identification of the dominant source of the increased concentrations and trigger activation. Groundwater modeling will then be used to provide an indication of the contaminant transport pathways and the rate and development of contaminant loading to the receiving environment. This information will be used to assess the potential impacts on the receiving environment. Modeling will also be used to assess the effectiveness and impact of various mitigative options.

A response plan will subsequently be designed with the intent of mitigating the predicted adverse effects. This will be done in consultation with technical experts and regulatory agencies. This plan might include:

1. Mitigation of the source area(s);
2. Installation of groundwater pumping wells to intercept the portion of aquifer flow that would prevent adverse effects in Rose Creek; or
3. A strategy for treatment, on surface, of intercepted groundwater.

In any event, notifications and designs will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 and 37). Specifically this would include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);
- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities that are not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

4. AMP Event 2, Degraded Water Quality in Vangorda Creek Downstream of Mine Facilities

4.1 Description

The water quality in Vangorda Creek downstream of the Vangorda Plateau mine facilities could be negatively affected by surface water runoff from the mine facilities and groundwater seepage. The water quality in Vangorda Creek downstream of the mine facilities is measured monthly at Station V8 at the foot bridge in the Town of Faro (Figure 4) for total metals, dissolved metals, pH, temperature, conductivity, total suspended solids, sulphate, ammonia and hardness (YWB 2004). Water quality in Vangorda Creek is also monitored monthly farther upstream in the main stem of Vangorda Creek at Station VGMAIN.

The environmental consequences of degraded water quality in Vangorda Creek is the potential exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Vangorda Creek and, possibly, the Pelly River. Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants which could source from the rock dumps, open pits and other mine facilities.

4.2 Specific Information or Issues

An analysis of the 1998 to 2002 reference period data for Vangorda Creek at V8 was carried out in preparation of the AMP protocol. A summary of this analysis is presented in Table 5. Water quality results below detection limit are assumed to be at detection limit for the purposes of statistical and graphical analysis. Details of the statistical analysis can be found in Appendix A.

Table 5. Summary of Reference Period Water Quality Data for Vangorda Creek at Location V8

	Total Copper (mg/l)	Total Suspended Solids (mg/l)	Sulphate (mg/l)	Total Zinc (mg/l)
Minimum	0.002	1	12	0.0054
25 Percentile	0.008	2	55	0.02
Median	0.015	5	98	0.03
75 Percentile	0.023	8	136	0.042
Maximum	0.046	184	703	0.26
Number of Samples	65	65	65	49
Number of Non-detects	6	6	0	4
Significant Trend (Increasing or Decreasing)	Decreasing	No	No	No

4.3 Narrative Trigger

The trigger for the implementation of the AMP is "contaminant concentrations in Vangorda Creek downstream of the mine facilities display a sustained and statistically significant increase over the 1998 to 2002 reference period".

4.4 Specific Indicators

The specific indicators that should be monitored at V8 to provide the information necessary to assess whether the trigger has been achieved are:

- Total Zinc (mg/l);
- Total Copper (mg/l);
- Total Suspended Solids (mg/l); and
- Sulphate (mg/l).

4.5 Specific Thresholds

The specific thresholds or triggers that will initiate an action plan, for any one of the specific indicators, will be as follows:

- Three consecutive monitoring results at V8 greater than the upper 75th percentile of the reference period (1998 – 2002); or

- A significant trend in the monitoring results from V8 defined as a statistically significant (0.05) increasing trend which, when extrapolated forward three years, would result in values greater than the 75^{th} percentile. For this test, the least squares method of linear regression is used to fit a trend line to the data. This can be done using the LINEST function in Excel. The F-statistic for this regression is calculated from the ratio of the variances. The F-statistic is used to test the null hypothesis that the data is a random scatter of points with a zero slope. The calculated F-statistic is compared to critical values of F statistic found in standard statistics texts. If the F-statistic is greater than the critical value, the null hypothesis fails and the linear model is significant. Using a significance level of 0.05, if the calculated statistic is greater than the critical value, we can be 95% confident that the data is not a random scatter and the linear regression model is justified. For purposes of the AMP trend line prediction, data from 2003 and on should be used for the regression analysis.

4.6 Monitoring Requirements

The monitoring information required is monthly total zinc, total copper, total suspended solids and sulphate concentrations measured at V8. This data will be used for direct comparison to the specific thresholds and to enable an updated projected trend.

Additional monitoring information that is required for analysis should the AMP triggers be activated include surface and subsurface water quality and flow data from locations upstream of V8. Both water quality and flow data is essential as they enable not only the analysis of contaminant concentrations but loadings as well. The locations required are surface water quality stations located upstream in Vangorda Creek drainage, effluent flow from the site, and surface flow and seepage from other mine facilities. Groundwater quality at the Vangorda Plateau area, as monitored under the Water Licence, will also be important information should the Vangorda Creek AMP be activated. The collection of this information is provided for through the monitoring requirements of the Water Licence. The monitoring locations are outlined in Table 6 along with sample frequency.

Table 6. Summary of Water Quality Stations for Vangorda Creek AMP

Sample Id.	Location	Frequency
Surface Samples		
V1	Main Stem Vangorda u.s. Pit	Q
V2	Grum Creek to Vangorda Creek	M
V4	Shrimp Creek	SSF
V5	West Fork at gravel pit	M
V8	Lower Vangorda Creek at the footbridge	M
V19	Vangorda Pit NW ditch	SF
V20	Vangorda Pit NE ditch	SF
V25BSP	Grum Ditch below Sheep Ponds	M/WD
V27	Vangorda Creek u.s. Shrimp Creek	SSF
V29 – V33	Vangorda Dump Drains	SF
Groundwater Samples		
V37 – V40	Vangorda Rock Dump Wells	SF
P01-01 to 03	Vangorda Rock Dump	SF
P96-9	Grum Rock Dump	SF
Annual Seep Samples – any relevant observed freshet seeps		

M = monthly, SF = spring and fall, A = annually, WD = weekly during discharge, SSF – spring, summer and fall

4.7 Evaluation of monitoring results

The management review of the relevant water quality data (V8) will be made on a monthly basis. This will be carried out when the water quality data is received from the laboratory. The laboratory turn around time for the standard analysis is approximately 2 weeks.

4.8 Approach to Responses

As per the general approach to the AMP, a staged response to degraded water quality in Vangorda Creek downstream of the mine facilities will be implemented if one of the triggers is activated. Four major steps are identified and summarized below. Although presented in a sequential order, some steps may occur concurrently or may be eliminated, depending on the individual circumstances of the trigger activation. In all cases, the approach to responses will be such that it expedites the process of responding to the trigger activation.

The initial response to the trigger will be the verification of the monitoring information. This will involve a comprehensive analysis of the laboratory results. The water quality at V8 may then require re-sampling if warranted (i.e. QA/QC data or field notes indicates sampling issues/errors). This re-sampling could be done within approximately 2 weeks of the previous sampling time with the results available approximately 4 weeks from initial trigger activation. Upon verification of the monitoring data that a threshold has been crossed and that the mine site is the likely cause, the YG Water Inspector will be notified in writing of the circumstances.

At this time a comprehensive analysis of the other related monitoring results from the locations outlined in Table 6 will be carried out. The goal of this analysis is to provide for a preliminary identification of the cause of the trigger activation. For example, review of the other data may provide an indication if the source of the increased concentration is from groundwater or upstream surface water inputs. A well, an analysis of the impacts of the trigger activation on the receiving environment will be conducted. The results of this analysis will be used as a basis for the development of an appropriate response plan to mitigate any identified or predicted impacts and to highlight any required modifications to the monitoring program.

Following this analysis, the next step will be to increase monitoring intensity to verify the source that resulted in the activation of the trigger. Depending on the preliminary source identification, this may require additional groundwater, seepage or surface water sampling. This may also require increasing the frequency and number of samples collected. These modifications to the monitoring program will be done in consultation with technical experts and regulatory agencies.

A response plan will subsequently be designed based on the trigger analysis described above. This plan, where appropriate, may include both short term and long term mitigation.

If the source of contamination is identified to be runoff or seepage from all or a portion of the mine facilities, then a short term mitigation measure may be implemented to control migration of contaminants at the source while a longer term mitigation plan is implemented. This might include pumping, berming, ditching or whatever other means are possible to the degree where water quality is not further degraded in the short term. A longer term mitigation system would then be designed. It would be designed in such a way to provide security until the implementation of the Final Closure and Reclamation Plan.

If the source of the contamination is identified to be groundwater flow that is too deep for interception by surface ditching, then a groundwater interception plan, or another long term remedial measure may be designed.

In any event, notifications and designs will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 and 37). Specifically this would include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);

- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

5. AMP Event 3, Degraded Water Quality in Rose Creek Downstream of Mine Facilities

5.1 Description

Water quality in Rose Creek downstream of the mine facilities could be negatively affected by surface runoff from the mine facilities and groundwater seepage from the Rose Creek Tailings Facility. The water quality in Rose Creek immediately downstream of the Mine Facilities is presently measured monthly at Station X14 (Figure 3) for total metals, dissolved metals, pH, temperature, conductivity, total suspended solids, sulphate, ammonia and hardness (YWB 2004). It is proposed to measure the water quality at X14 weekly during periods of effluent discharge to the creek. Water quality in Rose Creek is also monitored twice per year, winter and summer, in the receiving environment farther downstream at R3, mid length of Rose Creek, and at R4, upstream of the confluence with Anvil Creek.

The environmental consequences of degraded water quality in Rose Creek is the potential exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Rose Creek, Anvil Creek and the Pelly River. Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants which could source from the rock dumps, open pits, tailings and other mine facilities.

5.2 Specific Information or Issues

An analysis of the 1999 to 2003 baseline data for Rose Creek at X14, R3 and R4 was carried out in preparation of the AMP protocol. Per the Water Licence, water quality of 1998 is not being used for the purposes of the AMP for Rose Creek below the tailings containment area because 1998 is not considered to be a useful reference year given the atypical water conditions that were present on the mine site at the time of the transfer of management responsibilities to the interim receiver. A summary of this analysis is presented in Table 7. Water quality results that are below detection limit are assumed to be at detection limit for the purposed of statistical and graphical analysis. Presently there is insufficient data from R3 and R4 to utilize the water quality data at these sites as trigger locations. Details of the statistical analysis can be found in Appendix A.

Table 7. Summary of Reference Water Quality Data in Rose Creek at Location X14

	Total Copper (mg/l)	Sulphate (mg/l)	Total Zinc (mg/l)
Minimum	0.002	9	0.01
25 Percentile	0.005	63	0.031
Median	0.014	104	0.05
75 Percentile	0.022	166	0.08
Maximum	0.035	326	0.64
Number of Samples	49	49	49
Number of Non-detects	8	0	0
Significant Trend (Increasing or Decreasing)	Decreasing	No	No

5.3 Narrative Trigger

The trigger for the implementation of the AMP is "contaminant concentrations in Rose Creek downstream of the mine facilities display a sustained and statistically significant increase over the 1999 to 2002 reference period".

5.4 Specific Indicators

The specific indicators that should be monitored at X14 to provide the information necessary to assess whether the trigger has been achieved are:

- Total Zinc (mg/l);
- Total Copper (mg/l); and
- Sulphate (mg/l).

5.5 Specific Thresholds

The specific thresholds or triggers that will initiate an action plan, for any one of the specific indicators, will be as follows:

- Three consecutive monitoring results at X14 greater than the upper 75th percentile of the reference period (1999 – 2002); or
- A significant trend in the monitoring results from X14 defined as a statistically significant (0.05) increasing trend which, when extrapolated forward three years, would result in values greater than the 75th percentile. For this test, the least squares method of linear regression is used to fit a trend line to the data. This can be done using the LINEST function in Excel. The F-statistic for this regression is

calculated from the ratio of the variances. The F-statistic is used to test the null hypothesis that the data is a random scatter of points with a zero slope. The calculated F-statistic is compared to critical values of F statistic found in standard statistics texts. If the F-statistic is greater than the critical value, the null hypothesis fails and the linear model is significant. Using a significance level of 0.05, if the calculated statistic is greater than the critical value, we can be 95% confident that the data is not a random scatter and the linear regression model is justified. For purposes of the AMP trend line prediction, data from 2003 and on should be used for the regression analysis.

5.6 Monitoring Requirements

The monitoring information required is monthly (or weekly during times of discharge) total zinc, total copper and sulphate concentrations measured at X14. This data will be used for direct comparison to the specific thresholds and to enable an updated projected trend.

Additional monitoring information that is required for analysis should the AMP triggers be activated include surface and subsurface water quality and flow data from locations upstream of X14. Both water quality and flow data is essential as they enable not only the analysis of contaminant concentrations but loadings as well. The locations required are surface water quality stations located upstream in Rose Creek (diversion, North Fork and South Fork), surface seepage from the Rose Creek Tailings Facility, effluent flow from the Cross Valley Dam spillway, and surface flow and seepage from other mine facilities. Groundwater quality beneath and downgradient of the Rose Creek Tailings Facility, as monitored under the Water Licence and the Rose Creek Aquifer AMP, will also provide important information should the Rose Creek AMP be activated. The collection of this information is generally provided for through the monitoring requirements of the Water Licence with one exception, location X10 at the downstream end of the Rose Creek Diversion Canal. The monitoring locations are outlined in Table 8 along with sample frequency. Where required to fulfill the AMP, monitoring requirements in excess of the Water Licence requirements have been added (highlighted in *italics* in Table 8).

Table 8. Summary of Reference Water Quality Stations for Rose Creek AMP

Sample Id.	Location	Frequency
Surface Samples		
R3	Rose Creek Mid- length	WS
R4	Rose Creek upstream of Anvil Creek	WS
R5	Anvil Creek downstream of Rose Creek	WS
R6	Anvil Creek upstream of Rose Creek	WS
X2	North Fork of Rose Creek	M
X3	Pumphouse Pond	M
X10	*Lower End Rose Creek Diversion*	*M*
X5	Cross Valley Pond at Spillway	WD
X13	Cross Valley Dam Total Seepage	M
X14	Rose Creek downstream of diversion channel confluence	M/WD
Groundwater Samples		
X16	Downstream of Tailings Facility	SF
X17	Downstream of Tailings Facility	SF
X18	Downstream of Tailings Facility	SF
P01-02	Downstream of Tailings Facility	SF
P03-09	Downstream of Tailings Facility	SF
Annual Seep Samples (plus other relevant observed freshet seeps)		
GDHSECK	Guardhouse Creek at Intermediate Pond	A

M = monthly, SF = spring and fall, A = annually, WD = weekly during discharge, WS – winter and summer

5.7 Evaluation of monitoring results

The management review of the relevant water quality data (X14) will be made on a weekly basis during periods of discharge and on a monthly basis the remainder of the year. This will be carried out when the water quality data is received from the laboratory. The laboratory turn around time for the standard analysis is approximately 2 weeks.

5.8 Approach to Responses

As per the general approach to the AMP, a staged response to degraded water quality in Rose Creek downstream of the mine facilities will be implemented if one of the triggers is activated. Four major steps are identified and summarized below. Although presented in a sequential order, some steps may occur concurrently or may be eliminated, depending on the individual circumstances of the trigger activation. In all cases, the approach to responses will be such that it expedites the process of responding to the trigger activation.

The initial response to the trigger will be the verification of the monitoring information. This will involve a comprehensive analysis of the laboratory results. The water quality at X14 may then require re-sampling if warranted (i.e. QA/QC data or field notes indicates sampling issues/errors). This re-sampling could be done within approximately 2 weeks of the previous sampling time with the results available approximately 4 weeks from initial trigger activation. Upon verification of the monitoring data that a threshold has been crossed and that the mine site is the likely cause, the YG Water Inspector will be notified in writing of the circumstances.

At this time a comprehensive analysis of the other related monitoring results from the locations outlined in Table 8 will be carried out. The goal of this analysis is to provide for a preliminary identification of the cause of the trigger activation. For example, review of the other data may provide an indication if the source of the increased concentration is from groundwater or upstream surface water inputs. As well, analysis of the impacts of trigger activation on the receiving environment will be conducted. The results of this analysis will be used as a basis for the development of an appropriate response plan to mitigate any identified or predict impacts and to highlight any required modifications to the monitoring program.

Following this analysis, the next step may be to increase monitoring intensity to verify the source that resulted in the activation of the trigger. Depending on the preliminary source identification, this may require additional groundwater, seepage or surface water sampling. This may also require increasing the frequency and number of samples collected. These modifications to the monitoring program will be done in consultation with technical experts and regulatory agencies.

A response plan will subsequently be designed based on the trigger analysis described above. This plan, where appropriate, may include both short term and long term mitigation measures.

If the source of contamination is identified to be runoff or seepage from all or a portion of the mine facilities, then a short term mitigation measure may be implemented to control migration of contaminants at the source while a longer term mitigation plan is implemented. This might include pumping, berming, ditching or whatever other means are possible to the degree where water quality is not further degraded in the short term. A longer term mitigation system would then be designed. It would be designed in such a way to provide security until the implementation of the Final Closure and Reclamation Plan.

If the source of the contamination is identified to groundwater flow that is too deep for interception by surface ditching, then a groundwater interception plan, or another long term remedial measure may be designed.

In any event, notifications and designs will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 and 37). Specifically this would include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);
- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

6. AMP Event 4, Degraded Seepage Quality from the Grum Rock Dump

6.1 Description

Surface and subsurface seepage from the Grum Rock Dump contains contaminants that are released from the waste rock dump. The water quality of Grum Dump seepage is measured monthly at V2 (Figure 5) for total metals, dissolved metals, pH, temperature, conductivity, total suspended solids, sulphate, ammonia and hardness (YWB 2004). This seepage water flows into Vangorda Creek and has the potential to become contaminated to the degree where the receiving environment in Vangorda Creek is adversely affected. The trigger for the implementation of contingency measures is proposed to be surface water quality in Grum Creek prior to discharging into Vangorda Creek.

6.2 Specific Information or Issues

An analysis of the 1998 to 2002 reference period data for Grum Creek at V2 was carried out in preparation of the AMP protocol. A summary of this analysis is presented in Table 9. Water quality results below detection limit are assumed to be at detection limit for the purposes of statistical and graphical analysis. Details of the statistical analysis can be found in Appendix A. Review of the reference period data indicates that there is a statistically significant trend in the concentrations of sulphate in surface water at V2. In 2000 a rapid increase in sulphate concentrations occurred that has since leveled off. Present concentrations exceed the proposed 75th percentile trigger and it is anticipated that the AMP will be triggered upon implementation on July 1, 2004.

Table 9. Summary of Reference Water Quality Data for Grum Dump at Location V2

	Total Copper (mg/l)	Sulphate (mg/l)	Total Zinc (mg/l)
Minimum	0.002	28	0.010
25 Percentile	0.010	174	0.011
Median	0.017	380	0.050
75 Percentile	0.031	567	0.240
Maximum	0.061	849	3.350
Number of Samples	27	27	23
Number of Non-detects	1	0	3
Significant Trend (Increasing or Decreasing)	Decreasing	Increasing	No

6.3 Narrative Trigger

The trigger for the implementation of the AMP is "contaminant concentrations in seepage from the Grum Rock Dump display a sustained and statistically significant increase over the 1998 to 2002 reference period".

6.4 Specific Indicators

The specific indicators that should be monitored at V2 to provide the information necessary to assess whether the trigger has been achieved are:

- Total Zinc (mg/l);
- Total Copper (mg/l); and
- Sulphate (mg/l).

6.5 Specific Thresholds

The specific thresholds or triggers that will initiate an action plan, for any one of the specific indicators, will be as follows:

- Three consecutive monitoring results at V2 greater than the upper 75th percentile of the reference period (the appropriateness of 1998 – 2002 as the reference period for Grum Creek should be reviewed as part of the initial AMP Annual Review using information collected through 2004 to ensure that the event observed in the 2000 water quality data is not "masking" trends that might be more appropriate for on-going evaluation of triggers); or
- A significant trend in the monitoring results from V2 defined as a statistically significant (0.05) increasing trend which, when extrapolated forward three years, would result in values greater than the 75th percentile. For this test, the least squares method of linear regression is used to fit a trend line to the data. This can be done using the LINEST function in Excel. The F-statistic for this regression is calculated from the ratio of the variances. The F-statistic is used to test the null hypothesis that the data is a random scatter of points with a zero slope. The calculated F-statistic is compared to critical values of F statistic found in standard statistics texts. If the F-statistic is greater than the critical value, the null hypothesis fails and the linear model is significant. Using a significance level of 0.05, if the calculated statistic is greater than the critical value, we can be 95% confident that the data is not a random scatter and the linear regression model is justified. For purposes of the AMP trend line prediction, data from 2003 and on should be used for the regression analysis.

6.6 Monitoring Requirements

The monitoring information required is monthly total zinc, total copper and sulphate concentrations and flow data measured at V2. This data will be used for direct comparison to the specific thresholds and to enable an updated projected trend.

Additional monitoring information that is required for analysis should the AMP triggers be activated are surface and subsurface water quality and available flow data from the Grum Dump. Both water quality and flow data is essential as they enable not only the analysis of contaminant concentrations but loadings as well. The locations required are surface water quality stations associated with the Grum Dump and Grum Creek, and surface seepage and groundwater monitoring wells located at the toe of the dump. The collection of this information is provided for through the monitoring requirements of the Water Licence. The monitoring locations are outlined in Table 10 along with sample frequency.

Table 10. Summary of Reference Water Quality Stations for Grum Dump AMP

Sample Id.	Location	Frequency
Surface and Seepage Samples		
V2	Grum Creek upstream of confluence with Vangorda Creek	M
V2A	Grum Dump to Moose Pond	M
V14	Grum Rock Dump N. Toe Seep	SF
V15	Grum Rock Dump Central Toe Seep	M
V16	Grum Rock Dump S. Toe Seep	SF
Groundwater Samples		
P96-09	Grum Rock dump	SF
Annual Seep Samples – any relevant observed freshet seeps		

M = monthly, SF = spring and fall

6.7 Evaluation of monitoring results

The management review of the relevant water quality data (V2) will be made on a monthly basis. This will be carried out when the water quality data is received from the laboratory. The laboratory turn around time for the standard analysis is approximately 2 weeks.

6.8 Approach to Responses

As per the general approach to the AMP, a staged response to degraded water quality downstream of the Grum Rock Dumps will be implemented if one of the triggers is activated. Four major steps are identified and summarized below. Although presented in a sequential order, some steps may occur concurrently or may be eliminated, depending on the individual circumstances of the trigger activation. In all cases, the approach to responses will be such that it expedites the process of responding to the trigger activation.

The initial response to the trigger will be the verification of the monitoring information. This will involve a comprehensive analysis of the laboratory results. The water quality at V2 may then require re-sampling if warranted (i.e. QA/QC data or field notes indicates sampling issues/errors). This re-sampling could be done within approximately 2 weeks of the previous sampling time with the results available approximately 4 weeks from initial trigger activation. Upon verification of the monitoring data that a threshold has been crossed and that the mine site is the likely cause, the YG Water Inspector will be notified in writing of the circumstances.

At this time a comprehensive analysis of the other related monitoring results from the locations outlined in Table 10 will be carried out. The goal of this analysis is to provide for a preliminary identification of the cause of the trigger activation. For example, review of the other data may provide an indication if the source of the increased concentration is from groundwater or seepage. As well an analysis of the impacts of the trigger activation on the receiving environment will be conducted. The results of this analysis will be used as a basis for the development of an appropriate response plan to mitigate any identified or predicted impacts and to highlight any required modifications to the monitoring program.

Following this analysis, the next step may be to increase monitoring intensity to verify the source that resulted in the activation of the trigger. Depending on the preliminary source identification, this may require additional groundwater, seepage sampling, or conducting a test pitting program. This may also require increasing the frequency and number of samples collected. These modifications to the monitoring program will be done in consultation with technical experts and regulatory agencies.

A response plan will subsequently be designed based on the trigger analysis described above. This plan, where appropriate, may include both short term and long term mitigation measures.

If the source of contaminants is identified to be shallow seepage from all or a portion of the Grum Rock Dump, then a short term mitigation measure may be implemented to control migration of contaminants at the source while a longer term mitigation plan is implemented. This might include pumping, berming, ditching or whatever other means are possible to the degree where water quality is not further degraded in the short term. A longer term mitigation system would then be designed. This may involve surficial ditching near the toe of the rock dump(s) that directs seepage to a collection sump, from where the water would be pumped into the treatment system. It would be designed in such a way to provide security until the implementation of the Final Closure and Reclamation Plan.

If the source of the contamination is identified to groundwater flow that is too deep for interception by surface ditching or controlling at source, then a groundwater interception plan, or another long term remedial measure may be designed.

In any event, notifications and designs will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 and 37). Specifically this would include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);
- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

7. AMP Event 5, Degraded Water Quality in the North Fork of Rose Creek

7.1 Description

Water quality in the North Fork of Rose Creek could be negatively affected by rock dump seepage, seepage or overflow from the Zone 2 Pit, seepage from the disturbed area between the creek and the Zone 2 Pit and the rock drain at the haul road crossing, and contaminated groundwater from the Main/Intermediate waste rock dumps. The water quality in the North Fork of Rose Creek is measured monthly at Station X2 (YWB 2004) for total metals, dissolved metals, pH, temperature, conductivity, total suspended solids (TSS), sulphate, hardness and ammonia. The flow rate is also measured monthly at X2.

The environmental consequence of degraded water quality in the North Fork of Rose Creek is the potential exposure of aquatic resources, terrestrial resources and human resources to increased levels of contaminants in the North Fork, Rose Creek Diversion canal and, possibly, further downstream in Rose Creek, Anvil Creek and the Pelly River. Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants which could source from the rock dumps, open pits and other mine facilities.

7.2 Specific Information of Issues

Analysis of the 1998 to 2002 reference data for the North Fork of Rose Creek (at X2) was carried out in preparation of the AMP. A summary of this analysis is presented in Table 11. Water quality results that are below detection limit are assumed to be at detection limit for the purpose of statistical and graphical analysis. Details of the statistical analysis can be found in Appendix A.

Table 11. Summary of Reference Water Quality Data in the N. Fork of Rose Creek at Location X2

	Total Copper (mg/l)	Sulphate (mg/l)	Total Zinc (mg/l)
Minimum	0.002	4	0.009
25 Percentile	0.007	11	0.02
Median	0.015	21	0.03
75 Percentile	0.028	26	0.06
Maximum	0.253	52	0.5
Number of Samples	61	61	61
Number of Non-detects	8	0	4
Significant Trend (Increasing or Decreasing)	no	no	No

7.3 Narrative Trigger

The trigger for the implementation of the AMP is "contaminant concentrations in the North Fork of Rose Creek display a sustained and statistically significant increase over the 1998 to 2002 reference period".

7.4 Specific Indicators

The specific indicators that should be monitored at X2 to provide the information necessary to assess whether the trigger has been activated are:

- Total Zinc (mg/l)
- Total Copper (mg/l; and
- Sulphate (mg/l)

7.5 Specific Thresholds

The specific thresholds or triggers that will initiate an action plan, for any of the specific indicators, will be as follows:

- Three consecutive monitoring results greater than the upper 75th percentile of baseline (1998 – 2002) or
- A significant trend in the monitoring results defined as a statistically significant (0.05) increasing trend which, when extrapolated forward three years, would result in values greater than the 75th percentile. For this test, the least squares method of linear regression is used to fit a trend line to the data. This can be done using the LINEST function in Excel. The F-statistic for this regression is calculated from the ratio of the variances. The F-statistic is used to test the null hypothesis that the data is a random scatter of points with a zero slope. The calculated F-statistic is compared to critical

values of F statistic found in standard statistics texts. If the F-statistic is greater than the critical value, the null hypothesis fails and the linear model is significant. Using a significance level of 0.05, if the calculated statistic is greater than the critical value, we can be 95% confident that the data is not a random scatter and the linear regression model is justified. For purposes of the AMP trend line prediction, data from 2003 and on should be used for the regression analysis.

7.6 Monitoring Requirements

The monitoring information required is monthly total zinc, total copper and sulphate concentrations measured at X2. This data will be used for direct comparison to the specific thresholds and to enable an updated projected trend.

Additional monitoring information that is required for analysis should the North Fork AMP triggers be activated are subsurface and surface water quality and flow data from locations upstream of X2. Both water quality and flow data is essential as they enable not only the analysis of contaminant concentrations but loadings as well. The locations required are surface water quality stations located upstream along the North Fork of Rose Creek, surface seepage from the rock dumps and groundwater monitoring wells located at the toe of the rock dumps. The collection of this information is provided through the monitoring requirements of the Water Licence. The monitoring locations are outlined in Table 12 along with sample frequency.

Table 12. Summary of Reference Water Quality Stations for N. Fork Rose Creek AMP

Sample Id.	Location	Frequency
Surface Samples		
X2	North Fork of Rose Creek at access road	M
R7	N. Fork upstream of Faro Creek Diversion	M
R8	N. Fork downstream of Faro Creek Diversion	M
R9	N. Fork adjacent Zone 2 dumps	M
R10	N. Fork downstream Zone 2 dumps	M
FAROCR	Outlet of Faro Creek Diversion	M
Groundwater Samples		
BH1/2/4	Zone 2 Rock Dumps	SF
BH12/13/14	N. East Rock Dumps	SF
P96-6 and S1/2/3	Main/Intermediate Dumps	SF
Annual Seep Samples (plus other relevant observed freshet seeps)		
NE1	N. Seep to N. Fork from NE Dumps	A
NE2	Central Seep to N. Fork from NE Dumps	A
NE3	S. Seep to N. Fork from NE Dumps	A
NF1/NF2	Upstream/Downstream side of Rock Drain	A

M = monthly, SF = spring and fall, A = annually

7.7 Evaluation of monitoring results;

A management review of the relevant water quality data (X2) will be made on a monthly basis when the water quality data is received from the laboratory. The laboratory turn around time for the standard analysis is approximately 2 weeks.

7.8 Approaches to Responses

As per the general approach to the adaptive management plan, a staged response to degraded water quality in the North Fork of Rose Creek will be implemented if one of the triggers is activated. Four major steps are identified and summarized below. Although presented in a sequential order, some steps may occur concurrently or may be eliminated, depending on the individual circumstances of the trigger activation. In all cases, the approach to responses will be such that it expedites the process of responding to the trigger activation.

The initial response to the trigger will be the verification of the monitoring information. This will involve a comprehensive analysis of the laboratory results. The water quality at X2 may then require re-sampling if warranted (i.e. QA/QC data or field notes indicates sampling issues/errors). This re-sampling could be done within approximately 2 weeks of the previous sampling time with the results available approximately 4 weeks from initial trigger activation. Upon verification of the monitoring data that a threshold has been crossed and that the mine site is the likely cause, the YG Water Inspector will be notified in writing of the circumstances.

At this time a comprehensive analysis of the other related monitoring results from the locations outlined in Table 12 will be carried out. The goal of this analysis is to provide for a preliminary identification of the cause of the trigger activation. For example, review of the other data may provide an indication if the source of the increased concentration is from groundwater or upstream surface water inputs. As well, analysis of the impacts of trigger activation on the receiving environment will be conducted. The results of this analysis will be used as a basis for the development of an appropriate response plan to mitigate any identified or predicted impacts and to highlight any required modifications to the monitoring program.

Following this analysis, the next step will be to increase monitoring intensity to verify the source that resulted in the activation of the trigger. Depending on the preliminary source identification, this may require additional groundwater, seepage or surface water sampling. This may also require increasing the frequency and number of samples collected, or perhaps conducting a test pitting program. These modifications to the monitoring program will be done in consultation with technical experts and regulatory agencies.

A response plan will subsequently be designed based on the trigger analysis described above. This plan, where appropriate, may include both short term and long term mitigation measures.

If the source of contamination is identified to be seepage from all or portion of the rock dumps, then a short term mitigation measure may be implemented to control migration of contaminants at the source while a longer term mitigation plan is implemented. This might include pumping, berming, ditching or other whatever other means are possible to the degree where water quality is not further degraded in the short term. A longer term mitigation system would then be designed. This may involve surficial ditching near the toe of the rock dump(s) that directs seepage water to a collection sump, from where water would be pumped to the Main Pit. It would be designed in such a way to provide security until the implementation of the Final Closure and Reclamation Plan.

If the source of contamination is identified to be seepage from the Zone 2 Pit, then the water level in the Zone 2 Pit will immediately be lowered to the lowest achievable elevation. The Zone 2 Pit dewatering system will be immediately reevaluated and if required, plans for upgrading/repairing would be developed.

If the source of the contamination is identified to groundwater flow that is to deep for interception by surface ditching, then a groundwater interception plan, or another long term remedial measure may be designed.

In any event, notifications and designs will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 and 37). Specifically this would include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);
- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

8. AMP Event 6, Water level in Grum Pit Reaches Maximum Desired Elevation

8.1 Description

Water quality in the Grum Pit is currently non compliant with the discharge criteria in Water Licence QZ03-059 for the Faro and Vangorda Plateau mine sites (YWB 2004) and can not, therefore, be directly released to the receiving environment. The water elevation in the Grum Pit has been rising since mine shut down in 1998 but remained safely below an overflow level at the end of 2003. Further, a report has been completed (GLL 2003a) that indicates that it is unlikely that the pit will fill to a level requiring active management during the term of the Water Licence (to the end of 2008). Nonetheless, it remains possible that a series of extreme natural events could cause the in-pit water level to rise to a maximum desired operating range by 2008 and, therefore, an AMP is required to ensure that appropriate responses are implemented if necessary.

The environmental consequences of the water elevation in the Grum Pit reaching the maximum desired elevation could result in the absence of adequate emergency storage capacity for containment of a flood event and, ultimately, a release of non compliant water to the receiving environment, Vangorda Creek. This could result in the exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Vangorda Creek and the Pelly River.

Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants that could source from the pit.

8.2 Specific Information or Issues

An investigation of the Grum Pit was completed in 2003 (GLL 2003a) that developed information important to the AMP:

- A recommended maximum desired operating water level to maintain adequate storage for unforeseen flood events (i.e., an "action level");
  The recommendation is 1213.4 m asl, which is 18.9 m below the overflow elevation
- The projected filling timeframe with respect to the maximum desired water elevation; and
  The water level is projected to reach the maximum recommended elevation in 2014 ("normal" conditions) or 2012 ("conservative" conditions)
- A recommended management plan for the care and maintenance period.

The recommended plan includes monthly monitoring of the in-pit water level, quarterly monitoring of the pit lake water chemistry and implementation of a seasonal (summer) pumping and treatment program via the existing water treatment plant as the contingency against faster than projected filling.

Pertinent information from this study will be filed with the YWB by June 30, 2004 as required by Part , Item of the Water Licence and this information, as possibly modified before 2008, forms the basis of the AMP.

8.3 Narrative Trigger

The trigger for the implementation of contingency measures is "the water elevation in the Grum Pit reaches the maximum desired operating level."

8.4 Specific Indicators

The specific indicators that should be monitored to provide the information necessary to assess whether the trigger has been activated are:

- Pit water elevation; and
- Projected timeframe to maximum desired water elevation.

Supplementary monitoring information regarding pit lake water chemistry would be beneficial in the event that an action plan is required in the future that includes the treatment of pit water. However, this information is not essential to the AMP.

8.5 Specific Thresholds

The specific thresholds that will initiate the action plan will be as follows:

- The pit water elevation reaches 1210.8 m asl; and
  This threshold elevation, 2.6 m below the maximum desired water elevation and 21.5 m below the pit overflow elevation, will be used to initiate an early management response such that any necessary protocols or equipment can be put into place before the in-pit water elevation reaches the maximum desired elevation
  This threshold should provide preparatory timeframes of approximately 1½-years and 1-year for the normal and conservative filling projections, respectively, which is considered to be sufficient for implementation of the action plan
- The projected timeframe for reaching the maximum desired water elevation is projected to be one year or less under the conservative projection.
  This threshold will be used to initiate an early management response such that any necessary protocols or equipment can be put into place before the in-pit water elevation reaches the maximum desired elevation
  A one-year timeframe is considered to be sufficient for implementation of the action plan

8.6 Monitoring Requirements

The monitoring information that is required is:

- The pit water elevation; and
  For direct comparison to the specific thresholds and to enable an updated projection of the filling timeframe
- Local precipitation.
  To enable an updated projection of the filling timeframe

The collection of this information is provided through the monitoring requirements of the Water Licence.

Schedule A of the Water Licence requires the monitoring of water elevations in the Grum pit (station V23) on a monthly basis. The monitoring should be by direct survey, as per the current protocol carried out by the site environmental technicians, or by staff gauge calibrated by direct survey. The monthly monitoring frequency serves the purpose of the AMP.

Schedule C of the Water Licence requires the collection and review of precipitation data on an annual basis. In recent years, the best data available has been collected by Environment Canada at the Town of Faro airport and this data has been obtained from Environment Canada for the mine's reporting and review purposes. Beginning in 2004, climate measurement stations will be operated by the mine on both the Faro and Vangorda Plateau mine sites such that the precipitation data will be more representative of the conditions at the mine sites. Regardless of whether the airport data or the on-site data is employed, for the AMP, an annual review of monthly precipitation summaries will be undertaken to enable an update to the filling projection timeframes. An annual review of the data is sufficient for the purpose of the AMP.

8.7 Evaluation of Monitoring Results

A management review of the pit water elevations will be made on a monthly basis when the water level reading is obtained. This will provide an immediate assessment against the specific threshold value for the pit water elevation.

The updated pit filling projection will be prepared and evaluated as part of the annual AMP review. This is to be completed by February 28 of each year for inclusion into the Annual Environmental Report that is required to be filed with the YWB. In this way, the filling projection for the Grum Pit will be updated by February 28 such that appropriate actions can be initiated, if required, prior to the summer work season.

8.8 Approaches to Responses

As per the general approach to the adaptive management plan, a staged response to an increasing water elevation in the Grum Pit will be implemented if the response trigger is activated.

The initial response to crossing either of the specific thresholds will be verification of the monitoring information. This will involve either re-survey of the pit elevation or recalculation and cross checking of the pit filling projection. This should be done within 2 weeks of the initial indication from the monitoring data.

Upon verification of the monitoring data that a threshold has been crossed, the YG Water Inspector and the YWB will be notified in writing of the circumstances. At this time, the most recent pit lake water chemistry will be reviewed in the context of determining compliance with the Water Licence discharge criteria. This should be done within a one-week timeframe. Based on this compliance check, one of two plans will be implemented

1. Design of an operating system, which may or may not incorporate in-pit treatment, for direct release of water from the Grum pit to Vangorda Creek in a safe manner. The system should be designed to the same minimum operational safety standards as other similar operating facilities and structures on the Vangorda Plateau mine site; or
2. Design of a pumping system for integration of Grum Pit water into the summer season pumping program that is currently in operation for the Vangorda Pit.

In either event, notifications and designs will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 to 37). Specifically, this will include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);
- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

9. AMP Event 7, Disruption of Fannin Sheep Migration Through the Mine Site

9.1 Description

It is well documented that the Fannin sheep seasonal migration route between winter and summer areas passes through the Vangorda Plateau mine site and that the sheep have continued their migration pattern through the period of mine operations and care and maintenance activities. Mine personnel routinely observe the sheep migration during the course of their activities on the mine site.

The experience gained during the 1998 to 2002 care and maintenance period indicates that the proposed continuation of care and maintenance activities to 2008 should not disrupt the sheep migration patterns. The wide ranging land use by the Fannin sheep suggests that a disruption or irregularity in the migration pattern would more likely be caused by off-site effects.

However, regardless of the source, an irregularity or disruption in the migration pattern could negatively affect the health of the herd by delaying or preventing their established pattern of land use. Alternatively, an irregularity in the sheep migration could be an indicator of a previously unidentified affect on the health of the herd.

9.2 Specific Information or Issues

The Faro herd of Fannin sheep were investigated as part of the studies leading up to licencing of the Vangorda Plateau mine site in the late 1980's and early 1990's. These studies are referenced in the May 2002 Baseline Report (GLL 2002) and in the April 2003 Environmental Assessment Report (GLL 2003b) for renewal of the Water Licences for the Faro and Vangorda Plateau mine sites.

The sheep migrate through the Vangorda Plateau mine site twice per year. The spring migration from the wintering area to Mt. Mye typically occurs in early June. The reverse, fall migration typically occurs in early September. Care and maintenance activities, as authorized by the Water Licence, are commonly underway at these times and sheep are commonly observed by mine workers.

There are no trained sheep biologists on staff at the mine site and this is not deemed necessary for the purpose of the AMP. Therefore, mine personnel can not make professional or judgmental determinations regarding sheep behaviour or characteristics. In conjunction with the licencee , the expertise at the Yukon Government Department of Environment (YG DOE) will be required to make these determinations, using the information provided by mine personnel and any other information that is available to it. Further, input from the YG DOE will be required for the development any responses or actions to unforeseen events regarding the sheep resulting from mine site related activities.

Mine personnel maintain log books for wildlife observations, including the Fannin Sheep, into which personnel directly record observations at the time of the sighting. These log books will form the basis of the information that is passed on to YG DOE.

9.3 Narrative Trigger

The trigger for the implementation of contingency measures is "an observed disruption or irregularity in the migration of Fannin sheep through the mine site due to care and maintenance related activities" as determined by the licencee, in conjunction with YG DOE, based on observational information routinely provided by mine personnel and any other relevant information.

9.4 Specific Indicators

The specific indicators that should be monitored by mine personnel to allow for the assessment of whether the trigger has been activated are the locations, time and conditions of a sighting plus the number and behaviour of the animals, to the best ability of the observer.

9.5 Specific Thresholds

Given the specialized expertise that is necessary to evaluate migration patterns and the health of the herd, the determination of specific thresholds that will initiate an action plan will be done by the licencee in conjunction with YG DOE.

9.6 Monitoring Requirements

The monitoring information required is observations of the sheep migration through the mine site. Mine personnel routinely observe the sheep passing through the mine site in the course of their site activities. This level of monitoring is considered to be adequate to provide the information required and there is no intent in the AMP to require an increase in the number or qualifications of mine site personnel or to increase their work-related responsibilities. The intent of the AMP is to make use of the observations that mine personnel are in the position to gather for the increased protection of the herd.

The existing Wildlife Observations Logbook should continue to be used as the basis of recording and passing observations to YG DOE. Observations by mine personnel should be recorded at the time of the sighting or as close to as practical given the operating requirements of the mines and passed on to YG DOE (Faro Conservation Officer) on a monthly basis. The site manager may elect to communicate with YG DOE or YG DOE may contact the site manager on a more frequent basis if circumstances require.

The primary contact at YG DOE for the AMP will be the conservation officer located in the Town of Faro. The primary contact at the mine site for the AMP will be the Site Manager.

9.7 Evaluation of Monitoring Results

Given the specialized expertise that is necessary to evaluate migration patterns and the health of the herd, the evaluation of monitoring results against the trigger and specific thresholds will be done by the licencee in conjunction with YG DOE.

In an extreme circumstance where there is a clear and obvious concern or problem regarding the sheep health or behaviour, the site manager will immediately notify YG DOE and request specific direction.

9.8 Approaches to Responses

Given the specialized expertise that is necessary to evaluate migration patterns and the health of the herd, All action plans and responses for mine related impacts will be developed by the licencee in conjunction with YG DOE.

10. AMP Event 8, Wind Dispersed Tailings Result in Adverse Effects in the Terrestrial Environment

10.1 Description

The available information demonstrates that wind dispersed contaminants (i.e. heavy metals) are present in the terrestrial environment near the mine site. This information is described in the Water Licence Renewal Environmental Assessment Report (GLL 2003b). However, the data does not, at this time, clearly identify the source of the contaminants (i.e. tailings, waste rock, mining activities or emissions from the concentrator during operating periods, for example), the extent of their distribution, or whether the effects have increased, diminished or remained static through the care and maintenance timeframe (i.e. post-1998) in comparison to the operating period of the mine.

While the environmental consequences of levels of contaminants in the terrestrial environment have the potential to cause adverse effects on wildlife and human resource users, it is not possible to quantify these effects at this time. It is possible that there could be potential effects on socio-economic use, traditional/cultural use and human health.

10.2 Specific Information or Issues

Part F, Item 49 of the Water Licence requires the filing of the results of a Terrestrial Effects Study by the end of 2005, as was proposed in the Water Licence Renewal Application Report (GLL 3003c). This study will include investigation of possible wind dispersion of tailings and will form the basis of this AMP. The Terrestrial Effects Study will include, as part of the overall study, the following items that are important to the AMP and the possible wind dispersion of tailings:

- Design of a monitoring program;
- Collection of monitoring information;
- Assessment of the monitoring information;
- Determination of the need for mitigative action (i.e., determination of and evaluation of monitoring information against triggers and specific thresholds); and
- Recommended mitigation/action plans.

The Terrestrial Effects Study was undergoing a detailed final design during the winter of 2003/04 which was nearing completion in April 2004. The process has utilized information provided by Ross River Dena Council, Selkirk First Nation, Town of Faro, mine personnel, government agencies and a technical design team. The study review process will continue through the execution of the Terrestrial Effects

Study such that the First Nations governments, stakeholders and regulators will have an ongoing involvement in the study and, thereby, in the AMP.

Two summer field seasons (2004 and 2005) will be utilized to collect monitoring information such that the study report is scheduled for filing with the YB by the end of 2005. An Interim Study Report is anticipated to be available between the 2004 and 2005 field seasons that will provide initial results of the 2004 field season and that will highlight any preliminary indications of impacts.

A "reconnaissance" level study of metal levels in vegetation was carried out in 2001 by the Interim Receiver that is integrated into the Terrestrial Effects Study.

Mine personnel maintain a logbook for recording observations of wind blown tailings. All observed occurrences of visible wind-blown tailings are recorded even if tailings are not visibly dispersed outside of the containment area. These observations will be integrated into the Terrestrial Effects Study and, thereby, into the AMP.

10.3 Narrative Trigger

The trigger for the implementation of contingency measures under the AMP is "the 2005 Terrestrial Effects Study Report concludes that current and on-going wind dispersion of tailings is having a negative effect on the environment such that short term (i.e., to 2008) mitigation measures for a reduction in wind dispersion are recommended".

10.4 Specific Indicators

The specific indicators that should be monitored to provide the information necessary to assess whether the trigger has been activated will be developed through the Terrestrial Effects Study. These are likely to include air particulates, soil, vegetation and wildlife.

10.5 Specific Thresholds

The specific thresholds that will initiate the action plan will be developed through the Terrestrial Effects Study.

10.6 Monitoring Requirements

The type of monitoring information required will be developed through the Terrestrial Effects Study. This is likely to include air quality data, soil metal concentrations, vegetation (various types) metal concentrations and health assessment, wildlife assessments and continued recording of visible wind blowing of tailings by mine personnel.

10.7 Evaluation of Monitoring Results

The monitoring information will be evaluated as part of the Terrestrial Effects Study.

10.8 Approaches to Responses

The 2005 Terrestrial Effects Study Report will include recommendations for short term (i.e., to 2008) mitigation action plans for the reduction of wind dispersed tailings if these are concluded to be necessary. Those recommendations will also form the response plans under the AMP.

Notifications and designs, if appropriate, will be provided to the YWB according to the procedures provided in the Water Licence for minor modifications of existing structures (YWB 2004, Part D, Items 32 to 37). Specifically, this will include:

- Filing of design documents at least 90 days prior to construction (Item 32);
- All dams and diversions designed to withstand the 1:475 year return period earthquake (Item 33);
- All designs shall be sealed by a Professional Engineer registered to practice in the Yukon Territory (Item 34);
- Filing of a detailed construction schedule and other information at least 10 days prior to construction (Item 35);
- Notification of field amendments to the filed designs prior to their implementation (Item 36); and
- Filing of as-built report within 90 days of completion (Item 37).

Construction of any required facilities and implementation of any required workplans will then proceed according to the filed information and any directives returned by the YWB. Any works and/or activities not covered by the requirements of the Water Licence may be subject to a licence amendment and the need for an amendment would be evaluated at that time.

11. Summary

Table 13. AMP Summary

Event	Narrative Trigger	Indicators	Thresholds	Monitoring Locations	Monitoring Parameters
1 Degraded Groundwater Quality in Rose Creek Valley Aquifer	Contaminant concentrations in the Rose Creek Valley aquifer display a statistically significant increase in the downgradient direction over the 1998 to 2002 baseline	Dissolved Zinc, Dissolved Iron, and Sulphate	3 consecutive results exceed 75 percentile or statistically significant increasing trends	P03-09, X24, X25, P03-08, and P03-04	same as indicators
2 Degraded Water Quality in Vangorda Creek Downstream of the Mine Facilities	Contaminant concentrations in Vangorda Creek downstream of the mine facilities display a sustained and statistically significant increase over the 1998 to 2002 baseline	Total Zinc, total Copper, Total Suspended Solids, and Sulphate	3 consecutive results exceed 75 percentile or statistically significant increasing trends	Vangorda Creek V8	same as indicators
3 Degraded Water Quality in Rose Creek Downstream of the Mine Facilities	Contaminant concentrations in Rose Creek downstream of the mine facilities display a sustained and statistically significant increase over the 1999 to 2002 baseline	Total Zinc, total Copper, and Sulphate	3 consecutive results exceed 75 percentile or statistically significant increasing trends	Rose Creek X14	same as indicators
4 Degraded Seepage Quality from the Grum Rock Dump	Contaminant concentrations in seepage from the Grum rock dump display a sustained and statistically significant increase over the 1998 to 2002 baseline	Total Zinc, total Copper, and Sulphate	3 consecutive results exceed 75 percentile or statistically significant increasing trends	Grum Dump Seepage V2	same as indicators
5 Degraded Water Quality the North Fork of Rose Creek	Contaminant concentrations in the North Fork of Rose Creek display a sustained and statistically significant increase over the 1998 to 2002 baseline	Total Zinc, total Copper, and Sulphate	3 consecutive results exceed 75 percentile or statistically significant increasing trends	North Fork Rose Creek X2	same as indicators
6 Water Level in Grum Pit Reaches Maximum Desired Elevation	The water elevation in the Grum Pit reaches the maximum desired operating level.	pit water elevation, projected timeframe to maximum desired water elevation	water elevation 1210.8 m asl, projected timeframe less than one year	Grum Pit (water elevation), local climate station	pit water elevation, local precipitaion
7 Disruption of Fannin Sheep Migration through the Mine Site	An observed disruption or irregularity in the migration of Fannin sheep through the mine site due to mine activities, determined by licencee and YG.	locations, time and conditions of sighting	per YG DOE	Vangorda Plateau mine site	same as indicators
8 Wind Dispersed Tailings Result in Adverse Effects in the Terrestrial Environment	The 2005 Terrestrial Effects Study Report concludes that current and on-going wind dispersion of tailings is having a negative effect on the environment such that short term (i.e., to 2008) mitigation measures for a reduction in wind dispersion are recommended	per Terrestrial Effects Study	per Terrestrial Effects Study	per Terrestrial Effects Study	per Terrestrial Effects Study

12. References

GLL 2002. 2004 to 2008 Water Licence Renewal Project Description, Volume II, Baseline Report. May 2002.

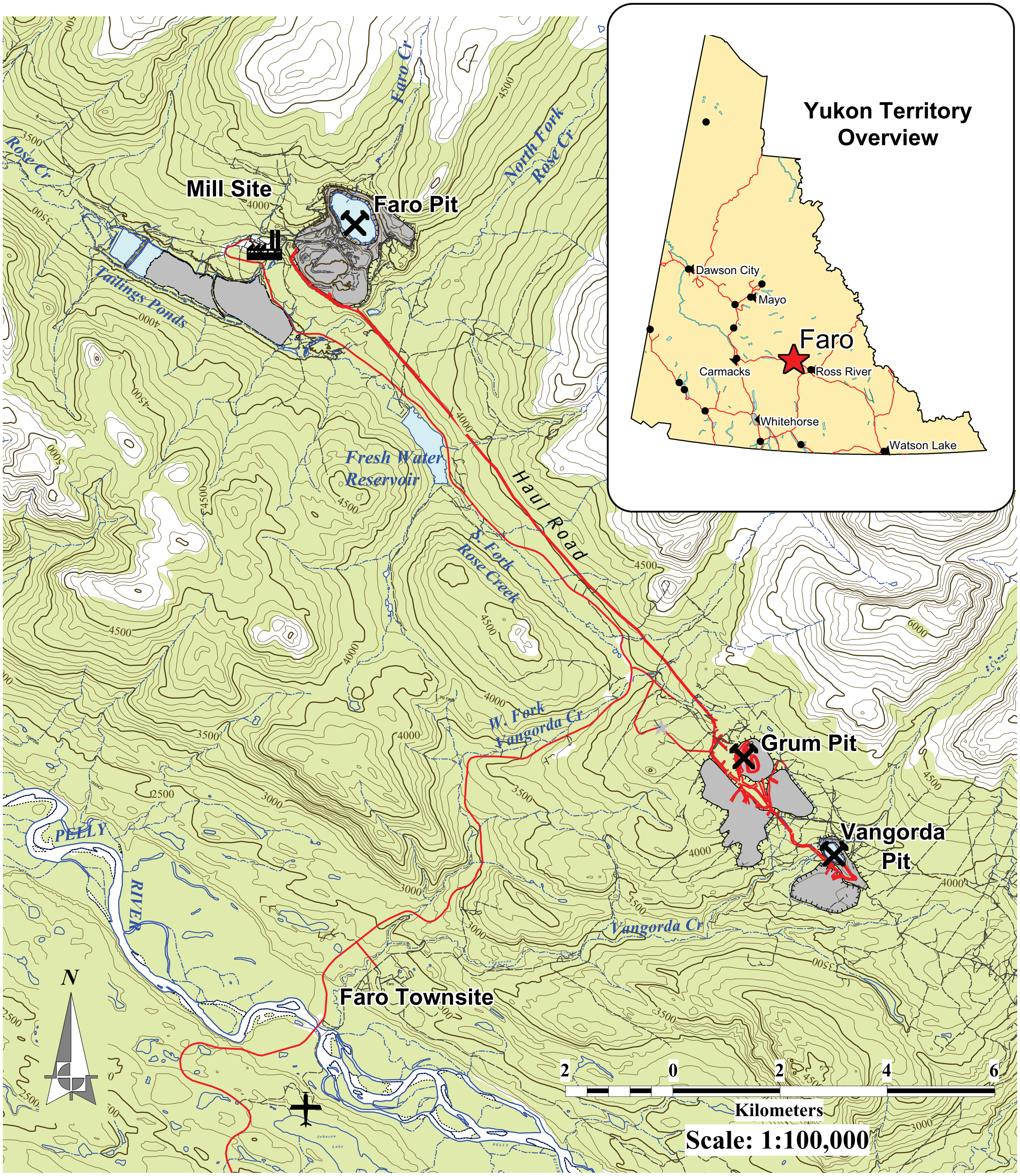
GLL 2003a. 2003 Studies of Care and Maintenance Management Alternatives for Grum Pit. October 2003.

GLL 2003b. 2004 to 2008 Water Licence Renewal Environment Assessment Report, Volume II, Description of the Existing Environment. April 2003.

GLL 2003c. 2004 to 2008 Water Licence Renewal Application Report. May 2003.

YWB 2004. Water Licence QZ03-059. Effective April 2004.

Figures



Site Name: FARO
File : 40302-D1-FIG1.PDF

Gartner Lee Limited

Scale: 1: 100,000

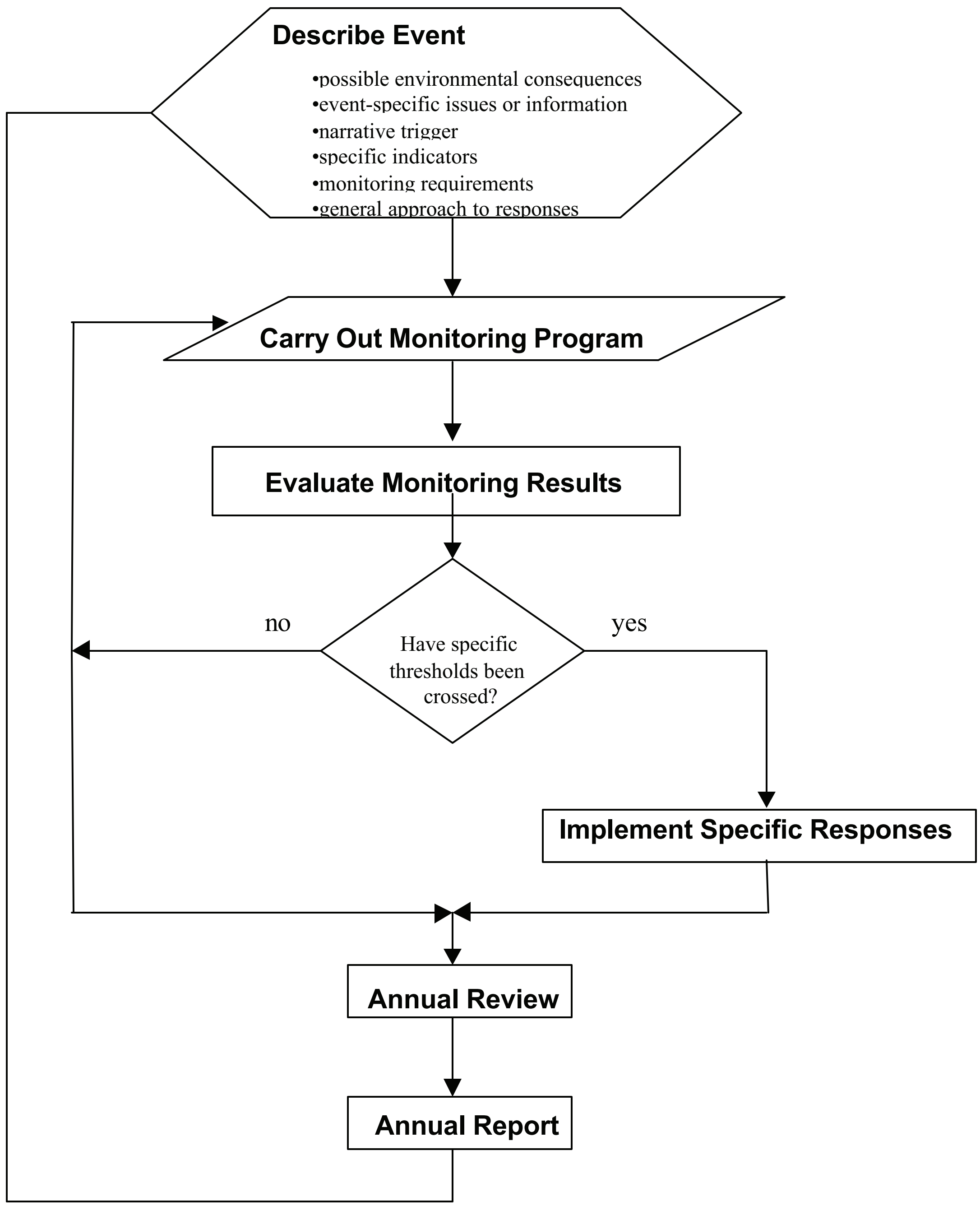
DELOITTE & TOUCHE INC.

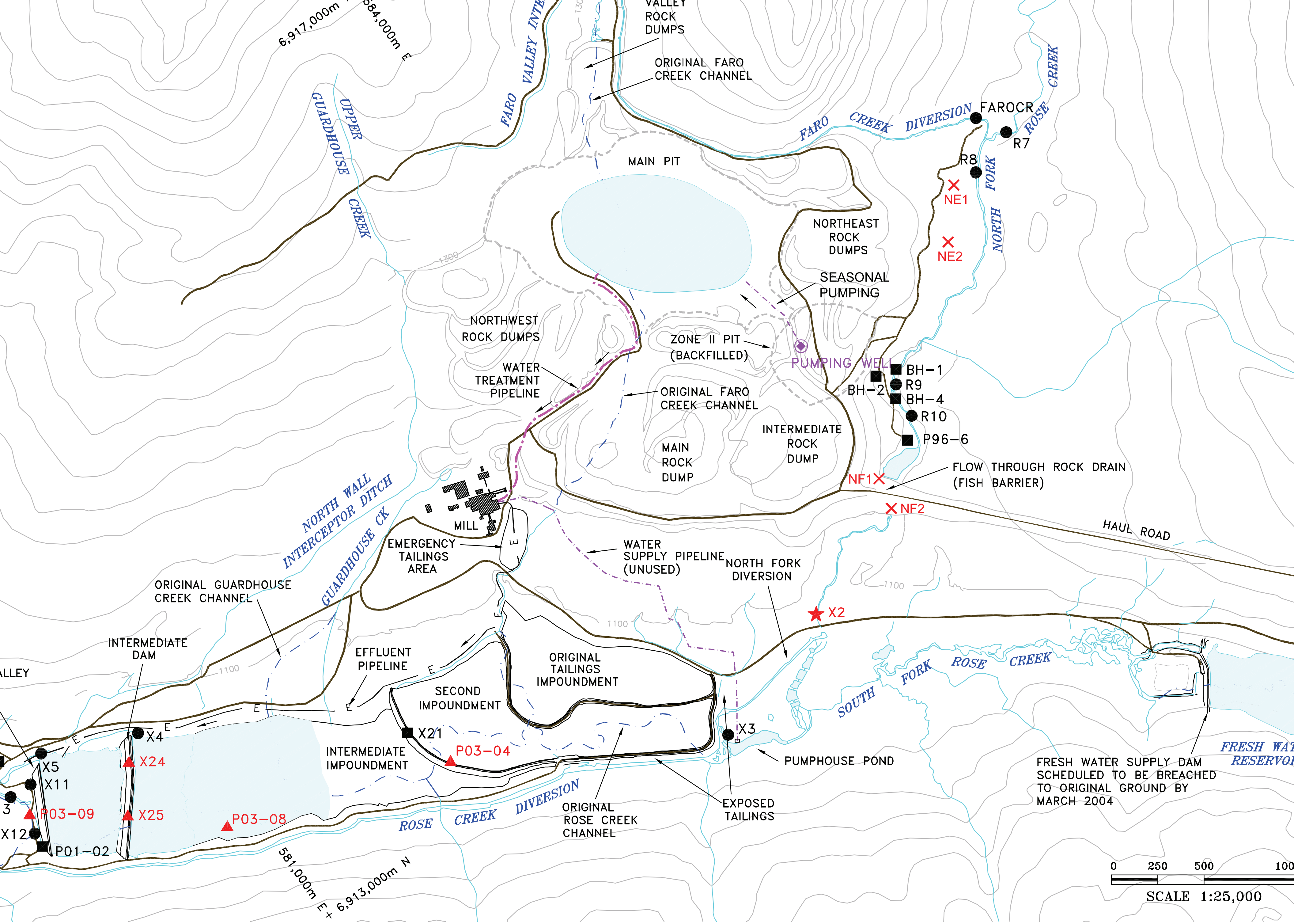
Project Location Map

Project No: 40-302
Date Issued: JUNE 2004

Figure 1

Figure 2 AMP Sequence of Activities





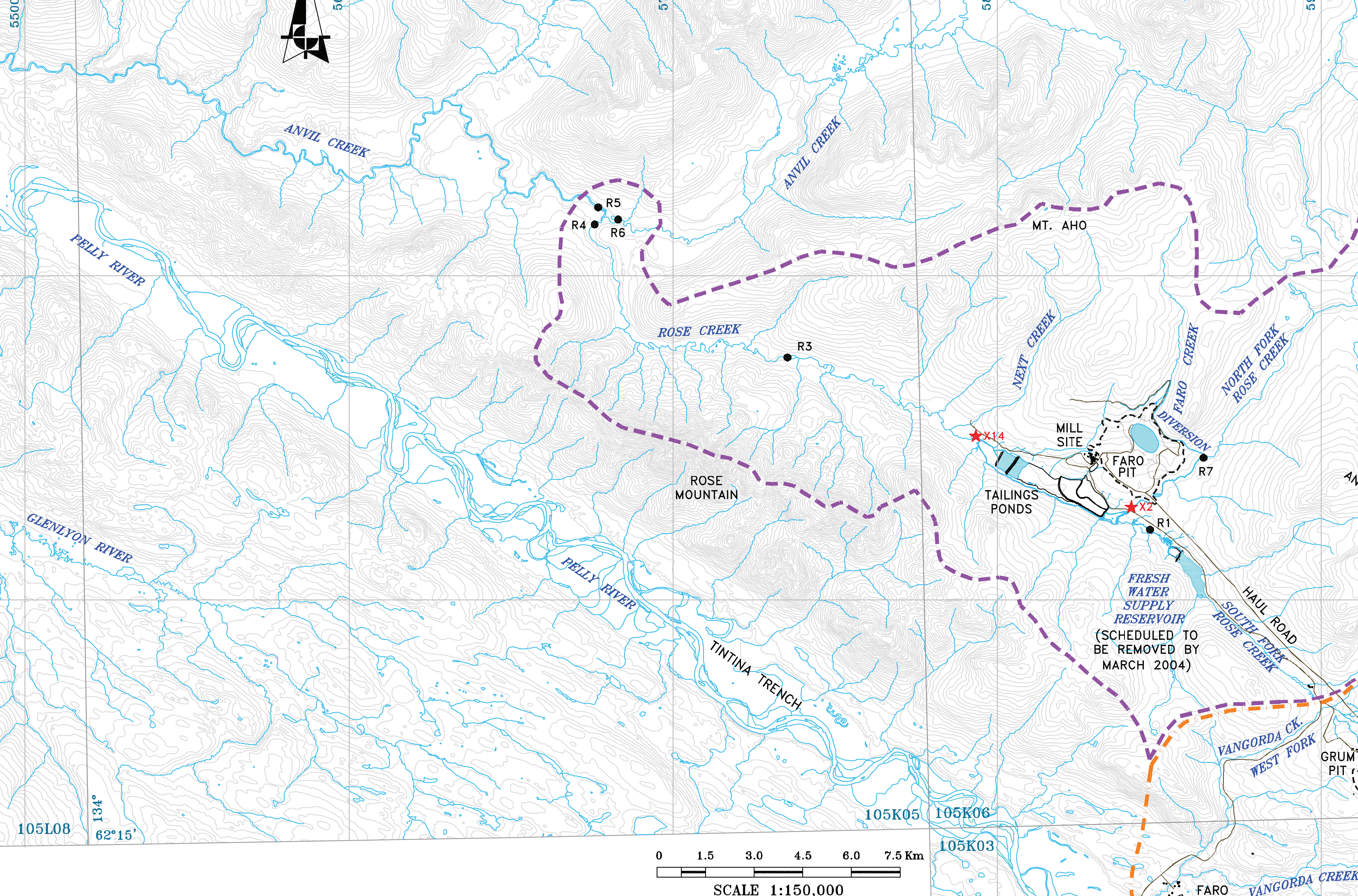
SURFACE WATER

AMP SURFACE WATER TRIGGER LOCATIONS

SOURCES OF INFORMATION:

1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. MAP COORDINATES ARE UTM NAD83 ZONE 8; CONTOUR INTERVAL 100 FT.

DRAWING INFORMATION:



V1 ● KEY MONITORING LOCATIONS

X14 ★ AMP SURFACE WATER TRIGGER LOCATIONS

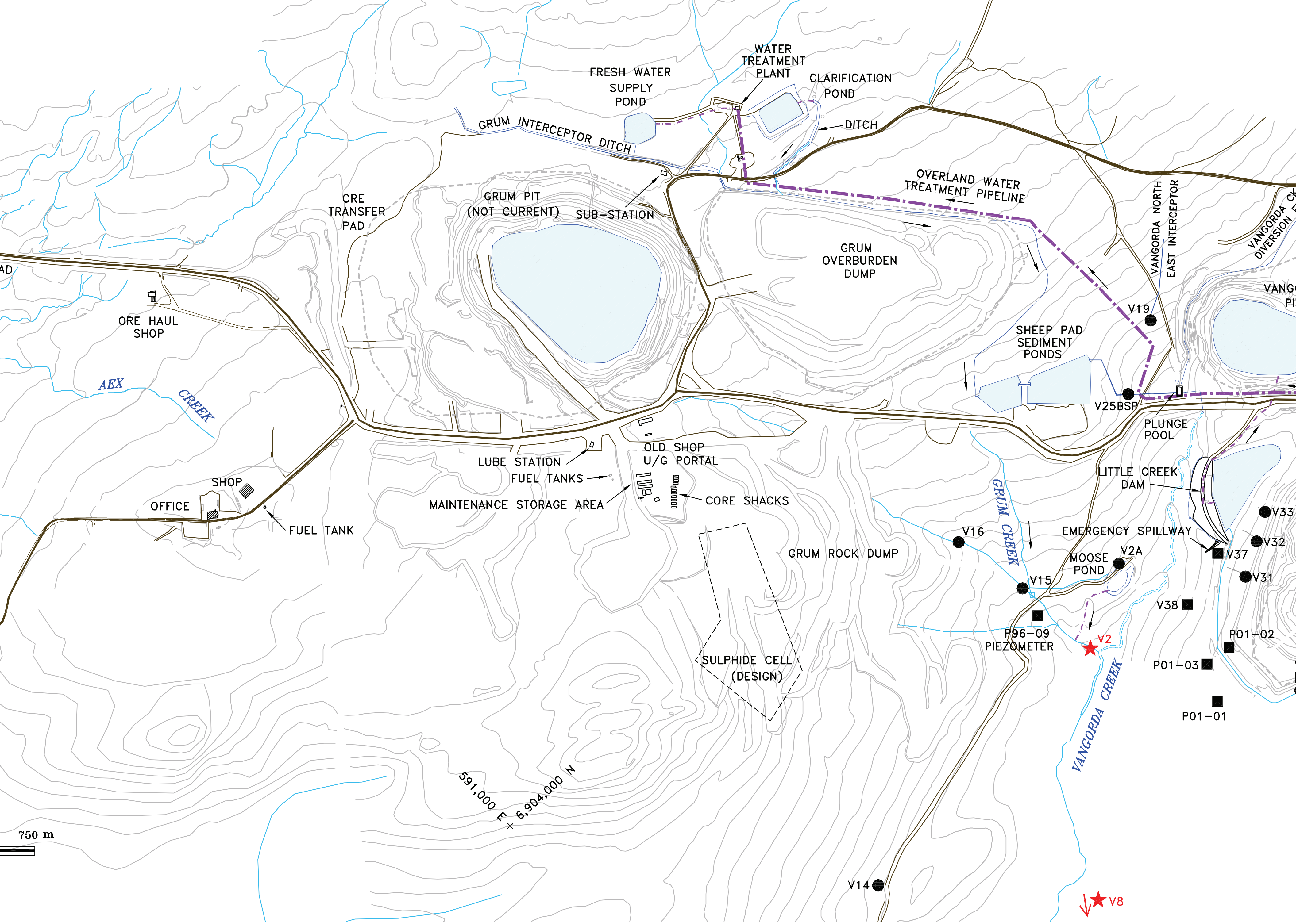
SOURCES OF INFORMATION:

1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON GEOCONSULTANTS INC.
3. VANGORDA MINE DETAILS PROVIDED BY ANVIL RANGE MINING CORPORATION

DRAWING INFORMATION:

ANVIL RANGE MINING CORPORATION
(INTERIM RECEIVER)
ADAPTIVE MANAGEMENT PLAN (AMP)
IMPLEMENTATION PROTOCOL

OVERVIEW OF AMP



WATER TREATMENT PIPELINE

SURFACE WATER

AGE

SOURCES OF INFORMATION:

1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON

DRAWING INFORMATION:

Appendices

Appendix A

Statistical Analysis

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Table A1. Reference Period Water Quality (1998 - 2002)

Station X24 - Rose Creek Valley Aquifer @ Intermediate Dam

X24A - 6.5 m	Dissolved Iron	Dissolved Zinc	Sulphate
Date Sampled	**(mg/l)**	**(mg/l)**	**(mg/l)**
06/01/98	0.27	<0.01	733
10/31/98	0.97	<0.01	734
06/19/99	0.19	0.26	717
10/29/99	0.06	<0.01	579
06/27/00	0.02	*2.5*	515
10/10/00	0.18	0.01	281
06/06/01	0.1	<0.01	438
09/06/01	<0.03	0.005	579
06/12/02	<0.03	<0.03	750
09/23/02	<0.03	<0.01	39
Minimum	0.020	0.005	39
25 Percentile	0.030	0.01	457.25
Median	0.080	0.01	579
75 Percentile	0.188	0.01	729
Maximum	0.970	0.26	750
Number of Samples	10	9	10
Number of Non-detects	3	6	0
X24C - 16.5 m			
06/01/98	0.28	<0.01	778
10/31/98	0.43	<0.01	980
06/19/99	0.15	0.17	684
10/29/99	<0.01	<0.01	<1
07/25/00	0.24	0.41	789
06/06/01	0.07	0.02	765
09/06/01	0.04	0.009	764
06/12/02	0.1	<0.03	1140
09/23/02	0.05	<0.03	1030
Minimum	0.010	0.009	1
25 Percentile	0.050	0.01	764
Median	0.100	0.02	778
75 Percentile	0.240	0.03	980
Maximum	0.430	0.41	1140
Number of Samples	9	9	9
Number of Non-detects	1	5	1
X24D - 28.3 m			
06/01/98	0.29	0.03	713
10/31/98	0.34	0.02	997
06/19/99	0.44	0.17	1084
10/29/99	<0.01	0.05	1050
06/27/00	0.1	*2.84*	922
10/10/00	0.22	<0.01	447
06/06/01	0.02	0.03	1026
09/06/01	<0.03	0.028	1020
06/12/02	<0.03	0.03	1060
09/23/02	<0.03	0.03	1150
Minimum	0.010	0.01	447
25 Percentile	0.030	0.0285	940.75
Median	0.065	0.03	1023
75 Percentile	0.273	0.045	1057.5
Maximum	0.440	2.84	1150
Number of Samples	10	10	10
Number of Non-detects	4	1	1

"Italics" = Value not included in Statistical Analysis

Table A2. Trend Analysis Statistical Summary (1998 - 2002)

Station X24 - Rose Creek Valley Aquifer @ Intermediate Dam

X24A (6.5m) Date Sampled	Dissolved Iron (mg/l)	Dissolved Zinc (mg/l)	Sulphate (mg/l)
Slope	-3.23×10^{-4}	-3.61×10^{-5}	-0.245
Intercept	12.070	1.364	9555.4
Regression Coefficient (R^2)	0.368	0.062	0.327
F Statistic	4.650	0.46	3.889
Degress of Freedom	8	7	8
Critical F-Statistic	5.32	5.59	5.32
Significant "+" or "-" Trend	No	No	No
X24C (16.5m)			
Slope	-1.62×10^{-4}	-1.513×10^{-5}	0.214
Intercept	6.130	0.634	-7085.9
Regression Coefficient (R^2)	0.450	0.004	0.141
F Statistic	5.720	0.029	1.148
Degress of Freedom	7	7	7
Critical F-Statistic	5.59	5.59	5.59
Significant "+" or "-" Trend	Decreasing Trend	No	No
X24D (28.3m)			
Slope	-2.18×10^{-4}	-2.308×10^{-5}	0.123
Intercept	8.150	0.893	-3602.8
Regression Coefficient (R^2)	0.546	0.075	0.099
F Statistic	9.630	0.564	0.885
Degress of Freedom	8	7	8
Critical F-Statistic	5.32	5.59	5.32
Significant "+" or "-" Trend	Decreasing Trend	No	No

"+" Increasing Trend
"-" Decreasing Trend

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Table A3. Reference Period Water Quality (1998 - 2002)

Station X25 - Rose Creek Valley Aquifer @ Intermediate Dam

X25A - 9.0 m Date Sampled	Dissolved Iron (mg/l)	Dissolved Zinc (mg/l)	Sulphate (mg/l)
06/01/98	0.21	<0.01	209
10/31/98	0.14	0.01	285
06/19/99	0.06	0.07	292
10/29/99	<0.01	<0.01	294
06/27/00	<0.01	0.57	276
10/10/00	0.16	<0.01	206
06/06/01	0.02	0.19	287
07/15/01	<0.01	0.01	294
06/12/02	0.17	<0.01	312
09/24/02	0.24	<0.01	292
Minimum	0.010	0.01	206
25 Percentile	0.013	0.01	278.25
Median	0.100	0.01	289.5
75 Percentile	0.168	0.055	293.5
Maximum	0.240	0.57	312
Number of Samples	10	10	10
Number of Non-detects	3	5	0
X25B - 19.2 m			
06/01/98	0.24	<0.01	372
10/31/98	0.15	0.01	429
06/19/99	0.21	0.03	445
10/29/99	<0.01	<0.01	408
06/27/00	<0.01	0.47	348
10/10/00	0.16	<0.01	177
06/06/01	0.55	<0.01	344
07/15/01	<0.01	0.03	381
09/05/01	0.5	<0.005	334
06/12/02	0.48	<0.01	333
09/24/02	0.51	<0.01	341
Minimum	0.010	0.005	177
25 Percentile	0.080	0.01	337.5
Median	0.210	0.01	348
75 Percentile	0.490	0.02	394.5
Maximum	0.550	0.47	445
Number of Samples	11	11	11
Number of Non-detects	3	7	0

"Italics" = Value not included in Statistical Analysis

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Table A4. Trend Analysis Statistical Summary (1998 - 2002)

Station X25 - Rose Creek Valley Aquifer @ Intermediate Dam

X25A - 9.0 m Date Sampled	Dissolved Iron (mg/l)	Dissolved Zinc (mg/l)	Sulphate (mg/l)
Slope	1.44×10^{-5}	-3.27×10^{-6}	0.03
Intercept	-0.426	-0.03	-830.4
Regression Coefficient (R^2)	0.007	9.67×10^{-5}	0.194
F Statistic	0.058	0.0008	1.93
Degress of Freedom	8	8	8
Critical F-Statistic	5.32	5.32	5.32
Significant "+" or "-" Trend	No	No	No
X25B - 19.2 m			
Slope	0.000	-1.433×10^{-5}	-0.0563
Intercept	-8.160	0.582	2428.7
Regression Coefficient (R^2)	0.306	0.003	0.172
F Statistic	3.980	0.027	1.869
Degress of Freedom	9	9	9
Critical F-Statistic	5.12	5.12	5.12
Significant "+" or "-" Trend	No	No	No

"+" Increasing Trend
"-" Decreasing Trend

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Table A5. Reference Period Water Quality (1998 - 2002)

Station V8 - Lower Vangorda Creek

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)	TSS (mg/l)
01/13/98	0.006	0.02	132	8
03/17/98	0.015	0.03	46	<1
04/14/98	0.037	0.26	136	4
05/19/98	0.031	0.07	24	13
06/30/98	0.008	0.02	86	1
07/21/98	0.036	0.04	27	<1
08/11/98	0.03	0.01	123	4
09/15/98	0.017	0.03	48	29
10/19/98	0.014	0.04	62	<1
11/17/98	0.025	0.04	179	2
12/31/98	0.04	0.02	111	2
01/19/99	0.034	0.02	190	3
02/23/99	0.026	0.06	136	5
03/23/99	0.034	0.08	238	12
04/20/99	0.02	<0.01	174	7
05/18/99	0.017		39	47
06/20/99	0.005	0.09	12	184
07/29/99	0.0204	0.021	31	85
08/30/99	0.0081	0.0054	36	3
10/12/99	0.02	<0.01	61	5
12/14/99	0.034	0.04	85	1
02/28/00	0.027	0.02	111	<1
03/23/00	0.006	0.01	109	1
04/27/00	0.018		128	3
05/15/00	0.013		67	1
06/20/00	0.012	0.01	22	1
07/25/00	0.013		33	9
08/29/00	0.003		34	44
09/12/00	0.021		47	16
09/26/00	<0.01		55	129
10/29/00	0.046	0.05	328	2
11/13/00	0.015	0.04	87	2
11/18/00	<0.01		100	1.4
12/14/00	<0.01		119	1.2
01/13/01	0.023	<0.01	219	2
02/10/01	0.017	<0.01	274	2
03/05/01	0.028		703	8
03/10/01	0.016	0.03	153	2
04/16/01	<0.002	0.03	138	4
05/14/01	0.008	0.02	76	9
06/13/01	0.011	0.06	20	31
06/17/01	0.011	0.04	23	30
07/14/01	0.002	0.02	54	8
08/14/01	0.005	0.05	75	9
09/08/01	0.028	0.03	64	2
09/17/01	0.006	0.02	61	3
10/15/01	0.003	0.05	94	8
11/13/01	0.012	0.05	98	6
12/14/01	<0.002	0.02	100	<1

Table A5. Reference Period Water Quality (1998 - 2002)

Station V8 - Lower Vangorda Creek

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)	TSS (mg/l)
01/15/02	0.003		135	<1
02/12/02	0.016		136	7
03/12/02	0.005		150	7
03/21/02	<0.002		175	4
04/15/02	0.003		168	8
05/13/02	0.008		56	45
06/16/02	0.007	0.016	37	12
06/25/02	0.012	0.042	105	5
07/16/02	0.016	0.041	200	6
08/12/02	0.016	0.025	239	8
09/16/02	0.021	0.021	60	6
09/27/02	0.021	0.021	66	3
10/15/02	0.025	0.058	74	5
11/12/02	0.024	0.02	100	7
12/10/02	0.023	0.036	119	5
12/15/02	0.014	0.054	113	6
Minimum	0.002	0.0054	12	1
25 Percentile	0.008	0.02	55	2
Median	0.015	0.03	98	5
75 Percentile	0.023	0.042	136	8
Maximum	0.046	0.26	703	184
Number of Samples	65	49	65	65
Number of Non-detects	6	4	0	6

Table A6. Trend Analysis Statistical Summary (1998 - 2002)

Station V8 - Lower Vangorda Creek

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)	TSS (mg/l)
Slope	-7.338×10^{-6}	-1.234×10^{-5}	0.0179	-0.0058
Intercept	0.287	0.491	-545.39	226.8
Regression Coefficient (R^2)	0.131	0.0349	0.0009	0.0106
F Statistic	9.481	1.698	0.573	0.677
Degress of Freedom	63	47	63	63
Critical F-Statistic	4.00	4.04	4.00	4.00
Significant "+" or "-" Trend	Yes "-"	No	No	No

"+" Increasing Trend

"-" Decreasing Trend

Table A7. Reference Period Water Quality (1999 - 2002)

Station X14 - Rose Creek Downstream of Mixing Zone

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
01/18/99	0.035	0.06	265
02/22/99	0.022	0.03	326
03/17/99	0.033	0.04	268
04/20/99	0.02	0.03	201
05/17/99	0.022	0.07	23
07/03/99	0.023	0.05	38
07/27/99	0.005	0.04	32
08/12/99	0.005	0.08	135
09/10/99	0.015	0.05	119
10/29/99	<0.002	0.02	76
11/22/99	0.027	0.05	104
12/14/99	0.03	0.08	114
01/27/00	0.027	0.02	206
02/28/00	0.032	0.64	179
03/23/00	0.009	0.03	185
04/27/00	0.026	0.09	324
05/15/00	0.008	0.07	60
06/26/00	0.008	0.1	83
07/25/00	0.016	0.14	153
08/29/00	0.004	0.1	63
09/25/00	<0.002	0.01	9
10/29/00	0.024	0.07	70
11/13/00	<0.002	0.07	83
11/18/00	<0.01	0.088	11
12/14/00	<0.01	0.051	96
01/13/01	0.021	0.07	111
02/10/01	0.03	0.11	142
03/10/01	0.02	0.04	153
04/16/01	0.004	0.08	166
05/14/01	0.015	0.12	130
06/17/01	0.006	0.03	18
07/14/01	0.014	0.04	56
08/14/01	0.006	0.04	138
09/17/01	0.002	0.03	83
10/15/01	<0.002	0.11	288
11/13/01	<0.002	0.07	83
12/15/01	<0.002	0.08	241
01/15/02	0.014	0.05	81
02/12/02	0.013	0.02	78
03/12/02	0.004	0.03	190
04/15/02	0.004	0.03	211

Table A7. Reference Period Water Quality (1999 - 2002)

Station X14 - Rose Creek Downstream of Mixing Zone

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
05/13/02	0.007	0.07	42
06/16/02	0.009	0.031	27
07/16/02	0.016	0.034	166
08/12/02	0.005	0.018	41
09/16/02	0.023	0.107	118
10/15/02	0.02	0.031	38
11/12/02	0.017	0.04	64
12/10/02	0.022	0.059	92
Minimum	0.002	0.01	9
25 Percentile	0.005	0.031	63
Median	0.014	0.05	104
75 Percentile	0.022	0.08	166
Maximum	0.035	0.64	326
Number of Samples	49	49	49
Number of Non-detects	8	0	0

Table A8. Trend Analysis Statistical Summary (1999 - 2002)

Station X14 - Rose Creek Downstream of Mixing Zone

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
Slope	-8.47×10^{-6}	-2.44×10^{-5}	-0.05
Intercept	0.327	0.969	1972.46
Regression Coefficient (R^2)	0.131	0.013	0.0647
F Statistic	7.095	0.632	3.249
Degress of Freedom	47	47	47
Critical F-Statistic	4.04	4.04	4.04
Significant "+" or "-" Trend	Yes "-"	No	No

"+" Increasing Trend
"-" Decreasing Trend

Table A9. Reference Period Water Quality (1998 - 2002)

Station V2 - Grum Creek to Vangorda Creek

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
01/12/98	0.008	0.02	82
03/17/98	0.018	<0.01	28
05/18/98	0.032	0.1	234
06/29/98	0.022	0.01	115
09/14/98	0.026	0.03	125
12/31/98	0.057	0.04	154
03/17/99	0.036	0.07	202
06/18/99	0.032	0.11	180
09/10/99	0.017	0.24	169
10/12/99	0.027	<0.01	191
12/13/99	0.036	0.05	146
03/22/00	0.012	<0.01	183
06/20/00	0.035	0.25	571
09/12/00	0.061		638
11/12/00	0.013	0.54	543
03/05/01	0.029	0.09	380
06/13/01	0.006	3.35	849
09/08/01	0.009	1.41	643
11/12/01	0.013	0.54	543
01/15/02	0.003		564
02/12/02	0.004		527
03/21/02	<0.002		488
04/15/02	0.004		349
05/13/02	0.010		482
06/25/02	0.013	0.038	615
09/27/02	0.017	0.011	622
12/15/02	0.016	0.011	620
Minimum	0.002	0.01	28
25 Percentile	0.010	0.011	174.5
Median	0.017	0.05	380
75 Percentile	0.031	0.24	567.5
Maximum	0.061	3.35	849
Number of Samples	27	21	27
Number of Non-detects	1	3	0

Table A10. Trend Analysis Statistical Summary (1998 - 2002)

Station V2 - Grum Creek to Vangorda Creek

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
Slope	-1.252×10^{-5}	0.0004	0.328
Intercept	0.481	-14.319	-11679.25
Regression Coefficient (R^2)	0.216	0.0877	0.672
F Statistic	6.888	1.825	51.298
Degress of Freedom	25	19	25
Critical F-Statistic	4.240	4.38	4.24
Significant "+" or "-" Trend	Yes "-"	No	Yes "+"

"+" Increasing Trend

"-" Decreasing Trend

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Table A11. Reference Period Water Quality (1998 - 2002)

Station X2 - North Fork Rose Creek at Access Road

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
01/12/98	0.007	0.03	21
02/24/98	0.011	0.05	24
03/17/98	0.014	0.02	7
04/13/98	0.042	0.35	22
05/18/98	0.027	0.05	6
06/15/98	0.05	0.06	19
07/21/98	0.037	0.04	6
08/10/98	0.053	0.03	21
09/25/98	0.028	0.04	14
10/19/98	0.018	0.03	18
11/17/98	0.023	0.03	28
12/21/98	0.028	0.02	32
01/18/99	0.034	0.03	31
02/22/99	0.027	0.07	32
03/17/99	0.049	0.02	26
04/20/99	0.026	0.02	24
05/17/99	0.016	0.05	4
07/03/99	0.018	0.05	8
07/27/99	0.009	<0.01	7
08/12/99	0.014	0.02	11
09/10/99	0.014	<0.01	10
10/29/99	0.007	0.02	19
11/22/99	0.037	<0.01	23
12/14/99	0.021	0.09	21
01/27/00	0.021	0.09	32
02/28/00	0.253	0.39	24
03/23/00	0.007	0.02	23
04/27/00	0.027	0.22	26
05/15/00	0.012	0.11	8
06/26/00	0.018	0.33	6
07/25/00	0.02	0.5	9
08/29/00	0.006	0.13	9
09/25/00	<0.01	0.022	11
10/29/00	0.03	0.01	13
11/13/00	<0.002	0.06	21
11/18/00	<0.01	0.03	19
12/14/00	<0.01	0.022	21
01/13/01	0.028	0.02	43
02/10/01	0.031	0.02	52
03/10/01	0.03	0.03	29
04/16/01	0.006	0.02	25

Table A11. Reference Period Water Quality (1998 - 2002)

Station X2 - North Fork Rose Creek at Access Road

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
05/14/01	0.009	0.07	13
06/17/01	0.012	0.02	5
07/14/01	0.002	0.06	9
08/14/01	0.007	0.03	13
09/17/01	0.007	0.03	15
10/15/01	<0.002	<0.01	22
11/13/01	<0.002	0.06	21
12/15/01	<0.002	0.02	22
01/15/02	0.005	0.09	28
02/12/02	<0.002	0.01	28
03/12/02	0.004	0.05	30
04/15/02	0.009	0.04	34
05/13/02	0.005	0.07	12
06/16/02	0.011	0.03	10
07/16/02	0.02	0.017	14
08/12/02	0.012	0.009	17
09/16/02	0.028	0.011	12
10/15/02	0.048	0.024	17
11/12/02	0.015	0.031	27
12/10/02	0.024	0.034	29
Minimum	0.002	0.009	4
25 Percentile	0.007	0.02	11
Median	0.015	0.03	21
75 Percentile	0.028	0.06	26
Maximum	0.253	0.5	52
Number of Samples	61	61	61
Number of Non-detects	8	4	0

Table A12. Trend Analysis Statistical Summary (1998 - 2002)

Station X2 - North Fork Rose Creek at Access Road

Date Sampled	Total Copper (mg/l)	Total Zinc (mg/l)	Sulphate (mg/l)
Slope	-1.191×10^{-5}	-2.12×10^{-5}	0.0018
Intercept	0.460	0.843	-48.296
Regression Coefficient (R^2)	0.036	0.0135	0.0097
F Statistic	2.224	0.807	0.581
Degress of Freedom	59	59	59
Critical F-Statistic	4.00	4.04	4.04
Significant "+" or "-" Trend	No	No	No

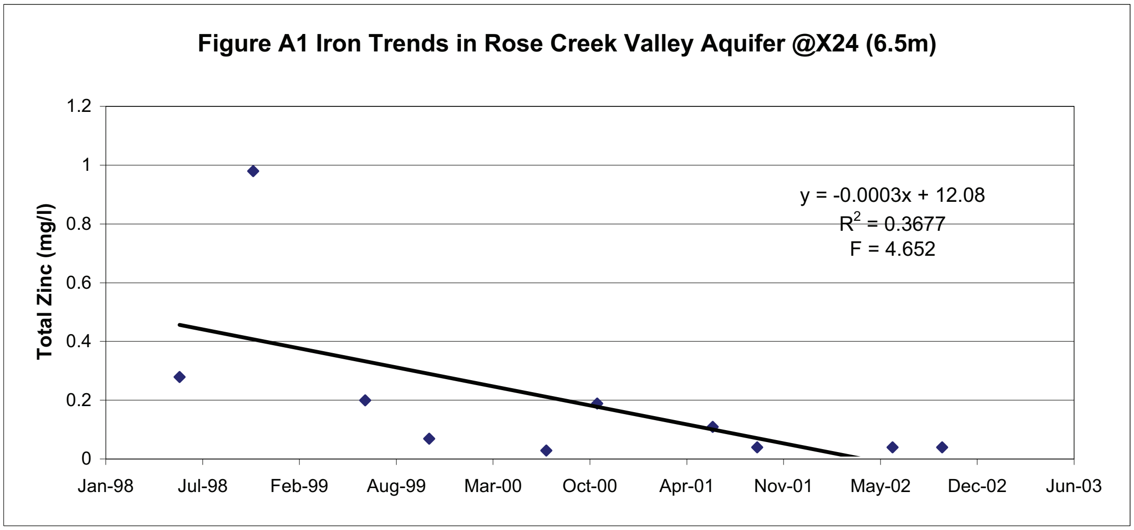


Figure A1 Iron Trends in Rose Creek Valley Aquifer @X24 (6.5m)
Total Zinc (mg/l)
1.2
1
0.8
0.6
0.4
0.2
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -0.0003x + 12.08
R^2 = 0.3677
F = 4.652

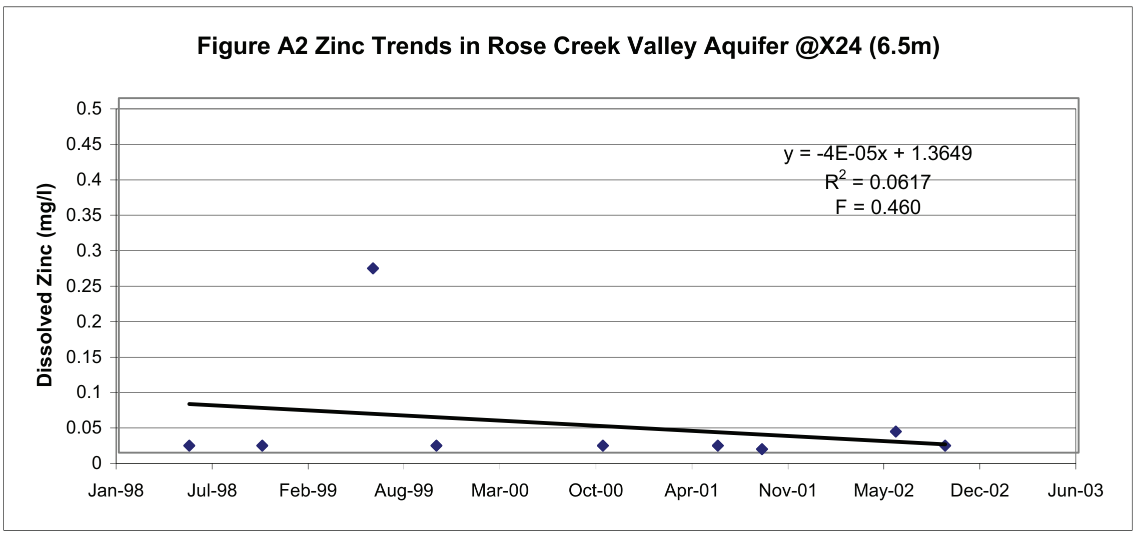


Figure A2 Zinc Trends in Rose Creek Valley Aquifer @X24 (6.5m)
Dissolved Zinc (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -4E-05x + 1.3649
R^2 = 0.0617
F = 0.460

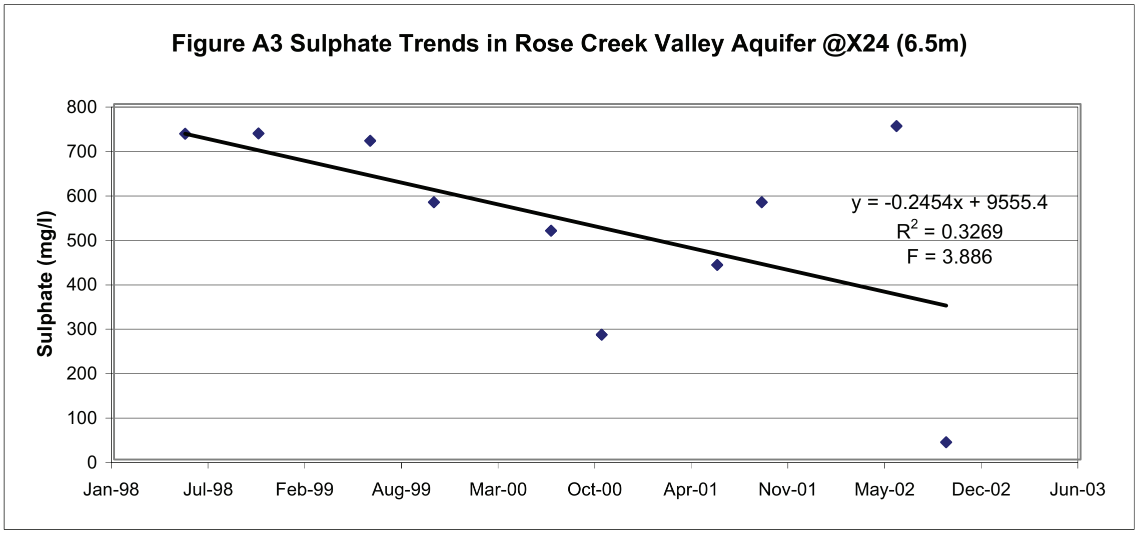


Figure A3 Sulphate Trends in Rose Creek Valley Aquifer @X24 (6.5m)
Sulphate (mg/l)
800
700
600
500
400
300
200
100
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -0.2454x + 9555.4
R2 = 0.3269
F = 3.886

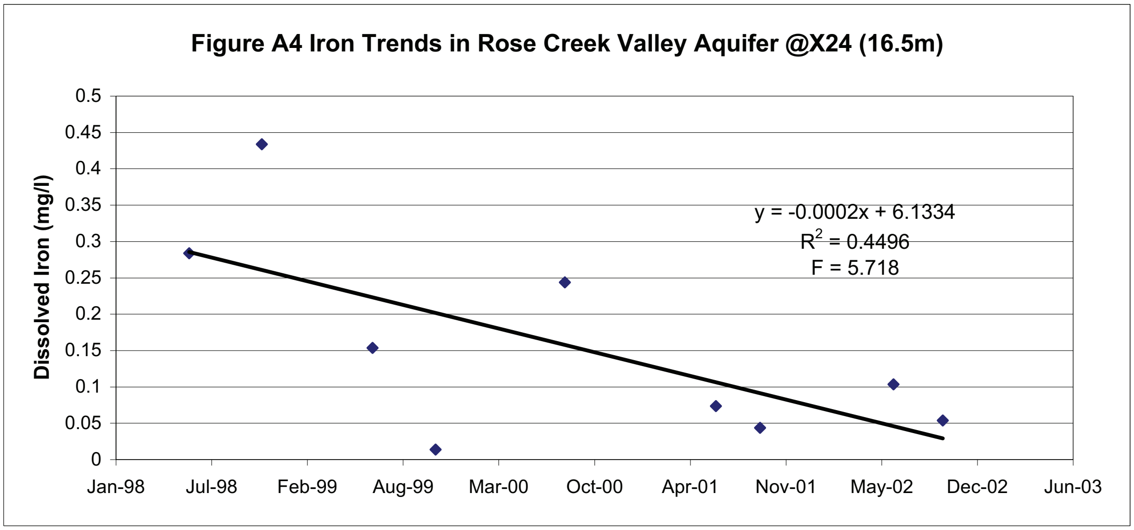


Figure A4 Iron Trends in Rose Creek Valley Aquifer @X24 (16.5m)
Dissolved Iron (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -0.0002x + 6.1334
R^2 = 0.4496
F = 5.718

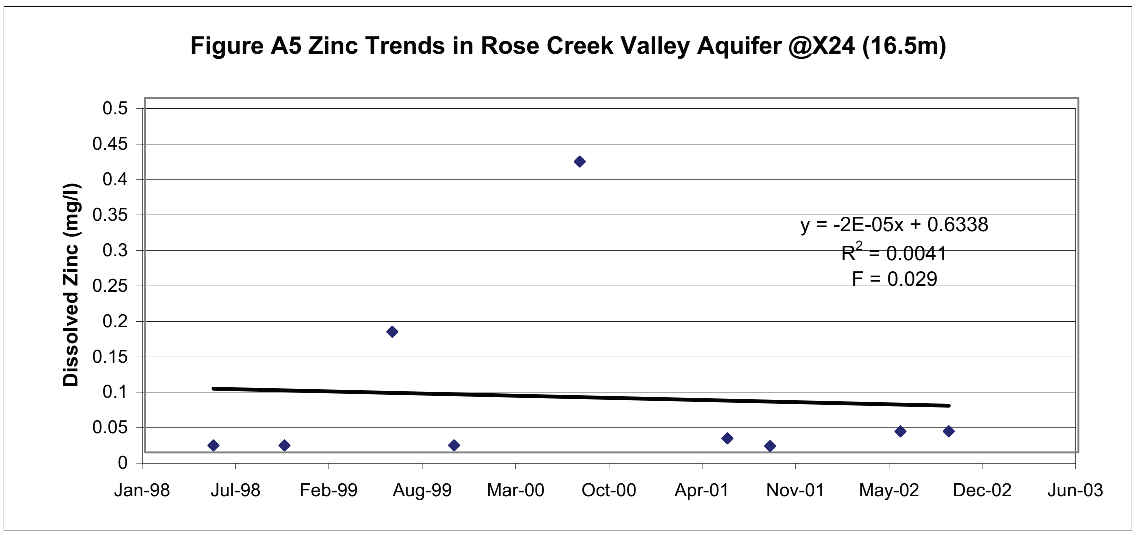


Figure A5 Zinc Trends in Rose Creek Valley Aquifer @X24 (16.5m)
Dissolved Zinc (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -2E-05x + 0.6338
R^2 = 0.0041
F = 0.029

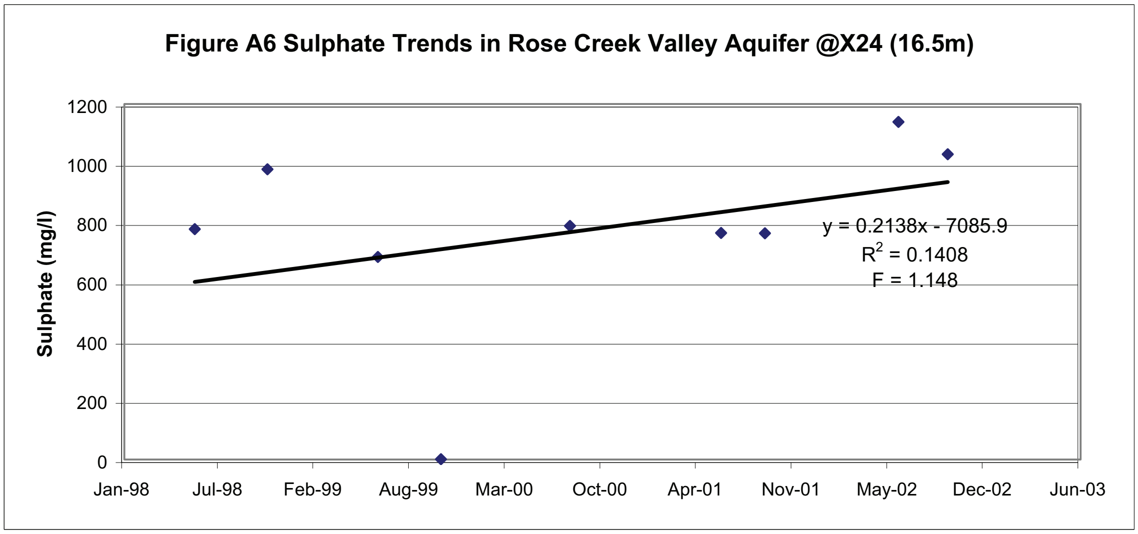


Figure A6 Sulphate Trends in Rose Creek Valley Aquifer @X24 (16.5m)
Sulphate (mg/l)
1200
1000
800
600
400
200
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = 0.2138x - 7085.9
R2 = 0.1408
F = 1.148

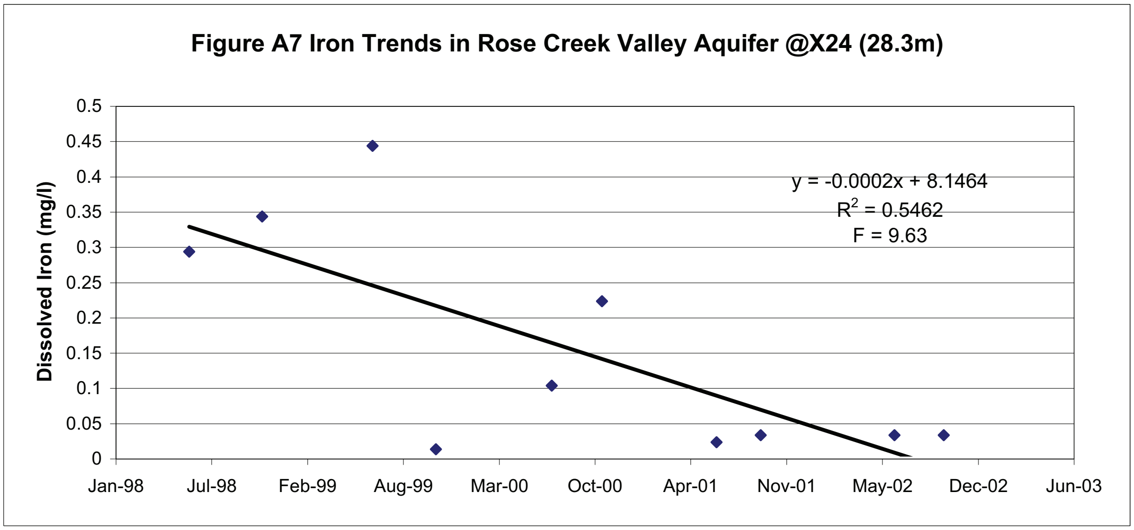


Figure A7 Iron Trends in Rose Creek Valley Aquifer @X24 (28.3m)
Dissolved Iron (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -0.0002x + 8.1464
R^2 = 0.5462
F = 9.63

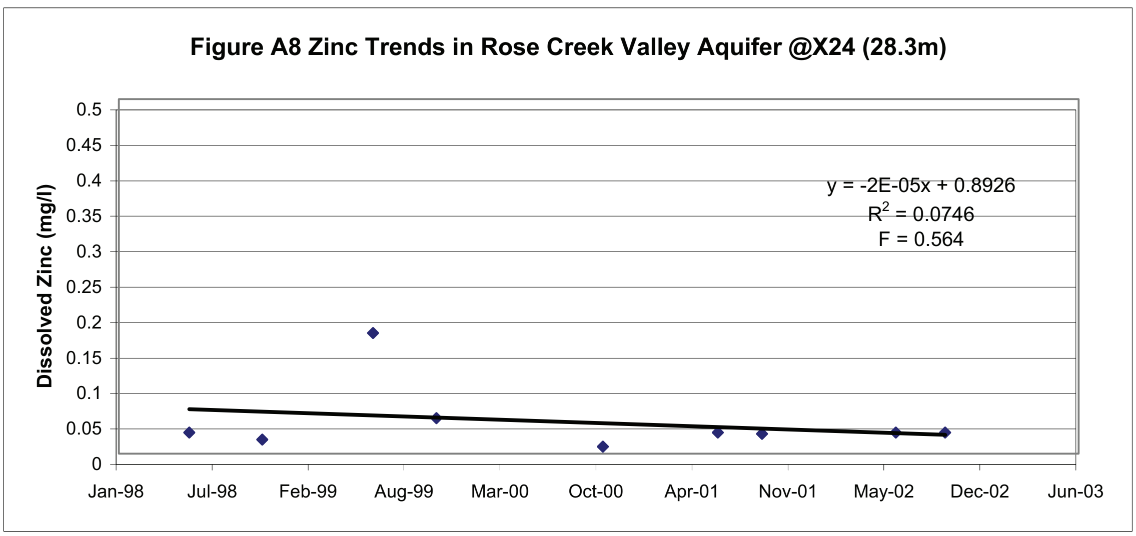


Figure A8 Zinc Trends in Rose Creek Valley Aquifer @X24 (28.3m)
Dissolved Zinc (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -2E-05x + 0.8926
R^2 = 0.0746
F = 0.564

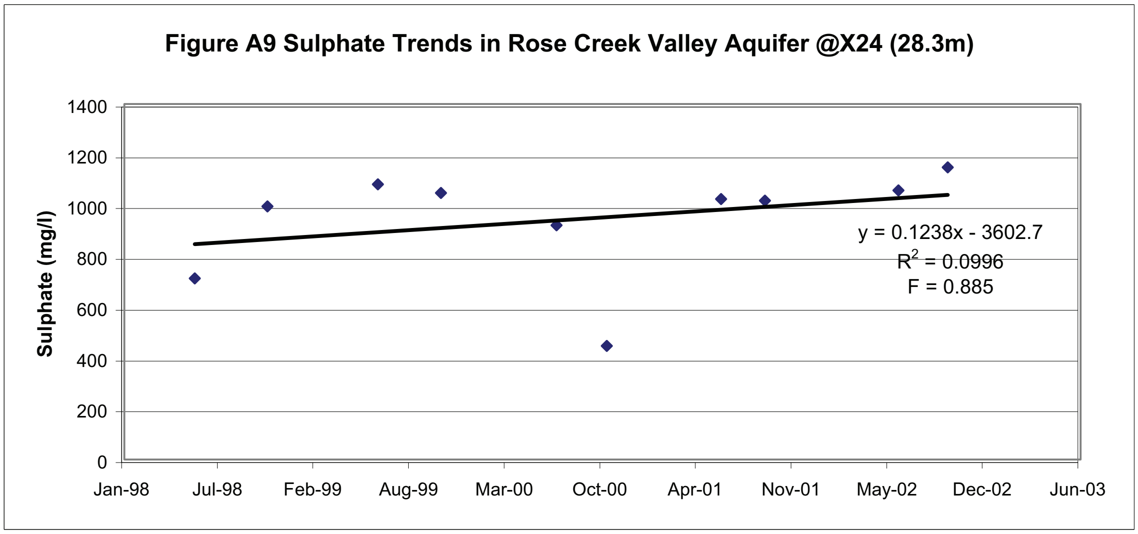


Figure A9 Sulphate Trends in Rose Creek Valley Aquifer @X24 (28.3m)
Sulphate (mg/l)
1400
1200
1000
800
600
400
200
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = 0.1238x - 3602.7
R2 = 0.0996
F = 0.885

Figure A10 Iron Trends in Rose Creek Valley Aquifer @X25 (9.0m)

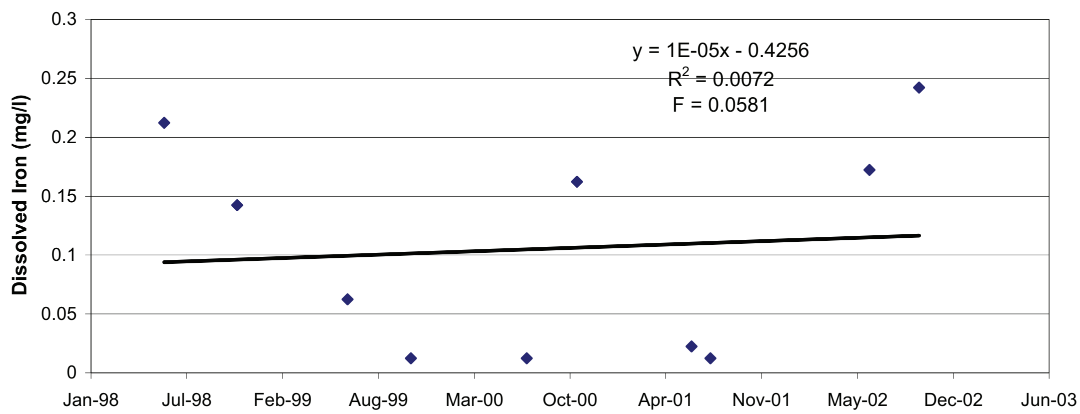
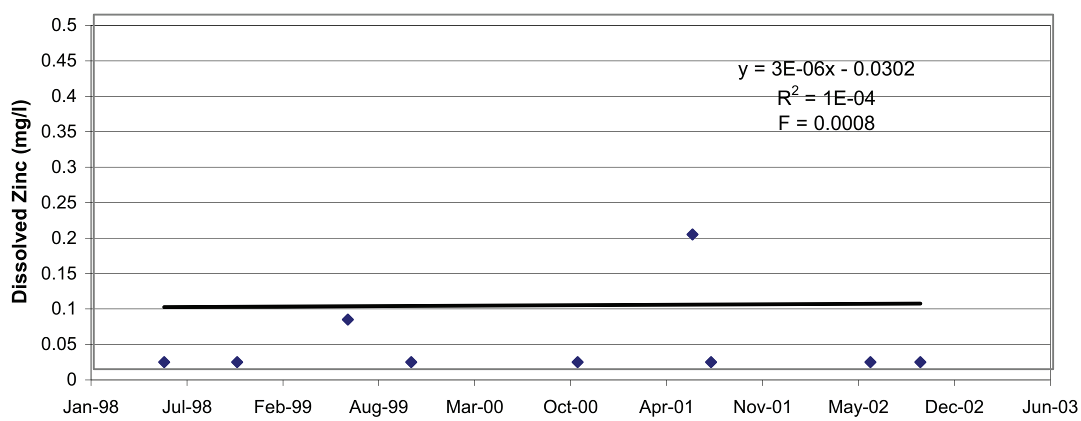


Figure A11 Zinc Trends in Rose Creek Valley Aquifer @X25 (9.0m)



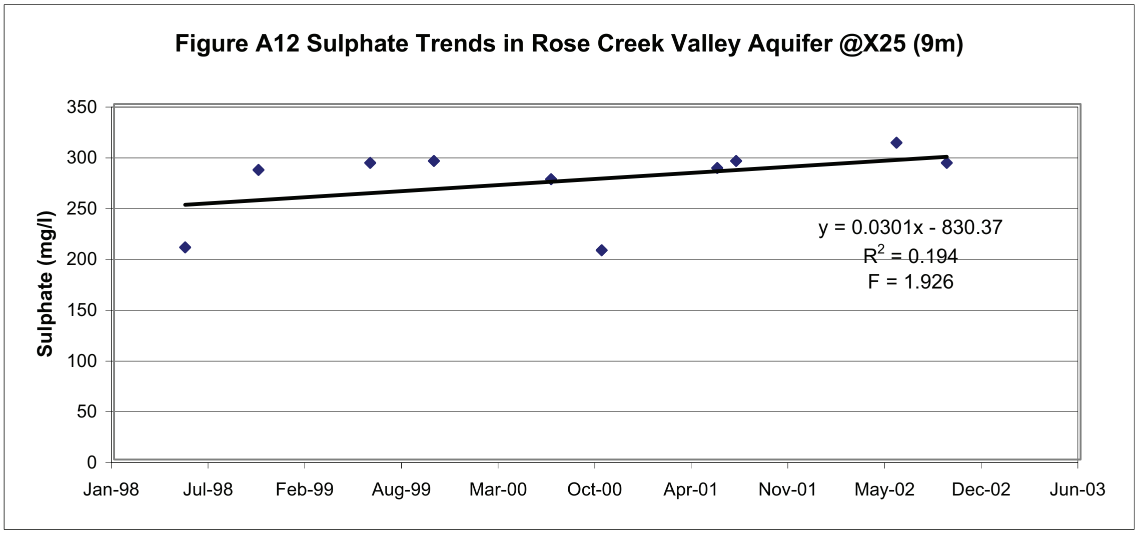


Figure A12 Sulphate Trends in Rose Creek Valley Aquifer @X25 (9m)
Sulphate (mg/l)
350
300
250
200
150
100
50
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = 0.0301x - 830.37
R^2 = 0.194
F = 1.926

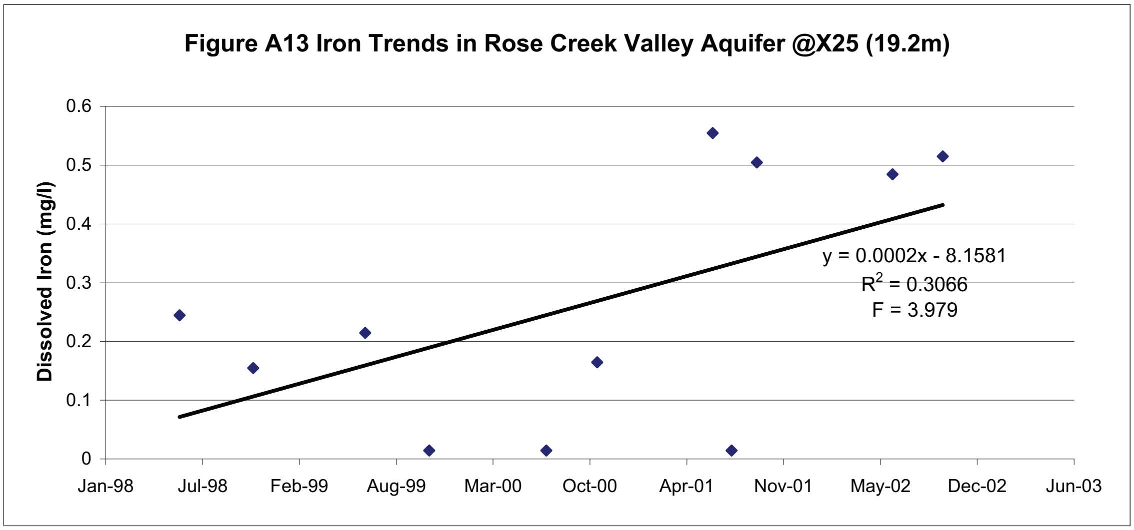


Figure A13 Iron Trends in Rose Creek Valley Aquifer @X25 (19.2m)
Dissolved Iron (mg/l)
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = 0.0002x - 8.1581
R^2 = 0.3066
F = 3.979

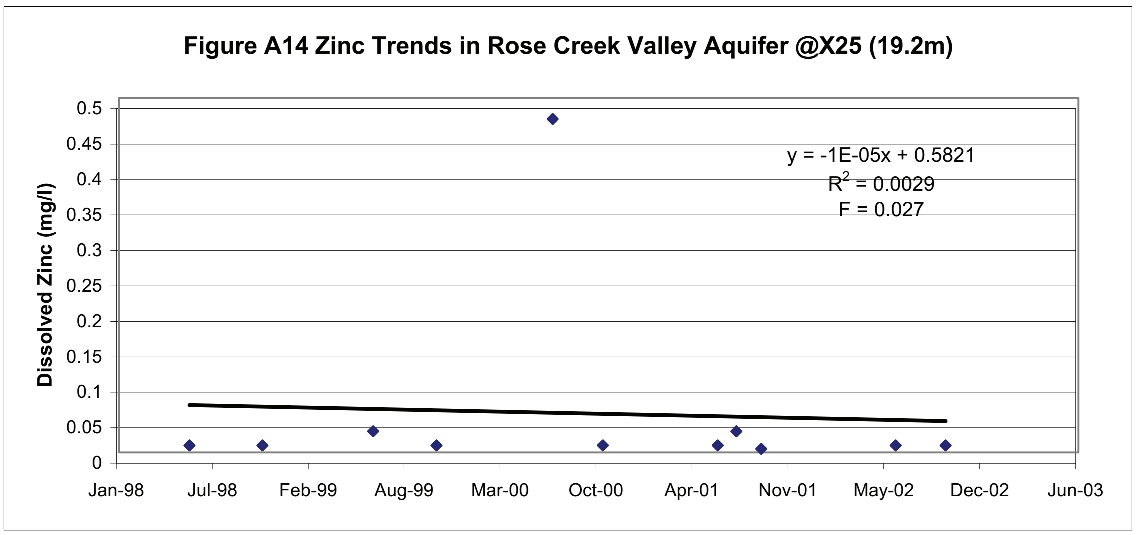


Figure A14 Zinc Trends in Rose Creek Valley Aquifer @X25 (19.2m)
Dissolved Zinc (mg/l)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -1E-05x + 0.5821
R^2 = 0.0029
F = 0.027

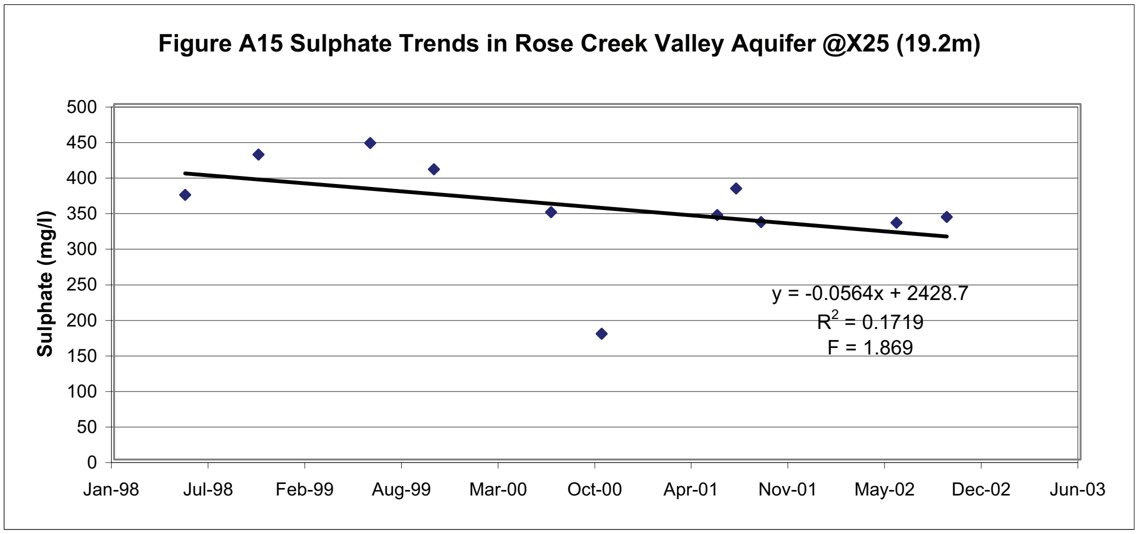


Figure A15 Sulphate Trends in Rose Creek Valley Aquifer @X25 (19.2m)
Sulphate (mg/l)
500
450
400
350
300
250
200
150
100
50
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -0.0564x + 2428.7
R2 = 0.1719
F = 1.869

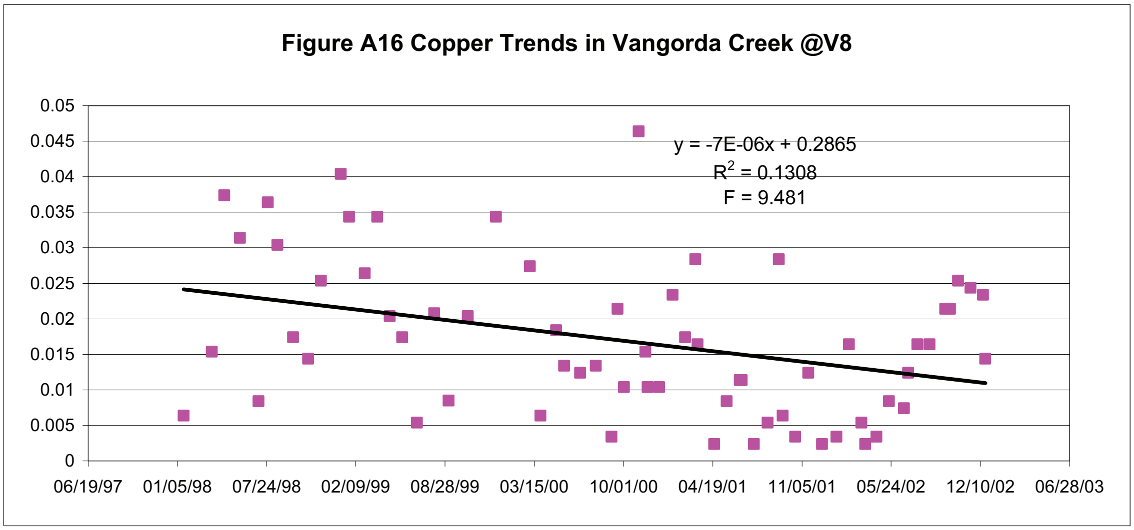


Figure A16 Copper Trends in Vangorda Creek @V8
y = -7E-06x + 0.2865
R2 = 0.1308
F = 9.481
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
06/19/97
01/05/98
07/24/98
02/09/99
08/28/99
03/15/00
10/01/00
04/19/01
11/05/01
05/24/02
12/10/02
06/28/03

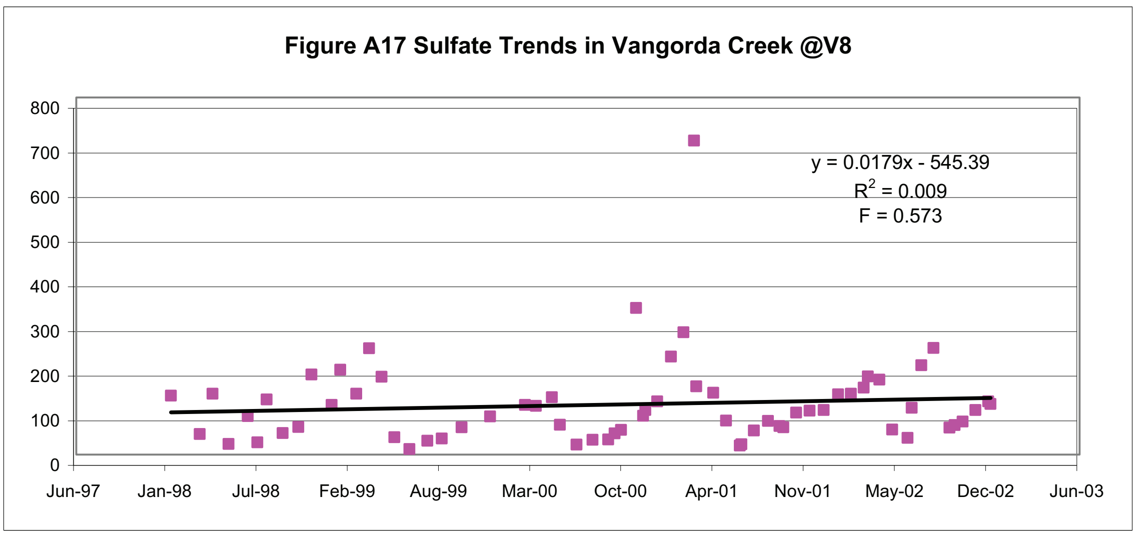


Figure A17 Sulfate Trends in Vangorda Creek @V8
y = 0.0179x - 545.39
R2 = 0.009
F = 0.573
800
700
600
500
400
300
200
100
0
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

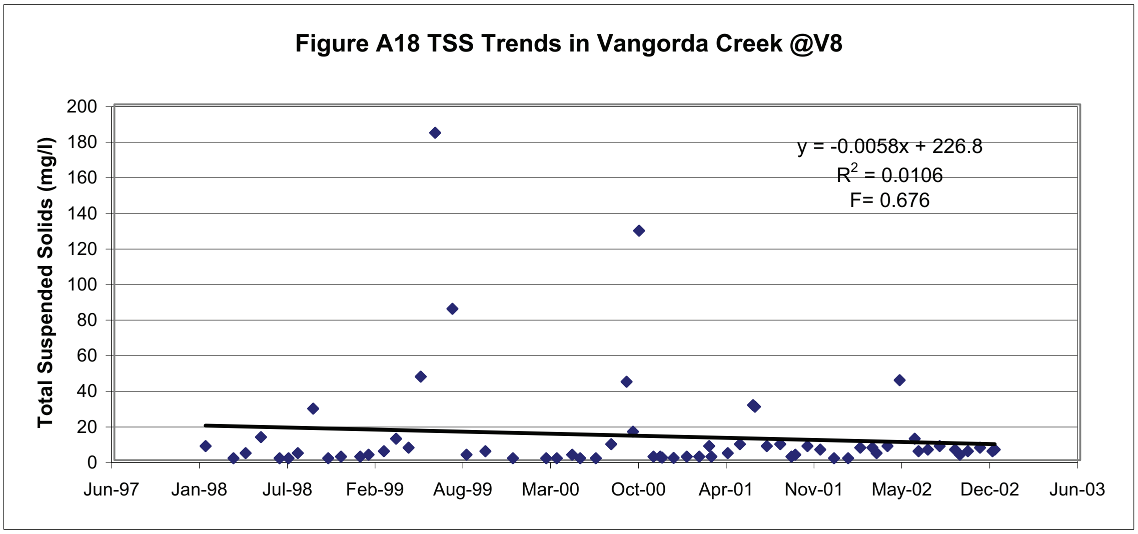


Figure A18 TSS Trends in Vangorda Creek @V8
Total Suspended Solids (mg/l)
200
180
160
140
120
100
80
60
40
20
0
y = -0.0058x + 226.8
R^2 = 0.0106
F= 0.676
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

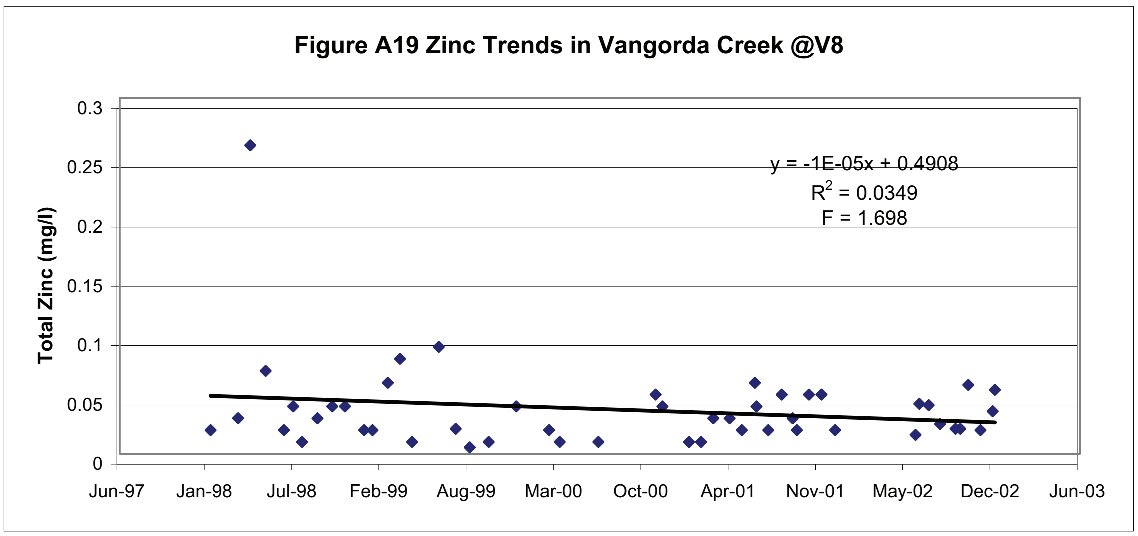


Figure A19 Zinc Trends in Vangorda Creek @V8
Total Zinc (mg/l)
0.3
0.25
0.2
0.15
0.1
0.05
0
y = -1E-05x + 0.4908
R^2 = 0.0349
F = 1.698
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

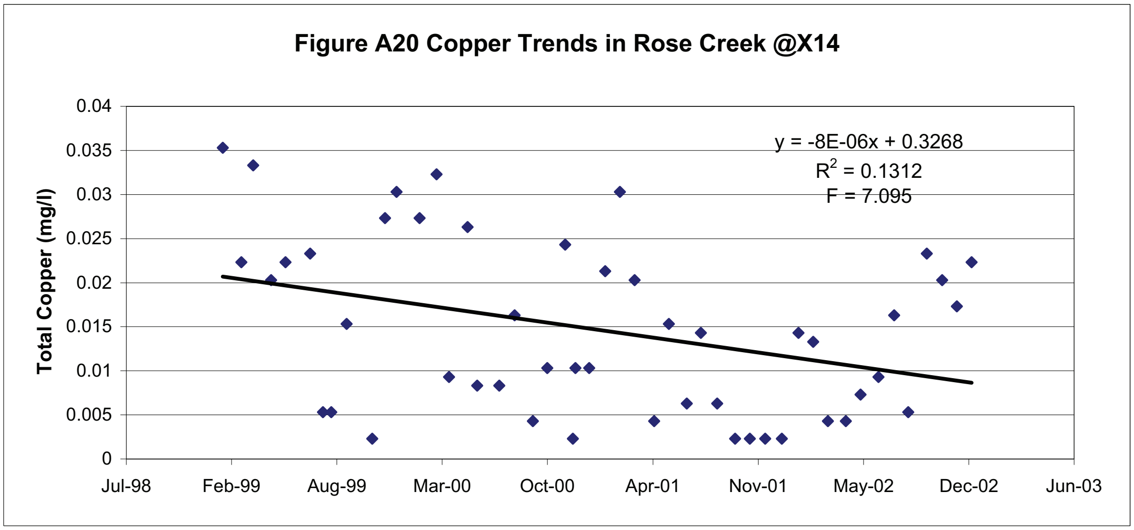


Figure A20 Copper Trends in Rose Creek @X14
y = -8E-06x + 0.3268
R2 = 0.1312
F = 7.095
Total Copper (mg/l)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

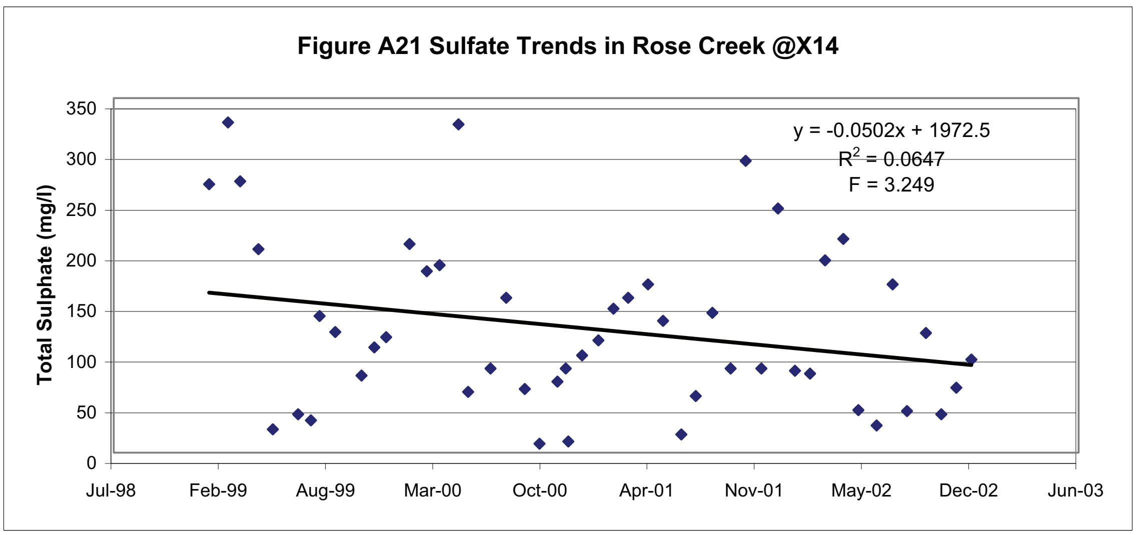


Figure A21 Sulfate Trends in Rose Creek @X14
y = -0.0502x + 1972.5
R2 = 0.0647
F = 3.249
Total Sulphate (mg/l)
350
300
250
200
150
100
50
0
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

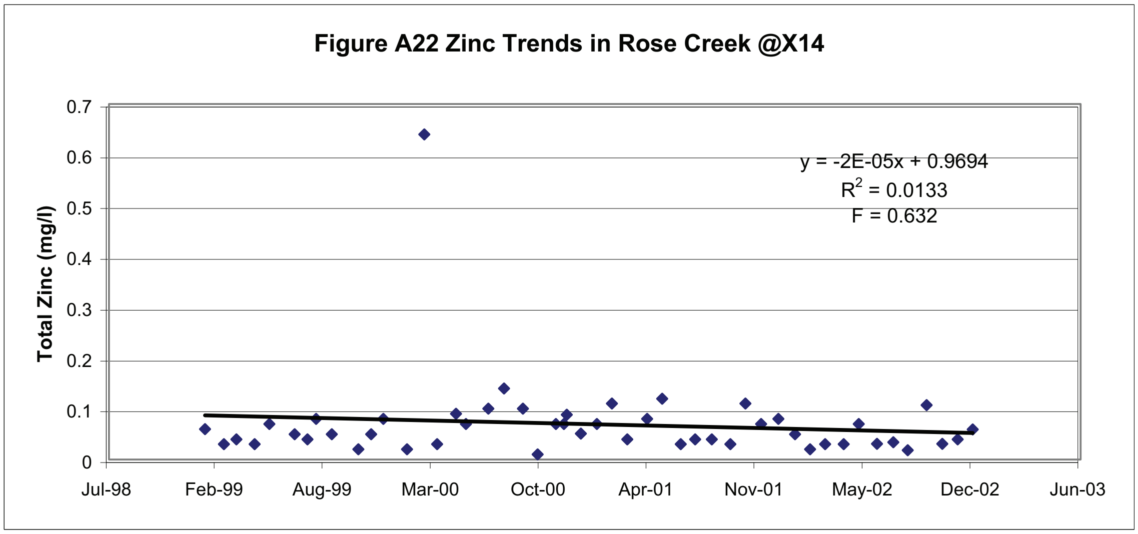


Figure A22 Zinc Trends in Rose Creek @X14
Total Zinc (mg/l)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
y = -2E-05x + 0.9694
R2 = 0.0133
F = 0.632
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

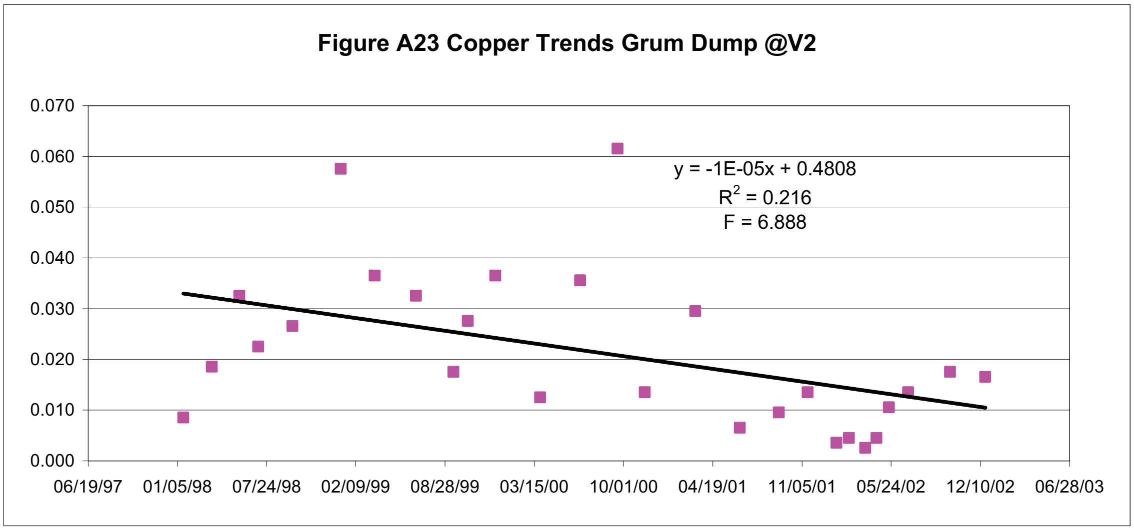


Figure A23 Copper Trends Grum Dump @V2
y = -1E-05x + 0.4808
R2 = 0.216
F = 6.888
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
06/19/97
01/05/98
07/24/98
02/09/99
08/28/99
03/15/00
10/01/00
04/19/01
11/05/01
05/24/02
12/10/02
06/28/03

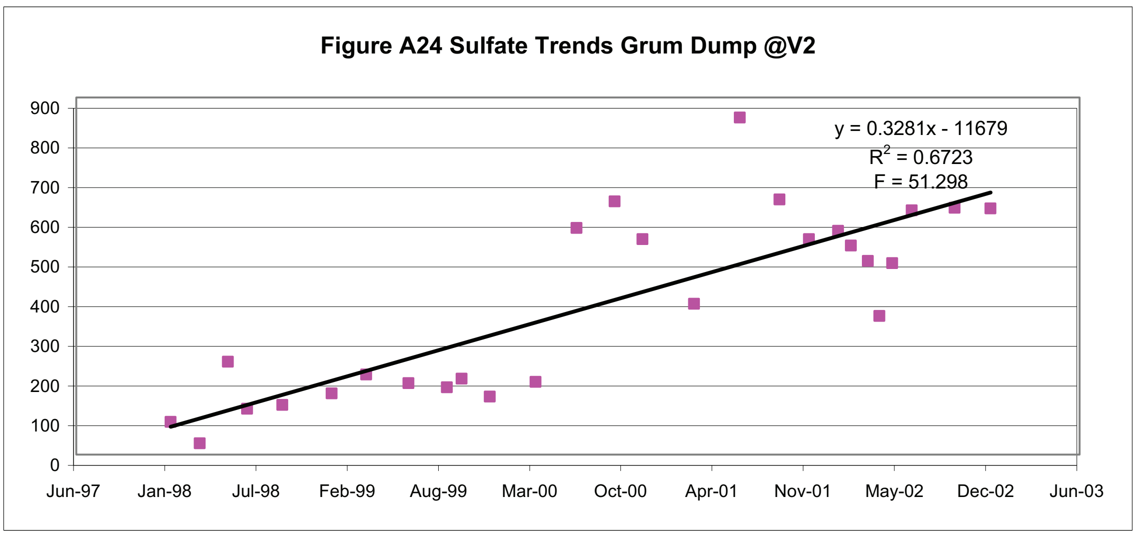


Figure A24 Sulfate Trends Grum Dump @V2
y = 0.3281x - 11679
R2 = 0.6723
F = 51.298
900
800
700
600
500
400
300
200
100
0
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

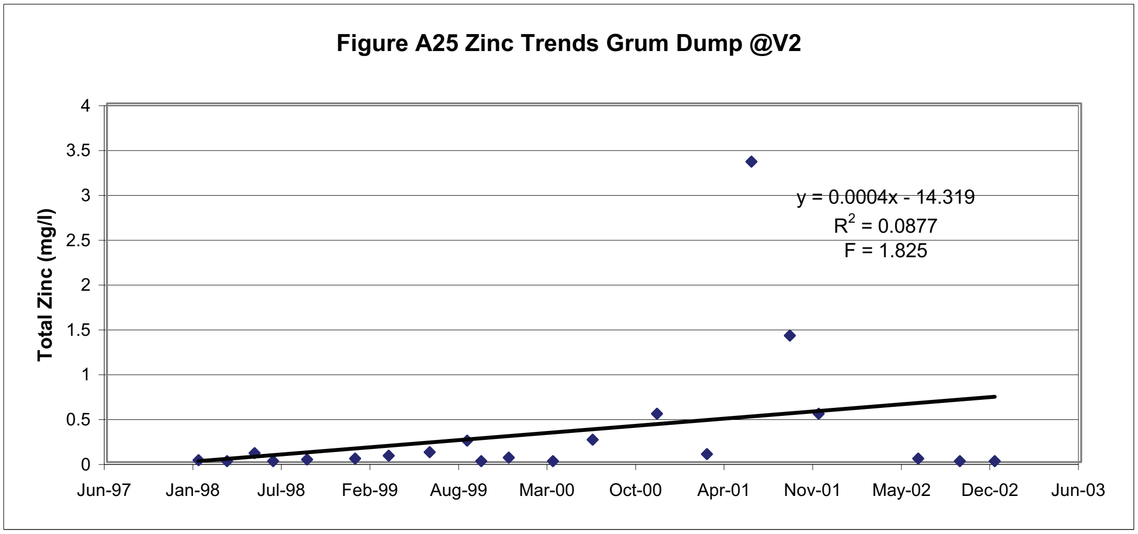


Figure A25 Zinc Trends Grum Dump @V2
Total Zinc (mg/l)
y = 0.0004x - 14.319
R2 = 0.0877
F = 1.825
0
0.5
1
1.5
2
2.5
3
3.5
4
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

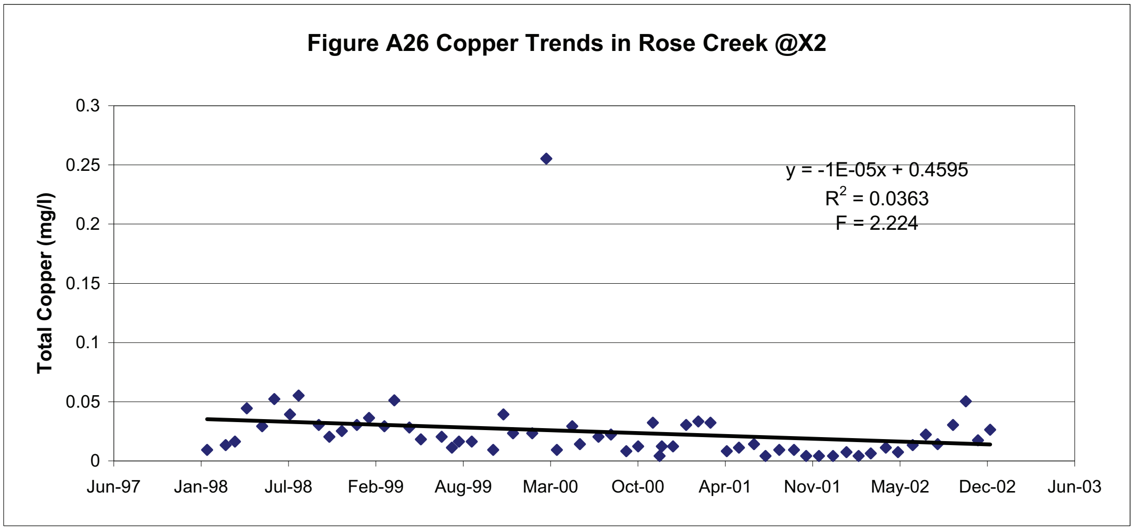


Figure A26 Copper Trends in Rose Creek @X2
Total Copper (mg/l)
0.3
0.25
0.2
0.15
0.1
0.05
0
y = -1E-05x + 0.4595
R^2 = 0.0363
F = 2.224
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

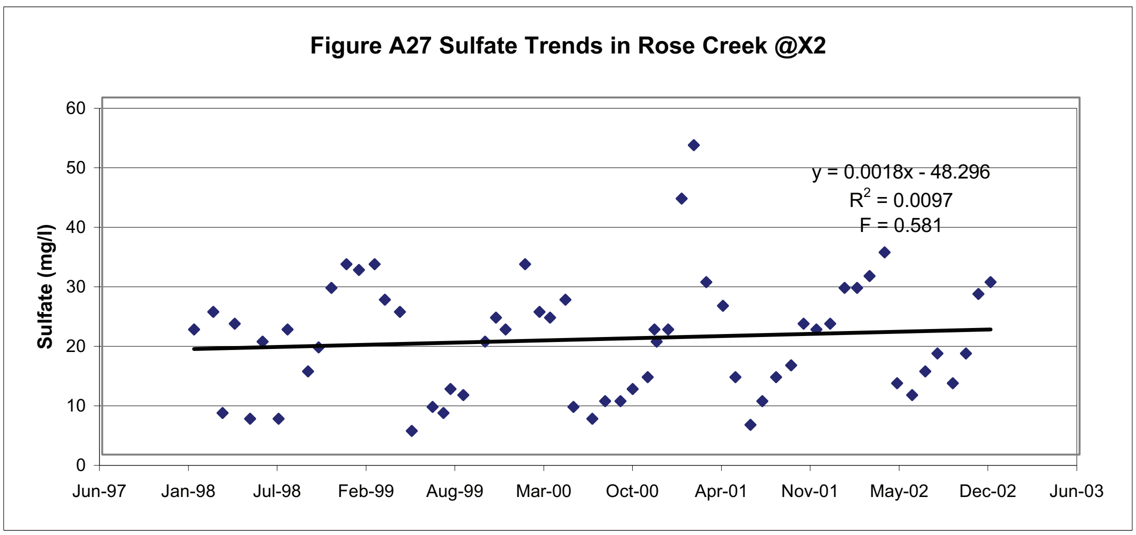


Figure A27 Sulfate Trends in Rose Creek @X2
Sulfate (mg/l)
60
50
40
30
20
10
0
y = 0.0018x - 48.296
R^2 = 0.0097
F = 0.581
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03

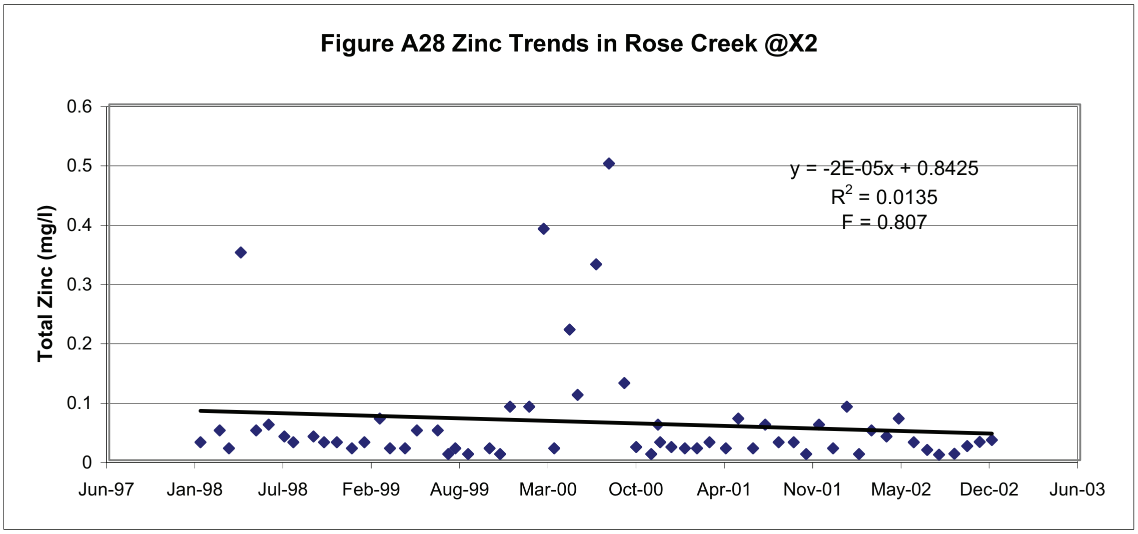


Figure A28 Zinc Trends in Rose Creek @X2
Total Zinc (mg/l)
0.6
0.5
0.4
0.3
0.2
0.1
0
Jun-97
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
y = -2E-05x + 0.8425
R2 = 0.0135
F = 0.807