TRUE NORTH
MINE

MONITORING PLAN

Prepared By

Fairbanks Gold Mining, Inc.
A Subsidiary of Kinross Gold Corporation
P.O. Box 73726
Fairbanks, Alaska 99707-3726

May 2012

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1.0 INTRODUCTION

1.1 Overview

Fairbanks Gold Mining, Inc. (FGMI), a wholly owned subsidiary of Kinross Gold Corporation (KGC), has prepared this monitoring plan for True North Mine. The plan is designed to address the objectives and goals of the Federal and State resource management agencies: U.S. Army Corps of Engineers (COE), and Alaska Departments of Natural Resources (ADNR), Environmental Conservation (ADEC), and Fish & Game (ADF&G).

It is the goal of FGMI to operate the True North Mine in a manner that will ensure the protection and, where possible, the enhancement of surface and groundwater quality. The reclamation and closure for True North Mine will assist FGMI in the long-term protection of State of Alaska land, wildlife, and water resources. Periodic updates of the monitoring plan will coincide with regulatory changes, annual reviews, process modifications, or anomalies noted as a result of monitoring and sampling.

This monitoring plan is an intricate part of the Project Management System (PMS) for the True North Mine.

Access by Federal and State regulatory personnel to the True North Mine facilities for the purpose of inspecting for reclamation, wildlife mortalities, or other appropriate compliance areas are statutory/regulatory mandates and will be adhered to by FGMI, with the request that agents contact mine management to gain access. The health and safety of FGMI employees and that of regulatory personnel is the rational for this request. Mining is regulated under the Mine Safety and Health Administration (MSHA) and their regulations require minimum training for employees and visitors for Hazard Recognition and Safety. Visitors as well as employees must wear safety equipment, approved by MSHA.

FGMI requests consideration by the regulatory agencies to conduct routine inspections during weekdays when administration and site managers are available to answer questions and, if necessary, accompany agents to different site components.

1.2 General Information

Date: January 2012

Name of Facility: Fairbanks Gold Mining, Inc. – True North Mine
Type of Facility: Gold Mine and Operation

Location: The True North Mine is within the Chatanika River watershed located on the northwest flank of Pedro Dome approximately 25 miles northeast of Fairbanks. The ridgelines drain into Murray Creek, a tributary of Dome Creek to the south; and Louis Creek, Whiskey Gulch, and Spruce Creek, tributaries of Little Eldorado Creek to the north. More specifically, the Millsite Lease boundary is located in portions of Sections 21, 27, 28, 29, 32, & 33, Township 3N, Range 1E, Fairbanks Meridian (Appendix A). The project site is located entirely on State and University of Alaska land. There is no federal land involved within the project boundaries and the closest residence is approximately one mile from the project boundary.

Corporate Information:

Business Name: Fairbanks Gold Mining, Inc.

Address: P.O. Box 73726
Fairbanks, Alaska 99707-3726

Telephone: (907) 488-4653

General Manager: Dan Snodgress

Fairbanks Gold Mining, Inc. is a wholly owned subsidiary of

Kinross Gold U.S.A., Inc.
Scotia Plaza, 52 Floor
40 King Street West
Toronto, Ontario, Canada, M5H 3Y2

Designated Contact Person for Regulatory Issues:

Name: Delbert Parr
Title: Environmental Manager
Telephone: (907) 490-2207

1.3 Site Description

The True North Mine (exploration area and mine site) is within the Chatanika River watershed located on the northwest flank of Pedro Dome approximately 25 miles northeast of Fairbanks. The ridgelines drain into Murray Creek, a tributary of Dome Creek to the south; and Louis Creek, Whiskey Gulch, and Spruce Creek, tributaries of Little Eldorado Creek to the north.

Environmental water quality monitoring will continue during the reclamation and closure period.

1.4 Objectives

The objectives for closure are:

1. Meet applicable surface and ground water quality standards (natural background conditions)
2. Growth media will be used where necessary to achieve successful revegetation on the waste rock dumps. Hindenburg Pit bottom has been capped with growth media
3. The 70% vegetative cover criteria has been or will be achieved, although not required, on stabilized areas excluding the pit

FGMI will continue monitoring and sampling through reclamation and closure.

2.0 RECLAMATION AND CLOSURE MONITORING

2.1 Groundwater Monitoring Wells

During the reclamation and closure period surface and groundwater will be monitored to track water quality trends and identify impacts associated with the placement of waste rock, and existing pit.

The groundwater associated with the main Hindenburg, East, Central, Shepard, and Zeppelin Pits will be monitored using TMW-6, TMW-7, and TMW-8. TMW-1 collapsed in 2004. A new well to replace TMW-1 was not able to be completed due to the unstable subsurface strata. MW-4 was destroyed during mining activities in 2003. TMW-9 has been inaccessible since 2006 when property owners on adjacent mining claims cut-off access. Monitoring Well TMW-13 was installed March 2003, but has never produced any water. Table 2-1 depicts which drainages are

Groundwater associated with the Shop Facilities, the Shop Rock Dump, and Growth Medium Stockpile will be monitored using TMW-2, TMW-3, TMW-8, and TMW-10. Monitoring Well TMW-10 was installed in October 2000.

Groundwater associated with the Spruce Rock Dump will be monitored using TMW-11 and TMW-12. Monitoring Well TMW-12 was installed March 2002.

Ground water monitoring wells (Appendix B Groundwater and Surface Water Location Map) will be sampled quarterly as outlined in Section 2.3 and water samples will be analyzed using Profile II (Table 2-1).

Table 2-1- Analytical Profile II -- Groundwater Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
Lab pH	*Arsenic	*Aluminum
Lab Conductivity	Fluoride	*Antimony
Temperature (field)	*Iron	*Barium
Total Suspended Solids	*Manganese	*Bismuth
Total Dissolved Solids	Nitrogen, Ammonia	*Cadmium
*Calcium	Nitrate as Nitrogen	*Chromium
*Magnesium	Nitrite as Nitrogen	*Copper
*Potassium	Total Phosphorus	*Lead
*Silicon		*Mercury
*Sodium		*Nickel
Sulfate		*Selenium
Sulfide		*Silver
Chloride		*Zinc
Alkalinity (as $CaCO^3$)		
Bicarbonate		
Total		
Calcium Hardness		
Magnesium Hardness		*Dissolved

2.2 Surface Water Monitoring

Surface monitoring during reclamation and closure will focus on those drainages that are down gradient from previous mining activities, reference Table 2-2. Murray Creek, Spruce Creek, Louis Creek, and Whiskey Gulch will monitor potential impacts from operations in the areas of the Hindenburg, East, Central, Shepard, and Zeppelin Pits, development rock dumps, and haul roads.

Table 2-2 Summary of Surface Water Sites by Drainages

Drainage	Location	Comment
Little Eldorado Creek	Louis Creek	Location consistent with 1999 sampling location
	Whiskey Gulch	Location consistent with 1999 sampling location
	Little Eldorado Creek	1999 location unknown, sample at point downstream of Marshall Gulch
Dome Creek	Murray Creek	Location consistent with 1999 Sampling location
Spruce Creek	Spruce Creek	Sample main channel of Spruce Creek down gradient and west of TMW-05

All surface water samples (Appendix B Groundwater and Surface Water Location Map) will be collected as outlined in Section 2.3 and analyzed using Profile I in Table 2-3.

Table 2-3 Analytical Profile I -- Surface Water Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
Lab pH Lab Conductivity Temperature (field) Turbidity Settleable Solids Total Suspended Solids Total Dissolved Solids *Calcium *Magnesium *Potassium *Silicon *Sodium Sulfate Chloride Alkalinity (as $CaCO_3$) Bicarbonate Total Calcium Hardness Magnesium Hardness	*Arsenic Fluoride *Iron *Manganese Ammonia as Nitrogen Nitrate as Nitrogen Nitrite as Nitrogen Total Phosphorus TPH	*Aluminum *Antimony *Barium *Bismuth *Cadmium *Chromium *Copper *Lead *Mercury *Nickel *Selenium *Silver *Zinc

*Total

2.3 Water Quality Monitoring and Sampling Schedule

Monitoring will continue at sampling locations within the watersheds affected by active reclamation continuing through completion of reclamation activities scheduled for the summer of 2012. Spruce Creek will continue to be monitored after 2012 reclamation is completed.

Table 2-4 Water Quality During Reclamation and Closure

Location	Parameters	Frequency
Surface Water Spruce Creek, Murray Creek, Louis Creek, Whiskey Gulch and Little Eldorado	Profile I	Quarterly
Groundwater Wells TMWs – 2, 3 ,6, 7, 8, 10, 11, 12	Profile II	Quarterly

able 2-5 Post-Closure Monitoring of Surface Water

Location	Parameters	Frequency
Lower Spruce Creek	Profile I	Will continue until such time it is no longer warranted.* Sample 2nd & 3rd quarter

* Lower Spruce Creek will be monitored the second and third quarters until the analytes have stabilized i.e. neither increasing nor decreasing. It is not FGMI's intent to be at True North for 30 years of sampling, although we have accounted for the decreasing sample schedule in the Financial Assurance calculations .

2.4 Stability Monitoring

Waste Rock Dumps that have visible indications of settlement features such as depressions, sloughs and or cracks will be monitored. Monitoring will include documenting movement with photographs. A site map based on the 2011 aerial survey will be used to map significant ground movement and define where the waste mass is moving. Methods are listed below:

1. Place a visible scale (a level rod or other large scale) across cracks or depressions so that the dimensions of the feature would be obvious in the photographs
2. Document on an aerial photo based site plan, the location of the camera and the direction in which it is pointing; including GPS coordinates. The features that continue to develop in the same area take the pictures from the same position each time
3. Note the date and time each picture is taken
4. Give each distinct feature a name or number
5. Take the pictures at the following times:
    a. When the depth of the feature becomes more than 6 inches, the length is more than 5 feet, or the opening is more than 3 inches
    b. As close to the first snowfall as possible in the fall
    c. As soon as they become visible in the spring
    d. Immediately before and after any regrading or surface restoration

3.0 MONITORING, SAMPLE RECORDS, AND REPORTING

3.1 Documentation of Measurements, Sampling, and Inspections

For each measurement or sample taken pursuant to this monitoring plan the following information shall be recorded:

1. The exact place, date, and time of inspection, observation, measurement, or sampling
2. The person(s) who inspected, observed, measured, or sampled
3. The dates the analyses were performed and by which analytical facility
4. The analytical techniques or methods used
5. The accuracy of the analytical method (detection limits)
6. The results of all required analysis

3.2 Retention of Records

During reclamation and closure, all records of monitoring activities and results, calibrations, and maintenance records will be retained for a period of three years.

3.3 Monitoring Reports and Submission Schedules

Monitoring results will be submitted quarterly to the Large Mine Project Coordinator for distribution. All quarterly reports will be submitted no later than 60 days after the last day of the quarter.

4.0 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

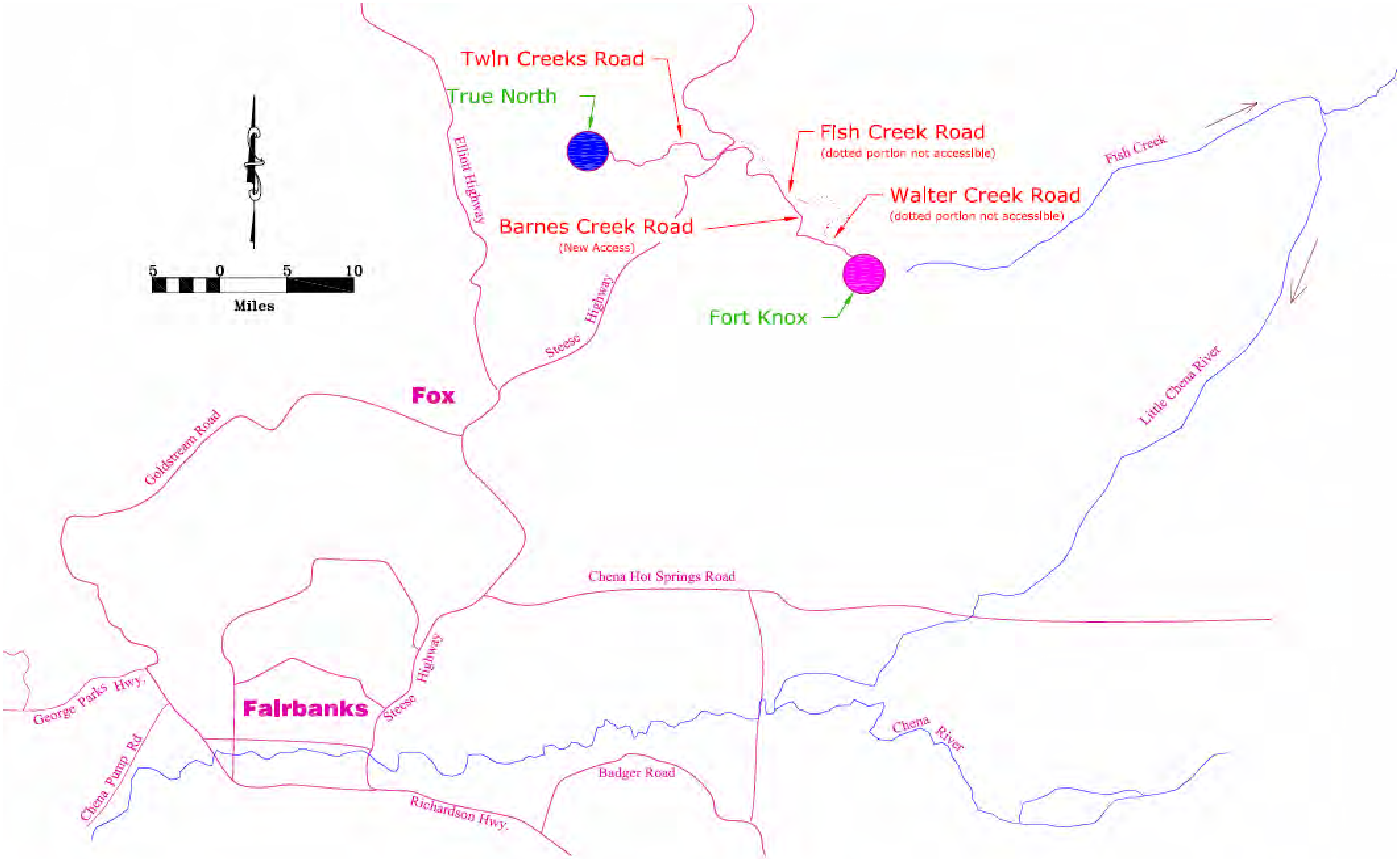
The *True North Mine Quality Assurance / Quality Control and Field Procedures Manual* has been designed to reflect current baseline and compliance monitoring at the True North Mine (Appendix C). The analytical QA/QC program for FGMI's contract laboratory, incorporated into the above referenced document, will be updated routinely or whenever a different laboratory is used.

5.0 IMPACTS TO AVIAN AND TERRESTRIAL WILDLIFE

Wildlife mortalities occurring within the True North Millsite Lease boundary will be reported to ADF&G.

APPENDIX A

TRUE NORTH MINE
SITE LOCATION MAP


Twin Creeks Road
True North
Fish Creek Road
(dotted portion not accessible)
Walter Creek Road
(dotted portion not accessible)
Barnes Creek Road
(New Access)
Fort Knox
Elliott Highway
Steese Highway
Fish Creek
5 0 5 10
Miles
Fox
Goldstream Road
Little Chena River
Chena Hot Springs Road
George Parks Hwy.
Fairbanks
Steese Highway
Chena Pump Rd
Chena River
Badger Road
Richardson Hwy.

APPENDIX B

TRUE NORTH MINE
GROUNDWATER WELL and
SURFACE WATER
LOCATION MAP

True North Monitoring Locations

APPENDIX C

TRUE NORTH MINE
QA/QC & Field Procedures Manual

QUALITY ASSURANCE/QUALITY CONTROL AND FIELD PROCEDURES MANUAL

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Updated January 2012

QUALITY ASSURANCE/QUALITY CONTROL
AND
FIELD PROCEDURES MANUAL

Submitted to:

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January 2012

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1 INTRODUCTION

1.1 Objectives

This Water Monitoring QA/QC and Field Procedures Manual is for the use of Fairbanks Gold Mining, Inc. (FGMI) operating personnel. This manual will be used to maintain the quality of field activities, sample collection, sample handling, laboratory and data analyses, and to document the quality of data at each processing level. The QA/QC program identifies major aspects of the project requiring specific quality control and demonstrates that quality control is a major focus for this project. Additionally, this manual will be used for training employees in approved field monitoring procedures (i.e. instrument calibrations, measurements, and maintenance).

This document will be periodically reviewed and updated by site personnel to reflect actual site conditions and permit monitoring requirements as they change.

1.2 Quality Assurance / Quality Control Program

The QA/QC program consists of three components:

- **Field QA/QC** identifies the procedures to be used in the field to verify that water samples and field monitoring data are collected according to the requirements of the project. The objective of field QA/QC is to assure that both field measurements and samples collected for laboratory analyses can be demonstrated to be representative of the environment sampled and are of known and acceptable quality.

- **Laboratory QA/QC** identifies the protocols to be used by the laboratories to demonstrate that project data are analyzed according to U.S. Environmental Protection Agency (EPA)-acceptable methodologies, and that reported values are accurate. The objective of the laboratory QA/QC program is to produce data that will meet state and federal analytical requirements.

- **Data QA/QC** identifies the protocols to be used to verify that laboratory and field data have been reported accurately. The objective of the data QA/QC program is to demonstrate that the data reported meets the specified requirements, including comparability with data from previous years.

1.3 Data Uses and Data Quality Objectives

Quality assurance requirements are established in this QA/QC program to achieve the project objectives for the data uses. Applicable quality control procedures, quantitative target limits, and level of effort for assessing the data quality are dictated by the intended use of the data and the nature of the required field and analytical methods. The project objectives are to collect data of known and sufficient quality for FGMI to comply with the analytical permit requirements during operation and ultimately closure. The analyses to be conducted on the various sample types have been presented in the project specific monitoring plans. Protocols and appropriate detection limits are included in the laboratory's QA/QC plan available to all FGMI environmental personnel.

Federal and state levels of concern (i.e. ambient water quality criteria or maximum contaminant levels) exist for many of the parameters being analysed in the water-monitoring program. EPA-approved analytical methods will always be used and will have detection limits low enough to determine if Alaska Water Quality Standards are being met.

1.4 Data Quality Parameters

The quality of laboratory data is measured by the precision, accuracy, representativeness, comparability, and completeness of the data. These parameters and the applicable quality control procedures and levels of effort are described below.

1.4.1 Precision

Precision is a qualitative measure of the reproducibility of a measurement under a given set of conditions. For duplicate measurements, analytical precision can be expressed as the relative percent difference. A quantitative definition of the relative percent difference is included in the current contract analytical laboratory's QA/QC Manual. The analytical laboratory uses a relative percent difference of 10% (+ or -) to determine their ability to accurately reproduce results. FMGI finds this level of relative percent difference acceptable, as it is the industry standard. The level of effort for precision measurement will be at a minimum frequency of one in 20 (5 percent) or one per batch, whichever is more frequent.

See Appendix B for quantitative definitions of data quality parameters

1.4.2 Accuracy

For samples processed by the analytical laboratory, accuracy will be evaluated through the use of matrix spikes and standard reference materials (SRMs) to establish the average recovery. A quantitative definition of average recovery is included in the current contract analytical laboratory's QA/QC Manual. The laboratory will perform matrix spike and matrix spike duplicate measurements at a minimum frequency of one in 20 samples for organic parameters, and matrix spikes of one in 20 for inorganic or miscellaneous samples, or one per batch, whichever is more frequent.

1.4.3 Representativeness, Precision and Accuracy

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the soil and water sampled. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed and are discussed in other sections of this document. Proposed documentation will establish that protocols have been followed and sample identification and integrity assured. Field blanks (Profile III only) and field duplicates obtained at a minimum frequency of 5 percent or one per Sample event will be used to assess field and transport contamination and method variation. Laboratory sample retrieval, storage, and handling procedures have also been developed and are discussed in other sections of this document. Laboratory method blanks will be run at the minimum frequency of 5 percent or one per set to assess laboratory contamination.

1.4.4 Comparability

Comparability is the level of confidence with which one data set can be compared with another. Comparability of the data will be maintained by using EPA-defined procedures. If unavailable or inappropriate, FGMI and Alaska Department Environmental Conservation, will discuss using other than approved EPA methods before use. A 30% relative percent difference will be considered acceptable for comparing duplicate samples between different laboratories. Comparability will also be maintained by the use of consistent units.

1.4.5 Completeness

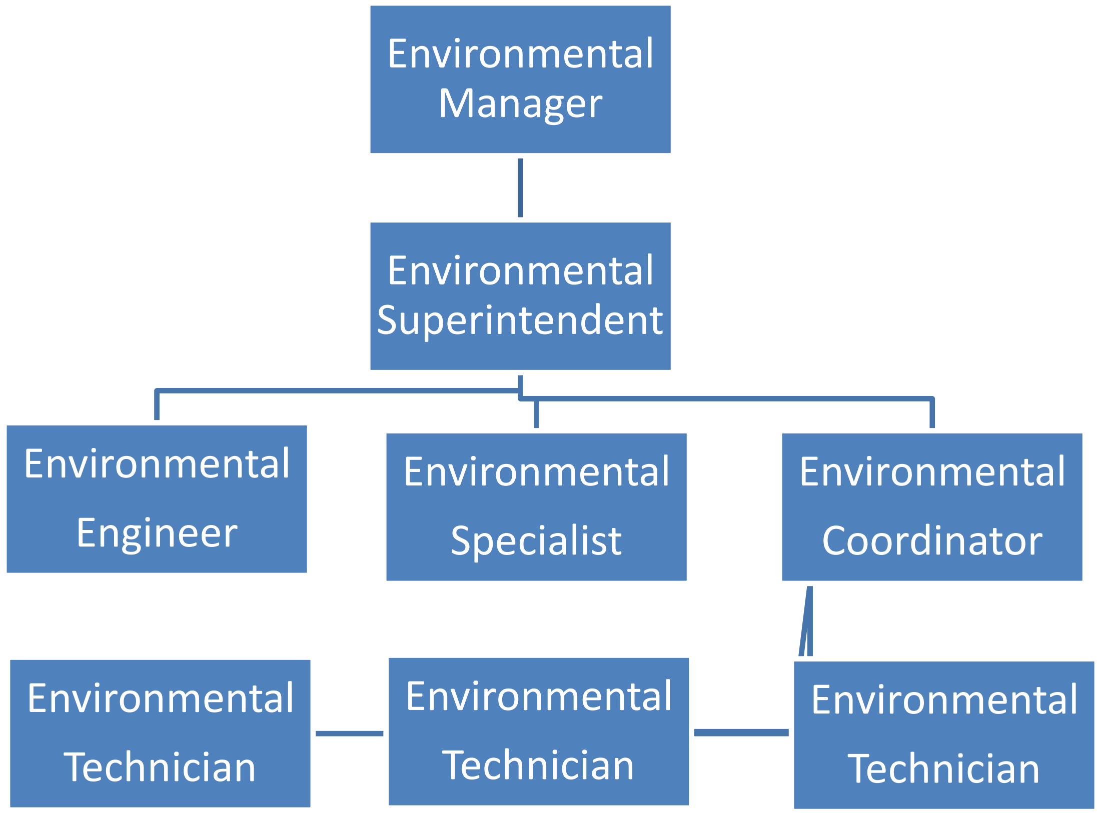
Completeness is a measure of the amount of valid data obtained from the measurement system. The target completeness objectives are approximately 90 percent for each analytical parameter; the actual completeness can vary with the intrinsic nature of the samples. The completeness of the data will be assessed during the data review.

1.5 Description of Duties

Environmental Manager
Maintains communication with outside agencies. Addresses data discrepancies and takes corrective measures.

Environmental Coordinator
Project manager, overseeing quarterly monitoring results. Acting as quality assurance officer, overseer data gathering protocols and verifying proper sample containers & preservatives. Responsible for maintaining close communication with analytical laboratories and tracking sample progress as well as verifying all data is within established parameters.

Environmental Technicians
Collecting samples according to approved methods as well as the collection of blank and duplicate samples. Labelling and packaging samples according to protocols to prevent leakage or cross-contamination. Properly completing chain of custody forms, and maintaining adequate documentation. Shipping samples at properly maintained temperatures and within holding times. Also responsible for field instrument calibration, decontamination, documentation, and operation and maintenance procedures.


Environmental Manager
Environmental Superintendent
Environmental Engineer
Environmental Specialist
Environmental Coordinator
Environmental Technician
Environmental Technician
Environmental Technician

2 FIELD QUALITY ASSURANCE / QUALITY CONTROL PROCEDURES

2.1 Purpose

Producing data of known quality that are considered representative of the sampling environment at an appropriate level of detail is achieved by establishing a QA/QC program with specified data gathering protocols overseen by an Environmental Specialist. The main components of the proposed QA/QC program include the following:

- Verification of use of proper sample containers and preservatives
- Collection and analysis of blank and duplicate samples
- Specific procedures for handling, labeling, and shipping samples
- Field equipment calibration
- Equipment decontamination
- Field documentation
- Field corrective action

Each Environmental Technician is responsible for implementing these components in the field. However, the Environmental supervisor will oversee each aspect of field operations to verify that these components are accomplished within the strict requirements of the project.

2.2 Quality Control Samples

To aid in evaluating the accuracy of the analytical data, a rinse blank and duplicate sample are collected and subjected to the same analyses as identified in task samples. One rinse blank is collected for every 20 unknown samples, or one per sampling event (quarterly), whichever is less. In addition, a minimum of one duplicate sample is collected for every 20-task samples, or one per sampling event (quarterly) whichever is less.

Equipment blanks for surface water sampling are taken by pouring distilled water into a decontaminated sample collection bucket, then sample bottles are filled from the sample collection bucket with a decontaminated one-litre plastic pitcher. Blanks will be analyzed along with the unknown samples.

2.3 Sample Collection, Labelling and Handling Procedures

Sample collection, labelling, and handling procedures are periodically checked by the Environmental Coordinator to verify that the following conditions are being met:

- Collection - Samples are collected according to approved sampling methods.
- Labeling - Samples are uniquely labeled using a code that prohibits unauthorized personnel from knowing the sampling locations.
- Packaging - Samples are correctly packaged to prevent leakage or cross-contamination; Sample containers with proper preservatives are used; Amber sample bottles for UV protection are used when necessary.
- Chain-of-custody forms - Chain-of-custody forms are properly completed to assure sample custody can be adequately documented.
- Shipping - Samples are hand delivered to the laboratory or proper shipping procedures are used, including maintenance of proper temperatures and specified holding times.

Each Environmental Technician is responsible for implementing the proper sample collection, labelling, and handling procedures. The Environmental Coordinator will oversee these activities.

Acids are used in some sample bottles as preservative and it is important to use correct procedures to handle any corrosive substances safely. Some of the commonly used acids are:

- Sulfuric Acid
- Nitric Acid
- Zinc Acid
- Sodium Hydroxide (base)
- Hydrochloric Acid

Personal protective gear, safety glasses and latex gloves, will be worn when opening sample bottles. In some cases an apron may be necessary, or rain gear and a face shield, when handling large quantities of acid or preservatives.

Adequate amounts of clean water will be kept on hand in the field, available for flushing eyes or skin that may come in contact with acids.

It is important to remember, if acid needs to be diluted, never pour water into acid. It is standard procedure to dilute acid by slowly pouring the acid into water.

2.3.1 Surface Water Grab Sampling

Below, the surface water grab sampling procedure is listed.

1. Decontaminate compositing container (plastic bucket) and one-liter pitcher. Decontamination procedures are described later in this section.
2. Locate sampling site at a point in the stream exhibiting greatest flow and/or highest velocity, if possible.
3. Surface water sample sites may require filling the plastic-bucket by direct submergence.
    a. When submersion is required; submerge plastic-bucket at sampling point such that mouth of container is under water surface at least 2 to 3 inches, if possible. Allow container to fill partially, rinse container by shaking, and then discharge this water. Repeat this procedure three times. Collect sample, and then transfer water from plastic-bucket into the sample bottles with one-liter pitcher.
4. Fill out appropriate field data form(s) see documenting sample location, time, and other pertinent information before leaving sample site.

2.3.2 Surface Water Grab Sampling through Ice

During winter months when ice cover is present, it may be necessary to use an ice chisel or a gas powered ice auger to obtain a sample.

1. Clear snow from ice, an area large enough for sampling equipment.
2. Drill or chisel sample hole in ice, periodically cleaning hole of ice chips.

3. After breaking through the ice, cut an area large enough to dip sample collection container in.
4. Purge three hole volumes from the opening prior to sampling, trying to remove all ice chips within the hole. This volume can be approximated from the hole-dimensions in the ice.
5. Follow surface water grab sample procedure steps 3 – 4 Surface Water Grab Sample Procedure.

2.3.3 Groundwater Sampling

Monitoring wells without dedicated pumps are sampled with a portable submersible electric pump. A description of the sampling procedure is given below.

1. Adjust the reel support pins (on bar below roller) so that the roller is centered over the well opening. Lift and hang the portable pump on the well casing by resting the support pins against the inside of the well casing.
2. Unlock the reel by pulling the pin lock mechanism outward and turning.
3. Using the operating handle, gently reel down the pump to the necessary level and lock the reel in place. The cable is marked every five feet.
4. <u>**DO NOT power the converter until the extension cord is connected**</u>**.** Connect the extension cord to the electrical box. Connect the other end of the extension cable to the converter.
5. Connect the discharge hose to the discharge port.
6. Power up the converter (220/240 V generator), turn the frequency control knob to approximately mid-range (12 o'clock position) and start the pump by moving the start/stop switch to the "start" position. Adjust the speed dial to the desired frequency or flow rate.
7. Purge at least three well casing volumes prior to sampling, taking field parameters (pH, conductivity, and temperature) at each casing volume. After finishing purging and if field parameters were stable, fill sample bottles directly from sample discharge hose. A filter will be used for filling the dissolved metals sample bottle. See Appendix A (Section 5.0) for complete groundwater filtering procedure. If field parameters were unstable during well purging, continue purging well until stable field parameters are achieved. Fill out appropriate field data form(s) documenting sample location, time, and other pertinent information before leaving sample site.
8. When finished pumping, move the start/stop switch to the "stop" position. Turn off the generator. Disconnect the extension cord.
9. Disconnect the discharge hose, unlock the reel, and rewind the hose and pump back onto the reel.

2.3.4 Sample Labelling

Each sample container will have a waterproof label large enough to contain the information needed to easily identify each sample. The information to be included on each label includes the project name, date, time, preservative (if added), and sampling code. The sample code will be formatted to indicate sample number and date. In the field record book, the sampler identifies each sampling location. Each sample will be identified with a multi-digit number, which includes the date, and identification number of the sample. An example of sample identification is as follows:

0512017777101

Where:

051201 = Date (Dec 1, 2005)
7777 = Employee's identification number
101 = Sequential sample number recorded in logbook for that date

All blanks and duplicates will be noted on field data sheets. Blanks and duplicates will be identified the same as other samples, including date and identification number.

2.3.5 Packaging

Each analytical sample bottle will be packed to prevent breakage and placed in an iced cooler to keep the samples cooled to 6°C. For hand delivered and shipped samples one copy of the chain-of-custody form will be placed in a sealed plastic bag. Additionally, for shipped samples, the cooler lid will be sealed with packing tape and at least one chain-of-custody seal will be attached to the outside of the cooler so that this seal(s) must be broken if the cooler is opened.

2.3.6 Chain-of-Custody

Chain-of-custody forms will be used for all samples. Once collected, the samples will remain within the custody of the sampler or will be locked up until the samples are prepared for shipment. Each time the sample bottle or sample changes hands, both the sender and receiver will sign and date the chain-of-custody form and specify what samples have changed hands. The pink carbon copy of the chain-of-custody form is retained by FGMI and the original (white) and yellow carbon copy is sent to the laboratory.

The following information is to be included on the chain-of-custody form:

- Sample identification code
- Signature of sampler
- Date and time of collection
- Project name
- Type of sample
- Number and type of containers
- Sample analysis requested (Profile I, II, III, Acid/Base Accounting, etc.)
- Inclusive dates of possession
- Signature of receiver

Other chain-of-custody components will include sample labels, sample seals, field data sheets and sample shipment receipts.

2.3.7 Shipping

FGMI personnel or courier will deliver samples to the designated laboratory as soon as feasible after collection.

2.3.8 Field Documentation

Field observations, field equipment calibration information, field measurements, and sample documentation, including sample identification, sample duplicates, and date and time the sample was collected, will be the responsibility of the entire sampling team.

Proper documentation for sample custody includes keeping records of all materials and procedures involved in sampling. Field data sheets will be used to record field data. The Environmental Technician will record all information on the sampling point and respective samples and replicates collected at each site. The Environmental Technician will review all data before leaving the sampling point. Completed field data sheets will be kept on file for any QA/QC checks. Additionally, the Environmental supervisor will inspect field documentation field data sheets regularly.

2.3.9 Corrections to Documentation

No accountable documents will be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on an accountable document assigned to one person, that person must make corrections by drawing a line through the error, initialling and dating the lined-out item, and entering the correct information. The erroneous information is not to be obliterated but is to remain legible. The person who made the entry will correct any subsequent error discovered on an accountable document. All such subsequent corrections will be initialled and dated.

2.3.10 Field Equipment Calibration

Field equipment used for collection, measurement, and testing is subject to a strict program of control, calibration, adjustment, and maintenance (See Appendix A). Portable water quality instruments will be used for the in situ measurement of pH, temperature, and conductivity. Calibrations will be performed daily prior to beginning any sample tasks. The standards of calibration are in accordance with applicable criteria such as the NIST (National Institute of Standards Technology), ASTM standards, or other accepted procedures outlined in the manufacturer's handbook of specifications. All calibration activities will be documented on Field Data Sheets.

The Environmental Technician will review data measured in the field, and final validation will be by the Environmental supervisor. Data validation will be completed by checking procedures used in the field and comparing the data with previous results. Data that cannot be validated will be so documented; corrective action may be required, as discussed later.

2.3.11 Decontamination Procedures

All sample processing equipment, such as buckets and hoses, which come into contact with a sample will be decontaminated by means of the following procedure:

1. Rinse in water
2. Wash with Alconox, or equivalent, in tap water
3. Double rinse in de-ionized water, and, if not to be used right away,
4. Air-dry
5. Place in plastic bag immediately after air-drying

The purpose of the water and Alconox, or equivalent, washes is to remove all visible particulate matter. This is followed by a de-ionized water rinse to remove the detergent. It is not anticipated that high concentrations of TPH will be sampled. If visible contamination is found, a solvent rinse will be added, followed by a de-ionized water rinse.

2.3.12 Field Corrective Action

Field sampling corrective actions includes procedures to follow when field data results are not within the acceptable error tolerance range. These procedures include the following:

- Comparing data readings being measured with readings previously recorded
- Recalibration of equipment (i.e., pH meters)
- Replacing or repairing faulty equipment
- Resampling when feasible

The Environmental Technician is responsible for ordering appropriate field corrective actions when deemed necessary. The Environmental supervisor will be responsible for overseeing these corrections. All field corrective actions will be recorded on the field data sheet.

3 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The laboratory QA/QC program is available to all FGMI personnel.

3.1 Data Quality Assurance/Quality Control Program

The data QA/QC program serves four major functions:

- Maintenance of a duplicate record of all field data
- Sample tracking through laboratory analysis
- Data validation
- Oversight of data management
- During field operations, the Environmental supervisor will receive copies of all field data sheets, which will then be filed in the Environmental Department Filing System. These duplicates will serve as a backup file and will be checked against the field data entered into the database management system.

The second major component of the data QA/QC program is sample tracking throughout the laboratory analytical process. The Environmental supervisor will maintain close communication with all analytical laboratories to verify sample receipt, proper sample management, and strict adherence to sample holding times. The laboratories will immediately inform the Environmental supervisor of sample breakages, inadequate sample media to meet QA objectives, and other sample problems. The Environmental supervisor will then notify the Environmental Technician and the Environmental Manager so that corrective action can be implemented as deemed necessary.

Following the receipt of the analytical data package, the Environmental supervisor will verify that all sample parameter data have been received and will compare detection limits and preliminary results with previous results. Should major discrepancies be found, the Environmental supervisor will communicate these to the Environmental Manager. Possible corrective measures will then be evaluated as deemed necessary.

A data review or validation process will also be performed on 20 percent of all analytical data received from the laboratories. Chemical data will be reviewed with regard to the following:

- Analytical methodology
- Detection limits
- Cross-contamination as indicated by blank data
- Accuracy and precision
- Adherence to holding times

Where data do not meet the requirements specified in this QA/QC program, the data will be flagged with qualifiers. These reviews of data will be summarized and included in the report of sampling data.

3.2 Data Reporting

On a quarterly basis, all water quality data will be compiled, reviewed and validated, and a report of results sent to the appropriate state agency. FGMI QA/QC documents and records are kept onsite and available for inspection upon request by regulators. The analytical laboratory has on file QC reports for all samples analysed and these are available for inspection, upon request, by regulators.

4 INSTRUMENT CALIBRATION, OPERATION, AND MAINTENANCE

4.1 Electrical Conductance

4.1.1 Instrument Calibration

At the beginning of each day of sampling, check instrument linearity.

1. Rinse probe with deionized water.
2. Measure conductivity of two potassium chloride solution standards, which bracket expected sample values.
3. Measure temperature of both solution standards.

Calculate cell constant for each standard to determine if instrument linearity is reasonable. The cell constant is the ratio of the computed conductivity to the measured conductivity of the standard solution.

4.1.2 Maintenance

1. Store meter in its case during transport.
2. Check batteries before taking meter into the field. Carry spare batteries in the field (9 volt).
3. Inspect conductivity probe for cracks or other damage.

4.1.3 Field Measurement Procedures

1. Turn instrument on.
2. Rinse plastic beaker with approximately 50 milliliters of sample water three times.
3. Place water sample in plastic beaker (fill to at least 50 millimeters).
4. Rinse probe with deionized or sample water and place in sample water.
5. Immerse conductivity probe in sample so that vent hole is submerged. Move probe around in sample to displace any air bubbles. Turn instrument on to appropriate scale to measure conductivity. Record conductivity reading after a stable reading is obtained.
6. Remove probe from sample and turn off instrument.

4.2 Field pH

4.2.1 Instrument Calibration

1. Calibrate pH meter at the beginning of each day of fieldwork when pH will be measured, and whenever the standard check is out of acceptable bounds.
2. Rinse pH electrode probe with deionized water.
3. Immerse electrode and temperature probe in beaker of fresh commercial calibration solution of pH 4.0. Calibrate meter to solution.
4. Remove electrode and temperature probe from solution, and then rinse with deionized water.
5. Immerse electrode and temperature probe in fresh pH 10.0 solution. Calibrate meter to solution.
6. Remove electrode and temperature probe from solution, and rinse with deionized water.
7. Measure pH of a third fresh calibration solution at pH 7.0. If measured value differs from expected value by more than 0.1 units, obtain fresh calibration solutions and recalibrate. If discrepancy persists, begin trouble-shooting procedures following meter-operating instructions: check batteries, connections, probe, etc.

4.2.2 Maintenance

1. Store meter in its case with electrode immersed in a pH 7 buffer solution.
2. Inspect electrode prior to use.
3. Check glass electrode for cracks or scratches.
4. Check batteries each time meter is used. Carry a spare battery pack into the field in the pH meter case.

4.2.3 Field Measurement Procedures

1. Rinse decontaminated glass beaker or sample bottle with approximately 50 milliliters of sample water three times.
2. Rinse pH electrode with deionized water.
3. If measurement is read ex situ, fill beaker with sample water.
4. Immerse electrode and temperature probe in sample while swirling the sample to provide thorough mixing. Turn on meter. Read pH to nearest 0.1 until the reading has stabilized (when beaker icon stops flashing).
5. Record sample pH. Note any problems such as erratic readings.
6. Rinse probe with deionized water and store according to manufacturer's directions.

4.3 Water Temperature

4.3.1 Linearity and Field Measurement Procedures

1. Use either a National Institute of Standards and Technology (NIST)-calibrated thermometer or a digital temperature probe calibrated against a NIST-calibrated thermometer to measure temperature.
2. Check thermometers for cracks or gaps in the mercury. Do not use thermometers if either cracks or gaps are visible.

3. When possible, measure temperature of surface water at midstream by submersing the thermometer or electronic temperature probe for approximately 1 minute or until temperature stabilizes.
4. When in situ temperature measurements are not possible, draw sample of at least 200 ml into a decontaminated beaker or sample bottle as soon after sampling as possible.
5. Place thermometer or electronic temperature probe in sample and allow temperature to stabilize.
6. Record temperature to nearest 0.5°C in field logbook or on field data sheet.
7. Rinse thermometer or electronic temperature probe with deionized water.
8. Check field thermometers or digital temperature probes against a NIST-certified laboratory thermometer, on a quarterly basis. Agreement should be within 0.5°C.

4.4 Dissolved Metal Filtration Method for Groundwater

1. Place disposable, high capacity, pre-cleaned, vacuum-type, and 0.45-micron filter in two-way hose fitting/reducer fitting after restricting flow to one outlet.
2. After inserting filter firmly into the two-way hose fitting adjust valves so as to divert flow through the filter.
3. Let at least three filter volumes run through the filter before filling sample bottles.

5 QUANTITATIVE DEFINITIONS OF DATA QUALITY PARAMETERS

5.1 Quantitative Definitions of Data Quality Parameters

5.1.1 Precision

If calculated from duplicate measurements:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, use relative standard (RSD) rather than RPD:

RSD = (s/y) x 100%
RSD = relative standard deviation
s = standard deviation
y = mean of replicate analyses

Standard deviation, s, is defined as follows:

$$S = \sqrt{\frac{\sum (y_I - y)^2}{n - 1}}$$

s = standard deviation
y_i = measured value of the i^{th} replicate
y = mean replicate measurements
n = number of replicates

5.1.2 Accuracy

For measurements where matrix spikes are used:

$$\%R = 100\% \text{ x } \left[\left(S - U \right) / C_{sa} \right]$$

%R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

For situations where standard reference material (SRM) is used instead of or in addition to matrix spikes:

$$\%R = 100\% \text{ x } \left(C_m / C_{srm} \right)$$

%R = percent recovery
C_m = measured concentration of SRM
C_{srm} = actual concentration of SRM Accuracy

5.1.3 Completeness (Statistical)

Defined as follows for all measurements:

$$\%C = 100\% \text{ x } \left(V/n \right)$$

%C = percent completeness
V = number of measurements judged valid
n = total number of measurements to achieve a specified statistical level of confidence in decision making

6 CASING VOLUMES TABLE

DIAMETER OF CASING (inches)	GALLONS PER LINEAR FOOT	LINEAR FEET PER GALLON
2.00	0.1632	6.1275
2.50	0.2550	3.9216
3.00	0.3672	2.7233
3.50	0.4998	2.0008
4.00	0.6528	1.5319
4.25	0.7369	1.3570
4.50	0.8362	1.2104
4.75	0.9206	1.0862
5.00	1.0200	0.9804
5.25	1.1246	0.8892
5.50	1.2342	0.8102
5.75	1.3489	0.7413
6.00	1.4688	0.6808
6.25	1.5938	0.6276
6.50	1.7238	0.5801
6.75	1.8590	0.5379
7.00	1.9992	0.5002
7.25	2.1445	0.4663
7.50	2.2950	0.4357
7.75	2.4505	0.4081
8.00	2.6112	0.3830

One Casing Volume = (Well Depth – Depth to Water) x Gallons per Linear Foot
One Purge Volume = One Casing Volume x 3.0

Note: Well Depth and Depth to Water are measured in feet!

Reference: Anderson, Keith E., 1989, "Water Well Handbook", Missouri Water Well & Pump Contractors Assn., Inc.